
STUDY MATERIAL

FOUNDATION PROGRAMME

BUSINESS ECONOMICS

PAPER 3



**THE INSTITUTE OF
Company Secretaries of India**
IN PURSUIT OF PROFESSIONAL EXCELLENCE
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ICSI House, 22, Institutional Area, Lodi Road, New Delhi 110 003
tel 011-4534 1000, 4150 4444 fax +91-11-2462 6727
email info@icsi.edu website www.icsi.edu

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Phones

41504444, 45341000

Fax

011-24626727

Website

www.icsi.edu

E-mail

info@icsi.edu

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FOUNDATION PROGRAMME – IMPORTANT NOTE

The study material has been written in lucid and simple language and conscious efforts have been made to explain the fundamental concepts of economics and to provide exposure to Indian economy and Statistical tools. This study material is divided into two main parts–

Part-A Economics, and

Part-B Elementary Statistics

There is computer based examinations for Foundation Programme of CS Course. Students are advised to go through instructions regarding computer based examinations available at ICSI website **www.icsi.edu**.

For supplementing the information contained in the study material, students may refer to the economic and financial dailies, commercial, legal and management journals, Economic Survey (latest), CS Foundation Course e-Bulletin, Suggested Readings and References mentioned in the study material and relevant websites.

The objective of the study material is to provide students with the learning material according to the syllabus of the subject of the Foundation Programme. In the event of any doubt, students may write to the Directorate of Academics in the Institute for clarification at **academics@icsi.edu**

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SYLLABUS

PAPER 3: BUSINESS ECONOMICS

Level of Knowledge: Basic Knowledge

Objective: *To familiarize the basic concepts and theories of economics, elementary statistics and mathematics.*

PART A: ECONOMICS (70 MARKS)

1. Nature and Scope of Economics

- Economics : Definition, Nature and Scope; Micro and Macro Economics; Positive and Normative Economics; Central Problems of an Economy; Production Possibility Curve and Opportunity Cost; Working of Economic Systems (Capitalistic Economy, Socialistic Economy, Mixed Economy); Economic Cycles; Inflation and Recession

2. Theory of Demand and Supply

- Utility Analysis - Total Utility and Marginal Utility; Law of Diminishing Marginal Utility; Law of Equi-Marginal Utility; Consumers' Equilibrium; Law of Demand & Elasticity of Demand; Law of Supply & Elasticity of Supply; Demand and Supply Equilibrium; Theory of Consumer's Behaviour – Marshallian Approach and Indifference Curve Approach

3. Theory of Production, Costs and Revenue

- Meaning of Factors of Production; Returns to Factor and Returns to Scale; Cost Concepts and Cost Curves; Revenue Concepts and Revenue Curves; Producers' Equilibrium

4. Forms of Markets and its Equilibrium

- Forms of Markets - Meaning and Characteristics
- Price and Output Determination - Equilibrium for Firm and Industry under
 - Perfect Competition
 - Monopoly
 - Monopolistic Competition

5. Money and Banking

- Concept of Money - Its Functions; Quantity Theory of Money; Credit Creation
- Central Bank (Reserve Bank of India) - Role and Functions
- Commercial Banks - Role and Functions
- Monetary Policy in India

6. Basic Characteristics of Indian Economy

- Development Initiatives through Five Year Plans

- Agriculture
 - Causes of Low Productivity
 - Farm Size Productivity Debate
 - Land Reforms: Meaning, Importance and Evaluation
 - Green Revolution and Its Effects
 - Globalisation and Indian Agriculture
- Industry
 - Development Policies and Experience
 - Industrial Policy Resolutions
 - New Industrial Policy 1991

7. Selected Areas of Indian Economy

- Population - Its Size, Rate of Growth and Its Implication for Growth
- Poverty - Absolute and Relative Poverty and Main Programs for Poverty Alleviation
- Unemployment - Types, Causes and Incidence of Unemployment
- Infrastructure - Energy, Transportation, Communication, Health and Education

PART B: ELEMENTARY STATISTICS (30 MARKS)

8. Statistics: An Overview

- Definition and Functions of Statistic; Statistical Techniques Commonly used in Business Activities; Law of Statistics; Limitations of Statistics

9. Collection and Presentation of Statistical Data

- Primary and Secondary Data; Classification and Tabulation of Data; Frequency Distribution of Data; Diagrams and Graphs

10. Measures of Central Tendency

- Mean
- Median
- Mode
- Standard Deviation

11. Mathematics of Finance

- Simple Interest
- Compound Interest
- Present Value & Future Value of an Annuity

12. Probability

- Sample Spaces, Events and Probability
- Set Theory: Union, Intersection, and Complement of Events
- Conditional Probability, Intersection, and Expected Value
- Random Variable, Probability Distribution, and Expectation

13. Index Numbers and Time Series Analysis

- Familiarization with the Concepts Relating to Index Numbers and Time Series (Simple Numerical Problems)

LIST OF RECOMMENDED BOOKS*

PAPER 3 : BUSINESS ECONOMICS

READINGS

1. H. L. Bhatia Micro Economic Theory; Modern Publisher, Gulab Bhawan, 6, Bahadurshah Zafar Marg, New Delhi.
2. M.L. Jhingan Micro Economic Theory; Konark Publishers Pvt. Ltd., A-149, Vikas Marg, Shakarpur, New Delhi-110 092.
3. S. K. Agarwala Economic System and Micro Economic Theory; Galgotia Publishing Company, 6A/4, WEA, Karol Bagh, New Delhi.
4. D.D. Chaturvedi Macro Economic - Analysis and Policy; Galgotia Publishing Company, 6A/4, WEA, Karol Bagh, New Delhi.
5. D.M. Mithani Macro Economics; Himalaya Publishing House.
6. D.M. Mithani Money Banking, International Trade and Public Finance; Himalaya Publishing House, Ramdoot, Dr. Bhalerao Marg, Girgaon, Bombay-400 004.
7. Ruddar Datt & K.P.M. Sundaram Indian Economy; S. Chand & Company Ltd., Ram Nagar, New Delhi.
8. S. P. Gupta, P. K. Gupta & Man Mohan Quantitative Techniques; Sultan Chand & Sons, 23, Daryaganj, New Delhi.
9. R. S. Bhardwaj Business Statistics, Excle Books, A-45, Narayana Phase-I, New Delhi
10. A. K. Agarwal & Sahib Singh Fundamental of Statistics; Frank Sons, Daryaganj, New Delhi.
11. R. S. N. Pillai & V. Bagarathi Statistics; S. Chand & Company Ltd. New Delhi.
12. S. Saha Business Statistics, New Central Book Agency, Kolkata
13. B. M. Agarwal Quantitative Techniques, Sultan Chand & Sons Pvt. Ltd., Daryaganj, New Delhi.
14. Pindyck and Rubinfeld Microeconomics; Pearson Education.
15. Suraj B. Gupta Monetary Economics; Sultan Chand & Sons Pvt. Ltd.

REFERENCES

1. Samuelson & William D. Nordhans Economics; McGraw Hills.
2. P. N. Chopra Advanced Economics Theory; Kalyani Publishers, New Delhi.
3. M. Maria John Kennedy Advanced Micro Economic Theory; Himalaya Publishing House, Delhi.

*This study material is sufficient from the point of view of syllabus. The students may refer these books for further knowledge and study of the subject.

4. A. C. L. Day Outline of Monetary Economics
 5. A. N. Agarwal Indian Economy
 6. I. C. Dhingra &
V. K. Garg Economic Development & Planning in India.
 7. K.R. Choudhary Basic Principles of Modern Micro Economics; Book Land Economic Series.
 8. Mural R. Spiegel &
Larry J. Stephans Theory and Problems of Statistics, Tata McGraw Hills, New Delhi
 9. S. P. Gupta Statistical Methods; Sultan Chand & Sons, New Delhi.
 10. Neva Goodwin,
Julie A Nelson,
Jonathan Harris Macro Economics in Context, PHI Learning Pvt. Ltd.
 11. Eleventh Five Year Plan Government of India Publication.
(2007 – 2012)
 12. Twelfth Five Year Plan Government of India Publication.
Approach Paper
 13. Economic Survey Government of India Publication.
(Latest)
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PART A

ECONOMICS

LESSONS

1.	Nature and Scope of Economics
2.	Theory of Demand and Supply
3.	Theory of Production, Costs and Revenue
4.	Forms of Market and its Equilibrium
5.	Money and Banking
6.	Basic Characteristics of Indian Economy
7.	Selected Areas of Indian Economy

Economics has been recognized as a special area of study for over a century. Economics and economists are words that almost everyone has heard of and used. But, what exactly is economics? Very few people can give a good definition or description of what this field of study is all about. If ordinary citizens cannot give a good definition or description of economics, they can be excused because even economists struggled long to define their own field.

We have to perform various and varied activities throughout the day. After attaining adulthood, we have our own family and we are required to make arrangement for food, clothes, house and other necessities of life for the members of our family. We have to activate ourselves to earn something, so that we may be able to meet the expenses. Our activities to generate income are termed as economic activities, which are responsible for the origin and development of economics as subject. Economics was originally introduced as a science of statecraft. It was concerned with the collection of revenue for the state i.e., government. Therefore, it becomes essential to acquaint students with basics of this subject so as to develop conceptual understanding.



Lesson 1

Nature and Scope of Economics

LESSON OUTLINE

- Economics: An Introduction
- Economics: Study of an Economy or Economic System
- Definition of Economics
- Leading Definitions of Economics
 - Wealth
 - Material Wealth
 - Scarcity and choice
 - Development and Growth
- Review Questions
- Nature of Economics
- Scope of Economics
- Central Problems of an Economy
- Production Possibility Curve
- Opportunity Cost
- Economic Cycles
- Working of an Economic System
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

In the present global, liberal and knowledge based environment, the understanding of economic issues has become quite indispensable for all sections in the society. Everyone wants to get rich, increase their wealth holdings, hold over productive resources and expand their business activities. So, people want to earn more and more profits, and exercise control over the market and other economic system; people are to raise their standard of living and enjoy more and more consumption; so as to make their future secure by updating their knowledge of economic issues and making decision in optimal manner subject to resource constraints. Besides, people also want to grow even in the adverse circumstances or at least survive under these circumstances. This shows people's eagerness to become economically stronger and viable, so that they can lead a better life style. This requires proper understanding of the economic issues. This lesson deals in definitional aspect of economics from perspectives of different economists. Also, defining the scope, nature and working of subject matter it deals with central problem of economy and PPC to solve these problems.

Often economics appears to be an endless procession of new puzzles, problems, and difficult dilemmas. But as experienced teachers have learned, there are a few basic concepts that underpin all of economics. Once these basic concepts have been mastered, learning is much quicker and more enjoyable.

Samuelson and Nordhaus

ECONOMICS: AN INTRODUCTION

Any discussion on a subject must start by explaining what the subject is all about *i.e.*, by *defining* the subject. The principal fact about Economics to be remembered always is that it is a *social science*.

The word 'Economics' originates from the Greek work '*Oikonomikos*' which can be divided into two parts:

- (a) '*Oikos*', which means 'House', and
- (b) '*Nomos*', which means 'Management'.

In a dialogue* between Xenophons and Critobulus; Greek scholars, on the subject of matter of economics:

"Tell me, Critobulus, is economics the name of a branch of knowledge, like medicine, smithing and carpentry?"

"I think so," replied Critobulus.

"And can we say what the function of economics is..."

"Well, I suppose that the business of a good economist is to manage his own estate well."

"Is it possible, then, for one who understands this art, even if he has no property of his own, to earn money by managing another man's estate...?"

"Yes, of course; and he would get a good salary"

"But what do we mean now by an estate? Is it the same thing as a house...?"

"Well, I think that everything a man possesses is part of his estate."...

"And you, I think, agree with me to this extent, that wealth is that from which a man can derive profit...."

Thus, Economics means 'House Management'. The head of a family faces the problem of managing the unlimited wants of the family members within the limited income of the family. Similarly, considering the whole society as a 'family', then the society also faces the problem of tackling unlimited wants of the members of the society with the limited resources available in that society. Economics; thus, would mean the study of ways in which mankind organizes itself to tackle the basic problem of scarcity of resources. All societies have wants more than resources available to satisfy them. Hence, economics is the study of alternate systems requisite to allocate these resources between competing ends.

The discipline of economics has gained widespread popularity in context of both; areas of academics and relating to formulation of policies. Lately, the understanding of economic issues has become quite indispensable for all sections in the society - individuals, households, business units, institutions, as well as governments. Everyone wants to get rich; wants to increase their wealth holding; wants to have hold over productive resources; wants to expand their business activities. People want to earn profits, and exercise control over the market and other economic system; people want to raise their living standard and enjoy more consumption; people want to make their future secure; everyone wants to grow from the current position. This explains that every aspect of human existence is affected by economics, directly or indirectly due to pervasive nature of economic issues and problems. That is why, people want to update their knowledge of economic issues and take advantages of that to satisfy their wants. Besides, people want to grow even in the adverse circumstances or at least survive under these circumstances. This shows that people want to become economically stronger and viable. For this reason, it becomes impossible to remain indifferent to this subject matter.

Some of the basic elements of the discipline of economics have always been in existence and always been known to the thinkers. However, for a long time, the discipline of economics was not known as a separate

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discipline. It was related to elements of several other disciplines, which covered non-economic aspects of human knowledge and philosophy as well. The main reasons for this phenomenon lie in the following facts:

1. The primary task of the discipline of economics is to study the working of an economy and the issues by it. For centuries, the understanding of typical economy of a country continued to remain relatively simple and underdeveloped.
2. The nature of economic problems and their solutions is closely linked with the structure, progress and development of the economic system. Economic problems faced by a more efficient industrial economic system are expected to be different from the ones underdeveloped simple agricultural economy faces. In a simple economy, human beings are mainly confronted with the problems of poverty and economic insecurity. In contrast, in a developed industrial economy, the problems are mainly of distributive justice and economic instability. The discipline of economics modernized at a pace of world development.
3. Economic problems of individuals and societies are interdependent on other social, cultural and political aspects of human existence.

For the reasons noted above, the discipline of economics, as it stands today, is the result of continuous developments. Most of these emerged over the last two centuries. This period witnessed a phenomenal increase in population, number of occupations and per capita income. There was a prolonged parallel development of the financial system. Consequently, the character and severity of economic issues and problems became complex. The vicious circle of this process conceived several additional issues and problems. Moreover, the nature of economic issues and problems is such that it tends to change when economists try to solve them, implying that there seldom is a situation to reach the final solution. As a consequence to the efforts which tackle economic issues, the boundaries of economics tend to expand.

The study of economics developed to cater to the needs of working of modern economy for arriving at a solution. For example, a need was felt to analyze the manner in which production and employment levels are determined and the steps that are needed to encourage these in order to raise standards of living. It is also noteworthy that a typical modern economy is unable to solve all its problems once for all. Instead, a host of new economic issues and problems keep emerging continuously. As a result of this ongoing interaction, the discipline of economics keeps evolving both in terms of coverage and in terms of depth of analysis.

ECONOMICS: STUDY OF AN ECONOMY OR ECONOMIC SYSTEM

Briefly speaking, economics can be defined as a study of an economic system in all its aspects - structure, working, performance, problems, and their solutions.

The meaning of the term, "study of an economy" includes:

- (a) Alternative forms of an economy like capitalism, socialism and a mixed economy.
- (b) Economic decisions and their implementation by
 - Individual economic units like individuals, households and business units
 - Groups of economic units, institutions
 - Public Authorities
- (c) Interrelationships between economic units and their groups.
- (d) The performance of individual economic units, their groups, and the economy as a whole.
- (e) Interrelationship between different economies.

However, the phrase 'study of the economy' remains vague and unclear, unless the meaning of the term "an economy" is known. An economy is the institutional structure through which individuals in a society coordinate

their diverse wants and desires. An economy consists of the economic system of a country.

The economic system comprises human being having variety of wants. These wants may be classified into basic two types:

- Economic Wants
- Non-Economic Wants

Broadly speaking, wants which can be satisfied by the consumption of goods and services, are economic wants. In contrast, non-economic wants are those which do not relate to consumption of goods and services.

Economic wants have several characteristics but the most significant are only two of them:

- Even if satisfied, the wants have a tendency to re-emerge.
- With the passage of time, the wants tend to increase in number and in variety.

This is the case because:

1. The “means” available for satisfaction are insufficient or limited in comparison with the wants to be satisfied. The means of resources do not increase rapidly enough to match the growing requirement of human wants.
2. This mismatch between the available resources and economic wants becomes a permanent problem for individual economic units and the society as a whole.
3. As a result, every society and its component economic units, adopt a two-fold course of action, namely, the following:
 - to increase the availability of resources by their own efforts.
 - to maximize the use of available resources in best possible economical manner. This includes to make best allocation of these resources in alternative uses i.e., to use these resources for satisfying the most pressing wants to the exclusion of the less pressing ones.
4. Accordingly, the society creates a set of institutions like those of money and credit, markets, a system of sales and purchase, system of facilities relating to production, transport, storage etc. to arrive close to solutions.

DEFINITION OF ECONOMICS

“If economists were laid end to end, they would not reach a conclusion.”

– **George Bernard Shaw**

It is very difficult to define economics because economics is very dynamic subject and there exists no single definition to the subject. It would not be very inappropriate to quote that there exist as many definitions of economics as there are number of economists in this universe. Each definition has an element that can not be disregarded so can the definition be not discarded. As a result, we come across a large number of definitions of economics, which appear to differ from each other.

The scope of economics not only keeps changing rather has been expanding since evolution. The dynamic nature of economics is on account of two ways; economies of similar types varies among systems and the same economy varies over time.

Still for proper understanding of any subject, it becomes necessary to define it as close as possible. A good definition of economics should be able to describe its subject matter (that is, its coverage and boundaries) in a precise manner.

It is noticed that, essentially, any specific definition is influenced by

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- the thinking and preferences of the economist defining the discipline
- the general level of development of the discipline of economics

To elaborate the above statement, most economists have their own views of what an economic system should be. They try to define economics in line with their respective viewpoints. Economists do not view and understand the economic system in an identical manner because they differ each other in their technical expertise.

To summarize, the main reasons for plethora of these definitions are:

- the stage of economic development
- the structure of the economy with reference to which the definition is elaborated
- the field of expertise of the economist
- the purpose for studying economics

LEADING DEFINITIONS OF ECONOMICS

Economics was originally introduced as a science of statecraft. It was concerned with the collection of revenue for the state i.e., government. Advisors to the government were also required to point out the best possible way of spending the revenue.

Over a period of time economists have emphasized different aspects of economic activities, and have arrived at different definitions of economics hand in hand with the stages of development of economics.

Stages as Economics developed as a subject:

1. Wealth Definition
2. Material Welfare Definition
3. Scarcity and Choice Definition
4. Development and Growth Definition

ECONOMICS AS A SCIENCE OF WEALTH: ADAM SMITH

During the eighteenth and the early part of nineteenth century, Adam Smith, considered to be the founding father of modern Economics, along with economists like J.B. Say and Walker defined economics as the science of wealth. Adam Smith systematized the concept in the form the book which was entitled as, “**An Enquiry into the Nature and Cause of the Wealth of Nations**” published in 1776.

The central point in Smith’s definition is wealth creation. Implicitly, Smith identified wealth with welfare. He maintained that the discipline of economics is meant to identify the factors (that is causes) which make one economy richer than the other. He assumed that, the wealthier a nation, the happier its citizens are. Thus, it was important to find out, how a nation could become wealthy. Economics is the subject which is concerned with an objective of how to make a nation wealthy in order to grow rich and to acquire political & military strength.

MAIN CHARACTERISTICS OF WEALTH DEFINITION

- (i) *Exaggerated Emphasis on Wealth*: These wealth centred definitions gave too much importance to the creation of wealth in an economy. The classical economists believed that economic prosperity of any nation depends only on the accumulation of wealth.
- (ii) *Inquiry into the Creation of Wealth*: These definitions show that economics also deals with an inquiry into the causes behind the creation of wealth.

- (iii) *A Study on the Nature of Wealth*: The term 'wealth' does not have a universally accepted meaning. However, these definitions have indicated that wealth of a nation includes only material manufactured goods. It is for this reason that to Adam Smith, labour was 'productive' if it produced material goods. In contrast, those who produced non-tangible services like teaching, music, etc. were non-productive. These persons were 'parasites' living on the wealth produced by others.

This led Adam Smith to conclude that for increasing the wealth of a nation, the use of labour should be primarily for "productive purposes".

EVALUATION

Merits-

- (a) Adam Smith was primarily concerned with the question of creation of wealth, that is, the means of consumption and the capacity to produce such means. In this sense, he was justified in defining economics as a science of wealth, which highlighted the need for an economy to acquire capacity to produce more.
- (b) During Smith's days, most economies including that of Britain were so poor that the problem of income inequalities did not attract sufficient attention. Therefore, Adam Smith also chose to ignore this problem.

Demerits-

- (a) Wealth concept of economics was bitterly criticized, because it assumed wealth as an end of human activities. Critics of the wealth definition of economics are unhappy about the fact that it accords primary place to 'wealth' to the neglect of the welfare aspects of man. It is maintained that after all, an economy is meant to serve the society and its members rather than the other way round.
- (b) Though Adam Smith could ignore the problem of distributive justice that is the problem of inequalities of income and wealth because of the underdevelopment of the economy during his days, it could not be avoided for long, particularly because the fruits of economic growth and riches were not reaching the masses. With growing national income, the rich were becoming richer and the poor were becoming poorer.
- (c) Adam Smith's definition of economics in terms of wealth was also criticized by philosophers and social thinkers for ignoring the 'higher' values of life and reducing it to a 'dismal science'. According to them, if this definition is accepted in life, there will be no place for love, affection, sympathy and patriotism. Absence of these values altogether was also not justified.
- (d) The concept of wealth as given by Adam was also rejected on the grounds that what matters is not just the production and consumption of tangible goods, but services matter equally. The relevance of services can be judged by this fact that provision of certain services is essential even for the maintenance and addition to the productive capacity of the economy. Examples can be given of education, health, medical care etc. Even defence, law and order, efficient systems of administration and justice also add to the security and working capacity of the society adding to its riches.

The criticism of the wealth definition of economics is not however fully justified. The fact remains that the problem of distribution of income and wealth comes only after they have been created. An economy should first aim at increasing its capacity to produce more of goods and services, since without them only poverty can be distributed and not riches. It is for this reason that a major portion of even modern day economics is devoted to the study of production, capital formation, growth and employment.

Adam's view later was supported by Ricardo. In early 19th century, as the economy developed, the problem of distribution of national income between members of the society could not be ignored for long. With the development of capitalist economies, problems of inequalities and "exploitation of labour" came to get prominence. Alternative

views were adopted by economists regarding what economics was all about. Some economists concentrated upon the tools and techniques of analysis, while others gave greater attention to the questions of economic well-being of the society.

Accordingly, while Adam Smith had emphasised the volume and variety of production as the primary subject matter of economics, Ricardo (in early 19th century) emphasised the distribution of wealth. In his own words, "The produce of the earth all that is derived from its surface by the united application of labour, machinery and capital is divided among three classes of the community, namely, the proprietor of the land, the owner of the stock of capital necessary for its cultivation, and the labourers by whose industry it is cultivated." Thus, "to determine the laws which regulate this distribution is the principal problem in Political Economy".

ECONOMICS AS A SCIENCE OF MATERIAL WELFARE: A. MARSHALL

After marginalising the earlier definitions of economics focussing on wealth, it became necessary to come out with more acceptable and wider definition of economics. It is so because more knowledge was accumulated by this time with regard to economics. Economists started taking note of the fact that actions of human beings are not guided by only economic motives. Non-economic considerations also play an equally important role in them. For this reason, theories dealing with the determination of wage rates of labour, prices of other inputs, and the distribution of national income between members of society, became an integral part of economics. But, for the sake of analytical simplicity, economists still viewed economics as a study of that part of human behaviour which could be measured in money terms and which could be attributed to a desire for economic gain. Under this definition the emphasis was given by two important economists namely; A. Marshall and A.C.Pigou. Marshall's definition is an admirable example of this approach, while Pigou adopted a definition of economics which was primarily concerned with the welfare dimension only. Therefore, Alfred Marshall came up with the importance of wealth. He emphasised the role of the individual in the creation and the use of wealth. He wrote: "**Economics is a study of man in the ordinary business of life. It enquires how he gets his income and how he uses it. Thus, it is on the one side, the study of wealth and on the other and more important side, a part of the study of man**". Marshall, therefore, stressed the supreme importance of man in the economic system. Marshall's definition is considered to be material-welfare centred definition of economics.

Alfred Marshall published his book, "**Principles of Economics**" in 1890, where he provided his definition of economics as "Political economy or economics is a study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of well-beings. Thus, it is on the one side, a study of wealth; and on the other, and more important side, a part of the study of man.

That is, he laid emphasis from wealth to material welfare. According to him, wealth acted only as means to attain the ends and the wealth should not be treated as an end in itself. According to Marshall, "End is the human welfare."

Marshall was the pioneer of welfare thought.

MAIN CHARACTERISTICS OF MATERIAL WELFARE DEFINITION

- (i) *Study of Material Requisites of Well-being*: These definitions indicate that economics studies only the material aspects of well-being. Thus, these definitions emphasise the materialistic aspects of economic welfare.
- (ii) *Concentrates on the Ordinary Business of Life*: These definitions show that economics deals with the study of man in the ordinary business of life. Thus, economics enquires how an individual gets his income and how he uses it.
- (iii) *A Stress on the Role of Man*: These definitions stressed on the role of man in the creation of wealth or income.

Marshall further maintained that the core of the subject matter of economics is not the creation and consumption of goods and services as such, but economic well-being or economic welfare of members of society. It is for this reason that he said that economics is that part of individual and social actions which is most closely connected with the attainment and with the use of material requisites of well-being. However, at this stage, it should be noted that according to Marshall, economics was concerned with that part of human welfare which is derived from material goods and services, and not from other social and political aspects of his life.

Followers in the neoclassical tradition, Pigou continued to define economics in terms of material welfare. According to Pigou, “The range of our inquiry becomes restricted to that part of social welfare that can be brought directly or indirectly into relation with the measuring rod of money”. He published his book “The Economics of Welfare” in 1920.

The definition by Pigou emphasizes social welfare aspect but only that part of it which can be related with the measuring rod of money. Money is general measure of purchasing power by the use of which the science of economics can be rendered more precise. Pigou’s definition of economics, therefore, was restricted only to such economic systems

- which were guided by the market forces or monetary terms
- in which production and investment were undertaken with the business motives

Clearly, the coverage of this definition was quite wide in one sense and restrictive in another. Since it covered the entire question of economic welfare, it was quite wide. At the same time, it was a restrictive definition because it excluded economies, which were not guided by monetary and market forces. In contrast, some economists advocated that the definition of economics should be extended to cover economic welfare, which can be derived from alternative forms of an economic system. Therefore, Marshall’s and Pigou’s definitions of economics being wider and more comprehensive were not spared of their share of criticism.

EVALUATION

Merits-

- (a) Welfare definitions of economic are more relevant, comprehensive and scientific than wealth definitions. Credit for transforming economics as a science of human welfare from a science of wealth goes to these definitions. Welfare definition stresses the fact that economics does not study wealth alone rather it studies human welfare aspects as well. Thus, welfare definition has accorded economics a status of a superior social science. Consequently Economics is being regarded as “an engine of social betterment”.

Demerits-

- (a) It is not possible to define the concept of welfare in a precise manner. It has not been found how to measure economic welfare accurately and in a universally acceptable manner. One way of defining welfare is to say that it is the same thing as the objectives desired by the society as a whole.
- (b) Economics studies even those activities which are not expected to add to economic welfare of the society. For instance, those activities which reduce its welfare, such as activities leading to environmental degradation.
- (c) Economics is study the production and consumption of goods and services which collectively affect our welfare. Therefore, it is inappropriate to restrict economics to the study of only tangible or material goods. This unnecessarily restricted the scope and subject matter of economics. Further, in view of social thinkers and medical professionals, there are several goods and services, the consumption of which does not add to the welfare of either the consumers or the rest of the society. Leading examples of such items include tobacco and addictive drugs. Such items may be termed ‘bads’ instead of ‘goods’.

Welfare concept was criticised by the pioneers of 'Scarcity Concept'. According to these economists, it will be an injustice to the subject, if it is restricted to ordinary business of life, concerned with economic activities and related to human welfare only.

According to Robbins, the materialistic definition is classificatory and not analytical. The division of activities into economic and non economic activities is completely unscientific and uneconomic. Robbins also pointed out that welfare definition of economics involve value judgement because it prescribes policies which is likely to use the concept of welfare. But, he v=considers economics as neutral between ends. Basically, value judgment is with in jurisdiction of philosophy and not economics.

ECONOMICS AS A SCIENCE OF SCARCITY AND CHOICE: L.ROBBINS

Marshall's definition was the most popular and accepted definition of economics at one time. Lionel Robbins has however offered most scientific definition in his famous book published in 1932, titled "**An Essay on the Nature and Significance of Economic Science**".

According to him, "Economics is the science, which studies human behaviours as a relationship between ends and scarce means which have alternative uses." Robbins based his definition of economics on the following facts.

- The ends or wants of an economy are unlimited in number and variety, and they keep increasing with the passage of time.
- An economy always has shortage of resources compared with to the wants to be satisfied.
- It is possible to select between several alternative resources for satisfying a given want.
- Man has therefore, to choose between wants.
- Similarly, it is possible to use a given resource for the satisfaction of several alternative wants.

Since scarce resources are limited in supply, according to Robbins definition, such scarce resources might be put for alternative uses. It is implied here that the alternative uses to which the commodity can be put should be of varying degrees of importance, so that, it becomes possible to select the use or the uses to which the commodity is to be put. The scarcity definition has sharply defined the scope of economics. It has delimited the field of economics by building a boundary wall around it. There can now be no misconception or haziness about the sphere of economics. Any problem marked by scarcity of means and multiplicity of ends, becomes *ipso facto* an economic problem, and as such, a legitimate part of the science of economics. According to this approach certain universal truth are regarded as the basis of economic problems. Every individual and economy has unlimited wants and scarce means to satisfy these wants. Inability to satisfy unlimited wants with limited resources creates the problems of choice making i.e., fixing priority of wants to be satisfied. As resources can be put to alternative uses, we will have to take decision as to which specific want should be satisfied with particular means. In this way, choice making or decision making is the means of tackling all these economic problems.

MAIN CHARACTERISTICS OF SCARCITY AND CHOICE DEFINITION

Robbins maintains that if we define economics with an emphasis on its welfare aspects, we will have to judge the existing performance of the economy and suggest possible improvement in its structure and working. Such a use of economics for "normative purposes", that is, for drawing policy inferences, necessitates that the society should have a widely accepted set of goals. However, this condition is satisfied only in theory. In reality, no society possesses a universally agreed set of goals. Moreover, there is no agreement regarding the relative emphasis to be accorded to even the accepted goals.. For example, modern economies are usually faced with the problem of both unemployment and inflation. And it is generally agreed that an economy should get rid of them. In practice. However, it is not possible to do so. If an attempt is made to reduce unemployment, inflationary

forces become stronger and prices go up. And if prices are prevented from rising, unemployment level increases to an unacceptable level. In other words, though both goals are desirable in themselves, it is not possible to achieve them simultaneously. They are contradictory to each other. At the most they can be achieved only partially. But there is seldom any agreement as to the exact balance between the two which the economy should aim at. Similarly, another example of the society facing contradictory goals is the choice between consuming away its current national income or saving it for capital accumulation and economic growth. This choice is more difficult for developing countries where the existing level of consumption is very low and there is a strong need for economic growth as well. Yet another example, we can expect a general agreement that eradication of unemployment, poverty and regional economic disparities should be achieved. But there is bound to be a difference of opinion in deciding the order of their priority.

For this reason, amongst others, Robbins believe that, as economists, we should not go into the question of policy inferences. This task should be left to other disciplines. Economists should only study economics in terms of “what is” and not what “ought to be”. According to Robbins, economists should concentrate upon the study of the manner in which an economy tries to solve its problem of scarcity of means of satisfaction as compared with its needs. The job of an economist should be restricted to only investigation and reporting the findings. He should not say anything about its welfare aspects. He should accept the facts as they are and should not make recommendations for “improving the working of the economy”. Robbins says that “Whatever Economics is concerned with, it is not concerned with the causes of material welfare as such.” Whatever be the goals which the society is trying to achieve, the economists should maintain their neutrality between them. “The ends may be noble or they may be base.” But economics has nothing to say about it.

Of course, having acquired the requisite knowledge, economists are better equipped to make recommendations for improving the working of the economy. Over years, their capacity to do so has increased rapidly on account of the development of statistical, mathematical and econometric methods. They are in a better position in exploring the issues connected the problem of “choice”. But they should do so only because they are better informed and concerned citizens and not in their capacity as economists.

EVALUATION

Merits-

- (a) *Study of Human Behaviour*: The definition has a study of human behaviour instead of a study of a social man. Economics studies the economic activities of all human beings whether living in or out of society. Economics studies the behaviour of man both at individual and social level.
- (b) *Analytical*: Economic problems arise because ends (wants) of man are unlimited but the means to satisfy them are not only scarce but also have alternative uses. Man has to make a choice with regard to ends and scarce means. This definition is a scientific analysis of the origin of economic problems and their solution.
- (c) *Wider Scope*: Economics encompasses all sorts of economic activities whether they are related to material goods or non – material services; whether they are conducive to well – being or not.
- (d) *Universal*: This definition is concerned with the problem of unlimited ends (wants) and scarce means. This problem is found at any place and in any type of economy, that is capitalism, socialism etc.
- (e) *More Logical Explanation of Economic Problem*: This definition has offered amore logical and precise explanation of the nature of economics. Economic problem does not arise due to material well – being. It arises mainly due to the scarcity of means in relation to their demand. Problem of choice or Valuation, which is the main problem of economics, arises because of scarcity of means and their alternative uses.

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Demerits-

- (a) Critics of scarcity definition also hold the view that since it is possible to use knowledge of economics in an attempt to curing the ills of the economy, there is no justification in adopting an attitude of indifference towards the problems of unemployment, poverty, inflation, regional disparities, and low rate of economic growth. A better course would be to use our knowledge of economics in devising policies for achieving maximum possible economic welfare with minimum possible resource cost and human labour.
- (b) The shortage of “merit goods” provides a very strong argument in hands of the critics of scarcity approach. Merit goods are those goods, the consumption of which benefits not only the consumers, but also the non-consumer. Examples of such goods are education, health, cleanliness, etc. Generally, the cost of production of such goods is high and a large section of the population is not able to pay their market-determined prices. Therefore, left to the market forces, their supplies tend to be insufficient. Obviously, the authorities should step in with measures to supplement their supplies and make them available to the society at affordable prices.
- (c) Another argument for not agreeing with Robbins is the existence of several public services (like defence, law and justice, etc.) which cannot be provided by the market. It is not possible to sell them and recover production costs. Only the authorities can provide them by incurring expenditure out of their budgetary resources.
- (d) Robbins has made economics quite impersonal and colourless. By making it a complete positive science and excluding normative aspects he has narrowed down its scope.
- (e) His definition does not cover the theory of economic growth and development. While Robbins takes resources as given and talks about their allocation, it is totally silent about the measures to be taken to raise these resources i.e. national income and wealth.
- (f) Robbins assumed rationality on the part of economic units in their behaviour. But in real life situation, a man is influenced more by customs and habits than by rational outlook.

ECONOMICS AS A SCIENCE OF DEVELOPMENT & GROWTH: PAUL SAMUELSON

Samuelson has also given similar but somewhat different definition of economics as given by Robbins. He has emphasised upon the twin themes of economics—**scarcity and efficiency**.

Professor Samuelson offered more comprehensive definitions of economics as under.

“Economics is the study of how people and society end up choosing, with or without the use of money, to employ scarce productive resources that could have alternative uses to produce various commodities over time and distributing them for consumption, now or in the future, among various persons or groups in society. It analyses costs and benefits of improving patterns of resource allocation”.

The above definition is very comprehensive in the sense that, it does not restrict to material well-being or money measure as a limiting factor. But it considers economic growth over time.

His book **Economics: an Introductory Analysis**, first published in 1948, was one of his famous works on economics.

MAIN CHARACTERISTICS OF DEVELOPMENT AND GROWTH DEFINITION

- (i) *Growth-orientation*: Economic growth is measured by the change in national output over time. The definition says that, economics is concerned with determining the pattern of employment of scarce resources to produce commodities ‘over time’. Thus, the dynamic problems of production have been brought within the purview of economics.

- (ii) *Dynamic Allocation of Consumption*: Similarly, under this definition, Economics is concerned with the pattern of consumption, not only now but also in the future. Thus, the problem of dividing the use of income between present consumption and future consumption has been brought within the orbit of economics.
- (iii) *Distribution*: The modern definition also concerns itself with the distribution of consumption among various persons and groups in a society. Thus, while the problem of distribution is implicit in the earlier definitions, the modern definition makes it explicit.
- (iv) *Improvement of Resource Allocation*: The definition also says that, economics analyses the costs and benefits of improving the pattern of resource allocation. Improvement of resource allocation and better distributive justice are synonymous with economic development. Thus, issues of development of a less developed economy have also been made subjects of the study of economics.

WHICH OF THESE DEFINITIONS IS THE BEST?

Different economists have given different definitions of economics. Boulding is of the opinion that any single concise definition of economics will be inadequate. Of course to define it as “a study of mankind in an ordinary business of life” is to give a very wide view of economics.

According to Adam Smith, “economics is a study of wealth. Robbins is of the view that economics is a science that studies human behaviour as a relationship between ends and scarce means which have alternative uses.

Picking up the term ‘wealth’ from the definition of Adam Smith, ‘welfare’ from that of Marshall, ‘Scarcity’ from that of Robbins and ‘economic growth’ from that of Samuelson, an acceptable definition of economics can be constructed in these words.

“Economics is a subject that studies those activities of man which are concerned with the maximum satisfaction of wants or with the promotion of welfare and economic growth by the efficient consumption, production and exchange of scarce means having alternative uses.”

REVIEW QUESTIONS



1. Economic problems of individuals and societies are not _____ of other social, cultural and political aspects of human existence.
2. The nature of economic problems and their solutions is closely linked with the _____ and its progress and development.
3. The primary task of the discipline of economics is to study the working of an economy and the _____ faced by it.
4. It is well known to us that the economic systems, as created by different societies, _____ from each other.

NATURE OF ECONOMICS

Nature of economics is to discuss whether Economics is science or art or both and if it is a science whether it is a positive science or a normative science or both.

ECONOMICS – AS A SCIENCE AND AS AN ART

The very first question to describe the nature of economics is to ask - whether economics is a science or an art or both.

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(i) **Economics as a Science:** A subject is considered science if:

- It is a systematised body of knowledge which studies the relationship between cause and effect.
- It is capable of measurement.
- It has its own methodological apparatus.
- It should have the ability to forecast.
- If we analyse economics, we find that it has all the features of science.

Like science, it studies cause and effect relationship between economic phenomena. To understand, let us take the law of demand. It explains the cause and effect relationship between price and quantity demanded for a commodity. It says, given other things constant, as price rises, the demand for a commodity falls and vice versa. Here, the cause is price and the effect is fall in quantity demanded. Similarly like science, it is capable of being measured; the measurement is in terms of money. It has its own methodology of study (induction and deduction) and it forecasts the future market condition with the help of various statistical and non-statistical tools. Thus, a major portion of economic laws are of this type and therefore, economics is science.

The subject matter of economics is the economic behaviour of man which is highly unpredictable. Money which is used to measure outcomes in economics is itself a dependent variable. It is not possible to make correct predictions about the behaviour of economic variables.

But it is to be noted that economics is not a perfect science like physical science. The fact is that we cannot rely upon the accuracy of the economic laws. The predictions made on the basis of economic laws can easily go wrong.

This is because economists do not have uniform opinion about a particular event. The problem of actual results differing from the predicted ones arises on account of the fact that in economics we cannot have controlled experiments.

(ii) **Economics as an Art:** A discipline of study is termed an art if it tells us how to do a thing that is to achieve an end (objective). It is noteworthy that the final justification for studying economics lies in the possibility of our ability to use it for solving economic problems faced by us. Prof. J. M. Keynes says that “An art is a system of rules for the achievement of a given end.”

We know that in practice, economics is used for achieving a variety of goals. Every individual economic unit whether acting as a consumer as a producer as an investor as a supplier of an input or in any other capacity has an economic goal to achieve. It decides its course of action by keeping in mind the end to be achieved and the situation faced by it. Even at national level the authorities formulate a variety of policies. In certain cases they attempt to plan and operate the entire economy so as to achieve a given set of ends. Therefore, whether some theoreticians like it or not, economic laws are widely used and relied upon at all levels of our economic activities. And that makes economics an art.

Art is nothing but practice of knowledge. Whereas science teaches us to know, art teaches us to do. Unlike science which is theoretical, art is practical.

If we analyse economics, we find that it has the features of being an art also. Its various branches, consumption, production, public finance, etc. provide practical solutions to various economic problems. It helps in solving various economic problems which we face in our day-to-day life.

Thus, economics is both a science and an art. It is science in its methodology and art in its application.

Economics as Positive Science and Economics as Normative Science

(i) **Positive Science:** As stated above, Economics is a science. But the question arises, whether it is a positive

science or a normative science. A positive or pure science analyses cause and effect relationship between variables but it does not pass value judgment. In other words, it states what is and not what ought to be. Professor Robbins emphasised the positive aspects of science but Marshall and Pigou have considered the ethical aspects of science which obviously are normative. According to Robbins, economics is concerned only with the study of the economic decisions of individuals and the society as positive facts but not with the ethics of these decisions. Economics should be neutral between ends. It is not for economists to pass value judgments and make pronouncements on the goodness or otherwise of human decisions. An individual with a limited amount of money may use it for buying liquor and not milk, but that is entirely his business. A community may use its limited resources for making guns rather than butter, but it is no concern of the economists to condemn or appreciate this policy. Economics only studies facts and makes generalizations from them. It is a pure and positive science, which excludes from its scope the normative aspect of human behaviour.

Complete neutrality between ends is, however, neither feasible nor desirable. It is because in many matters the economist has to suggest measures for achieving certain socially desirable ends. For example, when he suggests the adoption of certain policies for increasing employment and raising the rates of wages, he is making value judgments; or that the exploitation of labour and the state of unemployment are bad and steps should be taken to remove them. Similarly, when he states that the limited resources of the economy should not be used in the way they are being used and should be used in a different way; that the choice between ends is wrong and should be altered, etc. he is making value judgments.

(ii) Normative Science: As normative science, economics involves value judgments. It is prescriptive in nature and described 'what ought to be' or 'what should be the things'. For example, the questions like what should be the level of national income, what should be the wage rate, how much of national product be distributed among people - all fall within the scope of normative science. Thus, normative economics is concerned with welfare propositions.

Thus, it is unnecessary to debate the question as to whether economics is a science or an art; whether it is positive or normative science. Basically, it is both. So, we should acknowledge the usefulness of both. The scope of improving the scope of economy will always be there.

SCOPE OF ECONOMICS

The horizon of economics is gradually expanding. It is no more a branch of knowledge that deals only with the production and consumption. However, the basic thrust still remains on using the available resources efficiently while giving the maximum satisfaction or welfare to the people on a sustainable basis. Given this, we can list some of the major branches of economics as under:

(i) Micro Economics: This is considered to be the basic economics. Microeconomics may be defined as that branch of economic analysis which studies the economic behaviour of the individual unit, may be a person, a particular household, or a particular firm. It is a study of one particular unit rather than all the units combined together. The microeconomics is also described as price and value theory, the theory of the household, the firm and the industry. Most production and welfare theories are of the microeconomics variety.

(ii) Macro Economics: Macroeconomics may be defined as that branch of economic analysis which studies behaviour of not one particular unit, but of all the units combined together. Macroeconomics is a study in aggregates. Hence, it is often called Aggregative Economics. It is, indeed, a realistic method of economic analysis, though it is complicated and involves the use of higher mathematics. In this method, we study how the equilibrium in the economy is reached consequent upon changes in the macro-variables and aggregates. The publication of Keynes' General Theory, in 1936, gave a strong impetus to the growth and development of modern macroeconomics.

(iii) International Economics: As the countries of the modern world are realising the significance of trade and commerce with other countries, the role of international economics is getting more and more significant nowadays.

(iv) Public Finance: The great depression of the 1930s led to the realization of the role of government in stabilising the economic growth besides other objectives like growth, redistribution of income, etc. Therefore, a full branch of economics known as Public Finance or the fiscal economics has emerged to analyse the role of government in the economy. Earlier the classical economists believed in the *laissez faire* economy ruling out role of the government in economic issues.

(v) Development Economics: After the Second World War many countries got freedom from the colonial rule, their economics required different treatment for growth and development. This led to emergence of new branch of economics known as development economics.

(vi) Health Economics: A new realisation has emerged from human development for economic growth. Therefore, branches like health economics are gaining momentum. Similarly, educational economics is also coming up.

(vii) Environmental Economics: Unchecked emphasis on economic growth without caring for natural resources and ecological balance, now, economic growth is facing a new challenge from the environmental side. Therefore, Environmental Economics has emerged as one of the major branches of economics that is considered significant for sustainable development.

(viii) Urban and Rural Economics: Role of location is quite important for economic attainments. There is also much debate on urban-rural divide. Therefore, economists have realised that there should be specific focus on urban areas and rural areas. Therefore, there is expansion of branches like urban economics and rural economics. Similarly, regional economics is also being emphasised to meet the challenge of geographical inequalities. There are many other branches of economics that form the scope of economics. There are welfare economics, monetary economics, energy economics, transport economics, demography, labour economics, agricultural economics, gender economics, economic planning, economics of infrastructure, etc.

CENTRAL PROBLEMS OF AN ECONOMY

The problem of scarcity of resources which arises before an individual consumer also arises collectively before an economy. On account of this problem and economy has to choose between the following:

- (i) Which goods should be produced and in how much quantity?
- (ii) What technique should be adopted for production?
- (iii) For whom goods should be produced?

These three problems are known as the central problems or the basic problems of an economy. This is so because all other economic problems cluster around these problems.

1. What to produce?

There are two aspects of this central problem— firstly, which goods should be produced, and secondly, what should be the quantities of the goods that are to be produced. The first problem relates to the goods which are to be produced. In other words, what goods should be produced? An economy wants many things but all these cannot be produced with the available resources. Therefore, an economy has to choose what goods should be produced and what goods should not be.

The priority has to be made between consumer or producer goods; or general or capital goods; or civil goods or defence goods.

The second problem is what should be the quantities of the goods that are to be produced. Production of goods depends upon the use of resources. Hence, this problem is the problem of allocation of resources. If we allocate more resources for the production of one commodity, the resources for the production of other commodities would be less.

2. How to produce?

The second central problem faced by any economy is which technique should be used for the production of given commodities. This problem arises because there are various techniques available for the production of a commodity such as, for the production of wheat, we may use either more of labour and less of capital or less of labour or more of capital. With the help of both these techniques, we can produce equal amount of wheat. Such possibilities exist relating to the production of other commodities also.

Therefore, every economy faces the problem as to how resources should be combined for the production of a given commodity. The goods would be produced employing those methods and techniques, whereby the output would be the maximum and cost of production would be the minimum.

3. For whom to produce?

The main objective of producing a commodity is its consumption in the economy. However, even after employing all the resources of an economy, it is not possible to produce all the commodities which are required. Therefore, an economy has to decide as to for whom goods should be produced. This problem is the problem of distribution of produced goods and services. Therefore, what goods should be consumed and by whom depends on distribution of National Product.

All the three central problems arise because resources are scarce. Had resources been unlimited, these problems would not have arisen. For example, in the event of resources being unlimited, we could have produced each and every thing we wanted, we could have used any technique and we could have produced for each and everybody.

Besides, what, how and for whom there are three more problems which are also regarded as basic problems.

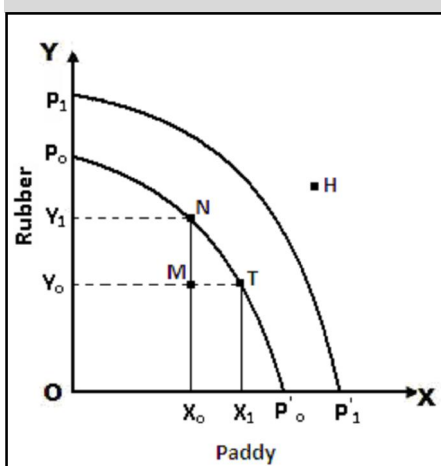
PRODUCTION POSSIBILITY CURVE

Professor Paul Samuelson is a leading figure among those economists who have explained the working of the economic system through these three questions. According to Samuelson, the main functions of an economic system are to answer these three questions.

Explanation of these Problems using Production Possibility Curve

Professor Samuelson used the concept of the production possibility curve to explain the economic problem of a society. A **production possibility curve** is the locus of all such combinations of two commodities which can be produced in a country with its given resources and technology.

Fig.1.1: Production Possibility Curve



In Fig. 1.1, $P_0P'_0$ is the production possibility curve of a country. It shows different combinations of paddy (X) and natural rubber (Y) which of the country can produce with its available resources and technology. It can choose any such combination like N or T which lies on this curve.

- 1. Limited Resource:** Here, the combination point N shows $0Y_1$ amount of natural rubber and $0X_0$ amount of paddy. Again, the combination point T shows $0Y_0$ amount of natural rubber and $0X_1$ amount of paddy. Thus, point N shows relatively higher amount of natural rubber as compared to point T. It implies that if the country wants to produce more of paddy, it has to reduce the production of natural rubber. This shows the limited availability of natural resources. Due to this reason, the country cannot choose any such combination like 'H' which lies beyond the production possibility curve.
- 2. Problem of 'What to Produce and in What Quantity':** This curve also reflects the problem of 'what to produce'. If the country uses all of its resources for the production of only natural rubber, then the maximum possible production of natural rubber will be OP_0 . In that case, there will be no production of paddy. Similarly, if the country uses all of its resources for the production of paddy then, the maximum possible production of paddy will be OP'_0 . But in that case, the production of natural rubber will be zero.
- 3. Efficient Utilisation of Available Resources:** If the country chooses the combination point M, *i.e.*, if it produces $0X_0$ of paddy and $0Y_0$ of natural rubber then it would indicate inefficient utilisation of resources. Here, the country can increase the production of paddy from $0X_0$ to $0X_1$ by keeping the production of natural rubber unchanged at $0Y_0$ (*i.e.*, the country can move from point M to T). Similarly, in this situation, the country can also increase the production of natural rubber from $0Y_0$ to $0Y_1$ by keeping the production of paddy unchanged at $0X_0$ (*i.e.*, the country can move from point M to N.). Thus, if the country chooses any combination of X and Y on the production possibility curve, it implies efficient utilisation of available resources. However, if it chooses any combination that lies below that curve, it would indicate inefficient utilisation or underutilisation of existing resources.
- 4. Improvement in Technology and Increase in the Amount of Resources:** If new resources are available or if the level of technology is improved (*e.g.*, application of high-yielding varieties of seeds, better methods of cultivation, better irrigational facilities, etc.) then the whole production possibility curve will shift outward. This is shown by $P_1P'_2$ curve in Fig. 1.1. In that case, the country can produce more of both X and Y commodities.

OPPORTUNITY COST

Opportunity cost is the value of alternative foregone in order to have something else. This value is unique for each individual. You may, for instance, forgo ice cream in order to have mashed potatoes. For you, the mashed potatoes have a greater value than dessert. But you can always change your mind in the future because there may be some instances when the mashed potatoes are just not as attractive as the ice cream. The opportunity cost of an individual's decisions, therefore, is determined by his or her needs, wants, time and resources (income).

This is important to the production possibility curve/ production frontier because a country will decide how to best allocate its resources according to its opportunity cost. Therefore, if the country chooses to produce more wine than cotton, the opportunity cost is equivalent to the cost of giving up the required cotton production.

Let's look at another example to demonstrate how opportunity cost ensures that an individual will buy the less expensive of two similar goods when given the choice. For example, assume that an individual has a choice between two telephone services. If he or she were to buy the most expensive service, that individual may have to reduce the number of times he or she goes to the movies each month. Giving up these opportunities to go to the movies may be a cost that is too high for this person, leading him or her to choose the less expensive service.

Remember that opportunity cost is different for each individual and nation. Thus, what is valued more than something else will vary among people and countries when decisions are made about how to allocate resources.

REVIEW QUESTIONS

1. “Economics is the _____ that studies human behaviour as a relationship between ends and scarce means which have alternative uses.”
2. In economics the central problem is different _____
3. A recession is a period during which aggregate output _____

WORKING OF AN ECONOMIC SYSTEM

An economic system is an entire set of arrangements and institutions meant for meeting the two fold objectives of a society:

- increasing the availability of resources
- ensuring the economic use

It is well known that economic systems, as created by different societies differ from each other. The economic system of even a given society keeps evolving and changing overtime, partly on account of on going efforts of the society to meet the problem of the scarcity of resources.

Broadly speaking, types of economic systems are based upon per capita income, prioritization of individuals to spend their resources and scarcity of both income and resources. The best possible solution to these three potential problems is the basis of a successful economic system. Precedence set by society, its individuals and the government for the attainment of resource mobility and individual freedom is fundamental to the right choice of system for any society. There are three different types of economic system.

- Capitalist Economy
- Socialist Economy
- Mixed Economy

A CAPITALIST ECONOMY

A Capitalist economic system is one which is characterized by free markets and the absence of government intervention in the economy. In practice a capitalist economy will need some government intervention, primarily to protect private property. In the real world, many economies which are viewed to have a capitalist economic system may have government spending taking up 35% of GDP. This is because the government pays for welfare, health, education and national defence. However, the economy is still viewed as capitalist because in the area of private enterprise firms are free to decide what to produce and for whom. Capitalist economic systems invariably lead to inequalities of wealth and income. However, it is argued that this inequality provides an incentive for wealth generation and economic growth. A Capitalist economic system is often contrasted to a Socialist or Communist economic system where economic decisions are made centrally by government agencies.

Features:

1. Capitalism derives its name from the fact that in this system, means of production are not owned by the government or by cooperatives. They are owned privately, that is by individuals and households. Business units (and therefore, the resources owned by them) also belong to individuals and households. The institution of private property also covers the right to inheritance. The institutions of property and inheritance have two strong implications.

2. People acquire a motive for earning more, because they are allowed to keep their earnings both for current and future use. For this reason, they are always on the look out for opportunities of increasing their income. In the process, if need be, they are also ready to work hard. The net result is that a capitalist system is characterised by a high production potential.
3. Private property and inheritance lead to ever-increasing inequalities of income and wealth. These inequalities, in their turn, result in unequal opportunities of earning an income. The market prices of various goods and services fail to correspond to their relative worth to the society. Therefore, a cumulative process develops in which the owners of capital are able to add to their incomes faster than the workers can add to their incomes, since they have to depend upon the income from their labour only.
4. Capitalism is also characterised by what is known as the policy of laissez-faire on the part of the authorities. The term laissez-faire means absence of state intervention in the working of the economy. The solution of the basic problems of the economy is left in the hands of market mechanism. In other words, the authorities do not try to regulate the prices, demand or supply. The market mechanism, through the interaction between demand and supply forces, brings about changes in prices. The prices, in turn, act as signals for individual economic units and guide them in their respective activities as consumers and producers, etc.
5. In theory, it is usually assumed that the market structure of a capitalist economy is competitive in nature. In practice, however, it need not be so. It is possible that while the authorities are following a policy of laissez-faire, the market itself is not competitive enough. It may have strong monopoly elements. It may be what we call a 'monopolistic competition', or there may be other forms of technical or institutional hurdles in the way of competition.
6. Another salient feature of capitalism is the use of money and credit. This is so because a capitalist system, by its very nature, tends to become quite complex with a large variety of goods, services and occupations. The producers undertake production mainly for sale in the market and not for self-consumption. Similarly, a capitalist economy tends to have production projects which have a long technical life. All these aspects of capitalism necessitate an elaborate system of financing its economic activities and therefore the use of money and credit.
7. In capitalism, all economic activities are guided by market forces. Producers produce only those goods and services which are demanded by consumers in the market. The entire economy operates to meet the needs and preferences of the consumers. This characteristic of capitalism is known as that of 'consumer sovereignty'.

Merits:

1. Capitalist system is self regulatory.
2. The process of economic growth is faster under capitalism. It has a tendency to register a huge rate of growth in national income and per capita income.
3. The capitalist system decides 'what to produce' and 'how to produce' in consonance with the forces of demand and supply.
4. Capitalistic system provides an incentive for efficient decision making and their implementation in the form of economic gains to the decision makers which ensure a high degree of operative efficiency in the system.
5. It provides flexibility to adapt to the changed circumstances.
6. It ensures individual freedom giving entrepreneurs incentive to work hard.
7. Capitalism ensures optimal allocation of resources in different uses.

Demerits:

1. Capitalism generates inequalities of income and wealth.
2. Wide differences in economic opportunities.
3. Distortion in the production pattern.
4. Capitalism wastes its productive resources.
5. Production of merit goods is not profitable.
6. Business units produce only those goods and services which are profitable.
7. Loss of human values and welfare.
8. Increases the wastage of resources as a result of competition.

A SOCIALIST ECONOMY

The concept of a socialist economy has its origin in the drawbacks of capitalism. There are no pre-determined details of a socialist system, but its main features are well recognized. This system tries to get rid of the drawbacks of capitalism and incorporate those features which are considered to be desirable. For example, it aims at removing the problems of inequalities of income and wealth, inequalities of economic opportunities, unemployment, cyclical fluctuations, and waste of productive resources. The advocates of socialism believe that most of these drawbacks come into being because of certain basic features of capitalism including the institutions of private property and inheritance, and the use of market mechanism.

In the words of H. D. Dickinson, “Socialism is an organisation of the society in which the material means of production are owned by the whole commodity and operated by organs, representative of and responsible to, all members of community according to a general plan, all members of community being entitled to get benefits from the results of such socialist planned production on the basis of equal rights.”

According to Maurice Dobb, “The fundamental character of socialism consists in its abolition of class relations which form the basis of Capitalist production through expropriation of the propertied class and the socialisation of land and capital.”

Accordingly, Socialism is basically designed to have the following salient features.

Features:

1. In a socialist economy, the institutions of private property and inheritance are abolished. The ‘private sector’ as we understand by this term, does not exist. It means that the ownership of means of production is not in the hands of individuals and households. Instead, they are owned by the government authorities and/or cooperatives or society. Individuals and households do not own any business concerns. And no one is an employee of a private business. Private ownership is allowed only in the case of consumption goods and personal belongings, and that too only to a limited extent. And to that extent, even inheritance of ‘private property’ may be allowed. An important implication of the abolition of private property and inheritance is that economic decision-making is no longer left in private hands.
2. A socialist economy is not guided by free working of a market mechanism. It is rendered ineffective. In a sense, its operation is “frozen”. Consumers and producers are not allowed freedom in their decision-making. The consumers have to take decisions within the limits set by the authorities. They also lay down production schedules and decide what to produce, how much to produce, and what resources to be used as inputs. Thus, demand and supply forces are not to respond to changes in prices.. Instead they are regulated with the objective of serving the national interests as a whole. Similarly, prices are not allowed to fluctuate in response to changes in demand and supply. They are also controlled and regulated by the

authorities. Only in some cases, cooperatives may be permitted to change the prices within certain limits. Systematic operation of a complex economy necessitates a complex and vast set up of decision-making. In capitalism, this complex task is handled by market mechanism. But in socialism, its substitute has to be created. This is usually done in the form of centralised economic planning.

3. A socialist economy recognises the ill-effects of money and credit. In capitalist system, these create cyclical fluctuations and inequalities of income and wealth. Ideally, therefore, a socialist economy prefers not to have these institutions. But the hard reality is that it cannot do without them. In an economy, which produces a large number of goods and services, cannot have an efficient system of physical rationing. It has to create and operate a complex system of income distribution which is not possible without using money in some form. Accordingly, it is not able to completely discard the use of money and credit but restricts it to the minimum necessary extent.
4. Capitalism derives its name from the fact that in this system, means of production are not owned by the government or by cooperatives. They are owned privately, that is by individuals and households. Business units (and therefore, the resources owned by them) also belong to individuals and households. The institution of private property also covers the right to inheritance.
5. Another important feature of socialism is to have class less society. Since under socialism, no property is privately owned, so there is no question of existence of classes. Every person in the society gets the share in production according to his own merits.

Merits:

A socialist economy discards the use of market mechanism and replaces it with some form of regulatory authority, such as the planning commission. It also abolishes the institutions of private property and inheritance. Given these features of the socialist economy, it tries to remove the basic demerits of capitalism by pursuing the objectives of

- distributive justice
- social security
- elimination of fluctuations of economy
- coordinated development
- elimination of social disputes.

Demerits:

While socialism is able to get rid of the problems of income inequalities, unemployment and cyclical fluctuations of national income and prices, it is not able to provide economic incentives and disincentives for hard work and initiative. As a result, it continues to suffer from slow growth rate, poor productivity of labour and low per capita income. On account of these weaknesses of the economy, it becomes difficult to raise the consumption standards of the masses. And this gives rise to the necessity of restructuring the economic system for better results.

A MIXED ECONOMY

A mixed economy tries to

- avoid the ill-effects of both capitalism and socialism
- secure the benefits of both.

For this reason, it incorporates some elements of both capitalism and socialism. However, there is no pre-determined and standardised proportion in which their features could be selected and combined.

Features:

1. The selection of detailed features of a mixed economy is made with reference to the working of market mechanism, and its expected effects (both beneficial and harmful) on the society as a whole. In other words, we take up one segment of the economy at a time, and adopt the following procedure.
2. It is decided that working of the selected segment of the economy should be guided by free market mechanism if the net effect of this arrangement is expected to be beneficial for the society as a whole.
3. If the working of the segment under consideration can be made beneficial for the society by subjecting the working of market mechanism to some regulatory measures, then the said segment is subjected to be governed by a regulated market mechanism. In other words, in this case, the interaction between demand, supply and prices is regulated in a manner and to the extent found necessary.
4. Working of a segment under free market mechanism may be harmful for the society in certain respects. If it is possible to make its working beneficial by regulating the market mechanism, the said segment is again subjected to a regulated market mechanism. However, the extent and nature of regulatory measures are revised from time to time in light of the changing circumstances.
5. In some other cases it may be found that market mechanism continues to have net ill-effects even after restrictions and regulations. In such cases, therefore, market mechanism is not allowed to operate at all. The authorities take over one or more functions of market mechanism, namely, demand decisions, supply decisions and prices. This is generally done through public sector undertakings, which need not be guided market forces.
6. Socialistic society offers equal opportunity to all to rise above level of standards. For this, state authority make available health, education, transport facilities to all, either subsidized or free of cost.
7. Since equalities of income and wealth in society is the major objectives in socialist economy, the authority tries to achieve it by social or state ownership of means of production.

Thus, in a mixed economy, the net result is that market mechanism is not totally abolished. It is allowed to operate with different degrees of freedom in different segments of the economy. Indian economy provides a very good example of a mixed economy as it operates in practice.

In theory, a mixed economy is far superior to either capitalism or socialism since it tries to acquire beneficial features of both. In practice, however, it suffers from many drawbacks. Some of these arise on account of the fact that it is extremely difficult to work out the details of a mixed economy. The system has a tendency to suffer from several inner contradictions. Once the rules and procedures for its working have been formulated, it is not possible to revise them frequently or rapidly. The economy, therefore, fails to adjust itself to changing circumstances as rapidly as it should. The success of a mixed economy also depends upon the integrity and expertise of the government administration, the expertise and freedom of the management, and the willingness of the workers to recognise their moral duty of increasing productivity.

ECONOMIC CYCLES

The term economic cycle (or business cycle) refers to economy-wide fluctuations in production or economic activity such as income employment, savings and investment over several months or years. These fluctuations occur around a long-term growth trend, and typically involve shifts over time between periods of relatively rapid economic growth (an expansion or boom), and periods of relative stagnation or decline (a contraction or recession or depression).

Business cycles are usually measured by considering the growth rate of real gross domestic product. Despite being termed cycles, these fluctuations in economic activity do not follow a mechanical or predictable periodic pattern.

Stages of the Economic Cycle

Economic Boom/ Inflation

A boom occurs when national output is rising strongly at a rate faster than the trend rate of growth (or long-term growth rate) of about 2.5% per year. In boom conditions, output and employment are both expanding and the level of aggregate demand for goods and services is very high. Typically, businesses use the opportunity of a boom to raise output and also widen their profit margins.

Characteristics of an Economic Boom

- Strong and rising level of aggregate demand - often driven by fast growth of consumption
- Rising employment and real wages
- High demand for imported goods & services
- Government tax revenues will be rising quickly
- Company profits and investment increase
- Increased utilization rate of existing resources
- Danger of demand-pull and cost-push inflation if the economy overheats.

Economic Slowdown

A slowdown occurs when the rate of growth decelerates - but national output is still rising. If the economy continues to grow (albeit at a slower rate) without falling into outright recession, this is known as a soft-landing.

Economic Recession

A recession means a fall in the level of real national output (i.e. a period when the rate of economic growth is negative). National output declines, leading to a contraction in employment, incomes and profits. The last recession in Britain lasted from the summer of 1990 through to the autumn of 1992. When real GDP reaches a low point at the end of the recession, the economy has reached the trough - economic recovery is imminent.

An economic slump is a prolonged and deep recession leading to a significant fall in output and average living standards.

Characteristics of an Economic Recession

- Declining aggregate demand for output
- Contracting employment / rising unemployment
- Sharp fall in business confidence and profits and a decrease in capital investment spending
- De-stocking and heavy price discounting
- Reduced inflationary pressure and falling demand for imports
- Increased government borrowing lower interest rates from central bank
- The last stage of economic recession is depression, at which the economic activities touches its low point in terms of production, employment, savings and investment.

Economic Recovery

A recovery occurs when real national output picks up from the trough reached at the low point of the recession.

The pace of recovery depends in part on how quickly aggregate demand starts to rise after the economic downturn. And, the extent to which producers raise output and rebuild their stock levels in anticipation of a rise in demand.

LESSON ROUND UP

- An economy exists because of two facts, i.e. Human wants are limited and resources are scarce.
- The basic problem of scarcity gives rise to many of the economic problems.
- The subject matter and scope of economics are given by various economists:
 - Wealth aspect by Adam Smith
 - Welfare aspect by Alfred Marshall
 - Scarcity and Choice aspect by Lionel Robinson
 - Development and Growth aspect by Paul Samuelson
- Nature of economics may be classified into as science or art or both and if it is a science whether it is a positive science or a normative science or both.
- Scope of economics has a varied arena as following:
 - Micro Economics
 - Macro Economics
 - International Economics
 - Public Economics
 - Development Economics
 - Health Economics
 - Environmental Economics
 - Urban and Rural Economics
- The problem of scarcity of resources leads to three central problems of economy as following:
 - Which goods should be produced and in how much quantity?
 - What technique should be adopted for production?
 - For whom goods should be produced?
- The concept of the production possibility curve is used by economists to explain the economic problem of a society. A **production possibility curve** is the locus of all such combinations of two commodities which can be produced in a country with its given resources and technology.
- There are three types of economic systems:
 - Capitalist Economy
 - Socialist Economy
 - Mixed Economy
- The economic problems of the system are solved differently under each economic system. Capitalist economy uses tool of price mechanism, whereas; socialist economy uses tool of central planning as against the mixed economy which employs a mix of both.

- The economy worldwide suffers from fluctuations in economic activities which are known as business cycles. A business cycle is composed of periods of rising prices and low unemployment percentages, shifting to periods falling prices and high unemployment percentages besides other leading characteristics.

GLOSSARY

Ends	The objectives pursued by human beings while engaged in economic activities.
Means	The instruments or resources used in attaining the perceived objectives.
Scarcity	The imbalance between ends and means.
Laissez Faire	Free market economics with a minimum of government intervention.
Economics	The Word Economics Has Greek Origin. Oikos Plus Nomos Meaning House Management. The word economics has something to do with economizing on the use of means to attain ends out of scarce resources.
Positive Economics	Deals with scientific issues and questions. Solves economics central problems without value judgment.
Normative Economics	Deals with ethical issues, questions and problems. Solves economic problems bringing in value judgment.
Micro Economics	Analysis of any single unit of economics.
Macro Economics	Analysis of all units of economics studied together.
Production Possibility Curve	The locus of output combinations which an economy can produce using technically most efficient methods of production and allocating resources in an economically efficient manner.

SELF-TEST QUESTIONS

1. How would you explain the rapid growth of the science of economics ? Does it serve a useful purpose in the solution of our practical problems ?
2. Why do we have a large number of definitions of economics ? How do you reconcile them with each other?
3. What do you mean by an economic system ? Why does it come into existence? What are its basic problems ?
4. We cannot have a fixed and permanent definition of economics because its coverage is always undergoing a change and expansion. Elaborate this statement and illustrate your answer with suitable examples.
5. Critically comment on Adam Smith's view that economics is a science of the nature and causes of the wealth of nations. Highlight the drawbacks of this view.
6. "We cannot define economics in general acceptable terms. The definition will follow the objective of defining it." Elaborate.
7. State and discuss Marshallian definition of economics.
8. "Economics discusses the use of scarce resources for satisfying unlimited ends." Critically elaborate this definition of economics.
9. Distinguish between economics as an art and economics as a science. Which of the two do you prefer and why ?

Lesson 2

Theory of Demand and Supply

LESSON OUTLINE

- Introduction
- Demand
- Utility Approach
 - Law of Diminishing Marginal Utility
 - Law of Equi-Marginal Utility
- Consumer Equilibrium
- Derivation of Law of Demand
- Determinants of Demand
- Supply
- Determinants of Supply
- Determination of Equilibrium Price and Quantity
- Effect of Changes in the Conditions of Demand and Supply on Market Price
- Elasticity of Demand and Supply
- Theory of Consumer's Behavior
 - Marshallian Approach
 - Indifference Curve Approach
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

The theory of demand and supply is a theory of price and output in competitive markets. In a market economy, individual consumers make plans of consumption and individual firms make plans of production based on the changes in market prices.

Economists use the term invisible hand to describe the frequent exchanges in the market because everyone (no matter consumer or producer) takes the market price as a signal on trade and makes exchanges with private property rights (defined and protected by laws).

The price system works in a market economy only if there is free choice within the market.

The following section explains how the market price is determined by the interaction of consumers (demand) and producers (supply).

In the latter parts, the factors causing a change in price are explained. In this chapter; you'll find the basics of demand and supply analysis. You will learn about the various factors that can shift a supply or demand curve up or down, the concepts of equilibrium and market adjustment, and the signaling and rationing functions of prices.

An old story says that if you want an "educated economist," all you have to do is get a parrot and train the bird to squawk "demand and supply" in response to every question about the economy! Not smart enough, but ... It's true that the theory of demand and supply is a central part of economics. It is widely applicable, and also is a model of the way economists try to think most problems through...

INTRODUCTION

Demand and Supply is perhaps one of the most fundamental concepts of economics and it is the backbone of a market economy. Analysis of the determination of prices of goods and services in the market is an indispensable part of the subject matter of economic theory. When an economy is guided by market mechanism, prices are determined by interaction between demand and supply forces, that is, they are the result of an interaction between decisions taken by buyers and sellers.

Why is the price of diamonds far higher than the price of water? People need water to survive; diamonds are luxuries. The answers lie in the forces of demand and supply.

The market of an economy comprises of two different groups of participants: Consumers and Producers. Demand analysis focuses on the behavior of consumers, while supply analysis examines the behavior of producers. The consumer indirectly tells the producer what she is willing to buy and how much she is willing to pay based on her actual spending patterns. The producer supplies the product if she can make a profit by doing so. The forces of demand and supply coordinate to arrive at an equilibrium price and quantity of output which best satisfies the consumers and reaps maximum profits to producers.

Demand and Supply analysis is an extremely powerful analytical tool, yet it is little understood and often confused. There is no “law of demand and supply”. Infact, there are two separate laws: a law of demand and a law of supply. Each works independently of the other. (The terms good or service will be used interchangeably).

DEMAND

Meaning of Demand

Demand refers to how much (quantity) of a product or service is desired by buyers. The quantity demanded is the amount of a product people are willing to buy at a certain price. Demand for a good by a consumer is not the same thing as his desire to buy it. A desire becomes a demand only when it is ‘effective’ which means that, given the price of the good, the consumer should be both willing and able to pay for the quantity which he wants to buy.

Thus three things are essential for a desire for a commodity to become effective demand.

- desire for a commodity
- willingness to pay
- ability to pay for the commodity

For instance, demand for Mercedes Benz can be considered as demand only when it is backed by desire, willingness and ability to pay

Law of Demand

The consumer’s decisions are guided by several elements, such as income, tastes and preferences etc and an assumption is established that these factors remain constant. Among the many causal factors affecting demand, price is the most significant and the price- quantity relationship called as the Law of Demand is stated as follows:

“The greater the amount to be sold, the smaller must be the price at which it is offered in order that it may find purchasers, or in other words, the amount demanded increases with a fall in price and diminishes with a rise in price”. In simple words other things being equal, quantity demanded will be more at a lower price than at higher price. The law assumes that income, taste, fashion, prices of related goods, etc. remain the same in a given period. The law indicates the inverse relation between the price of a commodity and its quantity demanded in the market.

Thus ‘*Ceteris Paribus*’;

- (a) With a change in the price of the good, the consumer changes the quantity purchased by him. Normally, the consumer buys more of a good when its price falls and reduces the quantity when its price increases.

- (b) The quantity demanded must be related to the time interval over which it is purchased. For example, it is meaningless to say that a consumer buys 5 kg of sugar when its price is Rs. 12 per kg. The quantity bought must specify the time period, i.e., per day, per week, per month, or over some other period.

Factors determining demand for a commodity are: Price, Income of the consumer, Tastes & Preferences, Demographic factors, Seasonal factors etc.

Three Alternative Ways of Expressing Demand

Demand for a good by an individual or the market as a whole is conventionally expressed in three alternative forms, namely;

- a demand schedule
- a demand curve
- a demand function

General form of the demand function is $D_x = f(P_x, Y, T)$

In a demand function $D_x = f(P_x, Y, T)$. The dependent variable is D_x , i.e. the demand for a commodity (a normal good) and P_x (price), Y (income) and T (tastes and preferences of a consumer) are independent variables. In other words, the demand for a commodity is determined or dependent upon the mentioned three independent variables.

Example of a demand function for good X is $D_x = 2000 - 10P_x$

where, D_x denotes quantity of demanded of good X, P_x denotes the price of good X, Y represents income level of the consumer and T (constant) is a measure of his tastes and preferences.

Demand Function: A demand function of an individual buyer is an algebraic form of expressing his demand behaviour. In it, the quantity demanded per period of time is expressed as a function of several variables. A demand function may be in a generalized form or a specific form. In the latter case, the function describes the exact manner in which quantity demanded is supposed to vary in response to a change in one or more independent variables.

Demand Schedule: A demand schedule is a tabular form of describing the relationship between quantities demanded of a good in response to its price per unit, while all non-price determining variables remain unchanged. A demand schedule has two columns, namely

- price per unit of the good (P_x)
- quantity demanded per period (D_x)

The demand schedule is a set of pairs of values of P_x and D_x .

There are two types of demand schedule, namely

- individual demand schedule
- market demand schedule

Table: 2.1 Individual Demand Schedule for Commodity X

Price per unit of Commodity X ₹	Quantity Demanded for Commodity X (Units)
10	6000
20	5000
30	4000
40	3000
50	2000
60	1000

From individual demand schedules one may draw the market demand schedule. Market demand schedule is the horizontal summation of individual demand schedules. The illustration of market demand schedule is given as under (See Table 2.2).

Table: 2.2 Market Demand Schedule for Commodity X

Per unit Price of Commodity X (Rs)	Quantity Demanded for Commodity X by Consumer – A (Units)	Quantity Demanded for Commodity X by Consumer– B (Units)	Market Demand (Units)
P_x	Q_A	Q_B	$Q_A + Q_B$
10	6000	9000	15000
20	5000	8000	13000
30	4000	7000	11000
40	3000	6000	9000
50	2000	5000	7000
60	1000	4000	5000

For instance, if the price of bike is Rs50,000 and at this price, Consumer A demands 2 bikes and Consumer B demands 1 bike then the market demand for the bike will be 3 (sum total of the demand of the two consumers). Likewise by adding up the individual demand for a commodity at different price levels, we can ascertain the market demand for the commodity.

Demand Curve: A demand curve is a graphic representation of the demand schedule. It is a locus of pairs of prices per unit (P_x) and the corresponding demand-quantities (D_x). (See. Fig 2.1)

Fig. 2.1: Demand Curve

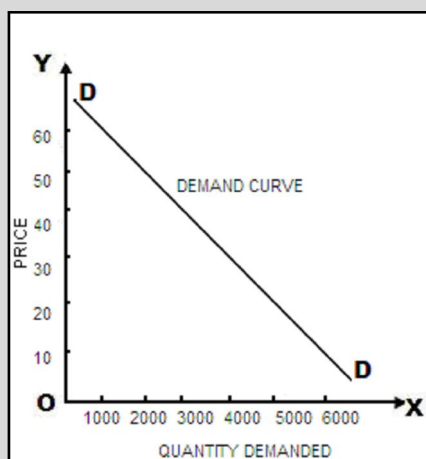


Fig 2.1 shows demand curve, where X axis is quantity demand and Y axis shows prices. As the price increases from 10 to 60 the quantity demanded declines 6000 to 1000, establishing a negative relation among the two.

This thus, implies that the conventional demand curve, owing to other things being constant is downward sloping.

To explain the Law of Demand, various approaches may be employed in analyzing its behaviour for a typical individual consumer. The Utility approach is one of them.

UTILITY APPROACH

Meaning of Utility

Utility of a good is its expected capacity to satisfy a human want. To a consumer, the utility of a good is the satisfaction which he expects from its consumption. It is the extent to which it is expected to satisfy his want(s). It is obvious that

utility of a good to a consumer can differ from the satisfaction which he actually derives from its consumption.

The fact that utility of a good is the satisfaction which the consumer expects from its consumption implies that it is a subjective thing. It depends upon the mental assessment of the consumer and is determined by several factors which influence the consumer’s judgment. These factors include, for example, the intensity of the want(s) to be satisfied. Utility of a good varies with the intensity of the want to be satisfied by its consumption. This fact leads to a few important inferences.

- Utility of a good differs from consumer to consumer. This is because a given want can be felt in different intensities by different consumers.
- The utility of a good keeps changing even for the same consumer on account of changes in the intensity of the want(s) to be satisfied by its use. This change may be the result of a shift in the circumstances faced by the consumer, or it may take place in the process of the satisfaction of the want itself.
- The utility of a good is not to be equated with its usefulness. Satisfaction of a want need not add to the welfare of the consumer. For example, smoking, drug taking or consumption of similar other things is believed to be harmful for the health of the consumer. But the consumer believes that they have utility for him because he can use these to satisfy his wants.

In economics, we are not concerned with the ‘normative’ aspect of utility. While studying the problem of price determination of a good, we are only concerned with the ‘reasons for’ and ‘intensity of’ its demand by the consumers. It does not matter whether its consumption adds to their well-being or not. So long as the consumers expect to derive some ‘satisfaction’ from a good (that is, so long the good has a ‘utility’ for them), they will be ready to buy it at some price and create a demand for it in the market.

As we know that though total utility usually goes up with the increase in the consumption of a good, marginally utility usually decreases with each additional increase in the consumption of a good. For example, if we take the case of a chocolate bar, then it will be observed that after consuming one chocolate bar your sweet tooth has been satisfied. Your marginal utility and total utility after eating one chocolate bar will be quite high. But if you eat more chocolate bars, the pleasure of each additional chocolate bar will be less than the pleasure you received from eating the one before- probably because you are starting to feel full or you have had too many sweets for one day.

Chocolate Bars Eaten	Marginal Utility of Chocolate	Total Utility of Chocolate
0	0	0
1	70	70
2	10	80
3	5	85
4	3	88

The above table shows that total utility will increase at a much slower rate as marginal utility diminishes with each additional bar. Notice how the first chocolate bar gives a total utility of 70 but the next three chocolate bars together increase total utility by only 18 additional units.

Measurement of Utility

The need for measuring utility arises so that it can be used in the analysis of demand behaviour of individual consumers, and therefore, of the market as a whole. The basis of the reasoning is that a consumer compares utility of a good with the price he has to pay for it. He keeps buying its additional units so long as the utility from them is at least equal to the price to be paid for them. In economic theory, utility can be measured in two ways:

- Cardinal Approach
- Ordinal Approach

Cardinal Utility Approach

Human wants are unlimited and they are of different intensity. The means at the disposal of a man are not only scarce but they have alternative uses. As a result of scarcity of resources, the consumer cannot satisfy all his wants. He has to choose as to which want is to be satisfied first and which afterward if the resources permit. The consumer is confronted in making a choice.

For example, a man is thirsty. He goes to the market and satisfy his thirst by purchasing coca cola instead of tea. We are here to examine the economic forces which make him purchase a particular commodity. The answer is simple. The consumer buys a commodity because it gives him satisfaction. In technical term, a consumer purchases a commodity because it has utility for him.

The utility can be measured in cardinal numbers such as 1, 3, 10, 15, etc. The utility is expressed in imaginary cardinal numbers tells us a great deal about the preference of the consumer for a good. In cardinal measurement, utility is expressed in absolute standard units, such as there being 20 units of utility from the first loaf of bread and 15 units from the second.

Pareto, an Italian Economist, severely criticized the concept of cardinal utility. He stated that utility is neither quantifiable nor addible. It can, however be compared. He suggested that the concept of utility should be replaced by the scale of preference.

Ordinal Utility Approach

Ordinal utility approach is purely subjective and is immeasurable. The theory of consumption is based on the scale of preference and the ordinal ranks or orders his preferences. Ordinal measurement of utility is the one in which utility can not be expressed in absolute units. Utility from two or more sources is only 'ranked' or 'ordered' in relation to each other. Utility from one source may be 'equal to', 'more than' or 'less than' utility from another source. But it is not possible to state the difference in absolute or numerical units.

The fact is that utility is a subjective thing and varies from person to person and from one situation to another. For this reason, it is neither possible to measure it in absolute terms, nor compare utility of a good for two individuals. This implies that cardinal measurement of utility is only a theoretical phenomenon, and has less validity in practice. Utility is best measured in ordinal terms.

However, in a number of cases, analysis of demand decisions requires the use of a cardinal measurement of utility. For this reason, economists adopted a standard unit of measuring utility and called it 'util' (also frequently used in plural as 'utils'). But 'utils' itself happens to a subjective, discretionary and imprecise measure and, therefore, does not determine the demand behaviour of consumers.

To overcome this limitation, Marshall advocated that utility of a good to the consumer should be measured in units of money which the consumer is willing to pay for buying the commodity. For example, if a consumer is willing to pay, at the most, five rupees for the first bottle of a cold drink and only four rupees for the second one, then according to this approach, the utility of the first bottle to the consumer equals five rupees and that of the second equals four rupees. This approach was widely accepted and seemed to be useful in analyzing demand decisions of the consumers because, in practice, the consumers pay for their purchases in monetary terms.

Concepts of Total, Average and Marginal Utility

When a consumer buys a good, the utility derived from it varies with its quantity, and generates three concepts; namely

- Total Utility(TU)
- Average Utility(AU)
- Marginal Utility(MU)

If a consumer buys n units of a good X then, for him, Total utility (TU) from it is the summation of utilities derived

from all the n units. By dividing this total utility (TU) by the number of units of X, that is n, the resultant is Average utility (AU) of these units of X to the consumer. The additional satisfaction a consumer gains from consuming one more unit of a good or service is Marginal utility (MU).

Symbolically, if U_i stands for the utility of i^{th} unit of good X, then

- $TU_n = \sum U_i$
- $AU_n = TU_n/n$
- $MU_n = TU_n - TU_{n-1}$

In the case of a 'perfectly divisible' good, MU equals the first derivative of TU with respect to X, i.e.

Marginal utility of n^{th} unit of consumption, $MU_n = dTU/dX$

It is clear that utility of good X to the consumer is directly related to the intensity of the want to be satisfied through its consumption which is explained as follows:

- For a given consumer, the three measures of utility depend upon the intensity of the want, which he expects to satisfy.
- When a consumer consumes a good to satisfy his want, its intensity also undergoes a change. Therefore, the three measures of utility are also affected by the stock of X with the consumer.
- The intensity of a want being satisfied tends to change over time. The capacity of different goods to satisfy wants also differs. These factors also cause a shift in the three measures of utility.
- Generally speaking, wants are not felt with equal intensity by all consumers. Therefore, the measures of utility tend to vary from consumer to consumer.

Table:2.3 Total, Average and Marginal Utility of Slices of Bread

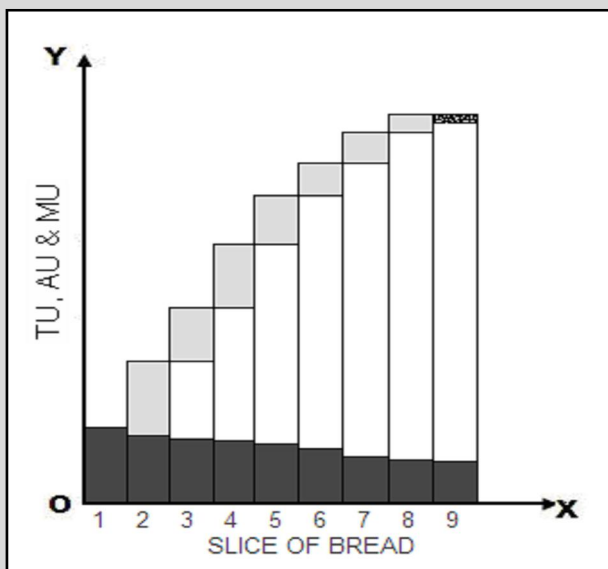
Slices of Bread	Total Utility	Average Utility	Marginal Utility
1 st	40	40	40
2 nd	78	39	38
3 rd	113	37.7	35
4 th	144	36	31
5 th	170	34	26
6 th	190	31.7	20
7 th	203	29	13
8 th	208	26	5
9 th	204	22.7	-4

Table 2.3 illustrates interrelationship between three concepts of utility by considering a hypothetical example of a consumer who consumes slices of bread to satisfy his hunger. It should be specifically noted that the consumer is to consume bread without allowing any unreasonable time gap between the intakes of successive slices. This assumption is essential to ensure that the intensity of hunger of the consumer decreases as he consumes additional slices. By implication, the marginal utility of slices also falls, and depending upon the number of slices consumed, it can even become zero or negative. In Table 2.3, units of MU are shown in column 4. It becomes negative when the consumer consumes 9th slice. Figures of TU are shown in column 2. At each stage, TU is the

cumulative total of the MU in column 4. Thus, for example, for four slices, TU equals 144, that is, (40 + 38 + 35 + 31). Average utility is shown in column 3. Its entries are obtained by dividing the figures in column 2 with their corresponding figures in column 1.

It should be noted that, for the first slice, all the three measures of utility are equal to each other. Moreover, since MU falls with successive slices of bread, therefore, TU increases at a decreasing rate. It reaches its maximum when MU falls to zero and actually declines when MU becomes negative. In our example, TU reaches its maximum with 8th slice and decreases with the consumption of 9th slice because its MU becomes negative (-4). It should also be noted that when MU is falling, AU also falls but at a slower rate. This fact can be verified by comparing figures in column 3 with those in column 4.

Fig. 2.2: Total Utility, Average Utility and Marginal Utility of Slices of Bread



In Fig. 2.2, information contained in Table 2. 3 is expressed in the form of a bar diagram. Each step along X-axis represents one slice of bread. Total height of a bar represents total utility corresponding to the number of slices consumed. The upper portion of a bar shaded by dots represents the MU of the corresponding number of slice. Similarly, the portion of a bar shaded diagonally represents the AU of the slices consumed. It should be noted that MU of 9th slice is negative. As a result, the height of the bar also decreases. And so is the case with the shaded portion representing AU.

In the figure, Total Utility is Height of the bar, Average Utility is dark-shaded area and Marginal Utility is light-shaded area.

Fig. 2.3: Total, Average and Marginal Utility

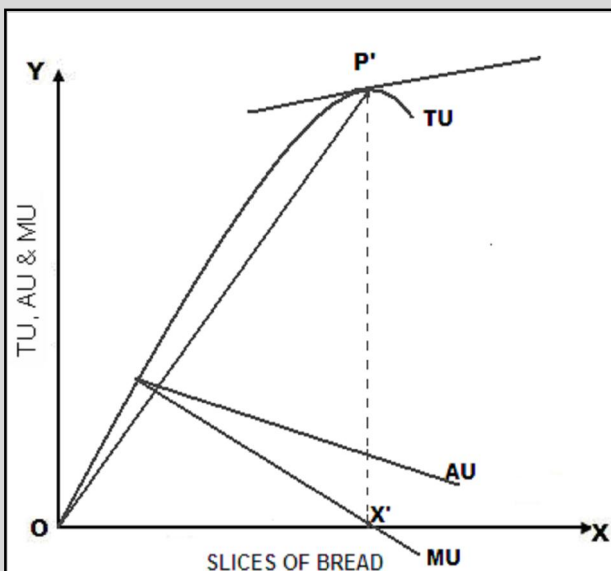


Fig. 2.3: Total, Average and Marginal Utility

A generalized way of showing the relationship between three measures of utility is to take good X and assume that it is perfectly divisible, that is, it can be divided into infinitesimally small units. In this case, TU, AU and MU of X can be expressed in the form of curves. The three curves of utility become smooth with a type of interrelationship shown in Fig. 2.3.

The figure shows that initially the total utility curve slopes upwards to the right. This indicates that the total utility will rise with consumption of additional units of the commodity. However, the increase in total utility is not constant, but falls steadily.

In other words, the total utility rises at a falling rate. This is shown by corresponding downward or negative slope of the marginal utility curve. When the total utility reaches its maximum value, marginal utility becomes zero. Before this point, though marginal utility falls, it always remains positive. The total utility stops rising at this stage. When consumption is expanded beyond this, the total utility starts to fall because marginal utility becomes negative.

It is conventionally assumed that MU diminishes with successive units of good X. This shows:

- Marginal Utility Curve slope downwards.
- Average Utility Curve falls slower than Marginal Utility Curve. Therefore, AU curve has a flatter slope and lies above MU curve.
- Total Utility Curve rises at a diminishing rate. It reaches its maximum distance from X-axis when MU is zero. Thereafter, it also slopes downwards, when MU is negative.

Geometrically, TU curve itself provides complete information regarding total, average and marginal utility as follows. Given the quantity of good X (say, OX'), we consider the corresponding point (P') on TU curve. Then, the perpendicular distance $P'X'$ measures total utility of the quantity OX' . The slope of the ray from the origin to P' , (OP') measures its average utility. The slope of the tangent to total utility curve at point P' measures marginal utility. Recall that marginal utility is also the first derivative of total utility with respect to quantity of the good that is dTU / dX .

REVIEW QUESTIONS



1. What is demand?
2. What is demand function?
3. Explain concept of demand with the help schedule and curve?
4. What do you understand by utility?
5. Explain the relationship between TP, AP and MP.

LAW OF DIMINISHING MARGINAL UTILITY (DMU)

The law of diminishing marginal utility states that as the stock of a commodity increases with the consumer, its marginal utility to the consumer decreases. It can eventually fall to zero and become even negative. The law describes a familiar psychological tendency of the human beings.

Marshall says that “the additional benefit which a person derives from a given increase in his stock of a thing diminishes with every increase in the stock that he already has.”

The specific behaviour of marginal utility as described by the law of DMU follows from the conventional (and realistic) assumption that the intensity of a given want keeps decreasing if the process of its satisfaction is continued without interruption, that is, a single want can be fully satisfied provided the consumer consumes a large enough quantity of the relevant good/service. In other words, during the process of its satisfaction, nothing should happen to increase its intensity. For example, the consumer should not allow an unduly long interval between the consumption of any two units of the good; he should not get news of an unexpected change in his income or the price of the good, etc. It should also be noted that the good to be consumed should be homogeneous. Its successive units should have the same technical specifications. Any change in them can cause a change in the intensity of the want being satisfied and thereby violate the law of DMU.

Assumptions

- All the units of the given commodity are homogenous i.e. identical in size shape, quality, quantity etc.
- The units of consumption are of reasonable size. The consumption is normal.
- The consumption is continuous. There is no unduly long time interval between the consumption of the successive units.

- The law assumes that only one type of commodity is used for consumption at a time.
- Though it is psychological concept, the law assumes that the utility can be measured cardinally i.e. it can be expressed numerically.
- The consumer is rational human being and he aims at maximum of satisfaction.

Exceptions to the Law

The law of DMU is violated only if one or more of the assumptions upon which it is based get violated. Since utility of a good is related to the mental perception of the consumer regarding the intensity of the want to be satisfied and the capacity of the good to satisfy it, therefore, the law of DMU is violated if for some reason,

- the intensity of the want increases, or
- the consumer comes to think that the intensity of his want has increased.

It is for this reason that marginal utility of a good tends to increase if there is an unduly long interval between the consumption of two units of a good. Marginal utility of a good may also increase, if the want of the consumer is intensified by consuming a very small quantity of it (such as, a very little quantity of water given to a very thirsty person).

The exceptions to the law of DMU are as follows:

- (a) Hobbies: In case of certain hobbies like stamp collection or old coins, every addition unit gives more pleasure. MU goes on increasing with the acquisition of every unit.
- (b) Miser: In the case of miser, greed increases with the acquisition of every additional unit of money.
- (c) Reading: Reading of more books gives more knowledge and in turn greater satisfactions.

Uses of the Law of DMU

The concept of marginal utility of a good and the manner, in which it changes in relation to a change in its stock with a typical consumer, plays a central role in demand analysis.

- (a) It is directly linked with the price which the consumer is ready to pay for different quantities of the good under consideration. The analysis is based upon the assumption that the decision of the consumer is guided by his 'rationality', that is his economic interest. He buys an additional unit of a good only if its marginal utility is equal to or greater than the price to be paid for it. Given that the law of DMU applies to the good, we are able to derive the law of demand which states that the quantity demanded of a good is inversely related to its price per unit.
- (b) The relationship between diminishing marginal utility of a good and its price helps in explaining the determination of its price in the market. It also helps in explaining paradoxes like water (which is so essential for life) being cheaper than diamonds (which is luxury). A paradox of water and diamond states that water having higher utility is priced lower than diamond. It implies that diamond despite having lower utility is priced higher. Why it happens so? This is so because in pricing of a commodity apart from the utility factor the availability of the product or commodity also plays a significant role. The products which are available in abundance or in plenty will have a lesser control on the price inspite having a higher utility. Similarly, commodities having lower utility but are scarce in supply will command a higher price. This holds true not only for diamond but for other scarce commodities like, gold, costly metals etc.
- (c) The law of DMU can be extended to the case where a consumer is faced with the decision to divide his total expenditure over a number of goods. This extension leads to the law of equi-marginal utility.

The law of Diminishing Marginal Utility can be extended in understanding the scenario where a consumer is needs to spend or allocate his/her income on multiple products, i.e. How much money to be allocated on each item? The extended version of law of diminishing marginal utility can be seen in law of equi marginal utility.

- (d) The law of DMU is highly useful to the authorities also in working out their social welfare programmes. They can take steps by which goods and services are allocated between members of the society in such a way

that marginal utility of each good/service tends to be the same for every individual. If a particular good does not satisfy this condition, then its successive units should be transferred from those for whom it has smaller marginal utility to those for whom it has higher marginal utility. For example, marginal utility of a 'basic necessity' like nutritious food is expected to be higher for a poor family than for a rich one which has already enough of it. Therefore, if through rationing, taxes, subsidies, or other methods, some of it is transferred from richer families to the poorer ones, total utility of the society as a whole is expected to increase.

The law of diminishing marginal utility helps us to define and measure the concept of 'Consumer Surplus'. Consumer surplus can be defined as an economic measure of consumer satisfaction, which is calculated by analyzing the difference between what consumers are willing to pay for a good or service relative to its market price. A consumer surplus occurs when the consumer is willing to pay more for a given product than the current market price.

Law of Equi-Marginal Utility

The law of diminishing marginal utility plays a crucial role in explaining the demand behaviour of a typical consumer and determination of his equilibrium when he is facing the following circumstances.

- The consumer is allowed to buy all or some out of specified goods, say A, B, C...N.
- Each good obeys the law of DMU, and its marginal utility schedule is known.
- Each good has a fixed price for the consumer. It does not vary with the quantity purchased by the consumer.
- The amount of expenditure to be incurred by the consumer is given. However, the consumer need not spend the same amount on each good, and their quantities can differ.

Consumer's equilibrium is the solution of this problem. It describes the respective quantities of goods A, B, C...N which the consumer buys. The law of equi-marginal utility describes the rule by which the consumer takes this decision.

We assume that the consumer decides to divide his total expenditure between different goods by taking into consideration not only their respective marginal utilities but also their per unit prices. A consumer is guided by marginal utility which he can derive by spending each additional rupee. It is on this basis that he decides to allocate his expenditure between alternative goods. If, for example, he finds that a rupee spent on Good A brings greater utility than if it is spent on good B, he chooses to spend it on the A rather than on B. Thus, the consumer tries to satisfy the following two conditions:

- (a) The marginal utility derived from a good is not less than the price paid for it. That is, for good A, $MU_a \geq P_a$, where MU_a is the marginal utility of good A and P_a is price per unit of good A. That is the ratio MU_a/P_a must be 1.
- (b) The ratio $MU_a/P_a = MU_b/P_b$ that is marginal utilities derived from the expenditure of last rupee on all goods are equal to each other. If for example, $MU_a/P_a > MU_b/P_b$, it means that the consumer can get greater marginal utility by shifting some of his expenditure from good B to good A. By doing so, he is able to get greater total utility by spending same amount of money. If however, the two ratios are equal, no addition to the consumer's total utility takes place by shifting his expenditure between goods.

Thus, the law of equi-marginal utility states that consumer distributes his expenditure between different goods in such a way that the marginal utility derived from the last rupee spent on each good is the same.

Symbolically,

$$MU_a/P_a = MU_b/P_b = MU_c/P_c = \dots\dots\dots = MU_n/P_n \text{ (Consumer Equilibrium)}$$

Thus, the consumer, while dividing his expenditure between goods considers both their marginal utilities and prices. By equating the ratios of marginal utilities to prices of goods, the consumer succeeds in deriving maximum possible utility from his expenditure. This is the best position which he can attain.

It is clear that the consumer's equilibrium will change if there is a change in

- his total expenditure
- marginal utility schedule of any good
- price of any good

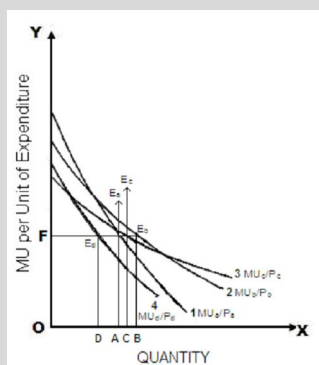
Table 2.4 provides a hypothetical application of the law of equi-marginal utility. It is assumed that our consumer is to spend 12 rupees and choose between four goods, A, B, C and D. Figures in the first row reveal that the first rupee spent on good A yields 40 units of utility for the consumer. If same rupee is spent on good B, the utility derived by the consumer is 38 units. And so on.

Recalling that the consumer will spend each additional rupee on that good which brings him maximum marginal utility (that is having highest MU/P), we note that he will spend his 1st rupee on good D which brings him 45 units of utility. Similarly, the 2nd rupee is spent on good C (which brings 44 units of utility) ; the 3rd rupee is again spent on D (with marginal utility of 42); the 4th and 5th rupees are spent on goods A and C (not necessarily in this order); the 6th rupee goes to good D; 7th and 8th rupees are spent on goods A and B (not necessarily in this order); while the remaining four rupees are spent one each on A, B, C and D (not necessarily in this order). As a result, in all, he spends three rupees on A, two rupees on B, three rupees on C, and four rupees on D. The utility derived by him is 114 units from A, 74 units from B, 120 units from C, and 162 units from D, the total being 470 units. Any other division of his expenditure on these four goods would yield the consumer a smaller total utility. It should also be noted that when marginal utility from a rupee spent on two or more goods is the same, the consumer may spend it on either of them. Thus, in our example, we cannot say for certain whether the consumer will spend 4th rupee on A and 5th on C, or it will be the other way round. And if his total expenditure is only five rupees, the 5th rupee may be spent on either of the two goods with the same result.

Table: 2.4 Application of the Law of Equi-marginal Utility

Expenditure	MU _a /P _a	MU _b /P _b	MU _c /P _c	MU _d /P _d
1 st Rupee	40	38	44	5
2 nd Rupee	38	36	40	42
3 rd Rupee	36	32	36	39
4 th Rupee	34	29	32	36
5 th Rupee	32	26	28	33
6 th Rupee	20	23	24	30
7 th Rupee	18	20	20	27
8 th Rupee	16	17	16	24
9 th Rupee	14	14	12	21

Fig. 2.4: Law of Equi-marginal Utility



The Law of Equi-marginal utility may also be explained with the help of a diagram. In Fig. 2.4, X-axis represents expenditure in rupees on a good A, and Y-axis represents the corresponding marginal utility, per rupee spent, from that good. This gives a downward sloping curve (like MU_a/P_a) for each good to which the consumer allocates a part of his expenditure. In Fig. 2.4, we have four such curves.

The consumer spends OA rupees on A, OB rupees on B, OC rupees on C, and OD rupees on D. The utility of the last rupee spent on each of the four goods is equal to OU.

Consumer Equilibrium under Utility Analysis

Equilibrium means a position of rest characterized by absence of change. Consumer equilibrium is the situation when a consumer secures maximum satisfaction out of his expenditure. Basically, he attains the equilibrium

position at a point when he maximizes his total utility given his income and price of commodities he consumes. Any deviation from this point places the consumer in the sub optimal situation.

Under utility analysis, a consumer with a single commodity attains equilibrium at a point where $MU = Price$

If MU of additional unit of a commodity is more than its price then consumer will purchase the commodity, on the other hand if MU from the purchase of additional unit is less than the price then he will not purchase the commodity. He will purchase the commodity up to the point where MU derived from the purchase of additional unit of Commodity is equal to its price.

In case of two or more commodities, consumer attains equilibrium at a point where $MU_1 = MU_2 = \dots = MU_n$ if price for all commodities are the same. But in case of differences in prices, the equilibrium equation will be :

$$MU_1/P_1 = MU_2/P_2 = \dots = MU_n/P_n$$

Limitations of the Law

In reality, the Law of Equi-marginal utility suffers from several limitations which come in the way of its implementation by the consumer. These are as follows:

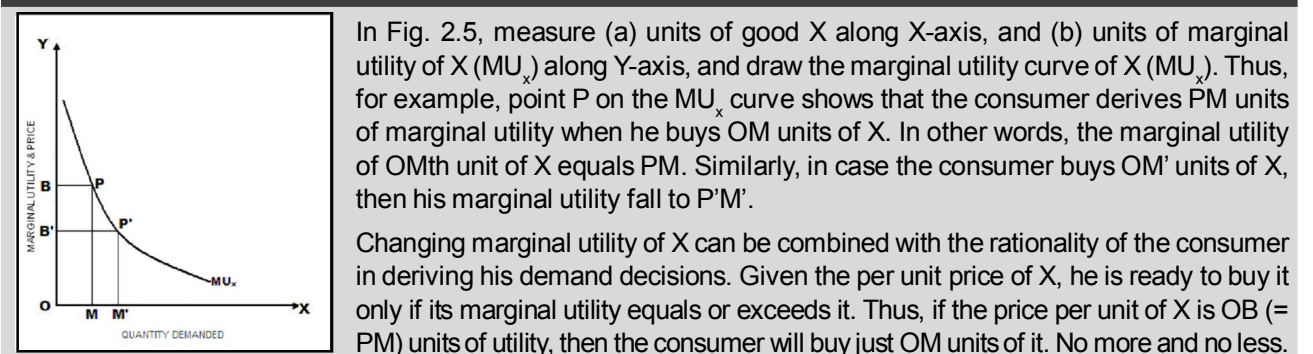
- (a) The assumption that the goods on which the consumer spends his money are perfectly divisible, i.e., goods can be bought even in extremely small quantities does not hold true at times. The consumer is faced with lumpy goods. They are not divisible into very small quantities. He has to buy an entire quantity of a good or not at all. This is more so in the case of durable consumption goods. For example, he cannot buy half of a shirt, one-tenth of a bicycle. Consequently, he fails to apply the law of equi-marginal utility in practice.
- (b) The law also suffers from the unrealistic nature of its other assumptions. One such assumption is that the consumer has complete knowledge of the prices and availability of all consumer goods. However, this is generally not so. In several cases, the consumer does not possess sufficient information regarding the prices of goods he is interested in. In some cases, he may have incorrect information regarding the price and/or availability of a good.
- (c) The law assumes independence of utility schedules of goods. It means that utility derived from one good is not affected by the quantity purchased of other goods. In reality, however, many goods are related to each other by being substitutes or complements to each other. In such cases, the marginal utility derived from a given good depends not only upon its own quantity, but also upon the quantity of the related good.
- (d) The law makes a questionable assumption that the consumer is able to accurately determine the marginal utility schedules of all the goods.

DERIVATION OF LAW OF DEMAND — UTILITY ANALYSIS

Law of demand describes the changes in the market demand for a good in relation to its alternative prices. It says that in normal situations, quantity demanded of a good falls when its price increases and vice versa. In other words, the quantity demanded and the price of a good are inversely related to each other.

Utility approach helps in deriving the law of demand.

Fig. 2.5: Marginal Utility of Goods and its Demand Curve



If he buys a smaller quantity, he foregoes some surplus units of utility (which he gets over and above the price paid) from earlier units of X. This is because the price X does not change with its quantity purchased by the consumer. Though the consumer gets higher marginal utility from earlier units of X, the price paid by him for those units does not increase. And if he buys more than OM units of X, he gets smaller utility from those additional units, but has to pay the same price OB per unit. This reasoning can also be applied to the situation where price per unit of X is OB' (= P'M'). In that case the consumer buys just OM' of X - neither more, nor less. Translating these findings into overall demand decisions of the consumer, the consumer decides to buy more of X when its price falls and vice versa.

Reasons for Negative Slope of the Demand Curve

Some of the major reasons for normal behaviour of the demand curve are listed below:

- (a) *The Law of Diminishing Marginal Utility*: The law provides that when a consumer buys additional units of a good, its marginal utility falls. A consumer always compares the marginal utility of a good with the price to be paid for it; the price which he is willing to pay for additional unit of a good falls. Conversely, if the price of a good falls, the consumer is induced to buy more of it. In other words, the price and quantity demanded of a good move in opposite directions and the demand curve assumes a negative slope.

Units of oranges consumed	Price of each orange	Marginal Utility
01	20	26
02	21	25
03	22	24
04	23	23
05	24	22

From the above table it can be concluded that a consumer will stop consumption at 4th unit of orange as at this stage the price paid for the orange is equivalent to the marginal utility. Thus a consumer always draws a comparison between the marginal utility of a good with the price to be paid for it. With the rise in price of the commodity the willingness to pay for additional unit of a good falls and vice-versa.

- (b) *The Law of Equi-Marginal Utility*: While deciding to buy a commodity, a consumer compares not only its price with its own utility, but also with the possibility of a gain of utility by buying its substitute goods. In other words, the consumer compares the ratio of marginal utility to price of one good with that of other goods. If for example, $MU_a/P_a > MU_b/P_b$, it means that the consumer can get greater marginal utility by shifting some of his expenditure from good B to good A. This induces him substitute the lower priced good for other goods in expenditure.
- (c) *Increased Real Income*: A fall in the price of a good increases the real income of the consumer. He is able to buy more of the good under question, or buy more of other goods. Similarly, an increase in the price of a good reduces his real income. In this case, the income effect leads to a reduction in the demand of the good. This factor also contributes to the downward slope of demand curve.

A person 'X' has got Rupees 10000 as the nominal income. Now the amount of goods and services he can purchase with those Rs10000 is nothing but real income. So when the price of a particular commodity falls, the real income, i.e. the purchasing power of the customer increases and that is how at decreased price customer can buy more of a particular commodity.

An Increase / Decrease in Demand versus an Expansion/Contraction in Demand

The law demonstrates the price-quantity relationship while determining the demand schedule (curve/ function), whereas there are various other factors that affect the demand schedule. It should be noted that the 'location' of

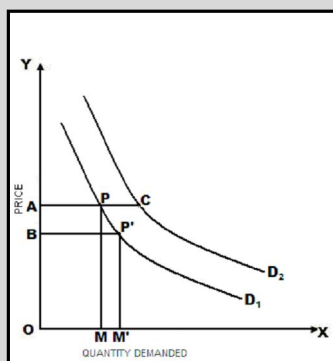
a demand curve (that is its distance from origin) is determined by factors other than its own price, while its slope is determined by its price. In other words, demand for a good changes when

- a consumer moves from one point to another on the same demand curve (Movement along demand curve)
- when the entire demand curve shifts its position (Movement from one demand curve to the other)

Movement along Demand Curve: A demand curve is drawn on the assumption that all factors determining the demand behavior of a consumer, other than the price of the good itself, remain the same. When price of the good changes, the consumer moves along the given demand curve and changes the quantity demanded of the good.

A reduction in quantity of demand on account of an increase in price is termed 'a contraction' of demand. In this case, the consumer moves upwards along the demand curve. In contrast, if the price of the good falls, the consumer moves downwards along the demand curve and buys more of the good. This is termed an 'expansion' of demand.

Fig. 2.6: Expansion/Contraction and Increase/Decrease in Demand



Consider demand curve D_1 . When price of good X falls from PM to $P'M'$, the quantity of good X bought by the consumer increases from OM to OM' and MM' is the 'expansion in demand'. In contrast, the reduction in demand from OM' to OM (= MM') on account of increase in price from $P'M'$ to PM is the 'contraction' in demand.

Movement from One Demand Curve to the Other: If the quantity demanded changes without change in price, the consumer shifts from one demand curve to the other. Such a movement is termed 'increase' in demand when the consumer moves to the outer demand curve to the right. And it is termed a 'reduction' in demand when the movement is to the inner demand curve to the left. Thus, in Fig 2.6, we may consider two demand curves D_1 and D_2 .

With a given price OA per unit of X, the consumer buys OM , if he is on demand curve D_1 and OM' if he is on demand curve D_2 . Thus, a shift from point P on D_1 to point C on D_2 is called an 'increase' in demand and a shift in the reverse direction is termed a 'reduction' in demand.

Exceptions to the Law of Demand

The normal law of demand is widely applicable to a large number of goods. However, there are certain exceptions to it on account of which a change in the price of a good does not lead to a change in its quantity demanded in the opposite direction.

- (a) *Expected Change in the Price of a Good:* While an actual change in the price of a good leads to a change in its demand in the opposite direction, an expected change in its price changes the demand in the same direction. When the price of a good is expected to increase, consumers increase the demand-quantity so as to avoid paying a higher price later. Similarly, when the price of a good is expected to fall, the consumers postpone their purchases of it.
- (b) The consumer may not consider a good as 'normal' or 'superior'. There are four types of such goods.
 - **Inferior Goods:** Some goods are consumed generally by poorer sections of the society. It is believed that with an increase in income such a consumer should move to a 'better' quality substitute good. For example, with an increase in income, a typical poor consumer shifts his demand from coarse grains to finer varieties of cereals. Therefore, with a fall in the price of a good (more so a necessity on which the consumer is spending a large part of his budget), the real income of the consumer goes up. If, he considers the good under consideration an inferior good, he reduces its demand and buys more of its substitute(s).
 - **Giffen Goods:** Some special varieties of inferior goods are termed as Giffen goods. Cheaper varieties

of this category like bajra, cheaper vegetable like potatoes come under this category. Sir Robert Giffen of Ireland first observed that people used to spend more their income on inferior goods like potato and less of their income on meat. But potatoes constitute their staple food. When the price of potato increased, after purchasing potato they did not have so many surpluses to buy meat. So the rise in price of potato compelled people to buy more potato and thus raised the demand for potato. This is against the law of demand. This is also known as Giffen paradox. So giffen goods are products that people continue to buy even at high prices due to lack of substitute products.

- **Ignorance:** In some cases, the consumers suffer from the false notion that a higher priced good is of better quality. This happens mainly in the case of those goods where a typical consumer is not able to judge the quality easily. In such cases, the sellers may be able to sell more not by lowering the price but by raising it.
 - **Conspicuous Consumption:** Certain goods are meant for adding to one's social prestige. These form the part of 'status symbol' for showing that their user is a wealthy or cultured person. The consumers consider it as a distinction to have these goods. In other words, a commodity may be purchased not because of its intrinsic value but because it is expected to add to the social prestige of the buyer. For example: Diamonds and expensive jewellery, expensive carpets. Their demand falls, if they are inexpensive.
- (c) *Change in Fashion:* A change in fashion and tastes affects the market for a commodity. When a broad toe shoe replaces a narrow toe, no amount of reduction in the price of the latter is sufficient to clear the stocks. Broad toe on the other hand, will have more customers even though its price may be going up. The law of demand becomes ineffective.
- (d) *Complementary Goods:* Law of demand may be violated in the case of complementary goods also. For example: if the price of the DVD player falls leading to increase in its demand, in spite of rise in price of DVDs, their demand will increase.

Determinants of Demand

Demand for a good by a consumer can vary in response to several factors such as its own price, prices of other related goods, income of the consumer, tastes and preferences of the consumer etc.

Symbolically, $D_x = f (P_x, P_1, P_2, P_3, Y, T, \dots)$ where P_x is the price per unit of good X, P_1, P_2, P_3, \dots are the per unit prices of the related goods, Y is the income of the consumer, T represents the tastes and preferences of the consumer. Following are the leading determinants of demand:

- (a) *Price of the Commodity:* The first determinant of the demand for a good is its own price. The consumer compares the marginal utility expected from a good with its price and decides whether it is worth buying or not. A fall in the price induces the consumer to buy more of the good and an increase in the price causes a fall in demand.
- (b) *Prices of Related Commodity:* Prices of related commodity also affect the demand of the commodity (say X). There are two ways in which a good can be related to another good:
- Substitute goods: If the price of a substitute good, Y increases, the demand for that good falls and the consumer wants to buy more of X instead. In contrast, if the price of the substitute good falls the consumer increases the demand for that good and hence wants to buy less of X. It has positive cross price effect.
 - Complement goods: If the price of a complementary good, Y increase, the demand for that good falls so does the demand of its complement X. In the same way, a fall in the price of a complementary good causes an increase in the demand for X. It has negative cross price effect.
- (c) *Levels of Income:* The demand for a good is also affected by the levels of the income of the consumer. With an increase in income the consumer wants to buy more of a good. However, if the good is considered an 'inferior' one, he is expected to reduce its demand when his income increases.

- (d) *Expected Change in Price*: Demand of a good is inversely related to the direction of expected change in its price. A consumer wants to buy a good before its price goes up and wants to postpone its purchase if its price is expected to fall.
- (e) *Other Factors*: Other factors which affect the aggregate market demand for a good include the size of population, the marketing and sale campaigns by the suppliers, the 'selling expenses' incurred by the sellers, the tastes and preferences of the buyers, and distribution of income and wealth. For example, the richer sections are likely to spend a smaller proportion of their incomes on basic necessities and a larger proportion on luxuries and durable consumer goods.

REVIEW QUESTIONS



1. What are the determinants of demand?
2. Give reasons for negative slope of demand?
3. Explain law of diminishing marginal utility.
4. What are the exceptions to the law of demand?
5. Distinguish between expansion /contraction of demand with increase/ decrease of demand.

SUPPLY

Meaning of Supply

Supply represents how much the market can offer. The quantity supplied refers to the amount of a certain good producers are willing to supply when receiving a certain price. The supply of a good or service refers to the quantities of that good or service that producers are prepared to offer for sale at a set of prices over a period of time. According to Watson, Supply always means a schedule of possible prices and amounts that would be sold at each price. The supply is not the same concept as the stock of something in existence—by the stock of commodity X in Delhi, it means the total quantity of Commodity X in existence at a point of time; whereas, by the supply of commodity X in Delhi, it means the number of quantity actually being offered for sale, in the market, over a specified period of time.

Law of Supply

The law of supply states that a firm will produce and offer to sell greater quantity of a product or service as the price of that product or services rises, other things being equal. There is direct relationship between price and quantity supplied. In this statement, change in price is the cause and change in supply is the effect. Thus, the price rise leads to supply rise and not other wise. It may be noted that at higher prices, there is greater incentive to the producers or firms to produce and sell more. Other things include cost of production, change of technology, price of related goods (substitutes and complements), prices of inputs, level of competition and size of industry, government policy and non economic factors.

Thus '*Ceteris Paribus*';

- (a) With a increase in the price of the good, the producer changes the quantity that he is willing to offer more of goods in the market for sale.
- (b) The quantity supplied must be related to the specified time interval over which it is offered.

Three Alternative Ways of Expressing Supply

Supply of a good by an individual producer/firm or the market/industry as a whole is conventionally expressed in three alternative forms, namely;

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- a supply function
- a supply schedule
- a supply curve

Supply Function: A supply function of an individual supplier is an algebraic form of expressing his behaviour with regard to what he offers in market at the prevailing prices. In it, the quantity supplied per period of time is expressed as a function of several variables.

General form of the supply function is $S_x = f(P_x, C_x, T_x)$

Example of a supply function for good X is $S_x = 200 + 15P_x$

where, S_x denotes quantity supplied of good X, P_x denotes the price of good X, C_x represents cost of production and T_x is technology of production.

Supply Schedule: A supply schedule is a tabular statement that shows different quantity or service that are offered by the firm or producer in the market for sale at different prices at a given time. It describes the relationship between quantities supplied of a good in response to its price per unit, while all non-price determining variables remain unchanged. A supply schedule has two columns, namely

- price per unit of the good (P_x)
- quantity supplied per period (S_x)

The supply schedule is a set of pairs of values of P_x and S_x

There are two types of supply schedule, namely

- individual supply schedule
- market supply schedule

Table: 2.5 Individual Supply Schedule for Commodity X

Price per unit of Commodity X ₹	(Rs)Quantity for Commodity X (Units)
10	1000
20	2000
30	3000
40	4000
50	5000
60	6000

Individual supply schedule relates to the supply of a good or service by one firm at different prices, other things remains constant or equal. The market supply schedule, on the other hand, like market demand schedule is the sum of the amount of good supplied for sale by all the firms or producers in the market at different prices during a given time. Let us assume, there are two producers for a good.

Table: 2.6 Market Supply Schedule for Commodity X

Per unit Price of Commodity X ₹	Quantity Supplied for Commodity X by Producer- A (Units)	Quantity Supplied for Commodity X by Producer - B (Units)	Market Demand (Units)
P_x	Q_A	Q_B	$Q_A + Q_B$
10	1000	2000	3000
20	2000	3000	5000

30	3000	4000	7000
40	4000	5000	9000
50	5000	6000	11000
60	6000	7000	13000

Supply Curve: The individual supply curve is a graphical representation of the information given in individual supply schedule. The higher is the price of the commodity or product, the greater will be the quantity of supply offered by the producer for sale and vice versa, other things remains constant.

Fig. 2.7: Supply Curve

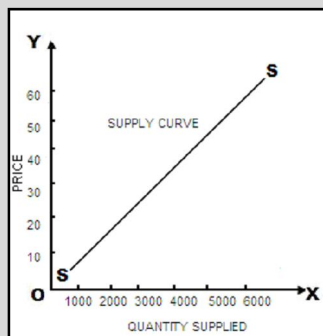


Fig 2.7 shows supply curve, where X axis is quantity supplied and Y axis shows prices. As the price increases from 10 to 60 the quantity supplied rises from 1000 to 6000, establishing a positive relation among the two.

This thus, implies that the supply curve, is upward sloping. The individual supply curve is based on the data given in Table 2.5.

Reasons for positive slope supply curve

Law of supply states that there exist positive relationship between the price of a product and its quantity supplied, *ceteris paribus*. The supply curve slopes upward from left to right. It means that the supply of a product increases with increase in its price and decreases with decrease in its price. Here, the question emerges that why law of supply behave in this fashion and not otherwise.

Some of the reasons or explanations given by the economists in this regard are stated as under:

Producers hire and use resources in order to make profits from the sale of the output produced, at least in the private enterprise sector of a mixed economy. In economics, it is assumed that a common objective of firms is not only to make profits, but to maximize profits. Hence, since most firms could supply other products apart from the good or service in question, it is unlikely that they would be prepared to supply large amounts of this good or service if the price were very low, because this implies low profits after production costs have been taken into account. Indeed, there must be some price at which no firms would be prepared to supply a product because it is so low that it would not cover the minimum cost at which each unit of that product could be produced.

Conversely, the higher the price that firms can charge to sell a product, given the costs of the factors of production, the more profitable that product becomes and the larger the amount that will be supplied to the market. Hence, we can make the logical assumption that, other things being equal (including the number of firms in the market, the scale of production of each firm and the costs of factors), the higher the price of a good or service, the greater will be the quantity supplied of that good or service to the market, and vice versa.

An Increase / Decrease in Supply versus an Expansion/Contraction in Supply

As in the case of demand, the law demonstrates the price-quantity relationship while determining the supply schedule (curve/ function), whereas there are various other factors that effect the supply schedule. It should be noted that the 'location' of a supply curve (that is its distance from origin) is determined by factors other than its own price, while its slope is determined by its price. In other words, supply for a good changes when

- a producer moves from one point to another on the same supply curve (Movement along supply curve)
- when the entire supply curve shifts its position (Movement from one supply curve to the other)

Movement along Supply Curve: An increase in price will increase the quantity supplied, but a decrease in price will reduce the quantity supplied. The supply curve is positively sloped- upward and to the right, as against the demand curve which is negatively sloped.

A reduction in quantity of supply on account of an increase in price is termed 'a contraction' of supply. In this case, the supplier moves upwards along the supply curve. In contrast, if the price of the good falls, the supplier moves downwards along the supply curve and offers to sell more of the good. This is termed an 'expansion' of supply.

Thus Increase/Decrease and Expansion/Contraction in the Supply can be summarized in the following manner:

Expansion/Contraction in the Supply

- When the price of the good changes the producer moves along the given supply curve and changes the quantity supplied
- An increase in the quantity of supply due to an increase in price is termed as contraction of supply for that good.
- If the price of the good falls the producer moves downwards along the supply curve and sells more of the good. This is called expansion in the supply for that good.

Fig. 2.8: Change in Quantity Supplied

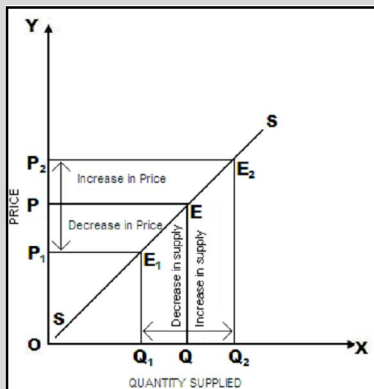


Fig 2.8 shows supply curve, where X axis is quantity supplied and Y axis shows prices.

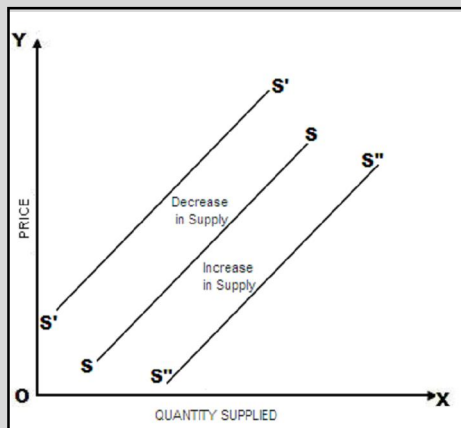
Movement along the supply curve is shown in this fig, where the cause of such change in quantity supplied account only for the change in own price of the commodity, other things being equal.

Movement from One Supply Curve to the Other: If the quantity supplied changes without change in price, the supplier shifts from one supply curve to the other. Such a movement is termed 'increase' in supply when the producer moves to the outer supply curve to the right. And it is termed a 'reduction' in supply when the movement is to the inner supply curve to the left.

Increase/Decrease in Supply

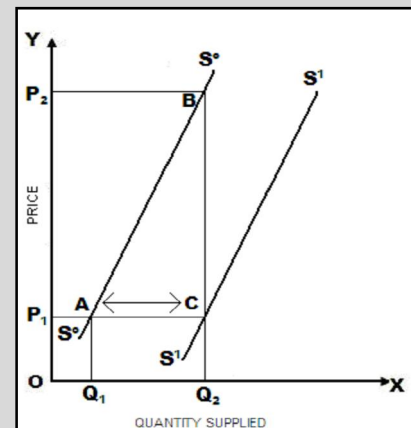
- The location of a supply curve (that is the distance from origin) is determined by factors other than its own price, while its slope is determined by its price.
- If the quantity supplied changes without change in the price, the manufacturer shifts from one supply curve to the other. Such a movement is called increase in supply.
- A shift in the reverse directions is termed as reduction or decrease in supply.

Fig. 2.9: Change in Supply



Thus, in Fig 2.9, we may consider supply curves S' and S'' which shift to the left and right from supply curve S implying decrease and increase in supply respectively.

Fig. 2.10: Change in Price/Change in Conditions of Supply



In Fig 2.10,
 S° = Original supply curve
 S^1 = New supply curve
 P_1 = Original price
 P_2 = New price
 Q_1 = Original quantity supplied
 Q_2 = New quantity supplied

There are two kinds of change, which can result in the quantity supplied changing from Q_1 to Q_2 . If the price of good is increased by the suppliers from P_1 to P_2 , then there will be a movement up in the supply curve from point A to point B—this is termed an expansion of supply (a movement down a supply curve is termed a contraction of supply where the quantity supplied is reduced) but not an increase in supply since supply at the old price, P_1 , is still the same.

If the supply at P_1 increases, then Q_2 will be supplied instead of Q_1 at the same price P_1 —this is correctly termed an increase in supply. This is shown by moving the supply curve from S° to S^1 and the movement from A to C in Fig 2.10.

Exceptions to the Law of Supply

The normal law of supply is widely applicable to a large number of goods. However, there are certain exceptions to it on account of which a change in the price of a good does not lead to a change in its quantity supplied in the positive direction. The law of supply is not a universal principle that applies to all markets under all circumstances. There are, in fact, numerous important exceptions to the law of supply.

- (a) *Expected Change in the Price of a Good:* While an actual change in the price of a good leads to a change in its supply in the same direction, an expected change in its price changes the supply in the opposite direction. When the price of a good is expected to increase, supplier decreases the supply-quantity so as to avoid selling a lower prices in current period and sell more at even higher prices in future period.
- (b) *Monopoly:* If the supply side of the market is controlled by small number of sellers then the law of supply might not operate. For example, in case of monopoly (single seller) may not necessarily offer a larger quantity supplied even though the price is higher. Market control by the monopoly allows it to set the market price based on demand conditions, without cost constraints imposed from the supply side.
- (c) *Competition:* Other market structures like oligopoly and monopolistic competition might be facing more competition, thereby offering to sell larger quantities at lower prices and negating the law of supply.
- (d) *Perishable Goods:* In cases of perishable goods the supplier would offer to sell more quantities at lower prices to avoid running into losses due to damage of the product.

- (e) *Legislation Restricting Quantity*: Suppliers cannot offer to sell more quantities at higher prices where the government has put regulations on the quantity of the good to be offered or the price ceiling at which the good is to be offered in market. Producers are unable to play with either of the factors on their own.
- (f) *Agricultural Products*: Since the production of agricultural products can not be increased beyond a limit, the supply can also not be increased beyond this limit even if the prices are higher; the producer is unable to offer larger quantities.
- (g) *Artistic and Auction Goods*: The supply of such goods can not be increased or decreased easily. Thus, it is difficult to offer larger quantities even if the prices shoot up.

Determinants of Supply

At any point in time, the total quantity supplied of a good or service in the market is influenced by number of factors. Some of the important factors include the following:

- (a) *Costs of the Factors of Production*: The cost of factor inputs such as land, labour, capital, raw materials etc. is one of the determinant factors which influence the market supply of a product. For instance: if the price of labour goes up, then the supply of the product will decline due to scarce resources.
- (b) *Changes in Technology*: The change in technology as a result of constant research and developments in terms of improved machinery, improved method of organization and management helps the business units or firms to reduce the cost of production. All this contributes significantly to increase the market supply at given prices.
- (c) *Price of Related Goods (Substitutes)*: Prices of related commodity also affect the supply of the commodity (say X). If the price of a substitute good, Y increases, the supply for that good increases and the producer would shift the allocation of resources to Y from X.
- (d) *Change in the Number of Firms in the Industry (Market)*: A change in number of firm in the industry as a result of profitability also influences the market supply of a good. For example, an increase in number of firms in the industry attracted by higher profit would increase the quantity supplied of good over the range of prices.
- (e) *Taxes and Subsidies*: A change in government fiscal policy in terms of change in tax rate or amount of subsidy may influence the supply of a good in the market. A decrease / increase in the amount of tax/ subsidy on the good would allow firms to offer larger amount of a good at a given range of prices.
- (f) *Goal of a Business Firm*: The goal of a business firm such as profit maximization, sales maximization or both is also responsible to influence the market supply of a good or service. In case the firm is interested to maximize profit, the same may be attained by decreasing the market supply of a good under certain conditions whereas as goal of sales maximization will increase the supply.
- (g) *Natural Factors*: Natural Factors such as climatic changes, particularly in the case of agricultural products influence its supply.
- (h) *Changes in Producer or Seller Expectations*: The supply curve like the demand curve is drawn for a certain time period. If the expectations of the future prices change drastically in a market. For example, prices of good and service are expected to rise suddenly, the firm would hold current production from the market in anticipation of higher prices and thus influences supply of the good.

DETERMINATION OF EQUILIBRIUM PRICE AND QUANTITY

In economics, equilibrium is a situation in which:

- there is no inherent tendency to change
- quantity demanded equals quantity supplied
- the market clears and becomes stable (That is, at the market equilibrium, every consumer who wishes to

purchase the product at the market price is able to do so, and the supplier is not left with any unwanted inventory.)

- Difference between the price and value of a commodity
- Price as 'value in exchange'
- Equilibrium price is the price at which the producer and consumer are ready to exchange the goods.

Law of demand and law of supply explains separately the 'plans' of consumers as to how much they would buy at a given price and the 'plans' of producers as to how much they would offer for sale at the given price. The demand curve and the supply curve really show what consumers and producers would do if they were given the opportunity.

Although the demand would be very high, in practice consumers may never get the opportunity to buy the product at that low price because suppliers are not willing to supply at that price. Similarly, although suppliers may be prepared to offer a large amount for sale at a high price, they may not be able to sell it all because the consumers are not willing to buy at that high a price.

The demand for a product and the supply of a product are two sides of the market, and it is necessary to bring these together to establish equilibrium in the market which is the point where both the sides of the market are satisfied simultaneously.

This can be better understood with the help of following illustration. (See Table 2.7). Let us take demand and supply schedule for good X and analyze for equilibrium position.

Table 2.7: Demand and Supply Schedule for Commodity or Good X

Per unit Price of Commodity X (₹)	Quantity Demanded for Commodity X in the market (Units)	Quantity Supplied for Commodity X in the market (Units)	Description
P_x	Q_d	Q_s	
10	5000	3000	Excess Demand
20	3000	5000	Excess Demand
30	1000	7000	Excess Demand
40	9000	9000	Demand = Supply
50	7000	11000	Excess Supply
60	5000	13000	Excess Supply

Fig. 2.11: Demand and Supply Curves

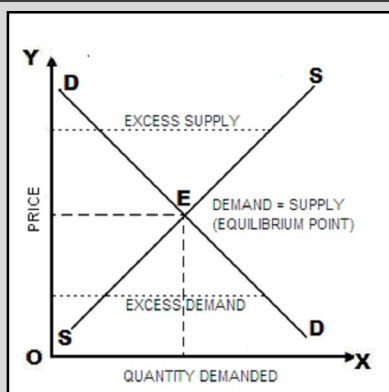


Fig 2.11 shows a demand and a supply curve, where X axis is quantity and Y axis shows prices.

In the figure the market equilibrium is established based on the data from Table 2.7

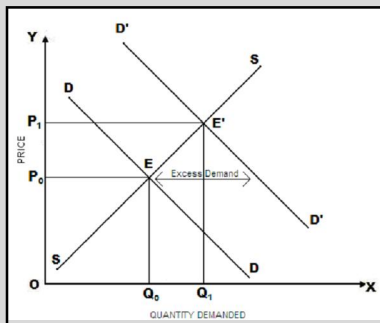
The equilibrium is the state when Demand equals Supply which is at point E.

EFFECT OF CHANGES IN THE CONDITIONS OF DEMAND AND SUPPLY ON MARKET PRICE

The market price, or equilibrium price, is determined by the interaction of demand and supply at a given time with given conditions of demand and supply. Remember that the demand curve and the supply curve for a commodity are both drawn up on the assumption that the conditions of demand supply (i.e., all other factors which might affect the demand for or supply of the commodity) remain constant. The equilibrium price will remain as a stable price in the market as long as the conditions of demand and/or supply do not change. If any of these conditions change, this will create excess demand or excess supply at the original equilibrium price and so this equilibrium price will itself change.

For example, a condition of demand is the level of consumer income. If the level of income increases, there will be an increase in demand for a commodity X at the existing market price. Hence, if the price remains the same, supply will be the same as before, and with increased demand there will be a shortage, causing pressure on the existing price, which suppliers will then raise. On other hand, if consumer's level of income decreases, other things remains constant, with decreased demand there will be shortage of demand, causing existing price to fall.

Fig. 2.12: Changes in the conditions of demand and supply on market price

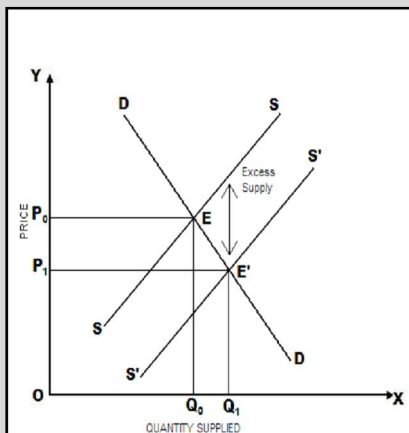


This effect can be represented diagrammatically as in Figure 2.12 making use of the technique of shifting the position of the demand curve to represent a change in conditions of demand.

In Figure 2.12, the demand curves DD and $D'D'$ show the effect of an increase in demand as a result of a favorable change in conditions of demand (such as an increase in consumers' income levels) — $D'D'$ being the new demand curve. Before the increase in demand, the equilibrium price was P_0 and the equilibrium output was Q_0 .

As a result of the increase in demand, excess demand occurs at the price P_0 , causing suppliers to expand output and raise the market price. A new equilibrium is established at P_1 and a new higher equilibrium output at Q_1 . Notice that a change in conditions of demand does not cause a movement of the supply curve—this could only result from changes in conditions of supply. The expansion of supply is correctly shown by a movement up the existing supply curve. Similarly, the demand curve DD' shows the effect of decrease in demand as result of fall in consumers level of income. (Not shown in diagram).

Fig. 2.13: Change in condition of supply on market price



In Figure 2.13, the supply curves SS and $S'S'$ show the effect of an increase in supply as a result of a favorable change in the conditions of supply (such as a reduction in the costs of production because of productivity increases)— $S'S'$ being the new supply curve. Before the increase in supply, the equilibrium price was P_1 and the equilibrium output was Q_0 . As a result of the increase in supply, excess supply occurs at the price P_0 , causing suppliers to lower the price in order to expand demand. A new the equilibrium price is established at P_1 with a higher the equilibrium output at Q_1 . Notice again that a change in conditions of supply does not cause a shift in the demand curve. The expansion of demand as a result of the lower the equilibrium price is correctly shown by a movement along the existing demand curve. Similarly, the supply curve $S''S''$ shows the effect of decrease in supply as result of rise in cost of production in consumers' level of income.

It is useful to summarize the effects of changes in the conditions of demand and of supply on the equilibrium price and output, assuming that we are operating in a free market. This is done under the heading of the 'laws of demand and supply'. (Not shown in diagram)

Laws of Demand and Supply in a Free Market

In economics a law is a statement of general tendency—a prediction of what is likely to happen in so many cases that it can be generalized into a law. The laws of demand and supply state that:

- Excess demand for a commodity will cause a rise in its price.
- Excess supply of a commodity will cause a fall in its price.
- Price will settle at one point where the quantity demanded equals the quantity supplied—the equilibrium price.
- An increase in demand (a movement of the demand curve to the right) will cause a rise in price and a rise in the quantity bought and sold.
- A decrease in demand (a movement of the demand curve to the left) will cause in price and a fall in the quantity bought and sold.
- An increase in supply (a movement of the supply curve to the left) will cause a fall in price and a rise in the quantity bought and sold.
- A decrease in supply (a movement of the supply curve to the left) will cause a rise in price and a fall in the quantity bought and sold.

ELASTICITY OF DEMAND AND SUPPLY

Meaning of Elasticity

Perhaps one of the most useful concepts in demand and supply analysis, certainly from the point of view of a person interested in business strategy, is that of elasticity. Elasticity is a common concept that economists rely upon for the measurement between two variables say, elasticity refers to the ratio of the relative change in a dependent to the relative change in an independent variable i.e. elasticity is the relative change in the dependent variable divided by the relative change in the independent variable. For example, the ratio of percentage change in quantity demanded to percentage change in some other factor like price or income.

Elasticity of Demand

Elasticity of demand forms part of demand analysis and is useful in cases where demand curve analysis fails to provide reliable results. Elasticity of demand is mainly of three types:

- Price Elasticity of Demand
- Cross Price Elasticity of Demand
- Income Elasticity of Demand

Price Elasticity of Demand

The law of demand indicates the direction of change in quantity demanded in response to a change in price. It does not express the magnitude of change in amount demanded in response to a change in price. This information is provided by the tool of elasticity of demand. The concept of elasticity of demand refers to the degree of responsiveness of quantity demanded of a good to a change in its price.

According to Marshall “the elasticity (or responsiveness) of demand in a market is great or small according as the amount demanded increases much or little for a given fall in price or diminishes much or little for a given rise in price”.

Elasticity of demand differs with different commodities. For the same commodity, elasticity of demand differs from person to person. It may be noted that the elasticity of demand has a negative sign because of the direction of change (negative slope).

The formula for calculating price elasticity is:

$$E_d = \frac{\text{Change in Quantity Demanded}}{\text{Change in Price}}$$

There are five cases of Elasticity of Demand in which it responds:

- Perfectly elastic demand
- Perfectly inelastic demand
- Relatively elastic demand
- Relatively inelastic demand
- Unitary elastic demand

Perfectly elastic demand: The demand is said to be perfectly elastic when a very insignificant change in price leads to an infinite change in quantity demanded. A very small fall in price causes demand to rise infinitely. Likewise a very insignificant rise in price reduces the demand to zero. This case is theoretical which is never found in real life. The demand curve in such a situation is parallel to X-axis. Numerically, elasticity of demand is said to be equal to infinity. ($E_d = \infty$)

Perfectly inelastic demand: The demand is said to be perfectly inelastic when a change in price produces no change in the quantity demanded of a commodity. In such a case quantity demanded remains constant regardless of change in price. The amount demanded is totally unresponsive of change in price. The elasticity of demand is said to be zero. The demand curve in such a situation is parallel to Y-axis. Numerically, elasticity of demand is said to be equal to zero. ($E_d = 0$)

Relatively elastic demand: The demand is relatively more elastic when a small change in price causes a greater change in quantity demanded. In such a case a proportionate change in price of a commodity causes more than proportionate change in quantity demanded. For example: If price changes by 10% the quantity demanded of the commodity change by more than 10%. The demand curve in such a situation is relatively flatter. Numerically, elasticity of demand is said to be greater than 1. ($E_d > 1$)

Relatively inelastic demand: It is a situation where a greater change in price leads to smaller change in quantity demanded. The demand is said to be relatively inelastic when a proportionate change in price is greater than the proportionate change in quantity demanded. For example: If price falls by 20% quantity demanded rises by less than 20%. The demand curve in such a case is relatively steeper. Numerically, elasticity of demand is said to be less than 1. ($E_d < 1$)

Unitary elastic demand: The demand is said to be unit when a change in price results in exactly the same percentage change in the quantity demanded of a commodity. In such a situation the percentage change in both the price and quantity demanded is the same. For example: If the price falls by 25%, the quantity demanded rises by the same 25%. It takes the shape of a rectangular hyperbola. Numerically, elasticity of demand is said to be equal to 1. ($E_d = 1$).

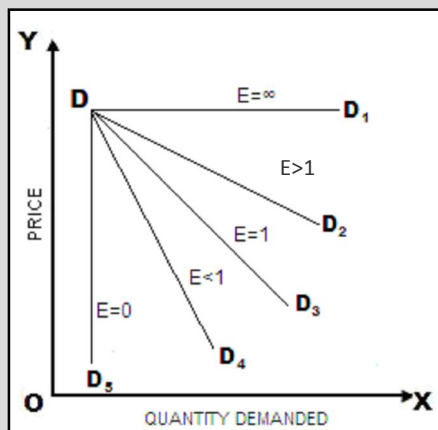
Fig. 2.14 Types of Price Elasticity

Fig 2.14 shows demand curve, where X axis is quantity demanded and Y axis shows prices.

Different types of price elasticity discussed above can be shown in a diagram.

DD₁ – Perfectly Elastic Demand

DD₂ – Elastic Demand

DD₃ – Unitary Elastic Demand

DD₄ – Inelastic Demand

DD₅ – Perfectly Inelastic Demand

Methods of Measuring Price Elasticity of Demand

Price elasticity of demand can be measured through three popular methods. These methods are:

- Percentage Method or Arithmetic Method
- Total Expenditure Method
- Graphic Method or Point Method

1. Percentage Method

According to this method, price elasticity is estimated by dividing the percentage change in quantity demanded by the percentage change in price of the commodity. Thus, given the percentage change of both quantity demanded and price; the elasticity of demand can be derived. If the percentage change in quantity demanded is greater than the percentage change in price, the elasticity will be greater than one.

If percentage change in quantity demanded is less than percentage change in price, the elasticity is said to be less than one. But if percentage change of both quantity demanded and price is same, elasticity of demand is said to be unit.

$$E_d = (\Delta D/D) / (\Delta P/P)$$

$$= (\Delta D/\Delta P) \times (P/D)$$

Where, ΔD is the change in demand and ΔP is the change in price, while original demand and price are D and P respectively.

2. Total Expenditure Method

Total expenditure method was formulated by Alfred Marshall. The elasticity of demand can be measured on the basis of change in total expenditure in response to a change in price. It is worth noting that unlike percentage method a precise mathematical coefficient cannot be determined to know the elasticity of demand.

By the help of total expenditure method, it is determined whether the price elasticity is equal to one, greater than one, less than one. In this method, the initial expenditure before the change in price and the expenditure after the change in price are compared.

$$\text{Total Outlay/ Expenditure} = \text{Price} \times \text{Quantity Demanded}$$

If, it is found that the expenditure remains the same, elasticity of demand is said to be one ($E_d = 1$). If the total

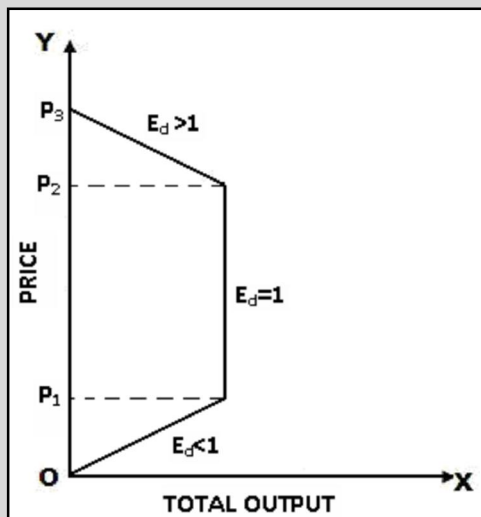
expenditure increases the elasticity of demand is said to be greater than one ($E_d > 1$). If the total expenditure diminished with the change in price elasticity of demand is less than one ($E_d < 1$).

Table: 2.8 Total Outlay and Expenditure method

Price	Total Expenditure	Elasticity of Demand
INCREASES	Increases	Less than 1
	Remains Same	Equal to 1
	Falls	More than 1
FALLS	Falls	Less than 1
	Remains Same	Equal to 1
	Increases	More than 1

The relationship presented in above table may also be shown graphically as under.

Fig. 2.15 : Price Elasticity of Demand using Total Outlay Method



In Fig 2.15, demand for commodity X is unitary elastic over the price range OP_1 to OP_2 because total outlay or expenditure does not change with change in price. Demand is inelastic over the price range O to OP_1 because total expenditure increases or decreases with rise or fall in prices. Demand is elastic over the price range OP_2 to OP_3 because total outlay increase with decrease in prices and decrease with increase in prices.

Total Expenditure or Total Outlay method has certain drawbacks. Firstly, It is not able to give us an exact numerical measure of elasticity of demand. It only tells us whether the elasticity is equal to, less than, or more than one. Therefore, this method fails to compare demand elasticities of different goods. Secondly, it is not possible to use this method in measuring demand elasticity when demand changes in the same direction as the price, as in the case of giffen goods.

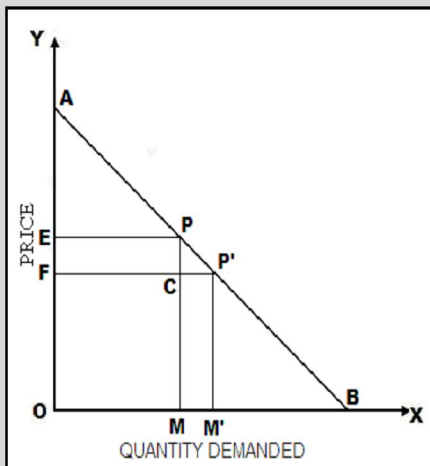
3. Graphic Method

Graphic method is otherwise known as Point Method or Geometric Method. According to this method, elasticity of demand is measured on different points on a straight line demand curve. The price elasticity of demand at a point on a straight line is equal to the lower segment of the demand curve divided by upper segment of the demand curve.

Thus, at mid point on a straight-line demand curve, elasticity will be equal to unity; at higher points on the same demand curve, but to the left of the mid-point, elasticity will be greater than unity, at lower points on the demand curve, but to the right of the midpoint, elasticity will be less than unity.

At a corner point on demand curve where there is no lower segment, elasticity of demand is equal to zero and where there is upper segment on demand curve, elasticity of demand is equal to infinity. ($E_d = \infty$)

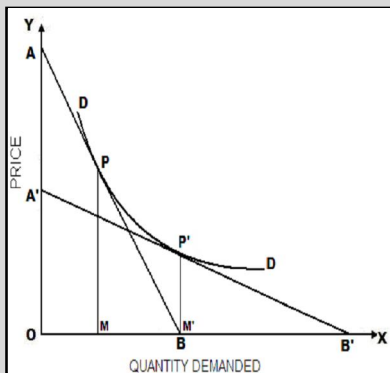
Fig. 2.16: Point Elasticity of Demand Straight Line Demand Curve



In Fig. 2.16, if the demand curve is a straight line and meets (or is extended to meet) X-axis and Y-axis at points B and A respectively, then elasticity of demand at point P on the demand curve is given by the ratio:

$\frac{\text{Segment of demand curve from point P to X-axis}}{\text{Segment of demand curve from point P to Y-axis}}$

Fig. 2.17 Elasticity of Demand for Curvilinear Demand Curve



When demand curve is curvilinear instead of a straight line, and we want to measure elasticity of demand at a point P on it, we should draw a tangent to it at point P, consider as if the tangent is the demand curve, and use the same approach as before in measuring elasticity of demand.

Thus, in Fig. 2.17, elasticity of demand at point P equals $PB/AP = BM'/OM'$, while at point P' it is $P'B'/A'P' = B'M'/OM'$.

DETERMINANTS OF PRICE ELASTICITY OF DEMAND

Price elasticity of demand is dependent upon a number of factors as follows:

- (a) *Price Level*: The demand is elastic for moderate priced goods but, the demand for very costly and very cheap goods is inelastic. The rich and the poor do not bother about the prices of the goods that they buy. Very costly goods are demanded by the rich people and hence their demand is not affected much by changes in prices. For example, increase in the price of maruti car from Rs. 3, 00,000 to Rs. 3, 20,000 will not make any noticeable difference in its demand. Similarly, the changes in the price of very cheap goods (such as salt) will not have any effect on their demand, for their consumption which is very small and fixed.
- (b) *Availability of Substitutes*: If a good has close substitutes, the price elasticity of demand for a commodity will be very elastic as some other commodities can be used for it. A small rise in the price of such a commodity will induce consumers to switch their consumption to its substitutes. For example gas, kerosene oil, coal etc. Will be used more as fuel if the price of wood increases. On the other hand, the demand of such commodities is inelastic which have no substitutes such as salt.
- (c) *Time Period*: A typical consumer finds it difficult to adjust his consumption of a good in the short run. He needs time to adjust to the changed situation. Therefore, demand elasticity of a good tends to increase in the long run.

- (d) *Proportion of Total Expenditure Spent on the Product:* Elasticity of demand for a good is also dependent upon the proportion of a consumer's budget spent on it. On account of a price rise of a good, a consumer feels more concerned if he is spending a large proportion of his budget on it. The extent of change in demand by the consumer is not significant in the case of those goods on which the consumer spends a very small proportion of his monthly budget. In the former case elasticity of demand is higher, while in the latter cases, it is low.

For example out of total monthly expenses of Rs10,000, the amount spent on multiplex tickets is Rs500, then a change in the price to Rs600 will not matter and there will be no change in demand.

- (e) *Habits:* Some products which are not essential for some individuals are essential for others. If individuals are habituated of some commodities the demand for such commodities will be usually inelastic, because they will use them even when their prices go up. A smoker generally does not smoke less when the price of cigarette goes up.
- (f) *Nature of the Commodities:* The demand for necessities is inelastic and that for comforts and luxuries is elastic. This is so because certain goods which are essential will be demanded at any price, whereas goods meant for luxuries and comforts can be dispensed with easily if they appear to be costly.
- (g) *Various Uses:* A commodity which has several uses will have an elastic demand such as milk, wood etc. On the other hand, a commodity having only one use will have inelastic demand. The consumer finds it easier to adjust the quantity demanded of a good when it is to be used for satisfying several wants than if it is confined to a single use. For this reason, a multiple-use good tends to have more elastic demand.
- (h) *Postponing Consumption:* Usually the demand for commodities, the consumption of which can be postponed has elastic demand as the prices rise and is expected to fall again. For example, the demand for v.c.r. is elastic because its use can be postponed for some time if its price goes up, but the demand for rice and wheat is inelastic because their use cannot be postponed when their prices increase.

Cross Price Elasticity of Demand

The change in the demand of a good x in response to a change in the price of good y is called 'cross price elasticity of demand'. Its measure is

$$E_d = \frac{\text{Change in Quantity Demanded of Good X}}{\text{Change in Price of Good Y}}$$

Symbolically, = $(\Delta d_x / \Delta p_y) / (D_x / P_y)$

- Cross price elasticity may be infinite or zero.
- Cross price elasticity is infinite if the slightest change in the price of good Y causes a substantial change in the quantity demanded of good X. It is always the case with goods which are perfect substitutes.
- Cross price elasticity is positive if the change in the price of good Y causes a change in the quantity demanded of good X in same direction. It is always the case with goods which are substitutes.
- Cross price elasticity is negative if the change in the price of good y causes a change in the quantity demanded of good X in opposite direction. It is always the case with goods which are complements of each other.
- Cross price elasticity is zero, if a change in the price of good Y does not affect the quantity demanded good X. In the case of goods which are not related to each other, cross elasticity of demand is zero.

Income Elasticity Of Demand

According to Stonier and Hague: “Income elasticity of demand shows the way in which a consumer’s purchase of any good changes as a result of change in his income.” It shows the responsiveness of a consumer’s purchase of a particular commodity to a change in his income. Income elasticity of demand means the ratio of percentage change in the quantity demanded to the percentage change in income.

$$E_y = \frac{\text{Percentage Change in Quantity Demanded of Good X}}{\text{Percentage Change in Real Income of Consumer}}$$

Symbolically, $E_y = (\Delta d_x / \Delta Y) / (D_x / Y)$ Where, Y denotes income of the consumer

It is noteworthy that sign of income elasticity of demand is associated with the nature of the good in question.

Normal Goods: Normal goods have a positive income elasticity of demand so as consumers’ income rises, demand also increases.

- Normal necessities have an income elasticity of demand between 0 and 1. For example, if income increases by 10% and the demand for fresh fruit increases by 4%, then the income elasticity is +0.4. Demand is rising less than proportionately to income.
- Luxuries have an income elasticity of demand, $E_y > 1$ i.e. The demand rises more than percentage change in income. For example, an 8% increase in income might lead to a 16% rise in the demand for restaurant meals. The income elasticity of demand in this example is +2. Demand is highly sensitive to income changes.

Inferior goods: Inferior goods have a negative income elasticity of demand. Demand falls as income rises. For examples, as income increases, the demand for cigarettes goes up against the low-priced local *bidis*.

Price Elasticity of Supply

The law of supply indicates the direction of change in quantity supplied in response to a change in price. It does not express the magnitude of change in amount supplied in response to a change in price. This information is provided by the tool of elasticity of supply. Like the elasticity of demand, the elasticity of supply is the relative measure of the degree of responsiveness of quantity supplied of a commodity to a change in its price.

The, greater the responsiveness of quantity supplied of a commodity to the change in its price, the greater is its elasticity of supply. To be more precise, the elasticity of supply is defined as a percentage change in the quantity supplied of a product divided by the percentage change in price. It may be noted that the elasticity of supply has a positive sign because of the direction of change (positive slope). However, it may vary between zero and infinity.

The formula for calculating price elasticity of supply is:

$$E_s = \frac{\text{Percentage Change in Quantity Supplied}}{\text{Percentage Change in Price}}$$

There are five cases of elasticity of supply in which it responds:

- Perfectly Elastic Supply
- Perfectly Inelastic Supply
- Relatively Elastic Supply
- Relatively Inelastic Supply
- Unitary Elastic Supply

Perfectly Elastic Supply: The supply is said to be perfectly elastic when a very insignificant change in price leads to an infinite change in quantity supplied. A very small fall in price causes supply to rise infinitely. Likewise a very insignificant rise in price reduces the supply to zero. The supply curve in such a situation is a horizontal line running parallel to x-axis. Numerically, elasticity of supply is said to be equal to infinity. ($E_s = \infty$)

Perfectly Inelastic Supply: The supply is said to be perfectly inelastic when a change in price produces no change in the quantity supplied of a commodity. In such a case, quantity supplied remains constant regardless of change in price. The amount supplied is totally unresponsive of change in price. The elasticity of supply is said to be zero. The supply curve in such a situation is a vertical line, parallel to y-axis. Numerically, elasticity of supply is said to be equal to zero. ($E_s = 0$)

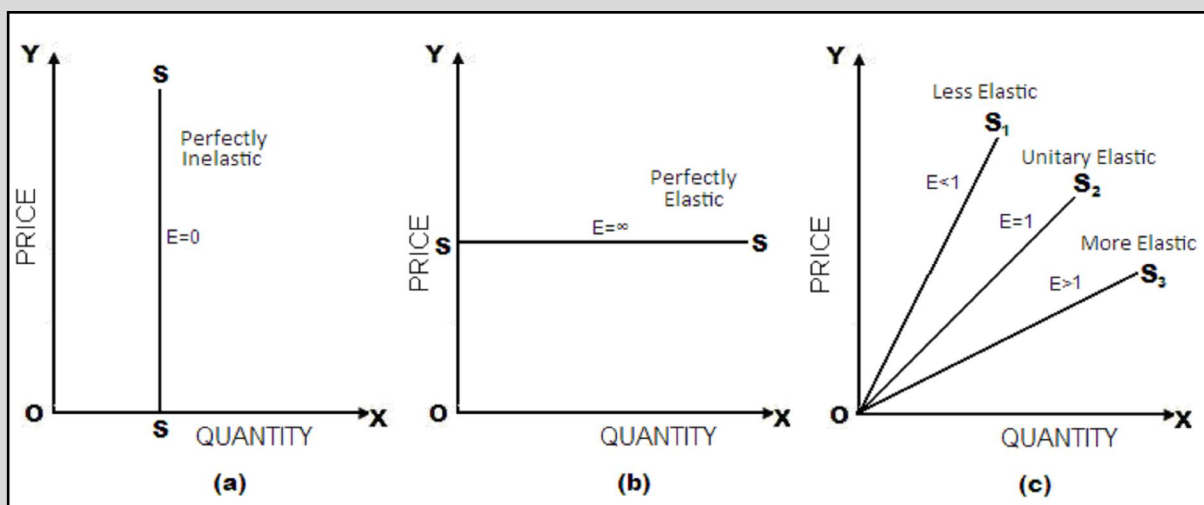
Relatively Elastic Supply: The supply is relatively more elastic when a small change in price causes a greater change in quantity supplied. In such a case a percentage change in price of a commodity causes more than percentage change in quantity supplied. For example: If price changes by 10% the quantity supplied of the commodity change by more than 10%. The supply curve in such a situation is relatively flatter. Numerically, elasticity of supply is said to be greater than 1. ($E_s > 1$)

Relatively Inelastic Supply: It is a situation where a greater change in price leads to smaller change in quantity supplied. The demand is said to be relatively inelastic when a percentage change in price is greater than the percentage change in quantity supplied. For example: If price rises by 20%, quantity supplied rises by less than 20%. The supply curve in such a case is relatively steeper. Numerically, elasticity of supply is said to be less than 1. ($E_s < 1$)

Unitary Elastic Supply: The supply is said to be unit when a change in price results in exactly the same percentage change in the quantity supplied of a commodity. In such a situation the percentage change in both the price and quantity supplied is the same. For example: If the price falls by 25%, the quantity supplied falls by the same 25%. It is a straight line through the origin. Numerically, elasticity of supply is said to be equal to 1. ($E_s = 1$)

(See Fig 2.18)

Fig. 2.18: Types of Price Elasticity



DETERMINANTS OF PRICE ELASTICITY OF SUPPLY

(a) Time Period: Time is the most significant factor which affects the elasticity of supply. If the price of a commodity rises and the producers have enough time to make adjustment in the level of output, the

elasticity of supply will be more elastic. If the time period is short and the supply cannot be expanded after a price increase, the supply is relatively inelastic.

- (b) **Ability to Store Output:** The goods which can be safely stored have relatively elastic supply over the goods which are perishable and do not have storage facilities.
- (c) **Factor Mobility:** If the factors of production can be easily moved from one use to another, it will affect elasticity of supply. The higher the mobility of factors, the greater is the elasticity of supply of the good and vice versa.
- (d) **Cost Relationships:** If costs rise rapidly as output is increased, then any increase in profitability caused by a rise in the price of the good is balanced by increased costs as supply increases. If this is so, supply will be relatively inelastic. On the other hand, if costs rise slowly as output increases, supply is likely to be relatively elastic.
- (e) **Excess Supply:** When there is excess capacity and the producer can increase output easily to take advantage of the rising prices, the supply is more elastic. In case the production is already up to the maximum from the existing resources, the rising prices will not affect supply. The supply will be more inelastic.

THEORY OF CONSUMER'S BEHAVIOR

In the theory of consumer behaviour, the foremost important element is how a rational consumer makes choices from the numerous commodities which are available to him. Consumer theory is concerned with how a rational consumer would make consumption decisions. What makes this problem worthy of separate study, apart from the general analysis of demand and supply theory, is its particular structure that allows us to derive economically meaningful results. The structure arises because the consumer's choice sets are assumed to be defined by the consumer's income or wealth.

There are two significant approaches of determining consumer behaviour:

- Marshallian Approach
- Indifference Curve Approach

Marshallian Approach

Alfred Marshall gave a significant contribution in the study of consumer behaviour. Marshall attempted to derive consumer's equilibrium in a one commodity framework. He considers that the consumer allocates his income on one good and the balance money income is composite good. To establish his theory, he made the following assumptions:

- Utility is cardinally measurable.
- Marginal utility of money remains constant.
- Demand for any single commodity is satiable i.e. Law of diminishing marginal utility (DMU) holds true.
- Two different commodities can never be perfect substitute of each other.
- Utility functions are independent for different commodities.
- Consumer is a price taker in the market.
- Consumer must be rational in nature.

Marshall considered that the buyer consumes only one commodity X, whose price is P_1 . He consumes X_1 amount of X out of his money income M. By consuming X_1 units of X consumer gets $U(X_1)$, units of utility which he sacrifices monetary utility of $\lambda P_1 X_1$ (where $\lambda = dU/dM$ i.e. marginal utility of money).

$$N(X_1) = U(X_1) - \lambda P_1 X_1$$

In the Marshallian approach, the consumer tries to maximize the utility that he derives keeping in view the money income he has in hand available to be spent on that good.

Limitations:

In spite of some good attempts, Marshallian theory is not free from criticism. These are:

- (a) The assumption of constant MU of money is impractical.
- (b) There are exceptions to the Law of Diminishing Marginal Utility. DMU may not always hold good.
- (c) The assumption of independent utilities ignores substitute and complement goods, which is unrealistic in nature.
- (d) This theory is only applicable for a one-commodity framework, whereas there exist numerous commodities.
- (e) Cardinal measurement of utility is unrealistic.

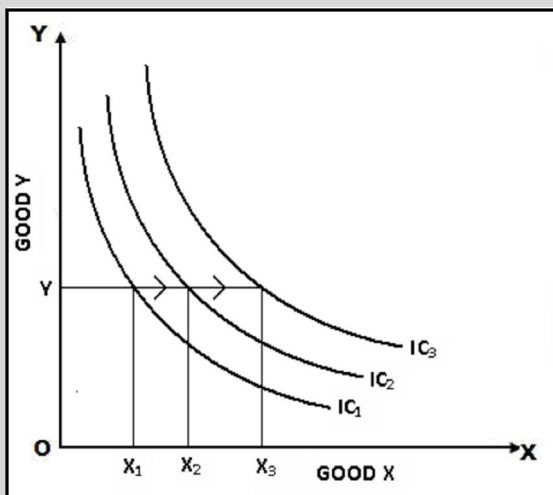
Indifference Curve Approach

Utility approach suffers from several drawbacks. For this reason, a consumer's demand curve derived with the help of utility approach also suffers from similar drawbacks. The technique of indifference curves tries to avoid these drawbacks and provide a technically superior analysis of demand. It believes that human satisfaction being a psychological phenomenon cannot be measured quantitatively in monetary terms as was attempted in Marshall's approach. In indifference curve approach, the preferences are ordered than to measure them in terms of money. This approach, is, therefore an ordinal concept based on ordering of preferences compared with Marshall's approach of cardinality. This approach to consumer behaviour is best understood in three distinct steps:

- Consumer Preferences (Indifference curve)
- Budget Constraints (Budget Line)
- Consumer Choices (Equilibrium)

Indifference Curves

An indifference curve is a curve which represents all those combinations of goods which give same satisfaction to the consumer. Since all the combinations on an indifference curve give equal satisfaction to the consumer, the consumer is indifferent among them. In other words, since all the combinations provide same level of satisfaction the consumer prefers them equally and does not mind which combination he gets.

Fig. 2.19: Indifference Curve Map

Assuming that there are two goods X and Y having their respective utility schedules for a consumer, an indifference schedule represents all those combinations of two goods from which the consumer expects to derive same total satisfaction. (See Figure 2.19)

Assumptions Underlying Indifference Curve Approach

1. The consumer is rational and possesses full information about all the relevant aspects of economic environment in which he lives.
2. The consumer is capable of ranking all conceivable combinations of goods according to the satisfaction he derives. Thus, if he is given various combinations say A, B, C, D, E he can rank them as first preference, second preference and so on.
3. If a consumer happens to prefer A to B, he can not tell quantitatively how much he prefers A to B.
4. If the consumer prefers combination A to B, and B to C, then he must prefer combination A to C. In other words, he has consistent consumption pattern behaviour.
5. If combination A has more commodities than combination B, then A must be preferred to B.

Properties of Indifference Curves

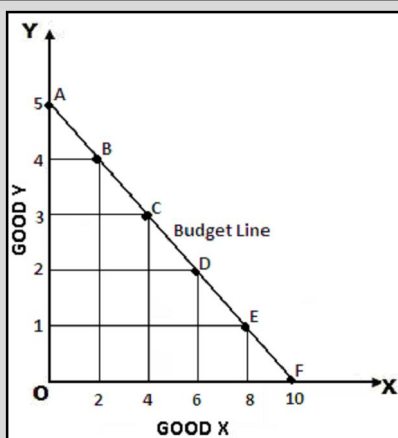
The following are the main characteristics or properties of indifference curves :

- (a) **Indifference curves slope downward to the right:** This property implies that when the amount of one good in combination is increased, the amount of the other good is reduced. This is essential if the level of satisfaction is to remain the same on an indifference curve.
- (b) **Indifference curves are always convex to the origin:** It has been observed that as more and more of one commodity (X) is substituted for another (Y), the consumer is willing to part with less and less of the commodity being substituted (i.e. Y). This is called diminishing marginal rate of substitution.
- (c) **Indifference curves can never intersect each other:** No two indifference curves will intersect each other although it is not necessary that they are parallel to each other. In case of intersection the relationship becomes logically absurd because it would show that higher and lower levels are equal which is not possible.
- (d) **A higher indifference curve represents a higher level of satisfaction than the lower indifference curve:** This is because combinations lying on a higher indifference curve contain more of either one or both goods and more goods are preferred to less of them.

Budget Line

A budget line or price line represents the various combinations of two goods which can be purchased with a given money income and assumed prices of goods. For example, a consumer has weekly income of ₹60. He purchases only two goods, X and Y. The price of good X is ₹6 and the price of good Y is ₹12. Given the assumed income and the price, of the two goods, the consumer can purchase various combination of goods or market combination of goods weekly. (See Figure 2.20)

Budget Line



In Fig 2.20, X axis and Y axis represents good X and good Y respectively. AF is the budget line showing various combinations of both goods that a consumer can afford in given income.

In indifference curves approach to demand analysis, Budget Line (BL) plays an integral role in the determination of consumer's equilibrium. It is a straight line joining two points on Y-axis and X-axis and has a negative slope. Its starting point on Y-axis represents the amount of Y that can be bought with given income and Price of Y (P_y). Its end point on X-axis represents the maximum amount of X which consumer can buy with given income and price of X (P_x).

The use of BL in determining a consumer's equilibrium is illustrated in Fig. 2.21 where it is labelled AB. It begins from point A on Y-axis and meets X-axis at point B. All the points along AB curve represent different combinations of X and Y which the market permits the consumer to have with his given income and prices of two goods.

Fig. 2.21: Consumer's Equilibrium

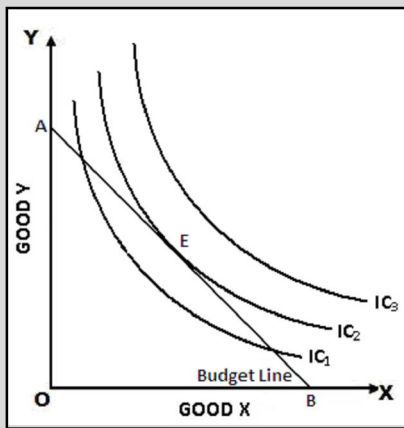


Fig 2.21 shows consumer's equilibrium at point E where, Budget line AB is tangent to the indifference curve IC_2 .

Which of the alternatives allowed by the market will be chosen by the consumer? Our assumption of economic rationality of the consumer states that out of the available alternatives, the consumer will try to choose that combination of X and Y which brings him to the highest indifference curve which the market permits him to reach. In this context, we should note that the BPL is a straight line and slopes downwards from left to right, and the indifference curves are convex to the origin. Therefore, if we take any particular indifference curve, we come across three possibilities. The BPL

- does not touch it at all
- intersects it twice
- is tangent to it
- it should also be noted that a BPL can be tangent to one and only one indifference curve

LESSON ROUND UP

- Demand means a desire or a wish to buy and consume a commodity or service provided consumer has adequate ability and is willing to buy.
- The consumer's decisions are guided by several elements, such as income, tastes and preferences etc and an assumption is established that these factors remain constant.
- Law of demand states that "the amount demanded increases with a fall in price and diminishes with a rise in price".
- Demand for a good by an individual or the market as a whole is conventionally expressed in three alternative forms, namely;
 - a demand function

- a demand schedule
- a demand curve
- Utility of a good is its expected capacity to satisfy a human want. To a consumer, the utility of a good is the satisfaction which he expects from its consumption.
- Utility can be measured in two ways:
 - Cardinal Approach
 - Ordinal Approach
- When a consumer buys a good, the utility derived from it varies with its quantity, and generates three concepts; namely
 - Total Utility(TU)
 - Average Utility(AU)
 - Marginal Utility(MU)
- Law of diminishing marginal utility states that “the additional benefit which a person derives from a given increase in his stock of a thing diminishes with every increase in the stock that he already has”.
- The law of equi-marginal utility states that consumer distributes his expenditure between different goods in such a way that the marginal utility derived from the last rupee spent on each good is the same.
- Demand for a good can change in two ways:
 - a consumer moves from one point to another on the same demand curve (Movement along demand curve)
 - when the entire demand curve shifts its position (Movement from one demand curve to the other)
- Demand Elasticity:
 - Types of demand elasticity: Price elasticity of demand; Cross price elasticity of demand and Income elasticity of demand.
 - Five cases of elasticity of demand: Perfectly elastic demand; Perfectly inelastic demand; Relatively elastic demand; Relatively inelastic demand and Unitary elastic demand
 - Methods of measuring price elasticity of demand: Percentage method or Arithmetic; Total expenditure method and Graphic method or Point method.
 - Factors affecting the elasticity of demand: Price level; Availability of substitutes; Time period; Proportion of total expenditure spent on the product; Habits; Nature of the commodities; Various uses and Postponing consumption.
- Supply means the quantity of goods offered for sale at pre determined price at a certain point of time.
- Law of Supply states that a firm will produce and offer to sell greater quantity of a product or service as the price of that product or services rises, other things being equal.
- Other things include cost of production, change of technology, price of related goods (substitutes and complements), prices of inputs, level of competition and size of industry, government policy and non economic factors.
- Supply of a good by an individual producer/firm or the market/industry as a whole is conventionally expressed in three alternative forms, namely;

- a supply function
- a supply schedule
- a supply curve
- Supply for a good can change in two ways
 - a producer moves from one point to another on the same supply curve (Movement along supply curve)
 - when the entire supply curve shifts its position (Movement from one supply curve to the other)
- Supply Elasticity:
 - Five cases of elasticity of supply: Perfectly elastic supply; Perfectly inelastic supply; Relatively elastic supply; Relatively inelastic supply and Unitary elastic supply
 - Determinants of price elasticity of supply: Time period; Ability to store output; Factor mobility; Cost relationships and Excess supply
- The market price, or equilibrium price, is determined by the interaction of demand and supply at a given time with given conditions of demand and supply.
- Elasticity refers to the ratio of the relative change in a dependent to the relative change in an independent variable. There are two types of elasticities:
 - Elasticity of Demand
 - Elasticity of Supply
- The consumer behaviour can be studied from two approaches;
 - Marshallian Approach
 - Indifference Curve Approach
- In the Marshallian approach, the consumer tries to maximize the utility that he derives keeping in view the money income he has in hand available to be spent on that good.
- In indifference curve approach, the preferences are ordered than to measure them in terms of money. This approach, is, therefore an ordinal concept based on ordering of preferences.

GLOSSARY

Ceteris Paribus	<i>Ceteris paribus</i> or <i>caeteris paribus</i> is a Latin phrase, literally translated as “with other things the same” or “all other things being equal or held constant”.
Demand Curve	A demand curve is the curve showing the relationship between the quantities of a good which consumers would be willing to purchase at alternative prices.
Law of Demand	<i>Ceteris paribus</i> , the quantities demanded of a good and its own prices are inversely related.
Supply Curve	A supply curve is the curve showing relationship between the quantities supplied of a commodity by the producer at alternative prices.
Law of Supply	<i>Ceteris paribus</i> , the quantities supplied of a good and its own prices are positively related.
Utility	It is defined as a want satisfying power of a commodity. It is the sensation which an

	individual derives from consuming a commodity. It can be measured on numerical scale as well as ordinal.
Cardinal Utility	Cardinal utility is a view of utility measurement based on the presumption that the satisfaction of wants and needs is a quantifiable characteristic of human activity. In other words, utility can be measured with numerical values (1, 2, 3, etc.) along a scale. If so, then the utility generated from consumption can be evaluated against an objective standard, which then makes it possible to compare utility among different goods and among different people.
Ordinal Utility	Ordinal utility is a view of utility measurement based on the presumption that the satisfaction of wants and needs is not a quantifiable characteristic of human activity and that preferences are subjective. Preferences among goods can be ranked (first, second, third, etc.) but not measured according to a scale. In this regard, consumers need only specify whether one good is more or less preferred than another. How much more or less a good is preferred is not important.
Marginal Utility	Marginal utility is the extra satisfaction generated from consuming one more unit of a good. Marginal Utility = $\frac{\text{change in total utility}}{\text{change in quantity}}$
Law of Diminishing Marginal Utility	The law of diminishing marginal utility means that the value of a good, the extra utility derived from good declines as more of the good is consumed. If the satisfaction obtained from a good declines, then buyers are willing to pay a lower price, hence demand price is inversely related to quantity demanded, which is the law of demand.
Consumers' Equilibrium	Consumer equilibrium exists when a consumer selects or buys the combination of goods that maximizes utility. This is achieved by equating the marginal utility-price ratio for each good consumed or by equating the ratio of prices and the ratio of marginal utilities. In other words, buyers are willing to pay relatively higher prices for goods that generate relatively more marginal utility.
Indifference Curve	An indifference curve is a curve which represents all those combinations of goods which give same satisfaction to the consumer. Since all the combinations on an indifference curve give equal satisfaction to the consumer, the consumer is indifferent among them.
MRS	The rate at which an individual must give up "good A" in order to obtain one more unit of "good B", while keeping their overall utility (satisfaction) constant. The marginal rate of substitution is calculated between two goods placed on an indifference curve, which displays a frontier of equal utility for each combination of "good A" and "good B".
Price Elasticity of Demand	The relative response of a change in quantity demanded to a change in price. More specifically the price elasticity of demand is the percentage change in quantity demanded due to a percentage change in price.
Cross Elasticity	The relative response of a change in the demand for one good to a change in the price of another good. More specifically the cross elasticity of demand is percentage change in the demand for one good due to a percentage change in the price of another good.
Income Elasticity	The relative response of a change in demand to a change in income. More specifically the income elasticity of demand is the percentage change in demand due to a percentage change in buyers' income.

Price Elasticity of Supply	The relative response of a change in quantity supplied to a change in price. More specifically the price elasticity of supply is the percentage change in quantity supplied due to a percentage change in price.
Normal Goods	A normal good is a good that reacts positively to changes in buyers' income. If buyers have more income, then they purchase more of a normal good. If they have less income, then they reduce purchases of a normal good.
Inferior Goods	An inferior good is one that reacts negatively to changes in buyers' income. If buyers have more income, then they purchase less of an inferior good. If they have less income, then they increase purchases of an inferior good.
Giffen Goods	A consumer good for which demand rises when the price increases, and demand falls when the price decreases. Such goods are exceptions to the law of demand.
Superior Goods	Goods for which income elasticity of demand is greater than unity. For such goods the proportion of money spent on the goods tends to increase as the income increases.

SELF-TEST QUESTIONS

1. Define the concept of utility and distinguish between the concepts of total utility, average utility and marginal utility. Explain these concepts with the help of a numerical illustration and diagrams.
2. What is the relationship between marginal utility of a good and demand for it? How do you derive an individual consumer's demand curve for a good with the help of the concept of marginal utility?
3. What do you understand by demand for a good?
4. State and explain the law of demand. What is the reason for the negative slope of a demand curve?
5. Is the law of demand universally valid? If not, what are its exceptions? Why do these exceptions occur?
6. State and explain the law of equi-marginal utility. What are practical limitations of this law?
7. What are the determinants of demand for a good? Discuss any three of them?
8. Explain the determination of consumer's equilibrium with the help of utility analysis
9. Discuss the law of supply. Explain any three of its determinants.
10. Explain with the help of diagram change in quantity supplied and shift in supply of a product.
11. Explain market equilibrium for a commodity in the market. What happens if demand for a product if supply remains the same?
12. Define price elasticity of demand for a good. Discuss alternative methods of measuring it.
13. Distinguish between price, income and cross elasticities of demand.
14. Differentiate between total expenditure and proportionate methods of measuring elasticity of demand. Highlight their respective merits and demerits.
15. Highlight the main determinants of elasticity of demand for a good.
16. Distinguish between increase/decrease of demand with expansion/contraction of demand. Why does a demand curve shift its location?
17. What is elasticity of supply? Discuss its various determinants.

Suggested Readings

1. Misra and Puri: Modern Microeconomics
2. H. L. Ahuja : Modern Microeconomics
3. M. L. Seth: Principles of Economics

Lesson 3

Theory of Production, Costs and Revenue

LESSON OUTLINE

- Theory of Production
- Factors of Production
- Law of Diminishing Returns or Law of Variable Proportions
- Law of Returns to Scale
- Theory of Costs
- Review Questions
- Theory of Revenue
- Producer's Equilibrium
 - MR – MC Approach
 - TR – TC Approach
- Economies and Diseconomies of Scale
 - Internal
 - External
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

Markets have two sides: consumers and producers. Uptil now we focused on the consumer side of the market. We now focus on the other one, the producer side of the market.

The traditional theory of any enterprise is to plan the prices and output in a manner that maximizes profits in the short as well as long run. It is of an emergent importance to learn how the firms can produce efficiently and how their costs of production change with the change in the prices of inputs and level of output.

In this section, you will learn how to use the theory of production so as to maximize the profit.

Profit of the firm may be maximized by minimization of costs or/and maximizing revenue. The producers' equilibrium would be derived with the help of different theories of production. You will also learn the concepts of returns to scale, economies and diseconomies of the scale.

Consuming means extracting utility from matter, producing means creating utility into matter.

Fraser

PRODUCTION

Meaning

Production is another important economic activity. It directly or indirectly satisfies the wants and needs of the people. Satisfaction of human wants is the objective of production.

Production is the conversion of input into output. The factors of production and all other things which the producer buys to carry out production are called input. The final goods and services produced are known as output. In economics, the term production is not the same as in common language where it is usually taken to mean 'creation' of something. In economics, the term production carries a wider connotation. It stands for creation of 'value', which can be of two varieties, namely 'use value' and 'exchange value'. Thus, production is the activity which creates or adds utility and value.

According to Edwood Buffa, "Production is a process by which goods and services are created"

Factors of Production

The resources needed to produce a given product are called factors of production. Production of goods and services needs various inputs which are known as 'Factors of Production', 'Agents of Production', 'Productive Resources' or sometimes even 'Productive Services'. The level of production depends upon both the quantity of inputs and the efficiency with which they are employed in the process of production. All the units of factors of production are 'homogenous', so far as their productive capacity is concerned. They are perfect substitute of each other. Replacing one unit by another does not change the total output. According to Marshall, the four major factors of production are:

- Land
- Labour
- Capital
- Entrepreneurship

The level of production depends upon both the quantity of inputs and the efficiency with which they are employed in the process of production. It is also noteworthy that economic growth of a country, in a way, represents its productive capacity which, in turn, depends upon the technology and amounts of productive resources.

1. Land: Land is not created by mankind but it is a gift of nature available to us free of cost. So, it is called as natural factor of production. It is also called as original or primary factor of production. Normally, land means surface of earth. But in economics, land has a wider meaning.

Land includes earth's surface and resources above and below the surface of the earth. It includes following natural resources :-

- On the surface (e.g. soil, agricultural land, etc.)
- Below the surface (e.g. mineral resources, rocks, ground water, etc.)
- Above the surface (e.g. climate, rain, etc.)

Land is the sum total of those productive resources which are provided 'free of cost' by nature to us that is to say those resources on which no human effort has been expended to make them actually usable in a productive process

The salient features of land are highlighted below.

- Land is a free gift of nature to mankind. It is not a man-made factor but is a natural factor.

- Land is primary factor of production.
- Supply of land is perfectly inelastic i.e. fixed in quantity. Neither it can be increased nor decreased.
- Land is a passive factor in the sense that it can not produce anything of its own. It needs help of Labour, Capital, Entrepreneur, etc.
- There is no social cost of land since; it is a gift of nature to society. It is not created by society by putting any efforts and paying any price. So its supply price for society is zero. At the same time, the supply price for individual is not zero.
- Land is a perfectly immobile factor.
- Economic reward for the use of land is rent.

2. Labour: The term labour is used to mean several things and can be a source of great deal of vagueness and imprecise statements. The term labour refers to only human effort (or activity) which can be physical mental or a mixture of the two. It does not include the work performed by animals or machines or nature.

Labour lately is known as human resource. All companies need labor in order to carry out production. Everyone from the manual workers, to the owner of the company falls under the classification of human resources. Without this factor, there would be no production because nobody would be working.

The salient features of labour are highlighted below.

- Labour can not be separated from laborers. Worker sells their service and doesn't sell themselves.
- Labour can not be stored. Once the labour is lost, it can not be made up. Unemployed workers can not store their labour for future employment.
- Labour is an active factor of production unlike; land.
- Labour is heterogeneous. No two persons possess the same quality of labour. Skills and efficiency differs from person to person. So, some workers are more efficient and productive than others in the same job.
- Labour is an imperfectly mobile factor.
- Labour supply is inelastic in general. Supply of labour depends upon many factors like size of population, age and sex composition, desire to work, quality of education, attitude towards work, etc. Thus, supply cannot be changed easily according to changes in demand.
- The amount of labour is the product of (i) duration of time over which it is performed and (ii) the intensity with which it is performed.

Supply of labour in a country refers to

- the total number of workers available for labour
- the intensity with which they can work
- the duration for which they work
- their efficiency (or productivity)

3. Capital: Capital is another important factor which plays a huge role in the production. Capital includes things like tools, machines, and other things that a business uses in order to produce their goods or services. At some level, all companies rely on their capital in order to run successfully. Without these things, the company would be unable to carry out production.

The term Capital may mean different in different disciplines; in economics, capital is that part of wealth which is used for production. It is one of the factors of production/ input. The word capital in economics may mean either of the three;

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- assets
- money/ wealth
- income

The salient features of capital are highlighted below.

- Capital is not a gift of nature. It is man made, secondary as well as an artificial factor of production.
- Capital helps in increasing level of productivity and speed of production.
- Supply of capital is relatively elastic.
- Capital is not perishable like labour. It has a long life subject to periodical depreciation.
- Capital is a perfectly mobile factor.
- Capital has a social cost. Capital as a resource has alternative uses. It can be put to either of the uses. The society in order to have one of them sacrifices another; accounting it as social cost.

4. Entrepreneurship: Factors of production viz. land, labour and capital are scattered at different places. These can not produce economic goods and services by themselves. They have to be brought together and, in a coordinated way, made to pass through a productive process to create output. According to Kaldor, entrepreneurship consists of three major functions, viz, coordination, management and supervision. All these factors have to be assembled together. This work is done by enterprise through entrepreneur. This is the function of an entrepreneur; to bring the required factors together and making them work harmoniously.

This final factor of production of entrepreneurship involves the activity right from start of the business to assembling of other factors in order to carry out production smoothly. It is not possible for an entrepreneur to start production process without other factors of production viz. land, labour, capital. Entrepreneurship is an independent factor of production.

The salient features of an entrepreneur as a factor of production are highlighted below.

- Entrepreneur should be able to plan, organize, manage and allocate other primary factors of production efficiently.
- Entrepreneur should be able to define objective precisely.
- Entrepreneur should be able to deal with numerous risks involved in entrepreneurship.
- Entrepreneur should be able to incorporate innovation and adopt modern techniques of production.
- Entrepreneur should be able to take decisions promptly. Quick decisions are expected but hasty decisions may be avoided. At the same time, delay in decisions may increase cost of project and reduce the profits.

I. THEORY OF PRODUCTION

Theory of production basically determines, how the producer, given the state of technology combines various inputs economically to produce a definite amount of output in an efficient manner. In the production process, firm converts combination of inputs/factors of production, into outputs/finished goods/products.

Production Function: The functional relationship between input and output is known as Production Function. The production function states the maximum quantity of output which can be produced from any selected combination of inputs. In other words, it states the minimum quantities of input that are necessary to produce a given quantity of output.

The production function can be expressed in form of an equation in which the output is the dependent variable and inputs are the independent variables. The equation is expressed as follows:

$$Q_x = f(L, K, T, \dots, n)$$

Where, Q_x = Output

L = Labour

K = Capital

T = Level of Technology

n = Other Inputs Employed in Production

There are two types of production function:

- Short run production function and
- Long run production function

Short run production function is defined as that time period during which a firm cannot vary the quantity of all its inputs.

$$Q = 2000 + 3X + 5Y^2 - 0.2Z^3$$

On the other hand, the term long run is defined as that time period over which a firm can vary all factors of production and therefore, can choose between different scales or sizes

$$Q = 2X + 3Y^2 - 2Z^3$$

Assumptions of Production Function

The production function is based on the following set of assumptions:

- The level of technology remains constant.
- The firm uses its inputs at maximum level of efficiency.
- It relates to a particular unit of time.
- A change in any of the variable factors produces a corresponding change in the level of output.
- The inputs are divisible into most viable units.

There are two types of production function - short run production function and long run production function.

Short run is defined as that time period over which a firm is unable to vary the quantities of all inputs. In the short run production function, the quantity of only one input varies while all other inputs remain constant. In contrast, long run is defined as that time period over which a firm can vary quantities of all factors of production and therefore, can switch between different scales. In the long run production function all inputs are variable. There are two alternative theories to these production functions i.e.

- Law of Diminishing Returns or Laws of Variable Proportions (to analyze production in the short period)
- Law of Returns to Scale (to analyze production in the long period)

LAW OF DIMINISHING RETURNS OR LAW OF VARIABLE PROPORTIONS

The law of variable proportion is the modern approach to the 'Law of Diminishing Returns (or The Laws of Returns). The law of variable proportion shows the production function with one input factor variable while keeping the other input factors constant.

The law of variable proportion states that, if one factor is used more and more (variable), keeping the other factors constant, the total output will increase at an increasing rate in the beginning and then at a diminishing rate and eventually decreases absolutely provided there is no change in technology.

According to K.E. Boulding, "As we increase the quantity of any one input which is combined with a fixed quantity of the other inputs, the marginal physical productivity of the variable input must eventually decline".

According to P. A. Samuelson, "An increase in some inputs relative to other fixed inputs will in a given state of

technology, cause output to increase but after a point the extra output resulting from the same additions of extra inputs will become less and less”

Marshall defined the law by saying, “An increase in the capital and labor applied in the cultivation of land causes in general a less proportionate increase in the amount of product raised until it happens to coincide with an improvement in the art of agriculture.”

It should be noted that Marshall recognizes that this law is applicable only in the short run when the technology can be assumed to be given and inputs can be combined only within a given range of combinations.

This law states the effect of variations in factor proportion on output. When one factor varies and the others fixed; the proportion between the fixed factor and the variable factor will vary. That is why; the law is called the law of variable proportion.

Assumptions of the Law

The law of variable proportion is valid with the following assumptions:

- The technology remains constant. If there is an improvement in the technology, due to inventions, the average and marginal product will increase instead of decreasing.
- There are two factors of production. One input factor is variable and other factor is kept constant.
- All the units of the variable factors are identical in all respects. They are of the same size and quality.
- A particular product can be produced under varying proportions of the input combinations.
- The law operates in the short run.

In short-period, when the production of an output is sought to be increased; by increasing an additional unit of variable factor to a given quantity of fixed factors, the law of variable proportions comes into operation. The law of variable proportions provides the result to varying the proportions of the fixed and variable factors of production. When the quantity of one factor is increased while all other factors remain constant, then the proportion between the fixed and variable factors is altered.

The law of variable proportions states, “as the proportion of variable factor is increased, the total production at first increases more than proportionately, then proportionately and finally less than proportionately”. The classical economists called it the Law of Diminishing Returns. They derived it by applying more and more labour to a fixed acreage of land, and thought of it as associated particularly with agriculture. But, it is a general principle that can be applied to any production operation. It is now usually called the Law of Variable Proportions. It can also be called the Law of Diminishing Marginal product or Diminishing Marginal Returns or simply as Diminishing Returns.

“An increase in the capital and labour applied in the cultivation of land causes in general a less than proportionate increase in the amount of product raised unless it happens to coincide with an improvement in the arts of agriculture.”

Alfred Marshall

It should be noted that Marshall recognizes that this law is applicable only in the short run when the technology can be assumed to be given and inputs can be combined only within a given range of combinations.

Earlier, economists distinguished this law into three separate laws of returns; namely diminishing, increasing and constant returns. Modern Economist, however, stated that these are three different aspects of the same law, viz. ‘Law of Variable Proportions’. There are three stages to this law in the following sequence:

- Stage of Increasing Returns
- Stage of Diminishing Returns
- Stage of Negative Returns

Table 3.1: Stages of Law of Returns

Labour Units	Capital Units	Total Product	Average Product	Marginal Product	Stage
1	10	8	8	8	STAGE I
2	10	20	10	12	
3	10	36	12	16	
4	10	48	12	12	STAGE II
5	10	55	11	7	
6	10	60	10	5	
7	10	60	8.6	0	
8	10	56	7	-4	STAGE III
9	10	51	5.7	-5	
10	10	45	4.5	-6	
11	10	38	3.6	-7	

Total Product or Total Physical Product (TPP): is the total quantity of output a firm obtains from a given quantity of inputs (L, K).

Average Product or Average Physical Product (APP): is the total physical product (TPP) divided by the quantity of input.

$$APP_L = TPP/L$$

$$APP_K = TPP/K$$

Marginal Product or Marginal Physical Product (MPP): It is the increase in total output that results from a one unit increase in the input, keeping all other inputs constant.

$$MPP_L = \Delta TPP / \Delta L$$

or

$$MPP_L = TPP_n - TPP_{n-1}$$

In the above table, the average product and marginal product increases at first till 4th unit of labour and then starts to decline. The total product initially increases at an increasing rate till the employment of the 4th unit of labour. Beyond, the marginal product started diminishing. The marginal product declines faster than the average product. At the 6th unit, the total product is at its maximum. For 7th unit, marginal product is zero and the marginal product of 8th unit is negative. Thus, when more and more units labour are combined with other fixed factors, the total product increases first at an increasing rate, and then at a diminishing rate and finally it becomes negative.

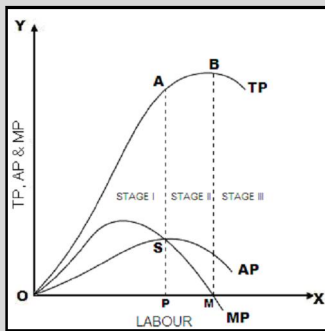
All the three stages taken together describe the Law of Variable Proportions.

- **Stage I:** Total product increases at an increasing rate and this continues till the end of this stage. Average product is increasing. Marginal product increases at an increasing rate. Thus TP, AP and MP - all are increasing. Hence this stage is known as stage of increasing returns. The stage I ends where average product reaches its highest point, so here, the efficiency of variable factor (labour) is maximum. There are two important reasons for increasing returns:
 - indivisibility
 - specialization
- **Stage II:** Total product continues to increase at a diminishing rate until it reaches its maximum point at the end of this stage. Both AP and MP diminish, but are positive. At the end of the second stage, MP becomes zero. MP is zero when the TP is at the maximum. AP shows a steady decline throughout this stage. As both AP and MP decline, this stage is known as stage of diminishing returns. The main cause of the

application of the law of diminishing returns is the scarcity of one or other factor of production. When variable factors are increased on a fixed factor, this law applies. In other words, the elasticity of the substitution between the factor is not infinite.

- **Stage III:** In this stage, the TP starts to decline. AP shows a steady decline, but never becomes zero. MP becomes negative. As MP becomes negative this stage is known as stage of negative returns. The phenomenon of negative return emerges as result of application of excessive number of units of variable factor in relation to fixed factor, so they get in each other's way, with the result that TP starts diminishing. Besides, the application of excessive number of units of variable factor improves the efficiency of a fixed factor.

Fig. 3.1: Law of Variable Proportions



In the Fig3.1, x axis shows labour levels and y axis shows TP, AP, and MP.

Stage I is till point A on TP curve where TP increases, MP=AP.

Stage II is till point B on TP curve where TP reaches maximum, AP steadily falls and MP=0.

Stage III is beyond point B on TP curve where TP begins to fall and MP becomes Negative.

Table 3.2: Relationship between TP, AP and MP

STAGE	DIRECTION OF TP	DIRECTION OF AP	DIRECTION OF MP
FIRST	Increasing at Increasing rate	Increasing	Increasing
SECOND	Increasing at Diminishing rate	Decreasing	Decreasing
THIRD	Decreasing	Steadily Decreasing	Declines
	Reaches Maximum		Zero
	Starts to Decline		Becomes Negative

Where to operate?

It may be noted from the numerical illustration and diagram; both the stage I and III are similar. Under stage I, the fixed factor is too much in relation to the variable factor; therefore, marginal product of fixed factor is negative. In stage III, variable factor is too much in relation to the fixed factor, therefore, marginal product of variable factor is negative.

This stage is also ruled out on ground of technical inefficiency. Thus a rational producer will never choose to produce in Stage I and III. Stage II, however, presents the range of rational production decision; where both AP and MP falling but AP is greater than MP through out this stage. At the end of this stage, MP of variable factor is zero and TP is maximum. It is stage of operation suitable for rational producer.

Limitations of Law of Variable Proportion

The law of variable proportions is based on unrealistic set of assumptions.

- A homogeneous unit of variable input (especially labour) is an illogical assumption. Every unit of labour or worker is different from each other.
- The assumption of constant input prices and technique of productions also seems unrealistic in the present dynamic world.

LAW OF RETURNS TO SCALE

Law of Returns to Scale is a long run concept. In the long run, all factors of production becomes variable as the

firm is able to alter its stock of inputs in long run which is not the case in short run. When all factors are changed in some proportion, the behaviour of output is analyzed with the help of laws of returns to scale. Thus, this law takes into consideration not the varying units of inputs but changing scale of production. The scale of production of the firm is determined by those input factors which cannot be changed in the short period. If the firm increases the units of both factors labour and capital, its scale of production increases.

A return to scale is the rate at which the output increases with the increase in all inputs proportionately. There are three cases to return to scale:

- Increasing Returns to Scale
- Constant Returns to Scale
- Diminishing Returns to Scale

Increasing Returns to Scale: When inputs are increased in a given proportion and output increases in a greater proportion, the returns to scale are said to be increasing. In other words, proportionate increase in all factors of production results in a more than proportionate increase in output is a case of increasing returns to scale. Thus, if all inputs are doubled then total output is more than doubled.

For example, if the inputs are increased by 40% and output increased by 50%, return to scale are increasing. It is the first stage of production. If the industry is enjoying increasing returns, then its marginal product increases. As the output expands, marginal costs come down. The price of the product also comes down.

Constant Return to Scale: When inputs are increased in a given proportion and output increases in the same proportion, the returns to scale is said to constant. Thus, if all inputs are doubled then total output is also doubled.

For example, if inputs are increased by 40% and output also increases by 40%, the return to scale are said to be constant. This may also be called homogeneous production function of the first degree. In case of constant returns to scale the average output remains constant. Constant returns to scale operate when the economies of the large scale production balance with the diseconomies.

Decreasing Returns to Sale: If the firm continues to expand beyond the stage of constant returns, the stage of diminishing returns to scale will start to operate. If a proportionate increase in all inputs results in less than proportionate increase in output, the returns to scale is said to be decreasing. Thus, if all inputs are doubled then total output is less than doubled.

For example, if inputs are increased by 40%, but output increases by only 30%, it is a case of decreasing return to scale. Decreasing return to scale implies increasing costs to scale.

Increasing Returns: % change in output > % change in inputs
Constant Returns: % change in output = % change in inputs
Decreasing Returns: % change in output < % change in inputs

Phases of production

Phase I:

Increasing returns to scale:

- TP increases
- AP increases
- MP increases

Phase II:

Constant returns to scale:

- TP reaches at the highest peak
- AP initially increases then starts falling down
- MP starts falling

Phase III:

- TP starts falling down
- AP decreases
- MP becomes negative

Table 3.3: Returns to Scale

Units of Capital	Units of Labour	Total Output	% Change in Inputs	% Change in Output	Returns to Scale
20	150	3000	–	–	
40	300	7500	100	150	Increasing
60	450	12000	50	60	Increasing
80	600	16000	33	33	Constant
100	750	18000	25	13	Decreasing

II. THEORY OF COSTS

In the process of its decision-making, in order to be able to decide the price of the product at which it would offer the same in market; a firm needs to acquaint itself with the costs of producing the product. The cost of supplying the product is determined by the productivity and the prices of the inputs used. The cost function of a firm shows a relationship between output produced and the associated cost of producing it. Hence, costs are nothing but input prices. There are four major inputs as discussed; land, labour, capital and entrepreneurship. The costs attached with each are; rent, wages, return/interest and profits respectively.

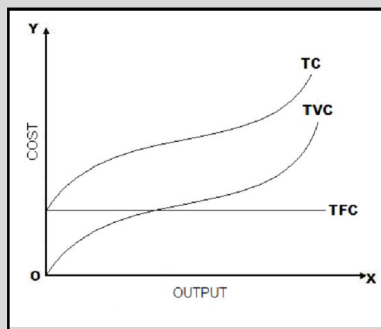
Like production; costs of a firm may also be analyzed in the context of

- Short Run Costs
- Long Run Costs

Short Run Costs

In short run, since some of the factors of production are fixed and other may vary; similarly, there are two categories of costs in short run: Fixed cost and Variable cost. The firm needs to employ few fixed costs initially in short period irrespective of the level of output. It is obvious that total cost (TC) is the summation of total fixed costs (TFC) and total variable costs (TVC).

Fig. 3.2: Concepts of Total Cost of a Firm

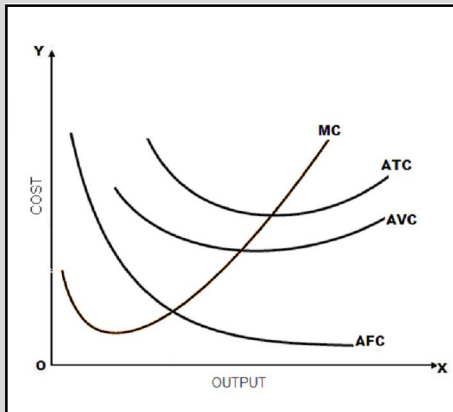


In this Fig. 3.2, X axis shows levels of output and Y axis shows costs.
 TC is Total Cost Curve
 TVC is Total Variable Cost Curve
 TFC is Total Fixed Cost Curve

Total Cost Curves: Graphically, if quantity of output is measured along X-axis and costs are measured along Y-axis, then the Total Fixed Cost Curve (TFC) runs parallel to X-axis (See Fig. 3.4). In contrast, total variable costs

and total output are positively related. They move together. With zero output, the variable costs of the firm are also zero. The total variable cost (TVC) curve, therefore, starts from the point of origin. If we add the two curves vertically, we get a corresponding curve which represents total cost (TC). Its starting point on Y-axis coincides with that of TFC curve.

Fig. 3.3: Average and Marginal Cost of a Firm



In this Fig. 3.3, X axis shows levels of output and Y axis shows costs.

MC is Marginal Cost Curve

ATC is Average Total Cost Curve

AVC is Average Variable Cost Curve

AFC is Average Fixed Cost Curve

Average Fixed Cost (AFC) Curve: Since total fixed costs do not change with level of output, therefore, average fixed cost (AFC) declines with increase in the level of output and tends to infinity when output reaches zero. For first unit of output, AFC equals TFC. The AFC curve, therefore, is a rectangular hyperbola.

$$AFC = TFC / Q$$

Average Variable Cost (AVC) Curve: As output increases total variable cost also increases. But the rate of increase of TVC would depend on whether the law of eventual diminishing returns operates or not. When it is not operating TVC increases (slowly) less than proportionately to product (Q). As a result, AVC decreases. However, once the law starts to operate, TVC increases (steadily) more than proportionately to product implying increase in AVC. Consequently, the shape of the average cost curve is U-shaped. It first falls then rises.

$$AVC = TVC / Q$$

Total Average Cost, or Average Cost (ATC or AC) Curve:

$$AC = TC / Q$$

Since,

$$TC = TFC + TVC$$

∴

$$AC = (TFC + TVC) / Q$$

∴

$$AC = (TFC/Q) + (TVC/Q)$$

∴

$$(AC = AFC + AVC)$$

As output increases AFC is declining throughout. However, AVC is declining up to a point and later starts to rise. Therefore, AC is declining rapidly when both AFC and AVC are declining; whereas the gap of rise narrows as AFC continues to decline and AVC rises. Graphically, it is obtained by vertical addition of the AFC and AVC curves. AC curve lies above AVC curve. At each point, its vertical distance from AVC curve is exactly equal to the distance of AFC curve from X-axis. Therefore, AC curve is (i) U-shaped and with increasing output, its vertical distance from AVC keeps declining.

Marginal Cost (MC) Curve: Marginal cost is addition to total cost on account of the production of an additional unit. It is ratio of change in total cost to change in total output.

In short run, $TC = TFC + TVC$

$$MC = d(TC) / dQ$$

$$MC = d(TFC + TVC) / dQ$$

$$= (dTFC/dQ) + (dTVC/dQ)$$

Since, TFC does not change in short run, MC depends upon only TVC

$$\Rightarrow dTFC/dQ = 0$$

$$\therefore MC = d(TVC)/dQ$$

For this reason, MC curve is related to only AVC curve. Therefore, MC curve is also a U shaped curve. When AVC is decreasing, MC is less than it and MC curve lies below AVC curve. However, when the rate of fall of AVC slows down, MC curve reaches its lowest value and starts increasing and cuts AVC from below at its lowest point. In other words, when AVC is constant, MC is equal to it. In the next phase, when AVC curve slopes upwards, MC curve rises faster than the former and lies above it. It should also be noted that MC curve need not intersect AC curve at the lowest point of the latter. Whether it does so or not would depend upon the rate at which AVC increases compared with the rate at which AFC decreases. MC curve will intersect AC curve at its lowest point only if the rate of increase in AVC equals that of fall in AFC.

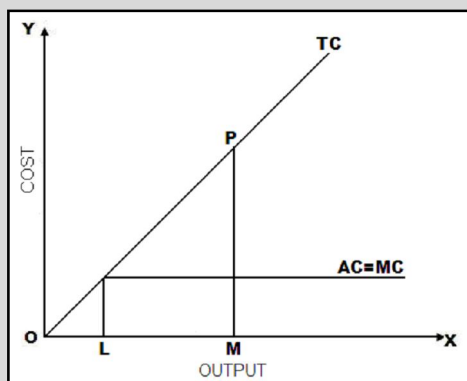
Long Run Costs

The term long run is defined as that length of time over which the firm gets an opportunity to vary if need be the quantities of all its inputs. In other words, there are no fixed factors in the long run and therefore there are no fixed costs. All factors are variable and as a result all costs are variable.

If a firm closes down, its total cost (TC) also falls to zero. Similarly, TC increases with an increase in output, but its rate of increase may not be proportionate to the increase in output.

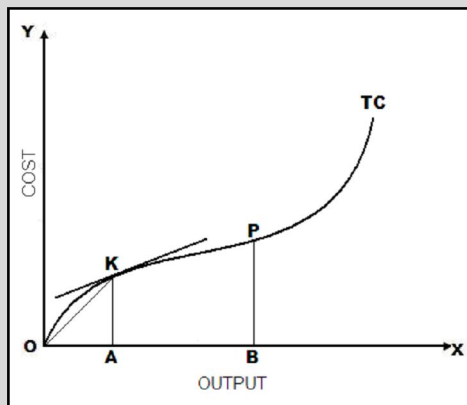
In classical reasoning, where productive efficiency is determined by proportion of inputs rather than their absolute quantities, total cost of production changes in direct proportion to output. Therefore, TC curve is a straight line with a fixed slope and starts from the origin. Further, in this case, both average cost and marginal cost are throughout equal to each other and remain constant. Their numerical value is equal to the slope of the TC curve.

Fig. 3.4: Long Run Total, Average and Marginal Costs



In this Fig. 3.4, X axis shows levels of output and Y axis shows costs.

In Fig 3.4, TC curve represents total cost of output of a firm for corresponding quantities of output. Thus, when the output of the firm is OM, total cost is PM, average cost is PM/OM. Marginal cost is also equal to the constant slope of TC curve, that is, PM/OM.

Fig. 3.5: TC, AC and MC with Varying Returns to Scale

In Fig. 3.5 TC curve starts from point O, rises at a decreasing rate till point P (corresponding to output scale OB). At this output, there are constant returns to scale. When scale of production exceeds OB, diminishing return set in and total cost curve starts rising at an increasing rate.

Modern economic theory contends that in the long run, a firm experiences varying returns to scale. With an expansion in the scale, it starts with the benefit of increasing returns. This is followed by constant returns which, in turn, are replaced by diminishing returns. If we take a point, say K, on TC curve, then the slope of the line joining it with origin O (that is, the slope of OK) measures AC and the slope of the tangent to the curve at this point measures MC.

REVIEW QUESTIONS



1. Explain the various cost concepts.
2. What is the difference between short run and long run costs?
3. Why average cost curve is U shaped?
4. How is marginal cost derived at?
5. Define TFC, AFC, AVC, TVC and MC.
6. What are the limitations of law of variable proportion?

III. THEORY OF REVENUE

Revenue or receipts of a firm are derived from the sale of its output. The basic reasoning related to cost concepts applies here as well. There are three concepts of revenue theory namely;

- Total Revenue
- Average Revenue
- Marginal Revenue

Total Revenue (TR) represents total sales proceeds of the firm and is equal to per unit price multiplied by the quantity sold.

$$\text{TR} = \text{Price Per Unit (P)} \times \text{Quantity Sold (Q)}$$

Average Revenue (AR) is, by definition, the per unit price of the product.

$$\begin{aligned} \text{AR} &= \text{TR} / \text{Q} \\ &= \text{Price Per Unit (P)} \end{aligned}$$

Marginal Revenue (MR) is the addition to total revenue when the quantity sold is increased by one unit. Marginal revenue is addition to total revenue on account of an additional unit of output sold. It is ratio of change in total revenue to change in total units sold.

$$MR = TR_n - TR_{n-1}$$

Or, $MR = d(TR)/dQ$

For the first unit sold, TR = AR = MR.

MR pertains to change in TR only on account of the last unit sold, while AR is based upon all the units sold by the firm. Therefore, any change in AR results in a much bigger change in MR. Reduction in MR is far bigger than that in AR; and similarly, an increase in MR is also much bigger than the corresponding increase in AR. The two are equal only when AR is constant.

The firm will not sell any quantity if TR or AR becomes zero or negative. However, MR can become negative if the fall in price is big enough.

Graphically, therefore, we have the following relationships.

Since TR, AR and MR equal for the first unit sold, therefore, the three curves start from the same point. TR curve slopes upwards so long as MR is positive. If MR is falling with an increase in the quantity of sale, then TR curve will gain height at a decreasing rate. It reaches its maximum height when MR curve touches X-axis. TR curve slopes downwards when MR curve goes below X-axis to become a negative figure.

A change in AR causes a much bigger change in MR. Therefore, when AR curve has a negative slope; MR curve lies below it and has a greater slope. Similarly, when AR curve has a positive slope, MR curve lies above it and has a greater slope. When AR curve is parallel to X-axis, MR curve coincides with it.

In case AR is a straight line, MR curve will bisect each perpendicular distance of it from Y-axis. However, if AR curve is parallel to X-axis, then MR curve coincides with it.

The above graphical relationships between AR and MR are shown in Fig. 3.6 to Fig. 3.9. In Fig. 3.6, AR has a constant value DD'. Therefore, AR curve starts from point D and runs parallel to X-axis. Since AR is a constant, MR is always equal to AR and the two curves coincide with each other.

In Fig. 3.7, AR curve starts from point D on Y-axis and is a straight line with a negative slope. It indicates that as quantity of good sold increases, its per unit price falls at a given rate. Accordingly, MR curve also starts from point D and is a straight line. However, it is a locus of all those points which bisect the perpendicular distances between AR curve and Y-axis. For example, FM = MA.

In Fig. 3.8, AR curve (DPD') has two segments. The first one starts from point D on Y-axis and is a straight line with a negative slope till point P. The second segment is a straight line (PD') parallel to X-axis. It means that as the quantity of good X is increased, its per unit price falls; but for all units in excess of quantity OK, the per unit price remains constant. Keeping in view the rules of drawing MR curve, draw a perpendicular PK from point P to X-axis. We find that MR curve starts from point D on Y-axis, and bisects each perpendicular distance from AR curve to Y-axis till point M' on perpendicular PK. However, at this stage, MR curve jumps to P and from there it coincides with AR curve.

In Fig. 3.9, we have the famous case of a 'kinked demand curve'. Here, AR curve is linear throughout but it has two segments with unequal slope. The segment DP starting from Y-axis has a smaller slope, while that from P to D' has a bigger slope. And this causes a kink in the AR curve at point P. Here also let us draw a perpendicular (PK) from P upon X-axis. Then, in terms of the rules of drawing MR curve, we find that it starts from point D, bisects each perpendicular distance from AR curve to Y-axis till it meets PK at point M. From here MR curve jumps to point P and is the locus of all points which bisect the perpendicular distance between segment PP' of AR curve and the perpendicular PK. Thus MR curve takes the peculiar shape of DMPM'

Fig. 3.6 : Relationship between AR and MR

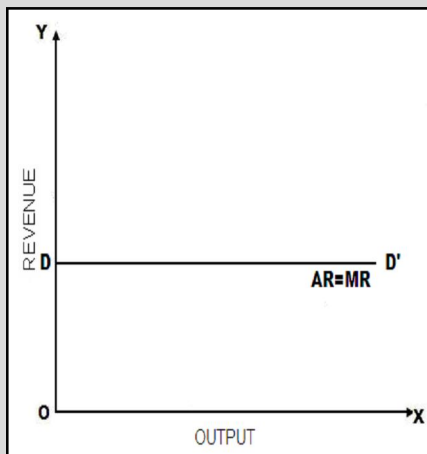


Fig. 3.7 : Relationship between AR and MR

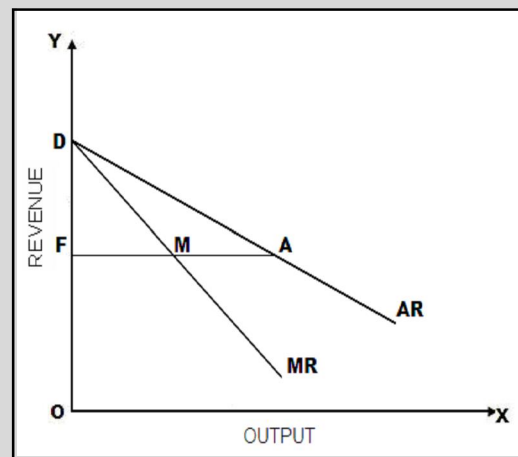


Fig. 3.8 : Relationship between AR and MR

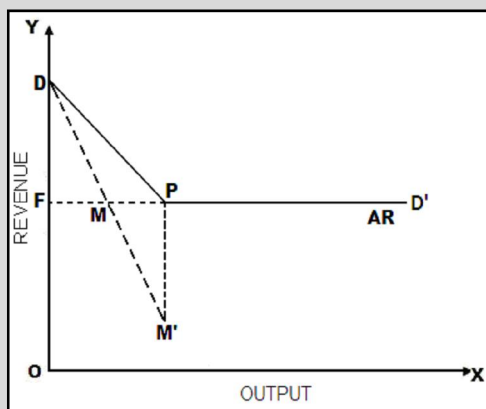
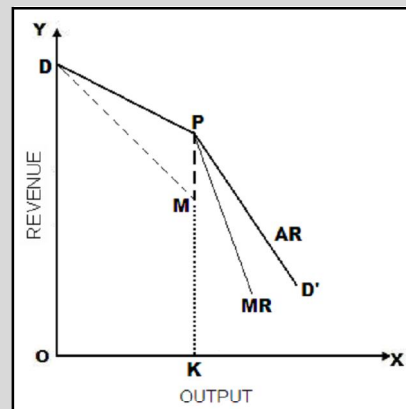


Fig. 3.9 : Relationship between AR and MR



PRODUCER'S EQUILIBRIUM

Producer's equilibrium refers to the level of output of a commodity that gives the maximum profit to the producer of that commodity.

$$\begin{aligned} \text{Profit}(\pi) &= \text{Total Revenue} - \text{Total Cost} \\ &= \text{TR} - \text{TC} \end{aligned}$$

Therefore, the output level at which 'total revenue less total cost' is maximum is called the equilibrium level of output. There are two approaches to arrive at producer's equilibrium.

- TR-TC Approach
- MR-MC Approach

TR – TC APPROACH

Total revenue less total cost or TR-TC is one approach of looking at the producer's equilibrium. According to this approach, there are two conditions of producer's equilibrium:

- The difference between TR and TC is maximum
- Profits falls if one more unit of output is produced (that is marginal cost becomes higher than marginal revenue if one more unit is produced)

MR – MC APPROACH

MR – MC approach is another way of identifying producer's equilibrium.

It is derived from the TR – TC approach. The two conditions of TR-TC approach when derived in terms of MR = MC approach become:

- $MR = MC$
- MC cuts the MR curve from below to become greater than MR after the $MR = MC$ output level.

1. $MR = MC$

When one more unit of output is produced, MR is the gain and MC is the cost to the producer. Clearly, so long as benefit is greater than the cost, or MR is greater than MC, it is profitable to produce more. Therefore, so long as MR is greater than MC, the firm has not achieved equilibrium level of output where the profit is maximum. The equilibrium is not achieved because it is possible for the firm to add to profits by producing more.

The producer is also not in equilibrium when MR is less than MC because benefit is less than the cost. By producing less, the producer or firm can add to his profits.

When MC is equal to MR, the benefit is equal to cost, the producer is in equilibrium subject to condition that MC becomes greater than MR beyond this level of output.

When MC equals MR, the producer's profit would be less if he produces output more than or less than the ' $MR = MC$ ' output as explained above.

Therefore, for attaining equilibrium to reach it is a necessary condition (but not sufficient) that MC equals MR.

2. MC is greater than MR after $MR = MC$

$MR = MC$ is a necessary condition but not sufficient enough to ensure equilibrium.

It is because the producer may face more than one $MR = MC$ outputs. But out of these only that output beyond which MC becomes greater than MR is the equilibrium output. It is because if MC is greater than MR, producing beyond $MR = MC$ output will reduce profits. And when it is no longer possible to add to profits the maximum profit level is reached.

On the other hand, if MC is less than MR beyond the $MR = MC$ output, it is possible to add to profits by producing more. Therefore this $MR = MC$ level is not the equilibrium level. For a producer to be in equilibrium, it is necessary that MC equals MR as well MC becomes greater than MR if more output is produced.

Table: 3.4 Equilibrium at Prevailing Prices

Price Per Unit	Output	Total Revenue	Total Cost	Marginal Revenue	Marginal Cost	Profits
8	1	8	6	8	6	2
8	2	16	14	8	8	2
8	3	24	20	8	6	4
8	4	32	28	8	8	4
8	5	40	38	8	10	2

Note that in the above illustration $MR = MC$ condition is satisfied both at output level of 2 units and the output level of 4 units. But the second condition, MC becomes greater than MR , is satisfied only at 4 units of output. Therefore, equilibrium output level is attained at 4 units.

Table: 3.5 Equilibrium at Lowering Prices

Price Per Unit	Output	Total Revenue	Total Cost	Marginal Revenue	Marginal Cost	Profits
8	1	8	5	8	6	3
7	2	14	8	6	5	6
6	3	18	12	4	4	6
5	4	20	15	2	3	5
4	5	20	19	0	5	1

In this illustration the two conditions of equilibrium are satisfied at 3 units of output. MC equals MR and MC is greater than MR when more output is produced. The producer is in equilibrium when he produces 3 units of output.

When a producer can sell more only by lowering the price, the MR curve is downward sloping. The typical MC curve is U-shaped.

ECONOMIES AND DISECONOMIES OF SCALE

The term economies of scale denotes saving in cost of production with an increase in the scale of output or the size of the plant. It should be noted that the existence of economies does not mean a reduction in total cost in absolute terms. It only means a reduction in relative terms and manifests itself in a reduction in average cost of output. Similarly, the term diseconomies refer to an increase in average cost of output when the plant size is increased.

Economies and Diseconomies of Scale are broadly divided into two categories;

- Internal economies and diseconomies of scale
- External economies and diseconomies of scale

Internal economies and diseconomies of scale are those economies which occur due to endogenous (or internal) causes. For example, in case of a firm, internal economies and diseconomies arise on account of some actions of the firm itself.

In contrast, external economies and diseconomies of scale are the result of some exogenous or external causes which are not directly connected with the activities of the firm.

The sources of economies and diseconomies are obviously the causes on account of which they come into existence. These sources can be many and are most likely to vary from one situation to another as also from firm to firm and industry to industry. For this reason, it is possible to classify them in a large variety of groups.

Economies of Scale: Internal

Internal economies of scale are associated with the expansion of the scale of output of the firm; they are derived indirectly as a result of expansion of the industry to which it belongs. Listed below are some of the leading sources of such economies.

Managerial Economies: These economies arise on account of the scope of employing better qualified and trained managers and other employees who are able to take quicker and more profitable decisions. In addition,

management experts are exploring new methods of improving the management of the firm and reducing its cost of operations.

Financial Economies: It is a common knowledge that most firms have to depend upon borrowed funds. The lenders, while deciding the rate of interest to be charged on their loans, give due importance to the 'creditworthiness' of the borrower. And other things being equal, bigger firms enjoy greater creditworthiness than the smaller one. Accordingly, they are able to borrow funds at lower interest rates. For the same reason, they have also the option of raising additional sources through equity capital.

Technical Economies: With an increase in the scale of output, the choice of inputs and their varieties becomes wider for the firm. It can go in for those machines and equipment etc. which have a higher marginal productivity as compared with their cost. In other words, it is possible to get a larger output per unit of cost incurred on them.

Bye-Products: An increase in the scale of output also generates bigger flows of wastes. When the scale is small, the firm is not able to use these products for additional earnings. However, when the generation of waste crosses a critical limit, it often becomes possible for the firm to produce certain bye-products or sell off the waste to other firms and thus add to its income.

Better Utilization of Inputs: Various inputs, particularly machines and equipment are lumpy and indivisible. They also require time intervals for 'maintenance' and 'servicing' etc. Any one of them can go out of order and require repairs. If a machine goes out of order, or is otherwise not able to operate, then a firm with a small scale is not able to find its substitute and its production suffers. For example, if a transport company has only one truck and that needs some repair, its employees are left unemployed for the time being, though the firm has to pay them all the while. In contrast, a firm with a bigger scale is able to adjust the availability of its machinery, equipment and employees etc. in such a manner that the 'downtime' of various inputs is adequately taken care of.

Economies of Inventories: A bigger-size firm is in a better position to adjust its stocks of inputs and finished products etc. in such a manner that the normal discrepancy between flows of production and sales are ironed out.

Marketing Economies: A large firm also reaps the advantages of buying and selling in bulk. As a result, it is able to procure its inputs at concessional prices. Similarly, on account of bulk selling, its average selling costs come down. It can also have separate sales and marketing departments which can undertake the job of marketing its product in a professional manner. In addition, its sheer size imparts it better bargaining strength.

Advertising: When a firm is not operating under conditions of perfect competition, it is obliged to undertake various activities to promote its sales of which advertising happens to be an integral part. It is found that a small firm is not able to afford advertising because it has to be repetitive to be successful. Moreover, with an increase in the advertising budget, a firm is able to diversify its programme so as to cover more effective media and in an optimum proportion. As a result, its per unit advertising expenses come down.

Risk Economies: A large firm can diversify its product lines and thereby reduce the average risk faced by it since all product lines are not likely to generate losses simultaneously. The firm can compensate its losses from some lines with profits from the others. A large firm has also better command over resources compared with a small firm.

Economies of Scale: External

These economies are those which are reaped by a firm not on account of its own efforts and increase in its scale but on account of the expansion and growth of the industry to which it belongs and also on account of overall development of the economy and markets.

Some of the major sources of these economies are as under:

Economies of Information: Availability of information is cheaper when we consider the industry as a whole. A firm requires continuous information regarding the prices of inputs and its product, as also likely changes in them on account of shifts in government policies and other developments. If the industry as a whole sets up facilities for providing information through various means of communication, it is much cheaper, than if it is done by the firm alone. As a result, when the authorities or the industry as a whole provides means of information, it becomes economical for the firm to use the same sets up.

Research and Development: The results of research undertaken by the authorities or by the industry as a whole are economical for the firm to use. Also, it is generally commercially viable for a research organisation to undertake research on its own and sell the findings to individual firms on payment basis than for the firms to undertake the same individually.

Economies of Concentration: When an industry is concentrated in a certain locality or region, its firms get incidental saving in costs in the form of cheaper and more reliable services. These services cover, for example, repairs, consultancy, banking, credit, insurance, financial advice, packing, transport, housing, communication, , training, housing, health care, and so on. An individual firm is able to make use of these services at competitive and economical prices.

Economies of Specialization: When a number of associated and interlinked industries get located in the neighborhood, they all provide support to each other and their costs come down. As a result, the individual firms also benefit from this development.

Diseconomies of Scale: Internal

In the long run, a number of factors may cause an addition to average cost of a firm. These sources of diseconomies are directly or indirectly linked to the inability of the problems of management which not only crop up when a firm is started, but keep increasing with its size Chamberlin terms them 'Complexities of Management'. Briefly these are as follows:

Limits of Entrepreneurship: A firm, by definition, can have only one unit of entrepreneurship though it can have a large number of units of every other input. Moreover, entrepreneurship, in the ultimate analysis, manifests itself in the form of decision-making human beings who have to bear the consequences of their decisions. Therefore, the willingness to take risk varies between individual entrepreneurs and between different situations. Very frequently, wrong or sub-optimal decisions are taken which result in avoidable costs.

Similarly, with an increase in the size of the firm and its activities and departments, the entrepreneurship has to institute a system of delegating responsibility of assessing the ever-changing situation and taking on the spot decisions. It has also to set up an effective monitoring system. All this adds to the operating costs of the firm. In addition, it is found that on account of increase in the size of the firm, a number of additional departments may become necessary (such as a department which maintains leave accounts of the staff). As the administrative set up expands, delays set in and a number of avoidable expenses have to be undertaken.

Managerial Autonomy: With increasing size of the firm, various managerial wings (such as technical, financial, sales, marketing and others) have to be given sufficient autonomy of decision-making. The managers heading these departments, however, do not have a direct personal stake in the success of the firm. In addition, problems of coordination between various departments of the firm have to be tackled. The net result is often diseconomies of scale.

X-inefficiency: It is argued that the traditional theory is wrong in assuming that a firm always uses its resources in the best possible manner. This is because, in practice, most of the ground level decisions are taken by individual managers and other employees of the firm. And their motivation is advancement of their own careers rather than optimizing the performance of the firm. Quite frequently, they also lack adequate incentive to do their best. Unless there is a very sound system of 'reward and punishment' for each employee, their performance is likely to lack necessary motivation.

Diseconomies of Scale: External

As in the case of external economies, external diseconomies of scale are thrust upon a firm by extraneous forces. They are not directly related to the growth in the size of the firm under consideration.

There are several reasons for the prices of inputs to move up or their quality to deteriorate. For example, the authorities may impose a tax on one or more inputs. Or there may be a wage revision in the industry or imposed by the authorities on the economy as a whole.

Similarly, it is also possible that prices of some imported inputs may go up because of one or more reasons including for example, customs duties imposed by the domestic government or by the exporting country or increase in cost of production abroad, etc.

It is possible that on account of war, strikes, some natural calamity, or quantitative restrictions imposed by domestic country or a foreign country, the availability of an essential input may become costlier or insufficient.

LESSON ROUND UP

- Production is an important economic activity. Satisfaction of human wants is the objective of production using factors of production namely; Land, Labour, Capital and Entrepreneurship.
- Theory of production basically determines, how the producer, given the state of technology combines various inputs economically to produce a definite amount of output in an efficient manner
- The functional relationship between input and output is known as Production Function.
- The law of variable proportion shows the production function with one input factor variable while keeping the other input factors constant. It is a short run concept. The law of variable proportion is the modern approach to the 'Law of Diminishing Returns (or The Laws of Returns).
- Law of Returns to Scale is a long run concept. In the long run, all factors of production become variable as the firm is able to alter its stock of inputs. When all factors are changed in some proportion, the behaviour of output is analyzed with the help of laws of returns to scale. A return to scale is the rate at which the output increases with the increase in all inputs proportionately.
- Costs are nothing but input prices. The relationship between cost and output is called cost function.
- There are two types of cost functions:
 - Short Run Costs
 - Long Run Costs
- In short run, since some of the factors of production are fixed and other may vary; similarly, there are two categories of costs in short run: Fixed cost and Variable cost.
- The term long run is defined as that length of time over which the firm gets an opportunity to vary if need be the quantities of all its inputs. In other words, there are no fixed factors in the long run and therefore there are no fixed costs.
- Revenue or receipts of a firm are derived from the sale of its output. There are three concepts of revenue theory namely;
 - Total Revenue

- Average Revenue
- Marginal Revenue
- Producer’s equilibrium refers to the level of output of a commodity that gives the maximum profit to the producer of that commodity. There are two approaches to arrive at producer’s equilibrium.
 - TR-TC Approach
 - MR-MC Approach
- There are economies of scale to production process which is saving in cost of production with an increase in the scale of output or the size of the plant. The term diseconomies refer to an increase in average cost of output when the plant size is increased.
- The sources of economies and diseconomies are obviously the causes on account of which they come into existence.

GLOSSARY

Production	The activity which adapts natural resources to make goods and services.
Land	All free gifts of nature and natural resources are included in land as factor of production.
Labour	All human resource whether involved physically or in mental capacities.
Capital	All man made; non labour and non natural resources are considered as capital in production process. This is the part of the resources that are not consumed currently and are set aside for investment.
Short Run	The period in which firm is unable to alter its factors of production. Thus, some of the inputs are fixed.
Long Run	The period in which firm is able to alter its factors of production. Thus, all the inputs in long run are variable.
Total Fixed Costs	The cost incurred on the fixed factors. That portion of total cost which is invariant with respect to variation in output levels.
Total Variable Costs	The cost incurred on the variable factors, raw materials, etc. This cost varies as the level of output produced varies.
Average Fixed costs	Total fixed cost divided by output.
Average Variable Costs	Total variable cost divided by output.
Total Cost	The sum total of total fixed and total variable costs.
Average Cost	The sum total of average fixed and average variable costs.
Short Run Marginal Cost	Addition to total cost divided by the addition to total output. This may also be given by the addition to total variable cost divided by the addition to total output.

Lesson 4

Forms of Market and its Equilibrium

LESSON OUTLINE

- Market Forms – Meaning and Characteristics
- Perfect Competition
- Equilibrium of the Firm
- Equilibrium of Industry
- Monopoly
- Equilibrium
- Monopolistic Competition
- Equilibrium
- Comparison between Perfect Competition, Monopoly and Monopolistic competition
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

There are a variety of markets ranging from perfect competition to monopoly to monopolistic competition. The equilibrium of these types of market arrives at different conditions which are based on the revenues earned and costs incurred. Broadly speaking, the market forces of demand and supply determines the equilibrium. This in lieu helps in deriving the price and output level of the firm and industry separately.

Out of all the various types of market, we study perfect competition, monopoly and monopolistic competition. There are various distinguishing features among these and several common characteristics as well.

This lesson of the study examines a broad range of markets and explains how the pricing and output decisions of the firm depend upon the different type of market structure.

Market is any area over which buyers and sellers are in close touch with one another, either directly or through dealers, that the price obtainable in one part of the market affects the prices paid in other parts.

Benham

MARKET FORMS – MEANING AND CHARACTERISTICS

The concept of a market is central to the understanding of the determination of price and quantity of output of a commodity under consideration. In ordinary language, the term market refers to a public place in which goods and services are bought and sold. In economics, it has a different meaning. Different economists have tried to define market in different ways.

Cournot defines market as, “not any particular market place in which things are bought and sold, but the whole of any region in which buyers and sellers are in such free intercourse with each other that the prices of the same goods tend to equality easily and quickly”.

To Ely, “Market means the general field within which, the force determining the price of particular product operate”.

Stonier and Hague explain the term market as “any organisation whereby buyers and sellers of a good are kept in close touch with each other”.

Thus a market has the following basic components.

- BUYERS: There should be buyers of the product. If a country consists of people who are very poor, there can hardly be market for luxuries like cars, VCR etc.
- SELLER: A commodity should be offered for sale in the market. Otherwise there is no question of buying the commodity. Therefore, existence of sellers is a necessity for any market.
- CONTACT: Buyers and sellers should have close contact with each other.
- PRICE: There should be a price for the commodity. The exchange of commodities between buyers and sellers occurs at a particular price which is mutually agreeable to both the buyers and sellers.

This is because, in a modern economy, most of the production does not take place for self-consumption by the producers themselves. Thus, by the term market of a good, it should not be taken to mean a place where the buyers and sellers meet each other and conduct purchase and sale transactions. The market consists of two components;

- A Firm
- An Industry

A FIRM

A firm is a business unit engaged in the task of producing and selling of goods or services. It is identified by the fact that it is only one unit of entrepreneurship. The entrepreneurship may not be provided by a single individual. It may be exercised jointly by a board or a group of individuals in some defined manner. However, the firm has a unified and coordinated authority of decision making. In essence, these decisions relate to the objectives (such as, profit maximisation, or sales maximisation, etc.) and other policy decisions (such as, what to produce) of the business unit.

AN INDUSTRY

An industry is a set of firms which are conceptually closely associated in the sense of having some common type(s) of activities. A good example of an industry is a set of firms which are producing a certain type of a manufactured good or providing a certain type of service. The good supplied by the firms of the industry may be homogenous in the sense that the buyers believe that products of all firms are perfect substitutes of each other.

A consignment of the good, by itself, does not provide the identity of the supplier. The buyers, therefore, are indifferent between the sources of supply. Instead, they select between alternative supplier firms by comparing the prices being asked by them. In contrast, the industry may also comprise those firms which are producing differentiated products. This means that the product of one firm can be distinguished from that of the other. The buyers do not consider the products of different firms as perfect substitutes. However, if the firms are to belong to one industry, then their products must be close substitutes of each other.

There is no pre-determined number of firms which an industry must have. Their number can vary according to the structure of the market. At one extreme, it may have only one firm in which case it is called a monopoly or a one-firm industry. At the other extreme, an industry may have such a large number of firms that each of them accounts for an extremely small portion of the total supply of the industry and is not able to influence the price of the product. Between these two extremes, there can be several other possibilities.

There are various kinds of markets prevailing in the economy. From the point of view of syllabus the following are covered.

- PERFECT COMPETITION
- MONOPOLY
- MONOPOLISTIC COMPETITION

PERFECT COMPETITION

Perfect Competition in economic theory has a meaning diametrically opposite to the everyday use of the term. In practice, businessmen use the word competition as synonymous to rivalry. In theory, Perfect Competition implies no rivalry among firms. Perfect Competition, therefore, can be defined as a market structure characterized by complete absence of rivalry among the individual firms. That is to say perfect competition is a market structure where there is a perfect degree of competition and single price prevails.

Perfect Competition Market is a hypothetical market structure where in every seller takes the market prices as the price of his own product, firms are incapable of influencing the market price either by acting singly or in a group.

Main Features

- (i) *Homogeneous Product*: In a perfect competition, it is not possible to distinguish between the products of individual firms. There are no distinctive features of the product associated with any specific firm. The product, in that sense, is homogeneous and undifferentiated. To the buyer, product supplied by one firm is a perfect substitute of that supplied by another.
- (ii) *Large Number of Sellers*: Perfect competition is characterized by a large number of firms. Here, the term large denotes the fact that no individual firm is in a position to significantly influence the total supply of the industry and thereby affects the price of the product. Every firm in the industry is thus, a price taker. It can sell any quantity of its own product at the going price. For it, the demand for its product is perfectly elastic. It, of course, must be remembered that the maximum quantity, which this firm can supply, is insignificantly small when viewed in relation to the aggregate supply of the industry as a whole.
- (iii) *Large Number of Buyer*: Perfect competition is also characterized by a large number of buyers who are in competition with each other for the available supply. Their number is so large that any single buyer may change the quantity purchased without significantly affecting the total demand in the market and affecting the price of the product. Like an individual firm, an individual buyer is also a price taker. He can buy any quantity of the product he likes at going price. To him, the product has perfect elasticity of supply.

- (iv) *Full Knowledge of Market:* It is assumed that in perfect competition, every buyer and seller has full knowledge of the prevailing price of the product, as also the prices being asked by the sellers and being offered by the buyers. This 'perfect knowledge' enables every buyer and seller to make use of any opportunity that may exist to strike a better bargain.
- (v) *Economic Rationality:* Economic rationality is another feature of perfect competition. It means that every buyer and seller is motivated by his own economic interest in his decisions to buy or sell. This, coupled with the assumption of perfect knowledge, ensures that a uniform price prevails in the market.
- (vi) *No Transportation Cost:* It is assumed that there is no transaction cost to be incurred by buyers and sellers in their activities. The price paid by a buyer is exactly equal to the price received by the seller. There is no resource cost in terms of time or other expenses to be incurred i.e. there are no transaction costs. In particular, a seller has no need to incur any selling expenses (say, in the form of advertisements) because his product is not differentiated from the products supplied by other sellers.
- (vii) *Free Entry and Exit:* Perfect competition is also characterized by free entry and exit. Basically, the terms *entry* and *exit* apply to the suppliers, though their coverage can be extended to buyers also. It means that, given enough time, any existing firm can close down and leave the industry or any new firm can enter the industry. There is no legal, institutional, or technical hurdle in doing so. It is only estimated economic benefits or losses that guide the firms in these decisions. Similarly, any existing buyer of the product can increase his purchases, cut them or reduce them to zero. New buyers can also enter the market and offer to buy any quantity they like.

EQUILIBRIUM OF THE FIRM UNDER PERFECT COMPETITION

Under perfect competition, the firms are unable to alter the price of the product by changing the quantity of its own output. The prices of the input are given; therefore, cost conditions are also given. In other words, under perfect competition, it can only decide to alter the quantity of its output without changing price of the product.

A firm is said to be in equilibrium when its profits are maximum, which in lieu depends on the cost and revenue conditions of the firm. The concepts of cost and revenue vary in short run and long run. Thus a competitive firm has four equilibrium states differing on the basis of period of operation as follows:

- Short Run equilibrium of a Competitive Firm
- Long Run equilibrium of a Competitive Firm
- Short Run equilibrium of a Competitive Industry
- Long Run equilibrium of a Competitive Industry

Short Run Equilibrium of a Competitive Firm

Under the short run period, the following are the major assumptions;

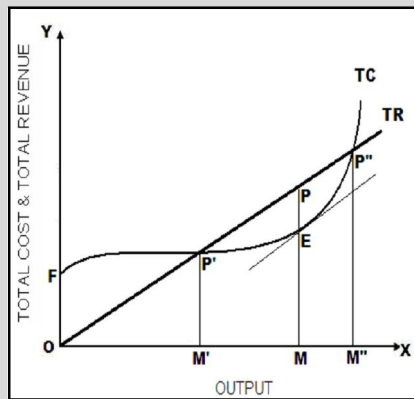
- Price of product is given in the market at which a firm can sell any quantity
- Plant size of firm is given (constant)
- Firm is facing given short run cost curves

The equilibrium conditions in such a case are similar as stated in previous unit. There are two approaches to deriving the maximum profit i.e. $\pi = TR$ less TC or at a point where MR equates MC .

Since a perfectly competitive firm is a price taker, it is faced with a straight line demand curve i.e. AR is parallel to X axis as its Marginal Revenue (MR). It can also be seen that, given the assumption of profit maximisation by

the firm, it will be in equilibrium when there is no scope for either increasing its profit income or reducing its loss by changing the quantity of output. It cannot improve its economic position by changing the output.

Fig. 4.1: Equilibrium of a Firm using TR and TC Curves



In the Fig. 4.1, X axis shows levels of output and Y axis shows costs and revenues.

TR is Total Revenue Curve

TC is Total Cost Curve

P is Equilibrium Point, where the distance between TR and TC is maximum

A general case of this equilibrium of the firm, in the short run and under perfect competition, is illustrated in Fig 4.1.

The equilibrium point is attained when,

$$\pi = TR - TC$$

is maximum; where $TR = P \times Q$ (P is given as constant) and TC is total cost.

Therefore, in short run since prices are given, the TR curve is a straight line through the origin O as shown in the figure. Its slope is positive and equal to the price of the product and Average Revenue (AR). In the short run, a firm has to incur both fixed and variable costs. Fixed costs are there even when the output is reduced to zero. As a result, total cost (TC) curve starts from Y-axis at a positive distance from origin O. Assuming that fixed costs are OF, the TC curve starts from point F on the Y-axis. The short run average cost curve (SAC) is U-Shaped. The total cost curve in the figure is represented by TC.

Before point P',	TC > TR	⇒ Total Loss
From P' to P'',	TC < TR	⇒ Normal Profit
At P,	PE	⇒ Maximum Profit
After P'',	TC > TR	⇒ Total Loss

Thus, OM is the equilibrium output of the firm in the short run under perfect competition. At any other output, its total profit is less than PE. It is also noted that if the output is reduced to OM' or increased to OM'', the profit of the firm is reduced to zero. Further, for output less than OM' or greater than OM'', TC exceeds TR and results in a loss for the firm.

The conditions of profit maximisation (or loss minimization) can be translated into what are known as marginal conditions. Thus profit,

$$\pi = TR - TC \text{ is maximized if}$$

- its first derivative is zero
- second derivative is negative

Differentiating $\pi = TR - TC$ with respect to Q;

$$d\pi = dTR/dQ - dTC/dQ$$

$$\Rightarrow d\pi/dQ = 0$$

$$\Rightarrow \frac{dTR}{dQ} - \frac{dTC}{dQ} = 0$$

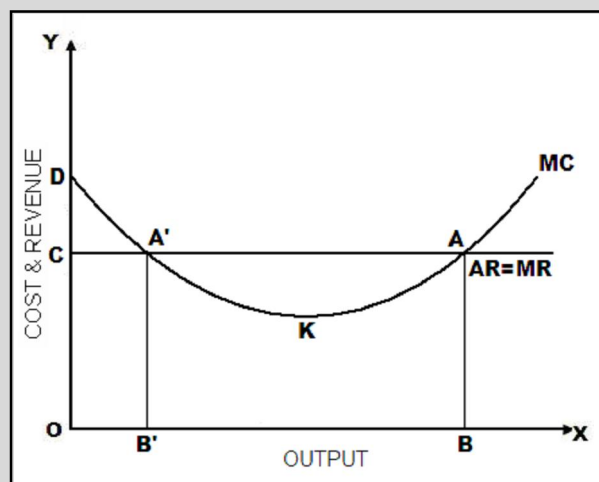
$$\Rightarrow \frac{dTR}{dQ} = \frac{dTC}{dQ}$$

$MC = MR$; this is the first marginal condition.

$\frac{d^2\pi}{dQ^2} < 0$; this is the second marginal condition.

Graphically, this condition states that for equilibrium of the firm, MC curve should intersect MR curve from below and, after intersection, lie above MR curve. If we translate this condition in ordinary words, it means the following. The firm should keep on adding to its output as long as $MR > MC$ because additional output adds more to its revenue than to its cost and thus its profit income increases. Furthermore, if its MC is equal to MR but the firm finds that by adding to its output, MC becomes smaller than MR, then the firm should decide to increase its output.

Fig. 4.2 : Equilibrium of a Firm using MC and MR Curves



On account of perfect competition, the demand for the product of the firm is perfectly elastic. The firm can sell all its output at the going price in the market. Accordingly, its demand curve (AR curve) runs parallel to X-axis throughout its length and its MR curve coincides with AR curve.

As regards the supply side, we should recall the set of four cost curves of the firm, namely, the AFC, the AVC, the MC and the ATC. Out of these, the supply curve of the firm is that portion of the MC curve which lies above AVC curve and is upward sloping. The actual equilibrium of the firm is determined by the intersection of its supply and demand curves. An explanation of this phenomenon is provided below.

To begin with we note that, in the short run, the firm cannot avoid fixed costs. They have to be incurred even if production is reduced to zero. However, the variable costs are directly related to the quantity of output. The implication is that, in the short run, the firm cannot avoid losses by not producing. Therefore, it decides to continue production even at a loss, provided the loss does not exceed its fixed costs. It means that the firm would decide to produce if its average price (that is, per unit price of the good) equals or exceeds its AVC.

On account of the law of variable proportions, the average variable cost curve is U-shaped. Let us also recall that marginal cost represents a change in the total cost so that it is related only to the variable costs and not fixed costs. And since AVC curve is U-shaped, MC curve is also U-shaped. It lies below AVC curve when the latter is

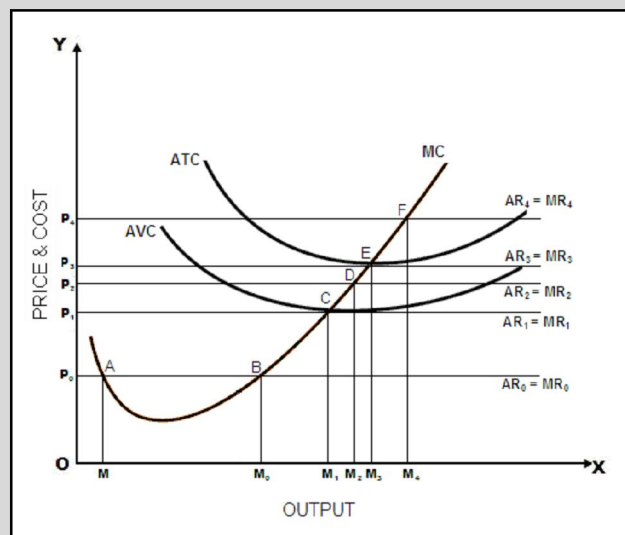
downward sloping. However, MC curve starts rising when the rate of fall in AVC curves slows down, intersects it at its lowest point, and rises above it.

We have also seen above that a firm attains its best possible position (that is, the position of maximum profit or minimum loss) when its MC curve cuts its MR curve from below. At the same time, price per unit of the product must be able to recover at least the average variable cost. When the price exceeds AVC, the firm is able to recover a part of its fixed costs also with a resultant reduction in its losses. In case the price equals the average of total cost, the firm is able to recover its full costs (including the component of 'normal profit'). And if the price is still higher, it earns an abnormal profit.

Thus, in determination of short term equilibrium of the firm, two conditions should be satisfied:

- MC must equal MR and cut it from below
- AR must equal or exceed AVC

Fig. 4.3 : Equilibrium of a Competitive Firm in Short Run



In Fig 4.3, we consider five different prices to illustrate the supply behaviour and associated equilibrium of the firm. There is an average revenue curve corresponding to each price. It runs parallel to X-axis and the MR curve also coincides with it.

1. When the price is OP_0 , the corresponding MR_0 curve cuts MC curve at two points, A and B. At point A, none of the above-stated two conditions of equilibrium is satisfied. At point B, MC curve cuts MR_0 curve from below but the second condition is not satisfied. AR is still less than AVC. Therefore, the firm incurs a loss greater than its fixed cost if it decides to produce when the price is OP_0 . The firm, therefore, decides to close down but it cannot leave the industry.
2. If the price happens to be higher and equal to OP_1 (that is, equal to the least possible average variable cost), the firm decides to produce. In this case, not only MC curve cuts MR_1 curve from below (a point C); AR_1 is also equal to AVC. Thus, we find that either the firm does not produce at all, or it produces at least equal to OM_1 .
3. In the third case, price (OP_2) exceeds AVC but is still less than ATC. MR_2 and MC curves intersect each other at point D. The firm produces OM_2 . It still incurs a loss but less than its fixed costs because it is able to recover a portion of the latter.
4. In case the price rises to OP_3 , the firm is able to recover its full cost including fixed costs. Its MC curve cuts MR_3 curve from below at point E and $AR_3 = ATC$. All the conditions of its equilibrium are satisfied. It produces OM_3 .

5. If the price rises even further, say, P_4 , the point of intersection of MR_4 and MC curves moves to F . The firm is able to recover not only its total cost but is able to earn an abnormal profit also. It produces OM_4 .

It should be noted from above that in the short run, existing firms can close down but they cannot leave the industry and new ones cannot enter it. Therefore, when our firm is incurring a loss, it continues production so long, its' loses do not exceed fixed costs. Similarly, if it earns an abnormal profit, they are not wiped out by new firms entering the industry.

Long Run Equilibrium of a Competitive Firm

Long term is defined as that period in which the firm has the opportunity of varying all its inputs. There are no fixed costs and therefore average fixed cost curve vanishes. The average cost (AC) curve denotes average total cost (ATC) curve. More precisely, in the long run the firm can decide to go in for any of the alternative plants of different scales.

We have seen earlier that in the long run, the average cost (AC or LRAC) curve of the firm formed by its short run average cost curves (that is, plant curves) is also U-shaped. Up to a certain scale, there are increasing returns and LRAC curve slopes downwards. This is followed by the phase of constant returns in which LRAC curve is neither rising nor falling. And the third phase is that of diminishing returns to scale in which LRAC curve slopes upwards. We have also seen that corresponding to the U-shaped LRAC curve, long term marginal cost (LRMC) curve is also U-shaped and that it cuts LRAC from below at the lowest point of the latter.

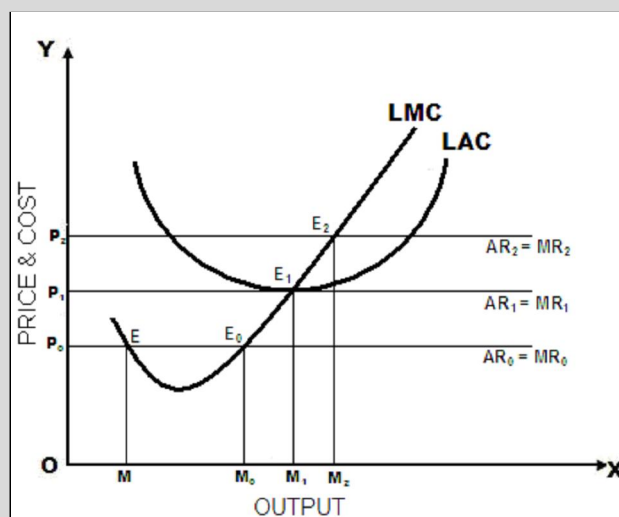
Since the firm can vary all its inputs in the long run, it follows that it has the option to close down and leave the industry. Similarly, new firms can also enter the industry. This condition, termed 'free entry and exit of firms' has two implications.

- The firm is not compelled to operate when incurring a loss. It can leave the industry.
- No firm is able to earn an abnormal profit (that is, a profit in excess of the 'normal'one). It can only earn 'normal profit' which forms a part of its costs and is incorporated in its LRAC curve. This happens because abnormal profit earned by existing firms attracts new firms. And as they enter the industry, supply increases, price comes down and abnormal profit is wiped out.

At this stage, let us specifically note that two conditions have to be satisfied for the firm to be in state of long run equilibrium.

- MC curve must intersect MR curve from below
- $AR \geq AC$, so that the firm does not incur a loss and close down. In practice, however, on account of free entry and exit of firms, AR cannot exceed AC and is equal to the latter

Fig. 4.4: Long Run Equilibrium of a Competitive Firm



Determination of long run equilibrium of the firm under perfect competition is explained in Fig. 4.4 in which output is measured along X-axis and costs are measured along Y-axis. The firm is a price taker. For it the price of its product is given and fixed. It can sell any quantity it can produce at the going price. Its AR curve runs parallel to X-axis and MR curve coincides with it.

For the purpose of explaining the determination of firm's equilibrium, we are considering three alternative prices given to the firm by the industry.

1. Let us assume that the price in the market is below the optimum cost of the firm, say, OP_0 from which we get corresponding average revenue (AR_0) and marginal revenue (MR_0) curves. Now MR_0 curve cuts LMC curve at two points, E and E_0 , but none of these is a long term equilibrium position of the firm. At point E, LMC curve cuts MR_0 curve from above. At E_0 , LMC curve cuts MR_0 curve from below, but the second condition of equilibrium is not satisfied. $AR_0 < LAC$ and the firm incurs a loss.
2. Similarly, if the price of the firm's product is more than the optimum cost (least possible average cost) of the firm, the firm cannot be in stable equilibrium (even though both conditions of equilibrium are satisfied). Thus, let the price be OP_2 with average revenue curve (AR_2) and marginal revenue curve (MR_2). LMC curve is intersecting MR_2 curve from below at point E_2 and $AR_2 > LAC$. But the firm is not allowed to enjoy the abnormal profit. New firm enters the industry, supply increases and price falls till no firm can earn abnormal profit.
3. Long run stable equilibrium of the firm is attained at a point where when price of the product is equal to its optimum cost of production. In Fig. 4.5, this equilibrium price is OP_1 . In this case, marginal revenue curve (MR_1) cuts LMC curve from below at lowest point of LAC (E_1). At the same time, AR_1 is equal to LAC, so that the firm does not incur a loss or earn an abnormal profit. At this stage, there is no incentive for existing firms to leave the industry or new ones to join it. The corresponding equilibrium output is OM_1 .

In conclusion, we may also note that in long run equilibrium, the firm produces an 'optimum' output at the least possible average cost. It is this position where the firm is operating under 'constant returns' to scale. Consequently, its $MC = AC$. At the same time, $MC = MR$ and $AR = AC$, so that we get $AC = AR = MC = MR$

EQUILIBRIUM OF INDUSTRY UNDER PERFECT COMPETITION

An industry comprises all the firms which are producing goods which the buyers consider substitutes of each other. As such the determination of price of such a product is the result of interaction between total demand for the output of all the firms taken together and their supply.

On the demand side, the important fact to be noted is that a change in its supply affects the price of the product also. The industry is not a price taker. Though the contribution of an individual firm in total supply is so insignificant that it cannot make any noticeable difference to the price of the product, this is not so with the industry. The change in supply made by the firms taken together alters the aggregate supply to such an extent that it cannot sell more without lowering the price. This results in a downward sloping demand curve for the industry.

The fact of a negatively sloped demand curve for the industry can also be understood as follows. A firm can sell more of its output by attracting customers from its competing firms. In the process, the total sales of the industry need not increase. But an industry can sell more when the existing buyers buy more of its product and/or new buyers enter the market and buy its product. Now it follows that existing buyers are already equating their marginal utility with the price. They would buy more only if price falls. Similarly, for the new buyers, the existing price is higher than the marginal utility of the product. And, therefore, they would also buy more of the good only if the price is reduced. Accordingly, the demand curve for the product of the firm must have a negative slope indicating that more of the product can be sold only by reducing its price.

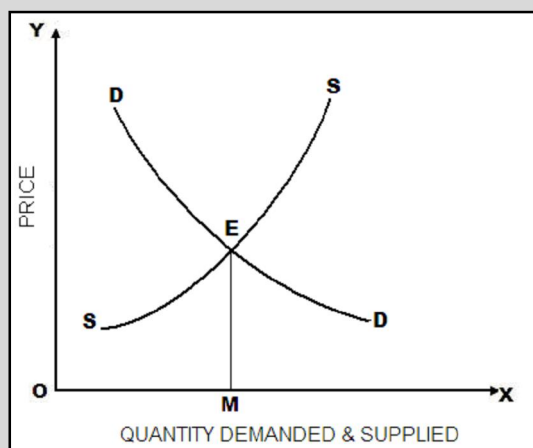
The exact location and slope of the demand curve varies from product to product and also for the same product from one time interval to the other. There can also be several reasons on account of which its demand curve

may shift in its slope and location. However, there is no theoretical basis for predicting these changes. Therefore, even while recognising that demand curve for a product can and often does shift over time, the economists assume that it retains its position when we move from short term to long term. In other words, demand curve for the industry is always drawn with a negative slope without specifically providing for a change in either its exact slope or its exact location.

Short Run Equilibrium of a Competitive Industry

We have noted above that when an industry changes the quantity of its supply, there is a corresponding change in the price of its product also. It follows, therefore, that when it is in equilibrium, there is no tendency on its part to change the quantity of its output. We also know that the price of the industry's product is determined by intersection of its demand and supply curves. Having seen the nature of industry's demand curve, we may look into the nature of its supply curve which is obviously the summation of individual supply curves of the firms constituting it. That is to say, we get the industry's supply curve by adding the quantities which its firms are ready to sell at alternative prices. Since the supply curve of a firm, in the short run, is that upward sloping portion of its marginal cost curve which lies above its average variable cost curve, therefore, the supply curve of the industry also is upward sloping.

Fig. 4.5 : Short Run Equilibrium of a Competitive Industry



In fig 4.4, DD is demand curve and SS is supply curve. The intersection of both curves at E is the equilibrium of a competitive industry.

Short term equilibrium of the industry, which is determined by the intersection of its demand and supply curves, is illustrated in Fig. 4.5, in which quantities demanded and supplied are measured along X-axis and price per unit is measured along Y-axis. While the demand curve is downward sloping, the supply curve has a positive slope. In Fig. 4.5, short term demand and supply curves of the industry intersect at point E. The equilibrium price and output of the industry are, therefore, EM And OM respectively. It is noteworthy that in case the industry happens to be in a non-equilibrium position, it automatically gets adjusted to its equilibrium position This is because, in such a case, there is either an excess of supply or an excess of demand at the existing price. In case of excess supply, the firms are left with unsold stocks which they try to dispose off by reducing price. And in case of excess demand, some customers are not able to buy the quantities they wanted to. They, therefore, bid up price in competition with each other.

Long Run Equilibrium of a Competitive Industry

The slope of the demand curve of industry remains negative even in the long run, implying that it can sell more of the product only by reducing the price and vice versa.

However, the long run supply curve of the industry cannot be derived by horizontal summation of the supply curves of the individual firms. The reason is that in the long run, existing firms can leave the industry and new

ones can join it. Moreover, it is possible that due to various reasons, the industry may suffer from some internal/external diseconomies or enjoy some economies. These factors can shift the position of the long term supply curve of the industry. Another fact which complicates the derivation of long run supply curve of the industry is that while in the short run, individual firms may incur losses or enjoy abnormal profit, in the long run, these possibilities tend to be wiped out. When the industry is in equilibrium, its individual firms are also simultaneously in such equilibrium that they neither make an abnormal profit nor incur a loss.

Thus, long run supply curve of the industry is derived by taking into account all these determining variables. It is not derived by adding those portions of the MC curves of the individual firms which lie above the AC curves of the firms. Instead it is the locus of the pairs of those points which represent quantities of its output and the least average cost at which its firms can produce it.

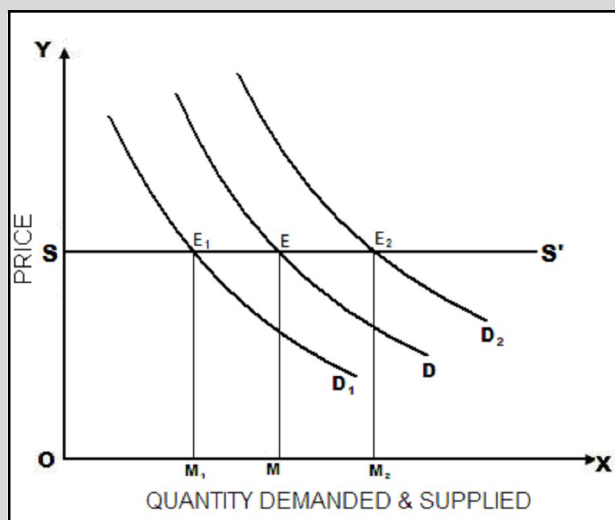
Economists believe that the factors at work in the long run may result in one of the three situations, namely, that of diminishing, constant, and increasing returns, indicating the shift in the average cost of its firms. These three cases are explained below.

REVIEW QUESTIONS



1. Homogeneous Product produced by all the firm in the Industry is one of the important feature of _____.
2. A firm which just covers its _____ of production is called shut down point.
3. Under perfect competition an industry is said to be in short-run equilibrium when the market is cleared at a price when industry demand is _____ to industry supply.

Fig. 4.6: Long Run Equilibrium of a Competitive Industry under Constant Returns



In Fig. 4.6, the supply curve of the industry is SS' and its demand curve is DD_1 . The two intersect at point E_1 with OM_1 and E_1M_1 as equilibrium output and price respectively. At the same time, all the firms of the industry are also at equilibrium such that for each firm, its $MC = MR = AC = AR$ and it operates at the least possible average cost. As a result, there is no incentive for any firm to leave the industry or enter it.

Constant Returns

In this case, the expansion of the industry does not lead to net economies or diseconomies. They are either not there or they get neutralised by each other. As a result, the average cost of the industry as a whole remains constant as it expands. Its demand curve is downward sloping and its supply curve is parallel to X axis. It means

that while the quantity demanded responds, to a limited extent, to a change in price of the product, the elasticity of supply is perfect. The industry curtails its supply to zero if the price offered is reduced even by a small margin. On the other hand, at the going price, it is ready to sell as much as the buyers are ready to buy.

In Fig. 4.6, the supply curve of the industry is SS' and its demand curve is DD_1 . The two intersect at point E_1 with OM_1 and E_1M_1 as equilibrium output and price respectively. At the same time, all the firms of the industry are also at equilibrium such that for each firm, its $MC = MR = AC = AR$ and it operates at the least possible average cost. As a result, there is no incentive for any firm to leave the industry or enter it.

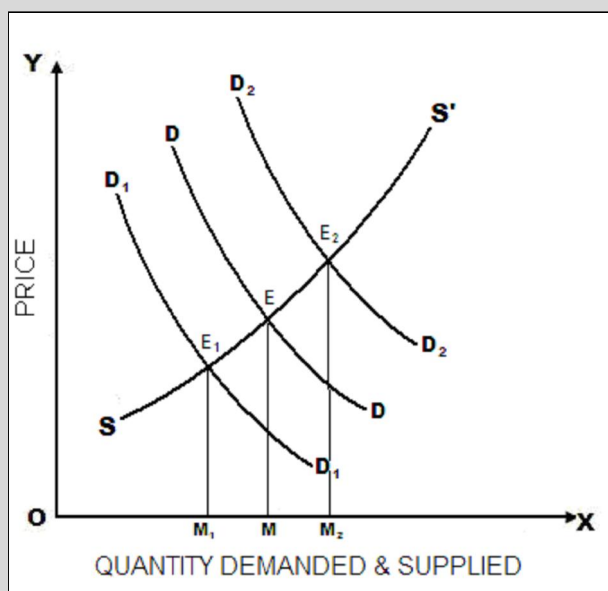
Fig. 4.6 also depicts the alternative equilibrium position if demand curve happens to be differently located. It is seen that shifting of the demand curve does not result in a change in price. It only results in a change in the quantity of supply.

Diminishing Returns

Let us assume that when existing firms of an industry expand their output, their average cost of production increases. Similarly, let us assume that if new firms enter the industry, they also face higher average product cost.

This implies that the expansion of the industry generates more diseconomies than economies and the net result is an increase in the average cost of production. The supply curve of the industry, therefore, slopes upwards and implies that the industry will be ready to sell more only if the price offered increases.

Fig. 4.7: Long Run Equilibrium of a Competitive Industry under Diminishing Returns



In Fig. 4.7, the demand and supply curves intersect at point E. The corresponding equilibrium price and supply happen to be EM and OM respectively. If there is an increase in demand so that the demand curve shifts to the position D_2D_2 , there is an increase in both price and quantity of output. In contrast, if the demand decreases and the demand curve shifts to the position D_1D_1 , there is a reduction in both price and quantity of supply.

The demand curve of the industry is downward sloping in this case also. And its equilibrium is determined by the intersection of demand and supply curves. Diagrammatic illustration of determination of this equilibrium is given in Fig. 4.7, in which the demand and supply curves intersect at point E. The corresponding equilibrium price and supply happen to be EM and OM respectively. If there is an increase in demand so that the demand curve shifts to the position D_2D_2 , there is an increase in both price and quantity of output. In contrast, if the demand decreases and the demand curve shifts to the position D_1D_1 , there is a reduction in both price and quantity of supply.

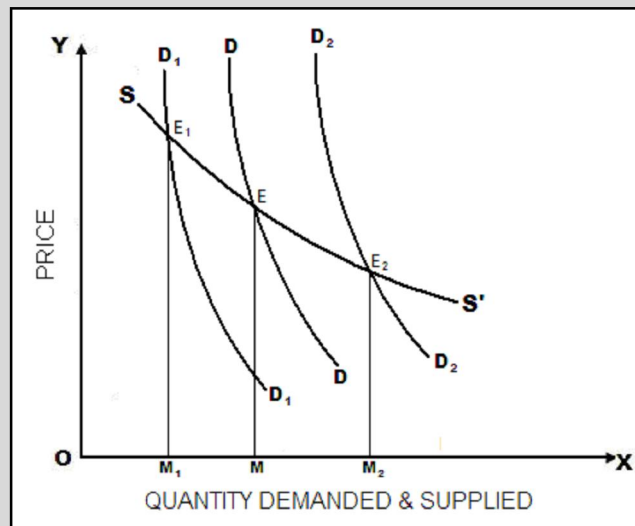
Increasing Returns

In this case, the average cost of production of the industry declines with its expansion and its supply curve has a negative slope.

Some analysts claim that the very possibility of increasing returns is ruled out in a competitive industry. They say that it is logically contradictory to maintain that an industry can have increasing returns when its firms are facing diminishing returns. The critics point out that individual firms have U-shaped average cost curves even in the long run. As a result, when existing firms expand their output, their average cost is bound to increase, at least beyond a stage. It means that when an industry expands its output beyond a certain quantity, it is bound to face an increase in average cost of production.

Marshall's answer to the critics lies in his distinction between the effect on average cost of production when the expansion takes place in the industry as a whole instead of only in an individual firm. He maintained that it is possible that when a single firm expands it faces diminishing returns, but if all the firms expand simultaneously, there are increasing returns due to several economies that arise on account of their collective expansion. In other words, even when expansion of each individual firm results in an increase in its average cost of production, an expansion by the industry as a whole can still generate a variety of economies which are internal to the industry but external to the individual firms. For example, the expansion of the industry may cause an expansion in the industries supplying its inputs. This may lead to better quality and/or lower prices of certain inputs and other services etc. The industry may also find that, with an expansion in its size, adoption of certain technologies which were hitherto too expensive becomes economical. Several new specialised and technically efficient services (such as those of transport and repair works) may become available. As a result, while an individual firm continues facing diminishing returns, for the industry as a whole average cost may fall with expansion.

Fig. 4.8: Long Run Equilibrium of a Competitive Industry under Increasing Returns



In Fig. 4.8, the supply curve of the industry SS' is negatively sloped depicting increasing returns, The demand curve, DD , is also negatively sloped, and the two intersect each other at E . It is noteworthy that for a stable equilibrium, it is necessary that after the point of intersection, demand curve lies below supply curve. It means that though the average cost of production falls with an increase in output, the price at which additional output can be sold falls still faster. In Fig. 4.8, this condition of stable equilibrium is satisfied. The industry produces an output of OM and sells it at a price of EM per unit.

It should be noted that when the industry is operating under increasing returns, an increase in the demand for its product will lead to an increase in quantity supplied but a fall in price. For example, in Fig. 4.8, with an increase in demand, the demand curve shifts from position DD to D_2D_2 , This results in a new equilibrium position represented by point E_2 and a fall in price from EM to E_2M_2). In contrast, if there is a reduction in demand, the buyers will have to pay a higher price for a smaller output. For example, if the decrease in demand shifts the demand curve from DD to D_1D_1 , output will fall from OM to OM_1 and the price will increase from EM to E_1M_1 .

MONOPOLY

The term monopoly means a single seller. In economics, this term refers to a firm the product of which has no close substitute in the market. It is, in that sense, a single firm industry.

Moreover, irrespective of the profit income of the existing producer firm, new firms cannot enter the industry. Hurdles to their entry may be on account of various reasons. There may be legal barriers, or the producer may own a technology or a naturally occurring substance which others cannot avail of. It is also possible that the size of the market may be too small and no new firm may find it economically worthwhile to enter it.

In the absence of a substitute product, the monopolist is free to fix a price of his choice. He can refuse to sell his product for a price below the one decided by him. However, he cannot determine the demand for his product. He cannot force the buyers to buy his product at a price of his choice. A buyer will buy it only if its price does not exceed its marginal utility to him.

Therefore, if the monopolist wants to increase his sales, he has to reduce the price of his product so as to induce

- existing buyers to buy more
- new buyers to enter the market

Therefore, the demand conditions for his product are not the ones which are associated with a firm under competitive conditions. Instead, the demand conditions faced by him are similar to the ones which are faced by the industry as a whole. In other words, a monopoly firm faces a negatively sloped demand curve for his product. In the long run, the demand curve can shift both in its slope and location. However, there is no theoretical basis for determining the direction and extent of this shift.

As regards his cost of production, it may be assumed that a monopoly firm faces a given technology. Moreover, the monopolist faces conditions similar to those faced by a single firm under competitive conditions. He is not the sole buyer of the inputs used by his firm, but only one in the entire market. He has no control over the prices of the inputs used by him.

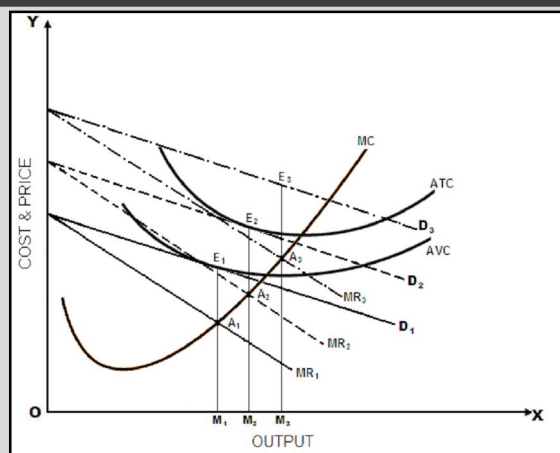
We have seen earlier that when a firm aims at maximising its profit, it attains its equilibrium when

- its MC curve cuts its MR curve from below
- its $AR > AC$

Short Run Equilibrium of a Monopolist

In the short run, by definition, the monopolist firm cannot vary all its factors of production. Its short run cost curves are similar to the ones faced by a firm operating in the short run and under perfect competition. It is also noteworthy that, in the short run, the monopolist may incur a loss but it will shut down the plant only if the loss exceeds its fixed costs. On the other hand, if the demand for its product is quite strong, it may make an extra profit.

Fig. 4.9 : Short Run Equilibrium of a Monopolist



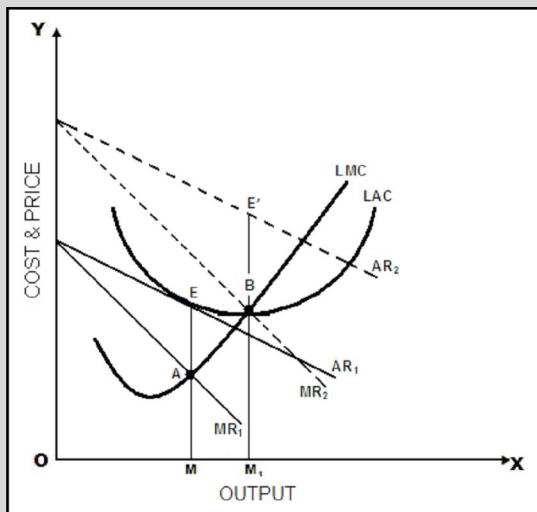
Determination of short run equilibrium of a monopoly is depicted in Fig. 4.9 with quantity of output measured along X-axis. Correspondingly, price and cost of production are measured along Y-axis. We have drawn three cost curves of the monopoly, namely, average variable cost curve, average total cost curve and marginal cost curve. Similarly, three alternative demand curves have been drawn to explain alternative possible positions of equilibrium.

1. Demand curve labeled D_1 is tangent to AVC curve at point E_1 . Its corresponding marginal cost curve MC intersects MR_1 curve from below at point A_1 . Thus, we note that while the first condition of equilibrium of the firm is satisfied, the monopolist is not able to recover his full cost of production. However, the loss which is equal to fixed costs cannot be reduced by closing down the plant. In this situation, therefore, the monopolist decides to produce OM_1 quantity of output, sell it at price E_1M_1 and suffer a loss equal to fixed costs. Note that there would be no production if the demand curve lies to the left of its position of D_1 . In that case the monopolist would have added to his losses by operating his plant. Consequently, his best option would have been to close down the plant and minimize the loss to fixed costs.
2. If the demand curve lies to the right of D_1 , the monopolist is able to recover a part of his fixed cost also. He is able to recover his full cost of production if the demand curve happens to be tangent to ATC curve (such as D_2). With D_2 as the demand curve, equilibrium position of the monopolist is given by the intersection of MC curve with MR_2 curve at A_2 which corresponds to the point of tangency (E_2) of D_2 with ATC curve. In this case not only MC curve cuts MR_2 curve from below but, at the same time, $AR = ATC$. The monopolist makes a normal profit by producing OM_2 and selling it at price E_2M_2 .
3. The monopolist may earn an abnormal profit if the demand curve lies further to the right of D_2 (such as D_3). As before, the equilibrium position of the monopolist is determined with reference to the point of intersection between MC curve and MR_3 curve at A_3 . The monopolist decides to produce OM_3 and is able to sell it at price E_3M_3 .

Long Run Equilibrium of a Monopolist

In the long run, by definition, the monopolist can vary all the inputs. Therefore, the determination of equilibrium of the firm can be analyzed with the help of only two cost curves, namely, AC and MC. Moreover, the monopolist would not stay in the market if he is to operate at a loss. By implication, therefore, the demand curve must be tangent to the AC curve or must lie to the right and intersect it twice.

Fig. 4.10 : Long Run Equilibrium of a Monopolist



In Fig. 4.10, long term AC and MC curves of the monopolist are drawn U-shaped. The reasons for their being U-shaped have been discussed earlier. As before, equilibrium of the firm is that its MC curve should cut MR curve from below and its AR should be greater than or equal to AC. In Fig. 4.10, we depict two alternative cases of the determination of equilibrium of the monopolist, namely, (i) with normal profit, and (ii) with abnormal profit. Remember that the monopolist will not operate in the long run if there is a loss.

In the first case, demand curve (AR) of the monopolist is AR_1 and it is tangent to AC or LAC curve at point E. It should be noted that if demand curve lies to the left of AC curve, the monopoly is not able to recover its AC at any output and, therefore, it closes down and leaves the market. However, when AR curve is tangent to AC curve, the monopoly is able to recover its average cost (including normal profit) and is; therefore, ready to stay in the market and produce. Further, it should be noted that, by the very nature of relationship between MR and AR on the one hand and between MC and AC on the other, (i) the perpendicular drawn from point E to X-axis, (ii) the MC curve and (iii) MR curve are concurrent (at point A). As a result, all the conditions of equilibrium of monopoly are satisfied. Thus, at point A, MC curve of the firm cuts MR curve from below. At the same time, AR is equal to AC at point E. Accordingly; the monopoly produces OM and sells it a price EM per unit which covers its average cost including normal profit.

In the second case, the monopolist is able to make an abnormal profit. Its marginal revenue curve is MR_2 which cuts its MC curve from below at point B. The corresponding height of its average revenue curve (AR_2) is $E'M_1$. Accordingly, the monopolist produces OM_1 and is able to sell it at $E'M_1$ per unit with an extra profit of $E'B$ per unit. Moreover, this extra profit is not competed away because there is no substitute good in the market and no new firm can enter the market and produce it.

Discriminating Monopoly

Since a monopolist can fix the price of his product, it is possible that he may find it profitable not to charge a uniform price for his entire output but sell it at varying prices. The term used to denote this phenomenon is 'price discrimination' and the monopoly practicing it known as 'discriminating monopoly'. Thus, price discrimination is the absence of a policy of uniform price for the entire output. Instead, the monopolist sells portions of it at two or more prices. And this happens even when the product is homogeneous and one unit of it cannot be distinguished from the other. Professor Pigou mentions three types of price discrimination.

- The monopolist may charge a separate price for each unit sold by him. This is known as the price discrimination of first degree.
- The monopolist may sell his output in 'batches' or 'lots', charging a separate price for each batch or lot. This is known as price discrimination of second degree.
- The monopolist may split up the market for his product on the basis of the buyers, He may divide buyers into two or more categories and charge from each category a different price. This is known as price discrimination of third degree.

Reasons for Price Discrimination

There are three main reasons for price discrimination viz.

- Monopoly awareness of consumer ignorance for the cost of product
- There are two different markets
- Charge of discriminating prices for the same product or services from the different customers

The monopolist is aware of consumer ignorance for the cost of product due to lack of knowledge and communication of proper information. In rendering professional services or personal services discriminating price can be charged by a monopolist from different customers. A doctor specialist having monopoly in his professional specialisation can charge higher fee from rich and lesser fee from poor clients. Such discrimination is possible when the service rendered or commodities cannot be resold.

Price discrimination may be practiced under the circumstances when cost difference might exist due to distance between one market or another, lower price in poorer market and higher prices in sophisticated market could be charged. Such price discrimination occurs when firm's different markets are separated by distance or by national

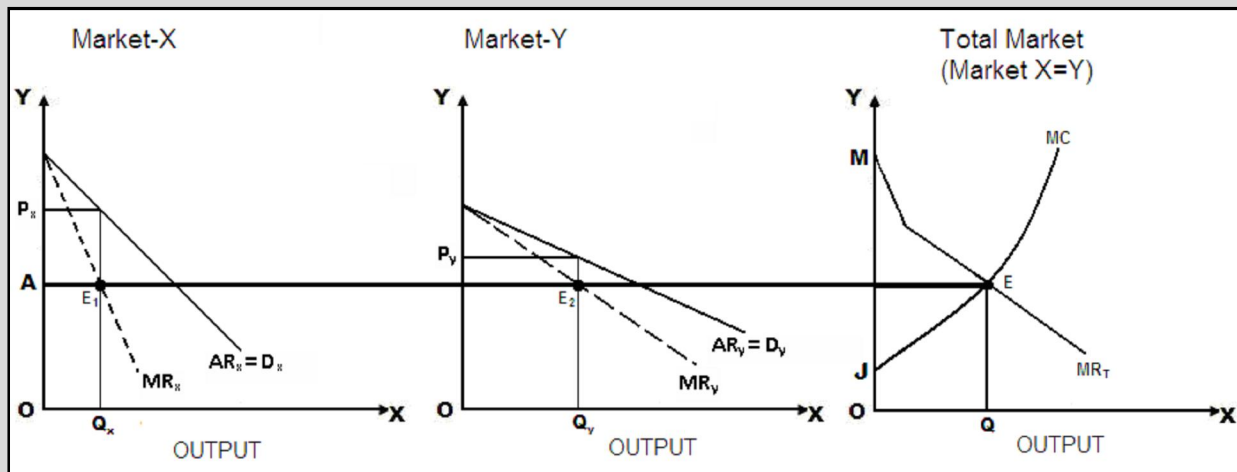
frontiers; cheaper commodity in one market may not be resold at dearer markets because of excessive cost of transportation.

Equilibrium under Price Discrimination

Profit maximisation is the basic objective before a discriminating monopolist. For this purpose he would like to avail of every opportunity what is available to any ordinary monopolist. The basic rule according to W.J. Baumol which he has to follow is that marginal revenue in all the markets where he is practicing discrimination should be similar. Monopolist can allocate his product in different markets on the basis of available MR from the best combination. The total market shows the aggregate AR and MR and the profit maximizing output of OQ. The optimum level of output for the firm is determined at OQ since at this level of output $MR = MC$. The whole output OQ cannot be profitably sold in one market because of the limited size of market. Therefore, the monopolist must allocate output OQ between two markets i.e. X and Y in such proportion that the necessary condition of profit maximisation is satisfied i.e. in both markets i.e. $MC = MR_x = MR_y$

The price and output in each market is determined by the intersection of the aggregate marginal cost curve and the specific marginal revenue curve. In market X the price charged is P_x which is higher than P_y in market Y. P_x is higher because the demand in market X is more inelastic than in market Y. Assuming that the costs are similar for each market, the supplier will make more profit in market X than in market Y. The total output of this monopolist is OQ which equals $OQ_x + OQ_y$. (See figure 4.11)

Fig.4.11: Market Demand for Monopoly



REVIEW QUESTIONS



- _____ is the form of market organization in which there is a single firm selling a single commodity for which there are no close substitutes.
- A monopolist can increase his sale only by _____ the price of his product and thereby maximize his profit.
- No monopolist ever operates on the _____ portion of the average revenue curve or the demand curve.

MONOPOLISTIC COMPETITION

At the end of the lesson, you will be able to:

- Understand the characteristics of the monopolistic competition
- Understand the concept of product differentiation and its significance under the monopolistic competition.
- Analyze the equilibrium of a firm under the monopolistic competition.

The types of market under which we discussed the determination of equilibrium of a firm/industry in the foregoing portions do not exist in reality. They are all hypothetical and only help us in analyzing the real markets in a logical and systematic manner. The case of a monopolistic competition is one such market which we shall discuss below.

A monopolistic competition is defined as that market structure in which each seller produces a 'differentiated product'. The concept of product differentiation means that the product marketed by one seller can be distinguished from the products marketed by other sellers in some form or other. Some of the important methods of product differentiation include: trade marks, brand names size packing or color etc. of the item and technical specifications etc.

Thus, in this market structure, each seller is a monopolist of his differentiated product. The buyers can get it only from him and from none else. At the same time, however, the products offered by different sellers are close substitutes of each other. The buyers are always comparing the prices of their products together with the perceived 'quality' of each. In other words, there is also an intense competition between suppliers for a share in the market. For this reason, it is a market structure in which there is a competition between a group of firms while each firm is a monopolist of its own product. It is, therefore, termed as monopolistic competition.

However, defining a monopolistic competition in this manner, though very realistic, poses certain problems of its own.

- Since the products supplied by the competing firms are not homogeneous, therefore, we cannot define the concept of a 'market demand for the product' precisely, that is, it is not possible to determine the average revenue curve of the 'industry' as a whole.
- Not only that, it is very difficult to even define an industry in a precise manner for the reason that its constituent firms are not supplying the same product. At the most, we may think of a 'group' of firms selling close substitutes of each other.
- It is not possible to have a satisfactory definition of even a 'group'. This is because the 'product group' (such as scooters, or motor cycles) under consideration is itself in competition with other 'product groups'.

Given these limitations, let us mention some of the salient features of the monopolistic competition.

Features of Monopolistic Competition

1. The first feature of monopolistic competition, as mentioned above, is product differentiation. A buyer can get a specific type of the 'product' only from one final source (may be, through the dealers and sub-dealers, etc.).
2. Product differentiation necessitates incurring of selling expenses on the part of firms under market structure of monopolistic competition.
3. Monopolistic competition is characterized by a large number of sellers. The demand and supply conditions of these sellers are inter-dependent. However, in spite of their large number, no individual seller becomes a price taker. He has the authority to demand a price of his choice, though he also considers the demand conditions for his product while exercising this authority. In other words, in spite of there being a large number of sellers, the demand curve for the product of an individual seller is downward sloping. Its demand is not perfectly elastic. It also has large number of buyers also.
4. The fact that each firm produces a 'differentiated product' implies that it can distinguish it further by varying its 'quality'. An improvement in the 'quality' implies an increase in its average cost of production

while deterioration in quality implies a reduction in average cost of production. Also an improvement in quality is expected to 'increase' the demand for the product so that, for each given quantity, the buyers are ready to pay a higher price.

5. The firms under the monopolistic competition face a competitive market as regards the inputs used by them. They also have to operate within a given technological range. The result is that no firm is able to compete out its rival by producing a 'better quality' product at a lower average cost.
6. It is assumed that each firm has an accurate knowledge of its demand and cost conditions. This feature implies that the firm is able to estimate the impact of any change in the quantity and/or quality of its product on both its cost of production and average revenue. This knowledge, therefore, enables the firm to maximize its expected profit income.
7. Every existing firm can leave the 'group' of firms belonging to the 'product group' (sometimes inaccurately called the industry). Similarly, new firms can enter the group and produce close substitutes of the existing products in the group. This free entry and exit of firms ensures that, in the long run, no firm incurs a loss and no firm is able to earn abnormal profit.
8. At the same time, every firm in monopolistic competition is assumed to pursue the goal of profit maximisation. Its aim is not to maximize sales proceeds, or an increase in the market share, etc.
9. It is also assumed that in monopolistic competition all firms have identical cost and demand conditions. This simplifying assumption helps us in analyzing the determination of group equilibrium. It enables us to analyze the working of an individual firm and use it as the representative of the working of the entire group. In the absence of this assumption, we have to separately work out the determination of output, product quality, and price of each firm within the group.
10. Product differentiation necessitates incurring of selling expenses on the part of firm under the monopolistic competition.

Since product differentiation and selling expenses form the foundation of monopolistic competition, let us explain them a little further.

Product Differentiation

The concept of product differentiation covers all those criteria on the basis of which the product of one firm can be distinguished from that of the other.

The differentiation may be or may not be real. A real differentiation refers to the technical features of the product, including its technical life and performance, durability, cost of operation and maintenance, and the like. In contrast, a non technical or imaginary differentiation may also be there. It may take the form of brand names, trade marks, packing, size, shape, and so on. The non technical differentiation of a product aims at adding to its subjective appeal to the buyers so that they are induced to 'increase' its demand and are ready to pay more for it. In reality, however, the two forms of differentiation are so mixed up that it becomes nearly impossible to demarcate between the two.

However, irrespective of the nature of product differentiation, it is expected that its adoption by a firm would 'increase' its demand. It provides an opportunity to the firm to tell the buyers that the combination of 'product quality' and price offered by it is better than similar combinations offered by its competing firms. On this account, therefore, a firm under the monopolistic competition is not a price taker. The demand curve for its product develops an inverse relationship with the product price. The firm can raise the price of its product without losing all its customers. And it has to lower the price if it wants to sell a larger quantity of its product. In other words, the demand curve of each firm in monopolistic competition corresponds to that for the 'industry' as a whole, with the difference that it is comparatively more elastic. It is downward sloping and not parallel to X-axis.

It must also be recalled that, in monopolistic competition, the products of firms are close substitutes of each other. As a result, they have high positive cross elasticities. The market for the product of one firm is not clearly

separated from the market segments occupied by the products of its rival firms. The firm under consideration can gain or lose a market share of its product both by its own price decisions and those of its rivals. In addition to this, the demand conditions for the product of a firm are affected by its own 'selling expenses', as also by the expenses incurred by its rivals.

Selling Expenses

This leads us to the consideration of the other basic feature of monopolistic competition, namely selling expenses. They are to be distinguished from the production expenses in the sense that the latter are incurred so as to 'produce' the product.

'Selling expenses' are all those outlays which are made in order to create and/or increase its demand. They are aimed at shifting the demand curve of the advertised product to the right so that the buyers should agree to pay more for a given quantity (or are ready to buy more at a given price). Selling expenses may be incurred in several ways though in each case the objective of incurring them is to 'increase' the demand for the product under consideration. They not only include advertisement through different media, show rooms and selling campaigns but also 'offer discounts' and 'incentives' to the dealers and customers. Furthermore, selling expenses may be informative and educative in the sense that they try to convince the customers through 'informing' them of the 'benefits' of using the items being advertised that they should buy this item in preference to something else. Similarly, some selling expenses are incurred to neutralize the perceived impact being created by the activities of the rival firms (or rival product groups). It is also possible that a firm may decide to adopt an aggressive posture and incur selling expenses to create a market for its product or capture a bigger share of the existing market of the 'product group'.

It should be noted that, under monopolistic competition, a major portion of selling expenses incurred in the economy is likely to be neutralizing in its effect or it may only encourage consumption expenditure at the cost of saving. Since, in the ultimate analysis, all selling expenses imply a resource cost for the economy, it is worth asking whether 'non-educative' competitive selling expenses are desirable.

As noted above, the forms of selling expenses are undergoing continuous changes over time. The options available to the advertisers have rapidly expanded with new media. 'Selling' or 'marketing' has acquired a professional dimension. Repetitive and expensive sales campaigns have become necessary for most firms for survival in the market.

It is generally agreed that the impact of selling expenses on demand for an item follows the law of variable proportions. That is to say, the average selling expenses per unit of sales exhibit the three phases of (i) increasing, (ii) constant, and (iii) diminishing returns in terms of addition of the quantity demanded on account of successive additions to selling expenses. This phenomenon is explained by pointing out that advertisement and other forms of selling expenses gain effectiveness only if they are incurred heavily and repeatedly. Moreover, an addition to the selling budget opens up more effective and wider options to the firm. However, the sources of these benefits tend to get exhausted as the size of selling budget is increased. The average selling cost curve (ASC curve) assumes a U-shape. However, given the selling budget of the firm, the average selling cost curve will be a rectangular hyperbola. It will be similar to the average fixed cost curve of the firm.

EQUILIBRIUM OF THE FIRM UNDER MONOPOLISTIC COMPETITION

While analyzing the determination of equilibrium of a firm under monopolistic competition, it should be noted that we can have two types of its demand curve. Both will be downward sloping.

- It is assumed that a price revision by our firm is not associated by a retaliatory action by its rival firms. In this case, the demand curve of the firm under consideration will have smaller slope. The elasticity of demand for its product will be more elastic.
- In case, the rival firms follow the price revision by our firm, then the demand for its product will become less elastic. Our firm will have to resort to a bigger reduction in price to get a given addition in the demand

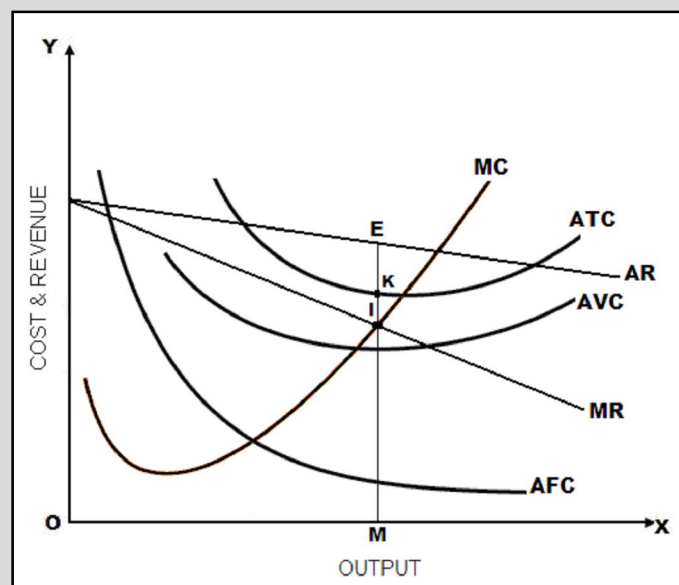
for its product. Similarly, for a given fall in demand, it will be possible to raise the price by a higher amount. Its demand curve will be steeper in this case.

Short Run Equilibrium under Monopolistic Competition

At this stage, we need not repeat the conditions of equilibrium of a firm. We may also recall that in the short run, the firm may be able to earn an abnormal profit if the demand for its product is quite strong. The abnormal profit is not competed away because in short run new firms cannot enter the 'group' and enhance the supply of the 'product group'. In other words, it is not possible for additional supplies of close substitutes to enter the market and reduce the absolute share of our firm. Similarly, it is also possible for it to operate at a loss subject to the condition that the loss should not exceed its fixed costs.

As in the case of other market structures, in monopolistic competition also a firm is faced with certain fixed costs in the short run. In addition to some production costs, they may include some components of firm's selling expenses as well. Similarly, some other components of selling expenses can fall in the category of variable expenses.

Fig. 4.12: Short Run Equilibrium under Monopolistic Competition



In Fig. 4.12, both AR and MR curve of the firm have negative slopes. AVC curve comprises not only variable production costs but also variable components of selling expenses. Both MC and AVC curves are expectedly U-shaped and the former cuts the latter at its lowest point. ATC curve represents average of the total cost of the firm, including fixed selling expenses.

Equilibrium of the firm is determined with reference to the point I where MC curve of the firm intersects its MR curve from below. The firm decides to produce a quantity of OM while it is able to charge a price of EM per unit. It should be noted that the firm is making an extra profit of EK per unit which is not competed out by the entry of rival firms.

However, depending upon the relative location of cost and revenue curves, the firm could also be in equilibrium with

- only normal profit
- covering a part of fixed costs and therefore, incurring a loss less than its fixed costs,
- a loss equal to total fixed costs
- In the last case, the AR curve would be tangent to AVC curve

Let us now consider the question of 'group equilibrium', that is, simultaneous equilibrium of all the firms in the group. We notice that the cost and demand conditions of individual firms differ from each other. Moreover, they produce differentiated products so that it is not possible to derive the supply and demand curves for the group as a whole. Chamberlin overcomes this difficulty by making the 'uniformity assumption'. He assumes that all firms in the group have identical cost and demand conditions. As a result, when in equilibrium, all firms produce same quantities of their respective products and sell them at the same price. It is obvious that this is a highly unrealistic assumption. It was probably better to admit that we cannot talk of the concept of 'group equilibrium' and that we have to consider the determination of equilibrium of each firm individually.

Long Run Equilibrium under Monopolistic Competition

In discussing long run equilibrium of a firm under monopolistic competition we should specifically note the following facts.

- In the long run, there are no fixed costs. The firm can not only vary all its inputs, it can also vary its selling costs. Moreover, it is possible for the firm to make a choice between alternative product qualities.
- No firm can be compelled to operate at a loss. It can always leave the industry. Therefore, when loss making firms leave the group, the absolute market shares of the remaining firms increase. Their demand curves shift rightwards and upwards. This process continues till it becomes possible for the remaining firms to produce without incurring a loss.
- Similarly, if the demand is strong so as to bring abnormal profit income to the existing firms, new firms can enter the 'product group', and produce close substitutes of the existing products. This increases the total supply of the 'product group' and with given demand, reduces the demand shares of the existing firms. As a result, the demand curve of an individual firm cannot stay above its long term average cost curve.
- Each firm operating under monopolistic competition is thus able to make a choice between alternative combinations of
 - product quality
 - product differentiation
 - selling costs
- In addition, it must also take note of the fact that any variation of price on its part can lead to a price reaction by its rivals also. Conceptually, therefore, it faces a much steeper demand curve than would be case without price reaction by its rivals.

Fig. 4.13 : Long Run Equilibrium of Firm under Monopolistic Competition

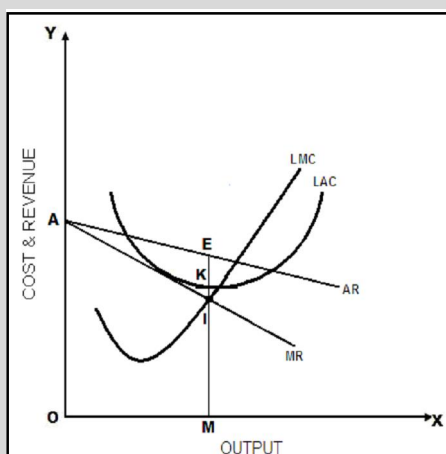
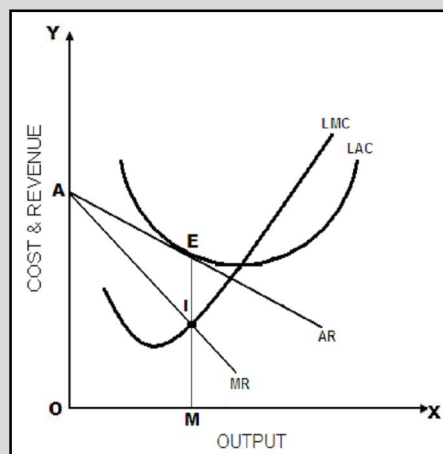


Fig. 4.14: Long Run Equilibrium of Firm under Monopolistic Competition



It follows from the above that a firm under monopolistic competition is exposed to a continuous interaction with rest of the firms in the group. Its decisions are not independent of what the other firms are doing. It also notes the fact that its demand curve not only depends upon the actions of its rivals but also upon the quality of its own product and the selling expenses incurred by it. Therefore, it considers alternative combinations of its cost components relating to product quality and selling expenses etc. and estimates the corresponding slope and position of the demand curve.

Let us assume that our firm has selected the product quality and the amount of selling expenses as represented by LAC curve in Fig. 4.13 which has its corresponding long term MC curve (LMC). The latter curve intersects MR curve from below at I. In this case, the firm would decide to produce a quantity OM of its product and sell it at a per unit price of EM which brings it a per unit profit of EK. However, as noted above, in the long run, the firm is not allowed to earn abnormal profit. New firms enter the market and produce close substitutes. This results in a reduction in the market shares of the existing firms including ours. Its AR curve shifts leftwards till it becomes tangent to LAC curve, as at point E in Fig. 4.14. Once this happens, our firm earns only a normal profit. There is no incentive for new firms to enter the market. Similarly, the process of entry of new firms and reduction in market shares of existing firms cannot continue indefinitely. Once the profit income of the existing firms is reduced to normal level, there is no incentive left for new firms to enter the market.

As a result, long term equilibrium of a firm under monopolistic competition is given by the point of tangency between its AR curve with its LAC curve which is at point E in Fig. 4.14 in the case of our firm.

It should be noted that in monopolistic competition, firms earn only normal profit, in the long run as they do under perfect competition. Presence of monopolistic competition does not improve their profitability. Further, on account of

- negatively sloping demand curves
- U-shaped long term average cost curves
- free exit and entry of firms
- competition among firms

They all produce below their 'optimum capacity' as the equilibrium is to the left of minimum point of the average cost curve. Some productive capacity of theirs remains unutilized. This increases their average cost of production which they charge from the consumers by adding them to the supply price. The firms operating under monopolistic competition also incur selling expenses which they charge from the consumers.

Similarly, the consumers also suffer in several ways.

- They get a smaller supply compared with what the economy can produce by effectively utilizing its productive capacity.
- The average cost of production is more than the minimum average cost of optimum level of output and the consumers have to bear it in the form of higher prices.
- They also pay for the selling expenses incurred by the sellers.
- In the net, therefore, 'for a given quality of product they pay a higher price, and for a given price they get an inferior product'.

The only possible gain to the consumers is in the form of the 'variety' of products. However, some thinkers believe that the variety does not bring in any addition of utility to the body of consumers taken together because every consumer cannot afford to buy 'better' quality of every product. And those who have a sense of deprivation suffer a loss of utility on that account.

The economy also suffers in the sense that its productive capacity is not utilized fully. Also the firms use up a

large amount of productive resources in selling expenses most of which are incurred only to counteract the impact of rivals and have no real benefit for the economy.

EVALUATION OF MONOPOLISTIC COMPETITION

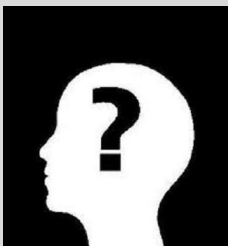
Merits

1. An important merit of monopolistic competition is that it is much closer to reality than several other models of market structure. Firstly, it incorporates the facts of product differentiation and selling costs. Secondly, it can be easily used for the analysis of duopoly and oligopoly.
2. Under monopolistic competition, it is possible to see that even when each individual firm produces under conditions of increasing returns, not only the firm under consideration but the entire group of firms can be in equilibrium.
3. Moreover, monopolistic competition is able to show that even when each individual firm is producing under increasing returns, it still earns only normal profit in the long run. The theory of monopolistic competition helps us in bringing in the concept of market share of an individual firm. This opens up the possibility of considering those situations in which a firm may be pursuing a goal other than profit maximisation.
4. In monopolistic competition we are able to consider the interaction between several interdependent variables on the basis of which a firm takes its decisions.

Demerits

1. The biggest conceptual difficulty with monopolistic competition is the concept of a 'group' of firms. There is no standard theoretical foundation for deciding the boundaries of a group.
2. Related with the concept of a group of firms, we face the difficulty of defining the meaning of a 'close substitute'. We are not told at what values of cross elasticity, two products become close substitutes of each other.
3. The theory of monopolistic competition fails to take into account the fact that the demand by final consumers is largely influenced by the retail dealers because the consumers themselves are not fully aware of the technical qualities of the product.
4. Similarly, the theory fails to fully account for the determination of equilibrium quantities and prices of goods like raw materials and other inputs. To a large extent, their demand is governed by a combination of the technical quality, price, and timely availability rather than by brand name, etc. Given the technical quality of an input, its demand is governed more by its price and availability than its brand name.

REVIEW QUESTIONS



1. _____ is not the characteristics of monopolistic competition
2. _____ incorporates the facts of product differentiation and selling costs.

Comparison between Perfect Competition, Monopoly and Monopolistic competition

There are certain common and non-common features among different form of markets exists in a system. Some of the major points of distinction among these markets are presented in the following table.

Features	Perfect Competition	Monopoly	Monopolistic Competition
Number of selling firm	Large	Single	Varied but not too many
Number of buyers	Large	Large	Large
Size of the market for each firm	Very small	Large	Small
Entry and exit condition	Free	No entry	Free
Degree of monopoly power	Zero (NIL)	Full	Limited
Price Uniform and low	Very	High	Moderate
Price policy of firm	Price taker	Price Maker	Price Maker (some control over price depending on consumer brand loyalty)
Market knowledge	Information	Complete/Incomplete	Incomplete
Capacity Utilization	Optimum	Sub-optimum	Sub-optimum
Price Elasticity of Demand for individual firm	Perfectly elastic (Infinite)	Less elastic	High
AR and MR Curve	Equal	Different	Different
Selling Cost	Nil	Small	Large
Social Welfare	Maximum	Not Maximum	Not Maximum
Equilibrium Conditions	MR=MC Slope(MC) < Slope (MC)	MR=MC Slope < Slope of MR	MR=MC Slope (MC) < Slope (MC)
Nature of decision variable	Only output	Both price and output are within his control but at one time decision can be taken only about one of them. It faces a trade off between price and output	Nature and extent of product differentiation and hence the level of selling expenses.

LESSON ROUND UP

- The concept of a market is central to the understanding of the determination of price and quantity of output of a commodity under consideration. Market means the general field within which, the force determining the price of particular product operate
- The market consists of two components:
 - A Firm
 - An Industry
- There are various kinds of markets prevailing in the economy.
- Perfect Competition has following characteristics:
 - Large Number of Sellers and Buyers
 - Homogeneous Product
 - Free Entry and Exit
 - Firm is a price taker
 - Full Knowledge of Market
 - Economic Rationality
 - No Transportation Cost
- The perfect competition firm is in equilibrium when $MC = MR$ and MC cuts the MR curve from below.
- Monopoly
 - Monopoly means a single seller and large number of buyers
 - No close substitute
 - A single firm industry
 - Monopolist is free to fix a price of his choice. Firm is price maker.
 - Irrespective of the profit income of the existing producer firm, new firms cannot enter the industry
 - A buyer will buy it only if its price does not exceed its marginal utility to him
- The equilibrium for monopolist is at a point where $MR = MC$.
- One of the important features of the monopolist is price discrimination, where he charges different prices for homogeneous product to different consumers.
- Monopolistic Competition
 - Monopolistic Competition means large number of sellers and buyers
 - Close substitutes
 - All firms are monopolists of their differentiated product
 - The main feature is product differentiation and selling expenses comprising of marketing costs.

GLOSSARY

Profit Maximizing Conditions	The necessary condition is marginal revenue equals to marginal cost. The sufficient condition is marginal cost curve is intersecting the marginal revenue curve from below.
Economic Profits	Difference between total revenue and total cost incurred on inputs.
Normal Profits	When total revenue and total costs equals. Normal Profits = Zero Economic Profits
Homogeneous	Two or more products that are identical in every possible respect.
Short Run Equilibrium	A competitive firm attains short run equilibrium when $MR = SMC$ with SMC rising.
Long Run Equilibrium	A competitive firm attains long run equilibrium when $MR = LMC$ with LMC rising and $P = AR = LAC$.
Break Even Condition	When total sale proceeds covers total costs of production.
Shut Down Condition	When price of the good falls below the average variable costs. If the price of the firm is such that it is not even able to cover its variable costs, the firm should shut down.
Degree of Monopoly	Monopoly power is the degree of power held by the monopolist to set the price for a good.
Price Discrimination	When the product is sold to different consumers at different prices.
Product Differentiation	Slight differences that exist between two or more goods that are essentially the same and which satisfy the same basic want or need. This is generally pursued in monopolistic competition.
Selling Costs	All expenditures pertaining to selling activities after the product has been produced. An important component is advertising and other sales promotion expenditures including giving free gifts and other promotional activities.

SELF-TEST QUESTIONS

1. What do you understand by equilibrium of a firm ? Explain your answer.
2. What is meant by the term market in economics ? Distinguish between the following market structures (i) perfect competition, (ii) monopoly, and (iii) monopolistic competition.
3. Clarify the statement that a firm is a price taker under perfect competition but not so in monopoly or monopolistic competition. Give reasons for your answer.
4. Explain the concept of optimum output. Under what conditions is it achieved by a firm ?
5. Analyse the determination of short run equilibrium of a firm operating under perfect competition. Can it be in equilibrium while incurring a loss ? Give reasons for your answer.
6. Explain the determination of long term equilibrium of a firm under perfect competition. Show, inter alia, that it will produce at the least possible average cost of production.

7. Is it necessary for a firm to produce optimum level of output under monopoly or monopolistic competition ? Explain with the help of diagrams.
8. Discuss the determination of equilibrium of a perfectly competitive industry under conditions of (a) constant returns, (b) diminishing returns, and (c) increasing returns.
9. Define a monopoly. Define its characteristics as distinguished from those of perfect competition.
10. Do you agree with the statement that a monopoly can attain its long term equilibrium with abnormal profit, but not at a loss ? Give reasons for your answer.
11. It is claimed that price charged by a monopoly is always higher than the competitive price ? Why ?
12. What do you understand by price discrimination by a monopolist ? What are its various kinds ?
13. Explain the determination of equilibrium output and prices when a monopoly is practising price discrimination.
14. What do you understand by the concept of monopolistic competition ? What are its salient features ?
15. What are selling expenses in monopolistic competition ? How are they differentiated from cost of production? What should they be incurred by a firm operating under monopolistic competition ?
16. “Under monopolistic competition, consumers pay more for a given product and get an inferior product for a given price”. Explain.
17. Enumerate merits and demerits of monopolistic competition.

Suggested Readings

1. H. L. Ahuja, Modern: Microeconomics
2. A. Koutsoyiannis: Modern Microeconomics

Lesson 5

Money and Banking

LESSON OUTLINE

- Concept and Nature of Money
- Functional Approach
- Liquidity Approach
- Credit Creation
- Review Questions
- Quantity Theory of Money
 - Transaction Approach
 - Cash Balance Approach
- Central Banks – Role and Functions
- Commercial Banks – Role and Functions
- Monetary Policy in India
 - Quantitative Measures
 - Qualitative Measures
- Lesson Round UP
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

With the advent of banking sector and emerging financial markets in the economy, one requires a precise understanding concerning money; what exactly would term money imply; any object (not necessarily rupee) that circulates widely as a means of payment or does it involve something more to it. Besides this, what is the connection between money, banks, and credit system?

The purpose of this study is to get the students acquainted with the concept of money and thereby relating it to different approaches which helps in defining the functions of money.

The chapter further deals with the process of credit creation and how different theories of money works.

Since the entire financial structure revolves around banks and financial institutions it becomes significant to deliberate upon the role and functions of central and commercial banks.

Further, economy of any nation depends or say is run by effective monetary policy. At this stage, it becomes essential to acquaint students with the tools of monetary process and policy in India.

Money is a matter of functions four, A Medium, a Measure, a Standard and a Store.

A Famous quote

CONCEPT AND NATURE OF MONEY

Economists and thinkers have found that it is not easy to define money though easily recognisable. This is because, over recorded history, a large variety of items have performed the role of money. For this reason, it cannot be defined by referring to its tangible features, such as, the stuff it is made of, its weight, size, shape, colour, chemical composition, and so on. The exact form of money has undergone innumerable changes. These changes have been influenced by the dynamism of the society as a whole which includes its political, social, and economic institutions and the policies of the government.

The evolution of money has proved to be an unending and continuous process which can be seen from the fact that apart from the commodity money and metallic money, lately there is an emergence of paper money and a variety of other financial instruments.

It is noteworthy that money is not something which, having come into existence continues to be in its original form. Various things have served as money at different times and places. These have varied from shells, goats, cows, and rice to silver and gold pieces and to coins, paper currency, notes and to demand deposits of bank.

Money was brought into existence to tide over the difficulties of barter, but in the process it has helped economy in such a manner that its use has become indispensable. It has responded to the ever changing nature of the economy and its growing complexity. In turn, it has helped the economy in acquiring those complex features without which the latter could not develop.

Faced with the difficulties in defining money, the economists used the different approaches as the tool to arrive at an appropriate definition to it. There are two approaches adopted by economists to define money; namely

- Functional Approach
- Liquidity or Generalized Purchasing Power Approach.

Functional Approach

The functions of money have been well summed up in a couplet:

“Money is a matter of functions four,
A Medium, a Measure, a Standard and a Store.”

In recent days, the economists have added some new functions to these four functions.

The functions of money can be classified under three main heads:

- Primary Functions or Original Function
- Secondary Functions
- Contingent Functions

I. Primary Functions

The main functions performed by money are called primary or original function. The primary functions of money are as follows:

1. **Medium of Exchange:** This medium of exchange function is one of the most important and oldest function of money. Money works as a medium of exchange. The exchange was difficult in barter system due to the lack of double coincidence of wants. With the invention of money, the limitations of barter system could be overcome. Money has a generalized purchasing power. Money is used as medium of exchange;

where it is earned by selling one's goods and services and used to buy another set of goods and services. The basic idea involved in this concept is that a seller may be accepting, by way of sales proceeds, an item which has no intrinsic value for him, that is, which has no economic use or utility for him.

Over recorded history, thousands of items have performed the role of money, that is, that of a medium of exchange. These days, money exists in a variety of forms. Of these, legal tender, that is, official currency [both coins and currency notes] happens to be the dominant form of money. However, quantity-wise, non-currency forms of money; Cheques, Credit Cards etc. are far exceeding the currency-money.

Money provides economic freedom to the greater extent. It helps to bring others product within our reach. The integral feature for money to serve as medium of exchange is to have a general acceptability. Any thing that is to serve this function of money must be acceptable generally by all. In other words, all should accept money for payment of goods and services. Hence, all things serving merely as a medium of exchange cannot be called money.

2. **Measure of Value:** Money customarily serves as common measure of value or unit of account in terms of which the values of all goods and services are expressed. This makes possible meaningful accounting systems by adding up the values of a wide variety of goods and services whose physical quantities are measured in different units. In the traditional barter economy, the evaluation of a commodity was a difficult task as it varied with the variation in the commodity exchanged. For similar reasons, it was almost impossible to keep accounting records. The invention of money has served as common denominator for value determination.

The monetary unit used in calculation is called unit of account. The prices of goods and services are expressed in money. This also facilitated the computation of ratio of exchange between any pair of goods. However, money as a measure of value is not perfect. For its own value does not stay constant. Unlike other invariant physical units of measures (kilograms, meter, liters etc.), the value of money changes from place to place and over time. To be satisfactory measure of value. It is essential that monetary units must be invariable. It must maintain the stable value. A fluctuating monetary units always creates a number of social economic problem. Normally, it may be noted that value of money i.e. purchasing power, does not remain constant; it rises during the period of falling process and falls during the period of rising prices. Hence, some economists opined that the unit of account function is desirable but not necessary quality of money.

II. Secondary Functions

The relatively less important functions of money are called secondary function. Since, this function originates from primary functions. These functions are also called derived functions. The secondary functions of money are as follows: -

3. **Standard of Deferred Payment:** Money serves as the standard of deferred payment or units in which future or deferred payments are made. This function applies to interests, rents, salaries, pensions, insurance premium etc. The lending and borrowing acts are easily expressed in money. Due to the qualities of stability in value, general acceptability and durability, money is regarded best for these transactions.

The process of credit was possible in barter system also, but was largely inconvenient and uncertain in terms of quality and quantity due to the changing nature of commodities; some of which were perishable also. The purchasing power of money falls when there is rapid rise in the price of goods and services. Money ceases to be the good store of value and men lose faith in money. Money ceases to work as a standard of deferred payment after it loses faith. As for example, most of the contracts in Germany were made in Swiss Frank or U.S. Dollar in 1923, Whereas Mark was the national currency of Germany.

4. **Store of Value:** The fourth function of money is to serve as a store of value because it is easy to spend

and easy to store. Money serves as store of value in the short run as well as long run. By performing the function of store of value, the money provides security to individuals to meet unpredictable contingencies and to pay debt that are in terms of money. In barter exchange system, commodities could not be stored for a longer period of time. Money has a unique nature of durability and stability in value; thus it is can be stored for a long time. This has introduced in people, a trend of making savings from the incomes for future purposes.

This function of money; store of value is necessary but not sufficient condition to term anything as money. Although, money functions as a store of value, but all things functioning as store of value cannot be termed as money. For instance: things like diamond, jewellery work as a store of value. But, these do not serve the primary functions of money, hence are not termed as money; therefore not used as money.

5. **Transfer of Value:** Money serves as the function of transfer of value or purchasing power. People transfer value by selling commodities or property to others and by buying commodities and property with others. Money has facilitated the transaction of goods in distant places.

III. Contingent Functions

Prof. Kinley has mentioned four contingent functions of money. These functions are as follows

6. **Basis of Credit:** In present days, the use of credit money like Cheque, Draft, bill of exchange, Promissory Notes is expanding widely. The credit instruments are issued on the basis of cash reserve. The credit instrument like Cheque is issued on the basis of money deposits. Hence, money is a basis of credit.
7. **Distribution of National Income:** The national banks also create credit on this basis. Income is produced by the joint efforts and coordination of different factors of production. This national income is distributed among the factors in monetary terms. The contribution of all factors is calculated in monetary terms. The distribution of production among factors would be difficult in the age of modern specialized labour in the absence of money.
8. **General Form of Capital:** Money works as a general form of capital. In present times almost all wealth or capital are kept in the form of money. This increases the liquidity and mobility of capital.
9. **Maximum Benefit:** People derive maximum satisfaction from own income by the help of money. According to law of equi-marginal utility, people derive maximum satisfaction when they spend by making marginal utility equal in all goods. People spend money to make marginal utilities of all commodities equal and derive maximum satisfaction by the help of money. Likewise, the producers also spend money in different factors so as to make marginal productivity of all factors equal. This increases total output and yields maximum benefit to the producers.

Liquidity Approach

This approach of defining money is based upon a conceptual framework similar to that used in the functional approach. Generally acceptability of money by creditors in discharge of their claims, and by sellers as sales proceeds, means that money has a generalized purchasing power.

It is a claim upon the resources of the society and can be exercised in a variety of ways. In other words it can be used to acquire other goods and services. This economic capacity of an item to be readily acceptable in the market is termed its 'liquidity'. It is seen that acceptability and liquidity go together and convey roughly the same meaning.

An item cannot have liquidity unless it is marketable, that is unless it can be sold or exchanged in the market. But given this precondition for the very existence of liquidity, items differ in their liquidity because of the difference in the quality of their marketability or acceptability. An item which is more readily acceptable by the creditors (and

has, therefore, better marketability) is more liquid than the other. Cash or official currency, by its very nature, is the most liquid asset. Liquidity-wise, cash is followed by non-currency financial assets while tangible assets (that is, “commodities”) are least liquid. Also, within each asset category, liquidity differs from one asset to the other. Liquidity of an asset is deeply influenced by several factors including the following:

1. The first factor which determines the liquidity of an asset is the rapidity with which it can be sold or exchanged. Liquidity content of an asset is inversely related with the average time taken to convert it into cash (which is most liquid) in the market.
2. Selling an asset is often accompanied with a cost in terms of both money and other resources. A higher marketing cost reduces the liquidity of an asset.
3. Liquidity of an asset also depends upon the probability and extent of capital loss/gain associated with its sale. The idea is that the market price of an asset can differ from the price at which it is purchased. Accordingly, the acceptability of an asset declines if its market price is liable to fluctuate. By inference, the liquidity of an asset is inversely related to the probability and extent of its price fluctuation.

The liquidity approach emphasizes the function of money as a store of money. It implies that money is not qualitatively different from other assets. Liquidity is the property of all assets; only the degree of liquidity varies. The liquidity approach includes in the measurement of money those assets that are highly liquid, i.e., those assets that can be converted into money quickly. In other words, any asset for which no nominal capital gain or loss is possible qualifies as a perfectly liquid asset and is therefore identified as money. Those assets for which only slight capital gains or losses are possible are highly liquid and are called near-money assets.

Liquidity of an asset depends upon two factors: existence of secondary market and the maturity period of the asset.

- The liquidity of an asset is increased by the existence of organized secondary markets
- Shorter the term to maturity of the assets, greater the liquidity. Money has no term to maturity, therefore it is perfectly liquid

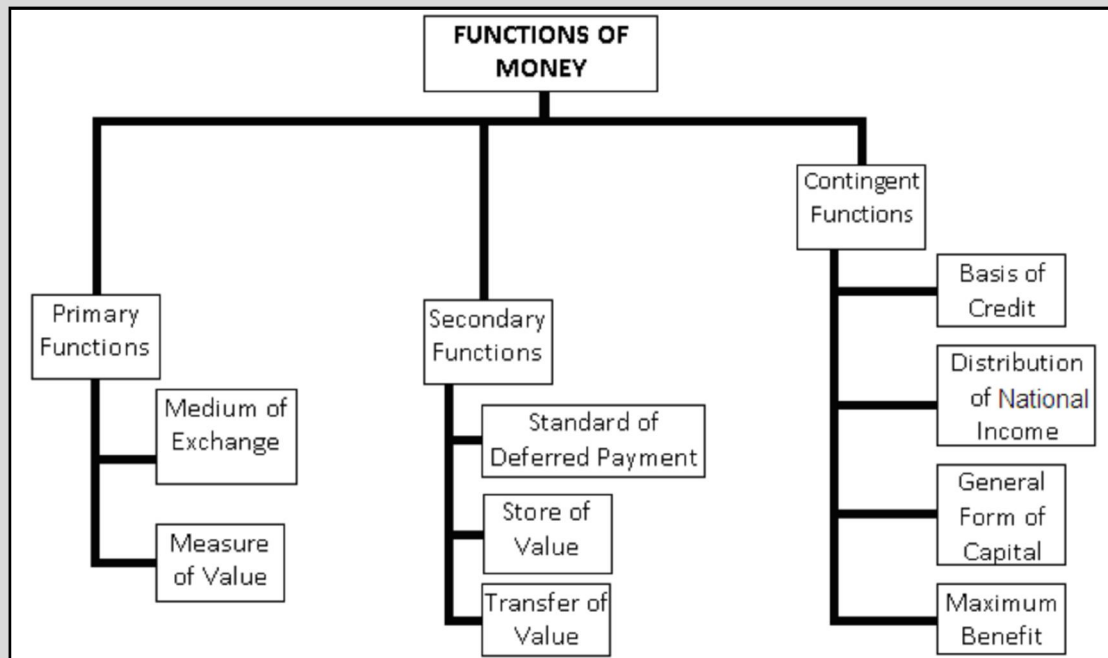
Inclusion of near-money assets in the definition of money makes it empirically more realistic and enables it to explain the actual economic changes in a better way. Measures of money based on the liquidity approach are highly correlated with economic activity. Economic activity or the level of aggregate expenditure in the country is more a function of overall liquidity rather than of total money stock (i.e., currency and demand deposits). The prevalence of near-money assets greatly increases the overall level of liquidity and hence the level of economic activity. An increase in the money supply by the monetary authority leads to an increase in the liquidity with the public. This increase in liquidity will cause further portfolio adjustments.

Though the liquidity approach provides a broader and better measure of money supply, its adoption in the actual world is difficult due to following reasons:

1. If money is theoretically defined to mean anything that serves the liquid-store-of money function, then money will include all medium of exchange assets. This would be a broader definition of money. But, the empirical difficulties with this definition are:
 - where the list of measures of money will stop
 - how to quantify the liquidity content of a medium.
2. Though the liquidity approach is superior to the transactions approach, but the actual definition of money must take into consideration the empirical realities, the institutional framework of the economy and the availability of data.
3. Certain problems relating to the concept of liquidity creates further difficulties in adopting the liquidity approach:

- It is not easy to quantify the liquidity content of an asset
 - Liquidity contents of an asset may not be constant.
4. Since the central bank does not have much control over the lending activities of the non-bank financial institutions, the existence and growth of near-money assets may create problems in the effective implementation of the monetary policy.

Fig. 5.1: Functions of Money



CREDIT CREATION

Concept of Credit

The word credit denotes trust or confidence which one economic unit may place in the other. In the present context, the reference is to the trust which a lender places in the debtor in the latter's capacity and willingness to pay back the loan together with its interest.

In a modern monetary economy, money acts as a generalized purchasing power. It is a claim upon the resources of the society which can be exercised by its owner. When a lender gives a loan to the borrower he transfers a part of his claims upon the resources of the society to the debtor and in return is entitled to receive back the claims of a bigger value [because of interest] in future.

Simultaneously, he is expressing confidence that his debtor would honor his obligations; he is giving his borrower the credit of ability and willingness to do so. In economics the terms credit, loans and advances have the same meaning. In a modern economy, it is very common for economic units to extend credit to each other. In addition to the borrowing and lending transactions, the sellers are continuously extending credit to their buyers. In this context, however, the financial institutions hold a special position. The very nature of their operations is to provide a bridge between the final lenders and final borrowers. They borrow from the final lenders (or savers) in the market and give loans to the final borrowers. In the process, they sell their own financial liabilities and buy financial claims upon others. Their operating surplus arises from the difference in the interest paid to their own

creditors and interest charged from their borrowers. Interest rate which a borrower has to pay for getting a loan depends, amongst other things, upon the creditworthiness of the borrower.

A financial institution is considered to be more creditworthy by the lenders in the market. And therefore it is able to borrow at lower interest rates. In contrast it can charge a higher interest rate from its borrowers because the latter have a lower creditworthiness in the market. In addition, the average term to maturity of the loans taken by the financial institutions is shorter than the average maturity of the loans extended by them. And this also contributes to the interest rate differential.

Within the category of financial institutions, banks occupy a special position. Their peculiarity lies in the fact that they provide the market with more means of payment than they take from the market in the form of cash, and this they do through the process of loan giving and deposit creation. Banks accept a variety of deposit. For us, an interesting variety is that of “cash deposits”. However, these deposits do not add to the means of payment available to the market. The market loses a certain amount of its cash holdings to the banks and get, in return, an equivalent amount of “deposit money”. However, the story does not end with the creation of these “primary deposits”.

The banks find that though depositors are entitled to come and encash their deposits as and when they want to, all of them do not do so very often. Moreover, even those depositors who do so, encash only a part of their deposits. As a result, a bank is left with some surplus cash which it can use for giving loans to others. Thus, a process of giving loans and creation of deposits comes into existence which results in the “creation of secondary deposits”. It is a form of means of payments which the market acquires. For the market, these means of payment which have been created through the process of loan-giving by the bank are like official money. As a result, this manner of adding to the money supply with the public is termed “credit creation”.

Credit Creation by Banks

A bank differs from other financial institutions because it can create credit. Banks have the ability to expand their demand deposits as a multiple of their cash reserves. This is because of the fact that demand deposits of the banks serve as the principal medium of exchange, and, in this way, the banks manage the payments system of the country. Banks add to the aggregate means of payments available to the market through deposits. Broadly speaking, these deposits may be divided into two categories, namely;

- cash deposits
- credit deposits

Cash deposits refer to that form of deposits which are created when customers bring cash to a bank and deposit the same with it. In this process, the public finds that there is no net addition to the means of payments possessed by it. There is only a change in their form; that is, some cash is replaced by bank deposits. Cash deposits may also be referred to as primary deposits.

The other category of deposits is more important for our purpose. A bank is a financial institution and has the objective of earning a profit income. Its main source of operating surplus is the difference between interest paid on its liabilities and interest earned from its assets. Cash balances appear on the asset side of its balance sheet. But it cannot earn any interest income from them. It must acquire other income earning assets for this purpose. It finds that the maximum income which it can earn is from the loans and advances given by it to its customers or borrowers. However, loans extended by a bank to its borrowers result in the creation of deposits in favour of the borrowers and thus add to the means of payment with them. The loan deposits so created are termed secondary deposits or derived deposits. Numerically, the addition to money supply is equal to excess of its deposit liabilities over its cash holdings. Since this addition takes place via loan-giving activity of the bank, the process is known as that of credit creation.

The fact of credit creation by banks can be verified both with the help of theory and their balance sheets. As stated above, a bank is a financial firm and has the objective of earning a profit income. For this reason, therefore, a bank “borrows short and lends long.” In other words, it contracts liabilities which, on an average, have a shorter duration and it acquires assets which, on the average, have a longer duration. Its assets are dominated by the category of “loans and advances” which bring a high interest income to the bank. Its liabilities are dominated by its deposit liabilities some of which are interest free while the rest of them carry comparatively low interest rates. Therefore, the bank is interested in creating the maximum possible deposit liabilities (preferably of the demand deposit variety).

The fact of credit creation can also be verified by looking at the balance sheet of any bank. It is seen that the cash balances with the bank are always a fraction of its deposit liabilities. As a result, the bank provides the market a much larger amount of means of payment (in the form of bank deposits) than it takes away from it (in the form of cash balances).

Process of Credit Creation

Credit creation is one of the important functions of a commercial bank. It constitutes the major component of money supply in the economy. The process of ‘Credit Creation’ begins with banks lending money out of primary deposits. Primary deposits are those deposits which are deposited in banks. Since, banks cannot lend the entire primary deposits so they are required to maintain a reserve with RBI which constitutes a certain proportion of primary deposits as per RBI Act & Banking Regulation Act. After maintaining the minimum required reserves, the bank may lend the remaining portion of primary deposits to borrowers. As banks lend the money, the process of credit creation commences.

Customers use these loan amounts to make payments. While making payments, they issue a Cheque against the loan deposits. The person who receives the Cheque, deposits it in another bank or same bank. For that bank, this would account as the primary deposit. A proportion of this deposit would be kept as a reserve and the balance will be used for lending further loans and advances. This process is repeated by other banks. This is how credit process is created.

During the process of credit creation, there arise two important issues which hold utmost consideration, namely profitability and liquidity.

- Profitability: Banks are guided by the profit earning motives in its operations. So the loans granted must be in a manner which earns an interest higher than what banks pay on its deposits.
- Liquidity: Banks on the other hand, subsequently should be able to meet its commitment to pay cash to its depositors as and when the depositors decide to exercise their right to demand cash against their deposits.

The bank credit creating process is based on the assumption that during any given time interval, only a fraction of its customers will be in genuine need of cash and that all customers would not turn up for demanding cash against their deposits at one point of time. At any given time, only a fraction of total deposits would be used to pay cash. Therefore, banks can lend the remaining proportion of money into market thereby, creating credit.

The net result is that a bank is able to meet the demand for encashment by its depositors by maintaining cash reserves which are only a fraction of its deposit liabilities. This phenomenon is known as that of “fractional cash reserves”, or “cash deposit ratio” being less than one.

In other words, the bank is subject to pulls from two opposite directions. The objective of profitability dictates that the bank should create additional deposits by giving loans to its customers and thus reduce the cash deposit ratio. The objective of liquidity dictates that the bank should be able to meet the demand for cash by its depositors and therefore maintain a very high cash deposit ratio. Accordingly, the bank tries to maintain that cash deposit ratio which is able to meet both requirements in a balanced manner.

Steps in the Process of Credit Creation

Assumptions to the process for simplification:

- There is only one bank named B, in the market.
- All deposits of cash and Cheques are made through this bank only.
- Cash Deposit Reserve maintained by bank is R%. i.e.

$$\frac{\text{Cash Reserves}}{\text{Deposit Liabilities}} \times 100 = R\%$$

- There is no net cash leakage. It means that the cash withdrawn by depositors is returned to it by the customers in the form of fresh deposits.
- The initial deposit with the bank is C = ₹100/=

Case 1: One Bank – No Cash Leakage

With the above assumptions, we find that the bank B starts with an deposit liability of ₹ 100 matched by an initial cash balance of ₹ 100. However, once the use of bank deposits by bank clients settles into a routine, the bank finds that, per period of time, there is an outflow of ₹ 10 matched by an equivalent inflow of cash of ₹ 10. As a result, the bank management discovers that it has a surplus of ₹ 90 which can be used for acquiring some income earning asset. Therefore, when borrowers apply for loans, the management is able to lend them ₹ 90. As it does so, it acquires an asset termed 'loans and advances' worth ₹ 90 and simultaneously contracts an additional deposit liability of ₹ 90. This is the second round of deposit creation and first round of credit creation. At the end of the second round of deposit creation, the bank has assets of ₹ 190 (cash ₹ 100 plus loans and advances ₹ 90) matched by liabilities of ₹ 190 (cash deposits ₹ 100 plus loan deposits, or credit creation, of ₹ 90).

When the circulation of deposits of ₹ 190 settles to a routine affair, the bank finds that out of its cash reserves of ₹ 100, only ₹ 19 (₹ 10 + ₹ 9) are in circulation and it has a spare balance of ₹ 81 left with it. Consequently, the third round of deposit creation (and the second round of credit creation) brings in deposit liabilities of ₹ 81.

In this manner, the bank B keeps creating deposits by giving loans. But it does so in stages and not in one step. When the process of credit creation is completed, the deposit liabilities of the bank stand at ₹ 1000 out of which ₹ 900 are due to the credit creation. It means that by losing ₹ 100 in the form of cash, the market has acquired means of payment, totaling ₹ 1000, in the form of bank deposits. There is a net addition of ₹ 900 to the money supply, or means of payments, in the hands of the market and this corresponds to the loans (₹ 900) given by the bank in several rounds of deposit creation.

The process of deposit creation can be presented in the form of a geometrical progression

Credit Amount

$$\begin{aligned} &= ₹ 100 / [1 - (1 - 0.1)] \\ &= ₹ 100/0.1 \\ &= ₹ 1000 \end{aligned}$$

This is the figure of total deposits created by the bank out of which credit creation is sum of second term onwards, which is ₹ 900.

$$\begin{aligned} \Rightarrow \quad \text{Total deposits created} &= C / [1 - (1 - R)] \\ &= C / R \end{aligned}$$

Case 2: One Bank – Cash Leakage

Keeping other assumptions the same, and dropping the assumption of no net cash leakage, that is, let us admit that some of the cash withdrawn by the depositors leads to a permanent loss of cash by the bank. It follows that such a loss of cash reduces the capacity of the bank to create credit by a multiple of this loss in the same manner as an acquisition of cash adds to its credit creation capacity. It should also be remembered that the loss of cash is exactly equal to the reduction in bank deposits, since every withdrawal from a deposit implies an equivalent payment of cash by the bank to the depositor.

Let C and R stands as stated in case 1, L stands for the deposits created by loans given by the bank, so that total deposits created are (C + L) and K stands for the portion of deposits encashed by the depositors, so that cash withdrawn = K (C+ L). This means that the deposits left after cash withdrawal equal (C + L) (1 - K), and cash balances left with the bank are equal to C - K (C + L).

Now in the end of the process, the cash balances of the bank are to be R proportion of its deposit liabilities. This gives us the following equation.

$$R = [C - K (C + L)] / (C + L) (1 - K)$$

Solving for L, we get

$$L = C(1-R) (1-K) / [R + K(1-R)]$$

In our numerical example, let us put K= 0.1. Then L is approximately equal to ₹ 426.3. This means that in addition to the initial cash deposit of ₹ 100, the bank creates loan deposits of ₹ 426.3, thereby creating a total deposit liability of ₹ 526.3. The clients withdraw ₹ 52.64 with the result that the bank is left with a cash reserve of ₹ (100 - 52.63 = 47.37) and a deposit liability of ₹ (526.3 - 52.64= 473.66) which means that the value of R = 10%. It is this cash deposit ratio which the bank is to maintain on its deposits to sustain their circulation.

Case 3: A System of Banks – No Cash Leakage

In this case, the basic assumption of one bank is discarded for a system of banks. Process of credit creation remains unchanged. It passes through similar several stages, though with the following differences.

- The process becomes more detailed and credit creation is shared by all the banks put together. When one bank extends loans to its customers and creates deposits in their favour, they pay to others either through Cheques or through first drawing cash and then paying them. However, payments made out of the deposits of a bank need not be to the customers of the same bank. Therefore, some withdrawals get deposited with other banks which, in turn, give loans and create deposits.
- If customers are unevenly distributed between the banks, the shares of credit creation of individual banks would also be unequal.
- Total credit created by the banking system as a whole can be different from the case when entire credit was created by a single bank. This happens if the cash deposit ratios maintained by individual banks differ.
- The process of credit creation must be pursued by the entire banking system collectively and evenly. No individual bank can create credit out of step with others. If it does so, it will lose cash balances to the other banks and will have to stop.

Case 4: A System of Banks –Cash Leakage

The process in this case applies similar to the findings of a single bank with cash leakage. Just as a single bank can create less credit when there is a cash leakage, similarly, credit creating capacity of the entire banking system also declines when it faces cash leakage. The process of credit creation remains the same in its essence. Only its arithmetic may change on account of differences between individual banks such as their size, cash deposit ratios, geographical spread etc.

It should be noted that cash leakage is a fact and to assume that it is not there is unrealistic. This is because, with an increase in total money supply, the public does not want to hold all its additional money balances in the form of only cash or bank deposits. It wants to divide them into both in varying proportions.

Limitations on Credit Creation

Though banks would prefer to hold an unlimited capacity of creating credit with an objective of profitability, in practice banks are faced with numerous limitations in doing so. These limitations result in making the credit creation process by banks as a non-profitable activity. Thus, a bank would keep creating additional credit so long as:

1. loans extended by the banks to its customers have a negligible chance of turning into bad debts
2. the difference between the interest rates that the banks charge on loans and advances lent is greater than that the banks give to depositors on the money deposited with the bank

In other words, the limitations of credit creation by banks operate through shifts in their balance between liquidity and profitability.

The limitations on credit creation by banks may be considered in respect to the following factors:

- the capacity of banks to create credit,
- the willingness of banks to create credit
- demand for credit in the market

Capacity to create credit is a matter of

- the availability of cash deposits with the bank
- the factors that determine their cash deposit ratio

It may be recalled that a bank is willing to create credit so long as

- it estimates that it will be profitable to do so
- it is able to maintain the liquidity requirements

As regards the demand for credit

- demand for credit must exist in market
- borrowers should be creditworthy (to avoid bad debts against their loans)
- amount of loan granted should not exceed the paying capacity of the borrower

In many situations, due to a policy pursued by the central bank, it is difficult to get fresh loans from the banks and we get the impression that demand for credit is unlimited. But factually it is not so. A persistent excess demand for credit exists only under inflationary conditions. But these conditions cannot last forever because continuous inflationary pressure can disrupt the financial system itself. In other words, the concept of a limitless demand for bank credit is only an illusion and not a reality.

REVIEW QUESTIONS



1. There are _____ main head for defining money based on its functions.
2. Medium of Exchange is _____ function of money
3. Money has a _____ purchasing power.
4. In audit creation process, deposits are dividend into cash and _____ deposits.

QUANTITY THEORY OF MONEY

Economists have always been interested in answering a two-fold question, namely, what determines the level of prices in general and what causes a variation in it. The Quantity Theory of Money seeks to explain the factors that determine the general price level in an economy. The theory states that the price level is directly determined by the supply of money. There are two versions of the Quantity Theory of Money:

- Transaction Approach
- Cash Balance Approach

Transaction Approach

The transaction approach to the Quantity Theory of Money is given by Fisher which may be explained with the help of following equation of exchange.

$$MV = PT$$

- where, **M is the total supply of money**
V is the velocity of circulation of money
P is the general price level
T is the total transactions in physical goods

This equation means, in an economy the total value of all goods sold during any period (PT) must be equal to the total quantity of money spent during that period (MV).

Fisher Version/Transaction Approach

Assumptions:

- (i) Price level is to be measured over a period of time
- (ii) There are no credit sales in the market
- (iii) Money is only a medium of exchange
- (iv) Each unit of money can change hands several times during the said time interval. Thus, total cash payment = MV, where: M = Money supply and V = Velocity.
- (v) All cash payments received during the year must be equal to the volume of goods and services sold multiplied their respective prices. Thus, total cash payment = PT, where: P = Price and T = Time period.

When these two assumptions are made the Equation of Exchange becomes the Quantity Theory of Money which shows that there is an exact, proportional relationship between money supply and the price level. In other words, the level of prices in the economy is directly proportional to the quantity of money in circulation. That is, doubling the total supply of money would double the price level.

This version proceeds with the idea that price level is determined by the demand for and supply of money.

Fisher also extended the equation of exchange so as to include demand (bank) deposits (M') and their Velocity (V') in the total supply of money. Thus, the equation of exchange becomes:

$$P = (M_1V_1 + M_2V_2)/T$$

M₁ = Currency

M₂ = Bank's money

V₁ & V₂ = Respective Velocities

Thus, the level of general price level depends on all the five variables of equation.

In the words of Irving Fisher, "Other things remaining unchanged, as the quantity of money in circulation increases the price level also increases in direct proportion and the value of money decreases and vice versa".

If the quantity of money is doubled the price level will also double and the value of money will be one half. On the other hand if the quantity of money is reduced by one half the price level will also be reduced by one half and value of money will be twice.

Fisher's Transaction Approach can explain the causes of hyperinflation that occurs during war or emergency. It can also explain certain long term trend in prices. But it cannot explain normal peace time inflation. This shortcoming has been modified by the Cambridge version or the Cash-Balance Approach.

Cash Balance Approach

The Cash-Balance Approach to the Quantity Theory of Money may be expressed as:

$$\pi = kR/M$$

where, π = **the purchasing power of money**

k = **the proportion of income that people like to hold in the form of money**

R = **the volume of real income**

M = **the stock of supply of money in the country at a given time**

This equation shows that the purchasing power of money or the value of money (δ) varies directly with k or R, and inversely with M.

Since δ is the reciprocal of the general price level

$$\text{Since, } \pi = 1/P$$

$$\Rightarrow \pi = kR/M$$

$$1/P = kR/M$$

$$M = kRP$$

If we multiply the volume of real income (R) by the general price level (P), we have the money national income(Y).

$$M = kY$$

where, Y is the country's total money income

In the Cash Balance approach k was more significant than M for explaining changes in the purchasing power (or value) of money. This means that the value of money depends upon the demand of the people to hold money.

CENTRAL BANKS

A central bank is an apex institution of a country's monetary and financial system. Since the monetary system (which includes commercial banks) is a dominant part of the financial system of a country; the central bank is the apex system to the country's financial system also. As such it plays a leading role in organizing, running, supervising, regulating and developing the monetary- financial system. The best way to define a central bank is to say that it is the apex financial institution of the country and subject to certain legal boundaries is vested with the authority to regulate, guide and help the financial system. It is not guided by profit motive and gives precedence to the economic interests of the country over its gains. Till the end of 19th century, central banking came into existence out of slow evaluation of some existing commercial banks. These banks were mostly in private ownership but through their strength and dominating size, came to acquire certain powers which were considered there of central banking. However, overtime, their working was bound by codes and ethics of rules and practices. Consequently, central banking developed into a distinct entity of its own. Central banks came into existence in the early 20th century through official legislation. The practice of creating a full-fledged central bank so as to take charge of the existing financial system got an impetus by the recommendations made by the International Financial Conference held at Brussels in 1920s. A large number of Central Banks were established thereafter. A

central bank in a country takes into purview the design and conduct of the monetary and credit policy as its special responsibilities. The central bank is the central regulatory authority in any economy on the banking and financial structure of the country. RBI, the central bank of our country came into existence in 1935.

Functions of a Central Bank

Central banking functions have evolved gradually over decades. Their evolution has been guided by ever-changing need to find new methods of regulating, guiding and helping the financial system (particularly, the banks). In other words, the evolution of central banking functions has tended to coincide with the evolution of the financial systems of the world economies. There are two types of functions that a central bank performs, namely;

- Leading Functions
- Other Functions

Leading Functions

- (a) Issue of Notes:** It is one of the primary functions of a central bank. The entire financial system of a country, with ever increasing volume and variety of the financial instruments, institutions and markets, needs a stable supply of legal tender money. This legal tender tends to vary, both in volume and composition, to the changing requirements of the economy. Accordingly, the central bank of the country is granted the sole right to issue currency (including that of the government of the country). The central bank exercises a monopoly over issuing bank notes in the economy.

The central bank is given monopoly of note issue for two reasons:

- Currency notes issued by a central bank are its liabilities corresponding to which it acquires certain assets which can be a source of income to it.
- Through appropriate legislation or otherwise, it can be ensured that the central bank does not over-issue currency notes.

The main advantages of granting the monopoly right of note issue to the central bank are given below:

1. It brings uniformity in the monetary system of note issue and note circulation.
2. The central bank can exercise better control over the money supply in the country. It increases public confidence in the monetary system of the country.
3. Monetary management of the paper currency becomes easier. Being the supreme bank of the country, the central bank has full information about the monetary requirements of the economy and, therefore, can change the quantity of currency accordingly.
4. It enables the central bank to exercise control over the creation of credit by the commercial banks.
5. The central bank also earns profit from the issue of paper currency.
6. Granting of monopoly right of note issue to the central bank avoids the political interference in the matter of note issue

In the initial stages, central banks were privately owned and were competing with other banks for business. During those days, therefore, they were tempted to over issue notes so as to earn more income. Consequently, the authorities felt that steps should be taken against this misuse of the privilege of monopoly of note issue. The solution of this problem was sought in removing, partially or fully, the temptation to over issue notes, that is, in ensuring that the assets acquired by the central bank against its note issue are not income yielding. The non-income yielding assets for backing the note issue were to be gold bullion and coins.

A maximum limit of note issue may be prescribed without any reference to its backing in terms of gold. Clearly, this method is highly restrictive. The supply of legal tender fails to respond to increasing needs of an expanding economy. Revising the limit through legislation can be quite cumbersome and disruptive.

It may be prescribed that the gold backing of note issue must not fall below a prescribed percentage.

(b) Bank to Bankers: The second main function of a central bank is that of being a bank to the banks. This signifies that the central bank has the same relationship with the commercial banks in the country that the latter share with their customers. It provides security to their cash reserves, gives them loan at the time of need, gives them advice on financial and economic matter and work as clearing house among various member banks. The central bank acts as the bankers' bank in three capacities:

- as custodian of the cash preserves of the commercial banks
- as the lender of the last resort
- as clearing agent

In this way, the central bank acts as a friend, philosopher and guide to the commercial banks.

As a custodian of the cash reserves of the commercial banks the central bank maintains the cash reserves of the commercial banks. Every commercial bank has to keep a certain percentage of its cash balances as deposits with the central banks. These cash reserves can be utilized by the commercial banks in times of emergency.

The centralization of cash reserves in the central bank has the following advantages:

1. It inspires confidence of the public in the banking system of the country.
2. It provides the basis of a larger and more elastic credit structure than if these amounts were scattered among the individual banks.
3. Centralised reserves can be used to the fullest possible extent and in the most effective manner during the periods of seasonal strains and financial emergencies.
4. It enables the central bank to provide financial accommodation to the commercial banks which are in temporary difficulties. In fact the central bank functions as the lender of the last resort on the basis of the centralised cash reserves.
5. The system of centralized cash reserves enables the central bank to influence the creation of credit by the commercial banks by increasing or decreasing the cash reserves through the technique of variable cash-reserve ratio.
6. The cash reserves with the central bank can be used to promote national welfare.

As the supreme bank of the country and the bankers' bank, the central bank acts as the lender of the last resort. In other words, in case the commercial banks are not able to meet their financial requirements from other sources, they can, as a last resort, approach the central bank for financial accommodation. The central bank provides financial accommodation to the commercial banks by rediscounting their eligible securities and exchange bills.

The main advantages of the central bank's functioning as the lender of the last resort are:

1. It increases the elasticity and liquidity of the whole credit structure of the economy.
2. It enables the commercial banks to carry on their activities even with their limited cash reserves.
3. It provides financial help to the commercial banks in times of emergency.
4. It enables the central bank to exercise its control over banking system of the country.

As the custodian of the cash reserves of the commercial banks, the central bank acts as the clearing house for these banks. Since all banks have their accounts with the central bank, the central bank can easily settle the claims of various banks against each other with least use of cash. The clearing house function of the central bank has the following advantages:

1. It economizes the use of cash resources by banks while settling their claims and counter-claims.
2. It reduces the withdrawals of cash which enables the commercial banks to create credit on a large scale.

3. It keeps the central bank fully informed about the liquidity position of the commercial banks.

(c) Banker to the Government: The central bank of the country also acts as a banker to the government. This function normally involves three things;

- providing ordinary banking services to the government
- being a public debt agent and underwriter to the government
- being an advisor

As a Banker to Government, the central bank performs the same functions for the government as a commercial bank performs for its customers. It maintains the accounts of the central as well as state government; it receives deposits from government; it makes short-term advances to the government; it collects Cheques and drafts deposited in the government accounts; it provides foreign exchange resources to the government for repaying external debt or purchasing foreign goods or making other payments.

As an Agent to the Government, the central bank collects taxes and other payments on behalf of the government. It raises loans from the public and thus manages the public debt. It also represents the government in the international financial institutions and conferences.

As a Financial Adviser to the Government, the central bank gives advise to the government on economic, monetary, financial, banking and fiscal matters such as deficit financing, devaluation, trade policy, foreign exchange policy, etc.

(d) Custodian of Foreign Exchange Reserves: Central bank is the custodian of the foreign currency obtained from various countries. This has become an important function of central bank. These days, because with its help it can stabilize the external value of the currency. This arrangement helps the authorities in managing and co-ordinating the monetary matters of the country more effectively. This is because there is a direct association between foreign exchange reserves and quantity of money in the market. The foreign exchange reserves are influenced by international capital movements, international trade credits etc. Because of the interaction between the domestic money supply, price level, and exchange reserves, the central bank frequently faces several contradictory tendencies which have to be reconciled.

(e) Management and Regulation of Exchange Rate: A related function which is assigned to the central bank is the management, regulation and stabilisation of the exchange rate. This task is facilitated when the central bank is also the custodian of official foreign exchange reserves. The need for a stable exchange rate has emerged with the rapidly growing global connections. In this context, it was essential that this function be handled by an expert agency; for which central bank of the country is considered the best agency. The central bank being the apex institution of the entire financial system of the country possesses maximum data and has the expertise of estimating the financial trends and the type of corrective measures needed. Moreover, it has several regulatory powers over the financial system. It can contemplate and take the complementary measures needed for ensuring the success of the steps taken in the area of exchange rate.

(f) Credit Control: These days, the most important function of a central bank is to control the volume of credit for bringing about stability in the general price level and accomplishing various other socio economic objectives. The central bank has acquired the rights and powers of controlling the entire banking. A central bank can adopt various quantitative and qualitative methods for credit control such as bank rate, open market operation, changes in reserve ratio selective controls, etc. Over the years, credit control has become a leading function of a modern central bank. In earlier days, the term credit control referred to the regulation of only the volume of money and credit. Currently, the term is used in a wider meaning and covers not only the volume of money and credit, but also its components, its flows, its allocation between alternative uses and borrowers, terms and conditions attached to credit. The need for credit control arises because it is observed that “money cannot manage itself”. Left to unregulated market forces, flows of money and credit have the tendency to accentuate cyclical fluctuations.

Other Functions

(a) Collection of Data: Central banks in almost all the countries collect statistical data regularly relating to

economic aspects of money, credit, foreign exchange, banking etc. from time to time. The committees and commission are appointed for studying various aspects relating to the aforesaid problem.

- (b) Central Banking in Developing Countries:** The basic problem of less developed countries is the problem of lack of capital formation whose main causes are lack of saving and investment. Therefore, central bank can play an important role by promoting capital formation through mobilizing savings and encouraging investment.

It is believed that an underdeveloped country requires an all-frontal approach in solving its problems of poverty and growth. Though regulation of the volume of money and credit and its other dimensions, the central bank plays a key role in its growth policy, much more is needed to make it really effective. Viewed in this manner, the functions of a central bank come to cover a much wider field than is conventionally considered in the case of central banks of developed countries.

A central bank is different for different countries.

For instance,	For India	Reserve Bank of India
	For USA	Federal Reserve
	For Europe	European Central Bank
	For China	People's Bank of China

Reserve Bank of India (RBI)

The RBI was established on April 1, 1935, under the Reserve Bank of India Act, 1934 as a private shareholders' bank with fully paid up share capital of Rs.5 crores on the basis of the recommendations of the Hilton Young Commission. The Government held shares of nominal value of Rs. 2,20,000. It was nationalised on January 1, 1949.

The executive head of the bank is called Governor, who is assisted by Deputy Governors and other Executive officers in the administration of the bank. For general direction, the bank has a central board of directors, supplemented by four local boards at Delhi, Calcutta, Madras and Bombay for four respective regional areas; northern, eastern, southern and western.

The head office of the central bank is in Mumbai. The bank has 22 offices across the country.

COMMERCIAL BANKS

A commercial bank is a financial institution authorized to provide a variety of financial services, including consumer and business loans, savings accounts etc. Earlier commercial banks were limited to accepting deposits of money or valuables for safekeeping and verifying coinage or exchanging one jurisdiction's coins for another's. By the 17th century, most of the essentials of modern banking, including foreign exchange, the payment of interest, and the granting of loans, were in place.

Broadly speaking, the functions of a commercial bank can be classified in the following two categories:

- Primary Functions
- Secondary Functions

Primary Functions

- (a) Accepting Deposits:** The commercial banks accept deposits from public, businessmen and others in form of
- Saving Deposits
 - Time Deposits
 - Current Deposits

Under the saving deposits banks accept small deposits from households or persons in order to encourage savings in the economy.

Fixed deposits are accepted for a fixed time period specified in advance. It carries higher rate of interest as compared to saving deposits.

In case of current account, the banks undertake the obligation of paying all cheques against the deposits of the customers subject to adequate fund in the account. In many cases the current account balance runs into overdrafts to a certain pre-specified limit. No interest is paid on such deposit types. These are mostly availed by business houses.

(b) Lending of Fund: The other important activity covered in the array of functions of the commercial banks is lending of the fund to the users in form of Loans and Advances; Cash Credit, Overdraft and Discounting of Bills etc.

Loans are like advances extended by the bank to his customers with or without security for a specified period of time at an agreed rate of interest. In this case, banks credit the loan amount in the customer's account who may withdraw the same as per his needs.

Under the Cash credit facility, banks offer his customers to borrow cash up to certain specified limit against the security of goods.

Overdraft is like an arrangement offered by the banks where customers are permitted temporarily to overdraw from his current account without security upto a certain pre specified limit. Banks also deals in discounting and purchasing bills. In both the situations, banks after charging discounts and commissions to credit the amount of bills in customer's accounts which shall be recovered from customers debtors on maturity of the instrument..

Secondary Functions

(a) Agency Service: Banks acts as an agents to their customers by rendering various services on behalf of customers like:

- Collection of bills, draft, cheques dividends etc
- Payments of insurance premium, loan instalments, rent, bills etc
- Acting as representatives of customers for stock exchange operations such as purchase and sale of securities etc
- Acting as an executors, administrators, trustee of an estate of customers
- Other services such as preparation income tax returns, claiming of tax refunds etc.

(b) General Utility Services: Commercial banks also offers variety of general utility services such as issuing travellers cheques, locker facilities for keeping valuables in safe custody, issue of debit and credit cards, etc. to their customers.

Thus the functions of commercial banks can be summarized as below:

Primary Functions	Secondary Functions
Accepting Depositsv - The commercial banks accepts deposits from public, businessmen and others in the form of - Saving Deposits - Time Deposits - Current Deposits	Agency Service - Collection of bills, draft, cheques, dividends, etc. - Payments of insurance premium, loan installments, etc. - Acting as an executor, administrator or trustee - Other services such as preparation of income tax returns, claiming of tax refunds etc.

Lending funds	General Utility Services
<ul style="list-style-type: none"> – Loans and Advances – Cash Credit – Overdraft – Discounting of Bills 	<ul style="list-style-type: none"> – Issuing travelers cheques – Locker facilities for keeping valuables in safe custody – Issue of debit and credit cards

REVIEW QUESTIONS



1. Two versions of Quantity Theory of money are _____ and _____.
2. Central Banks acts by Bank to _____ and _____.
3. Central Bank of Europe is _____.
4. RBI was established on _____.

MONETARY POLICY IN INDIA

By monetary policy, we meant; the policy which results in changes in the supply of money. Consequently, it is natural to define credit policy as policy concerned with changes in supply of credit. Monetary Policy of a country is the Central Bank's policy for controlling the availability, cost and use of money and credit with the help of monetary measures in order to achieve certain definite goals. These goals are:

- Maximising feasible output
- High rate of growth in GDP
- Full employment
- Price stability (optimal rate of inflation)
- Greater equality in the distribution of income and wealth
- Positive balance of payments
- High rate of savings and investment
- Reduction in Income Inequalities
- Regional Balance Development

Monetary policy is the process by which the monetary authority of a country controls the supply of money, often targeting a rate of interest for the purpose of promoting economic growth and stability. In Indian context, the monetary policy relates to the policy decisions that the government with RBI formulates in order to stabilize the volume and composition of money supply, the size and distribution of credit, the level and structure of interest rates, and the effects these monetary variables on macro economic variable like; savings, investments, output level, prices and income. Monetary theory provides insight into how to craft optimal monetary policy.

The monetary policy is implemented by RBI through instruments of credit control. These instruments are classified into two types:

- Quantitative or General Measures
- Qualitative or Specific Measures

General or Quantitative Credit Control Measures

These measures are non-discriminatory as between banks and as between the uses to which credit may be given. These are driven towards influencing the total volume of credit in the banking system without special indication as to how these may be put to use. They aim at regulating only the aggregate volume of money and credit available to the economy. They do not distinguish between the purposes for which borrowers use the loans, or the type of borrowers who are getting the loans. These measures are used on the assumption that there is a free market mechanism in the economy. Therefore, the authorities need not worry about the part of the economy in which the additional credit supply is injected, or from which these are drained out. The effect is felt by the entire economy or not at all.

The leading instruments associated with general credit control measures are:

- Bank Rate Policy
- Open Market Operations
- Variable Reserve Requirements
- Repo Rate and Reverse Repo Rate

(a) Bank Rate: Bank rate is the interest rate at which a central bank provides loans to banks. It is widely known as the traditional weapon of credit control used by central bank in regulating the levels of supply of money in the economy. Correspondingly, bank rate is the rate at which the central bank discounts the bills and other instruments of commercial banks which are redeemable at par. In practice, the two rates result in the same cost of borrowing from the central bank so that the two terms can be used interchangeably.

The central bank being the lender of the last resort, the bank rate is the rate at which it is ready to extend credit which has a direct impact upon the levels of interest rates prevailing in the country. When the market has to pay more for its funds from the central bank, it increases the interest rate charged from the business sector. It is expected that, faced with a demand for increased interest rates, the borrowers curtail their demand for credit and investment activity slows down. Moreover, higher cost of borrowing funds adds to the cost of production and supply, which means that the suppliers must increase prices or bear the extra cost themselves. In the former case, market demand decreases and results in a recession. And in the latter case, there is a dampening effect on fresh investment. In contrast, a reduction in bank rate leads to a fall in the level of interest rate in the market. The cost of borrowing funds comes down resulting in a downward impact on the cost structure of the business sector. Ordinarily, therefore, with an increase in bank rate, the demand for business loans is expected to fall and vice versa.

(b) Open Market Operations (OMO): When use of bank rate is not effective enough in regulating the volume of money and credit, the central bank can resort to the use of open market operations. This instrument refers to the practice of sale and purchase of commercial paper (like trade and exchange bills) and government securities by the Central bank in the market on its own initiative in order to control the volume of credit. These days, even swapping operations (that is, simultaneous buying and selling of securities of different maturities) are also introduced in OMO. In practice, however, OMO are confined to government securities only.

The Open market operations have two way effects on the economy. Firstly, through the change in the amount of credit available in the market and secondly, by impacting the rates of interest. When the central bank sells securities, and receives sales proceeds from the buyers, an equivalent reduction takes place in the amount of money supply in the market. To the extent the commercial banks lose cash balances; the capacity to create credit is reduced by a multiple of this loss. The net result is that there is a multiple reduction in the amount of money and credit available to the market. Similarly, when the central bank wants to increase the availability of money and credit in the market, it resorts to buying of securities and, in the process, loses cash to the market.

Another effect generated by OMO is that on rate of interest. Other things being equal, when the central bank

sells securities, their prices fall. This, by itself, means an increase in the rate of return on securities and a corresponding increase in the market rate of interest. An increase in market rate of interest is also supported by the fact that the sale of securities results in a reduction in the availability of money and credit in the market. Similarly, when the central bank buys securities, other things being the same, an increase in their demand causes an increase in their prices and a corresponding reduction in the rate of return on them. Also, there is an injection of legal tender in the market and that leads to a fall in the interest rate.

(c) Variable Cash Reserve Requirements: The traditional instruments of quantitative credit control, bank rate policy and open market operations, suffer from certain inherent defects and have been found unsuitable to serve the interests of underdeveloped countries. Hence, an entirely new and unorthodox instrument of quantitative credit control, in the form of variable reserve ratio, came into vogue. The central bank used this method to control credit using two types of reserves namely;

- Cash Reserve Ratio (CRR)
- Statutory Liquidity Ratio (SLR)

Cash Reserve Ratio refers to the percentage of the deposits that the commercial banks are required to maintain with the central bank, being subject to variations by the central bank. The central bank, then, acts as the custodian of the cash reserve of the commercial banks.

Statutory Liquidity Ratio refers to the percentage of total deposits of the commercial banks that the commercial banks are required to maintain with themselves in form of liquid assets viz. - cash, gold or approved government securities.

By changing these ratios, the central bank is in position to control the level of credit in the market. The central bank imparts liquidity and confidence into the system by altering these ratios. This reserve requirement is subject to changes by the central bank depending upon the monetary needs and conditions of the economy.

A higher CRR means a reduction in the capacity of the banks to create credit while a lower CRR has the opposite effect. CRR has the disadvantage that it reduces the profitability of the banking operations. The central bank pays an interest rate on these deposits which is lower than what the banks can get from their market borrowers. In addition, if a bank fails to meet the requirement of maintaining the stipulated minimum balance (which is related to its own deposit liabilities and is therefore a variable amount), it is subjected to some form of a penalty. For this reason, most banks tend to maintain more than necessary deposit balances with the central bank.

(d) Repo Rate and Reverse Repo Rate: In addition to the above instrument, another tool used by central bank is Repo and Reverse Repo Rate. Repo rate is the rate at which commercial banks borrow money from the central bank in case of any shortage of funds they face. RBI lends money to bankers against approved securities for meeting their day to day requirements or to fill short term gap. A reduction in the repo rate will result in increased borrowing powers of the banks hence increased amounts with the banks to lend out. Consequently, this will increase the supply of credit. Reverse Repo rate is the opposite concept. It is the rate at which RBI borrows money from commercial banks. An increase in reverse repo rate can cause banks to transfer more funds to RBI due to attractive interests hence, reducing lending capacity.

Qualitative or Selective Credit Control Measures

By the very nature, these measures are directed at regulating selective segments of the economy. Selective credit control measures are exercised through issuing specific instructions to the banks. They can be discriminatory as between banks, between borrowers, between purposes for which credit is extended.

The central bank generally uses the following forms of credit control:

- fixing the margin and the maximum amount that a borrower can avail against the securities

- issuing consumer credit regulation
- issuing directives to commercial banks comprising of statement and warnings regulating the activities of commercial banks,
- rationing of credit for controlling the purposes for which credit is granted
- morally persuading to co-operate with the monetary policy
- taking action directly against erring commercial banks

The central bank has a major role to play in the monetary policy of the country. It needs to stabilise the financial system. The central bank makes frequent changes in the policy to keep the economy functioning through its monetary system in accordance to its goals and needs.

LESSON ROUND UP

- Money is an important component of the economy. Money was brought into existence to tide over the difficulties of barter system that was the traditional method to trade.
- There are two approaches adopted by economists to define money
 - Functional Approach
 - Liquidity or Generalized Purchasing Power Approach
- The functional approach defines money based on following functions:
 - Medium of Exchange
 - Measure of Value
 - Standard of Deferred Payment
 - Store of Value
 - Transfer of Value
 - Basis of Credit
 - Distribution of Social Income
 - General Form of Capital
 - Maximum Benefit
- The liquidity approach provides acceptability of money by creditors in discharge of their claims, and by sellers as sales proceeds, means that money has a generalized purchasing power. The liquidity approach emphasizes the function of money as a store of money.
- Money facilitates the process of credit creation which is the process of inducing and extraction money supply in the economy.
- A bank differs from other financial institutions because it can create credit. The process of 'Credit Creation' begins with banks lending money out of primary deposits.
- During the process of credit creation, there arise two important issues which hold utmost consideration, namely profitability and liquidity.
- Quantity Theory of Money seeks to explain the factors that determine the general price level in an economy
- There are two versions of the Quantity Theory of Money:

- Transaction Approach
- Cash Balance Approach
- The overall control of an economy's financial and monetary structure is controlled by the apex institution known as central bank which is Reserve bank of India.
- A commercial bank is a financial institution authorized to provide a variety of financial services, including consumer and business loans, savings accounts etc.
- By monetary policy, it is meant; the policy which results in changes in the supply of money. Monetary Policy of a country is the Central Bank's policy for controlling the availability, cost and use of money and credit with the help of monetary measures in order to achieve certain definite goals.
- The monetary policy is implemented by RBI through instruments of credit control. These instruments are classified into two types:
 - Quantitative or General Measures
 - Qualitative or Specific Measures
- The leading instruments associated with general credit control measures are:
 - Bank Rate Policy
 - Open Market Operations
 - Variable Reserve Requirements
 - Repo Rate and Reverse Repo Rate
- Selective credit control measures are exercised through issuing specific instructions to the banks.

GLOSSARY

Barter System	Barter System is that system in which goods are exchanged for goods. In ancient times when money was not invented trade as a whole was on barter system.
Functional Approach	The approach to define money based on the functions of money.
Liquidity Approach	The approach to define money based on its characteristic of liquidity.
Deferred Payment	A debt which has been incurred and will be paid back at some point in the future.
Purchasing Power	The ability to purchase which is generally measured by income. The value of money, as measured by the quantity and quality of products and services it can buy. It is also called buying power.
Financial Institutions	An establishment that focuses on dealing with financial transactions, such as investments, loans and deposits. Conventionally, financial institutions are composed of organizations such as banks, trust companies, insurance companies and investment dealers.
Monetary Policy	The actions of a central bank, currency board or other regulatory committee (monetary authorities) that determine the size and rate of growth of the money supply, which in turn affects interest rates.

SELF-TEST QUESTIONS

1. How would you define money ? What are alternative approaches for doing so?
2. Distinguish between functional and liquidity approaches to defining money. Highlight their similarities and dissimilarities.
3. “Anything which is generally accepted by the creditors in discharge of their claims upon the debtors is money”. Elaborate
4. What are the alternative official measures of money supply in India ? Describe them in detail.
5. What is Quantity Theory of Money ? Assess its ability to explain the determination of and variation in the level of prices in general.
6. State, explain and critically discuss the Fisher’s version of Quantity Theory of Money.
7. State, explain and critically discuss the Cambridge version of Quantity Theory of Money.
8. Can the banks create unlimited amount of credit ? If not, why ?
9. What is meant by credit creation ? What is its process ? Illustrate your answer with the help of algebraic formulation and numerical examples
10. What are the factors which determine cash deposit ratio of a bank ? What are the sources of cash reserves of the banking system ?
11. Define a central bank and discuss its main functions.
12. “The central bank of an underdeveloped country has to be more than a conventional central bank. “ Elaborate this statement.
13. What is meant by credit control? What are its main categories? Also discuss their suitability for developed and underdeveloped economies.
14. Discuss in detail the nature and effectiveness of instruments of credit control which can be employed by the central bank.
15. Discuss the functions of commercial banks.

Suggested Readings

1. Suraj B. Gupta: Monetary Economics Institutions, Theory and Policy
2. G. Crowther: An Outline of Money
3. R. S. Sayers: Modern Banking
4. RBI Governor speeches on Monetary Policy

Lesson 6

Basic Characteristics of Indian Economy

LESSON OUTLINE

- Development Initiatives through Five Year Plans
- Review Questions
- Agriculture
 - Role of Agriculture in the Indian Economy
 - Causes of Low Productivity
 - Land Reforms
 - Green Revolution
 - Globalisation and Agriculture
- Review Questions
- Industry
 - Role of Industry in Indian Economy
 - Industrial Policy
 - New Industrial Policy 1991
- Review Questions
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

It is now well over half a century since India embarked on a policy of “planned economic development”. We have to rightly regard India as a key country in the struggle for the committed nations of the world, as the major counterforce to influence on the trends of growth and development patterns. We have to also regard the incredible contribution of Indian economy in the development through planned growth since 1951. Since then, it has been on a positive side of graph though, of course sometimes facing a downturn also.

In this context, it becomes essential to acquaint with the basic characteristics of Indian Economy comprising of developing agriculture and industry under Five year plans. Some other aspects covered are growth and development of agriculture and industries through plans.

Further, there have been attempts since the 80s to liberalise the industrial policy framework. This lesson also deals briefly with the New Industrial Policy, 1991 to enumerate on the impact of the policy on Indian economy.

With a population of just over 1.2 billion, India is the world’s largest democracy. In the past decade, the country has witnessed accelerated economic growth, emerged as a global player with the world’s fourth largest economy in purchasing power parity terms, and made progress towards achieving most of the **Millennium Development Goals**.

World Bank: India Country Overview 2011

DEVELOPMENT INITIATIVES THROUGH FIVE YEAR PLANS

When India became Independent, it was a highly backward economy. It possessed all the salient characteristics of underdevelopment such as low per capita income, low saving and investment mass poverty, inequalities, regional disparities, a limited extent of industrialisation, poor use of productive resources, poor health facilities, insufficient and inefficient infrastructure, dominance of agriculture, widespread unemployment and so on.

Committed to the objective of growth with distributive justice and removal of common ills like poverty and unemployment, the authorities came to the view that we should not commit ourselves to either a full-fledged market economy or a complete negation of it in the form of centralised planning. We choose to have a mixed economy with planning, a complementary role of public and private sectors, and an active role of the state.

The rationale of planning was derived from the reasoning that a poor country like India could not simultaneously pursue a multiplicity of objectives. It had to determine priorities in terms of their social and economic worth, while keeping in view the interlinkages and the need for providing a basis for a rapid self-sustained growth together with a progress towards distributive justice and socialistic pattern of society. Even the Constitution of the country directed the authorities to ensure that all the citizens had access to adequate means of livelihood. The directive principles of the Constitution also provided that concentration of economic power was to be prevented. There was, therefore, a need for a systematic restructuring of social and economic institutions. It was recognized that reduction in poverty and improvement in consumption standards was possible only by achieving a faster rate of economic growth through efficient and optimum allocation of productive resources. Planning was also needed to increase gross domestic saving and gross domestic investment together with acquiring improved technology and tackling the deficit balance of payments problem.

If, in our reasoning, we ignore the weakness of human nature and attitudes, it can be established that economic planning can accelerate the growth rate of the economy and achieve other objectives faster while avoiding the ills of a free market mechanism. However, the ground reality is that while government regulation and direction may be recommended for overcoming market failures, planning process itself also suffers from government failures. It is not possible to get rid of both types of failures by any means. We tried to achieve this impossible objective through the path of a mixed economy, but failed (as we were bound to). The inherent reason for market failures lies in the fact that in this system, the decision-makers are guided by their self-interest. In contrast, the government failures emanate from the fact that (i) the authorities are unable to judge the precise needs of the economy and the society, (ii) they are unable to implement their plans quickly and efficiently, and (iii) there is a lack of a strong mechanism of economic incentives and disincentives.

The Planning Commission was set up in March, 1950 by a Resolution of the Government of India which defined the scope of its work in the following terms :

“The Constitution of India has guaranteed certain Fundamental Rights to the citizens of India and enunciated certain Directive Principles of State Policy, in particular, that the State shall strive to promote the welfare of the people by securing and protecting as effectively as it may a social order in which justice, social, economic and political, shall inform all the institutions of the national life, and shall direct its policy towards securing, among other things, –

- that the citizens, men and women equally, have the right to an adequate means of livelihood.
- that the ownership and control of the material resources of the community are so distributed as best to sub serve the common good.
- that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment.

Having regard to these rights and in furtherance of these principles as well as of the declared objective of the Government to promote a rapid rise in the standard of living of the people by efficient exploitation of the resources of the country, increasing production, and offering opportunities to all for employment in the service of the community.

The Planning Commission will—

1. make an assessment of the material, capital and human resources of the country, including technical personnel, and investigate the possibilities of augmenting such of these resources as are found to be deficient in relation to the nation's requirements
2. formulate a Plan for the most effective and balanced utilization of the country's resources
3. on a determination of priorities, define the stages in which the Plan should be carried out and propose the allocation of resources for the due completion of each stage
4. indicate the factors which are tending to retard economic development, and determine the conditions which, in view of the current social and political situation, should be established for the successful execution of the Plan
5. determine the nature of the machinery which will be necessary for securing the successful implementation of each stage of the Plan in all its aspects
6. appraise from time to time the progress achieved in the execution of each stage of the Plan and recommend the adjustments of policy and measures that such appraisal may show to be necessary
7. make such interim or ancillary recommendations as appear to it to be appropriate either for facilitating the discharge of the duties assigned to it; or, on a consideration of the prevailing economic conditions, current policies, measures and development programmes; or on an examination of such specific problems as may be referred to it for advice by Central or State Governments

The principal task of the Planning Commission is to formulate the five-year plans. In this context, proper planning procedure is followed for the most effective and balanced utilization of the material, capital, and human resources. Special emphasis is given to appraisal of the progress in the implementation of the plan from time to time, and to recommend adjustments of policy and measures that are considered to be necessary in the light of such appraisal.

The Planning Commission also oversees the development programmes of the central ministries and the state governments with a view to achieve coordination at the highest level.

At the Union level, the role of Planning Commission is crucial. In investment planning, it provides an objective method of resource allocation reconciling the competing claims of various departments and agencies, taking into account the broad national objectives and priorities.

A national plan in India comprises of the plans of a central government, the state governments, the central and state public-sector undertakings, and the private sector of the economy. In the five year plan document, the amount of money, which is proposed to be invested under various plan heads during the period, is broken down into public sector outlay and private sector plan outlay.

The public sector outlay is the most important part in the plan as the government has direct control over the investment of this sector during a five-year plan period. It is further divided into the central plan and state plans, earmarking the projects and schemes to be launched. In this plan, specific schemes of financing are worked out for the Union and each state, indicating clearly the additional resources, and mobilization efforts that would need to be undertaken. These are integrated with the overall scheme of flow of funds for the economy.

Thus, preparation of the five-year plan for the nation's economy is a mammoth exercise involving many multiple

constitutional authorities and statutory agencies. The national plan must have the involvement and consent of the parties concerned. The formulation of each plan is preceded by considerable amount of technical work, prolonged consultations and intense lobbying to arrive at consensus, especially on the various parameters of state plans.

The need for building a consensus arises as India is a federal and democratic polity. The constitution provides for the demarcation of subjects between the Union, the State, and the Concurrent lists in the seventh schedule of the Constitution so as to conform to the notions of a federal polity.

Moreover, planning falls under the concurrent list. Therefore, it is the responsibility of both the Union and state governments. The national plan must be able to carry along the central ministries and state governments on a generally accepted course of action.

Even the democratic structure requires that the national plan should be formulated through consensus. Thus, it involves wide-ranging discussions and participation of non- departmental agencies also.

In addition to the involvement of specialized institutions, such as, the Reserve Bank of India, the Central Statistical Organisation, etc. The political leaders, business and industry groups, etc. are also involved at various stages. Public opinion is also sought on the important aspects of the plan. The Planning Commission seeks to ensure through the annual plans, which are the operational plans, that the sum total of outlays of the centre and the state tallies with the estimates of available resources.

In India, the Planning Commission was constituted in March 1950. It was assigned the task of formulating “a plan for most effective and balanced utilisation of the country’s resources”. The institution of planning commission has continued to exist since then and has been supplemented with planning bodies at state and local levels. Some of the main objectives of planning in India happen to be the following:

- (i) *Increase in National Income*: This objective gets translated into an increase in not only the national income, but also in the level of production and real per capita income.
- (ii) *Achieving Full Employment*: Unemployment is a curse in any society. It is more so when there is an inadequate social security or its total absence. Employment imparts dignity to human beings and is also an important means of reducing poverty and inequalities. The objective of planning was not to reduce inequalities by lowering the income levels of the richer sections but by raising the income levels of the poorer sections.
- (iii) *Reduction in Inequalities of Income and Wealth*: India being an extremely poor country, inequalities of income and wealth translate themselves into absolute poverty and destitution. There can be no difference of opinion regarding the desirability of reducing such inequalities, particularly because they also lead to inequality of economic opportunities.
- (iv) *Creation of a Socialist Society*: This was an obvious and generally accepted objective inclusive of there being equal opportunities of economic advancement for all sections of the society.
- (v) *Removal of Bottlenecks*: Removal of Bottlenecks in the way of economic growth *such as*, low rates of saving and investment, inefficient technology, problems of balance of payments, absence of basic industries and insufficient infrastructure, etc.
- (vi) *Industrialization*: Our plans adopted a strategy of industrialization of the economy with *particular* emphasis on heavy and basic industries. Though this strategy also assigned a high priority to agricultural growth, in practice, agricultural and rural development received inadequate attention. Some analysts are of the view that India, with its vast agricultural potential should have first concentrated on the development of agriculture and rural parts of the economy. Such an approach would have generated economic surplus needed for capital formation and investment.

- (vii) *Self-reliance*: Our plans also aimed at “self-reliance”. Critics claim that this objective was misinterpreted and led to the adoption of wrong priorities. Our plans and policies took it to mean freedom from the need to import and therefore a policy of “import substitution” regardless of its cost. The critics hold the view that this objective should have been taken to mean “ability to pay for our imports through our export earnings”. Viewed this way, we should have added to our export capacity and competitive strength in international markets.
- (viii) *Precedence to Public Sector*: In our planned growth, public sector was assigned a place of precedence over the private sector so as to acquire commanding heights of the economy and be in a *position* to use it for guiding the private sector along chosen lines. This was done while ignoring the fact those public sector undertakings is inherently less efficient than private ones.

Thus, the basic objectives of India’s Five Year Plans are rapid economic growth, full employment, self-reliance and social justice. Apart from these basic objectives, each five-year plan takes into account the new constraints and potential during the period and attempts to make the necessary directional changes and emphasis.

First Five-Year Plan (1951-1956)

The first Prime Minister of India, Jawaharlal Nehru presented the first five-year plan to the Parliament of India on 8 December, 1951. The plan addressed, mainly, the agrarian sector, including investments in dams and irrigation. The agricultural sector was hit hardest by the partition of India and needed urgent attention. The total planned budget of Rs 206.8 billion which was allocated to the following seven broad areas: (See Table 6.1)

Table 6.1: Areas of First Five Year Budget Plan¹

AREA	PERCENTAGE
Irrigation and Energy	27.1
Agriculture and Community Development	17.5
Transport and Communications	24.0
Industry	8.4
Social Services	16.4
Land rehabilitation	4.1
Other Sectors and Services	2.5

The most important feature of this phase was active role of state in all economic sectors. Such a role was justified at that time because immediately after independence, India was facing basic problems—deficiency of capital and low capacity to save.

The launching of first five year plan initiated a process of development aimed not only at raising the standards of living of the masses but also opening out to them opportunities for a richer and more varied life. This was sought to be achieved by planning for growth, modernization, self reliance and social justice implied reduction of inequality, unemployment and removal of poverty.

The target growth rate for first five year plan was 2.1% of annual gross domestic product (GDP); the achieved growth rate was 3.6%. The net domestic product went up by 15%. The monsoon was good, so there were relatively high crop yields, boost in exchange reserves and the per capita income, which increased by 8%. National income increased more than the per capita income. Many irrigation projects were initiated during this period, including the Bhakra Dam and Hirakud Dam. The World Health Organization, jointly with the Indian government, addressed children’s health and reduced the infant mortality, indirectly contributed to population growth.

1. The First Five Year Plan in Outline: www.planningcommission.gov.in

At the end of the plan period in 1956, five Indian Institutes of Technology (IITs) were established as major technical institutions. The University Grant Commission was set up to take care of funding and take measures to strengthen the programme of higher education in the country. Contracts were signed to start five steel plants, which came into existence in the middle of the second five-year plan. The first five year plan was based on Harrod Domar Model framework.

Target Growth Rate: 2.1% of GDP

Actual Growth Rate: 3.6% of GDP

Second Five-Year Plan (1956–1961)

The basic philosophy of the second five year plan was to give a 'big push' to the economy so that it enter the take off stage. It aimed at rapid industrialisation with particular emphasis on the development of heavy and basic industries. Unlike the first plan, which focused mainly on agriculture, domestic production of industrial products was encouraged in the Second plan, particularly in the development of the public sector. The plan followed the Mahalanobis model, an economic development model developed by the Indian Statistician Prasanta Chandra Mahalanobis in 1953. The plan attempted to determine the optimal allocation of investment between productive sectors in order to maximize long-run economic growth. It used the prevalent state of art techniques of operations research and optimization as well as the novel applications of statistical models developed at the Indian Statistical Institute. The plan assumed a closed economy in which the main trading activity would be centered on importing capital goods.

Hydroelectric power projects and five steel mills at Bhilai, Durgapur, and Rourkela were established. Coal production was increased. More railway lines were added in the north east.

The Atomic Energy Commission was formed in 1948 with Homi J. Bhabha as the first Chairman. The Tata Institute of Fundamental Research was established as a research institute. In 1957, a talent search and scholarship program was begun to find talented young students to train for work in nuclear power.

The total amount allocated under the second five year plan in India was Rs. 4,800 crores. This amount was allocated among various sectors as follows:

- Community and agriculture development
- Power and irrigation
- Social services
- Communications and transport
- Miscellaneous

Target Growth: 4.5% of GDP

Actual Growth: 4.0% of GDP

Third Five-Year Plan (1961–1966)

The third five year plan stressed on agriculture and improving production of wheat, but the brief Sino-Indian War of 1962 exposed weaknesses in the economy and shifted the focus towards the defence industry. In 1965-1966, India fought a war with Pakistan. The war led to inflation and the priority was shifted to price stabilization. The construction of dams continued. Many cement and fertilizer plants were also built. Punjab began producing wheat in abundance.

Many primary schools were started in rural areas. In an effort to bring democracy to the grassroot level, Panchayat elections were started and the states were given more development responsibilities.

State electricity boards and state secondary education boards were formed. States were made responsible

for secondary and higher education. State road transportation corporations were formed and local road building became a state responsibility.

Target Growth: 5.6% of GDP

Actual Growth: 2.2% of GDP

Three Annual Plans (1966 – 69)

Subsequent to the Third FYP, there was a plan holiday and three annual plans during 1966- 1969 were adopted. During the third five year plan period, the development process ran into serious difficulties. The country had to import large quantity of food grains as a result of falling growth in agricultural output and rapidly increasing population. There was large trade deficit, as huge investment in heavy industries required large imports without matching increase in exports. As a result, there was decrease in savings rate, widespread unemployment particularly in rural India and concentration of economic power in the hands of few urban industrialists and rich farmers. At this juncture, several research studies indicated that income inequality had increased in the country which indicated the failure of planning. This led to rethinking on the development strategy and India observed a 'plan holiday' during 1966-69.

- The prevailing crisis in agriculture and serious food shortage necessitated the emphasis on agriculture during the Annual Plans.
- During these plans a whole new agricultural strategy involving wide – spread distribution of High – Yielding Varieties (HYVs) of seeds, the extensive use of fertilizers, exploitation of irrigation potential and soil conservation was put into action to tide – over the crisis in agricultural production.
- During the Annual Plans, the economy basically absorbed the shocks given during the third Plan, making way for a planned growth.

Fourth Five-Year Plan (1969–1974)

The fourth plan had two principal objectives viz, growth with stability and progressive achievement of self reliance.

At this time Indira Gandhi was the Prime Minister. The Indira Gandhi government nationalized 14 major Indian banks and the Green Revolution changed the face of Indian agriculture. In addition, the situation in East Pakistan (now Bangladesh) was becoming dire as the Indo-Pakistani War of 1971 and Bangladesh Liberation War took place.

Funds earmarked for the industrial development had to be diverted for the war effort. India also performed the Smiling Buddha underground nuclear test in 1974, partially in response to the United States deployment of the Seventh Fleet in the Bay of Bengal. The fleet had been deployed to warn India against attacking West Pakistan and extending the war.

Target Growth: 5.7% of GDP

Actual Growth: 3.30% of GDP

The fourth plan experienced three consecutive years of drought (1971-73) and oil price shock of 1973.

Fifth Five-Year Plan (1974–1979)

This plan was initiated at the time when the country was reeling under an economic crisis arising out of rising inflation caused by the hike in oil prices. During this plan, stress was laid on employment, poverty alleviation, and justice. The plan also focused on self-reliance in agricultural production and defence. In 1978 the newly elected Morarji Desai government rejected the plan. Electricity Supply Act was enacted in 1975, which enabled the Central Government to enter into power generation and transmission.

The Indian national highway system was introduced for the first time and many roads were widened to accommodate the increasing traffic. Tourism also expanded.

Target Growth: 4.4% of GDP

Actual Growth: 5.0% of GDP

Sixth Five-Year Plan (1980–1985)

This plan aimed at direct attack on problem of poverty by creating conditions of an expanding economy. It marked the beginning of economic liberalization. Price controls were eliminated and ration shops were closed. This led to an increase in food prices and an increase in the cost of living. This was the end of Nehruvian Plan and Rajiv Gandhi was prime minister during this period.

Family planning programme was also expanded in order to prevent overpopulation. In contrast to China's strict and binding one-child policy, Indian policy did not rely on the threat of force. More prosperous areas of India adopted family planning programme more rapidly than less prosperous areas, which continued to have a high birth rate.

Target Growth: 5.2% of GDP

Actual Growth: 5.4% of GDP

Seventh Five-Year Plan (1985–1990)

The Seventh Plan marked the comeback of the Congress Party to power. The plan laid stress on improving the productivity level of industries by upgrading of technology.

The main objectives of the seventh five year plans were to establish growth in areas of increasing economic productivity, production of food grains, and generating employment opportunities.

As an outcome of the sixth five year plan, there had been steady growth in agriculture, control on rate of Inflation, and favorable balance of payments which had provided a strong base for the seventh five Year plan to build on the need for further economic growth. The seventh Plan had strived towards socialism and energy production at large. The thrust areas of the seventh five year plan have been enlisted below:

- Social Justice
- Removal of oppression of the weak
- Using modern technology
- Agricultural development
- Anti-poverty programs
- Full supply of food, clothing, and shelter
- Increasing productivity of small and large scale farmers
- Making India an Independent Economy

Based on a 15-year period of striving towards steady growth, the seventh Plan was focused on achieving the pre-requisites of self-sustaining growth by the year 2000. The Plan expected a growth in labour force of 39 million people and employment was expected to grow at the rate of 4% per year.

Some of the expected outcomes of the Seventh Five Year Plan of India are given below:

- Balance of Payments (estimates): Export: ₹33,000 crores, Imports: ₹54,000 crore, Trade Balance: (-) ₹21,000 crores
- Merchandise Exports (estimates): ₹60,653 crores
- Merchandise Imports (estimates): ₹95,437 crores

- Projections for Balance of Payments: Export: ₹60,700 crores, Imports: (-) ₹95,400 crores, Trade Balance: (-) ₹34,700 crores

In Seventh Five Year Plan, India strove to bring about a self-sustained economy in the country with valuable contributions from voluntary agencies and the general populace.

Target Growth: 5.0% of GDP

Actual Growth: 6.01% of GDP

Eighth Five-Year Plan (1992–1997)

The Eighth Plan was launched at a time which marked a turning point in both international and domestic economic environment. All over the world, centralised economies were disintegrating. On the other hand, economies of several regions were getting integrated under a common philosophy of growth, guided by the market forces and liberal policies. Indian planning needed to draw lessons from the previous plans and to be guided by its experience, gained during the last four decades.

1989-91 was a period of economic instability in India and hence, no five year plan was implemented. Between 1990 and 1992, there were only Annual Plans. In 1991, India faced a crisis in Foreign Exchange (Forex) reserves, left with reserves of only about US\$1 billion, high rate of inflation and fiscal deficit. Thus, under pressure, the country took the risk of reforming the socialist economy. P.V. Narasimha Rao was the twelfth Prime Minister of the Republic of India and head of Congress Party, and led one of the most important administrations in India's modern history overseeing a major economic transformation and several incidents affecting national security. At that time Dr. Manmohan Singh launched India's free market reforms that brought the nearly bankrupt nation back from the edge. It was the beginning of privatization and liberalization in India.

Modernization of industries was a major highlight of the Eighth Plan. Under this plan, the gradual opening of the Indian economy was undertaken to correct the burgeoning deficit and foreign debt. Meanwhile, India became a member of the World Trade Organization on 1 January 1995. This plan can be termed as Rao and Manmohan model of economic development. The major objectives included, controlling population growth, poverty reduction, employment generation, strengthening the infrastructure, Institutional building, tourism management, human resource development, involvement of Panchayat Raj, Nagar Palikas, N.G.O'S and Decentralization and people's participation. Energy was given priority with an allocation of 26.6% of the outlay. An average annual growth rate of 6.78% against the target 5.6% was achieved.

To achieve the target of an average of 5.6% per annum, investment of 23.2% of the gross domestic product was required. The incremental capital output ratio was 4.1. The saving for investment was to come from domestic sources and foreign sources, with the rate of domestic saving at 21.6% of gross domestic production and of foreign saving at the rate of 1.6% of gross domestic production.

Ninth Five-Year Plan (1997–2002)

Ninth Five Year Plan of India runs through the period from 1997 to 2002. The plan was formulated in the context of four important dimensions of state policy viz. quality of life, generation of productive employment, regional balance and self reliance. The plan focused or accelerated growth recognizing a special role of agriculture for its stronger poverty reducing and employment generation effects which would be carried over a 15 years period. The plan viewed the role of state and the private sectors as complementary and both were considered essential. Private sector activity needs properly organized market and hence, the emphasis was laid on economic liberalization.

The main objectives of the Ninth Five Year Plan of India are:

- to prioritize agricultural sector and emphasize on the rural development
- to generate adequate employment opportunities and promote poverty reduction
- to stabilize the prices in order to accelerate the growth rate of the economy

- to ensure food and nutritional security
- to provide for the basic infrastructural facilities like education for all, safe drinking water, primary health care, transport, energy
- to check the growing population increase
- to encourage social issues like women empowerment, conservation of certain benefits for the Special Groups of the society
- to create a liberal market for increase in private investments

Target Growth: 6.5% of GDP

Actual Growth: 5.35% of GDP

Tenth Five-Year Plan (2002–2007)

The Tenth Five Year Plan marked the return of visionary planning to India after long. During the past two decades than this plan, India was considered among one of the ten fastest growing economies in the world. The Tenth Plan aimed to take the country even further ahead, potentially to become the fastest growing country by the end of the Plan period.

The Tenth Five Year Plan, covering the period 2002-07, represented another step in the evolution of development planning in India.

The main objective of the tenth five year plan of India are:

- to attain 8% GDP growth per year.
- to reduce poverty ratio by 5 percentage points by 2007.
- to provide gainful and high-quality employment at least to the addition to the labour force.
- to send all children in India to school by 2003; all children to complete 5 years of schooling by 2007.
- to reduce gender gaps in literacy and wage rates by at least 50% by 2007; to reduce the decadal rate of population growth between 2001 and 2011 to 16.2%; to increase literacy rates to 75 per cent within the Tenth Plan period (2002 - 2007).

Additional points under Tenth Five-Year Plan (2002-2007)

- Envisaging a target of 3.97% agricultural growth
- Regionally differentiated strategy based on agro-climatic conditions and natural resources envisaged for 9th year plan for increasing the pace of growth in every region of the country to be continued during the 10th year plan.
- Sustainable development of natural resources.
- Crop diversification
- Blending traditional and frontier technologies.

Focus:

- Minimum Support Prices (MSPs) scheme: for 25 commodities
- Credit Availability
- Water Management: 'Micro Irrigation'
- Agriculture Diversification.

Eleventh Five-Year Plan (2007–2012)

The Eleventh Plan began in very favorable circumstances with the economy having grown at the rate of 7.7% per year in the Tenth Plan period. However, our people still lacked the basic requirements for a decent living in terms of nutrition standards, access to education and basic health, and also to other public services such as water supply and sewerage. Regional imbalances have emerged across and even within states. The Eleventh Plan seeks to remedy these deficiencies by seeking to accelerate the pace of growth while also making it more inclusive. The growth objective is to achieve an average growth rate of 9% per annum for the Plan period. The objective of inclusiveness is reflected in the adoption of 26 other monitorable targets at the national level relating to (i) income and poverty, (ii) education, (iii) health, (iv) women and children, (v) infrastructure, and (vi) environment. Some of these national targets have also been disaggregated into 13 state level targets and it is expected that the state governments design policies and programmes to achieve them.

The eleventh plan has the following objectives:

1. Income & Poverty

- Accelerate GDP growth from 8% to 10% and then maintain at 10% in the twelfth plan in order to double per capita income by 2016-17.
- Increase agricultural growth rate to 4% per year to ensure a broader spread of benefits.
- Create 70 million new work opportunities.
- Reduce educated unemployment to below 5%.
- Raise real wage rate of unskilled workers by 20%.
- Reduce the headcount ratio of consumption poverty by 10 percentage points.

2. Education

- Reduce dropout rates of children from elementary school from 52.2% in 2003-04 to 20% by 2011-12.
- Develop minimum standards of educational attainment in elementary school, and by regular testing monitor effectiveness of education to ensure quality.
- Increase literacy rate for persons of age 7 years or above to 85%.
- Lower gender gap in literacy to 10 percentage point.
- Increase the percentage of students going to higher education from the present 10% to 15% by the end of the plan.

3. Health

- Reduce infant mortality rate to 28 and maternal mortality ratio to 1 per 1000 live births.
- Reduce Total Fertility Rate to 2.1%.
- Provide clean drinking water for all by 2009 and ensure that there are no slip-backs.
- Reduce malnutrition among children of age group 0-3 to half its present level.
- Reduce anemia among women and girls by 50% by the end of the plan.

4. Women and Children

- Raise the sex ratio for age group 0-6 to 935 by 2011-12 and to 950 by 2016-17.
- Ensure that at least 33% of the direct and indirect beneficiaries of all government schemes are women and girl children.
- Ensure that all children enjoy a safe childhood, without any compulsion to work.

5. Infrastructure

- Ensure electricity connection to all villages and Below Poverty Line (BPL) households by 2009 and round-the-clock power.

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- Ensure all-weather road connection to all habitation with population 1000 and above (500 in hilly and tribal areas) by 2009, and ensure coverage of all significant habitation by 2015.
- Connect every village by telephone by November 2007 and provide broadband connectivity to all villages by 2012.
- Provide homestead sites to all by 2012 and step up the pace of house construction for rural poor to cover all the poor by 2016-17

6. Environment

- Increase forest and tree cover by 5 percentage points
- Attain WHO standards of air quality in all major cities by 2011-12
- Treat all urban waste water by 2011-12 to clean river waters
- Increase energy efficiency by 20 percentage points by 2016-17

REVIEW QUESTIONS



1. What are the objectives for formulation of five year plans?
2. What was the progress of five year plans till 1991?
3. Discuss the development initiatives of the latest five year plan.
4. Target Growth for Sixth Five Year Plan is _____.
5. The _____ plan experienced three consecutive years of drought.

AGRICULTURE

India agriculture has an extensive background which goes back to 10 thousand years. At present, in terms of agricultural production, the country holds the second position all over the world. In 2007, agriculture and other associated industries such as lumbering and forestry represented around 16.6% of the Gross Domestic Product of the country. In addition, the sector employs about 52% of the entire manpower. Regardless of the fact that there has been a gradual slump in its contribution to the gross domestic product of the country, India agriculture is currently the biggest industry in India. On the whole, it has a key role in the socioeconomic growth of the country.

In terms of agricultural contribution, the following states in India are the most developed states:

- Punjab
- Uttar Pradesh
- Madhya Pradesh
- Haryana
- Bihar
- Andhra Pradesh
- Maharashtra
- West Bengal

All these states play a key role in the agrarian development of India.

The total arable territory in India is 1,269,219 km², which represents about 56.78% of the overall land zone of the

country. Arable land in India is diminishing because of continuous strain from an ever-increasing number of inhabitants and growing urbanization. The overall water surface area of the country is 31440 km² and the country experiences a mean yearly precipitation of 1,100 mm. Irrigation represents 92% of the consumption of water and in 1974, it was 380 km². By 2025, the capacity will probably increase to 1,050 km², with the equilibrium justifying both household and industrial usage.

Role of Agriculture in the Indian Economy

In the Indian context, the vital role of agriculture arises out of the position this sector occupies in the overall economy of the country. Agriculture is a large sector of the economic activity and has a crucial role to play in the country's economic development by providing food and raw materials, employment to a large proportion of population, capital for its own development and surpluses for national economic development. Agriculture sector contributes a significantly large share to the national income of India. As a matter of fact, during the fifties it contributed around half of national output. In the sixties and the seventies its contribution, though it did show a fall, has been more than 44 percent. During eighties and nineties a further fall is indicated. During 2006-07, stood at about 18.5 percent which further fall down to 14.2 percent of GDP in 2010-11. This trend of the declining share of agriculture in the national income is an indication of economic progress and structural change that is gradually taking place. It is observed that the rate of change has been rather slow. The agriculture sector still holds the dominant position in the Indian economy. Agriculture has been and is a major source of livelihood in India. Over the years 1921-91, the size of labour force dependent on agriculture had more than doubled and over the next decade is projected to going by more than 25 percent. This is contrary to the development economists' observation that as country develops, the share of labour force dependent upon agriculture as a source of livelihood declines. The occupational structure of the country has shown a lack of flexibility, the large proportion of the increasing labour force, in the absence of any alternative employment opportunities, has been absorbed in agriculture. It is observed that while the share of agriculture in GDP has been declined significantly, its share in the manufacturing sector has gone up. However, corresponding to this structural shift in production, the structure of employment has shown little change.

The increasing labour force in agriculture would only add further to the already low productivity and disguised unemployment, unless steps are taken to raise the level of productivity and create alternative employment opportunities. Indian agriculture plays an important role in the country's international trade. The agricultural commodities are exported primarily, tea, cotton, jute, spices, coffee, sugar, fruits, etc. The important items of import have been cereals, vegetable oils and fats, etc. A large increase in the domestic production of rice, cotton, wheat has resulted in a decline in the proportion of imports of these commodities. As a result of these developments, the agricultural sector has emerged as a net earner of foreign exchange. Fluctuations in agricultural output levels play a crucial role in the state of the national economy. According to a NCAER Survey, for several consumer durables the rural market is growing much faster than the urban market. There is a direct relationship between agricultural production and income and demand for industrial goods. Similarly, performance in agriculture also influences total demand via. Government savings and public investment.

Since agriculture contributes significantly in the National Income, this sector is treated as major source of savings and hence capital formation for the economy. The pace of development is largely conditioned by the rate of capital formation in the economy. Since independence, large investment, both public and private, has been made in agriculture. In areas where agricultural practices are traditional, investment has also been on traditional lines like land and its improvement, tools and implements, farm structures, etc. But the pattern of investment in progressive areas, where modern technology has been adopted, has been predominantly in irrigation, land improvements, farm machinery and other infrastructures. Of course in recent years, public investment in agriculture sector has declined. To stimulate growth, substantial capital investments are required for various infrastructure and inputs.

In the process of development, interdependence and linkage between agriculture and industry has become stronger. Based on a recent study by Ahluwalia and Rangarajan, those important linkages that have been developed between the agricultural sector and the industrial sector over the last four and a half decades. These

are: (i) Production linkages; (ii) Demand linkages; and (iii) Savings and investment linkages. Production linkages arise from the interdependence of agriculture and industry for productive inputs i.e., supply of agricultural commodities viz. cotton, jute, sugarcane, etc. to agro-based industries and supply of fertilizers, machinery and electricity by industry to agriculture. These linkages have got further strengthened with agriculture's dependence on industry increasing at a faster rate than the dependence of industry on agriculture, reflecting the fast moving modernisation of the agricultural sector. There are strong demand linkages between the two sectors. The impact of urban income and industrialization on the demand for food and agricultural raw materials is generally recognized. Equally significant is the impact of rural income on industrial consumption goods i.e., clothing, footwear, edible oils, etc. Equally significant are the savings and investment linkages that have developed between the two sectors. The linkages, however, have been weakening.

Summing up, we conclude that agriculture occupies a central place in the economy. The sector has a razor's edge quality in the development process; good performance encourages many virtuous cycles and poor crops lead to vice like grips of stagnation, maturation and inflation. Its performance sets the pace of growth in the economy as a whole. A strong foundation of agriculture is a necessary condition for rapid economic and social development. Agriculture could contribute substantially to the improvement of the rural as well as the overall economy of the country and has the potential of becoming a leading sector in development. Increasing agricultural productivity makes an important contribution to the programmes of industrialization and general economic development and that is one of the necessary conditions, which must be fulfilled before an economy gets itself ready for a process of self-sustained growth.

The agricultural sector in India was not subjected to the regulations in the same way as, for example, industry. The Government's role in the field of agriculture has been confined largely to investments in infrastructure including research and extension and public procurement and distribution to the extent of about 10 to 15 percent of output of cereals, in market setting where private traders also operate. First five year plan was directed mainly towards increasing agricultural production and strengthening economic infrastructure like irrigation, power and transport. Agriculture was accorded the top most priority in the plan. The agricultural plan and programmes were directed to provide adequate food to support the increased population and raw materials needed for growing industrial economy and also to make available larger exportable surpluses of agricultural commodities in the second five year plan while the third five year plan was of great significance for the agricultural sector. The new strategy of agricultural production (Green revolution) came to be introduced in this period. A major change occurred with the introduction of the High Yielding Variety (HYV) seeds, which came to be widely adopted by the end of the third year plan. The new agricultural technology was expected to usher in the green revolution and was confined mainly to Punjab, Haryana and Western UP, with the introduction of new HYV varieties of Mexican wheat and dwarf rice from 1967-68. Besides, a new emphasis was placed on the role of agricultural technology as a major input of agricultural production. A policy of support prices for food grains was adopted in the country. In 1965, Agricultural Price Commission (now rechristened as Commission for Agricultural Costs and Prices (CACP) was set up to advise the Government from time to time on appropriate price policies for agricultural commodities. Government's price policy for agriculture produce seems to ensure remunerative prices to the growers for their produce with a view to encourage higher investment and production and to safeguard the interest of consumers. The Government decides on the support price for various agricultural commodities taking into account the recommendations of CACP. The development programmes fell broadly into two categories in the fourth plan i.e., those which aimed at maximizing production and those which aimed at remedying imbalances. fifth five year plan sought to modify and correct the weakness evidenced in the strategy of intensive production as also in the various area programmes during the fourth plan. The sixth five year plan has been accorded the highest priority for bridging the gap prevailing between actual and potential farm yields even at current levels of technology through the removal of the constraints responsible for this gap. The sixth plan was hailed a great success, production of food grain in 1983-84 reached to 152 million tones while green revolution had spread to eastern states and central states including West Bengal, Madhya Pradesh and Eastern Uttar Pradesh. The central element in the development strategy of the seventh plan was the generation of productive employment

opportunities and removal of poverty. This was sought to be achieved through increase in cropping intensity made possible by increased availability of irrigation facility, extension of new agricultural technologies to low productivity regions and to small farmers through measures to make the rural development programmes more effective in the creation of productive assets. The agricultural programmes for production of oilseed, sugar jute and cotton recorded higher than the plan targets whereas, food grains production was 199 million tones as against plan target of 210 million tones in the eighth five year Plan which focussed on increasing production using limited resources of land and water. The development strategy during the ninth year plan especially was focused on improving productivity and the quality of the horticulture crops through upgradation of production and farming technologies, supply of quality seeds and planting materials, technology transfer through demonstrations, reducing post harvest losses and improving marketability of produce, developing a strong base for supply of other critical inputs and human resource development. The three pronged strategy envisaged were :

- increase in overall employment and incomes by raising farm productivity and growth of other economic activities in the rural areas
- provision of gainful supplementary employment through poverty alleviation schemes
- distribution of food grains through public distribution system (PDS) at subsidised prices to those living below the poverty line

The ninth plan envisaged a growth rate of 4.5 % per annum in the agriculture sector. In order to achieve this, a regionally differentiated strategy based on Agro-climatic Regional Planning (ACRP) was envisaged to be implemented. The average annual growth rate during the plan was only 2.06 percent which was below the targeted growth. The deceleration of growth and stagnation in productivity were matters of concern. There were reports of hunger and malnutrition because of low purchasing capacity of a sizeable portion of households. The Government of India announced National Agriculture Policy (NAP) 2000 which envisaged the following type of growth:

- Growth that is based on efficient use of resources and conserve, our soil, water and bio-diversity
- Growth with equity i.e., growth which is widespread across regions and covers all farmers
- Growth that is demand driven and caters to domestic markets as well as maximizes benefits from exports of agro-products
- Growth that is sustainable technologically, environmentally and economically

NAP, envisaged a growth rate exceeding four percent per annum in the agriculture sector. The tenth plan envisaged a target of 3.97 percent growth. The thrust areas in the tenth plan envisaged were:

- Regionally differentiated strategy based on agro-climatic conditions and natural resources envisaged for the ninth plan for increasing the pace of growth in every region of the country, to be continued during the tenth plan.
- Sustainable development of natural resources.
- *Crop diversification*: The thrust would be on diversification towards high value/more remunerative crops considering agro-climatic conditions, endowment of land and water resources and market demand both within the country and outside.
- Blending traditional and frontier technologies.

Tenth plan priorities and thrust areas identified for the agriculture includes development of irrigation (micro-irrigation), diversification of high value crops, development of market infrastructure, increasing cropping intensity, rainwater harvesting etc. for the development of rain fed areas, revamping/modernizing extension systems and encouraging private sector increasing farm productivity development of eastern, north eastern regions etc.

Minimum Support Prices Scheme: In order to enable farmers to get remunerative prices for their produce and to encourage crop diversification, Government is implementing this scheme for 25 agriculture commodities.

Credit: The easy and timely availability of institutional credit in a hassle free manner to the farmers at a reduced rate of interest is the key ingredient for meeting their credit needs and encouraging investment for accelerated agricultural growth. In line with this requirement, the Government announced a comprehensive credit policy on 18th June, 2004.

Water Management: Water management holds the key for agricultural growth in the country. About 20 million hectares of additional land could be brought under irrigation by completing the on-going major and medium irrigation projects and by constructing field channels in command areas. In rain fed areas it is necessary to increase water use efficiency for optimum utilization of available water and to stabilize production for which a new centrally sponsored scheme “Micro irrigation” was approved in December, 2005.

Agriculture Diversification: Agricultural diversification is a major element in the strategy for accelerating agricultural growth. Horticulture has been a priority area for which mission mode has been adopted. National Horticulture Mission was approved for implementation in May, 2005 to give a new impetus for development.

The eleventh plan provides an opportunity to act decisively to consolidate the gains that have been made in the Tenth Plan and also to correct the deficiencies that have been observed.

The Central Vision of the eleventh plan is to build on our strengths to trigger a development process which ensures broad-based improvement in quality of life of the people, especially the poor, SCs/STs, other backward castes (OBCs), minorities and women. The National Development Council (NDC), in approving the Eleventh Plan, endorsed a target of 9% GDP growth for the country as a whole. This growth is to be achieved in an environment in which the economy is much more integrated into the global economy, an integration that has yielded many benefits but also poses many challenges. If this is achieved, it would mean that per capita GDP would grow at about 7.6% per year to double in less than ten years. However, the target is not just faster growth but also inclusive growth, that is, a growth process which yields broad-based benefits and ensures equality of opportunity for all.

The broad vision of the eleventh plan included several inter related components: rapid growth that reduces poverty and creates employment opportunities, access to essential services in health and education especially for the poor, equality of opportunities, empowerment through education and skill development, employment opportunities underpinned by the National Rural Employment Guarantee, environmental sustainability, recognition of women’s agency and good governance.

The strategy for inclusive growth in the eleventh plan is not just a conventional strategy for growth to which some elements aimed at inclusion have been added. On the contrary, it is a strategy which aims at achieving a particular type of growth process which will meet the objectives of inclusiveness and sustainability. This strategy must be based on sound macroeconomic policies which establish the macroeconomic preconditions for rapid growth. It must also include sector-specific policies which will ensure that the structure of growth that is generated, and the institutional environment in which it occurs, achieves the objective of inclusiveness in all its many dimensions.

The broad sectoral composition of growth associated with the projection (9%) involves doubling the growth rate of agriculture to 4% per year compared with a little over 2% per year in the tenth plan and raising the industrial growth rate from 9.2% in the Tenth Plan to between 10% and 11% in the eleventh plan. Further manufacturing is targeted to grow at over 12% per year and this is expected to provide high-quality employment.

A second green revolution however, is urgently needed to raise the growth rate of agricultural GDP to around 4 percent. This is not an easy task since actual growth of agricultural GDP, including forestry and fishing, is likely to be below 2 percent during the tenth plan period. The challenge therefore is to at least double the rate of agricultural growth and to do so recognize demographic realities—particularly the increasing role of women.

For four consecutive years from 2005-06 to 2008-09, food grains production registered a rising trend and touched a record level of 234.47 million tones in 2008-09. The production of food grains declined to 218.20 million tones during 2009-10. The country has made great strides in increasing food grains production since the mid-1960s.

Causes of Low Productivity

The causes for low productivity of Indian agriculture can be divided into 3 broad categories, namely;

- General factors
- Institutional factors
- Technological factors

I. General Factors

1. Increasing Population Pressure: The increasing pressure of population on land is an important demographic factor responsible for low yield in agriculture. The area of cultivated land per cultivator has declined from 0.43 hectare in 1901 to 0.23 hectare in 1981 despite an expansion of area under cultivation. Hence, agricultural sector has become overcrowded and this has adversely affected the agricultural productivity.

2. Traditional System of Cultivation: The Indian farmers, living in rural areas are generally tradition-bound, illiterate, ignorant, superstitious and conservative. Their attitude of apathy and neglect keeps the system of cultivation primitive. The farmers are not prepared to accept anything new as a consequence of which modernization of agriculture becomes difficult.

3. Inadequate Infrastructural Facilities: Shortage of finance, marketing and storage facilities are also responsible for agricultural backwardness in India. The co-operatives and other institutional agencies have not been able to eliminate the village money lenders. Storage facilities for farmers are not still available to preserve their agricultural product for a better price.

4. Natural Calamities: Indian agriculture is a gamble and still dependent on the monsoon. If monsoon becomes favorable, we have a good crop; otherwise agriculture is affected by drought, flood and cyclone.

II. Institutional Factors

1. Size of Holding: The small size of holdings in India is an impediment in the way of progressive agriculture. The average size of holdings in India is less than 2 hectares. In case of very small firms, it is difficult to introduce new technology. Further, due to fragmentation of holdings, a great deal of labour and energy is destroyed in cultivation.

2. Pattern of Land Tenure: The agrarian structure in India is not conducive for a progressive agriculture. The tenuous relationships were such that the big landlords used to have a considerable influence on their respective areas. The cultivator had no incentive for improvement and more production. Though the zamindari system has been abolished, absentee landlordism still prevails; heavy rents are still extracted and there is no security of tenancy. Under these circumstances, it is unwise to expect any remarkable increase in agricultural productivity due to the apathetic attitude of the cultivator of the land.

III. Technological Factors

1. Poor Techniques of Production: The technique of production adopted by Indian farmers is old, outdated and inefficient. The tradition-bound poor farmers have not yet been able to adopt the modern methods to get the best yield from their land. The seeds they use are of poor quality and the age-old, traditional wooden plough still exists in Indian agriculture. The farmers do not enjoy the benefits of agricultural research and development programmes. They consider agriculture as a way of life rather than a business proposition. Therefore, production remains at a low level.

2. Inadequate Irrigational Facilities: Indian agriculture is a gamble and dependent on monsoon due to non availability of irrigation facilities. In spite of several measures, irrigation facilities have not substantially increased in India.

Measures to Improve Productivity

The Food and Agricultural Organisation has suggested following measures to increase the productivity of Indian agriculture:

1. The farmers should be provided with a stable price for their agricultural products at a remunerative level.
2. There should be an expansion of adequate marketing facilities to sell the agricultural product.
3. The land tenure system should be changed in favour of the cultivator.
4. There should be a provision of supplying cheap credit on reasonable terms especially to small farmers for better techniques of production.
5. The modern inputs like fertilizers, pesticides and improved seeds should be made available to the farmers at reasonable prices.
6. There should be provisions of education, research and extension of agro-economic services to spread the knowledge of improved methods of farming.
7. The State should make provision for the development of resources which are not possible on the part of individual farmers e.g. large scale irrigation, land reclamation or resettlement projects.
8. There should be an extension of land used and intensification and utilization of land already in use through improved and scientific implements.

LAND REFORMS

The process of real land reform was carried out in states after independence. They started with providing security to the farmers in regard to their ownership of land during various Five Year Plans. Several measures of changing the land tenure system and improving the conditions of the agriculturists were taken. The first plan recognised that the pattern of land ownership and cultivation was a fundamental issue on national development.

The policy elaborated in second Plan was to remove such impediments in the way of agricultural production which arise from the character of the agrarian structure. The Third Plan envisaged implementation of the evolved policy during the Second Plan and embodied in legislation on the various aspects of land reform undertaken by states in pursuance of the accepted policies. In the fourth Plan suggestions were made for an orientation of land policy. In the fifth Plan, especially attention has been given to the tenancy problems.

- Abolition of Zamindari and doing away of middleman.
- Change on the land revenues and Bhumidari right of the farmers
- Determining the ceiling of the land
- Consolidation
- Providing land to the landless
- Co operative farming

1. **Abolition of Zamindari:** As soon as the popular Govt came to power in various states, the Zamindari system, due to which the middlemen earned a lot from the farmers, were do away with. Majority of farmers who were exploited by these middlemen came in direct contact of the Government. These middlemen used to get lot money, as a result of compensation but then abolition gave a relief to agriculturists in this country.

As a result of Zamindari abolition, the farmers got a lot of economic relief. Now the farmers after depositing certain prescribed land revenue, all the categories of the farmers who under took the job of dealing the land were given the right to cultivate the land.

Those persons who are in possession of land were given the right to have control over the land. They could cultivate the field that was under their possession, farmers conditions were improved but they were also given relief. The abolition of zamindari, mahalbari, zagirdari and other such systems which made the life of the farmers uncertain, provided the relief to farmers.

2. Change in the Land Revenues: As a result of the abolition of Zamindari, the farmers got the relief in land revenue. In most of the cases the land revenue was reduced. The farmers were required to deposit and revenue of certain years at a time, and this thing give them a lot of relief. They also got the ownership of the land. As a result of the Bhumidari right which was nothing but ownership of land, they secured the right to sell it or mortgage or do something for improving, their system of agricultural production.

3. Determining the Ceiling of the Land: After the abolition of Zamindari, ceiling was imposed on Zamindari in regard to their land. Later on, ceiling was imposed on the agricultural land. Now a person can not passes land beyond prescribed limit. Because of these most of the farmers who did not possess the land earlier are now getting it. This gives relief to them, in regard to their condition and agricultural situation.

4. Consolidation: In order to give the farmers economic holding, the process of consolidation was resorted to. Through this method, the farmers got one land instead of their scattered holdings. This process has been going on for several years and is now radically at the end. This consolidation of holding in spite of the various drawbacks caused by corruption amongst the agency responsible for it has given relief to the farmers.

The farmers have now their field at one place and do not have to run various places. This has improved their condition economically and also in other respect. As result of consolidation of holding, the land tenure system has improved and land reform was completed.

5. Providing Land to the Landless: Right from the beginning of the Five Year Plans, every attempt has been made to provide land to landless. The surplus land that was secured as a result of imposition of ceiling has been given away to these landless farmers. The land that was made cultivable and the land that was secured as a result of Bhudan Andolan was also distributed to these people.

In the recent years this programme has been very much accelerated and it is expected that very soon most of the landless people shall get land and they shall add to the agricultural production of this country.

6. Cooperative Farming: In various Five Year Plans and in other programme of the Government for the improvement of agriculture, the co operative farming has been included. Several co operative societies are set up for the purpose and certain pilot projects were also launched. As a result of these programmes the farmers at various places have got the relief.

Those who are having uneconomic holdings or small holding are able to join others and have mechanized the farming at low cost. As a result of these, the mechanization of agriculture has taken place and the farmers have been able to get better yield.

GREEN REVOLUTION

Indian agriculture has been the source of supply of our leading industries. Investment in agriculture, in irrigation facilities, tractors, warehouses etc. have been rising continuously, increasing the demand for industrial output and adding to the nation's capital stock. The significance of agriculture in India arises also from the fact that the development in agriculture is an essential condition for the development of the national economy.

Economic growth means a higher rate of growth in Gross National Product and it is obviously impossible to attain a higher rate of growth in the economy unless there is rapid growth in both the agricultural and non-agricultural sectors. The new agricultural strategy during 1964-65 was the only cause for starting green revolution in India. Green Revolution implies to improve agricultural production within a limited period and maintaining a high level agricultural production over a long period of time.

To improve agricultural production, green revolution envisages several steps, such as, use of high yielding varieties of seeds, use of chemicals, fertilizers, pesticides, use of improved technology, multiple cropping, irrigation facilities, providing agricultural credit to farmers, suitable price mechanism for agricultural production and land reforms. As a result of green revolution, the production of food grains increased a lot which ultimately made India a self reliant country in food grains. The production of wheat increased seven times and of rice three times. After independence in 1947, India was not in the condition to fulfill the requirement of food grains.

It was partly due to the natural calamities like famines, droughts, which struck India time to time and created the problem of food shortage. As a result, India had to depend on other countries to overcome this problem. Our farmer suffered a lot. Before the Green Revolution, they were struggling to make both ends meet as they did not have any agricultural facilities. For irrigation, they depend on monsoon which always played a gamble with them. If monsoon failed their crops failed which ultimately increased their problem.

In such circumstances, the Green Revolution proved to be a boon. It not only made our country self-sufficient in food- grains but also improved the condition of our farmers. They have started living a comfortable life. Thus, Green Revolution helped in satisfying the appetite of the millions as well as relieving the economy of the country from the problem of food scarcity.

Green Revolution started in the year 1967-68 with the growth of production in wheat and rice. The revolution was not easy to implement. It had to face a number of problems. Some of these include the following:

- The agricultural production in India per hectare and per worker was very low.
- There was overcrowding of workers in the field of agriculture.
- The methods of cultivation were traditional and conservative.
- The use of artificial (chemical) fertilizers was not known.
- The land holdings were very small, less than a hectare in many cases.
- Many farmers did not own their land. Zamindars held them as tenants.
- Fertilizers were inadequate and farmers were not aware of the latest techniques of production.

The Green Revolution is still going on. Efforts are being made to reach self-sufficiency in pulse and oil seeds also, where there is still some deficit. With the effective measures undertaken by government and the willingness of farmers to adopt scientific and new methods of cultivation, one can be sure that our country would not only prove to be self-sufficient, but it would also be in a position to export agricultural products to needy countries in the coming years.

GLOBALISATION AND AGRICULTURE

The term 'Globalisation' has been subjected to a variety of interpretations. Though it may simply mean global interconnectedness, it includes a number of interlinked and complex economic, technological, cultural, environmental and political processes.

Globalisation of agriculture means that every country of the world should have a free access to the markets of other countries as far as agricultural products are concerned. The Globalisation can be better understood in terms of the following:

1. Globalisation aims at integrating our national economy with that of the world. It is to be realized within a certain time frame. It is based on the philosophy of free and open international trade.
2. In the changed scenario, we have to make a better use of our favorable climatic and soil conditions.
3. We have relatively inexpensive, abundant human labour. Every effort will have to be made to raise their efficiency and equip them with new and advanced tools.
4. We have to make available manpower for new implements and machines to enable them to compete with their counterparts in the advanced countries of the world.
5. With globalisation we now have a better access to reasonably and abundant capital from different parts of the world.

6. Thus to begin with, we may have to face hardships and difficulties sometimes but it will pay us in the long run.
7. In order to stand in the global competition, India has to use its vast potential of agriculture in a systematic and planned manner.
8. We should develop some of the techniques which the developed countries have been using. Use of the biotechnology may be one such step. Creation of an unrestricted unified national market for farm products within the country may be another step.
9. Those countries which are deficient in food production will get their demands fulfilled by other countries.
10. The globalisation of agriculture is supposed to increase the production of food and improve the economic condition of farmers throughout the world.
11. The low productivity of the small farmers will be eliminated.
12. It is also argued that the poor will also stand to gain by the globalisation of agriculture.
13. It will enhance efficiency of food production.

Role of Service Sector in Indian Economy

Over a period of time service sector has occupied a prominent place in Indian economy. The importance of service sector can be observed in terms of the composition of national income, occupational pattern and standard of living. The recent statistics reveals that the share of service sector in the national income have grown tremendously. The share of service sector in GDP was 6.60% in 1950-51. The growth rate attained in 2005-06 was 13.7% . A higher income generation is possible in service sector. Service sector takes into account all types of services necessary for industrial growth. There is a considerable scope for FDI in this sector.

REVIEW QUESTIONS



1. How development of agriculture in India is supported by land reforms?
2. What is the contribution of globalisation in enhancing agricultural activities?
3. What are the causes of low productivity in agricultural sector?

INDUSTRY

ROLE OF INDUSTRY IN INDIAN ECONOMY

Industrialization is a process in which there is a sharp increase in the industrial share of GDP and of the labour force. It is thus the process by which the centre of gravity of the economy shifts from agriculture to industry. It is true that the available empirical evidence makes us believe the thesis that no country could have developed and reached its current state of economic development without an easy access to a sound agricultural base. Those countries which had an underdeveloped agricultural sector could afford to make use of agricultural resources of some other dependent country; in all other countries, agriculture served as the “leading sector” of growth. But it is also true at the same time that fast economic development everywhere has been made possible essentially due to rapid industrialization. As a matter of fact, the essential criteria that are being used to distinguish a developed economy from an underdeveloped one relate to proportion of work force engaged in industrial activity, the proportion of national output originating in the industrial sector, etc.

Industrialization involves:

- adoption of technologically superior techniques of production that help to transform basic raw materials and intermediate goods into manufactured goods
- application of modern techniques of management and organization like economic analysis, accountancy, management technique, etc

The Planning Commission observes three factors favouring rapid industrialization which are:

- the productivity of labour in industry is much higher than in agriculture
- in a under developed economy the surpluses created in the industrial sector are likely to be available for investment relatively more easily than surpluses in agricultural sector
- for industrial sector lends direct stimulus to the setting up of new activities through linkage effects

As a result of the pursuit of the objective of industrial self-sufficiency during five year plans, industrial structure has become considerably broad based. Further, the industrial sector has established linkages with primary producing sectors e.g., agriculture, the latter is dependent for its own production on a rising flow of inputs from the former.

The share of industry sector (i.e. manufacturing, electricity, mining, construction etc.) in our GDP at factor cost at constant prices registered a substantial increase over the first four decades and then tapered off to a near stagnant level. The share of this sector in GDP reached to 25.5% in 1996-97, and then dipped to 22.2% in 2001-02 while percentage share of this sector was only 13.2% in 1950-51. First four years of tenth plan had shown some upward trend. Its share in GDP was 24.1 percent in 2005-06. The above data, by and large conform the objective of our planning, which has been that, a rapid industrialization of our economy through direct public investment. However, with the introduction of the policy of liberalisation and globalization, this percentage share has hovered within a narrow margin. Principles of economics state that in a backward and developing economy, the secondary sector, in absolute terms, should be growing much faster than it actually did in our economy. This development could be partly explained by the fact that a rapid industrial growth is possible only if there is an equally rapid growth in infrastructure and other civic amenities. Even now, our economy suffers from a deficiency of essential infrastructure like electricity, transport etc.

The contribution of industry to GDP is an important indicator of a nation's progress in the process of structural transformation from a rural agricultural society to a more urban industrialized one. Further, an increase in per capita income is associated with a rise in the share of industry along with a fall in the share of agriculture in national income. It is significant to note that consumption of manufactured consumer goods is recognized as one of the most widely accepted measures of standard of living and of quality of life. Manufacturing industry provides the driving force for stimulating rapid economic growth. The growth rate of the manufacturing industry normally surpasses that of the agriculture and the service sectors. It is for this reason that industry is considered the backbone of an economy. It is in recognition of this special importance that raising industry's share in GDP is being ranked as for the most objective for this sector in planning process. It is perhaps pertinent to add that traditionally the political stature of a country has been commensurate with the size and structure of industry.

INDUSTRIAL POLICY

The industrial policy of a country is an important instrument to influence the contribution of industrial sector to the economic development of the country. The term 'industrial policy' of the government has a very wide scope and forms an integral part of its overall policy. This is more so because in India, the government assumed the responsibility of actively promoting economic development through planning and regulation.

Conceptually speaking, industrial policy concerns itself with policies, procedures, regulations, and controls

associated with the industrial units of the country and the pattern of industrial set up. In effect, however, industrial policy is also closely connected with rest of the economic policies of the government, including, for example, labour policy, fiscal policy, and tariff policy.

Industrial Policy Resolution, 1948

As stated before, after Independence, the government aimed at rapid industrialisation of the country through systematic planning so as to avoid wasteful employment of scarce productive resources of the economy. It was decided that the government would play an active role in industrial process through public sector undertakings and the role assigned to the private sector would be a complementary one. The process was set in motion right in 1948 itself with the Industrial Policy Resolution which reserved a sphere for the public sector, and had the following main features.

The industries were divided into four main categories as follows:

1. Some industries were reserved as exclusive monopoly of the Central Government. These included railways, atomic energy, and arms and ammunition.
2. In the second category, no new undertakings could be established in the private sector. They could be established only in the public sector. This category included iron and steel, aircraft manufacture, ship-building, manufacture of telephone, telegraphs and wireless apparatus, and mineral oils.
3. The third category contained those basic industries which, in the opinion of the Central Government, could need official planning and regulation. This category covered a long list including almost everything of basic importance to the economy, such as salt, automobiles, tractors, prime movers, electric engineering, heavy machinery, machine tools, heavy chemicals, fertilizers, electro-chemical industries, non-ferrous metals, rubber manufactures, power and industrial alcohol, cotton and woollen textiles, cement, sugar, paper and newsprint, air and sea transport, minerals and industries relating to defence.
4. The fourth category comprised 'the remainder of the industrial field'.

Thus, almost the entire burden of industrialisation of the country was assumed by the government. Private sector was assumed to be incapable and/or unsuitable for ushering in the industrialisation of the country. Obviously, the success or failure of the public sector was to determine the extent of healthy and efficient industrialisation of the country.

The relevance and necessity of foreign capital was recognized. But direct foreign investment was not viewed with favour. The ownership and management of business units were to remain in Indian hands and the persons managing them were to be preferably Indians. In the long run, this amounted to debarring direct foreign investment and, instead, procuring foreign capital in the form of loans.

Industrial Policy Resolution of 1956

With formal introduction of economic planning and specific adoption of the objective of creating a 'socialistic pattern of society', it was thought necessary to modify the industrial policy of 1948. The new resolution had the following features.

The division of industries between public and private sectors was re-demarcated as follows.

1. Schedule A contained 17 industries and were made the exclusive responsibility of the government.
2. Schedule B contained 12 industries. These were to be progressively owned by the State. The State would have the main responsibility of setting up new enterprises in it and private sector was expected only to supplement the efforts of the State.
3. Schedule C contained the remaining industries. In their case the private sector was to have the main initiative

of development. However, they were to fit within the economic and social priorities and policies of the government and were to be subject to the provisions of the Industries (Development and Regulation) Act, 1951.

The government was to ensure the development of transport and other infrastructure etc. so as to enable the private sector acquires confidence and operate efficiently. The government would also make arrangements for the promotion of appropriate institutions and for the availability of institutional finance. In the event of co-existence of both private and public sector undertakings in a certain field, the government would pursue a non-discriminatory policy between them.

The Resolution recognised the importance of village and small-scale industries. To this end, the government was to support them and help them in acquiring competitive strength by protecting them against large-scale enterprises and by supportive differential taxation and subsidies. Removal of regional economic disparities was another component of the Industrial Policy Resolution. The Resolution emphasised that the living and working conditions of the workers were to be improved and their productivity was to be enhanced. The policy regarding foreign capital continued to remain unchanged.

It is seen that, through the Resolution of 1956, the government acquired a right to nationalise any existing industry. In effect, it also made use of this right extensively such as in nationalising the business of life insurance, general insurance, coal mining and banking. The private sector got the message that any industry could be nationalised at the discretion of the government. In actual implementation of the policy, however, a number of weaknesses developed.

Industrial Policy Statement, 1977

The industrial policy was modified in December 1977 by a Statement in the Parliament. It recognised that the existing policy had led to a mixture of some benefits and distortions in the economy, but had also caused serious distortions like an increase in unemployment, widening of rural-urban disparities and stagnation of real investment rate etc. The growth of industrial output had averaged only between 2-4% per annum. Industrial sickness had increased and become widespread. Clearly, there was a need to rectify the distortions. The main elements of the policy were as follows.

The main thrust of the new industrial policy was a shift in favour of small-scale sector, which was classified, into three sectors.

1. Cottage and household industries, which were a source of providing large scale self-employment.
2. Tiny sector which was defined on the basis of a small amount of investment below a specified limit.
3. Small scale industries which were larger than the first two categories but were still having investment within specified limits.

The policy aimed at simultaneously promoting all types of small-scale and cottage industries. To this end, a number of measures were suggested. These included the following:

1. The existing list of 108 items reserved for the small sector was expanded to cover 807 items by May 1978.
2. A District Industries Centre (DIC) was to be set up in each district for providing all services for helping the entire small sector under a 'single roof'. The Industrial Development Bank of India (IDBI) was to create a separate wing for specifically helping the small sector. Later, this wing grew into a full fledged bank named Small Industries Development Bank of India (SIDBI).
3. The field of activities of the Khadi and Village Industries Commission was enlarged.

Steps were to be taken for effective development and use of technology suitable for the small sector so that the

productivity of the workers in it could increase. The area of operation for the large scale sector was restricted to the following:

1. Basic industries which were needed for providing infrastructure and for development of the small sector, such as steel, cement, refineries and the like.
2. Capital goods industries for meeting the requirements of machinery.
3. Industries which were best operated on a large scale and with advanced technology such as pesticides and fertilizers, etc.
4. Industries producing other non-reserved items.

The policy clarified the official stand on the growth of large business houses. It was stipulated that, for financing new projects and the expansion of existing businesses, large houses should be required to rely upon their internally generated resources instead of borrowed funds. The funds of public sector financial institutions would be largely going to the small sector.

The policy clarified that the public sector would be the producer of important and strategic goods of basic nature. It would bear the responsibility of encouraging and developing a wide range of ancillary industries and decentralisation of the industrial production.

Importing of technology was to be permitted in high priority areas provided the country itself was not in a position to provide the same.

The policy was rather prohibitive regarding foreign collaborations. It asserted that where foreign technological know-how was needed, existing collaborations would not be renewed. Moreover, as a rule, majority ownership and effective control was to be in Indian hands with possible exceptions in certain cases like those relating to export-oriented units.

The problem of sick industrial units had assumed alarming proportions. The government decided to have a unit by unit selective approach in keeping them alive.

Industrial Policy of 1980

When Congress Party came into power in 1980, it decided to modify the contents of the policy adopted in 1977. It reiterated the basic approach contained in the Industrial Policy Resolution of 1956. It re-emphasised the socio-economic goals of the earlier policy with certain clarifications and extensions, namely,

- optimum utilisation of installed capacity
- achieving higher productivity and more employment
- removal of regional disparities through preferential treatment for industrially backward districts
- enlarging the agricultural base of the economy by extending a preferential treatment to agro-related industries
- faster promotion of export oriented and import substitution industries.

The Policy statement of 1980 also recognised the need for improving the management of the public sector undertakings. The Policy Statement maintained that the division between large and small sectors as enshrined in the preceding Policy Statement was wrong, since the entire industrial sector was internally interdependent and a unified whole. It aimed at the development of big industries with associated ancillary, small and village industries at the periphery. The new policy statement also committed itself to the task of removing regional disparities by setting up industries in industrially backward areas and solving the problem of industrial sickness. An important step taken in this regard was to simplify the procedure of regulating unauthorised excess capacity installed in the private sector.

At this stage, it would be helpful to note the fact that the implementation of the industrial policy led to the creation of a network of legislative acts, rules, regulations, procedures and so on. Since further changes in industrial policy involved a relaxation in these restrictive measures, we should briefly familiarise ourselves with them to the extent necessary.

In this regard, the first major legislative piece was that of the Industries (Development and Regulation) Act, 1951. It was highly restrictive in nature, a sample of which is given below.

For setting up a new unit or for a substantial expansion of an existing unit, a license was needed from the government. The granting of this license could be subject to the conditions laid down by the government. The government could investigate the working of any undertaking and issue instructions. In case the instructions were not followed, the undertaking could be taken over by the government. Similarly, the government could control prices, methods and volume of production, as also the manner of its sale. Development Councils could be set up for an industry with sweeping powers.

Over years, actual implementation of industrial policy led to several deficiencies, particularly through the misuse of the industrial licensing. The practice led to concentration of industrial power in the hands of a few selected business families. There was hardly any reduction in either regional disparities or in inequalities or incidence of poverty. Moreover, once a license was granted, no monitoring of its use was there. Similarly, foreign collaboration was permitted in several non-essential and consumer goods.

Steps Initiated in 1984 and 1988

The decade of 1980s is marked with half-hearted and unsure steps at reforming the approach towards industrial licensing. A beginning was made in 1984 by liberalising licensing policy in favour of large business. In particular, they were freed from various provisions of Foreign Exchange Regulation Act (FERA) and Monopolies and Restrictive Trade Practices Act (MRTP). For example, the scheme for renewal of capacity was liberalised and automatic increase of capacity was allowed on the plea that this was needed to reap the economies of scale and technology. In January 1986, the government de-licensed 23 industries by freeing them from the provision of MRTP Act provided they were located in backward areas. The threshold asset limit of becoming an MRTP company was itself raised from erstwhile ₹20 crores to ₹100 crores. Similarly, the manufacturers were allowed to adjust the mix of their output to suit the needs of the market. This was termed the 'the concept of broad-banding'. Corresponding, raising of definitional limits of small scale industries were also adopted in the new approach.

January 3, 1988 saw further liberalisation of industrial licensing system as also some measures for promoting industrialisation of backward areas. Non-FERA and non-MRTP companies were exempted from obtaining licenses under the Industries (Development Regulation) Act provided their investment was below the stated limit and they were located in backward areas. They were also promised various tax benefits. In addition, the government planned to establish 100 growth centres in the next five years.

Industrial Policy of 1990

With the change in government at the Centre, some changes were announced in the industrial policy also, involving a number of details. They included measures for the promotion of small scale and agro-based industries. The investment limits of these industries were increased. A new apex bank SIDBI was established to specifically cater to their financial needs.

The procedures for industrial approvals were simplified and the threshold limits for delicensing were raised. Importing of capital goods, raw materials and components was made easier. Import of technology did not require official permission provided payment of royalty was not more than 5 percent. Foreign equity investment up to 40% was to be allowed on an automatic basis. Setting up of 100% export oriented units, having an investment up to ₹75 crores, could be set up in export processing zones without license.

In general, we may say that the 1990 policy aimed at the growth of small scale industries while extending liberalisation for the growth of medium and large scale sectors. Subject to certain limitations, it also allowed freedom for foreign collaboration.

NEW INDUSTRIAL POLICY 1991

At this stage, the Central Government expressly sought to restructure the economy with a fundamental shift. It was decided that the economy would no longer be a primarily regulated one. It would be primarily a market-oriented one. The changeover, however, would be in a phased and progressive manner so as to minimise any possible disruption, allow the Indian enterprises time and opportunity to acquire competitive strength against foreign competitors, gain the capacity to absorb foreign capital and technology at an increasing scale, and cause minimum dislocation to the employment of labour.

Consequently, the mild pace of liberalisation introduced in mid 1980s was adopted in a full-fledged manner in 1991. It was planned to liberalise the Indian economy from the clutches of the government regulation and control and let it be guided by market forces. Simultaneously, the government decided to integrate the Indian economy with rest of the world. To this end, therefore, a long line of successive measures were initiated. The areas of foreign investment have been successively expanded both in terms of the choice of products, location of business units, use of technology, management practices, and so on. The restrictions on the extent of ownership by Indians have been gradually relaxed with fully owned foreign companies or their subsidiaries coming into existence. At the same time, the licensing requirements have been either abolished or diluted along with simplifying the procedures for getting necessary clearances, if any. Imports have been liberalised to a great extent with a reduction in the number of categories of commodities and a lowering off the customs duties. In the process, we are fast approaching the ASEAN levels of customs duties.

An important component of the industrial policy since the onset of liberalisation is the encouragement of direct foreign investment and technology. Till the adoption of the New Economic Policy in 1990-91, we did not favour direct foreign investment and put several hurdles in its path. We had a policy of bringing in foreign capital only in the form of loans (and possibly grants). As a result, Indian external debt accumulated over years. Currently, we are one of the top heavily indebted developing countries of the world. This entails a heavy cost of servicing this debt in the form of payment of interest and repayment of the principal amount. Moreover, the burden of external debt increased with depreciation of the exchange rate. Another defect of our policy regarding external capital has been our inability to utilise it in the creation of export potential to the needed extent. This, therefore, compelled us to face balance of payments problems and the weakening of the exchange rate.

With steps in the direction of economic liberalisation and globalisation of the Indian economy, the government also changed its policy regarding inflow of foreign capital. Currently, it prefers its inflow in the form of direct foreign investment. Such a flow is beneficial for the economy in several ways. The investors bring in capital in those areas of investment which are assessed to be commercially viable. They can take home returns on investment only if they are profitable. Consequently, FDI comes only in only those fields which have more or less assured commercial viability. Moreover, inflow of investment tends to bring in improved technology and management techniques. They have also an inherent interest in exploring export possibilities. Above all, direct foreign investment has the advantage that eventual outflow of resources takes place only if the investment ventures are successful and, for repatriation of profits, the investors have to buy foreign exchange in the open market. At the same time, the public revenue of the government increases in the form of taxes collected from these business enterprises.

As expected, the inflow of direct foreign investment was very small in the beginning; and it is picking up only slowly. However, if the Indian economy continues to grow stronger and the policy of the government continues to be liberalised, the rate of inflow should increase to a substantial level.

Presently, thus main objectives of industrial policy of Government are :

- to maintain a sustained growth in productivity
- to enhance gainful employment
- to achieve optimal utilisation of resources
- to attain international competitiveness
- to transform India in to a major player in the global arena

Growth in the industrial sector was buoyant during the first two quarters April-June and July-September of 2009-10. The manufacturing sector in particular showed a remarkable robustness, growing at a rate of 12.6% of 9.9% respectively in these two quarters. Thereafter, industrial output growth has begun to moderate. This compares with global trends as a global manufacturing continued to rebound post crisis in the first half of 2010 and has, thereafter, moderated. India's post recovery industrial output growth has been largely driven by a few sectors such as automotive sector along with a revival in cotton textiles, leather, food product, and metal products. Some sectors have shown extreme month on month output volatility. The impact of favourable monsoon on the domestic demand driven industrial sector has not been wide spread. On the consumer non-durable segment in particular it has not been discernible so far but is expected to be visible in the fourth quarter of this fiscal year. Looking at IIT data for the past few months in the short term the industrial sector is likely to grow at a moderate but sustainable rate.

The Indian economy witnessed a swift recovery in 2009-10. The global economic meltdown had affected the Indian economy and GDP growth moderated to 6.8 percent (Provisional Estimate) in 2008-09 compared to an average of 9.5 percent in preceding three years. The impact global slow down was more intense on industry particularly the manufacturing sector. The fiscal and monetary policy interventions, however, provided the stimulus to the economy, leading to a recovery in the GDP growth to 8.00 % (Quick Estimate) in 2009-10 and 8.6 percent (Advanced estimate) in 2010-11. The Industrial and manufacturing sector emerged the key drivers in this revival.

Declining Role of Public Sector

Another leading component of the Government's industrial policy in the liberalised era is to leave those fields in which its competence is believed to be inferior to that of the private sector.

In other words, the new policy assigns a greater role to the market mechanism and private sector than to the public sector. The government no longer aims at controlling the commanding heights of the economy and using them for forcing the private sector along pre-selected lines. Instead, in the new policy, the role of the government is limited to -

- providing defence and social services
- assuming the primary responsibility of providing infrastructure (which may be supplemented with participation by the private sector)
- concentrating upon good governance by enforcing the laws and creating a safe and congenial atmosphere for economic growth

In line with this approach, therefore, the government is pursuing a policy of what is known as phased 'disinvestment' of public sector undertakings and taking steps for rehabilitating the viable weak units, while protecting, to the extent possible, the interests of the workers employed in them. At the same time, the government has been encouraging voluntary retirement by the employees so as to reduce the financial burden on public enterprises. In actual practice, however, the outlines of this policy have not been very sharp and its implementation has been below optimum. In most years, the achievement has been only a fraction of the target set in the budget for the year.

Disinvestment Policy

The present disinvestment policy has been articulated in the recent President's addresses to Joint Sessions of

Parliament and the Finance Minister's recent Parliament Budget Speeches. The salient features of the Policy are:

- Citizens have every right to own part of the shares of Public Sector Undertakings
- Public Sector Undertakings are the wealth of the Nation and this wealth should rest in the hands of the people
- While pursuing disinvestment, Government has to retain majority shareholding, i.e. at least 51% and management control of the Public Sector Undertakings

Approach for Disinvestment

On 5th November 2009, Government approved the following action plan for disinvestment in profit making government companies:

- Already listed profitable CPSEs (not meeting mandatory shareholding of 10%) are to be made compliant by 'Offer for Sale' by Government or by the CPSEs through issue of fresh shares or a combination of both
- Unlisted CPSEs with no accumulated losses and having earned net profit in three preceding consecutive years are to be listed
- Follow-on public offers would be considered taking into consideration the needs for capital investment of CPSE, on a case by case basis, and Government could simultaneously or independently offer a portion of its equity shareholding
- In all cases of disinvestment, the Government would retain at least 51% equity and the management control
- All cases of disinvestment are to be decided on a case by case basis
- The Department of Disinvestment is to identify CPSEs in consultation with respective administrative Ministries and submit proposal to Government in cases requiring Offer for Sale of Government equity

Micro, Small and Medium Scale Industries

Small-scale industry under IDRA, 1951, is one with an investment up to ₹1 crore in plant and machinery, excluding land and building. According to Section 7 of Micro, Small and Medium Enterprises Development Act, 2006, enterprises have been classified as a micro enterprise, a small enterprise, a medium enterprise according to quantum of investment made in Plant and Machinery. Section 7 provides for Classification of enterprises as a micro enterprise, a small enterprise, a medium enterprise, as under-

1. In the case of the enterprises engaged in the manufacture or production of goods pertaining to any industry specified in the First Schedule to the Industries (Development and Regulation) Act, 1951 classification is done on the basis of investment in plant and machinery and are classified as "An enterprise is a small enterprise, where the investment in plant and machinery is more than twenty-five lakhs rupees but does not exceed five crores rupees".
2. In the case of the enterprises engaged in providing or rendering of services classification is done on the basis of investment in equipment and are classified as "An enterprise is a small enterprise, where the investment in equipment is more than ten lakhs rupees but does not exceed two crores rupees".

Micro, Small and Medium scale industries has unique place in Indian scheme of planned economic development because of its contribution to national industrial production, export, employment, and creation of Industrial base.

Industrial Sickness

The policy of over-regulation of the entire industrial sector, coupled with restrictions on closing a financially sick

unit or reducing staff strength, led to a growing menace of industrial sickness, that is, the phenomenon of industry and business units running into a persistent loss and erosion of net worth. Instances also came to light where the entrepreneurs deliberately made a unit financially sick by exploiting it for personal gain. Over years, the growing menace of industrial sickness not only assumed a cancerous form but also endangered the financial institutions which had extended loans to them.

Factually speaking, the incidence of industrial sickness had been on the increase right from the beginning and even the new economic policy initiated in the 1990s was of little help in stemming this tide. The number of non-SSI sick units increased from 1401 in December 1980 to 3,317 in March 2001. Correspondingly, the number of SSI sick units increased from 23,149 to 2,49,630. Such a phenomenal growth in numbers presents a dismal picture of the state of affairs and the mismanagement from which the entire industrial sector suffers. It should be remembered that a leading cause of this disease is the faulty credit and regulatory policies pursued by the authorities. As a result, a number of financial institutions have come to suffer on account of the financial sickness of the units financed by them. For example, the outstanding bank credit to non-SSI sick industrial units increased from ₹1,520 crores in December 1980 to the phenomenal ₹21,270 crores in March 2001. Similarly, the outstanding bank credit to SSI sick units increased from ₹306 crores in December 1980 to ₹4,50 crores in March 2001. It is seen that in spite of relatively smaller number, non-SSI units are creating more serious financial problem for our economy.

The phenomenon of industrial sickness has been fed by both fraudulent approach by the owners and the faulty policies pursued by the authorities. The government has been guilty of over-regulating the industrial units to an extent that left little scope for a reasonable return on investment by fair means. At the same time, the government policies also provided an ample scope and temptation for frauds and mismanagement. Frequently, the permitted sales price was insufficient to cover the cost of inputs. The authorities also failed to formulate and implement a labour and wage policy in conformity with the needs of growing industrialization of the economy. The employing units were often forced to bear the wage bills of workers no longer needed by them. In the entire atmosphere of over-regulation, the owners of industrial units found ways of draining out resources to themselves through various means like job contracting, agency work and the like.

Normally, when a business unit turns financially sick, avenues should be explored for restructuring and reviving it. In the process, it may even be given a fresh injection of capital. In case this remedy is not expected to work, it should be allowed to close down. In India, however, the policy of the government has been to keep these units alive through financial support from itself and from the financial institutions with the objective of protecting the jobs of the employees.

In May 1987, the government set up the Bureau of Industrial and Financial Reconstruction (BIFR) for studying the possibility of rehabilitating those sick units which could be revived and suggest measures for doing so, including injection of fresh capital, reduction in staff through voluntary retirement schemes and so on. It started its work on May 15, 1987. However, public sector undertakings were brought under its purview only in December 1991. Till September 2006, as many as 6991 cases were referred to BIFR, including 296 relating to public sector undertakings. These measures, however, touched only a fringe of the problem of industrial sickness. Moreover, the basic causes giving rise to industrial sickness were not removed. As a result, the absolute number of sick units has been increasing with the passage of time.

In 2002, Companies (Second amendment) Act came into existence, providing for the establishment of a National Company Law Tribunal which was assigned the function of BIFR also. With the repeal of Industrial Companies (Special Provisions) Act, the new arrangement is expected to have several advantages over the earlier situation. Under the new system, the definition of industrial sickness has been improved and a fund has been set up for revival and rehabilitation of sick units.

Changes in our Industrial Patterns Due to the Five-Year Plans

As result of planned scheme of economic development of the country, one may note the following change in the industrial pattern.

1. **Building up of Infrastructure:** The rapid growth of the industrialization has developed a sound industrial infrastructure in the country. The productive capacity has increased remarkably though still inadequate through expansion of infrastructure facilities.
2. **Increase in Share of Industrial Sector in GDP:** The share of industrial sector in Gross Domestic Product of the country has slowly increased over the plan periods. The share of industry has increased from 15.05 percent in 1950-51 to 18.74 percent in 1960-61 to 26.92 percent in 1988-89.
3. **Building of Heavy and Capital Goods Sector:** The Mahalanobis Model in order to strengthen the industrial base of the country gave importance on the capital goods sector. Accordingly a wide range of engineering goods, iron and steel, metal and metal based products has been installed in the country.
4. **Emergence of Public Sector:** During the plan period, the public sector undertakings have increased considerably. The PSUs have employed 53 percent of the productive capital and accounted for 28 percent of total employment in the country. The public sector enterprises play an important role in the production of fuels, basic metal industries, fertilizers and communication equipment.
5. **Rapid Growth of Consumer Durables:** Due to the liberalization policy adopted in 1980s by the Government, the output of consumer goods industries has expanded considerably. During the periods 1981-82 to 1988-89, the output of motorcycles and scooters has increased by 18.8 percent per annum, that of radios and TVs by 28.65 percent per annum and of refrigerators, air conditioners by 12-18 percent per annum.
6. **Emphasis on Chemicals, Petro-Chemicals and Allied Industries in the 1980s:** The 1980s have experienced a rapid growth of chemicals, petrochemicals and allied industries in the country. In the earlier period the metal based product and machinery industries played a dominant role in the industrial growth of the country. But in 1980s their importance gradually declined and the country faced the prospect of further decline in future.

REVIEW QUESTIONS



1. What are the policy initiatives taken by Government to contribute to industrial growth of the country?
2. What are development initiatives of New Industrial Policy 1991?
3. Explain changes in our Industrial pattern due to five year plans.

LESSON ROUND UP

- Immediately after the attainment of independence, the government's foremost step was to start planned economic development for which the Planning Commission was set up in March 1950.
- The Planning Commission was set up with the objective to make an assessment of the material, capital and human resources of the country and to formulate plans for most effective and balanced utilization of the country's resources.
- The period of Five Year Plans is as follows:

PLAN	YEAR
1 st Five Year Plan	1951 to 1956
2 nd Five Year Plan	1956 to 1961
3 rd Five Year Plan	1961 to 1966

4 th Five Year Plan	1969 to 1974
5 th Five Year Plan	1974 to 1979
6 th Five Year Plan	1980 to 1985
7 th Five Year Plan	1985 to 1989
8 th Five Year Plan	1992 to 1997
9 th Five Year Plan	1997 to 2002
10 th Five Year Plan	2002 to 2007
11 th Five Year Plan	2007 to 2012

- The period from 1989 to 1991 was not idle. There were annual plans during this period because this period was characterized by political unrest. This period witnessed many changes.
- Development in agriculture and industry has taken place hand in hand in context of India.
- AGRICULTURE:
 - Agriculture is a large sector of the economic activity and has a crucial role to play in the country's economic development by providing food and raw materials, employment to a large proportion of population, capital for its own development and surpluses for national economic development.
 - During 2006-07, the sector's contribution stood at about 18.5 percent in GDP which further fall down to 14.2 percent of GDP in 2010-11. This trend of the declining share of agriculture in the national income is an indication of economic progress and structural change that is gradually taking place.
 - This is contrary to the development economists' observation that as country develops the share of labour force dependent upon agriculture as a source of livelihood declines.
 - Indian agriculture plays an important role in the country's international trade, and contributes significantly in the National Income, this sector is treated as major source of savings and hence capital formation for the economy.
 - There are various causes for low productivity of Indian agriculture and to improve upon them Green Revolution started in the year 1967-68 with the growth of production in wheat and rice.
- INDUSTRY:
 - Industrialization is a process in which there is a sharp increase in the industrial share of GDP and of the labour force. It is thus the process by which the centre of gravity of the economy shifts from agriculture to industry. It is true that the available empirical evidence makes us believe the thesis that no country could have developed and reached its current state of economic development without an easy access to a sound agricultural base. Those countries which had an underdeveloped agricultural sector could afford to make use of agricultural resources of some other dependent country; in all other countries, agriculture served as the "leading sector" of growth. But it is also true at the same time that fast economic development everywhere has been made possible essentially due to rapid industrialization
 - Industrialization involves: (i) adoption of technologically superior techniques of production that help to transform basic raw materials and intermediate goods into manufactured goods and (ii) application of modern techniques of management and organization like economic analysis, accountancy, management technique, etc.

- The industrial policy of a country is an important instrument to influence the contribution of industrial sector to the economic development of the country. Industrial policy concerns itself with policies, procedures, regulations, and controls associated with the industrial units of the country and the pattern of industrial set up. In effect, however, industrial policy is also closely connected with rest of the economic policies of the government, including, for example, labour policy, fiscal policy, and tariff policy.

GLOSSARY

Planning Commission	A commission delegated to propose plans for future activities and developments of the country for its effective growth.
Disguised Unemployment	When people do not have productive full-time employment and are not counted in the official unemployment statistics. Disguised unemployment includes people doing jobs that are completely unproductive, where productivity is essentially zero. An economy demonstrates disguised unemployment where number of people working are more than required to perform the job.
Zamindari System	System where British in pre colonial India collected the land taxes from farmers and assigned responsibility to local <i>zamindars</i> for collecting and paying to the government the taxes on the land under his jurisdiction.
Co-operative Farming	Farmers pool their small land holding and other resources to produce better yield and attain economies of scale.
Green Revolution	The term Green Revolution refers to the renovation of agricultural practices beginning in Mexico in the 1940s. Because of its success in producing more agricultural products there, Green Revolution technologies spread worldwide in the 1950s and 1960s, significantly increasing the produced per acre of agriculture.
HYV	High-yielding varieties (HYVs) are any of a group of genetically enhanced crops such as rice, maize and wheat that have an increased growth rate, an increased percentage of usable plant parts or an increased resistance against crop diseases. High Yielding Variety Seeds are developed to get higher yielding. The main advantages of High Yielding Variety seeds are yielding of farms with the use of HYV seeds in high compared to the use of traditional seeds. These crops formed the basis for the Green Revolution.
Public Investment	It is another name for Government investment.
GDP	Gross Domestic Product that is the market value of all final goods and services produced within a country in a given period.
New Industrial Policy	In the light of worldwide recession, a policy was announced in July 1991, which; besides liberalization of economy and globalisation, also aimed at building upon the gains achieved, to correct the distortions, maintain a sustained growth in productivity and gainful employment and attain international competitiveness.

SELF-TEST QUESTIONS

1. Discuss the salient features of Indian Economy. Do they indicate that India is still a backward country?
2. Discuss the role of agriculture in Indian Economy.
3. Discuss the role of industry in Indian Economy.

Lesson 7

Selected Areas of Indian Economy

LESSON OUTLINE

- Population-Size and Growth
- India's Population Policy
- Review Questions
- Poverty
- Review Questions
- Unemployment: Nature and Various Measures to Reduce it
- Infrastructure
 - Energy
 - Transportation
 - Communication
 - Health and Education
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

Various studies have proved that poverty and underdevelopment has direct link to population growth per se. The causes of underdevelopment can be both internal and external. Internal causes may include population growth, poverty, unemployment, etc.

Everywhere in the world, "Poverty Causes Population Growth; Causes Poverty". This is a vicious circle which needs to be taken care at an early stage, before it is far beyond the reach to maintain stable economy.

In this light, a brief introduction to these areas on Indian economy is required. This chapter aims to throw light upon the issues like population, poverty, unemployment and infrastructural developments. These issues are significant, not only from point of view of the economy but also from the point of view of individuals that form the economy. These issues needs immediate attention lest, the entire economy is handcuffed in a vicious circle of under development.

In the 1930s, when the British ruled the country, Jawaharlal Nehru described India's situation as follows:

"A servile state, with its splendid strength caged up, hardly daring to breathe freely, governed by strangers from afar; her people poor beyond compare; short lived and incapable of resisting disease and epidemic; illiteracy rampant; vast areas devoid of all sanitary or medical provision; unemployment on a prodigious scale, both among the middle classes and the masses."

On being sworn in as the first Prime Minister of independent India in 1947, Pt. Jawahar Lal Nehru called for "The ending of poverty and ignorance and disease and inequality of opportunity."

POPULATION – SIZE AND GROWTH

India accounts for 2.4 percent of world surface area but it supports 16.7 percent of the world population.

According to the final results for the Census of India 2001, the population of India crossed one billion and was enumerated at 1.03 billion. It is estimated approximately 1.154 billion in 2008-09. As per latest information, current population of India in 2012 is 1.22 billion. The figures show that India represents almost 17.31% of the world population, which means one out of six people on this planet lives in India. Thus, India has become the second country in the world after China to cross one billion marks. The decadal growth of population at 21.53 percent during 1991-2001, was the sharpest decline in the rate of growth of population witnessed since independence with the average exponential growth rate declining from 2.14 percent per annum during the previous decade to 1.93 percent per annum during 1991-2001.

The National Population Policy (NPP) 2000 outlines the long term objective of achieving a stable population by 2045, at a level consistent with the requirements of sustainable economic growth and social development. The census work for 2011 is in the process.

India is experiencing an explosive growth in its population with all the attendant ill-effects of this phenomenon. At the time of Independence, population of our country was only around 360 million. Since then, it has increased to more than three times that figure. The authorities did not realise the fact that an important by-product of economic growth happens to be a rapid growth in population. Economic growth unleashes several forces which accelerate population growth and tends to neutralise the gains of economic development. Insufficient attention was paid to the need of a vigorous and effective policy for population control. The result was that by 1961, our population had jumped to a figure of 439 million (which was 21.5% above 1951 figure). Even then the authorities remained sluggish in formulating and implementing an effective population policy. Consequently, our population continued to experience an unchecked growth. Having recorded 24.8% and 24.7% growth rates in the next two decades, it touched a figure of 683 million by 1981. The 1991 census put the figure at 844 million and the estimated figure for 2008-09 (as per Economic Survey 2009-10) is around 1154 million. While our death rate has fallen to a very commendable figure of 7.4 per thousand p.a., the corresponding figure for birth rate is still at a high of 22.8 per thousand per annum. Such a wide divergence between the two rates is adding rapidly to our population growth. In addition, with increasing life expectancy at birth, there is an increase in the proportion of aged persons and economic dependency.

The percentage decadal growth of population in rural and urban areas in the decade 1991-2001 was 18.08 percent and 31.48 percent respectively. Urban population constitutes 27.82 percent of the total population of the country, which is higher by 2.11 percent points as compared to the percentage in 1991. The density of population has increased steadily from 117 persons in 1951 to 325 persons per sq.km in 2001. However, the sex ratio of country as a whole has improved from 927 females per 1000 males in 1991 to 933 females per 1000 males in 2001. The sex ratio of a country as a whole in the age group 0-6 years was noticed to 927 females per one thousand males. The literacy rate for the country as a whole in 2001, worked out to 64.84 percent for the population aged seven years and above. The corresponding figures for males and females were 75.26 percent and 53.67 percent respectively. The literacy rate was estimated around 67.6 percent in 2005-2006.

It needs no iteration that a rapid increase in population has been a hurdle in our economic growth in several ways. It has made a tremendous addition to our demand for consumption goods (especially for the basic necessities like food, housing, clothing, health care, and education, etc.) thereby contributing to the demand for scarce productive resources. In addition, growing population has counterbalanced a sizeable portion of the increase in our national income leading to a slower increase in our per capita income. Faced with certain other drawbacks in our planning and growth strategy, we have also failed in providing adequate employment opportunities to our growing work force. As a result, there has been a rapid increase in unemployment, both

open and disguised. Population growth has also eroded the effectiveness of our poverty-eradication programmes. The unfortunate fact is that the population problem remains unsolved even now. Projections show that it would continue to grow rapidly for some more decades.

Some of the major causes of population explosion in India include the following:

Since Independence, in spite of inadequate public health care and other medical services we have been able to control many mass-killer diseases. Some of them like small pox have been totally eradicated and some epidemics like plague are well under control. Due to better healthcare of females, there has been a substantial decline in both infant mortality and female mortality during child-bearing. Unfortunately, we have failed in providing safe drinking water to our masses. Had we succeeded in providing this basic necessity, we would have been able to control a large number of additional diseases as well. All these factors have brought down the death rate and added to the reproductive life of our female population. The data given in the Economic Survey 2009-10 shows that our death rate fell from around 27.4 per thousand in 1950-51 to around 7.4 per thousand in 2008-09. This figure is very close to the level of death rate prevalent in the world's most advanced countries. Correspondingly, the life expectancy at birth (in years) has also recorded a creditable increase from around just 32 in 1950-51 to 62.6 for males and 64.2 for females in 2006-07, and is expected to increase further in the coming years.

While death rate has declined substantially, and is expected to stay low in the foreseeable future, fall in birth rate has been quite disappointing due to several reasons. It was 39.9 per thousand in 1950-51 and fell to only 25.0 per thousand in 2001-02 and 24.8 per thousand in 2002-03 and 22.8 per thousand in 2008-09. Leading causes for our failure in achieving the needed decline in birth rate include absence of an effective system of economic incentives and disincentives for promoting small family norms, insufficient availability of medical facilities for restricting family size, absence of social security (because of which children are considered a source of income to aged parents), low average age at marriage, better health and longer reproductive life span of potential mothers, and the like.

Age Composition

Age composition is a major factor in determining the overall productivity of a population, because it reflects that proportion of it which is to work and support the rest (namely, the old and the very young). An inevitable consequence of a rapid increase in population is caused by the excess of birth rate over death rate (and not by immigration) in a growing proportion of the younger age groups in the total population. Coupled with an increase in the average life expectancy at birth, the proportion of non-earning consumers in the total population increases and retards the rate of economic growth of the country. It is estimated that currently, more than one-third of our population is in the age-group of 1-14 years, while another 7-8 % is above 60 years. It is noteworthy that some of the advanced Western countries are facing a high dependency ratio on account of increasing proportion of retired and old people. In India, the dependency is high because of a high proportion of persons below the age of 14 years.

Density

The term density of population refers to the average number of persons per square kilometre of area. The density of population which a country can sustain depends upon its level of economic development. India has a vast geographical area but, on account of its economic backwardness, is not able to support its large and rapidly growing population. The density of its population was 363 persons per square km in 2004 and is expected to increase further. This projection highlights an urgent two-fold need to accelerate economic growth on the one hand and stemming the rate of population growth on the other. It should, however, be remembered that the latter cannot be achieved quickly enough. It is a long term phenomenon.

Urbanisation

In India, growing population has also led to increased urbanisation. This is partly explained by the lopsided growth of our economy in which it has become increasingly difficult to find gainful employment in rural areas.

The proportion of urban to total population increased from 17.3% in 1951 to 25.7% in 1991 and is expected to have crossed 30 % by the end of the century. As noted above, an important reason for migration from rural to urban areas has been the comparative lack of employment opportunities in the former. In rural areas, agricultural growth has been at a slow pace.

The phenomenon of green revolution has remained confined to only some selected regions of the country. Rest of the regions still face a scarcity of assured irrigation facilities, and other inputs. Agricultural reforms have also been uneven in different States. Moreover, agriculturally backward areas suffer from insufficient alternative employment opportunities (such as, in the form of small, village and cottage industries), dairy farming, and fisheries and so on. Though some poor surplus workers remain disguisedly employed on their family farms, the rest are compelled to migrate to cities in search of work and income.

It should be noted that urbanisation is a very resource-costly phenomenon for an economy like ours. It necessitates additional consumption of productive resources which have to be diverted from other uses. It requires the provision or augmentation of several collective services which may be avoided or provided only at marginal resource cost in rural areas. Examples of such collective services include the provision of urban transport, additional roads, crossings, traffic management, road lighting, and so on. Similar arrangements have to be made for treatment of drinking water, disposal of sewage and industrial waste, and the like. Urban areas also suffer from atmospheric and noise pollution. For that reason, only well developed economies can afford to have a high percentage of urbanised population.

Classification of Population by Economic Activity

The final results of 2001 Census reveal that out of total population of 103 crores in the country, 31.30 crores were main workers and 8.92 crores were the marginal workers whereas 62.64 crores were non-workers. Thus, the main workers constitute about 30.43 percent and marginal workers constitute about 8.67 percent of the total population. Among males 45.12 percent were main workers and 6.56 percent were marginal workers while among females 14.68 percent were main workers and 10.95 percent were marginal workers. Out of the total workers (main + marginal) 31.7 percent were cultivators, 26.5 percent were agricultural labourers, 4.2 percent were engaged in household industries and 37.6 percent were engaged in other economic activities. Thus, about 58.2 percent of working population was engaged in agriculture (i.e. cultivators and agriculture labourers) in 2001.

Quality of Population

Quality of population refers to a combination of the quality of life led by it and the level of its productivity. It is represented by a number of factors, including, (i) the level of health enjoyed by it, (ii) proneness to suffer from ill-health, diseases and epidemics, (iii) life expectancy at birth, (iv) infant mortality, (v) mortality of mothers in child birth, (vi) level of literacy, and (vii) technical skill and productivity of the labour force. Judged by these criteria, we may note that the quality of Indian population has steadily improved since Independence, but it is still very poor when compared with the standards achieved in advanced countries.

Let us start with the availability of cereals. Statistics of key Indicators of the economy shows that in spite of nearly four-fold increase in the production of food grains, their net per capita availability has not shown noticeable increase since 1970-71. The figure was 395 grams per day in 1950-51 and 418 grams in 1970-71. Having touched 469 grams in 1990-91, it declined back to 436 grams in 2008. It is worth noting that this poor performance is not only on account of rapidly increasing population, but also as a result of poor rate of growth registered by

pulses. Their per capita per day availability declined from 61 grams in 1950-51 to 42 grams in 2008. The performance in terms of availability of oilseeds has been equally disappointing.

In contrast, we have been able to control, to a significant extent, the mass killer diseases, and infant and female mortality (even though our infant mortality is still one of the highest in the world). And this has led to an increase in our life expectancy at birth from a low of only 32.1 years in 1950-51 to 60.3 years in 1993-94, and further to 63.87 years for males and 66.91 years for females in 2000-01. Similarly, the literacy rate (in spite of the extremely unrealistic manner of its official definition) has increased from a mere 18.33% in 1950-51 to 65.38% in 2000-01. The dark side of the story is that due to population explosion, the absolute number of illiterate persons in our country is higher than what it was at the time of Independence. Similarly, while we have been to check the wrath of mass killer diseases, we are still unable to provide safe drinking water to the masses or in situation to provide even elementary health care.

Thus, the indicators of quality of Indian population provide a mixed picture. Judged by the increase in life expectancy at birth, the quality of life has improved substantially since 1950-51. But as noted above, this achievement is accompanied by a failure along several other fronts including, for example, our failure to provide basic necessities like housing, hygienic living conditions, safe drinking water, nutritive food and health care. Food intake of the Indian masses is deficient in certain elements like proteins, vitamins and minerals. Dr. Amritya Sen argued in his writings to increase investment in primary education and health care to make available better life to the masses in the country. Similarly, while we have one of the largest workforces of scientists and technically qualified persons, an average Indian worker is still unskilled and untrained. Average capital intensity in Indian productive activities is quite low and the capital used is often of poor technical standard. In addition, we also suffer from a lack of initiative and work culture. The general tendency is to look for an opportunity to avoid hard labour.

Impact of Population on Economic Development

The growth of population creates hurdle in economic development of a country in a variety of ways. Some of them are discussed as under:

1. **Fall in Per Head Availability of Natural Resources:** Increase in population of a country result decrease in per head availability of natural resources. This shortfall can be made good by building up capital in the process of exploring natural resources by a rising population. In under-developed and low income economies including India, the capital building activity stays at a much lower level because (a) the growing population contributes less to production than it absorbs by way of increase consumption, (b) the quality of labour in under-developed economies also affects capital formation adversely, (c) proportion of workers of productive age to total population is highly adverse, (d) growing population results in diversion of resources not only to consumption expenditure but also to items for social overheads like education, health, housing, etc., so that volume of capital formation suffers.
2. **Adverse Land-man Ratio:** Rising population also distorts the land man ratio. Since the supply of land is inelastic, the rising population pressure on land is resulting in progressive decline in the available duty of per capita cultivated land.
3. **Mass Unemployment:** An economy, which is suffering from population explosion generally confronts with mass unemployment. Job opportunities do not widen in such economies because the labour force is increasing with no commensurate increase in complementary resources to it. Low income and reduced savings hamper investment and capital formation while increasing job avenues for the rising population are not available. Such economies usually face a backlog of unemployment, which keeps on enlarging because current additions to the labour force are not fully absorbed.
4. **Inadequate Social Overheads :** Growing population is proving to be a menace to the economy in the sense that it requires colossal investment to build up a commensurate social overhead in the form of

schools, houses, universities, hospitals, trains and systems of transport and communication, recreation centres etc. This necessitates diverting resources of the community away from economic development. This leaves very less amount of resources for investing in projects, which are productive in nature and lead to improvement in the standard of living of the people. Thus, the economy gets trapped in the Nurkse's vicious circle of poverty i.e. low investment, income and saving etc.

5. **Low Per Capita Income:** Population growth results in decline in per capita income and standard of living of masses. Per capita availability of a number of essential goods also declines if real income does not increase at the same pace.
6. **Energy Crisis:** Population growth has raised energy crisis. More and more energy is needed in future to meet increasing demand of the rising population.
7. **Falling Savings and Investment:** A rising population also influences saving and investment in the country because a large part of income generated in the economy is spent on consumption needs.
8. **Environmental Degradation:** The increasing population growth is also responsible for environmental degradation and pollution thereby causing serious problems in terms of air and water pollution, soil erosion, and floods.

India's Population Policy

The overriding objective of economic and social development is to improve the quality of lives that people lead, to enhance their well being, and to provide them with opportunities and choices to become productive assets in the society.

In 1952, India was the first country in the world to launch a national programme, emphasizing family planning to the extent necessary for reducing birth rates "to stabilize the population at a level consistent with the requirement of national economy". After 1952, sharp declines in death rates were, however, not accompanied by a similar drop in birth rates. The National Health Policy, 1983 stated that replacement levels of total fertility rate (TFR) should be achieved by the year 2000.

Half a century after formulating the national family welfare programme, India has:

- reduced crude birth rate (CBR) from 40.8 (1951) to 26.4 (1998)
- halved the infant mortality rate (IMR) from 146 per 1000 live births (1951) to 72 per 1000 live births (1998)
- quadrupled the couple protection rate (CPR) from 10.4 percent (1971) to 44 percent (1999)
- reduced crude death rate (CDR) from 25 (1951) to 9.0 (1998)
- added 25 years to life expectancy from 37 years to 62 years
- achieved nearly universal awareness of the need for and methods of family planning
- reduced total fertility rate from 6.0 (1951) to 3.3 (1997).

On 11 May, 2000 India was projected to have 1 billion (100 crores) people, i.e. 16 percent of the world's population on 2.4 percent of the globe's land area. If current trends continue, India may overtake China in 2045, to become the most populous country in the world. While global population has increased threefold during this century, from 2 billion to 6 billion, the population of India has increased nearly five times from 238 million (23 crores) to 1 billion in the same period. India's current annual increase in population of 15.5 million is large enough to neutralize efforts to conserve the resource endowment and environment.

India has more people than Europe, more than Africa, more than the entire Western Hemisphere. India's population

will exceed that of China by 2030 to become the world's most populous country, a distinction it will almost certainly never lose. Just one group, Indian boys below age 5, numbers 62 million-more than the total population of France. India's annual increase of nearly 19 million contributes far more to annual world population growth than any other country.

Stabilising population is an essential requirement for promoting sustainable development with more equitable distribution. However, it is as much a function of making reproductive health care accessible and affordable for all, as of increasing the provision and outreach of primary and secondary education, extending basic amenities including sanitation, safe drinking water and housing, besides empowering women and enhancing their employment opportunities, and providing transport and communications.

The National Population Policy, 2000 (NPP 2000) affirms the commitment of government towards voluntary and informed choice and consent of citizens while availing of reproductive health care services, and continuation of the target free approach in administering family planning services. The NPP 2000 provides a policy framework for advancing goals and prioritizing strategies during the next decade, to meet the reproductive and child health needs of the people of India, and to achieve net replacement levels by 2010. It is based upon the need to simultaneously address issues of child survival, maternal health, and contraception, while increasing outreach and coverage of a comprehensive package of reproductive and child health services by government, industry and the voluntary non-government sector, working in partnership.

In pursuance of these objectives, the following National Socio-Demographic Goals was to be achieved in each case by 2010 are formulated:

- Address the unmet needs for basic reproductive and child health services, supplies and infrastructure.
- Make school education up to age 14 free and compulsory, and reduce drop outs at primary and secondary school levels to below 20 percent for both boys and girls.
- Reduce infant mortality rate to below 30 per 1000 live births.
- Reduce maternal mortality ratio to below 100 per 100,000 live births.
- Achieve universal immunization of children against all vaccine preventable diseases.
- Promote delayed marriage for girls, not earlier than age 18 and preferably after 20 years of age.
- Achieve 80 percent institutional deliveries and 100 percent deliveries by trained persons.
- Achieve universal access to information/counselling, and services for fertility regulation and contraception with a wide basket of choices.
- Achieve 100 per cent registration of births, deaths, marriage and pregnancy.
- Contain the spread of Acquired Immune Deficiency Syndrome (AIDS), and promote greater integration between the management of Reproductive Tract Infections (RTI) and Sexually Transmitted Infections (STI) and the National AIDS Control Organisation.
- Prevent and control communicable diseases.
- Integrate Indian Systems of Medicine (ISM) in the provision of reproductive and child health services, and in reaching out to households.
- Promote vigorously, the small family norm to achieve replacement levels of TFR.
- Bring about convergence in implementation of related social sector programs so that family welfare becomes a people centred programme.

REVIEW QUESTIONS

1. According to 2001 census, urban rural population ratio is about–

(a) 35 : 65	(c) 28 : 72
(b) 32 : 68	(d) 25 : 75
2. According to 2001 census, the state having highest urban population is.....

(a) U.P.	(c) Tamil Nadu
(b) Maharashtra	(d) Kerala

POVERTY

Poverty is a social phenomenon and can be defined as a situation in which a section of the society is unable to fulfill even its basic minimum requirement of life. Poverty may be known as a state symbol in less developed countries. Laster R. Brown in his book 'World Without Borders' explains poverty thus; "Unfortunately it is not an economic abstraction, it is a human condition. It is despair, grief and pain. It is the despair of a father with a family of seven children in a poor country when he joins the, swelling ranks of unemployed with no prospects of unemployment compensation. Poverty is the longing of a young boy playing outside a village school but unable to enter because his parents lack a few rupees needed to buy text books. Poverty is the grief of parents watching a three year old child die of a routine childhood disease because they cannot afford any medical care." This is the grim, spectacle of poverty. By poverty we generally mean a situation in which a person fails to earn income sufficient to purchase his bare means of subsistence. A poor man is one who does not have command over the basic needs of life like enough food, clothing, drinking water and shelter on the material level. On the nonmaterial level a poor man is deprived of basic social needs like health and education.

Three broad concepts of poverty can be identified. Poverty can be defined as subsistence, inequality and externality. But poverty is mainly viewed in two ways absolute and relative. In absolute sense, poverty relates to subsistence. It means absence of the minimum physical quantities of food required for an individual daily. People are considered poor if they fail to attain minimum standard of consumption and nutrition necessary for their bare existence.

Absolute poverty can be measured through income levels. Besides, progress in health and nutrition, literacy levels, consumption of essential goods and services etc. may indicate the level of absolute poverty also. Thus, it relates to the minimum standard of living. This may be expressed in terms of income or consumption expenditure.

Relative poverty means difference in the relative standard living of the people. It stands for the large inequalities of income and wealth. In short, it relates to inequality in the level of living. It is due to maldistribution of national income. Some people are of high income group and some are of low income group. Hence, the later are relatively poorer than the former. This relative poverty is found in all the countries, developing and developed more or less. In India, we are mostly concerned with absolute poverty. Absolute poverty has been expressed in terms of minimum calories intake or recommended nutritional requirements.

The Planning Commission set up a Study Group in July 1962 to examine the question of poverty in the country. The Study Group suggested a private consumption expenditure of Rs. 20 (at 1960-61 prices) per capita per month as a basic minimum requirement of life, below which are regarded as poor. In 1979, following the recommendation of the Task Force on Projection of Minimum Needs and Effective Consumption Demand, the

poverty line is defined as “the per capita monthly expenditure needed to obtain the consumption of 2,400 calories per-capita per day in rural areas and 2,100 in urban areas in the base year 1973-74.” The poverty line so defined was ₹49.10 for rural areas and ₹56.60 for urban areas. The same poverty line was updated for subsequent years using stable indicators of changes in cost of living.

Causes of Poverty

Some of the causes responsible for poverty in India are discussed as under:

1. **Rapidly Rising Population:** The population during the last 45 years has increased at the rate of 2.2% per annum. On average 17 million people are added every year to its population which raises the demand for consumption goods considerably.
2. **Low Productivity in Agriculture:** The level of productivity in agriculture is low due to subdivided and fragmented holdings, lack of capital, use of traditional methods of cultivation, illiteracy etc. This is the main cause of poverty in the country.
3. **Under Utilized Resources:** The existence of under employment and disguised unemployment of human resources and under utilization of resources has resulted in low production in agricultural sector. This brought a down fall in their standard of living.
4. **Low Rate of Economic Development:** The rate of economic development in India has been below the required level. Therefore, there persists a gap between level of availability and requirements of goods and services. The net result is poverty.
5. **Price Rise:** The continuous and steep price rise has added to the miseries of poor. It has benefited a few people in the society and the persons in lower income group find it difficult to get their minimum needs.
6. **Unemployment:** The continuously expanding army of unemployed is another cause of poverty. The job seeker is increasing in number at a higher rate than the expansion in employment opportunities.
7. **Shortage of Capital and Able Entrepreneurship:** Capital and able entrepreneurship have important role in accelerating the growth. But these are in short supply making it difficult to increase production significantly.
8. **Social Factors:** The social set up is still backward and is not conducive to faster development. Laws of inheritance, caste system, traditions and customs are putting hindrances in the way of faster development and have aggravated the problem of poverty.
9. **Political Factors:** The British started lopsided development in India and reduced Indian economy to a colonial state. They exploited the natural resources to suit their interests and weaken the industrial base of Indian economy.

Removal of Poverty

The Government has initiated various steps under its planned scheme of economic development to increase national and per capita income and to reduce the poverty.

- The government believed that efforts towards developing the heavy industries and green revolution would create employment opportunities and income, would lead to rapid economic development. Thus government set plan objectives accordingly.
- Several land reform measures such as abolition of zamindari system, security of tenant farmers against eviction, fixation of rents, fixation of ceilings on land holdings, and distribution of surplus land among small and landless farmers were undertaken by the government.
- Cottage and small-scale industries which employ more laborers and less machinery were encouraged. The Government also reserved some production activities solely for these industries.

How to eradicate poverty in India?

The following measures can go a long way to reduce the inequalities of income. They are:

1. **More Employment Opportunities:** Poverty can be eliminated by provide more employment opportunities so that people may be able to meet their basic needs” For this purpose, labour intensive rather than capital intensive techniques can help solve the problem to a greater extent. During the Sixth and Seventh Five Year Plans, programmes like Integrated Rural Development Programme, Jawahar Rozgar Yojana Rural Landless Employment Guarantee Programme etc. have started with a view eliminate poverty in the rural sector.
2. **Minimum Needs Programme:** The programme of minimum needs can help to reduce poverty. This fact was realized in the early seventies as benefits of growth; not percolate to poor people and less developed countries are left with no choice except to pay direct attention to the basic needs of the low strata of the society. In the Five Year Plan, minimum needs programme was introduced for the first time.
3. **Social Security Programmes:** The various social security schemes Workmen’s Compensation Act, Maternity Benefit Act, Provident Fund Act, Employ, State Insurance Act and other benefits in case of death, disability or disease while on duty can make a frontal attack on poverty.
4. **Establishment of Small Scale Industries:** The policy of encouraging cottage and small industries can help to create employment in rural areas especially in backward regions. Moreover, this will transfer resources from surplus areas to deficit without creating much problem of urbanization.
5. **Uplift of Rural Masses:** As it is mentioned that India lives in villages, various schemes for the uplift of rural poor may be started. The poor living, in rural areas generally belong to the families of landless agricultural laborers, small marginal farmers, village artisans, scheduled castes and scheduled tribes. However it must be remembered that Government of India has introduced many schemes from time to time.
6. **Land Reforms:** Land reforms have the motto, “land belongs to the tiller”. Thus, the legislative measures were undertaken to abolish Zamindari System. Intermediaries ceiling on holdings was fixed. But it is a bad luck, these land reforms lack proper implementation. Even then, it is expected that if these reforms are implement seriously, it would yield better results which will be helpful to reduce the income of affluent section of society.
7. **Spread of Education:** Education helps to bring out the best in human mind and spirit. Therefore, it is urgent to provide education facilities to all. These should be given special facilities of stipend, free books and contingency allowance Education will help to bring awakening among the poor and raise their mental faculty level.
8. **Social and Political Atmosphere:** Without the active co-operation of citizens and political leaders, poverty cannot be eradicated from India. A conducive social political atmosphere is a necessary condition for eradicating the poverty from its root.
9. **To Provide Minimum Requirements:** Ensuring the supply of minimum needs to the poor sections of society can help in solving the problem of poverty. For this, the public procurement and distribution system should be improved and strengthened.

Poverty Alleviation Programmes

The authorities in the country have tried to reduce the incidence of poverty in the country even since independence. A large number of programmes have been experimented in the Indian soil to combat with poverty. Beginning

with Community Development Programmes in 1950s and traversing through agriculture-oriented programmes and target-oriented programmes, which know no bound. The most of the programmes have been designed either according to the suggestion of ILO or World Bank. The Govt, of India took certain measures to reduce poverty, inequality of income and wealth in its five year plan periods. Followings are some steps taken by the Government, from time to time.

1. **Integrated Rural Development Programme (IRDP):** Integrated Rural Development Programme was initiated in 1976-77 in 20 selected districts and further in 1980 it was started in all blocks of the country. The objective of the programme is to enable the selected families to cross the poverty line through a strategy of productive assets endowment. During the Seventh Five Year Plan period an outlay of ₹2.462 crores was provided for the programme and the target was to cover 20 million beneficiaries.
2. **National Rural Employment Programme (NREP):** National Rural Employment Programme was launched in October 1980. The basic objective of the programme was to generate additional gainful employment in the rural areas to bring about a general improvement in the overall quality of life in rural areas.
3. **Rural Landless Employment Guarantee Programme (RLEGP):** The RLEGP was launched on 15 August 1983 to generate additional employment in rural areas. The basic objective of the programme was to improve and expand employment opportunities to create productive and durable assets for strengthening rural infrastructure and to improve the overall quality of life in rural areas.
4. **Jawahar Rozgar Yojana:** Jawahar Rozgar Yojana has been introduced in 1989-90 with a purpose of generating more employment in the country. To create 837 million man days of employment a sum of ₹2623 crores was provided.
5. **Training of Rural Youth for Self-Employment:** This scheme was launched on August 15, 1979 with the sole aim of generating employment opportunities for the unemployed educated rural youth. The main thrust of this scheme is on equipping rural young in the age group of 18-35 years with necessary skills and technology to take up vocations of self employment in the broad fields of agriculture and allied industrial activities.
6. **Development of Women and Children.** This programme was launched during the Sixth Plan on a pilot basis in 50 districts and was continued in the Seventh Plan. The object of the programme is to improve the lot of rural women through the creation of income generation activities in a district.
7. **Drought Prone Area Programme:** DPAP was started in 1970-71 in the areas which are chronically affected by the drought. The main object of this programme is to organize permanent works to obviate scarcity relief and to generate adequate employment through labour intensive schemes.
8. **Desert Development Programme:** DDP was started in 1977 on the recommendations of the National Commission on Agriculture. The main objective of DDP was on controlling further diversification of desert areas and raising the productivity of local inhabitant.
9. **Minimum Needs Programme:** Keeping in view the basic notion of 'Garibi Hatao' and growth with justice "Minimum Needs Programme" was introduced in Fifth Five Year Plan. The programme aims at 100% employment in the age group of 16-24 by 1990.
10. **Employment Exchanges:** Government has set up about 890 employ exchanges offering information on the possible vocational avenues. These exchanges do not provide employment directly but are of great assistance in directing the unemployed youth to the possible areas of employment.
11. **Employment Guarantee Scheme:** This Scheme has been launched in states, such as, Maharashtra,

West Bengal, Kerala, Rajasthan etc. Under the schemes unemployed persons are given economic assistance.

12. **Development of Animal Husbandry and Agriculture:** In 1992-93, under Milk Development Plans of Operation Flood about 54 lakhs persons were provided employment. Under agriculture extension training programme, by 1994-95 employ opportunities to 16,000 persons were provided.
13. **Employment Assurance Scheme:** The Employment Assurance Scheme (was launched in 1994 in 1752 backward blocks in the country. The main objective of the scheme is to provide 100 days of unskilled manual work to the rural poor who are unemployed.
14. **Prime Minister's Rozgar Yojana (PMRY):** This Yojana was implemented in 1993 in order to give employment to more than 10 lakhs people by setting up seven lakhs enterprises during Eighth Plan in industry, service and business. In 1995-96, it generated employment for 3.75 lakhs people. It provided employment to 2.1 lakhs proper day in 1999-2000.
15. **Prime Minister's Integrated Urban Poverty Eradication Program (PMIUPEP):** This programme has been implemented in 1995- 96. This programme aims to provide employment to the urban poor. It will cover 50 lakhs urban poor living in 345 towns. The Central Government will incur an expenditure of ₹ 800 crores on this programme during a period of five years. It provided employment to 2.85 lakhs people in 1999-2000.
16. **Self-Employment Programmes:** Swarnajayanti Gram Swarozgar Yojana (SGSY). Integrated Rural Development Programme (IRDP) and allied programmes as Training of Rural Youth for Self Employment (TRYSEM), Development of Women and Children in Rural Areas (DWCRA) and Million Wells Scheme (MWS) have been restructured into a single self-employment programme called the Swarnajayanti Gramya Swarozgar Yojana (SGSY) from April 1999.
17. **Swaran Jayanti Rozgar Yojana:** This plan began on December 1, 1997. The previous programmes meant for providing employment to urban employed like Nehru Rozgar Yojana and Prime Minister Integra-Urban Poverty Eradication Programme were merged into it. It aims at providing self-employment or wage employment to urban unemployed and underemployed persons. It comprises of two plans: (i) Urban Self-Employment Programme-(USEP) and (ii) Urban Wage Employment Programme-(UWEP). In year 1997-98, a sum of ₹125 crores was spent on this yojana.
18. **Jawahar Gram Samridhi Yojana:** Jawahar Rozgar Yojana has been restructured as Jawahar Gram Samridhi Yojana with effect from April 1999. This Yojana has been formulated to improve the quality of life of the rural poor by providing the additional gainful employment.
19. **Other Programmes:** Government of India launched other employment and poverty alleviation programmes as under:
 - Pradhan Mantri Gramodaya Yojana (PMGY)
 - Pradhan Mantri Gramodaya Yojana (Gramin Awas)
 - Pradhan Mantri Gramodaya Yojana-Rural Drinking Water Project
 - Pradhan Mantri Gram Sadak Yojana (PMGSY)
 - Autyodya Anna Yojana (AAY)
 - Jai Parkesh Rozgar Guarantee Yojana (JPRGY)
 - Valmiki Ambedkar Awas Yojana (VAMBAY)

REVIEW QUESTIONS

1. Sampurna Gramin Rojgar Yojana has been launched from—
- 1st April, 2001
 - 25th Sept., 2001
 - 30th Sept., 2001
 - No scheme of such title has yet launched

UNEMPLOYMENT: NATURE AND VARIOUS MEASURES TO REDUCE IT

The nature of unemployment, in India sharply differs from the one that prevails in industrially advanced countries. According to Keynes, unemployment in these countries could be the result of a deficiency of effective demand. It implied that in such economies machines become idle and demand for the products of industry is no longer there. This type of unemployment caused by economic slowdown did arise in India during 1930s. But with the growth of economic activity, it has been possible to mitigate cyclical unemployment. Similarly, after the Second World War, when war-time industries were being closed, there was a good deal of frictional unemployment caused by retrenchment in the defence establishments, etc. These workers were to be absorbed in peacetime industries. Similarly, the process of rationalization which started in India from 1950 also caused displacement of labour. But more serious than cyclical unemployment or frictional unemployment in Indian economy are the prevalence of chronic under-employment or disguised unemployment in the rural areas and the existence of urban unemployment among the educated classes. It may emphasize that unemployment in India is not the result of deficiency of effective demand but a consequence of shortage of capital equipment or other complimentary resources. The committee of experts on unemployment in its report of May, 1973 estimated the likely number of unemployed in 1971 could be 18.7 million including 9 million who were without any job whatsoever and 9.7 million who worked for less than 14 hours per week treated at par with the unemployed. Out of this, 16.1 million unemployed were in the rural areas and 2.6 million in the urban areas. Unemployed as a percentage of total labour force worked out to 10.4 percent for the country as a whole; 10.9 percent for the rural areas and 8.1 percent for the urban areas. It was estimated that 8.5 million persons in rural areas and 1.2 million persons in urban areas were working for less than 14 hours/per week. Besides, this, 23.50 million persons working for less than 28 hours per week were severely under-employed. Similarly, 3.4 million persons working for 15 to 28 hours per week were severely under-employed. This is in all 26.9 million persons were severely underemployed. A person working for 8 hours a day for 273 days of the year is regarded as employed on a standard person year basis.

Three estimates of unemployment were generated in the 27th Round of National Sample Survey (NSS) on the basis of the recommendations of the Committee of Experts on unemployment estimates. These are :

- Usual Principal status employment or chronic unemployment i.e., persons who remained unemployed for a major part of the year. This measure is more appropriate to those in search of regular employment who may not accept casual work. This is referred to as “open unemployment”;
- Weekly status unemployment i.e., persons who did not find even an hour of work during the survey week; and
- Daily status unemployment i.e. persons who did not find work on a day or some days during the survey week.

The usual status unemployment rate is generally regarded as the measure of open unemployment during the reference year; the current weekly status (CWS) unemployment rate also measure chronic unemployment, but with reduced reference period of a week. The current daily status (CDS) is a comprehensive measure of unemployment, including chronic unemployment as well as under-employment, on weekly basis. In 1980, nearly 12 million persons fell in the category of usual status or open unemployment. The overall rate of usual status unemployment for India has risen from 4.23 percent in 1977-78 to 4.48% in 1980. On the basis of the NSS Survey, taking all persons under the weekly status criterion, 16 million persons might be considered as unemployed in the beginning of 1990. On the basis of earlier round of NSS, about 12 million persons were estimated to be severely under-employed in the beginning of 1990. The backlog of unemployment for planning process could thus be around 28 per cent at the beginning of the Eighth Plan. The latest and seventh quinquennial NSS survey, namely the 61st round conducted during July 2004-June 2005, constitutes an important source of information on employment and unemployment. The 61st round of NSSO survey reveals a faster increase in employment during 1999-2000 to 2004-05 as compared to 1993-94 to 1999-2000. Survey shows that over 47 million persons were provided employment during 2000 to 2005. Annual addition to employment on Usual Principal Status (UPS) basis went up from 5.347 million during 1993-94 to 1999-2000 to 9.58 million during 1999-2000 to 2004-05. Simultaneously, however, according to 61st round estimates, during 1990-2000 to 2004-05, labour force grew even faster at an annual rate of 2.54 percent compared to annual employment growth of 2.48 percent. As a result, despite the faster growth of employment, unemployment (on UPS basis) was higher at 3.06 percent of the labour force in 2004-05 compared to 2.78 in 1990-2000. Incidence of unemployment had come down from 2.88 percent in 1983 to 2.62 percent in 1993-94. The reversal of the declining trend in employment growth from an annual rate of 2.1 per cent in the ten years ending in 1993-94 to 1.6 percent in the five years ending in 1990-2000 to 2.5 per cent in the five years ending in 2004-05 is an encouraging development. Nevertheless, there is need for faster employment growth for not only absorbing the addition to the labour force, particularly with the ongoing demographic changes, but also for reducing the unemployment rate. The share of agriculture in total employment has come down from 61.67 percent in 1993-94 to 58.54 percent in 1999-2000, and further to 54.19 percent in 2004-05. With the declining share of agriculture in GDP, the scope for absorbing substantial additional labour force in agriculture is limited. While construction and services contributed in maintaining employment growth in the economy, employment growth in manufacturing fell short of potential.

As per suggestions of the Bhagwati Committee Report, 1973 Government of India implemented following schemes to provide employment and alleviate underemployment: (i) Rural Works Programme : Construction of civil works of a permanent nature; (ii) Marginal farmers and Agricultural labourers; families were to be assisted with subsidized credit support for agriculture and animal husbandry operations; (iii) Small farmers development agencies- To make available to small farmers credit to enable them to make use of the latest technology in farming practices, etc.; (iv) Integrated dry land agricultural development- To undertake permanent works like soil conservation, land development, water harnessing, etc.; (v) Agro-service centres — Financial assistance to unemployed graduates/diploma holders, graduates in agriculture and sciences. It aimed to help in setting-up workshops, repairing/hiring of machinery and technical services including supply of spare parts; (vi) Area Development Schemes – This relate to the development of infrastructure like road, market yards, etc. in command areas; and (vii) Crash programme for Rural Employment—The scheme was to generate additional employment through a network of rural projects of various kinds which are labour intensive and productive. The scheme had a two-fold purpose. Firstly, a project in each block was to provide employment to 100 persons on an average continuously over a working season of 10 months in a year. Secondly, each project was to produce works or assets of durable nature in consonance with the local development plan. The various schemes under the Fourth Plan or Crash Plans could not succeed in removing rural unemployment and under-employment because efforts were not made to organize the army of the rural unemployed into appropriate supply camps to be shifted to places of demand at the desired minimum wage. For providing rural employment a number of schemes were taken-up for implementation. These were : (i) Employment Guarantee Schemes, food for work programme, small farmers development agency, drought prone area programme and desert development programme, command area development programme etc. A multiple agencies have been involved in implementing these schemes. The

Sixth Plan proposed that such multiplicity of programmes for the rural poor operated through a multiplicity of agencies should be ended and replaced by one single integrated programme operate throughout the country. This programme was named as the Integrated Rural Development Programme (IRDP). The IRDP was initiated in October, 1980 in all the 5011 blocks in the country. The National Rural Employment Programme (NREP) was being implemented from October, 1980 as a centrally sponsored programme with 50 percent central assistance to create additional employment of the order of 300-400 million man days per year for the unemployed and underemployed. Besides this, the NREP aimed to create community assets for strengthening rural infrastructure. The Sixth Plan conceived of these two important programmes. The basic strategy was to promote self-employment of the poor households through IRDP so that with the transfer of productive assets, they may earn incomes that help them to cross the poverty level. The NREP was to provide wage employment to fill in the periods of seasonal and sporadic under employment. It was also intended to enlarge absorptive capacity of labour in rural areas in non-agricultural occupations by creating infrastructure-social and economic which helped to increase the productive capacity of the economy. To supplement NREP, a new Rural Landless Employment Guarantee Programme (RLEGP) was launched on the 15th August, 1983 with 100 per cent central assistance with the objective of generating gainful employment, creating productive assets in rural areas and improving the overall quality of rural life. The Government decided to merge NREP and RLEGP and a new employment programme named Jawahar Rozgar Yojana was launched on 28th April, 1989. Jawahar Rozgar Yojana aimed to reach every single village panchayat and was specially targeted to help people below the poverty line. Preference was to be given to SCs, STs and free bonded labourers. At least 30 per cent of the employment was to be provided to women under Jawahar Rozgar Yojana. Jawahar Rozgar Yojana has been modified from 1993-94 and was implemented in three streams. Wages under Jawahar Rozgar Yojana are paid at the rate notified for the prescribed schedule of employment under the Minimum Wages Act for the relevant works and may be paid partly in food grains and partly in cash. Jawahar Gram Samridhi Yojana (JGSY) was introduced in April 1999 as a successor to Jawahar Rozgar Yojana which was being implemented as a centrally sponsored scheme on a cost sharing ratio of 75:25 between the Centre and the States. Under this programme, all works that can result in the creation of durable assets are taken-up. Swaran Jayanti Gram Swarozgar Yojana (SGSY) was introduced in April, 1999 as a result of restructuring and combining the IRDP and Million Walls Scheme (MWS) into a single-self employment programme. It aimed at promoting micro-enterprises and helping the rural poor into self help groups. It was being implemented as a centrally sponsored scheme on cost sharing ratio of 75:25 between the centre and the states. The urban self-employment programme and urban wage-employment programmes of the Swaran Jayanti Shahari Yojana (SJSRY), which substituted in December, 1997 various programmes operated earlier for poverty alleviation. SJSRY is also funded on 75:25 bases between the centre and states. The Government of India introduced Employment Assurance Scheme (EAS) with effect from 2nd October, 1993 in rural areas in 1778 blocks of 261 districts. The scheme aimed at providing assured employment of 100 days of unskilled manual work to the rural poor who are in need of employment and seeking it. The scheme was drawn up on the model of Employment Guarantee Scheme of Maharashtra. The assurance of 100 days extends to all men and women over 18 years and below 60 years of age. National Rural Employment Guarantee Scheme (NREGs) Act passed in September, 2005. The NREGS was implemented from February, 2006 in 200 identified districts of the country with the objective of providing 100 days of guaranteed unskilled wage employment to each rural household opting for it. The on-going programmes of SGRY and National Food for Work Programme (NFFWP) have been subsumed under NREGs in these districts. NREGS will cover all districts of the country within five years. The NREGS a demand driven scheme has its focus on works relating to water conservation, drought proofing, land development, flood control and rural connectivity in terms of all weather roads.

The Eleventh Plan had identified the following weaknesses on the employment front:

- The rate of unemployment has increased from 6.1% in 1993-94 to 7.3% in 1999-2000, and further to 8.3% in 2004-05.
- Unemployment among agricultural labour households has risen from 9.5% in 1993-94 to 15.3% in 2004-05.

- Under employment appears to be on the rise, as evident from a widening of the gap between the usual status (US) and the current daily status measures of creation of incremental employment opportunities between the periods 1994 to 2000 and 2000 to 2005
- Non-agricultural employment expanded robustly at an annual rate of 4.7% during 1999-2005 but this growth was entirely in the unorganized sector and mainly in low-productivity self-employment.
- Despite fairly healthy GDP growth, employment in the organised sectors actually declined, leading to frustration among educated youth who have rising expectations.
- Although real wages of casual labour in agriculture continue to rise during 2000-2005, growth has decelerated strongly, as compared to the previous quinquennium (1994-2000), almost certainly reflecting poor performance in agriculture. However, over the longer periods 1983 to 1993-94 and 1993-94 to 2004-05, the decline is moderate for rural male agricultural casual labour, from 2.75% to 2.18% per annum.
- Growth of average real wage rates in non-agriculture employment in the period 1999-2000 to 2004-05 has been negligible. Seen over longer period of 2 decades, the wages have steadily increased at over 2% per annum.
- In respect of entire rural male casual labour, the growth in real wages accelerated from 2.5% (Period I ie 1983 to 1993-94) to 2.78% per annum in Period II (1993-94 to 2004-05).
- Real wages stagnated or declined even for workers in the organized industry although managerial and technical staff did secure large increase.
- The wage share in the organized industrial sector has halved after the 1980s and is now among the lowest in the world.

One reason for this is increasing capital intensity of the organized sector, another is outsourcing. The Eleventh Plan targets generation of additional employment opportunities in services and manufacturing, in particular, labour intensive manufacturing sectors e.g. food processing, leather products, footwear and textiles and in service sectors tourism and construction. It calls for elimination of distorting fiscal incentives which foster capital intensity; infrastructure investment; removal of distortions that tinker competition, greater emphasis on vocational training and skill development to improve employability of youth. It also calls for redressing the problems faced by village and small scale enterprises (VSSE) units and home based workers particularly women, e.g. non-availability of timely and adequate credit, unreliable power supply, burden of inspections, etc. Direct employment would be available in social sector like health and education and wage employment programme like NREGS.

Employment growth in the organized sector, public and private combined, has declined during the period 1994-2007. This has primarily happened due to decline of employment in the public organised sector. Employment opportunities in the current financial year were effected by the global financial crisis and economic slow down in India. The Government was concerned about the possible impact of the global financial crisis on the Indian economy including employment and several measures, financial and fiscal, were taken.

INFRASTRUCTURE

India is the seventh largest and second most populous country in the world. A new spirit of economic freedom is now stirring in the country, bringing sweeping changes in its wake. A series of ambitious economic reforms aimed at deregulating the country and stimulating foreign investment has moved India firmly into the front ranks of the rapidly growing Asia Pacific region and unleashed the latent strengths of a complex and rapidly changing nation. India's process of economic reform is firmly rooted in a political consensus that spans her diverse political parties. India's democracy is a known and stable factor, which has taken deep roots over nearly half a century. Importantly, India has no fundamental conflict between its political and economic systems. Its political

institutions have fostered an open society with strong collective and individual rights and an environment supportive of free economic enterprise.

India's time tested institutions offer foreign investors a transparent environment that guarantees the security of their long-term investments. These include a free and vibrant press, a judiciary that can and does overrule the government, a sophisticated legal and accounting system and a user-friendly intellectual infrastructure. India's dynamic and highly competitive private sector has long been the backbone of its economic activity. It accounts for over 75% of its Gross Domestic Product and offers considerable scope for joint ventures and collaborations.

Today, India is one of the most exciting emerging markets in the world. Skilled managerial and technical manpower that match the best available in the world and a middle class whose size exceeds the population of the USA or the European Union, provide India with a distinct cutting edge in global competition. The road transport sector has been declared a priority and will have access to loans at favorable conditions. The Monopoly and Restrictive Trade Practices Act (MRTP Act) was passed in order to encourage large industry to enter the road sector. The National Highways Act has been modified to help the reduction of tolls on national motorways, bridges and tunnels. Calcutta's Howrah Bridge is the world's busiest with a daily flow of 57,000 vehicles and innumerable pedestrians. Private participation in the energy sector has been encouraged with the reduction of import duties, a five-year tax exemption for new energy projects and a 16% return on equity.

ENERGY

Energy has been universally recognized as one of the most important inputs for economic growth and human development. There is a strong two-way relationship between economic development and energy consumption. On one hand, growth of an economy, with its global competitiveness, hinges on the availability of cost-effective and environmentally benign energy sources, and on the other hand, the level of economic development has been observed to be reliant on the energy demand.

Energy is an essential building block of economic development. In an effort to meet the demands of a developing nation, the Indian energy sector has witnessed a rapid growth. Areas like the resource exploration and exploitation, capacity additions, and energy sector reforms have been revolutionized.

However, resource augmentation and growth in energy supply have failed to meet the ever increasing demands exerted by the multiplying population, rapid urbanization and progressing economy. Hence, serious energy shortages continue to plague India, forcing it to rely heavily on imports.

It has been noted by the Planning Commission in 2002 that primary commercial energy demand has grown at the rate of 6% between 1981 and 2001. India currently faces coal shortage of 23.96 metric tonne. Production of petroleum reserves has been stretched from 5.7 Metric tonnes during 1970-71 to 110 metric tonnes in 2003-04.

Natural gas demand too has been steadily growing at the rate of about 6.5% during the last 10 years.

Comprehending that the dependence on energy is expected to increase further to achieve the targeted Gross Domestic Product (GDP), growth rate of 8% during the Tenth Five-year Plan, the Government of India has granted high priority to the energy sector.

Renewable energy sources offer viable option to address the energy security concerns of a country. Today, India has one of the highest potentials for the effective use of renewable energy. There is a significant potential in India for generation of power from renewable energy sources—wind, small hydro, biomass, and solar energy. Other renewable energy technologies, including solar photovoltaic, solar thermal, small hydro and biomass power are also spreading. Greater reliance on renewable energy sources offers enormous economic, social, and environmental benefits.

TRANSPORTATION

A well-knit and coordinated system of transport plays an important role in the sustained economic growth of a

country. India has a well-developed transport network comprising rail, road, coastal shipping, air transport etc. The total length of roads in India is over 30 lakhs kms including both metalled and unmetalled roads. In terms of road length, India has one of the largest road networks in the world. The national highways account for less than 2% of the total road network but carry 40% of the movement of goods and passengers. The total rail route length is about 63,000 km and of this 13,000 km is electrified. The railways carry over 11 million passengers and 11 Lakhs tones of goods everyday.

India has a long coastline, about 90% of sea borne trade is handled via major ports of Kandla, Mumbai, Nhava Sheva, Marmagao, Cochin, Tuticorin, Chennai, Vishakapatnam, Paradwip, Haldia, Goa and Kolkata. Air travel is a fastest means to reach in any part of the world. A domestic air service is looked after by Indian airlines and private airlines while the international airport service is looked after by Air India. Mumbai, Chennai, Kolkata and Delhi are the four major international airports of India.

COMMUNICATION

The Communication sector is amongst the fastest growing in the country. The Indian Communication industry has weathered this storm well. It is indeed creditable that the industry and services in India has reasonably continued its robust growth in the year 2003-04. This sector has emerged as one of the fastest growing sectors in the economy.

The telecom services have been recognized the world-over as an important tool for socio-economic development for a nation. It is one of the prime support services needed for rapid growth and modernization of various sectors of the economy. Indian telecommunication sector has undergone a major process of transformation through significant policy reforms, particularly beginning with the announcement of NTP 1994 and was subsequently re-emphasized and carried forward under NTP 1999. Driven by various policy initiatives, the Indian telecom sector witnessed a complete transformation in the last decade. It has achieved a phenomenal growth during the last few years and is poised to take a big leap in the future also.

The Indian Telecommunications network with 621 million connections (as on March 2010) is the third largest in the world. The sector is growing at a speed of 45% during the recent years. This rapid growth is possible due to various proactive and positive decisions of the Government and contribution of both by the public and the private sectors. The rapid strides in the telecom sector have been facilitated by liberal policies of the Government that provides easy market access for telecom equipment and a fair regulatory framework for offering telecom services to the Indian consumers at affordable prices. Presently, all the telecom services have been opened for private participation also. The Government has taken following main initiatives for the growth of the Telecom Sector:

1. **Liberalization:** The process of liberalization in the country began in the right earnest with the announcement of the New Economic Policy in July 1991. Telecom equipment manufacturing was delicensed in 1991 and value added services were declared open to the private sector in 1992, following which radio paging, cellular mobile and other value added services were opened gradually to the private sector. This has resulted in setting up large number of manufacturing units in the country. As a result most of the equipment used in telecom area is being manufactured within the country. A major breakthrough was the clear enunciation of the governments' intention of liberalizing the telecom sector in the National Telecom Policy resolution of 13th May 1994.
2. **National Telecom Policy 1994:** In 1994, the Government announced the National Telecom Policy which defined certain important objectives, including availability of telephone on demand, provision of world class services at reasonable prices, improving India's competitiveness in global market and promoting exports, attractive FDI and stimulating domestic investment, ensuring India's emergence as major manufacturing / export base of telecom equipment and universal availability of basic telecom services to all villages. It also announced a series of specific targets to be achieved by 1997.
3. **Telecom Regulatory Authority of India (TRAI):** The entry of private service providers brought with it the

inevitable need for independent regulation. The Telecom Regulatory Authority of India (TRAI) was, thus, established with effect from 20th February 1997 by an Act of Parliament, called the Telecom Regulatory Authority of India Act, 1997, to regulate telecom services, including fixation/revision of tariffs for telecom services which were earlier vested in the Central Government.

TRAI's mission is to create and nurture conditions for growth of telecommunications in the country in manner and at a pace, which will enable India to play a leading role in emerging global information society. One of the main objectives of TRAI is to provide a fair and transparent policy environment, which promotes a level playing field and facilitates fair competition. In pursuance of above objective, TRAI has issued from time to time a large number of regulations, orders and directives to deal with issues coming before it and provided the required direction to the evolution of Indian telecom market from a Government owned monopoly to a multi operator multi service open competitive market. The directions, orders and regulations issued cover a wide range of subjects including tariff, interconnection and quality of service as well as governance of the Authority.

The TRAI Act was amended by an ordinance, effective from 24 January 2000, establishing a Telecommunications Dispute Settlement and Appellate Tribunal (TDSAT) to take over the adjudicatory and disputes functions from TRAI. TDSAT was set up to adjudicate any dispute between a licensor and a licensee, between two or more service providers, between a service provider and a group of consumers, and to hear and dispose of appeals against any direction, decision or order of TRAI.

- 4. New Telecom Policy 1999:** The most important milestone and instrument of telecom reforms in India is the New Telecom Policy 1999 (NTP 99). The New Telecom Policy, 1999 (NTP-99) was approved on 26th March 1999, to become effective from 1st April 1999. NTP-99 laid down a clear roadmap for future reforms, contemplating the opening up of all the segments of the telecom sector for private sector participation. It clearly recognized the need for strengthening the regulatory regime as well as restructuring the departmental telecom services to that of a public sector corporation so as to separate the licensing and policy functions of the Government from that of being an operator. It also recognized the need for resolving the prevailing problems faced by the operators so as to restore their confidence and improve the investment climate.

Key features of the NTP 99 include:

- Strengthening of Regulator.
- National long distance services opened to private operators.
- International Long Distance Services opened to private sectors.
- Private telecom operators licensed on a revenue sharing basis, plus a one-time entry fee. Resolution of problems of existing operators envisaged.
- Direct interconnectivity and sharing of network with other telecom operators within the service area was permitted.
- Department of Telecommunication Services (DTS) corporatized in 2000.
- Spectrum Management made transparent and more efficient.

All the commitments made under NTP 99 have been fulfilled; each one of them, in letter and spirit, some even ahead of schedule, and the reform process is now complete with all the sectors in telecommunications opened for private competition.

HEALTH AND EDUCATION

A healthy manpower is a great feature of a developing economy as it leads to greater output per man. But the

health and under nourishment adversely effect the quality of manpower. But in UDCs people are underfed and under nourished which results in poor quality of manpower. There is also deficiency of proteins and vitamins in the diet of the people and due to the lack of medical facilities diseases are very common in the people. The best way to improve the quality of manpower in UDCs is to provide adequate food and better nourishment to people, better sanitary facilities and the extension of medical facilities which in turn will raise the efficiency and the productivity of the people. Human capital, is therefore, “needed to staff new and expanding government services to introduce new system of land use and new methods of agriculture, to develop new means of communication, to carry forward industrialisation, and to build the educational system. In other words innovation or the process of change from static or traditional society requires very large doses of strategic human capital.”

Health Development after Independence keeping in view the importance of health and nutrition, the government paid full attention to solve all the main problems cited above. As a result, a number of programmes were started. There is a lot of improvement in the state of health since we started planned economic development in 1951. The Birth Rate has fallen from 39.9 per thousand in 1950-51 to 25.8 in 2000-01. Death Rate has fallen from 27.4 per thousand in 1950-51 to 8.5 in 2000-01. Life expectancy has gone up from 32 years in 1950- 51 to 65.3 years in, 2000-01. Infant mortality rate has fallen to 68 per thousand in 2000-01 as a result of success of the maternal and child health component of family welfare programmes.

The number of medical colleges has gone up to 165 in 1998-99 as against 28 in 1950-51; the number of hospitals has increased from 2694 to 15,097 and number of dispensaries from 6,515 to 28,225 during the same period (1951-1999). There were no community centers in 1951 but in 1999 there were 2,913 community centers. Similarly there was no sub-centre in 1951 but there were 1, 36,379 in 1999. The number of primary health centers has gone up from 725 to 22,446 (28 times increase), the number of hospital beds has gone up from 1, 17,178 in 1950-51 to 8, 70,161 (seven times increase) in 1999. The number of doctors has gone up from 61,840 to 5, 03,900; of dentists from 3290 to 23,953 and number of nurses from 16,550 to 5, 65,696 during the period 1951-1999. In 1999, we had 5.2 doctors for every one lac population as against 17 doctors in 1951. Although tremendous expansion has taken place in health services even then as compared to advanced countries our position is not that good.

Health In India – Key Indicators

- India accounts for more than 20% of global maternal and child deaths, and the highest maternal death toll in the world estimated at 138,000.
- United Nations calculations show that India’s spending on public health provision, as a share of GDP is the 18th lowest in the world.
- Nearly 67% of the population in India does not have access to essential medicines.
- Infant Mortality Rate (IMR) in India was 67.6 in 1998-99 and has come down to 57 in 2005-06. Kerala heads the progress made so far with an IMR of 15/1000 births. Uttar Pradesh has the worst IMR in the country of 73/1000 births.
- Maternal Mortality Rate (MMR) is currently 4 deaths per 1000 births. India accounts for the largest number of maternal deaths in the world.
- 79% of the children between the age of 6-35 months, and more than 50% of women, are anemic, and 40% of the maternal deaths during pregnancy and child-birth relate to anemia and under-nutrition.
- There are 585 rural hospitals compared to 985 urban hospitals in the country. Out of the 6,39,729 doctors registered in India, only 67,576 are in the public sector.

Education in India – Key Indicators

- Only 66% per cent of the Indian people are literate (76% of men and 54% of women).

- While close to 90 per cent children in the 6-11 age group are formally enrolled in primary schools, nearly 40 per cent drop out at the primary stage. The enrolment ratios of Scheduled Caste (SC), Scheduled Tribe (ST) and Muslim children (especially girls) still remain far lower than the national average.
- 1.36 crores (40 per cent) children in the age group of 6-14 years remained out of school as on March 2005, four years after the launch of the Sarva Shiksha Abhiyan.
- Half of India's schools have a leaking roof or no water supply, 35% have no blackboard or furniture, and close to 90 per cent have no functioning toilets.
- The official teacher-student norm is 1:40, yet in some states classes average is one teacher per 80 children. The prescribed norm of a school being available within the radius of one kilometer is still not being fulfilled.
- Malnutrition, hunger and poor health remain core problems, which comprehensively affect attendance and performance in classes. The added burden of home chores and child labour influence a large number of children, especially girls, to drop out of school.

LESSON ROUND UP

- The Indian Economy has few selected areas which need to be considered for balanced growth and development of the economy.
 - Population
 - Poverty
 - Unemployment
 - Infrastructure
- Population is the number of people residing in the country. Economic definition of population would include characteristics of the population such as; nature, quality, composition, rate of increase etc.
- At the time of Independence, population of our country was only around 360 million. Since then, it has increased to more than three times that figure.
- Quality of Population refers to a combination of the quality of life led by it and the level of its productivity. It is represented by a number of factors, including, (i) the level of health enjoyed by it, (ii) proneness to suffer from ill-health, diseases and epidemics, (iii) life expectancy at birth, (iv) infant mortality, (v) mortality of mothers in child birth, (vi) level of literacy, and (vii) technical skill and productivity of the labour force.
- Stabilizing population is an essential requirement for promoting sustainable development with more equitable distribution. In this context, The National Population Policy, 2000 (NPP 2000) affirming the commitment of government towards voluntary and informed choice and consent of citizens while availing of reproductive health care services came into effect.
- The overriding objective of economic and social development is to improve the quality of lives that people lead, to enhance their well being, and to provide them with opportunities and choices to become productive assets in society.
- Poverty is a social phenomenon. Three broad concepts of poverty can be identified. As subsistence, inequality and externality. Two types of poverty are; Absolute poverty, a measured through income levels and Relative poverty, difference in the relative standard of living of the people.
- The Planning Commission set up a Study Group in July 1962 to examine the question of poverty in the India; its causes and remedies for eradication.

- The authorities in the country have tried to reduce the incidence of poverty in the country even since independence. A large number of programmes have been experimented in the Indian soil to combat with poverty.
- Unemployment is an economic condition where the work force of the country is not gainfully employed in productive activities thereby is unable to contribute in the aggregate output levels. It is inefficient utilization of human resources.
- India is the seventh largest and second most populous country in the world and therefore supports huge infrastructural framework comprising of Energy, Transportation, Communication, Health and Education.
- Energy has been universally recognized as one of the most important inputs for economic growth and human development.
- A well-knit and coordinated system of transport plays an important role in the sustained economic growth of a country.
- The Communication sector is amongst the fastest growing in the country. The Indian Communication industry has weathered this storm well. The Indian Telecommunications network with 621 million connections (as on March 2010) is the third largest in the world.
- A healthy manpower is a great feature of a developing economy as it leads to greater output per man.

GLOSSARY

National Population Policy (NPP) 2000	A population policy framed in the light of explosive growth of population with the objective to achieve a stable population by 2045, at a level consistent with the requirements of sustainable economic growth, social development, and environmental protection and to address the unmet needs for contraception, health care infrastructure, and health personnel, and to provide integrated service delivery for basic reproductive and child health care.
Sustainable Economic Growth	Sustainable economic growth means an increase over time in the output of an economy that integrates economic, social, and environmental considerations and that is supported by efficient institutions and sound policies. This growth must also enable the poor to participate in economic opportunities and enjoy its benefits.
Density of Population	Population density of a place (country, state, city, county, providence) or area is the equivalent of how many people there are per square mile of the place. It is computed by dividing the total population of the place by the area of the place - usually in square miles.
Absolute Poverty	Absolute poverty measures the number of people living below a certain income threshold or the number of households unable to afford certain basic goods and services.
Relative Poverty	Relative poverty measures the extent to which a household's financial resources falls below an average income threshold for the economy.
Poverty Trap	Poverty trap is a self-perpetuating condition where an economy, caught in a vicious cycle, suffers from persistent underdevelopment due to poverty.
Poverty Alleviation Programmes	In the light of increasing poverty level, government has introduced various programmes on national level to eradicate poverty or lessen it to some extent.
National Sample	The National Sample Survey Organisation (NSSO) came into existence in the year

PART B

ELEMENTARY STATISTICS

LESSONS

8.	Statistics: An Overview
9.	Collection and Presentation of Statistical Data
10.	Measures of Central Tendency and Dispersion
11.	Mathematics of Finance
12.	Probability
13.	Time Series and Index Numbers Analysis

Due to advanced communication network, rapid changes in behaviour, varied expectations and new market openings, it sometimes become difficult task of making quick and appropriate decisions. Therefore, there is a need for them to depend more upon quantitative techniques like tools of statistics and basic business mathematics. On the other hand, it is always required to take proper care in interpreting the values in statistics, lest it results in misleading conclusions.

For instance, a classical story provides that a village teacher was to cross river along with his family. He calculated the average height of family members as 5 feet and average depth of river is as 3 feet.

On the other side of the river, his children were missing. He again made calculation and arrived at the same result, so he wrote a couplet in urdu; *'Araba jyon ka tyon, toh kunba dooba kyon'*.

Statistics is broadly divided into two main categories. The two categories of statistics are descriptive statistics and inferential statistics. Descriptive Statistics: It is used to present the general description of data which is summarised quantitatively. Inferential statistics: It is used to make valid inferences from the data which are helpful in effective decision making for managers or professionals.

This section introduces students to the basic tools of statistics and their applicability to give them confidence in drawing relevant conclusions from provided data.



Lesson 8

Statistics: An Overview

LESSON OUTLINE

- Origin of Statistics
- Definitions of Statistics
- Statistics as Numerical Data
- Statistics as Statistical Method
- Nature of Statistics- A Science or An Art
- Scope of Statistics
 - Divisions or Classification of Statistics
 - Applications of Statistics
- Review Questions
- Limitations of Statistics
- Distrust of Statistics
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

The dynamism of the businesses, professions and organizations is based on the popular term “effective decision making”. In its ambit, it lays emphasis on another series of terms such as; statistical data and methods, forecasting, survey econometrics, mathematical models, research and development, etc. This indeed emphasizes the significant use of statistics which facilitates effective decision making, where we originally started from.

Application of statistics is wide in our day to day life to business to professions. It becomes essential to acquaint students with basic statistical methods because this is an era where everything is based on data, which helps in making decisions even in our day to day affairs, apart from business/professional decisions which needs to be based on critical thinking and analytical skills that are developed in the process.

The appropriate conceptual understanding is a must before practical skills of statistic are acquired. This lesson serves as an introduction and overview of statistics.

Statistics: The only science that enables different experts using the same figures to draw different conclusions.

Evan Esar

ORIGIN OF STATISTICS

The word 'Statistics' is as old as human society itself. It is regarded in general as groups of numerical statements of facts relating to certain human experience, put in systematic and logical manner. Perhaps this word of English language had its origin from the Latin word 'Status meaning political state'. Words 'Stato' and 'Statistik' were also used in similar sense in Italian and German languages respectively. In ancient days, the word statistics was used only for facts and figures required by the state for its official use and was known as "the science of king", "the science of state craft" and 'political arithmetic'. At that time, statistics was used to collect information relating to crimes, military strength and wealth for devising military and fiscal policies. It was also used to satisfy the needs of the ruling kings, the needs like number of soldiers, number of objects etc. which helped the state in administration. But today, statistics is not merely a bye product of the administrative set up of the state but it embraces all sciences—social, physical and natural and is finding numerical applications in various diversified fields such as agriculture, industry, sociology, psychology, planning, economics, business, management and so on. It is rather impossible to think of any sphere of human activity where statistics has not crept in.

The word statistics has acquired a wider meaning over the years. The set of quantitative data relating to phenomena whether concerning state or otherwise are called statistics. The word statistics is used in different senses by different persons. To a layman, statistics has become 'synonymous with figures'. For others, statistics is a discipline. It has grown today as a separate discipline or subject of study like mathematics or economics. Thus, the word 'statistics' is basically used in two senses i.e. as:

- Statistics Data
- Statistical Method

Statistics in the sense of numerical data basically refers to quantitative aspects and is in the form of numerical data. Statistics as statistical method refers to a body of knowledge which contains statistical principles and methods used for collection, organisation, presentation, analysis and interpretation of data. It is a branch of scientific methods used for dealing with those phenomena which can be described numerically either by measurement or by counting.

To resolve the controversy regarding the meaning of statistics, it is essential to go through various definitions given by experts on the subject from time to time.

DEFINITIONS OF STATISTICS

I. Statistics as Numerical Data

Some of the important and popular definitions of statistics as numerical data are presented as under:

"Statistics refers to the classified facts representing the conditions of the people in the State ... especially those facts which can be stated in numbers or in tables of numbers or in any tabular classified arrangement".

Webster

"Statistics are collection of noteworthy facts concerning state both historical and descriptive".

Gotfriedand Achenwall

"Statistics is an aggregate knowledge brought together for a practical end namely the knowledge of concrete states".

Wappans

"Statistics is numerical statement of facts in any development of enquiry placed in relation to each other".

Bowley

"By statistics, we mean quantitative data affected to a marked extent by multiplicity of causes".

Kendal

All the above mentioned definitions are narrow in scope. These definitions restrict their scope of statistics to facts relating to state only. According to modern thinkers, the scope of the science of statistics is considerably wide today and is applicable to almost anything worth mentioning such as biology, demography, economics, commerce etc. In a sense, above definitions are incomplete because of their poor coverage.

Prof. Horace Secrist has given most acceptable, popular and comprehensive definition of statistics in the sense of numerical data. According to him, "By statistics we mean aggregate of facts affected to marked extent by multiplicity of causes, numerically expressed, enumerated or estimated according to a reasonable standard of accuracy, collected in a systematic manner for a pre-determined purpose and placed in relation to each other".

According to this definition, the numerical data should possess the following major characteristics in order to be known as statistics.

Characteristics of Statistics

- (i) *Aggregate of Facts*: Statistics must relate to aggregate of facts. A single figure even though numerically expressed cannot be called statistics because such figures are unrelated and cannot be compared. Hence, we cannot draw any conclusions out of it. For instance, a single figure relating to the height of the student or marks of the student in the class in a particular subject is meaningless and irrelevant unless we are provided the complete data about all the students of the class in a school. It makes the comparison among students possible. Thus, we can say, that it is not the datum but the data which is the subject matter of statistics.
- (ii) *Affected by Multiplicity of Causes*: Generally speaking, statistical facts are not traceable to single factor. Since statistics are commonly used in social science, it is affected by multiple factors at the same time. For example, the prices of particular commodity are affected by number of factors such as supply, demand, import, export, income distribution, money in circulation, taste, etc. In natural sciences, like physics and chemistry, it is possible to isolate the effect of various factors on a particular item but it is very difficult to do so in social science. However, the science of statistics has provided the novel technique such as multiple correlation to study the joint effects of a number of factors on a single item.
- (iii) *Numerically Expressed*: It is only the numerical data which constitute statistics. Any qualitative expression such as rich, poor, good, bad, intelligent, young, old, honesty etc do not constitute statistics, and this is outside the scope of study of statistics unless a numerical equivalent value is assigned to each expression. For example, intelligence is not statistics but intelligence quotient designed by Dr. Spearman could be accepted as statistics of attributes. Thus, in statistics facts are expressed in numbers and not words but it does not mean that all numerical statements are statistics.
- (iv) *Enumerated or Estimated*: Statistical data relating to any subject could be collected either by actual counting or measurement or by estimation. In case, where the scope of enquiry is very large, enumeration is not advisable because it involves high costs and is also time consuming too. In such cases, data are estimated by using the powerful techniques of sampling and estimation. On the other hand, if number of units is less, they are actually counted or measured. For example to find out the number of students appearing in an examination in a particular class, we have to actually count, but to find out the number of persons attending a particular public meeting, we rely on estimates.

- (v) *Reasonable Degree of Accuracy*: Statistical data are collected only with a reasonable degree of accuracy. The data which are collected by enumeration are supposed to be accurate and precise but it is not so in the case of estimation. The degree of accuracy of estimated value largely depends on the nature and purpose of the enquiry. There cannot be a uniform standard of accuracy for all type of enquiries. For example, if the height of the students of a class are being measured, it is all right if measurement is correct to a centimeter but if we are measuring distance between two places say Delhi and Calcutta, the difference of a few kilometers may be ignored. Thus, in many statistical studies mathematical accuracy cannot be maintained but it is important that reasonable standards of accuracy must be maintained for drawing meaningful conclusions.
- (vi) *Systematic Manner*: The collection of data must be in a careful and systematic manner because data collected in haphazard and unsystematic manner may lead to erroneous, misleading fallacious conclusions. It requires careful planning of data collection approach in order to attain reasonable degree of accuracy.
- (vii) *Pre-determined Purpose*: It is essential that one must be clear in advance about the objectives and purpose of enquiry or data to be collected before actually going for it. If data are not collected with some objective, the whole effort in term of money and result would be waste. For example, if the, purpose of enquiry is to measure level of education in labour strata, it would not serve any purpose unless data are collected from the area dominated by labour strata.
- (viii) *Placed in Relation to Each Other*: The comparability is one of the important attributes for the numerical facts to be known as statistics. The numerical data may be compared period-wise or region-wise. For example, per capita income of India may be compared at a point of time to that of Pakistan, China, Brazil, Mexico, provided the data are homogeneous. They are related to same phenomena.

II. Statistics as Statistical Method

Statistics has developed as a full fledged discipline over a period of time. Basically, it is the science which provides tools for analysis and interpretation of huge amount of data collected for the purpose of decision-making in various fields of scientific enquiry.

Some of the popular definitions of statistics as statistical methods are given below for examination:

"Statistics may be called as the science of counting." **A.L. Bowley**

"Statistics may be rightly called the science of averages". **A.L. Bowley**

"The science of statistics is the method of judging collective, natural or social phenomenon from the results obtained by the analysis of an enumeration or collection of estimates." **King**

"Statistics is the science which deals with classification and tabulation of numerical facts as the basis for explanation, description and comparison of phenomenon." **Lovin**

"Statistics is the science which deals with the method of collecting, classifying, presenting comparing and interpreting numerical data collected to throw some light on any sphere of enquiry." **Selligman**

"Modern statistics refers to a body of methods and principles that have been developed to handle the collection, description, summarisation and analysis of numerical data. Its primary objective is to assist the researcher in making decision or generalisation about the nature and characteristics of all the potential observations under consideration of which the collected data form only a small part." **Lincon L. Chao**

"Statistics may be defined as the science of collection, presentation, analysis and interpretation of numerical data." **Croxton & Cowden**

Earlier definitions of statistics given by Prof. A.L. Bowley are inadequate and defective because they restrict the scope of statistics to counting and average. Prof. King's definition is comprehensive but it focuses on collection

of data, treating other methods of secondary importance. This is not a correct approach. Lovin's definition is fairly satisfactory because it indicates simple and scientific exposition of statistical methods.

Croxtton and Cowdon have given more satisfactory and acceptable definition. This definition brings into its fold various stages of statistical enquiry i.e., collection, presentation, analysis and interpretation of numerical data.

Thus, on examining above mentioned definitions, statistics may be defined as a discipline which is concerned with collection, organisation, presentation, analysis and interpretation of numerical data.

According to this definition, a brief detail of various stages of statistical enquiry are given below:

Stages of Statistical Enquiry

- (i) *Collection of Data*: Collection of statistical data constitutes one of the important aspects of statistical inquiry. During this stage, the relevant data are collected from various sources. The sources of data may be primary or secondary. In the case of primary data, data are originally collected by an investigator or agency, on the other hand, the data published or unpublished which have already been collected and processed by some agency or person and taken over from there and used by any other agency for their statistical work are termed as secondary. It may be observed that the distinction between primary and secondary data is matter of degree only.
- (ii) *Organisation and Presentation of Numerical Data*: Organisation and presentation of data is the second important stage of statistical enquiry. Generally, secondary data are available in organized form but primary data collected through survey in raw form needs their organisation. Some of the important components of organisation of data are editing, classification and tabulation of data. Editing of data removes omission, inaccuracies and inconsistencies whereas in classification, general items which have common characteristics are brought together before the tabulation. Subsequently, they are presented in table and finally the data is given the shape of a diagram, chart and graph wherever necessary.
- (iii) *Analysis of Numerical Data*: In this phase of statistical enquiry, the numerical data after collection, organisation and presentation is analyzed, in order to have deep understanding of the subject matter. In the process of analyzing numerical data, some of the popular measures, such as averages or measures of central tendency, dispersion, skewness, correlation, regression, association and attributes, interpolation and extrapolations are used. Probability and distribution, sampling, analysis of variance, index number and time series are also used if required to simplify the data.
- (iv) *Interpretation of Numerical Data*: The interpretation of data refers to drawing inferences and conclusions from the given data. The interpretation of data is most sensitive and difficult task which requires higher degree of skill, experience and common sense and balance judgment on the part of the investigator. If the data is misinterpreted, it may lead to misleading conclusions which results in wastage of time and resources and thus the object of enquiry may be defeated.

Importance and Functions of Statistics

Statistics is a useful science. There is hardly any area in social science or natural science where statistical methods are not effectively used. In fact, to a very striking degree, the modern culture has become a statistical culture and there is no ground for misgivings regarding the practical realization of the dream of H.G. Wells "statistical thinking one day be as necessary for effective citizenship as the ability to read and write." The science of statistics has gained an enormous importance and popularity because of various functions performed by it.

- (i) *Preciseness and Definiteness*: Statistics presents the facts in a precise and definite form. It is generally agreed that facts which are presented in numerical form are more precise and convincing. Statistics, in a sense, leaves, no scope for vagueness. For example, the statement that total population of India has

increased during 1981 to 1991. This statement does not give any idea about increase in population. But if we say that total population of India has increased to 856 millions during 1981-1991, this statement is more precise and conclusive.

- (ii) *Simplification in Understandable Form*: Statistics presents the large volume of complex data in meaningful and understandable form. In the words of W. King's, it is for the purpose of simplifying these unwieldy masses of facts that statistical science is useful. It reduces them to numerical totals or average which may be abstractly handled like any other number. It draws pictures and diagrams to illustrate general tendencies and thus in many ways adopts this group of ideas to the capacity of our intellects.
- (iii) *Facilitates Comparison*: Comparison is also one of the important functions of statistics. It enables us to understand the behaviour of data over a time period or at a point of time and has certain reasons for it. Averages, standard deviations, coefficient of variation, time series, Index number, correlation, graphs, diagrams are some of the statistical techniques which make the comparison of particular phenomenon possible.
- (iv) *Enrich Individual Knowledge and Experience*: Statistics is a science which provides opportunities to individuals to enrich their knowledge and experience. It is well established fact that statistics with the help of noble techniques and sound methodology has opened new vistas of knowledge which was closed to mankind otherwise. In a sense, statistics has provided such a master key to mankind that we can use it anywhere and can study any problem and on right terms.
- (v) *Formulation of Policies*: Statistics also helps in the formulation of various economic, business and other policies at state, national or global level. For example, framing of government policies on education, taxation, pollution, law and order need a sound statistical support. Poor statistical base and network in the economy may prove a handicap in designing sound policy and achieving expected results thereafter. Business organizations also make use of statistics to design their policies in areas of finance, marketing and personnel. They collect relevant information on various parameters, analyze it and draw inferences and then in the light of conclusions derived from or gathered information design their policies.
- (vi) *Business Forecasting*: Forecasting means formal process of predicting future events that will significantly affect the functioning of enterprise. Government and business units needs forecasting for designing better plans and policies and sound decision-making in order to use existing man and material resources optimally. To achieve this end, statistics offers various forecasting techniques such as time series, extrapolation in order to make reliable predictions on future. About statistical forecast, Prof. Bowley rightly observed that "A statistical estimate may be good or bad, accounts for the reverse, but almost in all cases it is likely to be more accurate than a casual observers' impression".
- (vii) *Framing and Testing Hypothesis*: Statistics also helps to formulate hypothesis and to test its validity and subsequently for developing sound theories. The hypothesis may be about any phenomena on political, social or economic aspects. In the words of Lord J.M. Keynes, it is rightly pointed out that the function of statistics is first to suggest empirical laws which may or may not be capable of subsequent deductive reasoning by checking its results and submitting them to the test of experience".

NATURE OF STATISTICS- A SCIENCE OR AN ART

Statistics as a Science

Statistics is a science or an art is a debatable issue. Science is a systematic body of knowledge which studies cause and effect relationship and tries to find out generalization. It basically explains the facts. The main features of science are:

- It is a systematic study of a subject
- It establishes the cause and effect relationship of a fact
- Its laws are universal in nature.

Keeping various statistical methods in view, statistics may be defined as a science in which we study various methods of collection, editing, classification, tabulation, presentation of facts through diagrams and graphs and condensation of data regarding various social, political and economic problems so that relationship may be established between various facts and the problems may be analysed, interpreted and forecasting may be done.

However, statistics is not an exact science or pure science like physics, chemistry etc. It may be called a science of scientific method. Statistics basically help other sciences to derive their own laws. Statistical knowledge is not for its own sake but for the sake of other knowledges. According to Tippet, "as a science the statistical method is a part of the general scientific methods and is based on the same fundamental ideas and processes."

Statistics as an Art

If science is the knowledge, art is action; an art is an actual application of science. A science teaches us to know and art teaches us to do. An art basically has the following characteristics:

- It is a group of actions to solve a problem.
- It does not describe facts but examines merits and demerits and tells us the way to achieve the objective.

On the basis of above characteristics of an art, statistics may be regarded as an art of applying the science of scientific methods. As an art, statistic facilitates better understanding and solution to the real life problems by way of offering quantitative information. The successful application of the methods of statistics usually depends upon the considerable degree of skill and vast exposure of statistician, who is using the statistical data for solving the real life problem. According to Tippet, "Statistic is both a science and an art. It is a science in that its methods are basically systematic and have general application and an art in that there successful application depends, to a considerable degree, on the skill and special experience of the statistician, and on his knowledge of the field of application."

Laws of Statistics

There are two important laws of statistics on which whole theory of sampling is based. These two laws are:

- Law of Statistical Regularity
- Law of Inertia of a Large Numbers

1. Law of Statistical Regularity: This law provides the basis of theory of probability in statistics. According to this law, if a large sample is taken from a population in a random way, it is bound to be fairly representative of the population. Prof. W.I. King has rightly observed in this regard. "The law of statistical regularity formulated in a mathematical theory of probability lays down that a moderately large number of items chosen at random from a very large group are almost sure on the average to have the characteristics of the large group".

This law holds good if it meets the following two conditions.

- random sample is taken
- the size of sample is large

2. Law of Inertia of Large Numbers: This law is corollary of the law of statistical regularity. This law states that the larger the size of sample, the more accurate the results are likely to be. It is because large numbers have greater stability, steadiness, consistency as compared to small numbers.

Scope of Statistics

It is very difficult to mark the scope of statistics because there is hardly any sphere of human activity where statistics does not creep-up. All disciplines whether social sciences or natural sciences or management, they

are using statistics in one form or another.

Broadly, the scope of statistics can be confined to the following two main aspects i.e.,

- Divisions or classifications of statistics
- Applications of statistics

Divisions or Classification of Statistics

Broadly speaking, statistics may be classified into four major categories which are discussed below:

1. Descriptive Statistics

Descriptive statistics deals with the numerical data. These data represents observations obtained either through counting or through some measurement process. They may define an entire population or universe and be derived through some sampling procedure. In other event, they represent the raw material of any subsequent statistical processing and may in some cases be sufficient by themselves to answer particular question or problem.

Descriptive statistics include the techniques such as collection and tabulation of data, averages or measures of central tendency, index number, dispersion, skewness, which help in summarizing and describing the main features of data. It also focuses its attention on characteristics of data which on account of its huge size would have escaped the attention of users.

2. Applied Statistics

This division of statistics is concerned with the application of statistical methods and techniques to the specific problems and facts of real life situations as they exist. Some of the important techniques which constitute the applied statistics are sample survey, quality control, quantitative analysis for business decisions, index numbers etc. For example, for the purpose of business forecasting such as demand of a particular product in the market, we have to make use of methods like extrapolation or least square which form the contents of applied statistics.

3. Inferential Statistics

It covers those methods and techniques of statistics which are used to draw conclusions and statistical inferences about the parameters of population on the basis of estimates derived from a sample. Similarly, the hypothesis in regard to the characteristics of sample is tested on the basis of population parameters. There are several significance tests which are designed for this purpose. These tests lay down the possibility of being true in individual cases. The statistical inferences or conclusions drawn from given data are not merely guesses but they are backed by prior exercise of logical thought and are based on fundamental theories of science of mathematics.

4. Inductive Statistics

Inductive statistics refers to those methods and techniques of statistics which help in estimating a particular phenomenon on the basis of random observation. For example, business forecasting is done with the help of inductive statistics.

5. Mathematical Statistics

It is that branch of statistics which is concerned with the application of various mathematical theories and techniques such as theory of measures and integration, differentiation, algebra, trigonometry, matrix theory, etc. to develop various statistical theories and techniques. It is basically concerned with mathematical aspects of statistics. In the words of Corner, "statistics is a branch of applied mathematics which specializes in data".

6. Analytical Statistics

It consists of those methods which are used in establishing functional relationship between variables. It is attempted through comparison, between two sets of data at a point of time in cross-section data or between two points of time otherwise. Important techniques form the part of analytical statistics includes association of attributes, correlation and regression, etc.

Applications of Statistics

Statistics has developed wide areas of its applications in the modern age of information technology. Some of the important areas of statistical applications are discussed as under:

1. State

Statistics is indispensable for functioning of the State. State authorities need different type of facts and figures on various matters to frame policies and guidelines in order to perform its functions smoothly. In earlier days, when statistics was science of statecraft, the object was to collect data relating to manpower, crimes, income, wealth etc. for formulating suitable military and fiscal policies. Presently, with the change in the nature of functions of the State i.e. from maintenance of law and order to promoting human welfare, the scope of application of statistics to State affairs has changed drastically. Today, State authorities collect statistics through their own agencies on multiple aspects i.e., population, AGRICULTURE, national income, defence, science, mineral resources, oceanography, space research, etc. Almost all ministries at Central or State level, depend heavily on statistical information for their smooth functioning. The availability of statistical information helps the government to frame suitable policies and guidelines to improve the overall working of the system.

2. Economics

Economics is concerned with the allocation of limited resources among unlimited ends in the most optimal manners. Statistics, provides statistical information to answer the basic questions in the economics i.e. what to produce, how to produce and for whom to produce. Statistical information basically helps to understand the economic problems and the formulation of economic policies. Earlier, in olden days, the applications of statistics to economics was limited because (i) at that time economic theories and principles were based on deductive logic; (ii) the statistical techniques were not developed for its applications in other disciplines. But in the present era of computers and information technology, statistical data and advanced techniques of statistical analysis have proved immensely useful. In economics, now the scholars have shifted their stand from deductive logic to inductive logic to explain any economic proposition. The inductive logic of reasoning requires observation of economic behaviour of large number of units. Thus, it requires a sound statistical support in the form of data as well as techniques.

The use of statistics and statistical techniques can be better examined in the following term:

- **Test and Verification of Economic Theories/Principles/Hypothesis:** Over the years economists have developed multiple theories and principles based on deductive reasoning in the areas of consumption, production, exchange, distribution, investment, business cycles and taxation etc. All these theories are merely for academic interests only unless they are put to empirical test or verification. Statistics serves this purpose and enables us to compare the theories in real life situations.
- **Understanding and Study of Economic Problems:** Statistics helps to understand the various economic problems with clarity and precision and also enables to frame suitable policies in relevant areas for better results. For example, income and wealth statistics are helpful to frame policies for reducing disparities of income whereas price statistics helps to understand the problem of inflation and cost of living in the economy.

- **Economic Planning:** Economic planning is an important aspect of economic policies of a country. An effective economic planning requires sound information base for different components of economy so that planner should be able to face future smoothly. Here, statistics helps to provide data and also tools to analyze for optimal results. Time series analysis, index numbers, forecasting techniques are some of the powerful techniques, which are immensely useful for the analysis of data in economic planning. Statistical techniques are also helping in framing planning models. In India economic models of different five year plans have extensively used the tools of statistics.
- **Measurement of National Income and Components:** Statistics also enables to study and measure various national income components and their compilations. It collects information on income, saving, investment, expenditure etc. and also establishes relations among them.

3. Business Management and Industry

In modern world, management of business organisation has become a complicated exercise as a result of change in size, technical know-how, quantum of production, number of personnel's employed, and capital employed, workers and increasing level of competition. Management while planning, organizing, controlling and communicating is confronted with alternative courses of action. In the face of uncertainty, management cannot adopt trial and error method. It is here that statistical data and powerful statistical techniques of probability, expectations, sampling, test of significance, estimation theory, forecasting and so on plays an indispensable role. In the words of Chao, "Statistics is a method of decision-making in the face of uncertainty on the basis of numerical data and calculated risks". Statistics thus, provides information to the business units which help in deciding location and size of business, demand forecasting, production planning, quality control, marketing decisions and personnel administration. In Industry, statistics is extensively used in 'Quality Control'.

4. Social Sciences and Natural Science

Statistics has its vast applications in social sciences. In social science, particularly sociology, the most important application is in the field of demography for studying mortality, fertility, marriage, population and growth. In education and psychology, it is used to determine the intelligent quotient (IQ).

- **Biology and Medicine:** Statistical tools for collection, presentation and analysis of observed data relating to the causes and incidence of diseases are of paramount importance in biology and medical sciences. For instance, the statistical pulse rate, body temperature, blood pressure, heart beats, weight, etc. of the patient greatly help the physician for proper diagnosis of disease. The most important application of statistics in medical science lies in using the test of significance for testing the efficacy of manufacturing drugs or injections or medicines for controlling/curbing specific diseases.
- **Research:** Statistics is also extensively used to conduct research in new areas and to open new vistas of knowledge to mankind. Experiments include impact of fertilizer on crops, soil etc.

REVIEW QUESTIONS



1. The word 'Statistic' is basically used in two senses, i.e., as : _____ and _____
2. _____ has given most acceptable definition of statistics.
3. Arrange in order in context of statistical enquiry

(a) Interpretation (b) Analysis (c) Collection (d) Organisation and Presentation

Answers: 1. Statistic Data, Statistic Method 2. Prof. Horace Secrist
3. (c)-(d) - (b)-(a)

LIMITATIONS OF STATISTICS

Statistics in spite of its immense use has certain limitations. Some of the important limitations are listed as under:

- (i) *Deals in Quantitative Data*: Statistics deals with quantitative data only and not the qualitative and descriptive facts such as honesty, efficiency, intelligence, blindness, etc.
- (ii) *Study of Groups and not Individuals*: Statistics deals with groups and not with individuals. This is a serious limitation of statistics. For example, income of an individual or profit of a particular business unit does not constitute the statistics because those figures are unrelated and incomparable whereas aggregate of figures relating to prices and consumption of various commodities, over different period of time will be statistics.
- (iii) *In-exact Science*: Statistical laws are not exact. Their results are true only on averages. They are valid only under certain set of assumptions. It is because of this, the science of statistics is less exact than natural sciences such as physics, chemistry, etc.
- (iv) *Misuse*: Statistics deal with figures which are innocent by themselves and do not bear on their face the level of their quality and can be easily distorted, manipulated by dishonest politicians or unscrupulous people for their selfish motives. It is a delicate subject and dangerous tool in the hands of non-experts. The user of statistical methods should not only have sound knowledge of the subject but also have self-control of an artist. In the words of W.I. King, "Statistics are like clay from which you can make a God or a devil as you please". At another place he opined "science of statistics is the useful servant but only of great values to those who understand its proper use".

DISTRUST OF STATISTICS

Distrust literally means lack of confidence or belief. The statistical statement or science of statistics is always subject to doubt and suspicion to the public because of its misuse by unscrupulous elements for their selfish motive. The common beliefs about statistics are as follows:

- An ounce of truth will produce tonnes of statistics.
- It can prove anything.
- It can prove nothing.
- Figures do not lie; liars make figure.
- Figures are innocent and easily believable.
- There are three type of lies—lies, damn lies and statistics.
- Figure though accurate, might be manipulated by selfish persons to conceal the truth and present a misleading and distorted picture of the facts to general public.

Here, it may be clarified that statistics is only a tool which if rightly used may prove extremely useful and if misused, might be disastrous. Statistics neither approves nor disapproves anything. There is a need for utmost care and precaution in the interpretation of statistical data in all of its manifestations. "Statistics should not be used as a blind man uses a lamp post for support instead of illumination".

LESSON ROUND UP

- Statistics in the sense of numerical data basically refers to quantitative aspects and is in the form of numerical data. Statistics as statistical method refers to a body of knowledge which contains statistical principles and methods used for collection, analysis and interpretation of data. It is a branch of scientific methods used for dealing with those phenomena which can be described numerically either by measurement or by counting.
- Prof. Horace Secrist has given most acceptable, popular and comprehensive definition of statistics in the sense of numerical data. According to him, "By statistics we mean aggregate of facts affected to marked extent by multiplicity of causes, numerically expressed, enumerated or estimated according to a reasonable standard of accuracy, collected in a systematic manner for a pre-determined purpose and placed in relation to each other".
- Statistics as statistical methods defined as a discipline which is concerned with collection, organisation, presentation, analysis and interpretation of numerical data
- There are two important laws of statistic i.e. the Law of Statistical Regularity; and the Law of Inertia of a large numbers.

GLOSSARY

Statistics	A type of mathematical analysis involving the use of quantified representations, models and summaries for a given set of empirical data or real world observations. Statistical analysis involves the process of collecting and analyzing data and then summarizing the data into a numerical form.
Statistical Enquiry	Statistical enquiry refers to a process of collection of data and presentation of the collected data in meaningful ways.
Analytical Statistics	The branch of statistics that is used in analyzing the data in terms of drawing meaningful conclusions, comparing two sets of data etc.
Inductive Statistics	The branch of statistics that deals with generalizations, predictions, estimations, and decisions from data initially presented.
Inferential Statistics	The branch of statistics that draws conclusions that extend beyond the immediate data alone.
Applied Statistics	The branch of statistics that extends to practical application of statistics, as opposed to the study of its theoretical basis.
Descriptive Statistics	Any calculation which attempts to provide a concise summary of the information content of data that is collection, organization, summarization, and presentation of data.
Hypothesis	A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation.

SELF-TEST QUESTIONS

1. Define 'Statistics'. What are its various functions and limitations?
2. What are the major characteristics of statistics when we consider it as numerical data?
3. "By statistics we mean aggregate of facts affected to a marked extent by multiplicity causes, numerically expressed, enumerated or estimated according to a reasonable standard of accuracy, collected in a systematic manner for a predetermined purpose and placed in relation to each other". In the light of above statement discuss the characteristics of statistics as numerical data.
4. "Statistics are like clay from which you can make a God or devil as you please". In the light of this statement, discuss the uses and limitations of statistics.
5. Comment briefly on the following statement:
 - (a) "Statistics can prove anything".
 - (b) "All Statistics are numerical statements but all numerical statements are not statistics".
6. "Statistics may be defined as a discipline which is concerned with the collection, organisation, presentation, analysis and interpretation of numerical data". Elucidate the statement.
7. Write short notes on the following :
 - (a) Laws of statistics
 - (b) Distrust of statistics
 - (c) Application of statistics.
8. Discuss the scope of statistics.
9. "Statistics should not be used, as a blindman uses a lamp post for support instead for illumination". Comment.
10. "Statistics widens the field of knowledge". Elucidate the above statement.

Suggested Readings

1. S.C. Gupta : Fundamentals of Statistics
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Lesson 9

Collection and Presentation of Statistical Data

LESSON OUTLINE

- Collection of Statistical Data
- Primary Data
- Secondary Data
- Methods of Collecting Primary Data
- Census and Sample Investigation
- Presentation of Data
- Classification of Data
- Tabulation of Data
- Review Questions
- Frequency Distribution of Data
- Diagrammatic Presentation of Data
- Graphic Presentation
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

As you can see, in today's scenario; collecting data and making an optimum decision has become an essential part of an economy. In other words, statistics is been proving to have emerged well in its role and usage in the era of developing economy. Collection and presentation of data is an integral part of any research or any economic decision making activity of an organisation. For instance, suppose a company wishes to introduce a new product, it has to collect data on market potential, consumer likings, availability of raw materials, feasibility of producing the product. Hence, data collection is the backbone of any decision making process.

Many a times, it is observed that the collected data is very rich in its content but it is difficult to draw relevant information from the same. Therefore, it is important to develop the ability to extract meaningful information from raw data to make better decisions. Statistics play an important role in this aspect. This lesson deals concisely with above issues by enumerating various methods of collecting and classifying data, conducting investigation, presenting data by using appropriate methods, diagrammatically or graphically.

You can use all the quantitative data you can get, but you still have to distrust it and use your own intelligence and judgment.

Alvin Toffler

COLLECTION OF STATISTICAL DATA

Introduction and Meaning

Collection of facts and figures about a phenomenon is one of the most important functions of statistics. For any statistical enquiry whether it is related to business, management, economics or natural sciences, the basic issue is to collect the facts and figures relating to a particular phenomenon.

Collection of data refers to systematic recording of results either by counting or by enumeration. The collected data should be quantitative i.e. numerical in nature so that we can apply statistical methods in presentation, analysis and interpretation of the same. The entire structure of statistical analysis for any enquiry is based on systematic collection of data.

Once a statistician is clear about the objectives and scope of enquiry, statistical units to be used, the degree of accuracy aimed in the final results, the next step in data collection is to decide about the sources of data and type of data to be used.

Broadly speaking, there are two types of data:

- Primary
- Secondary

Primary Data

It is the data, which is collected for the first time by investigators or enumerators working under his supervision to serve a particular purpose. Such a data is of original in nature. The sources from where these data can be collected are known as primary sources.

In India, the organizations such as Central Statistical Organisation (CSO), Census of India, National Sample Survey (NSS), and Reserve Bank of India (RBI) are the organizations, which collect and publish the primary data and so they are primary sources of data.

Secondary Data

Secondary data refers to the data which is originally collected and published by the authorities other than who require it. Such data is already available in some government publications, research study, journals or newspapers.

Main sources of secondary data may be classified in the following two categories:

1. **Published Sources:** Published sources of secondary data basically refers to various national/international organization/agencies which collect and publish the statistical data relating to business, trade, labour, price, consumption, production, investment, savings, population, unemployment, banks and financial institutions, corporations etc. These publications offer very useful sources of secondary data. Some of the important sources of secondary data in this category include the following:
 - Publications of the Central and State Governments, of Foreign Governments and international bodies like IBRD, IMF, ADB, ILO, UNO, WTO, WHO etc.
 - Publications of Semi-Government organisation e.g. Reserve Bank of India Bulletin, Reports on Currency and Finance.
 - Publications of CSO and NSS and other research bodies (ICAR & IARI, Delhi).

- Publications of various Chambers of Commerce, Trade Associations and Co-operative Societies.
- Reports of various Committees and Commissions appointed by the Government.

2. Unpublished Sources: It covers all those sources of secondary data where records are maintained by private agencies or business firms for their own use and are restrictedly available for use of general public. Data collected by research institutions are also included in the category of unpublished sources of secondary data.

Distinction between Primary and Secondary Data

It is very difficult to distinguish between primary and secondary data. The difference is merely of degree of detachment of original source. The data which is primary for one may be secondary to other. Some of the major points of distinction between the two types of data are listed as under:

Primary Data	Secondary Data
Primary data is first hand information and original in nature.	Secondary data is in the form of compilation of existing data or already published data.
The collection of primary data involves huge resources in terms of money and time, finance and energy.	Secondary data is relatively less costly.
Primary data is usually collected by keeping in mind the purpose for which it is collected so its suitability will be more.	Secondary data may or may not suit the purpose.
Primary data may be used as it is in its original form.	The use of secondary data requires lot of care and precaution.
Primary data are more reliable, accurate and adequate.	Secondary data are not always, reliable, accurate and adequate.

Choice of Data

A proper choice of type of data needed for any statistical investigation basically depends on consideration of various factors such as nature, objective and scope of enquiry, availability of financial resources, time, accuracy expected and the status of agency.

It is observed that presently in large number of statistical investigations, secondary data are generally used because of the availability of large amount of reliable published data from government sources (Central or State), Government agencies, international institutions and organizations, private organizations and research institutions, journals and magazines, etc. But primary data are usually collected under those situations where secondary data suitable for enquiry under study is either not available or it is not directly suitable for the purpose.

Precautions in the Use of Secondary Data

Secondary data needs utmost precautions in their use because they are collected for different purpose and by different agencies. Prof. Bowley rightly stated in this regard — "It is never safe to take the published statistics at their face value without knowing their meaning and limitations." So, it is essential for the users of secondary data to ensure the reliability, adequacy and suitability of data to the given problem under investigation. Some of the major precautions in this regard include the following:

- 1. Suitability of Data:** It is expected that the user of the secondary data should ensure that the data are suitable for the purpose of enquiry. The suitability of data can be judged in the light of the nature and scope of investigation, terms and units defined, etc.

2. Reliability of Data: The reliability of secondary data is another precaution, which needs special attention of the users. The users should take note of following points regarding reliability of secondary data:

- the reliability, integrity and experience of the collecting organisation
- the reliability of the source of information
- the methods used for collection and analysis of data
- the degree of accuracy desired by the company.

In case the data were collected on the basis of sample, the users should satisfy themselves regarding:

- adequacy of sample
- use of proper sampling technique
- collection of data by trained, experienced and unbiased investigator under the supervision of competent officer
- use of proper estimation techniques to estimate the population parameters.

3. Adequacy of Data: Even if the available secondary data are suitable and reliable from the users point of view, it may not be adequate enough for the purpose of the given enquiry. Adequacy of data is to be judged in the light of the requirements of the survey and the geographical area covered by the available data. Adequacy of the available data is also considered in the light of time period. Hence, in order to arrive at conclusions free from limitations and inaccuracies, the secondary data must be subjected to thorough scrutiny and editing before they are accepted for use.

Methods of Collecting Primary Data

Primary data may be collected by any one of the following method:

- Direct personal interview
- Indirect oral interview
- Information received from local agencies or correspondents
- Mailed questionnaire method
- Schedule sent through enumerators
- Telephonic survey

1. Direct Personal Interview: Under this method, investigators personally visit the respondents, ask them questions pertaining to the enquiry and collect the desired information. The information or data so collected from such type of interviews is an original one in nature.

Merits:

- It proves highly accurate and reliable data.
- It makes available to investigators supplementary information which helps them in the interpretation of results.

Demerits:

- It is a costly and time consuming method.
- The data collected under this method may be influenced by subjective attitude of investigators.
- The success of this method depends on the capability of the interviewer and the manner in which he

conducts the interview to gather the required information or data.

This type of method is suitable only in those cases where scope of enquiry is confined to single locality, area or region and there is no constraint on the utilization of resources like money and time.

2. Indirect Oral Investigation: Under this method, investigators collect data by contacting third-party or informants who are supposed to possess the information on the problem under investigation. For example, the information on the gambling, drinking, or smoking habits of an individual can best be obtained by interviewing his personal friends, relatives, neighbors who know him thoroughly well. Usually under this method, a small list of questions is prepared and these questions are put to different informants in the environments and then their answers are recorded. This type of procedure to collect actual data may be adopted by enquiry committee or commissions of enquiry.

Merits:

- It allows to extract information from the parties about the person who is reluctant to supply any information about the subject matter of enquiry if approached directly;
- It is time consuming and costly.

Demerits:

- The information collected under this method is sometimes not reliable.
- The success of this method is directly dependent on several factors, such as knowledge and representative character of informants, biasedness of witness about the matter and ability and sincerity of interviewer to extract information.

3. Information Received from Local Agencies or Correspondents: According to this method, the correspondents or local agencies in different regions collect the required information in their own way and subsequently submit their reports or transmit the information to the Central Office where data are processed and finally analyzed. This method of collecting information is usually adopted by newspaper agencies, which require periodical information in areas such as sports, economic trends, share markets, law and order, etc.

Merits:

- This method is economical and expeditious.
- It is ideal method for the situation where data is required on a continuous basis.

Demerits:

- The quality of data collected through this method is highly unreliable because of biasedness of local agents and the different techniques of data collection adopted by them.
- It is not useful for comprehensive and extensive study of a problem.

4. Mailed Questionnaire Method: Under this method, a well designed questionnaire is mailed to the informants with a request to fill it up and return the same within the specific time schedule. It is pointed out in the covering letter to the respondents that information supplied by them in the questionnaire will be kept strictly confidential. The investigators send questionnaire along with self-addressed envelope to respondents for quick and better response. In the prevalent knowledge based environment, an investigator may also e-mail the questionnaire to target group of respondent and can mobilize the desired information subject to certain conditions. This type of method is very popular among research workers, private agencies, etc.

Merits:

- It is most economical method in terms of time, money and manpower.

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- It may be used more effectively in cases where scope of enquiry is very wide and extensive.
- Direct information from respondents, leaves less scope for personal bias.

Demerits:

- This method does not work where majority of respondents are literate.
- There is low degree of reliability of the information supplied by informants.
- This method is not flexible.

The success of this method is based on the ability to design the questionnaire, knowledge of the respondents and their response to questionnaires.

5. Schedule or Questionnaire sent through Enumerators: Under this method of enquiry, the trained enumerators personally visits the informants and explain the objectives of enquiry, ask questions and record their replies. This method is commonly used by big business houses, research institutions and large public undertakings.

Merits:

- It enables to extract information from all type of respondents literate and illiterate.
- The information collected by this method is more accurate and reliable.
- This method is ideal for extensive surveys.
- In the case of poor response, the enumerators can personally persuade the informants to supply information.

Demerit:

- It is the most expensive method because the enumerators who collect information are paid workers.
- It is time consuming.
- It is hectic and tiring.
- The success of this method depends on skill of enumerators, object of enquiry, etc.

6. Telephonic Survey: Under this method investigator instead of presenting himself before the informants contact them on telephone and collect the desired information. This method is more convenient and less time consuming but subjective in nature.

Merit:

- It is convenient and less time consuming.

Demerits:

- It is subjective in nature.

CENSUS AND SAMPLE INVESTIGATION

Census and Sample Investigation are the two popular approaches used by the statistician to collect the primary data.

Under the census or complete enumeration method, data are collected for each and every unit of the population or universe which is a complete set of items which are of interest in any particular situation. For example if the marks obtained by all the students of B.A. (Hons.) Economics of Delhi University are recorded for analysis it will be called a census investigation. Another example is the case of population Census.

This method is generally recommended in those cases where area of investigation is limited and requires intensive examination or study of the population.

Merits of Census Investigation

The technique of census investigation is advocated by its users because of its various merits including the following:

1. **Intensive Study:** Under census investigation, data are obtained from each and every unit of population. It enables to study more than one aspect of each item of population. For example, in the census of India study which is conducted after every 10 years, data are collected regarding population size, males and females, education levels, handicap member in the family, source of income, caste, religion etc.
2. **Reliable Data:** The data collected under this method is likely to be more reliable, representative and accurate because in census every item is observed personally.
3. **Suitable Choice:** The census method is a suitable choice in the situations when different items of population are not homogeneous.
4. **Basis of Various Surveys:** Data of complete enumeration or census can also be used as a basis of various surveys.

Demerits of Census Investigation

Despite various merits discussed above, the census technique has certain demerits also. Some of these demerits include the following:

1. **Costly Method:** Census is very costly method of investigation since the data are collected by observing each and every item of population. This method is usually adopted by the government organization to collect detailed data such as population census or agricultural census, census of Industrial protection etc.
2. **Time Consuming:** This method is time consuming and requires more manpower to collect the original data.
3. **Possibilities of Errors:** There is large number of possibilities of errors in this method due to non-response, measurement, lack of preciseness of the definition of statistical units or personal bias of the investigators.

Sample Investigation

On the other hand, sample investigation refers to the process of learning about population on the basis of sample drawn from it.

To be more precise, in sampling technique instead of every items of the universe only a part of the universe is studied and conclusions are drawn on the same basis for the entire universe. The basic objectives of collection and analysis of sample investigation is to reveal certain characteristics of population:

- To estimate parameters of population, i.e. means, median and mode etc.;
- To test certain validity of statement about a population;
- To investigate the changes in population over time.

Basically, the sampling process involves mainly following three elements:

- selecting the sample
- collecting the information
- making an inferences about population.

Essentials of Sampling or Sample Investigation

Some of the important essentials of sample investigation include the following:

1. **Representativeness:** A sample is selected in such a way that it should in true sense represent the universe otherwise the results obtained from it may be misleading.
2. **Adequacy:** The size of the sample should be adequate enough to represent the parametric characteristics of the population.
3. **Independence:** There should be independent and at random selection of all the items covered under sample.
4. **Homogeneity:** Homogeneity is another essential element of sample investigation. According to this, there is no basic difference in the nature of units of universe and that of sample.

Merits of Sample Investigation

Some of the important merits of sample investigation include the following:

1. **Less Costly:** Data collection through sample investigation is less costly because in this case the task of data collection is confined only to a fraction of population.
2. **Less Time Consuming:** Sample investigation is less time consuming because it takes less time in collection, analysis and interpretation of data.
3. **Reliability:** Data collected under sample investigation are more accurate and reliable because of use of services of well trained investigators/experts.
4. **Detailed Information:** Since the sample investigation saves both time and money, it is always possible to collect detailed information in sample survey.
5. **Flexibility:** The data collected thorough sample investigation has greater scope of flexibility.

Demerits of Sample Investigation

Despite all the above mentioned merits, sample investigation has various demerits also including the following:

1. It is impossible to attain cent percent accuracy because the conclusions drawn about characteristics of population are based on the results obtained from the selected sample.
2. It creates the new source of error, i.e. 'random error' or 'sampling error'.
3. The results of sampling investigation are not satisfactory unless it uses the services of experts.
4. The sample may not be the representative of population because it depends on the mind set and attitude of the investigators.
5. It is not possible to use sample investigation method when the population possesses the heterogeneous character.

Distinction between Census and Sample

Some of the major points of distinction between the census and sample method of investigation are presented as under:

Attributes	Census Investigation	Sample Investigation
Type and nature of Enquiry	Comprehensive	Selective
Time required	More	Less
Accuracy & Reliability	As high as 100%	Less than 100%
Types of errors	Non sampling	Both
Suitability	For small surveys where the coverage of every item is necessary	For large coverage
Organizational work	Difficult	Easier
Cost	High	Low

PRESENTATION OF DATA

The presentation of statistical data generated from various sources is highly cumbersome and complicated exercise. It is an essential step after data collection to make the data really useful to its users. It broadly covers following aspects:

- Classification of data
- Tabulation of data
- Frequency distribution of data
- Diagrammatic presentations of data
- Graphic representation of data.

I. Classification of Data

Introduction

The data collected is usually very voluminous and large in quantity and as such they are not fit for analysis and interpretation. Hence the first step after collecting data is to classify it.

Classification of data means grouping of related facts into classes. According to Secrist, "classification of data is the process of arranging data into sequences according to their common characteristics or separating them into different but related parts". In the words of AM Tuttle, "a classification is a scheme for breaking a category into a set of parts called classes according to some precisely defined differing characteristics possessed by all the elements of the category". Both the definitions focus on arrangement of data on the basis of certain characteristics or criteria. In simplified words, it is similar to sorting of letters received in the post office into different lots on the basis of geographical areas.

For example, the students registered for Company Secretaryship Course during a financial year may be classified on the basis of any of the following criteria:

- Gender
- Level of Qualifications
- Regions
- Legal/Non-Legal Qualifications

- Professional Qualifications
- Others.

Thus, the same data can be classified in different ways based on different criteria, depending upon the requirements of the users. This process can be compared to sorting of letters in the post office

Advantages of Classification

Some of the advantages of classification of data are listed as under:

- It arranges and presents huge volume of unwieldy raw data in condensed and meaningful form so that it is easily understandable to the users.
- It facilitates meaningful comparison of data.
- It enables us to understand the relationship among variables which are classified on the basis of different criteria.
- It highlights significant features of the data at a glance.
- It makes the statistical treatment of the data easier because of its arrangement in relatively homogeneous groups based on certain criteria.

Principles of Classification

However, there is no hard and fast rule to classify raw data. It depends on the nature of data and the objectives of the study for which data are needed. The following principles may prove useful for sound technical classification of data.

- 1. Ambiguity:** There should not be any ambiguity and confusion regarding placing any observation/variable in the given arrangement or classification. It means that each and every item in the data must belong to one of the classes. A good and ideal classification is one which is free from residue class i.e. 'all others' or the rest because such class do not reveal the characteristics of data completely.
- 2. Mutually Exclusiveness:** Each item of the data should be mutually exclusive or non-overlapping that is an observed value belongs to one and only one of the classes.
- 3. Stability:** The classification of data should follow the principle of stability throughout the period of analysis in order to enable the user to properly carry out the analysis and comparison of data. For example, if the sales of refrigerators are classified by regions then advertising expenditure incurred for promoting the sale should also be classified regions wise.
- 4. Conformity to Objectives:** The data should be classified in such a way that it conforms to the objectives of the enquiry. For example, if we are interested in studying the relationship between company secretary qualification and gender then it is meaningless to classify the students registered for Company Secretaryship course according to age and region because it will not serve any purpose.
- 5. Flexibility:** Flexibility is an essential attribute for ideal classification so that it should be adjustable to new and changing conditions/circumstances. No classification is permanent to be used forever

Basis of Classification

Classification of data depends upon characteristics of data, and objectives of the enquiry.

Broadly speaking, the data may be classified on the following four bases:

- Geographical i.e. in relation to place, area or region

- Chronological i.e. on the basis of time
- Qualitative i.e. on the basis of some character or attribute
- Quantitative i.e. in terms of numerical values or magnitudes

Geographical Classification: Under this classification, data are classified according to geographical or location wise i.e., area wise, zone wise, region wise, state wise or country wise. For example, registration of students for Company Secretaryship course during the month of May 1991 and 1992 are given in the following tables.

Students Registration for CS Course		
Region	May 1991	May 1992
Eastern	355	319
Northern	418	438
Southern	522	403
Western	318	222
Foreign	2	1
TOTAL	1615	1383

This type of classification is generally listed in alphabetical order or in some other form depending upon the size or values as the case may be.

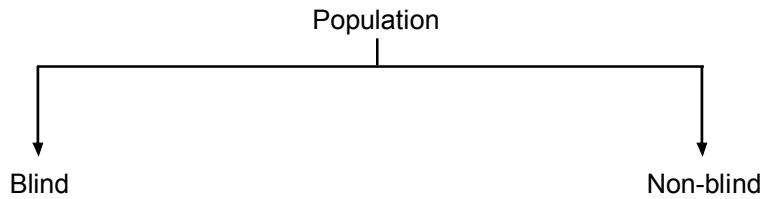
Chronological Classification: Under this type, data are classified on the basis of differences in time. For example, we may present the growth of population in India over different years as under:

Year	Population (Crores)
1891	23.6
1901	23.6
1911	25.2
1921	25.1
1931	27.9
1941	31.9
1951	36.1
1961	43.9
1971	54.8
1981	68.3
1991	84.4
2001	110.0

This type of classification is widely used in understanding the economic and business problems and to analyze their trend values over a period of time.

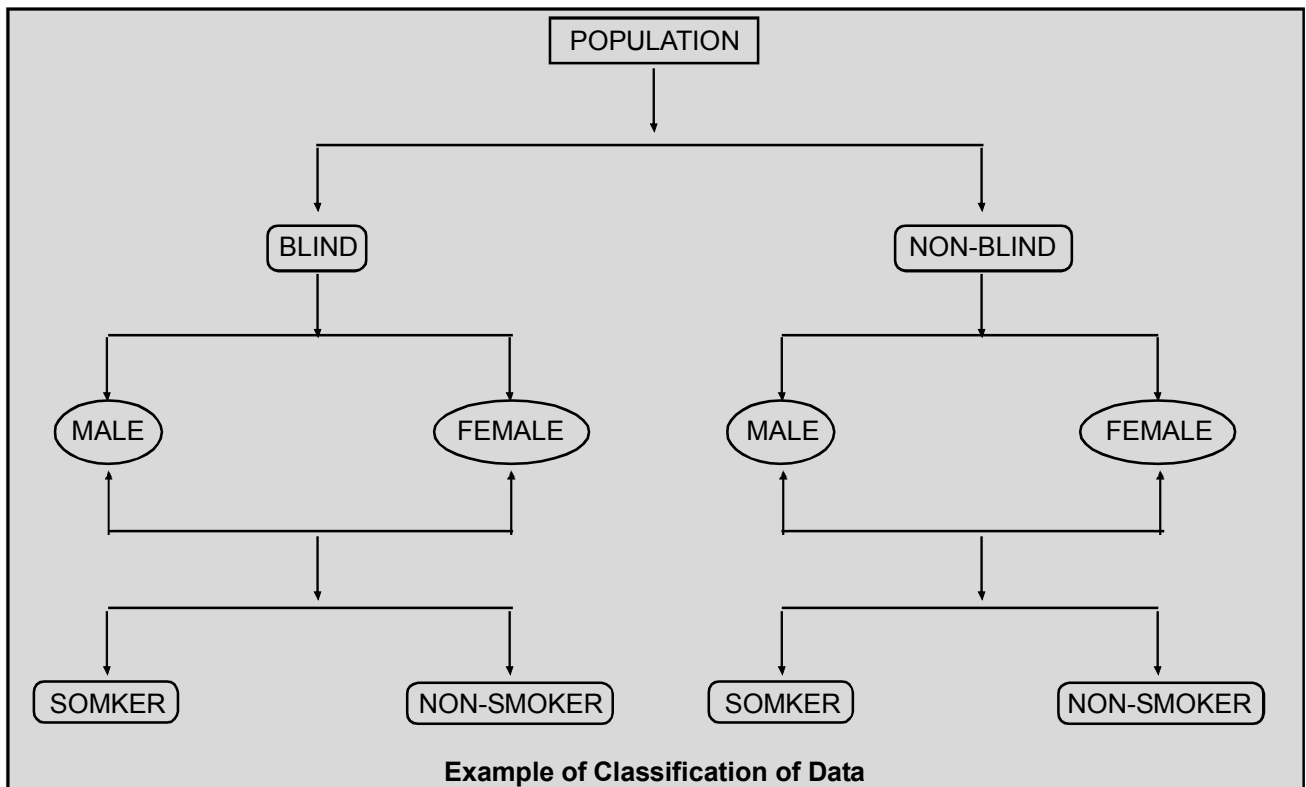
Qualitative Classification: In this type of classification, data are classified on the basis of certain qualitative/descriptive characteristics or presence and absence of attributes, such as intelligence, beauty, honesty, occupation and gender, etc. This type of classification may be simple or multiple. In simple classification, the data are classified

into two categories i.e., presence and absence of attributes. This form of simple classification would be as follows:



However, in multifold classification the given data are classified into more than two categories.

For example, the problem of blindness among students is being studied on the basis of gender and their smoking habits. The classification of data in such a case would be as under:



Quantitative Classification: It refers to the classification where data are classified on the basis of figures or criteria which are capable of quantitative measurement such as height, age, weight, income, expenditure, number of marks obtained by students etc. For example, marks obtained by 100 students of B.Com. (Hons.) in the statistics paper may be classified as under:

Marks obtained by B.Com Students	
Marks in Statistics	Number of Students
0-20	15
20-40	15
40-60	45
60-80	20
80-100	5

In the above mentioned table, the marks of the students are the variable and number of students are the frequency. Variable means a characteristic which varies. A variable may be discrete or continuous. A discrete variable is one which does not assume fractional values within the range of numbers whereas continuous variable is one which is capable of manifesting every conceivable fractional value within the range of fractional possibilities.

II. Tabulation of Data

Introduction

Tabulation refers to systematic and logical arrangement of data in columns and rows in accordance with some salient features and characteristics. According to A.M. Tulte, 'A statistical table is the logical listing of related quantitative data in vertical columns and horizontal rows of numbers with sufficient explanatory and qualifying words, phrases and statements in the forms of titles, heading and explanatory notes to make clear the full meaning of data and their origin. In the words of Secrist, "Table are means of recording in permanent form the analysis that is made through classification and by placing in just opposition things that are similar and should be compared".

Thus, it is clear from above two definitions that tabulation is a systematic and logical presentation of data such that it is easily understandable and comparable. It attempts to furnish the maximum information in the minimum possible space without sacrificing the quality and usefulness of data. The basic objectives of tabulation are to summarize the information in such a fashion that it can be easily analyzed compared and interpreted.

Significance of Tabulation of Data

Some of the major points of significance of Tabulation of data are discussed as under:

1. **Presentation of Complex Data in Systematic and Simplified Form:** Tabulation presents the complex raw data in systematic and simplified form so that it is easily understandable to a common man without wasting much time.
2. **Comparison:** Tabulation facilitates meaningful comparison of data because of division of table into parts, sub-parts, columns and rows.
3. **Identification of Data:** Tabulation enables easy identification of data as source of reference because data are arranged in tables with specific titles and numbers.
4. **Economy in Space and Time:** Tabulation also eliminates unnecessary and irrelevant details and presents the meaningful information only. In this way it saves time and space both.
5. **Discloses Trend and Pattern of Data:** Tabulation discloses the trend and pattern of data which cannot be otherwise understood if the presentation is descriptive.
6. **Facilitates Statistical Analysis:** Tabulation facilitates statistical analysis easier because of systematic presentation of data. It enables to make use of various statistical techniques such as averages, dispersion, correlation or time series, when data are tabulated in systematic fashion.

Essential Parts of a Table

Before going into details of the techniques of tabulation, it is useful to discuss about the essentials of a table. A table consists of statistical data systematically arranged in rows and columns. The actual form and structure of a table depends upon the nature of data tabulated and the purpose of study under investigation.

However, a table should contain the following parts:

- Table Number
- Title of the Table
- Sub-title or Head Note
- Captions and stub
- Body
- Footnotes
- Source Note

1. **Table Number:** Each and every table should be serially numbered so that it becomes easier for reference purposes in future. The number of a table may be either in the centre at the top of title or in the side of title at the top or in the bottom of the table at left hand side.
2. **Title of the Table:** It is a must for every table to have a suitable title which usually appears at the top of table. The title should be brief, precise, clear and self-explanatory so that the reader or user gets clear idea about the contents of table at a glance. Title should be written in phrases and in bold letters.
3. **Sub-title or Head Note:** A Sub-title or head notes refer to brief or short statement for explaining any point or points not included in the heading. It is placed below the title centered and is enclosed in brackets. The head notes are applicable for entire tables. For example, unit of measurements are always expressed as head notes such as 'rupees in thousands' or 'area in hectares' or 'quantity in liters' or in 'tonnes' etc.
4. **Captions and Stubs:** Captions and stubs are heading for the vertical columns and horizontal rows in a table respectively. They should be brief, concise and self-explanatory. Captions are written in the centre of the columns in small letters to economize the space whereas stubs are written at the extreme left of the row. The stubs are kept as narrow as possible without losing precision and clarity of statements.
5. **Body of the Table:** The body constitutes an important part of the table. It contains the numerical information which is presented to the users. The information is shown in columns and rows arranged according to captions and stubs.
6. **Footnotes:** Footnotes are used to clarify anything which is not otherwise clear by the heading, title, captions, stub etc. Footnote is given at the bottom of a table. The footnotes basically supply information on any of the following points:
 - to point out any specific detail of data
 - the sources in the case of secondary data
 - limitation of data if any
 Footnotes may be identified by members say 1, 2, 3 ... or letters i.e. a, b or symbols *, **/! etc.
7. **Source Note:** Below the footnotes or below the table, the source note of the data may be mentioned for the verification of the reader. The source note is required if the secondary data is used. In case data are taken from a research journal or periodical, then source note should contain the details such as name of the journal/periodical, date of its publication, volume number, table number if any, page number etc. It may help the users to satisfy himself about the accuracy of data.

A specimen table, containing all parts are given as under, in order to understand it clearly.

Table		
TITLE		
HEAD NOTE IF ANY		
STUB	CAPTIONS	TOTAL
STUB		
ENTRIES		ROW TOTAL
TOTAL	COLOUMN TOTAL	GRAND TOTAL
FOOTNOTES/ SOURCE NOTES		

Classification of Table

Tabulation of data may be classified on different basis depending upon the objectives, nature and the coverage of enquiry. Broadly speaking, it may be classified into following ways:

1. *Simple and Complex Table*: Simple Tabulation of data refers to the table where data are classified on the basis of single characteristics. It is also known as one way table whereas in the case of complex table manifold table data are classified and presented with respect to two or more characteristics simultaneously. The Table 1 & 2 respectively will illustrate both the types of tables.

TABLE 1	
India's Gross National Product at Factor Cost	
(Rupees in thousand Crores)	
YEAR	GROSS NATIONAL PRODUCT (at Current Prices)
1990-91	503.5
1994-95	903.9
1995-96	1059.8
1996-97	1230.5
1997-98	1376.8
1998-99	1601.1
1999-2000@	1771.0
@ Quick Estimates	
Source: Economic Survey 2000-2001	

The above table is a simple one, because it furnishes the data about one single characteristics of Indian economy i.e. Gross National Product. Table 2 is an example of the complex table which reflects two or more than two characteristics. In this case, it shows, India's export, import and trade balance over the years, i.e. from 1990-91 to 2000-2001.

Here, it may be clarified that as the order of table increases, the table becomes more and more confusing and complicated.

TABLE 2			
India's Export, Import and Trade Balance			
(Rupees in Crores)			
YEAR	Exports	Imports	Trade Balance
1990-91	32553	43198	-10645
1991-92	44041	47851	-3810
1992-93	53688	63375	-9687
1993-94	69751	73101	-3350
1994-95	82674	89971	-7297
1995-96	106353	122678	-16325
1996-97	118817	138920	-20103
1997-98	130101	154176	-24075
1998-99	139753	178332	-38580
1999-2000	162925	204583	-41658
2000-01(P)	129460	157256	-27796
(P) Provisional Estimates			
Source: Ministry of Finance, Government of India, Economic Survey 2000-2001			

2. *General Purpose or Reference Table and Specific Table:* General purpose tables are those tables, which serve general purpose and provide reference to the users. The basic purpose of this type of table is to present the data in such a fashion that individual item may be found readily by a reader. In this type of tables, we include the tables published by government or government agencies such as tables included in Economic Survey, Statistical Abstract of India, RBI Bulletin etc. On the other hand, specific purpose tables are those tables which are of analytical nature and prepared with the idea of making comparative studies and studying the relationship and significance of the figures provided by the data. Such type of tables uses interpretative figures such as ratio, percentage, in order to facilitate comparison. These tables are called derivative tables since they are derived from the general tables.

General Guidelines and Rules of Tabulation

There is no hard and fast rule to prepare a table. Basically, it depends on the nature of data and the objectives of the enquiry, and the skill and common sense on the part of investigator. In construction and tabulation common sense is the chief requisite and experience is the chief teacher. Tabulation of data is basically an art of presenting the data in a meaningful manner. Some of the general rules which may be followed in the construction of tables are given as follows:

- The table should be compact, easily understandable and free from confusions.
- The table should be designed keeping in view the size of paper to be used.
- There should be logical placement of items in the table to avoid confusion.
- All items should be clearly stated.

- The table should be complete and self-explanatory.
- Avoid the use of Ditto marks ("").
- Proper care should be taken for ruling and spacing between different rows and columns.
- The unit of measurement should be clearly stated in the form of head note.

Requisite of a Good Statistical Table

A good statistical table should possess the following requisites:

- A statistical table should aim at simplicity. Too much of detail and complexities should be avoided. But at the same time, it should be complete in itself and give explanation wherever necessary.
- It should have a clear, comprehensive and explanatory title. If necessary, there may be sub-title also.
- The stub and caption should be clear and concise and should be arranged in a way so that the objectives, whether a general purpose table, special purpose table, are fully achieved. The rows and columns can be lettered or numbered to facilitate reference.
- The head note should be clear and should indicate the units.
- Totals and sub-totals should be shown in the table to indicate the overall total and sub-totals of various columns as also to indicate that all items have been accounted for.
- The reference if any should be noted clearly at the bottom of the table.
- Whenever necessary the derived statistics should be shown in the table.
- A table should have balanced length and breadth.
- Use of abbreviation should be avoided.
- Greater clarity can be achieved by the use of variations in column width, width of lines, and faces of types (bold, italics etc.).
- There should be consistency in ruling.
- Zero should not be used to indicate the information that is not available. This can be well indicated by not available.

The following illustrations explain the above points.

Illustration 9.1

Present the following information regarding the employees of a factory in a suitable tabular form:

In 1985 out of a total of 3,500 workers of a factory 2,400 were members of a trade union.

The number of women employed was 400 of which 350 did not belong to a trade union. In 1990 the number of union workers increased to 3,160 of which 2,580 were men. On the other hand, the number of non-union workers fell down to 416 of which 360 were men.

In 1995 there were 3,600 employees who belonged to a trade union and 100 who did not belong to a trade union. Of all the employees in 1995, 600 were women, of whom only 16 did not belong to trade union.

Solution

Table showing the Gender-wise Distribution of Union and Non-Union Members in a Factory									
Category	1985			1990			1995		
	M	F	Total	M	F	Total	M	F	Total
Members	2350	50	2400	2580	580	3160	3016	584	3600
Non Members	750	350	1100	360	56	416	84	16	100
Total	3100	400	3500	2940	636	3576	3100	600	3700

M - Males; F - Females

Illustration 9.2

In a trip organised by a Local College of Delhi University, there were 80 persons, each of whom paid ₹150 on an average. There were 60 students each of whom paid ₹160. Members of the teaching staff were charged at a higher rate. The number of servants was 8 (all males) and they were not charged anything. The number of ladies was 30% of the total of which two was lady staff member.

Tabulate the above information.

Solution:

Table showing the Type of Participants, according to Gender and Contribution Made					
Type of Participants	Gender			Contribution per member (₹)	Total Contribution (₹)
	Males	Females	Total		
Students	38	22	60	160	9,600
Teaching Staff	10	2	12	200	2,400
Servants	8	—	8	—	—
Total	56	24	80	—	12,000

Notes :

$$\begin{aligned} \text{Total contribution} &= \text{Average contribution} \times \text{No. of persons who joined the trip} \\ &= 150 \times 80 = ₹12,000 \end{aligned}$$

Contribution of the staff per head has been obtained by deducting the contribution of students from the total and dividing the difference by the number of teaching staff, i.e.

$$= \frac{(12,000) - (60 \times 160)}{12} = \frac{12,000 - 9,600}{12} = \frac{2,400}{12} = ₹ 200$$

Illustration 9.3

In 1990 out of total 2400 students in a college in a metropolitan city, 1800 were for graduation and the rest for post graduation. Out of 1800 graduate students 600 were girls. However, in all there were 800 girls in the college. In 1995, the number of graduate students increased to 2000 out of which 700 were girls but the number of PG students falls to 500 of which only 400 were boys. In 2005, out of 1000 girls, 800 were for graduation where as total number of graduates were 2500. The number of boys and girls in PG classes were equal.

You are required to present the above information in tabular form and calculate the percentage increase in number of graduate students in 2005 as compared to 1990.

Solution:

Year	Graduate Students		PG Students		Total
	Boys	Girls	Boys	Girls	
1990	1200	600	400	200	2400
1995	1300	700	400	100	2500
2005	1700	800	200	200	2900

Percentage increase in graduate students in 2005 as compared to 1990
 $= \frac{700}{1800} \times 100 = 38.8\%$

REVIEW QUESTIONS

- _____ refers to systematic recording of result either by counting or by enumeration.
- Simple tabulation of data is based on _____ characteristics of data.
- _____ tables are derived from general tables.

Answers: 1. Collection of data 2. Single 3. Derivative

III. Frequency Distribution of Data**Introduction**

A tabular arrangement of data with corresponding frequency is known as frequency distribution. In other words, it is a specification of the ways in which the frequencies of the different elements of the population are distributed according to the size of variables under consideration.

To be more precise in the words of Croxton and Cowdon "Frequency distribution is a statistical table which shows the set of all distinct values of the variables arranged in the order of their magnitude either individually or in groups with their corresponding frequencies side by side". Thus, a frequency distribution consists of two parts one part shows magnitude of values whereas other part shows number of times a value or group of values has repeated.

Classification of Frequency Distribution

Broadly speaking, a frequency distribution may be classified into the following two categories:

- Ungrouped frequency distribution of discrete frequency distribution.
- Grouped continuous frequency distribution or continuous frequency distribution.

1. Ungrouped or Discrete Frequency Distribution: Under discrete frequency distribution, we count the number of times each value of a variable is repeated and the number (technically known as tally) is placed alongside the value to which it corresponds. (See Illustration)

Illustration 9.4

From the given information of number of rooms in house in a locality, construct the discrete frequency distribution.

1	3	2	2	2	2	1	2	1	1	1	3
2	2	3	3	3	3	3	3	2	3	4	1
3	2	6	2	1	6	2	1	5	1	5	2
1	5	2	3	4	2	7	4	2	3	3	4
4	3	4	4	2	3	1	4	3	2	2	1

Solution:

In this case, the variable is the number of rooms in each house and since it assumes only integer value so it is a discrete variable. The above information can be condensed in the form of discrete frequency distribution as under:

FREQUENCY TABLE		
No. of Rooms in the house(X)	Tally Bars	Frequency (f)
1	HHH HHH //	12
2	HHH HHH HHH III	18
3	HHH HHH HHH I	16
4	HHH III	8
5	///	3
6	//	2
7	/	1
TOTAL		60

In the above table X shows the number of rooms and (f) the frequency i.e. availability of rooms in the house. Literally bar is used to count the frequency.

The above distribution is discrete frequency distribution because every X value is associated with corresponding (f) values i.e. $X_1 = 1, f_1 = 12; X_2 = 2, f_2 = 18, X_3 = 3$ and $f_3 = 16, X_4 = 4, f_4 = 8, X_5 = 5, f_5 = 3, X_6 = 6, f_6 = 2, X_7 = 7, f_7 = 1$

2. Grouped Frequency Distribution: It is the distribution where the frequency refers to group of values. It is a tabular arrangement of data by classes together with the corresponding frequencies. This type of distribution is prepared when some variable assumes any fractional values particularly height and weight of the students.

The following table on frequency distribution of weight of 100 male students at Delhi University will help to understand the above point more clearly:

FREQUENCY TABLE		
Weights (X)	Tally Bars	Frequency (f)
40-50		5
50-60		18
60-70		42
70-80		27
80-90		8
Total		100

Basic Terminology Used in the Construction of Grouped Frequency Distribution

The basic terminology which is frequently used in the construction of grouped frequency distribution includes the following aspects.

Class Limit: The end numbers or the highest and lowest values that can be included in a class interval are known as the class limits of that class. For example, in above table 40-50 and 80-100 are the lower and upper class limits.

Class Interval: It is the difference between the upper limit and lower limit of the same class. The lower limit of a class is usually represented by symbol l_1 and upper limit by l_2 .

$$\text{Class Mid Point} = \frac{\text{Upper Limit} + \text{Lower Limit}}{2}$$

Class Frequency: The number of observations included in a particular class is known as the frequency of that class.

Exclusive Classification: Exclusive classification is the one whose class intervals are so determined that upper limit of one class is the lower limit of the next class. Example of this type of classification is as below:

Wages of workers (₹)	Workers(f)
500-600	35
600-700	30
700-800	20
800-900	10
900-1000	5
Total	100

The basic point of confusion in this type of classification is on placing the variable having upper unit value. For example, a worker getting ₹600 would be placed in the class of ₹500-600 or ₹600-700. The normal convention in this case is to include the value equal to upper limit in the next class. A more precise way to present the data is as under:

Wages of workers (₹)	Workers(f)
500 and above but below 600	35
600 and above but below 700	30
700 and above but below 800	20
800 and above but below 900	10
900 and above but below 1000	5
Total	100

Inclusive Classification: It refers to that classification where both the class limits are included in the class itself while determining the class intervals. The following example will illustrate this type of classification:

Marks	Students
1-10	4
11-20	5
21-30	6
31-40	10
41-50	5
Total	30

In this case, both the class limits lower as well as upper are included in the class interval. For example, marks 1 and 10 both are included in the class interval 1-10.

Class Boundaries: Under a situation where group frequency distribution is having a gap between upper limit of one class and lower limit of the next class, there arises a need of obtaining class boundaries. These class boundaries are obtained as under:

Lower Class Boundary = Lower class limit - $1/2.d$

Upper Class Boundary = Upper class limit + $1/2.d$

Where, d is known as the correction factor and it is the difference between upper class limit of any class interval and lower class limit of next class interval. The following example helps to understand the above point.

Class Limit (Wages)	Class Boundaries	Workers
6-10	5.5 - 10.5	4
11-20	10.5 - 20.5	5
21-30	20.5 - 30.5	6
31-40	30.5 - 40.5	10
41-50	40.5 - 50.5	5
Total		30

It may be noticed in the above table that upper boundary of one class is the same as the lower boundary of the next class. Basically, it is the process of making the distribution continuous.

Un-equal Class Intervals: In this type of cases, Class intervals for different classes are different. Following example illustrates this type of case:

Marks	Students
1-10	4
10-15	4
15-25	12
25-40	5
40-50	5
Total	30

Open End Classes: An open end class refers to those situations where the last class has no upper limit and the first class has no lower limit. The necessity of open end classes arises when there are few very high values or low values which are far apart from the majority of observation. The following example illustrates the case of open end classes.

Marks	Students
Less than 50	9
50-100	4
100-150	3
150-200	2
200 and above	2
Total	20

However, the use of open end classes creates difficulties in finding mid-values while analysing grouped frequency distribution. The best way to overcome this type of problem is to avoid the use of open end classes as far as possible.

Class Width or Size of Class Interval: It is the difference between the lower and upper class boundaries. If all class interval or frequency distribution has equal width then the width is denoted by C. It is generally preferable to have classes of equal width. Unequal width is resorted when some classes are over crowded and some have practically no frequency.

Frequency Density - It refers to the frequency of a class per unit of width and indicates concentration of frequency in the class.

$$\text{Frequency Density (FD)} = \frac{\text{Class Frequency}}{\text{Width of Class}}$$

General Rules for Constructing a Frequency Distribution

1. Determine the largest and smallest numbers in raw data and thus find the range (difference between largest and smallest numbers).
2. Divide the range into a convenient number of class interval having the different sizes or open end classes. The number of class interval depends on the number of items to be classified, magnitude of data and the level of accuracy. Class intervals are chosen in such a way that class marks or mid-points coincide with actually observed data. This tends to reduce the so called grouping error involved in further mathematical analysis. However, class boundaries should not coincide with actually observed data.
3. Determine the number of observations into each class intervals i.e. find the class frequencies. This is best done by using tally marks.

Determination of Number of Classes and Class Intervals

1. Determination of Number of Classes: In a group frequency distribution, the determination of number of classes/class interval is very tedious task. Generally, there is no hard and fast rule to decide the number of classes. Practically, the number of classes should be neither large nor too small. If the number of classes are large, some of the groups may have very small or no frequencies. This might give irregular pattern of frequencies in different class thus making the frequency distribution irregular. On the other hand, if the number of classes is small, large number of frequencies may get concentrated in small number of groups. This obscures some of the important features and characteristics of data, and thus results in loss of information. The number of class basically depends upon the total frequency, the nature of data, accuracy desired and ease of computation. However, there is need to keep a balance between these two factors i.e. irregularity of frequency distribution and loss of information in order to arrive at the optimum number of classes. The number of classes is inversely proportional to magnitude of class interval.

Prof. Sturges has suggested a rule (formula) in order to decide the approximate number of classes. The rule is as under:

$$K = 1 + 3.322 \log_{10} N$$

Where, K = Number of class intervals
 N = Total Number of observations in data

The value obtained by the above formula is rounded to the next higher figure.

For example, If N = 10

then, K = $1 + 3.322 \log_{10} 10$
 = $1 + 3.322 \times 1$
 = $1 + 3.322 = 4.322 \sim 4$

If N = 100,

then K = $1 + 3.322 \log_{10} 100$
 = $1 + 3.322 \times 2$
 = $1 + 6.644 = 7.644 \sim 8$

Sturges Rules very ingeniously restrict the number of classes 4 and 20 which is fairly reasonable number from practical point of a view. This rule does not work if the number of observations is very large or small.

2. Determination of Size of class: Like the number of classes, the magnitude of class intervals should be optimal and reasonable. Since the number of classes are inversely proportional to the magnitude of class intervals in a given distribution, the approximate value of the magnitude (width) of the class interval can be obtained by using Sturges rules as under:

$$\text{Magnitude of class (i)} = \frac{\text{Range}}{\text{Number Of Class}}$$

Where, Range = $X_{\max} - X_{\min}$
 = Highest value in distribution— Lowest value in distribution

$$i = \frac{H-L}{1+ 3.322 \text{ Log}_{10} N}$$

It may be pointed out, from practical point of view that it is desirable to take class interval of equal or uniform magnitude, throughout the frequency distribution. This will facilitate the computation of various statistical measures and also result in meaningful comparison between different classes and different frequency distribution.

IV. Diagrammatic Presentation of Data

Diagrams are another important method to represent the statistical data. They are nothing but geometrical figures such as lines, bars, squares, rectangles, circles, cubes, etc.

Diagrammatic presentation of data provides an easier method of understanding.

Advantages of Diagrammatic Presentation

Some of the advantages of diagrammatic presentation include the following:

1. *Easy to Understand:* Data presented in the form of diagram can be understood even by a common man. Due to their attractive and impressive character, the diagrams are very frequently used by various newspapers and magazines for the 'explanation of certain phenomena'. Diagrams are also useful in modern advertising campaign.
2. *Simplified Presentation:* Diagrams are used to represent a huge mass of complex data in a simplified and intelligible form.
3. *Reveals Hidden Facts:* A diagrammatic presentation may bring out certain hidden facts and relations which may not be revealed from classification and tabulation of data.
4. *Quick to Grasp:* The data, when presented in the form of diagrams, require less time to understand it.
5. *Easy to Compare:* The data, when presented in the form of diagrams, are easy to compare.
6. *Universal Acceptability:* The diagrams have universal applicability. These are used almost in every field of study like economics, business, administration, social institutions etc.

Limitations of Diagrammatic Presentation

In spite of the above advantages of diagrams, their usefulness is some what limited. One has to be very careful while drawing conclusions from diagrams. The main limitations are as under :

1. *Provides Vague Ideas:* Diagrams give only a vague idea of the problem which may be useful for a common man but not for an expert who wishes to have an exact idea of the problem.
2. *Limited Information:* The information given by diagrams vis-à-vis classification and tabulation is limited.
3. *Low Precision:* The level of precision of values indicated by diagrams is very low.
4. *Restricts Further Analysis of Data:* Diagrams do not lead to any further analysis of data.
5. *Portray Limited Characteristics:* Diagrams can portray only limited number of characteristics. Larger the number of characteristics, the more difficult is to understand those using diagrams.
6. *Possibility of Misuse:* Diagrams are liable to be misused for presenting an illusory picture of the problem.
7. *Fail to Present Meaningful Look in Certain Situations:* Diagrams do not give a meaningful look when various measurements have wide variation.
8. *Careful in Use:* Diagrams drawn on a false base line should be analyzed very carefully.

General Principles of a Diagrammatic Presentation

A diagrammatic presentation is a simple and effective method of presenting the information contained in statistical data. The construction of a diagram is an art, which can be acquired only through practice. However, the following rules should be observed in their construction, to make them more effective and useful tool of understanding a given problem:

1. Every diagram must have a suitable title written at its top to convey the subject matter in brief and unambiguous manner. The details about the titles, if necessary, should provided below the diagram in the form of a footnote.
2. A diagram should be constructed in a manner that it has an immediate impact on the viewer. It should be neatly drawn and an appropriate balance should be maintained between its length and breadth. A diagram should neither be too small or too large. Various aspects of the problem may be emphasized by using different shades or colors.
3. Diagrams should be drawn accurately by using proper scales of measurements. Accuracy should not be compromised to attractiveness.
4. The selection of an appropriate diagram should be carefully done keeping in view the nature of data and the objective of investigation.
5. When a diagram depicts various characteristics distinguished by various shades and colors, in index explaining these should be given for clear identification and understanding.
6. The source of data must also be indicated particularly when it has been from a secondary source.
7. As far as possible, the constructed diagram should be simple so that even a layman can understand them without any difficulty.

Types of Diagrams

There are a number of diagrams which can be used for the presentation of data. The selection of a particular diagram depends upon the nature of data, objective of presentation and the ability and experience of the person doing this task. Some popular types of diagrams are discussed below.

1. **Line Diagram:** In case of a line diagram, different values are represented by the length of the lines, drawn vertically or horizontally. The gap between successive lines is kept uniform. Although the comparison is easy, the diagram is not very attractive. This diagram is used when the number of items is very large.

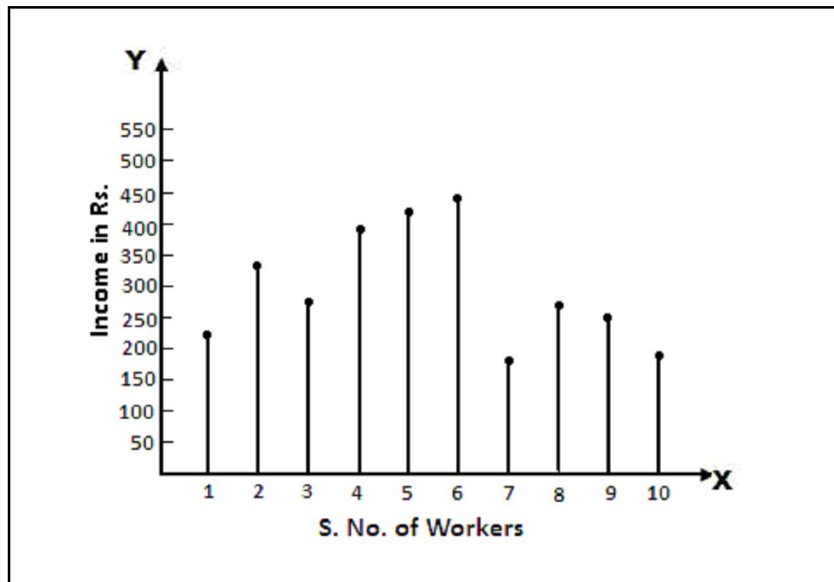
The following example enables to understand.

Illustration 9.5

The income of 10 workers in a particular week was recorded as given below. Represent the data by a line diagram.

S.No. of workers	1	2	3	4	5	6	7	8	9	10
Income (in ₹)	240	350	290	400	420	450	200	300	250	200

Solution :



Line Diagram of Income of 10 workers

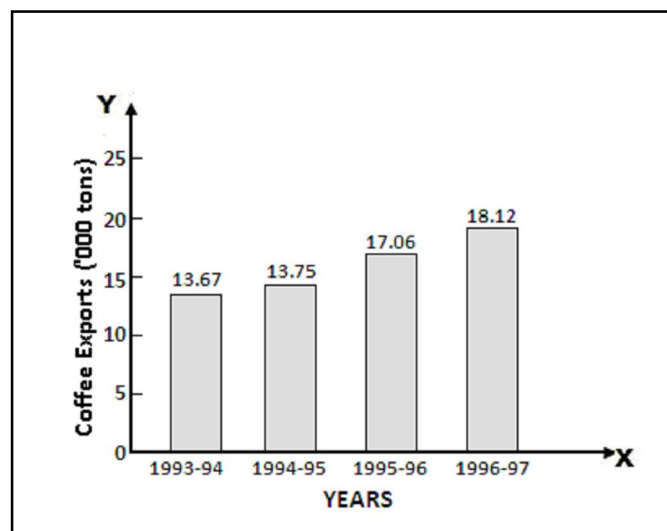
2. Simple Bar Diagram: In case of a simple bar diagram, the vertical or horizontal bars, with height proportional to the value of the item, are constructed. The width of a bar is chosen arbitrarily and is kept constant for every bar. The gaps between successive bars are also kept same. Bar diagrams are particularly suitable for representing individual time series or spatial services.

Illustration 9.6

Represent the following data by a bar diagram :

Years :	1993-94	1994-95	1995-96	1996-97
Coffee Exports ('0000 tons) :	13.67	13.73	17.06	18.12

Solution :



Bar Diagram of Coffee Exports

3. Multiple Bar Diagram: This diagram is also known as compound bar diagram. It is used when we want to

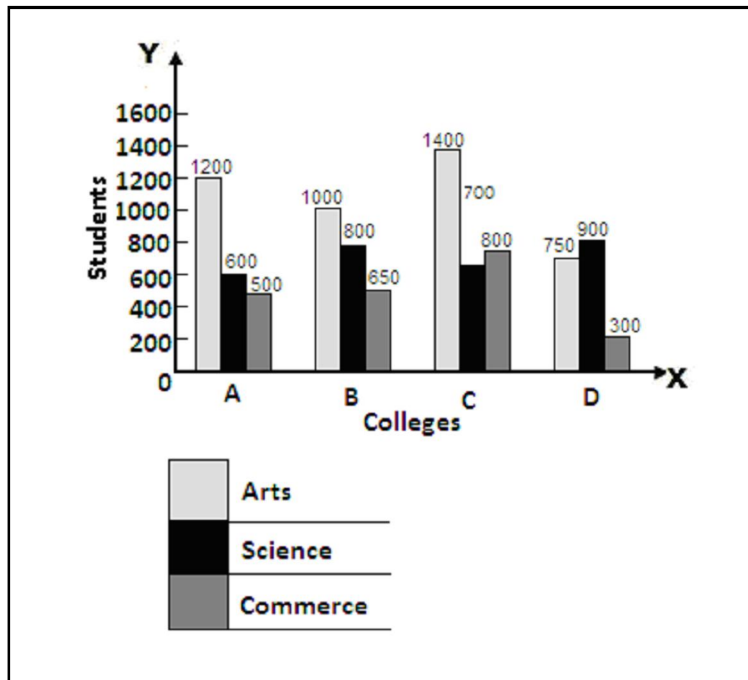
show comparisons between two or more sets of data. A set of bars for a period or related phenomena are drawn side by side without gaps while various sets of bars are separated by some arbitrarily chosen constant gap. Different bars are distinguished by different shades or colors.

Illustration 9.7

Represent the following data on faculty-wise distribution of students by a multiple bar diagram :

College	Students		
	Arts	Science	Commerce
A	1200	600	500
B	1000	800	650
C	1400	700	800
D	750	900	300

Solution :



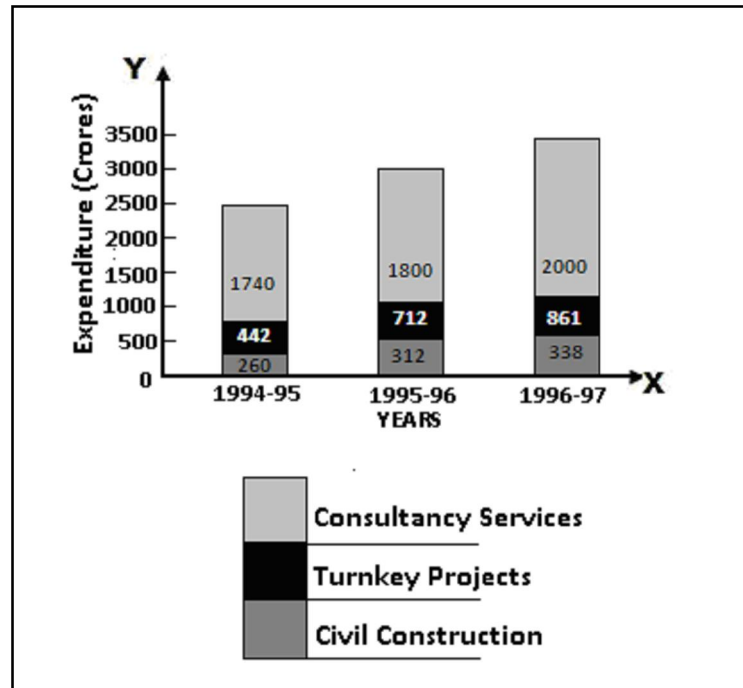
Multiple Bar Diagram

4. Sub-divided or Component Bar Diagram: In this diagram, the bar corresponding to each phenomenon is divided into various components. The portion of the bar occupied by each component denotes its share in the total. The sub-divisions of different bars should always be done in the same order and these should be distinguished from each other by using different shades or colors. A sub-divided bar diagram is useful when it is desired to represent the comparative values of different components of a phenomenon.

Illustration 9.8

The following table gives the value of (₹ in Crores) of contracts secured from abroad, in respect of Civil Construction, industrial turnkey projects and software consultancy in three financial years. Construct a component bar diagram to denote the share of an activity in total export earnings from the three projects.

Years	1994-95	1995-96	1996-97
Civil construction	260	312	338
Turnkey Projects	442	712	861
Consultancy services	1740	1800	2000
Total	2442	2824	3199



Component Bar Diagram

5. Circular or Pie Chart: Pie chart is an alternative to a component bar diagrams. A pie chart basically consists of a circle divided into sector by radii in such a way that areas of the sectors are proportional to the values of the component items under investigation. The whole circle, of course, represents the whole of data under investigation. It is also known as circular chart or percentage chart diagram.

Steps to draw Pie Chart

- Express the different components of the given data in percentages of the whole
- Multiply the each percentage components to 3.6 (since the total angle at the centre being 360 degree, it will represent the whole i.e. 100%)
- Draw a circle with convenient radius
- Divide the circle into different sectors with those central angles
- Shade different sector differently

Use of Pie Chart

The use of pie chart is quite popular as the circle provides a visual concept of the whole (100%). Pie charts are also one of the most commonly used charts because they are simple to use. Despite its popularity, pie charts should be used sparingly for two reasons:

- They are best used for displaying statistical information when there are no more than six components only, otherwise, the resulting picture will be too complex to understand.
- Pie charts are not useful when the values of each components are similar because it is difficult to see the differences between slice sizes.

(See Illustration 9.9)

Illustration 9.9

Represent the following data, on India's exports (₹ in Crores) by regions during April to February, 1997.

Region:	Europe	Asia	America	Africa
Exports:	32699	42516	23495	5133

Solution:

Total exports = 32699 + 42516 + 23495 + 5133 = ₹10,3843 crores

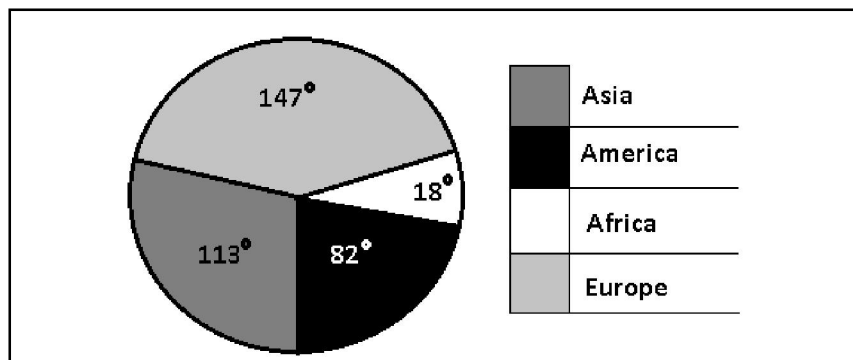
The angles for different regions are:

$$\text{Europe} = \frac{32699 \times 360}{103843} = 113^\circ$$

$$\text{Asia} = \frac{42516 \times 360}{103843} = 147^\circ$$

$$\text{America} = \frac{23495 \times 360}{103843} = 82^\circ$$

$$\text{Africa} = \frac{5133 \times 360}{103843} = 18^\circ$$



Pie-Chart

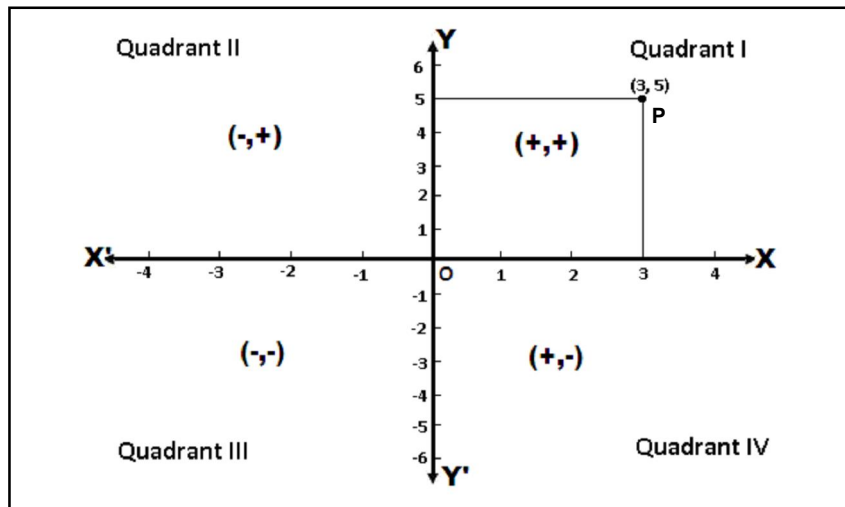
V. Graphic Presentation

Graphic presentation is another way of presentation of data. Graphs are commonly used for the presentation of time series and frequency distributions. Graphic presentation of data, such as diagrammatic presentation, also provides a quick and easier way of understanding broad features and to facilitate the process of comparison of two or more situations. In addition to this, it can also be used as a tool of analysis e.g. we can find median, mode etc. by means of graph.

Construction of a Graph

A point in a plane can be located with reference to two mutually perpendicular lines. The horizontal line is called

the X-axis and the vertical line the Y-axis. Their point of intersection is termed as origin. The position of a point in a place is located in terms of its distances from the two axes. If a point P is 3 units away from Y-axis and 5 units away from X-axis, its location will be as shown in the figure:



Graphical Plane

It should be noted here that the distance of the point from Y-axis is measured along X-axis and its distance from X-axis is measured along Y-axis. To measure 3 units from Y-axis, we move 3 units along X-axis and erect a perpendicular at this point. Similarly, to measure 5 units from X-axis, we move 5 units along Y-axis and erect a perpendicular. The point of intersection of these two perpendiculars is the required point. The position of the point is denoted by the pair of numbers (3, 5). These numbers are respectively termed as abscissa and ordinates of the point. Jointly they are termed as the coordinates of a point. The coordinates of a point, in general form, are written as (X, Y).

The four parts of the plane are called quadrants. It may be noted that X and Y are both positive in first, X is negative and Y is positive in second, X and Y are both negative in third and X is positive and Y is negative in fourth quadrant.

Different points can be plotted for a different pair of values e.g. for data on demand of a commodity at different prices, we can locate a point for each pair of quantity and price. These points are then joined by a line or a curve to get the required graph.

General Rules for a Graphic Presentation

For an attractive and effective graphic presentation, statistical data requires certain rules, principles and guidelines. Some of the major principles in this regard are discussed as under :

- (i) *Suitable Title*: It is essential for a graph to have a suitable title. It indicates clearly the subject for which the facts or data are presented in the graph.
- (ii) *Unit of Measurement*: The unit of measurement of a variable should be clearly stated below the title.
- (iii) *Suitable Scale*: There should be suitable scale so that the whole data may be represented in accurate manner. The respective sizes of the scale of X axis and Y axis cannot be rigidly laid down. About choice of scale, Bowley has rightly pointed out, "It is difficult to lay down rules for the proper choice of scales by which the figures should be plotted out. It is only the ratio between the horizontal and vertical scales that need to be considered. The figure must be sufficiently small for the whole for it to be visible at once: if the figure is complicated, related to long series of years and varying numbers, minute accuracy must be

sacrificed for this consideration. Supposing the horizontal scale is decided, the vertical scale must be chosen so that the part of the line which shows the greatest rate of increase is well inclined to the vertical which can be managed by making the scale sufficiently small and on the other hand all important fluctuations must be clearly visible for which the scale may need to be decreased. Any scale which satisfies both these conditions will fulfill its purpose”.

- (iv) *Index*: A brief index explaining various types of shades, colours, lines and designs used in the construction of the graph along with scale of interpretation showed may be given for clear understanding.
- (v) *Sources of Data*: The sources of information wherever possible should be given at the bottom of the graph.
- (vi) *Simplicity*: The Graph should be as simple as possible so that they are easily understood even by a ordinary person who does not have any exposure in the areas of statistics or mathematics.
- (vii) *Neatness*: Since the graphs is visual aids for presentation of statistical data, it is therefore, imperative that they are made neat, clean and very attractive by proper size and lettering, and use of appropriate devices like different colours, dashes, dark lines broken lines etc.

Merits of a Graph

The technique of graph offers numerous advantages to the users. Some of the major advantages are listed as under:

- The graph presents the data in such a fashion, that it is easier for the user to understand.
- It gives attractive presentation to statistical data as compared to tables. By looking at the graph, it is easier to notice the main features of data at a glance in trends and fluctuations.
- It is time saving device.
- It facilitates comparison of data relating to two different periods of time or two different regions.
- It does not require knowledge of mathematics on the part of the users to understand the message of graph.
- It is helpful to locate the median, mode and mean values of the data.
- It is helpful in forecasting, interpolation and extrapolation of data.

Limitations of a Graph

Although the technique of graph is a useful one, but it is not free from limitations. Some of its major limitations are as under :

- It lacks complete accuracy about facts.
- It depicts only few characteristics of data.
- The graph cannot be used in support of some statement.
- The graph is not a substitute for tabulation in all circumstances and for all purposes.
- It is not easy to a layman to understand and interpret the graph.
- It shows only the unreasonable tendency of the data and actual values are not always clear from the graph.

Types of Graphs

Basically, the graphs are broadly divided into two categories:

- Graph of time series or time series graph
- Graph of frequency distribution

Time Series Graph

A time series graph also known as historigram refers to a graph which depicts the value of a variable over a different point of time. In time series graph, time is the most important factor and the variable is related to time which may be either year, month, week, day, hour or even minutes and second. It is the most helpful device to understand and analyze the changes in a variable at different point of time. These types of graphs are widely used by economists, businessmen and statistician because:

- it is easy to understand;
- it enables to present more information of complicated nature in very simple and precise way.

The construction of this type of graph is very simple and does not require any technical skill on the part of users. Some of the major steps involved in the construction of time series graph are given as under:

- Represent time on horizontal or X axis and value of variable on vertical or Y axis. Ensure that the unit of time and value of variable should be clearly stated.
- Start Y value with zero and devise a suitable scale to present the value of a variable so that the whole data can be accommodated with in given space. For instance, 1 centimeter on the vertical scale may be equal to 100 units, 500 units or 1000 units. Like wise, it may be equal to year; month or days on horizontal axis.
- Plot the values of variable corresponding to the true factor and join different points by drawing a straight line.
- If there are more than one variable, than these value may be plotted on the graph by different types of lines.

A brief details of various types of graph are given as under:

1. **Line Graph:** A line graph is a way to summarize how two pieces of information are related and how they vary depending on one another.

In graph, the successive plotted points are joined with the help of a straight line.

Advantages:

- It can compare multiple continuous data sets easily
- Interim data can be inferred from graph line

Disadvantages:

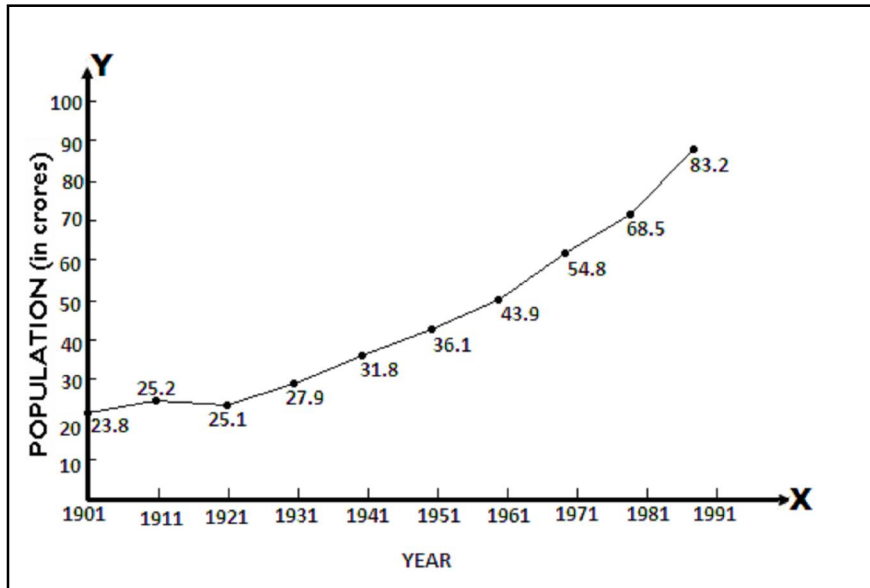
- It used only with continuous data.

Illustration 9.10

Represent the following population of India data by a suitable graph:

Year	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991
Population (in Crores)	23.8	25.2	25.1	27.9	31.8	36.1	43.9	54.8	68.5	83.7

Solution:



Line Graph

Use of False Base Line: The basic principle of drawing a time series graph is that vertical line must start from zero. If the fluctuations in the values of the dependent variable (to be presented on Y axis) are very small relative to their magnitude and if the minimum of these values is very distant (far greater) from zero, the point of origin, then for an effective portrayal of these fluctuations, the vertical scale is stretched by using false base line. In such a situation the vertical line is broken and the space between the origin 0 and minimum value (or some convenient value near that) of dependent variable is omitted by drawing two zigzag horizontal line above the base line. The scale along Y axis is framed accordingly. The false base line graph technique is useful from two points of views.

- to magnify the minor fluctuation in time series data
- to economize the space.

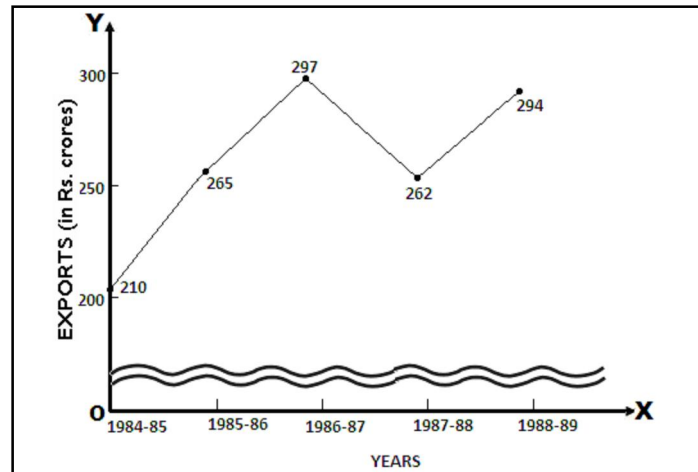
For better understanding of use of false base line see illustration 9.11.

Illustration 9.11

The yearly exports (₹ in Crores) of coffee are given below. Represent the data by a line graph.

Year	1984-85	1985-86	1986-87	1987-88	1988-89
Exports (₹ in Crores)	210	265	297	262	294

Solution :



Line Graph with false base line

Since the fluctuations in values are small in relation to their size, the graph will be drawn by the use of false base line, as shown below:

2. Net Balance Graph

When the net balance of, say, income and expenditure or revenue and cost or exports and imports etc. are to be shown, and then net balance graph is used. Different shades are used for positive and negative differences. See the following illustration.

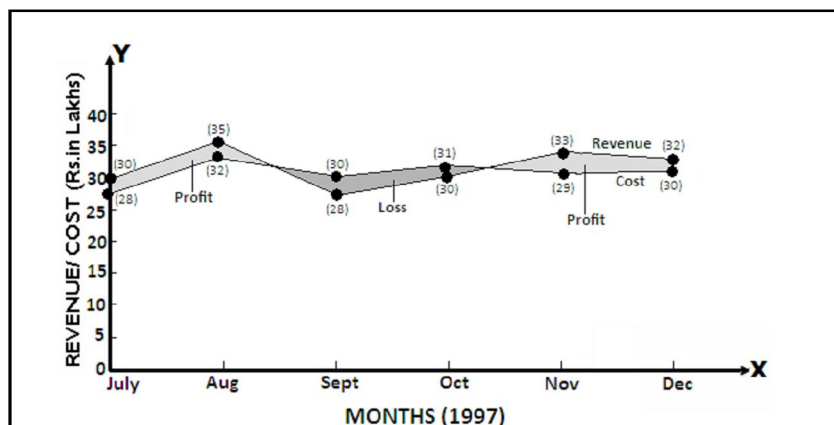
Illustration 9.12

Represent the following data on revenue and cost, of a company during July 1997 to December 1997, by a net balance graph.

Months (1997)	July	Aug.	Sep.	Oct.	Nov.	Dec.
Revenue (₹ in Lakhs)	30	35	28	30	33	32
Cost (₹ in Lakhs)	28	32	30	31	29	30

Solution :

We draw line graphs of revenue and cost separately. The gap between them will be either profit (when revenue is greater than cost) or loss. The distinction between profit and loss is made by shading the respective gaps in different styles, as shown in the following graph



Net Balance Graph

GRAPHS OF A FREQUENCY DISTRIBUTION

A frequency distribution can also be represented by means of a graph. The most common forms of graphs are discussed below.

1. Histogram: A histogram is a graph of a grouped frequency distribution in which class intervals are plotted on X axis and their respective frequencies on Y axis. On each class interval, a rectangle is created with height proportional to the frequency density of the class.

The histogram is a popular graphing tool. It is used to summarize discrete or continuous data which are measured on an interval scale. It is often used to illustrate the major features of the distribution of the data in a convenient form. A histogram divides up the range of possible values in a data set into classes or groups. For each group, a rectangle is constructed with a base length equal to the range of values in that specific group, and an area proportional to the number of observations falling into that group. This means that the rectangles will be drawn of non-uniform height. A histogram has an appearance similar to a vertical bar graph, but when the variables are continuous, there are no gaps between the bars. When the variables are discrete, however, gaps should be left between the bars.

Generally, a histogram will have bars of equal width, although this is not the case when class intervals vary in size. Choosing the appropriate width of the bars for a histogram is very important. Thus, the histogram consists simply of a set of vertical bars. Values of the variable being studied are measured on an arithmetic scale along the horizontal x-axis. The bars are of equal width and correspond to the equal class intervals, while the height of each bar corresponds to the frequency of the class it represents.

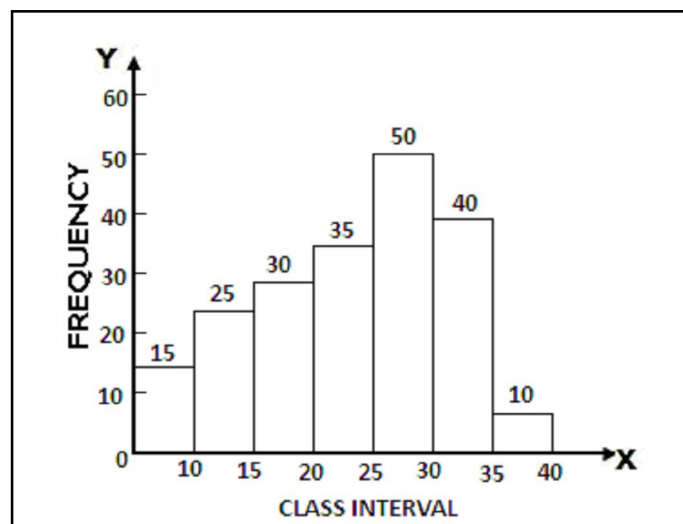
- Construction of a Histogram when Class Intervals are equal: When class intervals are equal, then there is no need of computing frequency density. We can take the height of each rectangle to be equal to the frequency of the class. (See Illustration 9.13).

Illustration 9.13

Draw a histogram for the following frequency distribution :

Class Intervals	5-10	10-15	15-20	20-25	25-30	30-35	35-40
Frequency	15	25	30	35	50	40	10

Solution:



Histogram

- Construction of a Histogram when Class Intervals are not equal: When different class intervals of a frequency distribution are not of equal width, we compute frequency density (= frequency ÷ class interval) of each class. The product of shortest class interval and the frequency density of a class is taken as the height of the corresponding rectangle. Thus, we can write the height of the rectangle of a class as under:

$$= \frac{\text{Frequency of the class} \times \text{Width of the Smallest Class Interval}}{\text{Width of the class Interval}}$$

OR
$$= \frac{\text{Frequency of the class}}{\text{Adjustment factor}}$$

Where Adjustment Factor (AF)
$$= \frac{\text{Width of the Class Interval}}{\text{Width of the Smallest Class Interval}}$$

The following illustration helps to understand the steps to construct a histogram when class intervals are not uniform.

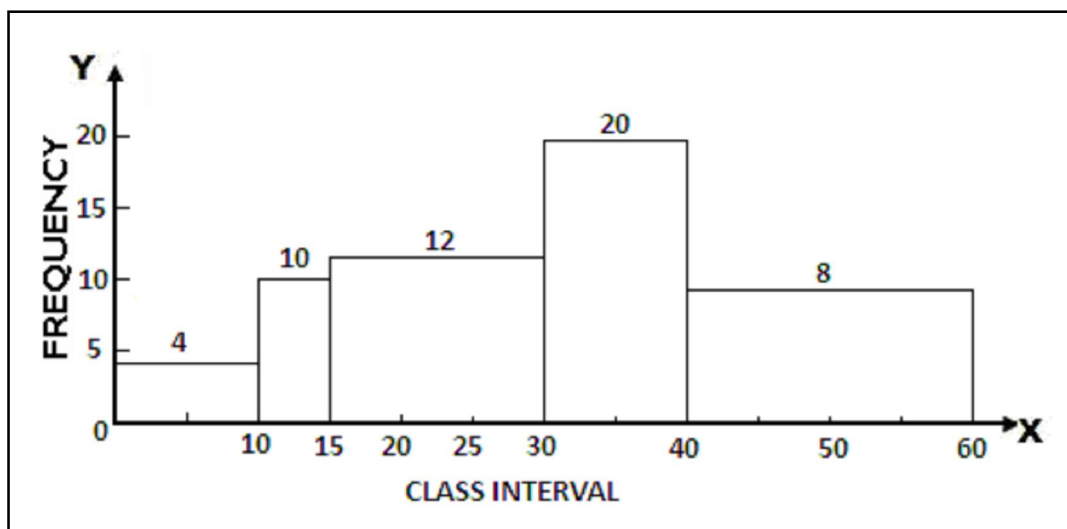
Illustration 9.14

Represent the following frequency distribution by a histogram :

Class Intervals	0-10	10-15	15-30	30-40	40-60
Frequency	8	10	36	40	32

Solution:

Class Intervals	Frequency (f)	Adjustment Factor (AF)	Adjusted Frequency = f/AF
0-10	8	2	4
10-15	10	1	10
15-30	36	3	12
30-40	40	2	20
40-60	32	4	8



Use of Histogram: The histogram is used for variable whose values are numerically expressed and measured on an interval scale. It is generally used in a situation when dealing with large data sets (greater than 100 observations). A histogram can also help to detect any unusual observations (outliers) or any gaps in the data.

2. *Frequency Polygon or Histogram*: A frequency polygon or Histogram is another method of representing a frequency distribution on a graph.

A frequency polygon is drawn by joining the midpoints of the upper widths of adjacent rectangles of the histogram, with straight lines.

Two hypothetical class intervals, in the beginning and at the end of the distribution, are created. The ends of the polygon are extended up to base line by joining them with the mid-points of the hypothetical classes. This step is required to make area under the polygon equal to the area under histogram. Frequency polygon can also be constructed without making rectangles. The points of frequency polygon are obtained by plotting mid-points of classes against heights of various rectangles, which are equal to the frequencies if all the classes are of equal width. A Histogram smoothes out the abrupt changes that may appear in histogram and is useful for demonstrating continuity of the variable being studied. (See Illustration 9.15)

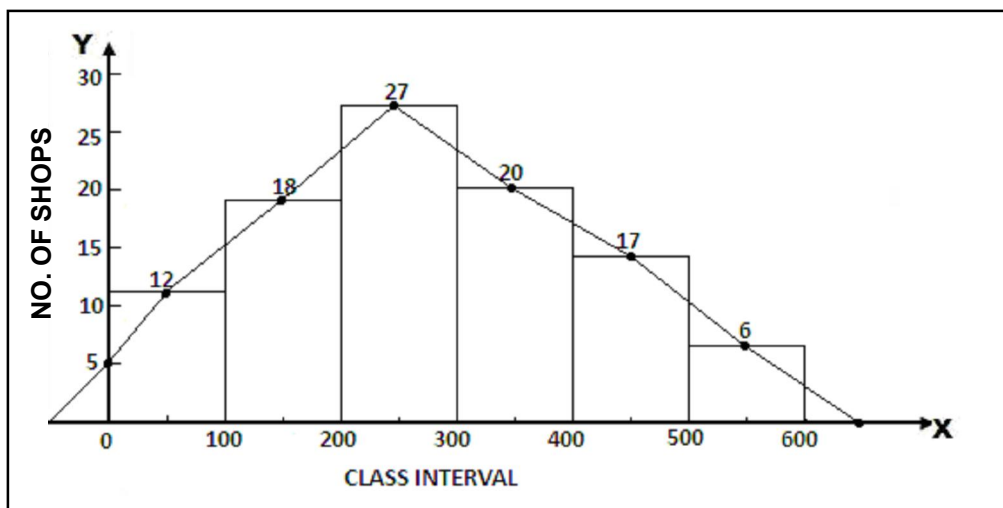
Illustration 9.15

The daily profits (in ₹) of 100 shops are distributed as follows :

Profit/Shop:	0-100	100-200	200-300	300-400	400-500	500-600
No. of Shops:	12	18	27	20	17	6

Construct a frequency polygon of the above distribution.

Solution:



FREQUENCY POLYGON

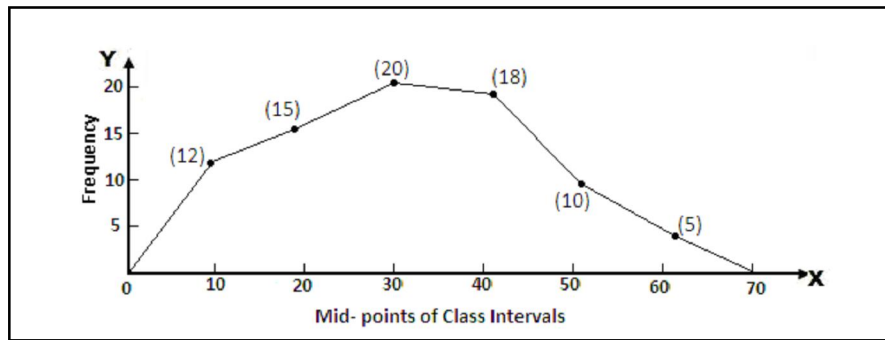
Illustration 9.16

Represent the following data by a frequency polygon.

Class Intervals:	5-15	15-25	25-35	35-45	45-55	55-65
Frequency:	12	15	20	18	10	5

Solution:

We shall construct the frequency polygon without making the histogram.



FREQUENCY POLYGON

- 3. Frequency curve:** When the verticals of a frequency polygon are joined by a smooth curve the resulting figure is known as a frequency curve. As the number of observations increases, there is need of accommodating more and more classes to accommodate them and hence the width of each class becomes smaller and smaller. In such a situation, the variable under consideration tends to become continuous and the frequency polygon of the data tends to acquire the shape of a frequency curve. Thus, a frequency curve may be regarded as a limiting form of frequency polygon as the number of observations tends to become large. The construction of a frequency curve should be done very carefully by avoiding, as far as possible, sharp and sudden turns. Smoothing should be done so that the area under the curve is approximately equal to the area under histogram or frequency polygon. The dotted curve represents the frequency curve of the data. See Illustration 15.
- 4. Cumulative Frequency Curve or Ogive:** The graphical representation of a cumulative frequency distribution is termed as a cumulative frequency curve or ogive. Since, a cumulative frequency distribution can be of 'less than' or more than type, accordingly, there are two types of ogives; 'less than ogive' and 'more than ogives'. The ogives can be better understood with the help of following illustration 9.17:

Illustration 9.17

Draw 'less than' and 'more than' ogives for the following distribution of weekly wages of 100 workers.

Weekly Wages (₹)	0-100	100-200	200-300	300-400	400-500
No. of Workers	8	30	35	20	7

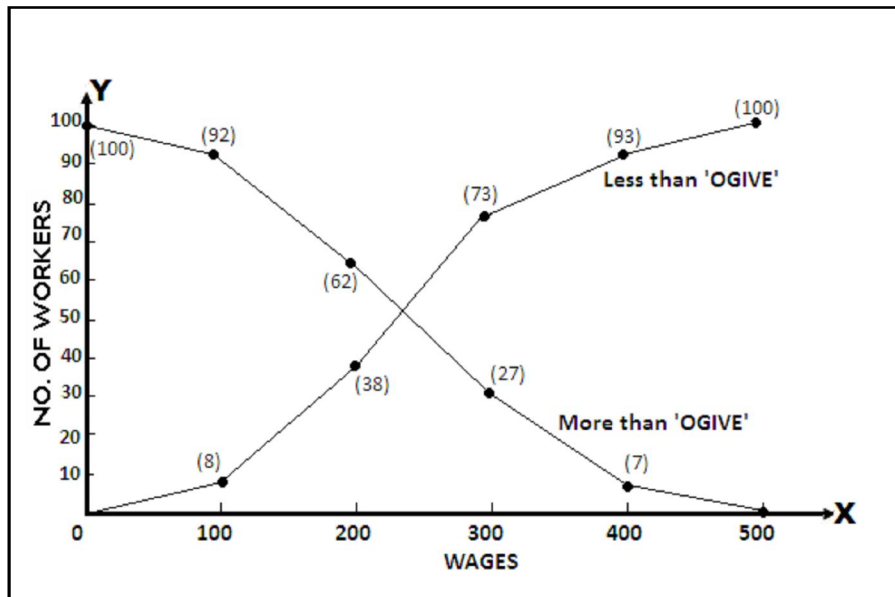
Solution:

First we contract the 'less than' and 'more than' type cumulative frequency distributions.

Wages Cumulative less than (₹)	Cumulative Frequency (Workers)	Wages Cumulative More than (₹)	Cumulative Frequency (Workers)
100	8	0	100
200	38	100	92
300	73	200	62
400	93	300	27
500	100	400	7

Note that the two ogives intersect at median.

An Ogive can be used to determine positional averages like median, quartiles, deciles, percentiles etc. We can also determine the percentage of cases lying between certain limits. Various frequency distributions can be compared on the basis of their Ogives.



LESSON ROUND UP

- Collection of data refers to systematic recording of results either by counting or by enumeration. Primary data is the data, which is collected for the first time by investigators or enumerators working under his supervision to serve a particular purpose. Such a data is of original nature. Secondary data refers to the data which is originally collected and published by the authorities other than who require it.
- Classification of data means grouping of related facts into classes. Classification of data depends upon characteristics of data, and objectives of the enquiry.
- Tabulation refers to systematic and logical arrangement of data in columns and rows in accordance with some salient features and characteristics. A tabular arrangement of data with corresponding frequency is known as frequency distribution.
- Presentation of data is to graphically represent the classified and tabulated data. There are number of diagrams which can be used for the presentation of data. The selection of a particular diagram depends upon the nature of data, objective of presentation and the ability and experience of the person doing this task. Some of the important types of diagram include line diagram, Simple Bar Diagram, Multiple Bar Diagram, Sub-divided or Component Bar Diagram, Circular or Pie Chart.

GLOSSARY

Data	Data collected in original form for statistical enquiry.
Census	The collection of data from every element in a population or universe or arena of statistical enquiry.
Sample	The collection of data from subgroup or subset of the population.
Discrete Variable	Variables (data) which assume a finite or countable number of possible values. Usually obtained by counting.
Continuous Variable	Variables (data) which assume an infinite number of possible values. Usually obtained by measurement.
Frequency	The number of times a certain value or class of values occurs.

Cumulative Frequency	The running total of the frequencies at each class interval level.
Frequency Distribution	The organization of raw data in table form with classes and frequencies.
Class Limits	Separate one class in a grouped frequency distribution from another. The limits could actually appear in the data and have gaps between the upper limit of one class and the lower limit of the next.
Class Width	The difference between the upper and lower boundaries of any class.
Class Boundary	It is the process of making the distribution continuous. The lower class boundary is found by subtracting 0.5 units from the lower class limit and the upper class boundary is found by adding 0.5 units to the upper class limit.
Class Mark	The middle point of the class. It is found by adding the upper and lower limits and dividing by two. It can also be found by adding the upper and lower boundaries and dividing by two.
Histogram	A graph which displays the data by using vertical bars of various heights to represent frequencies. The horizontal axis can either be the class boundaries, the class marks, or the class limits.
Frequency Polygon	A line graph. The frequency is placed along the vertical axis and the class midpoints are placed along the horizontal axis. These points are connected with straight lines.
Frequency Curve	A smooth frequency polygon.
Ogive	A frequency polygon of the cumulative frequency or the relative cumulative frequency.
Pie Chart	Graphical depiction of data as slices of a pie. The frequency determines the size of the slice. The number of degrees in any slice is the relative frequency times 360 degrees.

SELF-TEST QUESTIONS

1. Distinguish between primary and secondary data and discuss various methods of collecting primary data.
2. Define classification of data. What are its various objectives? Also discuss various methods of classification.
3. What is tabulation? Discuss its importance to the users.
4. Explain the requirements of a good statistical table.
5. Distinguish between following :
 - (a) Continuous and discrete variable
 - (b) Exclusive and inclusive class intervals
 - (c) 'More than' and 'less than' frequency tables.
6. What are the components of a table. Explain the main precaution you would take into account while tabulating your data.
7. Tabulate the following information about the Tea Habits of persons in Two cities of India i.e. A & B.

- CITY A – 70% people are male
 – 50% are tea drinkers
 – 40% are male Tea drinkers
- CITY B – 60% people are male
 – 40% are Tea drinkers
 – 30% are male Tea drinkers

8. From the following marks out of 100 in statistics for the 50 students, you are required to draw group frequency distribution along with their tally marks :

70	55	51	42	57
45	60	47	63	53
33	65	39	82	55
64	58	61	65	42
50	52	53	45	45
25	36	59	63	39
65	45	49	54	64
75	42	41	52	35
30	35	15	48	26
20	40	55	46	18

9. Describes with suitable examples the following types of diagrams:

- (i) Bar Diagram
- (ii) Multiple Bar Diagram
- (iii) Component Bar Diagram
- (iv) Pie Diagram

10 Distinguish between a historigram and histogram. Explain their construction with the help of suitable examples.

11. From the following data, construct :

- (a) Frequency Histogram
- (b) Frequency Polygon

<i>Wages Groups (₹)</i>	<i>No. of Workers</i>
0-10	2
10-20	4
20-30	11
30-40	15
40-50	25

50-60	18
60-70	15
70-80	4
80-90	3

12. Following is the distribution of marks in statistics obtained by 50 students in a college :

<i>Marks (More than)</i>	<i>No. of Students</i>
0	50
10	46
20	40
30	20
40	10
50	3

You are required to draw an ogive curve.

13. Explain the following:

- Class limits and Class interval
- Frequency Density
- Class Boundaries
- Cumulative Frequency Distribution
- Histogram
- Ogive

14. Distinguish between

- Tabulation and classification
- Simple table and complex table
- Simple and Cumulative frequencies

Suggested Readings

- Fundamentals of Statistics – *S. C. Gupta*
- Statistics, Theory, Method and Applications – *D. C. Sancheti & V. K. Kapoor*

Lesson 10

Measures of Central Tendency and Dispersion

LESSON OUTLINE

- Central Tendency
- Requisites of a Good Statistical Average
- Types of Average
 - Arithmetic Mean
 - Median
 - Mode
- Review Questions
- Comparative Merits and Demerits of Arithmetic Mean, Median and Mode
- Relation between Mean, Median and Mode
- Choice of a Suitable Average
- Dispersion
- Standard Deviation
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

In a statistical enquiry, after collection, classification and presentation of data, the important step is to draw relevant and meaningful conclusions out of the information so organized. This is where the need to understand basic statistical tools emerges.

The first and foremost of those tools are averages and dispersion. This section deals with the three most common measures of central tendency which are, the mean, the median, and the mode and one important measure of dispersion: standard deviation.

Apart from elaboration merits and demerits of each, a relationship between the three averages needs to be established and factors influencing the choice of suitable average should also be understood.

This lesson deals with these aforementioned tools in order to bring understanding of basic tools of statistical enquiry in students.

The inherent inability of the human mind to grasp in its entirety a large body of numerical data compels us to seek relatively few constants that will adequately describe the data.

Prof. R.A. Fisher

Introduction

A measure of Central Tendency or an average of a distribution is a single figure which can be regarded as a representative of the whole distribution. Different authors have defined the average of a distribution in different ways.

Some of the important definitions of an average are given as under:

“An average is an attempt to find one single figure to describe the whole of figures”.

Clark and Sekkade

“An average is a value which is typical or representative of a set of data”.

Murry R. Spiegel

“An average is a single value within the range of data that is used to represent all values in the series. Since an average is somewhere within the range of the data, it is also called a measure of Central Value”.

Croxton and Cowden

“A measure of central tendency is a typical value around which other figures congregate”.

Simpson and Kafka

Thus, it is clear from the above definitions that an average is a single figure that represents the frequency distribution of the large number of items.

Objectives and Significance

Some of the important objectives and significance of statistical averages are discussed as under:

- (i) *To Present Huge Mass of Data in a Summarized Form:* It is very difficult for human mind to grasp a large body of numerical figures. A measure of average is used to summarize such data into a single figure which is easier to understand and remember.
- (ii) *To Facilitate Comparison:* Different sets of data can be compared by comparing their averages. For example, the level of wages of workers in two firms can be compared by mean (or average) wages of workers in each of them.
- (iii) *To Help in Decision Making:* Most of the decisions to be taken in research planning etc. are based on the average values of certain variables. For example, if the average monthly sales of a company are falling, the sales manager may have to take certain decisions to improve it.
- (iv) *To Establish Precise Relationship:* It also focuses and establishes precise relationships among variables.

Requisites of a Good Statistical Average

An average is a single value representing a group of values and hence it should possess the following characteristics:

- (i) *Firmly Defined:* An average should not be flexible or that there would be no confusion with regard to its meaning and connotation. If an average is left to the estimation of an observer and if it is not rigid, it cannot be a representative of a series. The bias of the investigator in such cases would affect the value of the average considerably.
- (ii) *Easy to Understand and Simple to Compute:* An average should be readily understood even by a layman

otherwise its use is bound to be very limited. The properties of the average should be such that they can be easily understood by persons of ordinary intelligence. It should also be simple to compute so that it can be used widely. But ease of computation should not be sought at the expense of other advantages. For instance, a difficult average may be desirable so as to ensure greater accuracy.

- (iii) *Based on all the Items:* The average should depend upon each and every item of the series. If some of the items are not taken into account the average cannot be said to be a representative one. Further, the average itself is altered if any of the items is dropped. For example, the arithmetic mean of 35, 43, 25, 70, 60, 85 is 53. If one item is dropped say 43, the arithmetic mean would become 55.
- (iv) *Capable of Further Algebraic Treatment:* An average could be used for further statistical computations so that its utility gets enhanced. For example, if we are given the data about the average heights of boys and girls in a class and their numbers separately, then we should be able to work out the combined average.
- (v) *Not be Affected by Extreme Observations:* The average obtained in a particular field from two independent sample studies should not materially differ from each other. If one or two items unduly affect the averages i.e. either increases its value or reduces its value the average cannot be really typical of the entire series.
- (vi) *Sampling Stability:* An average should be least affected by sampling fluctuations, i.e., if we take independent random samples of the same size say 35 different groups from a given population and compute the average of each group, it is expected to get approximately the same value. The value so obtained from different samples should not vary much from one another. There may be some difference but these samples in which this difference is less are considered better than those in which this difference is more.
- (vii) *Capable of Calculation in case of Distributions Containing Open and Class-interval:* Sometimes, we are bound to use open end class interval for classification. Even in such situations, an average can be calculated very easily without making any assumptions regarding such open end class interval.

Types of Average

Various measures of average can be classified into two broad categories.

- **Mathematical Averages:** It covers Arithmetic Mean or Mean, Geometric Mean and Harmonic Mean. Further, each of these averages can be simple or weighted. (GM and HM are out of the scope of the syllabus.)
- **Positional Averages:** Median, Mode, Quartiles, Deciles and Percentiles.

Arithmetic Mean

Arithmetic mean is defined as the sum of observations divided by the number of observations.

If there are N individual observations $X_1, X_2 \dots X_n$, and then their arithmetic mean, denoted by \bar{X} , is given by

$$\bar{X} = \frac{X_1 + X_2 + \dots + X_n}{N} = \frac{\sum X_i}{N}$$

Where

- \bar{X} = Arithmetic Mean
- $\sum X_i$ = Sum of the Values of the Variable X
- N = Number of items.

Further, if the frequency of observations X_i is f_i ($i = 1, 2 \dots n$),

$$\bar{X} = \frac{f_1 X_1 + f_2 X_2 + \dots + f_n X_n}{f_1 + f_2 + \dots + f_n} = \frac{\sum f_i X_i}{\sum f}$$

The following illustration will help us to calculate Arithmetic mean in different situations.

If the frequency distribution is grouped, and then mid-points of the class intervals are taken as X_i values to calculate Arithmetic Mean.

Illustration 10.1

Compute the arithmetic mean of the following frequency distribution:

Class Intervals:	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency:	8	10	12	15	18	14	11	5

Solution:

Class Intervals	Mid-values (X)	Frequency(f)	fX
0-10	5	8	40
10-20	15	10	150
20-30	25	12	300
30-40	35	15	525
40-50	45	18	810
50-60	55	14	770
60-70	65	11	715
70-80	75	5	375
Total		$\Sigma f = 93$	$\Sigma fX = 3685$

$$\bar{X} = \frac{\Sigma fX}{\Sigma f}$$

$$\text{or } \bar{X} = \frac{3685}{93} = 39.6$$

Short-cut Method

This method is used when the magnitude of X_i values is large. The use of short-cut method is helpful in the simplification of calculation work.

Let A be the assumed mean, We can write

$$d_i = X_i - A$$

$$\text{or } \Sigma f_i d_i = \Sigma f_i (X_i - A) = \Sigma f_i X_i - A \Sigma f_i$$

Dividing both sides by N ($=\Sigma f_i$), we get

$$\frac{\Sigma f_i d_i}{N} = \frac{\Sigma f_i X_i}{N} - A$$

$$\text{or } \bar{X} = \frac{\Sigma f_i X_i}{N} = A + \frac{\Sigma f_i d_i}{N}$$

Illustration 10.2

The following is the distribution of weekly wages of workers in a factory. Calculate the arithmetic mean of the distribution.

Weekly Wages (₹)	240-269	270-299	300-329	330-359	360-389	390-419	420-449
No. of Workers	7	19	27	15	12	12	8

Solution:

Note that the given class intervals are inclusive. However, for the computation of mean, they need not be converted into exclusive intervals.

Weekly Wages (₹)	Mid-value (X)	Frequency = X-344.5	(f) _i d _i = X-A	f _i d _i
240-269	254.5	7	-90	-630
270-299	284.5	19	-60	-1140
300-329	314.5	27	-30	-810
330-359	A= 344.5	15	0	0
360-389	374.5	12	30	360
390-419	404.5	12	60	720
420-449	434.5	8	90	720
Total		∑f_i = 100		∑f_i d_i = -780

$$\begin{aligned} \bar{X} &= A + \frac{\sum f_i d_i}{\sum f_i} \\ &= 344.5 + \frac{(-780)}{100} \\ &= 336.7 \end{aligned}$$

Step Deviation or Coding Method

In a frequency distribution, if the X_i values are equally spaced, the computation work can be further eased by using step-deviation method.

We can define $U_i = \frac{X_i - A}{h}$ where, h is the difference of any two successive observations.

Multiplying both the sides by f_i and taking sum of all observations, we get —

$$\begin{aligned} \sum f_i U_i &= \frac{\sum f_i (X_i - A)}{h} = \frac{1}{h} \{ \sum f_i X_i - NA \} \\ \text{or, } \sum f_i X_i - NA &= h \sum f_i U_i \end{aligned}$$

Dividing both the sides by N, we get

$$\bar{X} = \frac{\sum f_i X_i}{N} = A + h \frac{\sum f_i U_i}{N}$$

Weekly Wages (₹)	Mid-value (X)	Frequency (f)	$d_i = X - 344.5$	$f_i d_i$	$U_i = \frac{X-344.5}{30}$	$f_i U_i$
240-269	254.5	7	-90	-630	-3	-21
270-299	284.5	19	-60	-1140	-2	-38
300-329	314.5	27	-30	-810	-1	-27
330-359	344.5	15	0	0	0	0
360-389	374.5	12	30	360	1	12
390-419	404.5	12	60	720	2	24
420-449	434.5	8	90	720	3	24
Total		$\Sigma f_i = 100$		$\Sigma f_i d_i = -780$		$\Sigma f_i U_i = -26$

Here $h = 30$, $A = 344.5$

Using this formula, we can find the mean of the above illustration as given below:

$$\begin{aligned}
 7 &= 344.5 + \left(\frac{-26}{1} \right) \\
 &= 344.5 - 7.8 \\
 &= 336.7
 \end{aligned}$$

Weighted Arithmetic Mean

In the computation of simple arithmetic mean, it is assumed that all the items (or observations) of the distribution are of equal importance. However, if all the items are not of equal importance, then simple arithmetic mean will not be a good representative of the distribution. Hence, the weighing of different items become necessary and weight are assigned in proportion to the importance of the item in the group i.e. more important item is assigned more weight.

Let W_1, W_2, \dots, W_n be the respective weights of X_1, X_2, \dots, X_n

Then,

Weighted Arithmetic Mean, $\bar{X}_w = \frac{\Sigma W_i X_i}{\Sigma W_i} = \frac{W_1 X_1 + W_2 X_2 + \dots + W_n X_n}{W_1 + W_2 + \dots + W_n}$

Illustration 10.3

Ram purchases 20 kgs. of Wheat, 10 kgs. of rice and 2 kgs. of ghee every month. If the price of wheat is ₹ 10 per kg., price of rice is ₹ 14 per kg. and price of ghee is ₹ 120 per kg. Find the average price per kg. per month.

Solution:

The simple average of the prices, $\bar{P} = \frac{10 + 14 + 20}{3} = \frac{144}{3} = ₹ 48$

Thus, the simple average is not representative of all observations because it is highly affected by the price of ghee, which is not very important in the group, since its consumption in a month is only 2 kg. In such a situation, the weighted arithmetic mean will be appropriate. The importance to various items can be based on its quantity consumed.

$$\text{Thus, } \bar{P}_w = \frac{20 \times 10 + 10 \times 14 + 2 \times 120}{20 + 10 + 2} = ₹ 18.125$$

Properties of Arithmetic Mean

Arithmetic mean possesses the following important properties:

1. The sum of deviations of a set of observations is zero when these deviations are taken from their arithmetic mean. The deviation of a set of observation X_i from its mean is written as $X_i - \bar{X}$. Then, sum of deviations is written as $\sum(X_i - \bar{X})$. The above property implies that

$$\sum(X_i - \bar{X}) = 0$$

2. The sum of square of deviations a set of observations is minimum, when the deviations are taken from their arithmetic mean.

This property implies that,

$$\sum f_i (X_i - \bar{X})^2 \leq \sum f_i (X_i - A)^2 \text{ where } A \text{ is any arbitrary origin.}$$

3. Arithmetic mean is capable of being treated algebraically. This property implies that if any two of the three values, \bar{X} , $\sum f_i X_i$ and N , are known, the third can be computed easily.

4. If N_1 and \bar{X}_1 are the number of observations and mean of a series and N_2 and \bar{X}_2 are the respective values of another series, then mean \bar{X}_{12} of the series may be obtained by combining the two series i.e.

$$\left(\bar{X}_{12} = \frac{N_1 \bar{X}_1 + N_2 \bar{X}_2}{N_1 + N_2} \right)$$

5. If a constant A is added (or subtracted) from every value of the series, then the mean of the series also gets added (or subtracted) by it.

According to this property if we write $X_1 + A, X_2 + A, \dots$ then the mean of the changed series = $\bar{X} + A$, where \bar{X} is mean of the X_1, X_2, \dots, X_n series.

6. If every value of a series is divided (or multiplied) by a constant h , then the mean of the series also gets divided (or multiplied) by it.

According to this property, if we write $\frac{X_1}{h}, \frac{X_2}{h}, \dots$ then the mean of the changed series = \bar{X}/h

Illustration 10.4

The average rainfall for a week, excluding Sunday, was 10 cms. Due to heavy rainfall on Sunday, the average for the week rose to 15 cms. How much rainfall was on Sunday?

Solution:

A week can be treated as composed of two groups. First group consisting of 6 days, excluding Sunday for which $N_1 = 6$ and $X_1 = 10$. The second group consisting of only Sunday for which $N_2 = 1$. Note that the mean of this group is equal to the observation itself that we want to find. Let this be X_2 . We are also given X_{12} (Combined mean) = 15.

$$\therefore 15 = \frac{6 \times 10 + \bar{X}_2}{7} \text{ or } 60 + \bar{X}_2 = 105 \text{ or } \bar{X}_2 = 45 \text{ cms}$$

Illustration 10.5

The mean weight of 20 employees in a company is 65 kgs. And the mean weight of 8 employees is 70 kgs. And another 7 is 55 kgs. You are required to find out the mean weight of remainder.

Solution:

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Mean weight of 20 employees in a company = 65 kgs

Total weight of 20 employees = 65 x 20 = 1300 kgs

Total weight of 8 employees whose mean weight is 70 kgs. = 560 kgs

Total weight of 7 employees whose mean weight is 55 kgs. = 385 kgs

Total weight of remaining 5 employees = 1300 – (560 + 385) = 355 kgs

Mean weight of these 5 employees = 355/5 = 71 kgs

Illustration 10.6

Two groups of students reported mean weights of 160 kg. and 150 kg. respectively. Find out, when the mean weight of both the groups together be 155 kg?

Solution

Let N_1 be the number of students reported in the first group and N_2 be the number of students reported in second group, then:

	Group-I	Group-II
Number of students	N_1	N_2
Mean Weights (kg.)	$\bar{X}_1=160$	$\bar{X}_2=150$

Combined Mean Weight $\bar{X}_{12} = 155$ kg

$$\bar{X}_{12} = \frac{N_1\bar{X}_1 + N_2\bar{X}_2}{N_1 + N_2}$$

$$155 = \frac{160N_1 + 150N_2}{N_1 + N_2}$$

$$155N_1 + 155N_2 = 160N_1 + 150N_2$$

Thus, the combined mean weight of both the groups together will be 155 kg when $N_1 = N_2$

Illustration 10.7

The mean weight of 150 students in certain class in a co-educational college in Delhi University is 60 kg. The mean weight of boys in the Class is 70 kg. and that of girls is 50 kg. Find the number of boys and the number of girls in the Class.

Solution:

Let N_1 and N_2 stand for number of boys and girls in the class respectively.

\bar{X}_1 = Mean weight of boys in the class

\bar{X}_2 = Mean weight of girls in the class

\bar{X}_{12} = Combined mean weight of boys and girls in the class

$$\bar{X}_{12} = \frac{N_1\bar{X}_1 + N_2\bar{X}_2}{N_1 + N_2}$$

$$60 (N_1 + N_2) = N_1 + 50 N_2$$

$$60 \times 150 = 70 N_1 + 50 N_2$$

$$9000 = 70 N_1 + 50 N_2 \quad \dots(i)$$

$$150 = N_1 + N_2 \quad \dots(ii)$$

Solving (i) and (ii) we may get,

$$9000 = 70 N_1 + 50 N_2$$

$$10500 = 70 N_1 + 70 N_2$$

±

$$\mathbf{-1500 = -20 N_2}$$

$$20 N_2 = 1500$$

$$N_2 = 1500 / 20 = 75$$

$$N_1 + N_2 = 150$$

$$N_1 + 75 = 150$$

⇒

$$N_1 = 75$$

Hence,

$$N_1 = 75 ; N_2 = 75$$

Illustration 10.8

The mean of a certain number of observations is 40. If two or more items with values 50 and 64 are added to this data, the mean rises to 42. Find the number of items in the original data.

Solution:

Let 'n' be the number of observations whose mean $\bar{X} = 40$

$$\text{Total of } n \text{ Values, } \bar{x} = \frac{\sum x_i}{n} \therefore \sum x_i = n(40) = 40n$$

Two more items of values 50 and 64 are added therefore, total of (n+2) values:

$$= \sum X_i + 50 + 64$$

$$= 40n + 50 + 64$$

$$= 40n + 114$$

Now, New Mean is 42

$$\therefore \bar{X} = \frac{\text{New Total of } (n+2) \text{ values}}{n+2}$$

$$\therefore 42 = \frac{40n + 114}{n+2}$$

$$\therefore 42n + 84 = 40n + 114$$

$$\therefore 2n = 30$$

$$\therefore n = 15$$

Therefore, the number of items in the original data = 15

Illustration 10.9

The mean weight of 98 students is found to be 50 lbs. It is later discovered that the frequency of the class interval (30-40) was wrongly taken as 8 instead of 10. Calculate the correct mean.

Solution:

$$\begin{aligned} \text{Incorrect mean, } \bar{X} &= 50 \text{ kg} \\ \Sigma f_i &= 98 \\ \therefore \text{Incorrect } \bar{X} &= \frac{\text{Incorrect } \Sigma f_i X_i}{\Sigma f_i} \\ 50 &= \frac{\text{Incorrect } \Sigma f_i X_i}{98} \\ \therefore \text{Incorrect } \Sigma f_i X_i &= 98 \times 50 = 4900 \\ \text{Now, Correct } \Sigma f_i X_i &= \text{Incorrect } \Sigma f_i X_i - (8 \times 35) + (10 \times 35) \end{aligned}$$

Note, the class-mark of class interval (30 – 40) is 35 and for the calculation of the mean, we consider class marks.

$$\begin{aligned} \text{Correct } \Sigma f_i X_i &= 4900 - 280 + 350 \\ &= 4970 \\ \text{Also, Correct } \Sigma f_i &= 98 + 2 = 100 \\ \therefore \text{Correct Mean} &= \frac{\text{Correct } \Sigma f_i X_i}{\text{Correct } \Sigma f_i} \\ &= \frac{4970}{100} \\ \bar{X} &= 49.70 \text{ lbs} \end{aligned}$$

Illustration 10.10

The average marks of three batches of students having 70, 50 and 30 students respectively are 50, 55 and 45. Find the average marks of all the 150 students, taken together.

Solution:

Let \bar{X} be the average marks of all 150 students taken together

	Batch-I	Batch-II	Batch-III
Marks	$\bar{X}_1=50$	$\bar{X}_2=55$	$\bar{X}_3=45$
No. of Students	$n_1=70$	$n_2=50$	$n_3=30$

$$\begin{aligned} \bar{X} &= \frac{n_1\bar{X}_1 + n_2\bar{X}_2 + n_3\bar{X}_3}{n_1 + n_2 + n_3} = \frac{70 \times 50 + 50 \times 55 + 30 \times 45}{70 + 50 + 30} = \frac{7600}{150} \\ &= 50.67 \text{ marks} \end{aligned}$$

Illustration 10.11

The mean salary paid per week to 1000 employees of an establishment was found to be ₹900. Later on, it was

discovered that the salaries of two employees were wrongly recorded as ₹750 and ₹365 instead of ₹570 and ₹635. Find the corrected mean salary.

Solution:

We first find the corrected sum of observation.

$$\begin{aligned} \text{Corrected sum of observations} &= \text{Uncorrected sum of observation} - \text{Sum of incorrect observations} + \\ &\quad \text{Sum of correct observations} \\ &= 900 \times 1,000 - 1,115 + 1,205 = 9,00,090 \\ \therefore \text{Correct Mean} &= 9,00,090/1,000 = ₹900.09 \end{aligned}$$

Merits and Demerits of Arithmetic Mean

Merits:

Out of all averages, arithmetic mean is the most popular average. It is widely used by experts and policy makers because of its following merits:

- It is easy to understand and easy to calculate.
- It is a rigidly defined average.
- It is based on all the observations and hence can be regarded as representative of the data.
- It is capable of being treated mathematically and hence is widely used in statistical analysis.
- It can be computed even if detailed distribution is not known but sum of observations and number of observations is known.
- It provides a good basis for the comparison of two or more distributions.
- It is widely used in business and commerce.

Demerits:

Although arithmetic mean satisfies most of the characteristics of a good statistical average, yet it has certain limitations also. Some of these limitations are given below:

- It can neither be determined by inspection nor by graphical location.
- It cannot be computed for a qualitative data because qualitative data are not measurable.
- It is unduly affected by extreme observations and hence is not a good representative of data having some extreme observations.
- The value of arithmetic mean of a data may not be an observation of the data and as such it is called a fictitious average.
- It cannot be computed for a distribution with open ends.
- It assigns equal weight to high and small observations which distort the averages.
- Arithmetic mean cannot be calculated in case even a single observation in a series is missing.
- In the absence of complete distribution of observations, the arithmetic mean may lead to fallacious conclusions. For example, there may be two different distributions with same arithmetic means.

MEDIAN

Median of a distribution is that value of the variant which divides it into two equal parts. In terms of the frequency curve, the ordinate drawn at median divides the area under the curve into two equal parts.

Median is a positional average because its value depends upon the position and not on magnitude of the items.

Determination of Median

1. When individual observations are given

The given observations are arranged in either ascending or descending order of magnitude. If n is the number of observations, then median is given by

(i) the size of $\frac{(N + 1)}{2}$ th observation if n is odd or

(ii) the mean of $(N/2)$ th and $(N/2 + 1)$ th observation if N is even.

Illustration 10.12

Find median of the observations in each of the following two cases :

(i) 25, 14, 28, 30, 25, 15, 32

(ii) 35, 20, 55, 27, 15, 40

Solution:

(i) Arranging the given observations in ascending order of magnitude, we have

14, 15, 25, 25, 28, 30, 32

Here, N is 7, therefore median is the size of $(7 + 1/2)$ th i.e. 4th item. Hence, median is 25.

(ii) Arranging the observations in ascending order, we may get

15, 20, 27, 35, 40, 55

Thus, the median is mean of 3rd and 4th observation = $(27 + 35/2) = 31$.

Note: the same value of median is obtained if the observations are arranged in the descending order.

Alternative Definition of Median

We have defined median as a value so that half (i.e. 50%) of the observations lie below it and half of the observations lie above it. However, the median = 25, obtained in illustration 12(i) is such that only two (i.e. 28.6%) observations are below it and three (i.e. 42.9%) observations are above it. This indicates that the definition of median, given above, is somewhat ambiguous. To avoid this ambiguity, the median of a distribution is often defined as that value of the variant *such that at least half of the observations are less than or equal to it and at least half of the observations are greater than or equal to it.*

2. When grouped frequency distribution is given (Interpolation Formula):

For a continuous or grouped frequency distribution, median is that value of the variant such that the ordinate at it divides the area under the histogram into two equal parts.

The following steps are involved in the computation of median.

- Locate the median class i.e. the class in which median lies. If $N (= \sum f_i)$ is the number of observation, then median class is the class in which $N/2$ th observation lies.
- The median is given using the following interpolation formula:

$$M_d = L_m + \frac{\frac{N}{2} - C}{f_m} \times h,$$

Where,

M_d = Median

L_m = lower limit of the median class

f_m = frequency of the median class

h = width of the median class

C = Cumulative frequency of class preceding the median class.

Important Mathematical Property of Median

It may be noted that the sum of deviations of the variables from their median, ignoring signs, is always the minimum. For example, the median of 2, 4, 6, 8, 10 is 6. The deviations from 6 ignoring signs are 4, 2, 0, 2, 4, is 12. This total is smaller than the one obtained if deviations are calculated from any other value. Thus, if deviations are taken from 8, the deviation ignoring signs would be 6, 4, 2, 0, 2 and the total is 14.

Illustration 10.13

The following table gives the marks obtained by 300 students of a management course. Find the median of the distribution.

Marks obtained	0-15	15-30	30-45	45-60	60-75	75-90	90-100
No. of students	26	34	64	76	60	30	10

Solution:

Marks obtained	Frequency (f)	Cumulative Frequency (C)
0-15	26	26
15-30	34	60
30-45	64	124
45-60	76	200
60-75	60	260
75-90	30	290
90-100	10	300

Since $N/2 = 150$, therefore, 45-60 is the median class.

Further, $L_m = 45$, $f_m = 76$, $h = 60-45 = 15$ and $C = 124$

$$M_d = \frac{45 + (150 - 124) \times 15}{76}$$

$$= 50.13 \text{ marks}$$

Remarks:

- Since the variable in a grouped frequency distribution is continuous, we always take exact value of $N/2$, including figures after decimals, when N is odd.
- The above formula is also applicable when classes are of unequal width.
- When class intervals are of inclusive type, then these should be changed to exclusive type before the computation of median.
- Median can be computed even if class intervals are with open ends.

Illustration 10.14

Find median of the following data

Age greater than (in yrs.)	0	20	30	40	50	60	70
No. of Persons	230	218	200	165	123	73	288

Solution

Note that it is a greater than type cumulative frequency distribution. First we convert it into a less than type form.

Class Intervals	Greater than Cumulative Frequency	Frequency	Less than Cumulative Frequency
0-10	230	12	12
10-20	218	18	30
20-30	200	35	65
30-40	165	42	107
40-50	123	50	157
50-60	73	45	202
60-70	28	20	222
70 and above	8	8	230

$N/2 = 230/2 = 115$, therefore median class is 40-50

Also $L_m = 40$, $f_m = 50$, $h = 10$, $C = 107$

$$\therefore M_d = 40 + \frac{115 - 107}{50} \times 10 = 41.6 \text{ years}$$

Illustration 10.15

The following table gives the distribution of daily wages of 900 workers. However, the frequencies of the two classes 40-50 and 60-70 are missing. If the median of the distribution is ₹59.25, find the missing frequencies.

Wages (₹)	30-40	40-50	50-60	60-70	70-80
No. of Workers	120	?	200	?	185

Solution:

Let f_1 and f_2 be the missing frequencies of the classes 40-45 and 60-70 respectively. We can write the given distribution in the following tabular form :

Class Intervals Wages (₹)	Frequency (f)	Cumulative Frequency (C)
30-40	120	120
40-50	f_1	$120+f_1$
50-60	200	$320+f_1$

60-70	f_2	$320+f_1+f_2$
70-80	185	900

Since median is given to be 59.25, the median class is 50-60. Thus, we can write,

$$59.25 = 50 + \frac{450 - (120 + f_1)}{200} \times 10 = 50 + \frac{330 - f_1}{20}$$

Solving this for f_1 , we get, $f_1 = 145$

Further, $f_2 = 900 - (120 + 145 + 200 + 185) = 250$

Merits and Demerits of Median

Merits:

- It is easy to understand and easy to compute. In case of individual observations or ungrouped data, it can be located even by inspection.
- It is rigidly defined.
- It is not much affected by extreme values.
- It can be determined even if the given distribution has open ends.
- It can also be located graphically.
- It can be computed for a qualitative data where ranking of items, according to the intensity of characteristics, is possible.
- It can be used in a situation when data is qualitative i.e., beauty, honesty etc.

Demerits:

- When the number of observations is large, the location of median requires their arrangement in ascending or descending order which is a very cumbersome process.
- It is a positional average and hence is not capable of being treated mathematically.
- For a grouped frequency distribution, the median is only estimated but not located.
- It is not based on all the observations and therefore cannot be regarded their good representative.
- Since weighted median, like weighted arithmetic mean, is not defined, it is not a suitable average when all the items are not of equal importance.

MODE

It is that value of the variant which repeats maximum number of times in a distribution and around which other observations are densely distributed. In the words of A.M. Tuttle, "Mode is the value which has the greatest frequency density in its immediate neighborhood".

If the frequency distribution is fairly regular, then mode is given by the value corresponding to maximum frequency. A frequency distribution is said to be regular in which the frequencies first increase in a gradual manner, reach a peak value and finally decline gradually in, approximately, the same manner as the values of the variable increase (or decrease).

The concept of mode as a measure of average is preferable to mean and median when it is desired to know the most typical size e.g. the most common size of shoes, the most common size of a garment etc.

Determination of Mode

1. By Inspection

When a frequency distribution is regular then mode can be determined just by inspection.

Illustration 10.16

Compute mode of the following distribution

X	1	2	3	4	5	6	7	8	9	10
f	4	6	8	12	17	11	7	6	5	3

Solution:

Since the distribution is fairly regular, therefore, mode of the above distribution is = 5.

2. By Method of Grouping

This method is used when the distribution is not regular. This method is explained through the following illustration.

Illustration 10.17

Determine mode of the following distribution

X	10	11	12	13	14	15	16	17	18	19
f	8	15	20	100	98	95	90	75	50	30

Solution:

The above distribution is not regular because there is a sudden increase in frequency from 20 to 100. Therefore, mode cannot be located by inspection. To obtain mode, we write the following grouping table.

Determination of Mode

X	f (1)	(2)	(3)	(4)	(5)	(6)
10	8 } 15 } 20 } 100 }	23	} 35	} 43	} 135	} 218
11	15 }	120				
12	20 }	193	} 198	} 293	} 283	} 260
13	100 }					
14	98 }	165	} 185	} 215	} 155	
15	95 }					
16	90 }	80	} 125			
17	75 }					
18	50 }					
19	30 }					

The highest frequency total in each of the six columns of the above table is identified and analyzed in the following table.

Variables

Columns	10	11	12	13	14	15	16	17	18	19
1				1						
2					1	1				
3				1	1					
4				1	1	1				
5					1	1	1			
6						1	1	1		
Total	0	0	0	3	4	4	2	1	0	0

Since the values 14 and 15 are both repeated maximum number of times, therefore the mode is ill defined. In this case, we can find the value of mode by the use of the formula. Mode = 3 Median-2 Mean, to be discussed later in this Chapter.

We note that for the given distribution Mean = 15.09 and Median = 15. Therefore, Mode = 3 × 15-2 × 15.09 = 14.82

Note: If the most repeated values in the above analysis table were not adjacent, the distribution would have been bi-modal.

3. By Interpolation Formula

For a grouped frequency distribution, we can determine modal class either by inspection or by method of grouping.

The exact location of mode is then determined by the use of the following interpolation formula :

$$Z = L_m + \frac{f_m - f_1}{2f_m - f_1 - f_2} \times h$$

Where,

- Z = mode
- L_m = lower limit of the modal class
- f_m = frequency of modal class
- f₁ = frequency preceding modal class frequency
- f₂ = frequencies succeeding modal class frequency
- h = width of the modal class.

Illustration 10.18

The frequency distribution of marks obtained by 60 students of a class is given below:

Marks	30-34	40-44	45-49	50-54	55-59	60-64
Frequency	3	5	12	18	14	62

Find mode of the distribution.

Solution:

The given class intervals should be converted into class boundaries. Since the distribution is regular, the modal class, by inspection, is 49.5 – 54.5

Further L_m = 49.5, f_m = 18, f₁ = 12, f₂ = 12, h = 5

$$\begin{aligned}
 \therefore \text{Mode, } Z &= 49.5 + \frac{18-12}{(2 \times 18) - 12 - 14} \times 5 \\
 &= 49.5 + \frac{6}{36 - 26} \times 5 \\
 &= 49.5 + \frac{6}{10} \times 5 \\
 &= 52.5 \text{ marks}
 \end{aligned}$$

Merits and Demerits of Mode

Merits:

- It is easy to understand and easy to calculate. Very often, it is located by just inspection.
- It can be located even when the variable is not measurable but categorization or ranking of observations is possible.
- It is not affected by extreme observations.
- It can be determined even for a distribution with open ends.
- Model value is a value around which there is a concentration of observations and therefore regarded as best representative of the observations.
- It can also be located graphically.

Demerits:

- It is not based on all the observations.
- It is not capable of further mathematical treatment.
- In certain cases, mode may not be rigidly defined and hence the important requisite of a good measure of central tendency is not satisfied.
- It is not easy to calculate unless the number of observations is sufficiently large and reveal a marked tendency of concentration around a particular value
- It is not suitable when different items of the data are of unequal importance.
- The mode of a distribution depends upon the choice of class width and hence is an unstable average.
- It is not suitable in the situation where weights are given to extreme values.
- Its value is most affected by fluctuations of sampling.

REVIEW QUESTIONS



1. The sum of square of derivatives from _____ is minimum.
2. Histogram is useful to determine the value of _____.
3. The relationship between mean, median and mode is _____.
4. State True or False
 - Median can be computed in an open-end frequency distribution.
 - Mean is not affected by the choice of assumed average.

Answers: 1. Mean 2. Mode 3. $M_o = 3M_d - 2\bar{X}$ 4. True, True

Comparative Merits and Demerits of Mean, Median and Mode

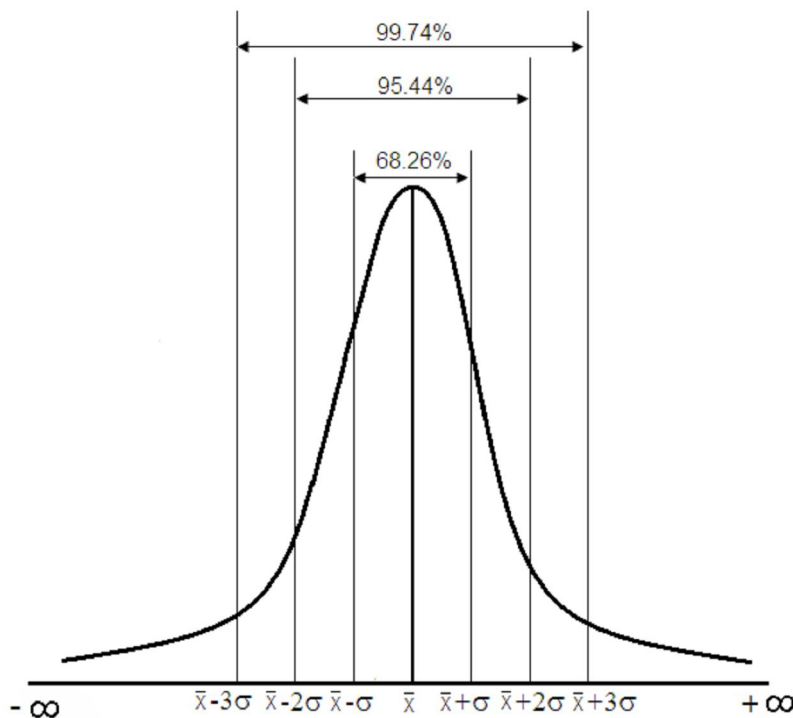
- All the three measures of averages are easy to understand and easy to compute. In certain situations, median and mode can be located just by inspection.
- Mean is highly affected while median is slightly affected by extreme observations. Mode is not affected by extreme observations.
- Mean is based on the magnitude of all the observations as opposed to median and mode.
- Only Mean is capable of algebraic treatment.
- If a distribution has open ends, we can compute median and mode but not mean.
- If a distribution has unequal class intervals, we can compute mean and median but not mode.
- All the three averages can be computed if the characteristics is measurable; median and mode can be computed if the characteristics is not measurable but items can be arranged in the order of its intensity, only mode can be computed if the characteristics is neither measurable nor can be arranged in order of intensity.
- Mean and median are rigidly defined while mode may not be rigidly defined in all situation.
- Like weighted arithmetic mean, weighted median or weighted mode is not defined.

Relation Between Mean, Median and Mode

A frequency distribution is said to be symmetrical about an ordinate (AB) if its frequency curve is divided into two parts, by this ordinate, such that one part is mirror image of the other. For a symmetrical distribution, we have Mean = Median = Mode, as shown in figure:

If a distribution is not symmetrical, it is termed as skewed. Empirically, it has been found that, for a moderately skewed distribution, we have

$$\bar{X} - M_o = 3 (\bar{X} - M_d) \text{ or } M_o = 3M_d - 2\bar{X}$$



Thus, it may be noted that $Z=3M_d - 2\bar{X}$

Illustration 10.19

In a moderately a symmetrical distribution–

- (a) The mode and median are 75 and 60 respectively, find mean.
 (b) The mean and mode are 50 and 37.5 respectively, find median.

Solution:

- (a) Using the empirical relation between mean, median and mode, we can write

$$\bar{X} - M_o = 3 (\bar{X} - M_d)$$

$$\text{or } 2\bar{X} = 3M_d - M_o$$

$$\text{or } \bar{X} = \frac{3M_d - M_o}{2} = \frac{3 \times 60 - 75}{2} = 52.5$$

$$(b) \text{ Also, } M_d = \frac{2\bar{X} + M_o}{3} = \frac{2 \times 50 + 37.5}{3} = 45.83$$

Choice of a Suitable Average

The choice of a suitable average depends upon the following three broad considerations :

- 1. Considerations based on the Suitability of Data for an Average:** The nature of the given data may itself indicate the type of average that could be used. For example, if the characteristics are not measurable, it is not possible to compute mean. Similarly, if the distribution is skewed, median may represent the data more appropriately because mean is highly affected by extreme observations and mode is not affected at all. Further, if the class intervals are of unequal width, mean and median can be satisfactorily calculated. However, an approximate value of mode can be computed by making class intervals of equal width under the assumption that observations in a class are uniformly distributed. The accuracy of the mode will depend upon the validity of this assumption. If a distribution has open ends, we can compute mode and median. An approximate value of mean can be computed only under the assumption that the width of first class is equal to the width of second class and the width of last class is equal to the width of last but one class.
- 2. Considerations based on the Purpose of Investigation:** If the purpose of investigation is to compute an average value (e.g. average income), then computation of mean is more appropriate. However, if we want to study the pattern of the distribution, e.g. number of persons having income between two values, the computation of median, quartiles, deciles and percentiles etc. might be more appropriate. In contrast to this, mode is computed when we want to determine the most common or modal size of the distribution.
- 3. Considerations based on the Merits of an Average:** The presence or absence of various characteristics of an average may also affect its selection in a given situation. If the requirement is that the average should be rigidly defined, then mean or median should be chosen in preference to mode. Similarly, if it is desired to compute an average based on all the observations, we select mean. Further, if the requirement is that an average should not be affected by extreme observations, then mode is most appropriate etc.

DISPERSION**Introduction**

Statistical average or the measures of central tendency gives us an idea of the concentration of the observations about the Central parts of the distribution but it does not tell us the full story. It is hardly fully representative of a mass unless we know the manner in which the individual items scatters around it. For instance, if we are given only the averages of a series of observations, we cannot form complete idea about the distribution since there

may exist a number of distributions whose averages are same but which may differ widely from each other in number of ways. Thus, it is necessary that the measures of statistical averages must be supported and supplemented by some additional summary measures to describe a distribution. One such measure is dispersion or a measure of variability of observations.

Meaning and Definition of Dispersion

Dispersion means the variation or scattering or deviation of the different values of a variable from their average. In other words, it is the extent of scatteredness of items around a measure of central tendency. It indicates the extent to which the values vary among themselves. Some of the important definitions of dispersion given by different experts are as under:

“Dispersion is the measure of variations of items”.

A.L. Bowley

“Dispersion is the measure of extent to which individual items vary”.

L.R. Connor

“The measure of the scatteredness of the mass of figures in a series about an average is called the measure of variation or dispersion”.

Simpson and Kafka

“The degree to which numerical data tend to spread about an average value is called the variation or dispersion of the data”.

Spiegel

Objectives and Significance of Dispersion

Some of the important objectives of dispersion along with their significance are:

- 1. To test the reliability of an average:** The reliability of a average depends upon the extent of dispersion in the data. A low value of dispersion implies greater degree of homogeneity among the observations and hence more reliable average.
- 2. To compare the extent of variability in two or more distributions:** Using a measure of dispersion, we can compare the degree of homogeneity of observations in different distributions. A distribution having lower value of dispersion is said to be more uniform or consistent.
- 3. To facilitate the computation of other statistical measures:** Various measures of dispersions are used in the computations of important statistical measures like correlation, regression, test statistics, confidence intervals, control limits etc.
- 4. To serve as a basis for control of variations:** The knowledge about the dispersion may be utilized to control variations in various areas of medicines, industry, incomes etc.

Characteristics of Good Measure of Dispersion

A good measure of dispersion should possess the following characteristics:

- It should easy to calculate and easy to understood.
- It should be rigidly defined.
- It should be based on all the observations.
- It should be capable of further mathematical treatment.
- It should not be in duly affected by extreme observations.
- It should not be much affected by the fluctuations of sampling.

Types of Dispersion

Various measures of dispersion can be classified into two broad categories:

1. The measures which express the variations in observations in terms of differences between certain selected observations e.g. range, inter quartile range, inter percentile range etc.
2. The measures which express the variations in observations in terms of average of deviations from a central value e.g. mean deviation, standard deviation etc.

Both categories of measure can be further divided into absolute and relative measures of dispersion. An absolute measure is expressed in terms of the unit of measurement of the variable. As opposed to this, a relative measure of dispersion, popularly known as coefficient of dispersion is expressed as a pure number, independent of units of measurement of the variable. Relative measures are often used for comparison of dispersion of various distributions.

Methods of Dispersion

The following are some of the important methods measures of dispersions :

- Range
- Inter-Quartile Range
- Mean Deviation
- Standard Deviation
- Lorenz Curve

Here, our discussion is restricted to the measure of standard deviation only from the point of view of syllabus.

STANDARD DEVIATION

Since mean deviation is the arithmetic mean of the absolute values of deviations, it is not very convenient to be algebraically manipulated. This necessitates a search for a measure of dispersion which is capable of being subjected to further mathematical treatment. One such measure is standard deviation or root-mean square deviation. Standard deviation may be defined as the positive square root of arithmetic mean of the squares of all the deviations of the values from their arithmetic mean. In brief, it refers to the square root of the mean of the squares of deviation from mean.

The standard deviation is usually denoted by Greek letter σ , is given as

$$\text{For } N \text{ individual observations } \sigma = \sqrt{1/N \sum (X_i - \bar{X})^2}$$

$$\text{For frequency distribution } \sigma = \sqrt{1/N \sum f_i (X_i - \bar{X})^2}$$

Note: We consider only positive square root of the above expression as standard deviation. Square of the standard deviation is known as variance of the distribution.

The above formulae are appropriate if X is a whole number. If X is not a whole number, the standard deviation is conveniently computed by using transformed form of the above formula, given below:

$$\begin{aligned} \sigma &= \sqrt{1/N \sum (X_i - \bar{X})^2} \\ &= \sqrt{1/N \sum (X_i - \bar{X})(X_i - \bar{X})} \\ &= \sqrt{1/N \sum (X_i^2 - X_i \bar{X}) - \bar{X} / N \sum (X_i - \bar{X})} \end{aligned}$$

Here in above equation, the second term is sum of deviations from \bar{X} which is equal to zero.

$$\begin{aligned} &= \sqrt{1/N (\sum X_i^2 - \bar{X}^2)} \\ &= \sqrt{1/N \sum X_i^2 - (\sum X_i / N)^2} \end{aligned}$$

= Mean of Squares - Square of the mean

Similarly, for a frequency distribution, we can write —

$$\sigma^2 = \left[\frac{\sum f_i X_i^2}{\sum f_i} - \left(\frac{\sum f_i X_i}{\sum f_i} \right)^2 \right]$$

The following illustration will help us understand the concept of standard deviation better.

Illustration 10.20

Calculate standard deviation of the following data

X	10	11	12	13	14	15	16	17	18
f	2	7	10	12	15	11	10	6	3

Solution:

X	f	fX	X - Mean	f (X - \bar{X})²
10	2	20	-4	32
11	7	77	-3	63
12	10	120	-2	40
13	12	156	-11	2
14	15	210	0	0
15	11	165	1	11
16	10	160	2	40
17	6	102	3	54
18	3	54	4	48
Total	76	Σ fX= 1064		Σ f (X - \bar{X})² = 300

$$\bar{X} = 1064/76 = 14$$

$$\sigma_x = \sqrt{300/76}$$

$$= \sqrt{3.95}$$

$$= 1.99$$

Short-cut Method

This method is based on an important property of variance (or standard deviation), given below:

The variance of a distribution is independent of the change of origin but not of change of scale.

Change of Origin

If a constant value, say, A is subtracted from each observation X_1, X_2, \dots, X_n , then resulting observation $X_1 - A, X_2 - A, \dots, X_n - A$ are said to be measured from A. This operation is termed as shifting of origin at A because $X_i - A = 0$ when $X_i = A$ ($i = 1, 2, \dots, n$).

Note: That the origin of X_i values is at 0

In this case $\sigma_x^2 = \sigma_d^2$, when $d = (X - A)$

Change of Scale

To make change of scale, we can divide (or multiply) every observation by a suitable constant.

For example, if X_i are measured in inches, then $Y_i = X_i/12$ ($i = 1, 2, \dots, n$) will be in feet. It is possible to make simultaneous change of origin and scale by making the transformation

$$dx_i = \frac{(X_i - A)}{h} \quad (i = 1, 2, \dots, n)$$

where, A refers to change of origin and h refers to change of scale. It can be shown that:

$$\sigma_x^2 = h^2 \sigma_{dx_i}^2$$

$$\sigma_x^2 = \left(\frac{\sum (f_i dx_i)^2}{N} \right) - \left(\frac{\sum (f_i dx_i)}{N} \right)^2 \times h^2$$

$$\sigma_x = \sqrt{\left\{ \frac{\sum (f_i dx_i)^2}{N} \right\} - \left(\frac{\sum (f_i dx_i)}{N = \sum f_i} \right)^2} \times h$$

Illustration 10.21

Calculate standard deviation of the following data:

Marks:	0-10	10-20	20-30	30-40	40-50
Frequency:	10	8	15	8	4

Solution:

Calculation of Standard Deviation

Marks	Mid-values (X)	f	$dx_i = X - 25/10$	f dx_i f	dx_i^2
0-10	5	10	-2	-20	40
10-20	15	8	-1	-8	8
20-30	25	15	0	0	0
30-40	35	8	1	8	8
40-50	45	4	2	8	16
Total		45		-12	72

$$\sigma_x = \sqrt{\frac{72}{45} - \frac{144}{45 \times 45}} \times 10 = 12.36$$

Illustration 10.22

Find the mean and standard deviation of the following observations:

$$X = 2, 5, 7, 8, 13$$

Transform the above observations such that:

- (i) The mean of the transformed series become 10, while the standard deviation remaining unchanged.
- (ii) The mean of the transformed series becomes 10 and the standard deviation becomes double the standard deviation of the given series.

Solution:

$$\bar{X} = \frac{2+5+7+8+13}{5} = 7$$

$$\sigma = \sqrt{\frac{4+25+49+64+169}{5} - 49} = 3.63$$

- (i) Since the standard deviation is not affected by change of origin, the transformed series with mean 10 and s.d. 3.63 is obtained by adding 3 to each observation. Thus, the required series is 5, 8, 10, 11, 16
- (ii) If every observation of the series is multiplied by 2, the mean and s.d. of the new series would be 14 and 7.26. Then, the required series is obtained by subtracting 4 from each observation. Thus, the required series is 0, 6, 10, 12, 22

Illustration 10.23

The mean and standard deviation of 10 observations are 35 and 2 respectively. Find the changed mean and standard deviation if –

- (i) each observation is increased by 4, and
- (ii) each observation is multiplied by 5.

Solution:

- (i) When each observation is increased by 4, the mean of the changed observations will also increase and it will become equal to $35 + 4 = 39$.

Since the increasing of all observations by a constant is change of origin, the standard deviation shall not change.

Thus, the mean and standard deviation when each observation is increased by 4 would be 39 and 2 respectively.

- (ii) When each observation is multiplied by 5, the mean of the new observations will be $35 \times 5 = 175$ and their standard deviation will be $2 \times 5 = 10$.

Co-efficient of Variation (CV)

The standard deviation is an absolute measure of dispersion. A relative measure, known as co-efficient of dispersion or variation, is given by

$$C.V = \frac{\sigma}{\bar{X}} \times 100$$

This measure is used to compare variability or homogeneity or stability or uniformity or consistency of two or more sets of data. The data having a higher value of the co-efficient of variation is said to be more dispersed or less uniform etc.

Note: The dispersion of two or more distributions can be compared on the basis of their standard deviations only if their means are equal and the units of measurements are same.

Illustration 10.24

The mean and standard deviations of two brands of light bulbs are given below:

	Brand I	Brand II
Mean	800 hours	770 hours
Standard deviation	100 hours	60 hours

Which brand of bulbs is more reliable ?

Solution:

Since means of the two brands are different, their reliability can be compared by computing the co-efficient of variations.

$$\text{Coefficient of Variation} = \frac{\sigma}{\bar{X}} \times 100$$

Putting the available information in the above formula, we get as under:

$$\text{C.V of brand I} = (100/800) \times 100 = 12.5\%$$

$$\text{C.V of brand II} = (100/700) \times 60 = 7.79\%$$

Since C.V of brand II is less, therefore, mean life of brand II is more reliable than mean life of brand I.

Merits and Demerits of Standard Deviation

Merits:

- It is a rigidly defined measure of dispersion.
- It is based on all the observations.
- It is capable of being treated mathematically.

Demerits:

- As compared to Range and Quartile Deviation etc., it is difficult to understand.
- It is difficult to compute.
- It is highly affected by extreme observations.
- Since the unit of standard deviation is same as the unit of observations, it cannot be used to compare the dispersions of the distributions expressed in indifferent units.

LESSON ROUND UP

- A measure of Central Tendency or an average of a distribution is a single figure which can be regarded as a representative of the whole distribution.
- An average is a single value within the range of data that is used to represent all values in the series. Since an average is somewhere within the range of the data, it is also called a measure of Central Value.
- The objectives and significance of statistical averages include presentation of huge mass of data in summarized form, facilitation of comparison, help in decision making and establishing the precise relationships.
- There are two types of averages i.e. mathematical and positional. Mathematical averages include the measures such as arithmetic mean, geometric mean and harmonic mean where as positional averages include measures like median and mode.

GLOSSARY

Mean	Sum of all the values divided by the number of values.
Median	The midpoint of the data after being ranked (sorted in ascending order). There are as many numbers below the median as above the median.

Mode	The most frequent number. There may not be a mode; there may be one mode; or there may be many modes.
Weighted Mean	The mean when each value is multiplied by its weight and summed. This sum is divided by the total of the weights.
Standard Deviation	A measure of dispersion calculated as the square root of the variance.

SELF-TEST QUESTIONS

1. Do you agree with the following statements :

- (i) Arithmetic mean can be calculated for a distribution with open ends.
- (ii) Median is not affected by extreme observations.
- (iii) The class limits should be exclusive for the determination of Median and mode.
- (iv) Mode can be calculated if class intervals are of unequal width.
- (v) Mean is based on all the observations.
- (vi) Mode is the value with maximum frequency in the data.
- (vii) The standard deviation of a set of values can be positive or negative.
- (viii) Standard deviation is independent of Change of origin but not of change of scale.
- (ix) If X_1 and X_2 are the means of two series, then the mean of the combined series will always lie between them.
- (x) The standard deviation can never exceed the range of a distribution.

2. (a) Calculate mean, mode and median from the following information:

Age (yrs.)	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
Frequency	50	70	100	180	150	120	70	60

(b) The average marks in English obtained by 400 students is 50. If the average marks of first and last 100 students are 75 and 25 respectively, then calculate the average marks.

3. (a) Define Median. What are its merits and demerits?

(b) The following is the distribution of weekly wages of workers:

Wages (₹)	50-100	100-150	150-200	200-250	250-300
No. of Workers	25	42	63	50	20

Determine –

(i) Median (Md)

4. If the mode of the following distribution is 24, find out the missing frequency corresponding to the class 20–30:

Exp (₹)	0-10	10-20	20-30	30-40	40-50
No of Families	14	23	?	21	15

5. Write short note on-

(a) Requisites of a good average

Lesson 11

Mathematics of Finance

LESSON OUTLINE

- Interest
- Simple Interest
- Compound Interest
- Conversion Period
- Review Questions
- Annuity
- Types of Annuity
- Payment Period
- Term of Annuity
- Present Value
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

Finance, one of the important fields for individuals, businesses, and organizations; addresses the ways in which monetary resources are to be raised, allocated, and used over time, taking into account the risks entailed in the projects. With the emergence of fields like actuarial science and insurance; scope of financial management in the organisation have increased manifold. It includes a number of interrelating disciplines, including statistics, finance, and economics.

From economic perspective, finance is the practical application of economics. The financial system is the means by which an economy allocates money to its highest valued use. The goal of any financial system is to make sure that those with good ideas get the money necessary to implement the ideas. This is explained by the fact that the 'people with ideas' borrow funds from 'people with money'. People do not give money without the expectation of getting something in return. In this context, this lesson deals with the practical aspect of the interest mechanism and annuity.

The affordability of light vehicles has been quite stable over the past ten quarters. Family incomes have been rising faster than vehicle prices, but higher interest rates have increased the cost of financing a new car.

Dana Johnson

INTEREST

Interest is the consideration paid by the borrower to the money lender for the use of his money.

The concept of interest involves two persons:

- Money lender
- Borrower

Borrower: Person who takes the money for his use.

Money Lender: Person who gives the money in the hope of getting some consideration i.e. the money lender charges from the borrower an amount which is more than what he gives to him. The difference is called interest. The rate of interest is decided mutually by the two parties i.e., the lender and the borrower.

Money lender can be an individual person or a bank or some other financial institution whereas borrower can be a single person or a company.

The money lender gives his money to the borrower and at the time of return, charges more than what he initially lent. This extra amount charged by the money lender for the use of his money is called **interest**. The rate of interest is decided mutually by the lender and the borrower. The sum borrowed is called the **Principal** or Capital and the sum paid by the borrower at the end of the period is called **amount**. The period for which the money is used is called **time**.

Interest can be reckoned in two ways:

- Simple Interest
- Compound Interest

SIMPLE INTEREST

The principal remains the same for the entire period, the money remains with the borrower.

If ₹ P is the principal i.e., amount borrowed and r of the rate of interest per year and n, the number of years for which the money remains with the borrower, then

$$\begin{aligned} \text{Simple Interest} &= P \times r \times n \\ &= \text{Principle} \times \text{Rate} \times \text{Time} \end{aligned}$$

If rate of interest is 'i' per rupee, per year.

Then,

$$\text{Simple interest for } n \text{ years} = P \times i \times n$$

If the rate of interest is r% per year

Then,

$$\text{Simple Interest for } n \text{ years} = \frac{P \times r \times n}{100}$$

$$\text{Amount due after } n \text{ years} = \text{₹} P + \frac{P r n}{100} = \text{₹} P \left(1 + \frac{r n}{100} \right) = \text{Principal} + \text{Interest for } n \text{ years} \quad (i)$$

COMPOUND INTEREST

In case of compound interest, interest also earns interest. At the end of each conversion period, interest is added to the principal and the amount thus formed becomes the principal for the next conversion period.

$$\text{Amount due after } n \text{ years} = P \left[1 + \frac{r}{100} \frac{\delta}{\delta} \right]^n \quad (\text{ii})$$

$$\text{Compound Interest} = P \left[1 + \frac{r}{100} \frac{\delta}{\delta} \right]^n - P$$

Note: Please note the difference between Result (i) and (ii).

Conversion Period

The period of time for which the interest is calculated is called the conversion period.

The conversion period is decided by the borrower and the lender. The conversion period may be one year, 6 months, 3 months or any other period.

$$\text{If the conversion period is one year, the amount due at the end of } n \text{ years} = P \left[1 + \frac{r}{100} \frac{\delta}{\delta} \right]^n$$

$$\text{Compound Interest} = P \left[1 + \frac{r}{100} \frac{\delta}{\delta} \right]^n - P$$

If the conversion period is 6 months, then for n years the number of conversion periods = $2n$ and if r is the annual rate of interest, then rate of interest for 6 months will be $r/2$. The amount due after n years or $2n$ conversion periods will be equal to;

$$= P \left[1 + \frac{r/2}{100} \frac{\delta}{\delta} \right]^{2n}$$

Similarly,

If the conversion period is three months, the amount due at the end of n years

$$= P \left[1 + \frac{r/4}{100} \frac{\delta}{\delta} \right]^{4n}$$

If there are m conversion periods in one year then,

$$\text{Amount due at the end of } n \text{ years} = P \left[1 + \frac{r/m}{100} \frac{\delta}{\delta} \right]^{mn}$$

Illustration: 11.1

A sum of ₹1200 becomes ₹1323 in two years at compound interest compounded annually. Find the rate percent.

Solution:

Let r % be the rate per annum.

$$1323 = 1200 \left[1 + \frac{r}{100} \frac{\delta}{\delta} \right]^2$$

$$\text{₹}1 + \frac{r}{100} \cdot \frac{\text{₹}^2}{\text{₹}} = \frac{1323}{1200}$$

$$\Rightarrow 1 + \frac{r}{100} = \sqrt{\frac{1323}{1200}} = 1.05$$

$$\Rightarrow \frac{r}{100} = 1.05 - 1$$

$$r = 0.05 \times 100$$

$$= 5\%$$

Illustration: 11.2

Find the compound interest for ₹ 1,000 for 4 years at 5% per annum when:

- (i) The interest is compounded annually
- (ii) It is compounded half-yearly
- (iii) It is compounded quarterly

Solution:

$$\begin{aligned} \text{(i) } CI &= 1000 \left[\text{₹}1 + \frac{5}{100} \cdot \frac{\text{₹}^4}{\text{₹}} \right] - 1000 \\ &= 1000(1.05)^4 - 1000 \\ &= 1215 - 1000 = \text{₹}215 \end{aligned}$$

$$\begin{aligned} \text{(ii) } CI &= 1000 \left[\text{₹}1 + \frac{5/2}{100} \cdot \frac{\text{₹}^{4 \times 2}}{\text{₹}} \right] - 1000 \\ &= 1000(1.025)^8 - 1000 \\ &= 1000(1.218) - 1000 \\ &= 1218 - 1000 \\ &= \text{₹}218 \end{aligned}$$

$$\begin{aligned} \text{(iii) } CI &= 1000 \left[\text{₹}1 + \frac{5/4}{100} \cdot \frac{\text{₹}^{4 \times 4}}{\text{₹}} \right] - 1000 \\ &= 1000 \left[\text{₹}1 + \frac{1.25}{100} \cdot \frac{\text{₹}^{16}}{\text{₹}} \right] - 1000 \\ &= 1000(1.0125)^{16} - 1000 \\ &= 1000(1.21989) - 1000 \\ &= 1219.89 - 1000 \\ &= \text{₹}219.89 @ \text{₹}220 \end{aligned}$$

Illustration: 11.3

The difference between simple and compound interest on a sum for three years at 5% per annum is ₹76.30. Find the sum.

Solution:

Let the sum = ₹ P

$$\text{Simple Interest for three years} = P \times \frac{5}{100} \times 3 = \frac{15P}{100} = 0.15P$$

$$\begin{aligned} \text{Compound Interest} &= P \left[1 + \frac{5}{100} \right]^3 - P \\ &= P (1.05)^3 - P \\ &= 1.15763P - P = 0.15763P \end{aligned}$$

Difference between compound interest and simple interest;

$$\begin{aligned} \Rightarrow \text{CI} - \text{SI} &= 0.15763P - 0.15P \\ &= 0.00763P \end{aligned}$$

$$\Rightarrow 0.00763P = 76.30$$

$$\Rightarrow P = \frac{76.30}{0.00763} = ₹10,000$$

REVIEW QUESTIONS

(1) If the interest on a certain sum for first year at 5% per annum compounded is ₹25 then, the total interest at the end of second year will be:

- (a) ₹51.25
- (b) ₹50
- (c) ₹26.25
- (d) None.

(2) The difference in compound interest and simple interest for one year for ₹1000 at 10% per annum is :

- (a) ₹10
- (b) ₹5
- (c) ₹0
- (d) None.

Answer: 1.(a) 2. (c)

Annuity

An annuity is a fixed sum paid at regular intervals under certain stated conditions. The interval may be either one year or half-year or quarter year or one month, etc., If nothing is mentioned about the period of interval, it is taken to be one year.

Types of Annuity

(i) **Annuity Certain:** Annuity payable for a fixed number of intervals is called annuity certain.

(ii) **Contingent Annuity:** An annuity whose payments continue till the happening of an event, the date of which cannot be foretold is called contingent annuity, i.e., the life insurance premium is paid periodically to the life insurance company by the insured person for certain number of years or till he dies whichever is earlier. In case, the insured person dies before the maturity of the policy, the periodic payments become contingent annuity and in this case, the contingent event is the death of the insured person. The monthly pension of the retired person continues till his death.

(iii) **Perpetual Annuity (or Perpetuity):** An annuity which continues forever (infinite number of years) is called perpetual annuity.

(iv) **Immediate Annuity (or ordinary annuity):** If the periodic payments are made at the end of each period; the annuity is called an immediate annuity or ordinary annuity.

(v) **Annuity Due:** If the periodic payments are made in advance at the beginning of each period, the annuity is called annuity due.

(vi) **Deferred Annuity:** If the period payments start only after a certain specified period (called deferred period), it is called a deferred annuity. A deferred annuity can be either a deferred immediate annuity or a deferred annuity due.

If the annuity is deferred for n years, the first payment will become due at the end of n^{th} year or $(n+1)^{\text{th}}$ year depending on whether the deferred annuity is a deferred annuity due or a deferred immediate annuity.

(vii) **Forborne Annuity:** An annuity left unpaid for a certain number of years is called forborne annuity for that number of years.

(viii) **Periodic Payment/Uniform Annuity/Variable Unity:** The amount of each payment of annuity is called the periodic payment or periodic rent of the annuity. If the periodic payments are all equal, the annuity is called level of uniform annuity. If the payments change in every period, it is called variable annuity.

Payment Period

The time between two successive payment dates of an annuity is called its payment period or payment interval.

Term of an Annuity

The total time from the beginning of the first payment period to the end of the last payment period is called the term of the annuity.

Amount of an Annuity (Future Value of an Annuity)

The amount of an annuity is defined as the total worth of all the payments of the annuity at the time of conclusion (i.e., at the end of the term) of the annuity. The amount of an annuity can also be defined as the sum of the future values of each of the Periodic Payments.

Amount of Annuity = Sum of the Periodic Payments + Sum of the Interests on the Periodic Payments

Case I: Immediate Annuity or Ordinary Annuity

In this case, the payments are made at the end of each period i.e., the payment made at the end of the first period will earn interest for $(n-1)$ periods at the end of n periods.

If $r\%$ per annum is the rate of interest and n the number of periods, A is the annuity period then ₹ A paid at the end

of first period will become $\text{₹}A \left(1 + \frac{r}{100}\right)^{n-1}$ at the end of n periods.

Total amount of the annuity at the end of n periods;

$$\begin{aligned}
 &= A \left(1 + \frac{r}{100}\right)^{n-1} + A \left(1 + \frac{r}{100}\right)^{n-2} + A \left(1 + \frac{r}{100}\right)^{n-3} + \dots + A \\
 &= A \frac{\left(1 + \frac{r}{100}\right)^n - 1}{\frac{r}{100}} \text{ where; } \frac{r}{100} = i
 \end{aligned}$$

Case II: Annuity Due

Annuity due i.e., payments are made in advance at the beginning of each period i.e., the payment made at the beginning of first period will earn interest for n periods and the total amount of the annuity:

$$\begin{aligned}
 &= A \left(1 + \frac{r}{100}\right)^n + A \left(1 + \frac{r}{100}\right)^{n-1} \dots A \left(1 + \frac{r}{100}\right) \\
 &= A \frac{\left(1 + \frac{r}{100}\right)^{n+1} - \left(1 + \frac{r}{100}\right)}{\frac{r}{100}} \\
 &= A(1+i) \frac{(1+i)^n - 1}{i} \text{ where, } \frac{r}{100} = i
 \end{aligned}$$

PRESENT VALUE

The present value of a given sum of money due at the end of a certain period of time is that sum which if invested now at the given rate of interest accumulates to the given sum at the end of the period.

If P is the Principal [Present Value] and r% per period is the rate of interest, then by compounding the interest period wise, the amount 'A' due after n periods is given by:

$$A = P \left(1 + \frac{r}{100}\right)^n \quad P = \frac{A}{\left(1 + \frac{r}{100}\right)^n}$$

= Present Value of 'A' due at the end of n years

We say that the present value of amount A due at the end of n period at r% per annum is $\frac{A}{\left(1 + \frac{r}{100}\right)^n}$

The present value or capital value of an annuity is the sum of the present values of all the payments.

Present value of an annuity 'A' (immediately annuity) to continue for n periods at r% per period.

$$\text{Present value of ₹A paid at the end of first period} = \frac{A}{1 + \frac{r}{100}}$$

$$\text{Present value of ₹A paid at the end of the second period} = \frac{A}{\left(1 + \frac{r}{100}\right)^2}$$

Present value of the annuity

$$\begin{aligned} &= \frac{A}{1 + \frac{r}{100}} + \frac{A}{\left(1 + \frac{r}{100}\right)^2} + \dots + \frac{A}{\left(1 + \frac{r}{100}\right)^n} \\ &= \frac{A}{1 + \frac{r}{100}} \left[1 + \frac{1}{1 + \frac{r}{100}} + \frac{1}{\left(1 + \frac{r}{100}\right)^2} + \dots + \frac{1}{\left(1 + \frac{r}{100}\right)^{n-1}} \right] \\ &= \frac{A}{1 + \frac{r}{100}} \left[\frac{1 - \left(1 + \frac{r}{100}\right)^{-n}}{1 - \frac{1}{1 + \frac{r}{100}}} \right] = \frac{100A}{r} \left[1 - \frac{1}{\left(1 + \frac{r}{100}\right)^n} \right] \end{aligned}$$

If $n \rightarrow \infty$, i.e., when annuity becomes a perpetuity, then:

$$\frac{1}{\left(1 + \frac{r}{100}\right)^n} \rightarrow 0 \text{ and } \frac{1}{\left(1 + \frac{r}{100}\right)^0} = 1$$

$$\therefore \text{Present value of perpetuity immediate } A = \frac{100A}{r}$$

If $\frac{r}{100} = i$; rate of interest per period per rupee, then

Present value of immediate annuity (ordinary annuity)

$$= \frac{A}{i} \left[1 - (1+i)^{-n} \right] = A_n$$

$$\text{or } A_n = \frac{A}{i} \left[1 - \frac{1}{(1+i)^n} \right]$$

and the present value of immediate perpetuity $\frac{A}{i}$

(i) Present Value of the annuity 'A' (when the annuity is considered annuity due) to continue for n periods at rate of interest r% per period

Present Value of ₹A paid in the beginning of first period = A

Present Value of ₹A paid in the beginning of second period = $\frac{A}{1 + \frac{r}{100}} = \frac{A}{1+i}$

Present value of ₹A paid in the beginning of nth period = $\frac{A}{\left(1 + \frac{r}{100}\right)^{n-1}}$

Present Value of the Annuity

= Sum of the present values of all the payments

$$\begin{aligned}
 &= A + \frac{A}{\left(1 + \frac{r}{100}\right)} + \frac{A}{\left(1 + \frac{r}{100}\right)^2} + \dots + \frac{A}{\left(1 + \frac{r}{100}\right)^{n-1}} \\
 &= A \left[1 + \frac{1}{1 + \frac{r}{100}} + \frac{1}{\left(1 + \frac{r}{100}\right)^2} + \dots + \frac{1}{\left(1 + \frac{r}{100}\right)^{n-1}} \right] \\
 &= A \left[\frac{1 - \frac{1}{\left(1 + \frac{r}{100}\right)^n}}{1 - \frac{1}{1 + \frac{r}{100}}} \right] = A \left[\frac{1 - \left(1 + \frac{r}{100}\right)^{-n}}{1 - \left(1 + \frac{r}{100}\right)^{-1}} \right]
 \end{aligned}$$

When the annuity becomes a perpetuity, i.e., $n \rightarrow \infty$ $\frac{1}{\left(1 + \frac{r}{100}\right)^n} = 0$

∴ Present value of perpetuity = $\frac{A}{1 - \left(1 + \frac{r}{100}\right)^{-1}}$

If $\frac{r}{100} = i$; the rate of interest per rupee per period, then

Present value of annuity due for n periods = $A \left[\frac{1 - (1+i)^{-n}}{1 - (1+i)^{-1}} \right]$

And present value of perpetuity = $\frac{A}{1 - (1+i)^{-1}}$

(ii) For immediate annuity (ordinary annuity)

$$\begin{aligned}
\frac{1}{\text{present value}} - \frac{1}{\text{amount of the annuity}} &= \frac{1}{A_n} - \frac{1}{S_n} \\
&= \frac{1}{\frac{A}{j} \left[1 - (1+i)^{-n} \right]} - \frac{1}{\frac{A}{j} \left[(1+i)^n - 1 \right]} \\
&= \frac{j}{A \left[1 - \frac{1}{(1+i)^n} \right]} - \frac{j}{A \left[(1+i)^n - 1 \right]} \\
&= \frac{j}{A \left[(1+i)^n - 1 \right]} \left[(1+i)^n - 1 \right] = \frac{j}{A}
\end{aligned}$$

Illustration: 11.4

Find the amount of annuity of ₹4000 per annum for 10 years reckoning compound interest at 10% per annum.

Solution :

Considering immediate annuity, the required amount

$$\begin{aligned}
&= 4000 + \frac{4000}{1.1} + \frac{4000}{1.1^2} + \dots + \frac{4000}{1.1^9} + 4000 \\
&= 4000 + 4000 \left(\frac{1}{1.1} + \frac{1}{1.1^2} + \dots + \frac{1}{1.1^9} \right) + 4000 \quad [\text{writing in the reverse order}] \\
&= 4000 \left[1 + \frac{1}{1.1} + \frac{1}{1.1^2} + \dots + \frac{1}{1.1^9} \right] + 4000 \\
&= 4000 \left[\frac{1 - \left(\frac{1}{1.1} \right)^{10}}{1 - \frac{1}{1.1}} \right] + 4000 = \frac{4000}{0.1} \left[1 - \left(\frac{1}{1.1} \right)^{10} \right] + 4000 \\
&= ₹63,760.
\end{aligned}$$

LESSON ROUND UP

- Borrower: Person who takes the money for his use.
- Money Lender: Person who gives the money in the hope of getting some consideration i.e. the money lender charges from the borrower an amount which is more than what he gives to him. The difference is called interest. The rate of interest is decided mutually by the two parties i.e., the lender and the borrower.
- Simple Interest: If Rs. P is the principal i.e., amount borrowed and r of the rate of interest per year and n, the number of years for which the money remains with the borrower, then

Simple Interest = Prn

$$= P \times R \times n$$

- Compound Interest: In case of compound interest, interest also earns interest. At the end of each conversion period, interest is added to the principal and the amount thus formed becomes the principal for the next conversion period.

$$\text{Amount due after } n \text{ years} = P \left(1 + \frac{r}{100} \right)^n$$

$$\text{Compound Interest} = P \left(1 + \frac{r}{100} \right)^n - P$$

- Annuity: An annuity is a fixed sum paid at regular intervals under certain stated conditions. The interval may be either one year or half-year or quarter year or one month, etc.,. If nothing is mentioned about the period of interval, it is taken to be one year.
- Types of Annuity: There are eight type of annuity – Annuity Certain, Contingent Annuity, Perpetual Annuity (or Perpetuity), Immediate Annuity (or ordinary annuity), Annuity Due, Deferred Annuity, Forborne Annuity, Periodic Payment/Uniform Annuity/Variable Unity.

GLOSSARY

Simple Interest	Interest computed only on the principal and not on principal plus interest earned or incurred in the previous period(s).
Compound Interest	Interest computed on the principal amount to which interest earned to-date has been added. Where compound interest is applied, the investment grows exponentially and not linearly as in the case of simple interest. In compound interest, interest also earns interest.
Annuity	It is series of fixed payments at fixed intervals, guaranteed for a fixed number of years or the lifetime under stated conditions.

SELF-TEST QUESTIONS

- Answer the following questions based on simple interest to the nearest rupee. How much interest has accrued if we are using simple interest? What is the new total balance?
 - Interest Rate: 1% each year; Principal: ₹147; Time: 6 years.
(Answer: Interest- ₹8.72 = ₹9 (approx.), Total balance – ₹156)
 - Interest Rate: 2% each year; Principal: ₹124; Time: 9 years.
(Answer : Interest - ₹22, Total balance – ₹146)
 - Interest Rate: 8% each year; Principal: ₹289; Time: 6 years.
(Answer: Interest - ₹139, Total balance – ₹428)
 - Interest Rate: 1% each year; Principal: ₹175; Time: 13 years.
(Answer: Interest - ₹23, Total balance – ₹198)
 - Interest Rate: 2% each year; Principal: ₹839; Time: 15 years.
(Answer: Interest - ₹252, Total balance – ₹1091)

(f) Interest Rate: 4% each year; Principal: ₹184; Time: 3 years.

(Answer: Interest - ₹22, Total balance – ₹206)

2. Braun invested a certain sum of money at 8% p.a. simple interest for 'n' years. At the end of 'n' years, Braun got back 4 times his original investment. What is the value of n?

(Answer: n= 37.5 Years)

3. Ann invested a certain sum of money in a bank that paid simple interest. The amount grew to ₹240 at the end of 2 years. She waited for another 3 years and got a final amount of ₹300. What was the principal amount that she invested at the beginning?

(Answer: Principal amount at the beginning – ₹200)

4. A bank offers 5% compound interest calculated on half-yearly basis. A customer deposits ₹1600 each on 1st January and 1st July of a year. At the end of the year, what is the amount he would have gained by way of interest?

(Answer: Amount – ₹121)

5. The difference between simple and compound interests compounded annually on a certain sum of money for 2 years at 4% per annum is ₹1. What is the sum?

(Answer: Sum = ₹625)

6. There is 60% increase in an amount in 6 years at simple interest. What will be the compound interest of ₹12,000 after 3 years at the same rate?

(Answer: C.I. = ₹3972)

7. The compound interest on Rs. 30,000 at 7% per annum is ₹4347. What is the period (in years)?

(Answer: Period-2 years)

Lesson 12

Theory of Probability

LESSON OUTLINE

- Introduction
- Some Basic Concepts of Set Theory
- Definition of a Set
 - Sub-set
 - Equal Sets
 - Null or Empty or Void Set
 - Disjoint Sets
 - Union of Two Sets
 - Intersection of Sets
 - Complement of a Set
 - Difference between Two Sets
- Factorial n
- Sample Space
- Equally Likely Events
- Mutually Exclusive Events
- Exhaustive Events
- Mathematical (or Classical) Definition of Probability
- Random Variables
- Probability Distribution and Expected Value
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

“Heads, you go first; tails, I do.” “I need to roll a three to win.” “If I can spin and land on a green slot, the jackpot is mine.” How many times have you played a game and hoped to win? What is the probability of winning?

This is the introduction to theory of probability which is an inevitable part of our lives, though we may not realise. Probability theory is useful in understanding, studying, and analyzing complex real world systems. Probability theory can be used to model and develop complex real world systems. A good understanding of probability theory is needed to develop simulations. In this context, the basic introduction to the theory is dealt in this lesson to acquaint students with terminologies of the theory and provides contextual understanding of the matter to the extent it may be useful in our day to day lives for decision making. Apart, it also has a stand in risk management in our professions, business and managerial aspects for smooth running of operations and decision making.

The 50-50-90 rule: Anytime you have a 50-50 chance of getting something right, there's a 90% probability you'll get it wrong.

Andy Rooney

INTRODUCTION

The theory of probability involves the study of a random phenomena.

In the vocabulary of statistics, “Random” does not mean haphazard but rather refers to a kind of order that emerges only in the long run. The long-run regularity of random phenomena can be described mathematically just as the fall of an apple or the motion of an asteroid can be predicted. The mathematical study of randomness is called *probability theory*.

Probability theory originated in the middle of the 17th Century. It began with Blaise Pascal (1623-1662). His interest and that of his contemporaries, Pierre Fermat among them, was occasioned by problems in gambling initially brought to their attention by a French nobleman, Antoine Gombauld, known as the Chevalier de Mere.

As interest in the natural sciences proliferated, so did demands for new laws of probability. Among prominent early contributions were the 19th Century mathematicians. Laplace, De Moivre, Gauss, and Poisson. Today, probability theory finds application in diverse disciplines such as biology, economics, operations research, astronomy, etc. A biologist might be interested in the distribution of bacteria in a culture, an economist in economic forecasts, a production engineer in the inventory of a particular commodity, an astronomer in the distribution of stars in different galaxies and so on. Considerable interest is also shown in this field as a mathematical discipline in its own right. The name of the brilliant Russian mathematician, A. Kolmogorov (1903-87) should be mentioned as a pioneer in this area.

Probability refers to chance, i.e., chance of happening of some event. In every walk of life, we make statements that are probabilistic and that carry overtones of chance. For example, we might talk about the probability that a bus will arrive on time, or that a child to be born will be a son, or that the stock market will go up, and so on. What is the characteristic feature in all the phenomena above? It is that they are not deterministic. Past Information, no matter how voluminous, will not allow us to formulate a rule to determine precisely, what will happen in the future. The theory of probability involves the study of this type of phenomena called *random phenomena*.

Probability theory has a central place in the theory and applications of statistics, since we are analyzing and interpreting data that involve an element of chance or uncertainty. The reliability of our conclusions is supported by accompanying probability statements.

To understand the ‘Theory of Probability’, the knowledge of some basic concepts of set theory is very essential and is given below:

SOME BASIC CONCEPTS OF SET THEORY

Definition of a Set

A collection of distinct and well-defined objects is called a **set**. The objects forming the set are called **elements** or members of the set. ‘Distinct’ means no two elements in a set are the same. By ‘well-defined’, we mean that we are given a rule by which we can determine whether a particular element is a member of the set under consideration.

Sub-set

A set ‘A’ is called a sub-set of a set ‘B’ if each element of set ‘A’ belongs to the set ‘B’. Set ‘A’ can be smaller than or equal to set ‘B’. If set ‘A’ is smaller than set ‘B’, then set ‘A’ is called proper sub-set of set ‘B’ and is denoted symbolically as $A \subset B$. If $A = B$, then also A is called sub-set of B because every set is its own sub-set also. Hence, $A \subseteq B$ denotes set ‘A’ is a sub-set of ‘B’. (The symbol includes the possibility $A = B$).

Examples:

1. Set of even integers is a proper sub-set of the set of positive integers.
2. Set (1, 2, 3) is a proper sub-set of the set (1, 2, 3, 4, 5).
3. Members of family form a set because each member is different and by seeing any person, we can say whether he/she belongs to a particular family or not.

Note: Elements of a set are enclosed inside the curly brackets { }.

If $A \subseteq B$ i.e., if A is sub-set of B, then B is called **Super set** of A and is denoted by $B \supseteq A$.

Equal Sets

Two sets A and B are said to be equal if all the elements of set A belongs to set B and all the elements of set B belongs to set A.

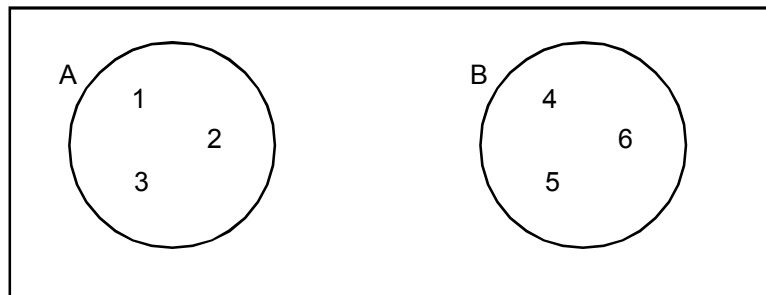
Null or Empty or Void Set

It is a set having no element and is usually denoted by ϕ or $\{ \}$.

Disjoint Sets

Two sets A and B are said to be disjoint, if there is no common element among them, i.e., if there is no element which belongs to both A and B together.

For example: If $A = \{1,2,3\}$ and $B = \{4,5,6\}$, then the sets A and B are disjoint.



VENN DIAGRAM OF DISJOINT SETS

Union of Two Sets

If A and B are two given sets, then their union is the set of those elements which belong either to A or B or to both, i.e., those elements which belong to at least one of the two sets, A and B.

The Union of A and B is denoted symbolically as $A \cup B$.

$$A \cup B = \{X \in A \text{ or } X \in B \text{ or } X \in \text{both A and B}\}$$

$$\text{Let } A = \{1, 2, 3, 4, 5\}; B = \{2, 3, 4, 6, 7\}$$

$$\text{Then } A \cup B = \{1, 2, 3, 4, 5, 6, 7\}$$

$$= \text{Elements of set A} + \text{Elements of Set B} - \text{Elements common to set A and B}$$

In case of disjoint sets,

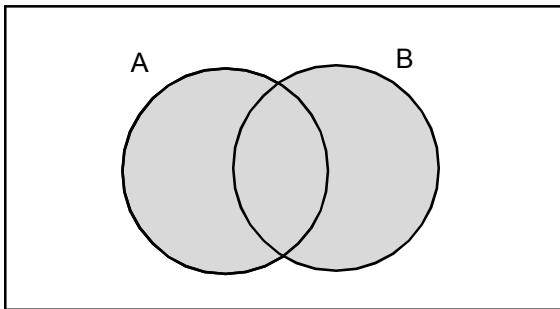
$$A \cup B = \text{Elements of set A} + \text{Elements of set B}$$

Any elements belonging to $(A \cup B)$ will belong to **at least one** of the two sets.

Intersection of Sets

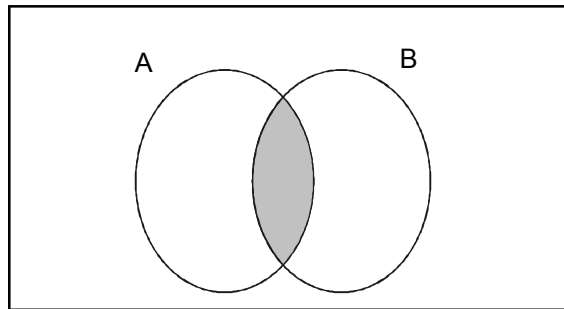
If A and B are two sets, then their intersection is the set of those elements which are common to both the sets A and B, i.e., which belong jointly to A and B, or which belong simultaneously to A and B. For example, if $A = \{1, 2, 3, 4, 5\}$; $B = \{2, 3, 4, 6, 7\}$, then the intersection of A and B (denoted symbolically as $A \cap B$ is the set containing the elements 2,3,4, i.e., $A \cap B = \{2, 3, 4\}$.

VENN DIAGRAM FOR UNION AND INTERSECTION



Shaded area represents $A \cup B$

Union of two sets



Shaded area represents $A \cap B$

Intersection of two sets

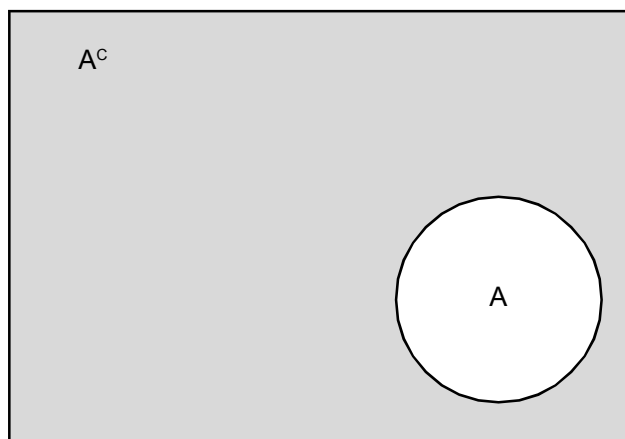
Note : Set A is a sub-set of $A \cup B$, B is a sub-set of $A \cup B$ but $(A \cap B)$ is a sub-set of A as well as B.

Complement of a Set

Let U be any set (generally called Universal set) and A be its sub-set. Then the complement of set A in relation to U is that set whose elements belong to U but not to A. Complement of A is denoted by A' or A^c .

If $U = \{1, 2, 3, 4, 5\}$ and $A = \{1, 2, 5\}$ then $A^c = \{2, 4\}$

i.e. $A^c = \{x : x \in U \text{ and } x \notin A\} = U - A, (A \cup A^c) \cup (A \cap A^c) = \phi$



Shaded area represents the complement of set A in relation to U.

De Morgan's Law

(i) $(A \cup B)^c = (A^c \cap B^c)$

(ii) $(A \cap B)^c = (A^c \cup B^c)$

Note : Complement of a set is always in relation to a universal set.

Difference between Two sets

If A and B are two sets, then their difference (A – B) is the set of all those elements of A which do not belong to B.

Element of (A – B) Elements of A – Elements common to A and B

$$= \text{Elements of A} - \text{Elements of } (A \cap B)$$

Elements of (B – A) = Elements of B – Elements of (A ∩ B)

Elements of (A – B) belong exclusively to A, i.e., exactly to A or only to A and elements of (B – A) belong exclusively to B.

If A = {3, 4, 5, 6, 7}, B = {6, 7, 8, 9},

then, (A – B) = {3, 4, 5}, (B – A) = {8, 9}

Some Important Results

If A and B are any two sets, then –

(i) $A - B = A \cap B'$

(ii) $B - A = B \cap A'$

(iii) $(A - B) \cup (B - A) = (A \cup B) - (A \cap B)$

Factorial

Factorial n is the continued product of first n natural numbers. Factorial n is symbolically written as n!.

$$n! = 1 \times 2 \times 3 \times 4 \times \dots \times (n - 1) \times n$$

$$= n \times (n - 1) \times (n - 2) \times \dots \times 4 \times 3 \times 2 \times 1$$

$$= n [(n - 1)!] = n(n - 1)[(n - 2)!]$$

Number of combinations of n things taken r at a time ($r \leq n$). [Symbolically written as ${}^n C_r$] is given by:

$${}^n C_r = \frac{n!}{r!(n - r)!}$$

$${}^n C_r = {}^n C_{n-r}$$

$$0! = 1, \text{ (By definition)}$$

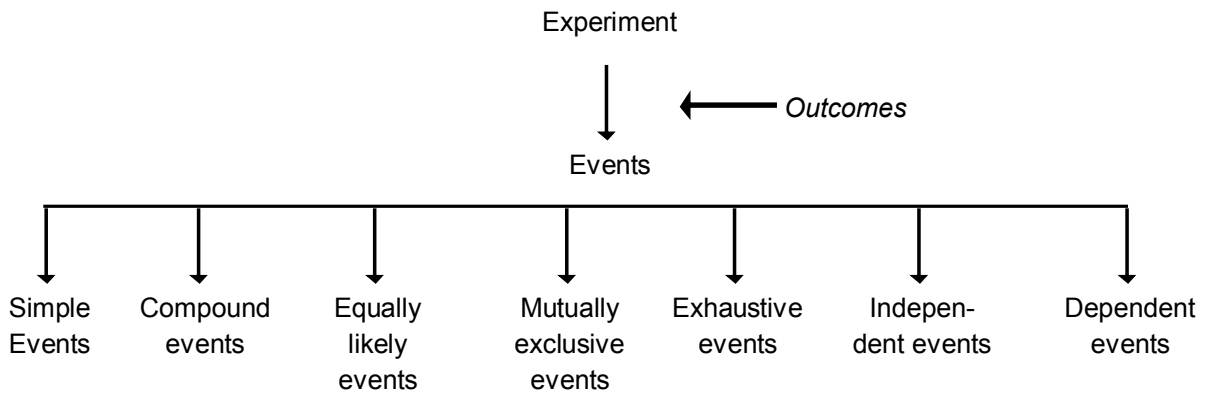
$$1! = 1$$

EXPERIMENT

Any operation that results in two or more outcomes is called an **experiment** and the performing of an experiment is called **trial**.

EVENTS

The results (or outcomes) of an experiment are called events.



(i) **Elementary** (i.e. simple) **Events** are those events which cannot be decomposed further.

(ii) **Composite Events** (or Compound Events) are those events which can be decomposed further into elementary events. In other words, an elementary event corresponds to a single possible outcome of an experiment and a compound event is an aggregate of some elementary events and can be decomposed into simple events.

Examples :

(i) Tossing of a coin is an experiment and the two possible outcomes:

- Turning up of head and
- Turning up of tail,

are simple events. The event ‘turning up of a head or tail’ is compound event because it can be decomposed into two simple events : (a) ‘turning up of head’ and (b) ‘turning up of tail’.

(ii) Throwing of a die is an experiment and the six possible outcomes are simple events [a die is a six faced cube and the faces are numbered from 1 to 6. When a die is thrown (or rolled), any of the six faces may come up].

The event that 3 comes up is a simple event but the event ‘an odd number comes up’ is a composite event because it can be decomposed further into three simple events: 1 comes up, 3 come sup and 5 comes up.

Similarly, an event ‘4 comes up’ is a simple event ‘an even number comes up’ is a composite event because it can be decomposed further into three simple events : 2 comes up, 4 comes up and 6 comes up.

Sample Space

The set of all possible outcomes of an experiment is called the sample space of the experiment and is denoted by S . Each outcome is called an element or a sample point of the sample space. Sample space is also called universal set or event space or possibility set. For example, if a die is thrown, there are six possibilities and we say that the sample space associated with the experiment of throwing a die consists of six sample points and is denoted as $S = \{1, 2, 3, 4, 5, 6\}$.

The sample space associated with the experiment of throwing a fair coin consists of two sample points, i.e., head and tail and is denoted as $S = \{H, T\}$ where H denotes head and T denotes tail.

An event is a sub-set of the sample space. An event may consists of one or more sample points. For example when a dice is thrown, the event that an even number appears consists of three sample points but the event that 1 appears consists of only one sample point.

Equally Likely Events

Events are said to be equally likely, if after taking into account all the conditions, no event can be expected to occur in preference to any other event in the same experiment.

For example: If a fair coin is tossed, there is equal chance of turning up of head or tail because in a fair (**unbiased or perfect**) coin, we cannot expect head to turn up more frequently than tail or vice versa, when a fair dice is thrown, there are six equally likely events.

Mutually Exclusive Events

Events are said to be mutually exclusive, if the occurrence of any one of them prevents the occurrence of any other event in the same experiment, i.e., at the same time.

Examples:

- (i) If a fair coin is tossed, turning up of 'head' and turning up of 'tail' are two mutually exclusive events because if head turns up, then tail cannot turn up in the same experiment and vice versa.
- (ii) If a fair dice is thrown (or rolled or flipped), there are 6 mutually exclusive events because only one face can come up at a time in any experiment.

Mutually exclusive events cannot occur simultaneously in the same experiment. Mutually exclusive events may or may not be equally likely. For example: if a coin is biased, the two events head and tail are mutually exclusive but not equally likely.

Exhaustive Events

The total number of all possible outcomes of a random experiment constitute an exhaustive set of events, i.e., the events are said to be exhaustive, if all possible cases {i.e., outcomes} are considered.

A random experiment is an experiment whose all possible outcomes are known and which can be repeated under identical conditions but it is not possible to predict the outcome of any particular trial in advance. (Sometimes the word random is omitted.)

Events are said to be mutually exclusive and exhaustive if: Every two of them are mutually exclusive and One of them necessarily occurs in any trial.

Mathematical (or Classical) Definition of Probability

If an experiment can result in $(m + n)$, equally likely mutually exclusive and exhaustive cases and m of them are favourable to the occurrence of an event 'A' and the remaining, i.e., n are against the occurrence of the event 'A' then the probability of the occurrence of event 'A' denoted by $P(A)$, is defined as the ratio:

$$\frac{m}{m+n} = \frac{\text{Number of cases favourable to the occurrence of the event 'A'}}{\text{Total number of equally likely, mutually exclusive and exhaustive cases}}$$

Probability of occurrence of event 'A' = $P(A)$

The probability of the occurrence of any event always lies between 0 and 1 and these are the two limits of probability

Instead of saying that the probability of occurrence of event A is $\frac{m}{m+n}$;

it is sometimes stated that;

Odds are m to n in favour of event A or n to m against the event A, i.e.,

Odds in favour of the event A =

$$\frac{\text{No. of cases favourable to the occurrence of the event A}}{\text{No. of cases against the occurrence of the event A}} = \frac{m}{n} = \frac{\frac{m}{m+n}}{\frac{n}{m+n}} = \frac{P(A)}{P(\bar{A})}$$

Odds against event A =

$$\frac{\text{Number of cases against the occurrence of the event A}}{\text{Number of cases in favour of the occurrence of the event A}} = \frac{n}{m} = \frac{P(\bar{A})}{P(A)}$$

Note : The ratio $\frac{m}{n}$ or $\frac{n}{m}$ is always expressed in its lowest form; i.e., as the ratio of two integers having no common factor.

If $m = 0$ i.e., if the number of cases favourable to the occurrence of event $A = 0$ then, $P(A) = 0$ i.e., event A is an impossible event. If $n = m$, $P(A) = \frac{m}{m} = 1$ i.e., event A is sure to happen and is called a **Certain (or sure) event**.

If neither $m=0$, nor $n=0$, then the probability of the occurrence of any event A is always less than 1. Therefore, the probability P of the occurrence of any event satisfies the relation $0 \leq P \leq 1$.

Important Notes:

- If the events are mutually exclusive and exhaustive, the sum of their individual probabilities of occurrence is equal to one. For example: If A , B and C are three mutually exhaustive events then; and $P(A) + P(B) + P(C) = 1$.
- The probability of the occurrence of one particular event is also called **Marginal Probability** of that event.

To choose an object at random from N objects means that each object has the same probability $\frac{1}{N}$ of being chosen.

SOLVED ILLUSTRATIONS

Illustration 12.1

If two coins are thrown, there are four possibilities, viz.,

$$\{HH, HT, TH, TT\}$$

Let E_1 be the event of getting one head and one tail,, then

$$P(E_1) = \frac{2}{4} = \frac{1}{2}$$

If E_2 is the event of getting two tails, then

$$P(E_2) = \frac{1}{4}$$

If E_3 is the event of getting two heads, then

$$P(E_3) = \frac{1}{4}$$

If E_4 is the event of getting head or tail, then

$$P(E_4) = \frac{4}{4} = 1 \text{ [Certain or Sure Event]}$$

If E_5 is the event of getting three head (or three tails or two heads and one tail or one head and two tails), then

$$P(E_5) = \frac{0}{4} = 0 \text{ [Impossible Event]}$$

Example 12.2 If two coins are thrown, what is the probability that head occurs on both the coins?

Solution : If two coins are thrown, the following cases are possible:

Coin I	Coin II
Head	Tail
Tail	Head
Tail	Tail
Head	Head

In total, there are four possibilities out of which there is only one possibility where both the coins throw head.

Therefore, required probability = $\frac{1}{4}$

Note:

(i) Similarly, the probability that both the coins throw tail = $\frac{1}{4}$

(ii) The probability that one coin throw head and the other coin throw tail = $\frac{2}{4} = \frac{1}{2}$

Illustrations 12.3: The percentages of 100 teenage offenders are in the following six categories :

Categories	Group A	Group B	Total
Non-offenders	28	42	70
First time offenders	05	15	20
Repeat offenders	07	03	10
Total	40	60	100

Suppose a teenager is chosen at random and the following events are defined.

- (i) Teenager is from Group A
- (ii) Teenager is from Group B
- (iii) Teenager is not an offender

Find the following probabilities :

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- (i) P(A) (ii) P(B) (iii) P(C)

Solution :

$$P(A) = \text{Probability that the Teenagers is from Group A} = \frac{\text{Number of teenagers in Group A}}{\text{Total Number of teenagers}} = \frac{28+5+7}{100} = \frac{40}{100} = 0.4$$

$$P(B) = \text{Probability that the Teenagers is from Group B} = \frac{\text{Number of teenagers in Group B}}{\text{Total Number of teenagers}} = \frac{45+15+3}{100} = \frac{60}{100} = 0.6$$

$$P(C) = \text{Probability that the Teenagers is not an offender} = \frac{\text{Number of teenagers who are not offenders}}{\text{Total Number of teenagers}} = \frac{28 + 42}{100} = \frac{70}{100} = 0.7$$

Illustrations 12.4: An analyst develops the following table of joint probabilities relating the size of firm (measured in terms of number of employees) and type of firm.

Number of Employees	Industry		
	Construction	Manufacturing	Retail
Under 20	0.2307	0.0993	0.5009
20 – 99	0.0189	0.0347	0.0876
100 or more	0.0019	0.0147	0.0113

If one is selected at random, find the probability of the following events :

- (i) P(A) = The firm employs fewer than 20 employees
- (ii) P(B) = The firm is in the retail industry
- (iii) P(C) = A firm in the construction industry employs between 20 to 99 workers
- (iv) P(D) = A firm in the retail industry employed more than 20 workers.

Solution:

(i) Required Probability, $P(A) = 0.2307 + 0.0993 + 0.5009 = 0.8303$

(ii) Required Probability, $P(B) = 0.5009 + 0.0876 + 0.0113 = 0.5998$

(iii) Required Probability $P(C) = \frac{0.0189}{0.2307 + 0.0189 + 0.0019} = \frac{0.0189}{0.2515} = 0.075$

(iv) Required Probability $P(D) = \frac{0.876 + 0.0113}{0.5009 + 0.876 + 0.0113} = 0.296$

Illustration 12.5: Find the probability that: (i) a leap year has 53 Sundays and (ii) a non-leap year has 53 Sundays.

Solution :

A leap year contains 366 days which is equal to $366/7 = 52 \text{ weeks} + 2 \text{ days}$.

These two days will always be consecutive days and the following possibilities will exist:

Sunday - Monday

Monday	-	Tuesday
Tuesday	-	Wednesday
Wednesday	-	Thursday
Thursday	-	Friday
Friday	-	Saturday
Saturday	-	Sunday

In the above seven possibilities, each day is repeated twice. Therefore, the probability of Sunday to be repeated 53 times in a leap year = $2/7$

A non-leap year contain 365 days i.e., $365/7 = 52$ weeks and 1 day. This one day can be any of the seven days of week.

∴ The probability that a non-leap year contains 53 Sundays = $1/7$

Illustrations 12.6: Three unbiased coins are tossed. What is the probability of obtaining:

- (a) all heads
- (b) two heads
- (c) one head
- (d) at least one head
- (e) at least two heads
- (f) all tails.

Solution :

When an unbiased coin is thrown, the probability of getting a head, $P(H) =$ Probability of getting a tail, $P(T) = \frac{1}{2}$

When three coins are thrown, the following sample space is obtained:

$S = (HHH); (HTT); (HTH); (HHT); (THH); (TTH); (THT); (TTT)$

(a) Probability of all heads = $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$

(Because out of 8 possibilities, there is only one possibility which contains three heads)

(b) Probability of two heads i.e., Probability of (H T H), (H H T) or (T H H)

$$= \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{3}{8}$$

(c) Probability of one head, i.e., Probability of (H T T), (T T H) or (T H T)

$$= \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{3}{8}$$

(d) Probability of at least one head = $1 -$ Probability of getting all tails

$$1 - \frac{1}{8} = \frac{7}{8}$$

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(e) Probability of at least two heads, i.e. Probability (H H T), (T H H), (H T H), or (H H H)

$$= \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{4}{8} = \frac{1}{2}$$

(f) Probability of all tails, i.e., Probability (T T T) = $\frac{1}{8}$

Illustrations 12.7: A card is drawn from a well-shuffled deck of 52 cards. Find the Probability of drawing a card which is neither a heart nor a king.

Solution:

In 52 cards, there are 13 cards of heart including one king. In the remaining 39 cards, there are three kings. Therefore, there are 36 cards which do not contain either card of heart or a card of king.

$$\text{Required Probability} = \frac{36}{52} = \frac{9}{13}$$

Illustrations 12.8: Five men in a company of 20 are graduates. If 3 men are picked out of the 20 at random, what is the probability that they are all graduates? What is the probability of at least one graduates?

Solution:

Total sample size = 20

Number of Graduates = 5

Number of Non-graduates = 20 – 5 = 15

Three graduates can be taken out of 5 Graduates in 5C_3 ways and 3 persons out of 20 can be taken in ${}^{20}C_3$ ways.

$$\begin{aligned} \text{(i) Required probability} &= \frac{{}^5C_3}{{}^{20}C_3} = \frac{\frac{5!}{3!(5-2)!}}{\frac{20!}{3!(20-3)!}} = \frac{\frac{5!}{3! \times 2!}}{\frac{20!}{3! \times 17!}} = \frac{5!}{3! \times 2!} \times \frac{3! \times 17!}{20!} \\ &= \frac{5 \times 4}{2 \times 1} \times \frac{3 \times 2 \times 1}{20 \times 19 \times 18} \\ &= \frac{1}{114} \end{aligned}$$

(ii) Probability of at least one graduate =

$$\begin{aligned} &= \frac{({}^5C_1 \times {}^{15}C_2) + ({}^5C_2 \times {}^{15}C_1) + ({}^5C_3 \times {}^{15}C_0)}{{}^{20}C_3} = \frac{(5 \times 105) + (10 \times 15) + 10}{1140} \\ &= \frac{525 + 150 + 10}{1140} = \frac{685}{1140} = \frac{137}{228} \end{aligned}$$

Illustrations 12.9: In a single throw of two dice, find the probability of getting: (a) P(A) = a total of 11, (b) P(B) = a total of 8 or 11, and (c) P(C) = same number on both the dice.

Solution:

When two dice are thrown together, total number of possibilities are $6 \times 6 = 36$.

(a) Total of 11 will be obtained in the following ways:

First Dice	Second Dice
5	6
6	5

i.e., 2 cases

$$\therefore \text{Required Probability, } P(A) = \frac{2}{36} = \frac{1}{18}$$

(b) Total of eight will be obtained in the following cases :

First Dice	Second Dice
2	6
6	2
5	3
3	5
4	4

i.e., 5 cases

$$\therefore \text{Required Probability, } P(B) = \frac{5}{36}$$

(c) There are six cases in which same number will appear on both the dice i.e., (1,1), (2,2), (3,3), (4,4), (5,5), (6,6)

$$\therefore \text{Required Probability, } P(C) = \frac{6}{36} = \frac{1}{6}$$

Illustration 12.10:

(a) A pair of dice is rolled, find the probability:

- (i) $P(A)$ = that the sum is neither 8 nor 10 and
- (ii) $P(B)$ = that the sum is greater than 12.

Solution:

When a pair of die is rolled, total number of possibilities is $6 \times 6 = 36$

(a) Let X denote the event of getting the sum 8 and Y denote the event of getting the sum 10. There are 5 possibilities for getting the sum 8, i.e., (2,6), (3,5), (4,4), (5,3), (6,2).

There are 3 possibilities for achieving the sum 10 i.e., (4,6), (5,5), (6,4)

Probability of getting the sum 8 = $P(X) = 5/36$

Probability of getting the sum 10 = $P(Y) = 3/36 = 1/12$

Probability that the sum is either 8 or 10 = $\frac{5}{36} = \frac{3}{36} = \frac{8}{36} = \frac{2}{9}$ {events are mutually exclusive}

Probability that the sum is neither 8 nor 10, $P(A)=1 - \text{Probability that sum is either 8 or 10}$

$$= 1 - P(A)$$

$$= 1 - \frac{2}{9} = \frac{7}{9}$$

(b) When two dice are thrown, a total sum greater than 12 is impossible and hence the probability of such an event is Zero.

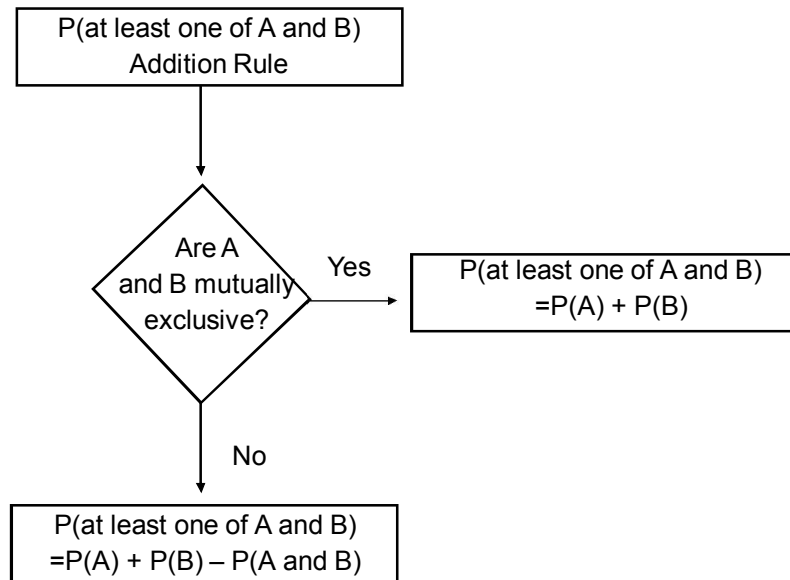
ADDITION RULE OF PROBABILITY (THEOREM OF TOTAL PROBABILITY)

If A and B are any two events then the probability that at least one of them occurs is denoted by $P(A \cup B)$ and is given by $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

When the events are mutually exclusive

$$P(A \cap B) = 0$$

And in that case $P(A \cup B) = P(A) + P(B)$



Multiplication Rule

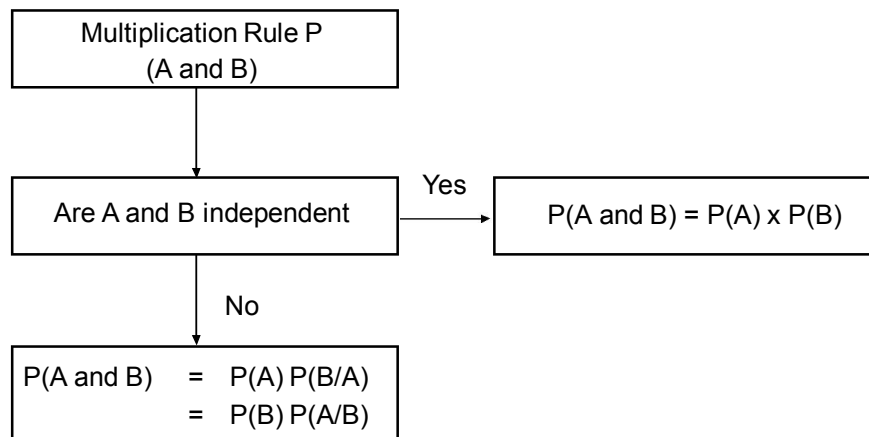
If A and B are two events, the probability of their joint occurrence or simultaneous occurrence is given by :

$$P(A \cap B) = P(A) P(B/A) = P(B) P(A/B)$$

When the events are independent;

$$P(A/B) = P(A);$$

$$P(B/A) = P(B)$$



∴ When the events are independent, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$P(A/B)$ is the conditional probability of the occurrence of event A, when it is known that event B has already occurred.

Similarly, $P(B/A)$ is the conditional probability of the occurrence of event B, when it is known that event A has already occurred.

If the events are independent, the occurrence of A do not affect the occurrence of B.

∴ $P(B/A) = P(B)$

Also, $P(A/B) = P(A)$

For example, in a family the gender of the second child is not affected by the gender of the first child or if a coin is thrown two times, the outcome of the second throw is not affected by the outcome of the first throw.

RANDOM VARIABLES

By *random* we mean *unpredictable*; when the same is applied in case of a random variable, means, we cannot with certainty predict its future value. Even through the entire past history of the variable is known, it is still unpredictable with certainty. If the variable is of the deterministic type, no such uncertainty exists.

However, quite a few random variables do exhibit statistical regularity. Consider a simple experiment of tossing an unbiased coin. We do not know in advance whether the outcome on a particular toss would be a head or tail. But, we know for sure that in a long sequence of tosses, about half of the outcomes would be heads. If this does not happen, we suspect either the coin or the person tossing it is biased. Statistical regularity of averages is an experimentally verifiable phenomenon in many cases involving random quantities. Hence, we are tempted to develop mathematical tools for the analysis and quantitative characterization of random variables.

Random Variable Definition

Although it may look simple at first sight to give a definition of what a random variable is, it proves to be quite difficult in practice. A random variable, usually written X , is a variable whose possible values are numerical outcomes of a random experiment. It therefore is a function that associates a unique numerical value with every outcome of an experiment. The value of the random variable will vary from trial to trial as the experiment is repeated.

The following paragraphs will cover the details.

Random Experiment: As Random variables are outcomes of a random experiment, it is essential to understand a random experiment as well. Where Random variables are outcomes, a random experiment is a process

leading to an uncertain out-come, before the experiment is run. It is usually assumed that the experiment can be repeated indefinitely under essentially homogeneous conditions. Result of a random experiment is not unique but it can be one of the various possible outcomes. Simple example is tossing an unbiased coin, where outcomes can be head or tail. You keep on tossing the coin a number of times under essential homogeneous conditions, the outcomes would keep on flipping between Head & Tail, without exactly knowing which toss would result in to what.

The outcome of an experiment need not be a number, for example, the outcome in a coin toss experiment can be 'heads' or 'tails'. However, we often want to represent outcomes as numbers. A random variable is a function that associates a unique numerical value with every outcome of an experiment. In the given example, if there are three trials (say); the number of times "Head" appears can be a random variable, which can assume values as, 0, 1, 2, & 3. Because in three trials, you can have minimum zero Heads and maximum three Heads.

Types of Random Variables

Classification of random variables is done based on their probability distribution. A random variable has either an associated probability distribution (discrete random variable) or probability density function (continuous random variable). Based on that, there are two types of random variable – Discrete and Continuous.

Discrete Random Variables

A discrete random variable is one which may take on only a countable number of distinct values such as 0,1,2,3,4,..... Discrete random variables are usually (but not necessarily) counts. If a random variable can take only a finite number of distinct values, then it must be discrete. Examples of discrete random variables include the number of children in a family, the number of people in an ATM queue, the number of patients in a doctor's surgery, the number of defective light bulbs in a box of ten etc.

The probability distribution of a discrete random variable is a list of probabilities associated with each of its possible values. It is also sometimes called the probability function or the probability mass function.

Suppose a random variable X may take k different values, with the probability that $X = x_i$ defined to be $P(X = x_i) = p_i$. The probabilities p_i must satisfy the following:

$$1: 0 < p_i < 1 \text{ for each } i$$

$$2: p_1 + p_2 + \dots + p_k = 1.$$

Example

1. A coin is tossed ten times. The random variable X is the number of "Tails" that are noted. X can only take the values 0, 1, ..., 10, so X is a discrete random variable. The above two properties hold in this case. For e.g. probability of 8 Tails, p_8 will definitely fall in the range 0 to 1. And also, the sum of probabilities for all possible values of Tails, $p_0 + p_1 + p_2 + \dots + p_{10} = 1$.

Note in case of ten trials, number of tails can be 0 to 10.

Continuous Random Variables

A continuous random variable is one which takes an infinite number of possible values (usually in a given range). Continuous random variables are usually measurements like, height, weight, the amount of sugar in an orange, time required to finish a task, interest earn etc. For e.g.: life of an individual in a community. A person may die immediately on his birth (life equals to zero years) or after attaining an age of 110 years (say). Within this range, he may die at any age. Therefore the variable "age" can take any value in the range 0 to 110, in this case.

A continuous random variable is not defined at specific values, since the values are infinite and therefore probability at a specific value is almost zero. Instead, it is defined over an interval of values, and is represented by the area under a curve.

Suppose a random variable X may take all values over an interval of real numbers. Then the probability that X is in the set of outcomes A , $P(A)$, is defined to be the area above A and under a curve. The curve, which represents a function $p(x)$, must satisfy the following:

- 1: The curve has no negative values ($p(x) \geq 0$ for all x)
- 2: The total area under the curve is equal to 1.

A curve meeting these requirements is known as a density curve.

A light bulb is burned until it burns out. Suppose the life of bulb ranges between zero hours (minimum) to 100 hours (maximum). The random variable Y is its lifetime in hours. Y can take any positive real value in the range 0 to 100, so Y is a continuous random variable. It is immaterial to calculate probability of Y at a specific point in the specified range; instead we wish to calculate probability between any two end points in the range, like 0-10, 50-70, less than 20, more than 90 etc. At any point in the complete range (0-100), $p(x) \geq 0$, and the total area in the probability curve from $p(x=0)$ to $p(x=100)$ would be equal to one.

EXPECTED VALUE

The expected value (or population mean) of a random variable indicates its average or central value. It is a useful summary value (a number) of the variable's distribution.

Stating the expected value gives a general impression of the behaviour of some random variable without giving full details of its probability distribution (if it is discrete) or its probability density function (if it is continuous).

Two random variables with the same expected value can have very different distributions. There are other useful descriptive measures which affect the shape of the distribution, for example standard deviation.

The expected value of a random variable X is symbolised by $E(X)$.

If X is a discrete random variable with possible values $x_1, x_2, x_3, \dots, x_n$, and $p(x_i)$ denotes $P(X = x_i)$, then the expected value of X is defined by:

$$\mu = E(X) = \sum x_i p(x_i)$$

where the elements are summed over all values of the random variable X .

If X is a continuous random variable with probability density function $f(x)$, then the expected value of X is defined by:

$$\mu = E(X) = \int x f(x) dx$$

Example

Discrete case: When a die is thrown, each of the possible faces 1, 2, 3, 4, 5, 6 (the x_i 's) has a probability of $1/6$ (the $p(x_i)$'s) of showing. The expected value of the face showing is therefore:

$$\mu = E(X) = (1 \times 1/6) + (2 \times 1/6) + (3 \times 1/6) + (4 \times 1/6) + (5 \times 1/6) + (6 \times 1/6) = 3.5$$

Notice that, in this case, $E(X)$ is 3.5, which is not a possible value of X .

Expected Values of Random Variables

We already looked at finding the mean in the section on averages. Random variables also have means but their means are not calculated by simply adding up the different variables.

The mean of a random variable is more commonly referred to as its Expected Value, i.e. the value you expect to obtain should you carry out some experiment whose outcomes are represented by the random variable.

In Probability theory, the **expected value** (or **expectation**, **mathematical expectation**, **EV**, **mean**,) refers, intuitively, to the value of a random variable one would “expect” to find if one could repeat the random variable process an infinite number of times and take the average of the values obtained. More formally, the expected value is a weighted average of all possible values. In other words, each possible value that the random variable can assume is multiplied by its assigned weight, and the resulting products are then added together to find the expected value. The weights used in computing this average are the probabilities in the case of a discrete random variable, or the values of a probability density function in the case of a continuous random variable.

Example:

A local club plans to invest \$10000 to host a baseball game. They expect to sell tickets worth \$15000. But if it rains on the day of game, they won't sell any tickets and the club will lose all the money invested. If the weather forecast for the day of game is 20% possibility of rain, is this a good investment?

Make a table of probability distribution.

Outcome	+\$3000	– \$12000
Probability	0.80	0.20

Use the weighted average formula.

$$\begin{aligned}
 \text{Expected value} &= 5000(0.8) - 12000(0.2) \\
 &= 4000 - 2400 \\
 &= 1600
 \end{aligned}$$

The club can expect a return of \$1600. So, it's a good investment, though a bit risky.

In other cases, we are asked to find the values of one or more variables involved in the model for which the experiment has a given expected value.

Example:

A company makes electronic gadgets. One out of every 50 gadgets is faulty, but the company doesn't know which ones are faulty until a buyer complains. Suppose the company makes a \$3 profit on the sale of any working gadget, but suffers a loss of \$80 for every faulty gadget because they have to repair the unit. Check whether the company can expect a profit in the long term.

Write the probability distribution.

$$\begin{aligned}
 E(X) &= \frac{49}{50}3 + \frac{1}{50}(-80) \\
 &= \frac{147}{50} - \frac{80}{50} \\
 &= \frac{67}{50} \\
 &= 1.34
 \end{aligned}$$

Since the expected value is positive, the company can expect to make a profit. On average, they make a profit of \$1.34 per gadget produced.

The intuitive explanation of the expected value above is a consequence of the law of average numbers: the expected value, when it exists, is almost surely the limit of the sample mean as the sample size grows to infinity. More informally, it can be interpreted as the long-run average of the results of many independent repetitions of an experiment (e.g. a dice roll).

Suppose random variable X can take value x_1 with probability p_1 , value x_2 with probability p_2 , and so on, up to value x_k with probability p_k . Then the **expectation** of this random variable X is defined as

$$E(X) = x_1p_1 + x_2p_2 + \dots + x_kp_k$$

Since all probabilities p_i add up to one ($p_1 + p_2 + \dots + p_k = 1$), the expected value can be viewed as the weighted average, with p_i 's being the weights:

$$E[X] = \frac{x_1p_1 + x_2p_2 + \dots + x_kp_k}{1} = \frac{x_1p_1 + x_2p_2 + \dots + x_kp_k}{p_1 + p_2 + \dots + p_k}$$

If all outcomes x_i are equally likely (that is, $p_1 = p_2 = \dots = p_k$), then the weighted average turns into the simple average. This is intuitive: the expected value of a random variable is the average of all values it can take; thus the expected value is what one expects to happen *on average*. If the outcomes x_i are not equally probable, then the simple average must be replaced with the weighted average, which takes into account the fact that some outcomes are more likely than the others. The intuition however remains the same: the expected value of X is what one expects to happen *on average*.

Example 1. Let X represent the outcome of a roll of a six-sided die. More specifically, X will be the number of pips showing on the top face of the die after the toss. The possible values for X are 1, 2, 3, 4, 5, and 6, all equally likely (each having the probability of $1/6$). The expectation of X is

$$E[X] = 1 \cdot \frac{1}{6} + 2 \cdot \frac{1}{6} + 3 \cdot \frac{1}{6} + 4 \cdot \frac{1}{6} + 5 \cdot \frac{1}{6} + 6 \cdot \frac{1}{6} = 3.5$$

Let X be a discrete random variable taking values x_1, x_2, \dots with probabilities p_1, p_2, \dots respectively. Then the expected value of this random variable is the infinite sum

$$E[X] = \sum_{i=1}^{\infty} x_i p_i$$

Given that the random variable X is continuous and has a probability distribution $f(x)$, the expected value of the random variable is given by:

$$E[X] = \int_{-\infty}^{\infty} xf(x) dx$$

Uses and applications

It is possible to construct an expected value equal to the probability of an event by taking the expectation of an indicator function that is one if the event has occurred and zero otherwise. This relationship can be used to translate properties of expected values into properties of probabilities, e.g. using the law of large numbers to justify estimating probabilities by frequencies.

PROBABILITY DISTRIBUTION

A probability distribution is a table or an equation that links each outcome of a statistical experiment with its probability of occurrence. The usefulness of probability theory comes in understanding probability distributions (also called probability functions and probability densities or masses). Probability distributions list or describe probabilities for all possible occurrences of a random variable.

Example: Let us consider a case of tossing a coin two times. This simple statistical experiment can have four possible outcomes: HH, HT, TH, and TT. Now, let the variable X represent the “number of Heads” that result from this experiment. The variable X can take on the values 0, 1, or 2. Where, a value of $X = 0$, signifies, none of the trials resulted in Head. A value of $X = 2$, means both the trials gives Head. Similarly we can interpret for $X = 1$. In this example, X is a random variable; because its value is determined by the outcome of a statistical experiment.

As stated above, probability distribution is a table or an equation that links each outcome of a statistical experiment with its probability of occurrence. In the experiment described above, the table below, which associates each outcome with its probability, is an example of a probability distribution.

Number of heads	Probability
0	0.25
1	0.50
2	0.25

These all probabilities are calculated using classical approach. The probability of $X = 1$, is 0.50 because, two outcomes (out of four) resulted in to one Head (HT, and TH).

Types of probability distributions: Broadly there are two types of Probability distribution, Discrete and Continuous. Within these two broad categories, there are many theoretical distributions defined.

Discrete probability distributions: It describes a finite set of possible occurrences, for discrete variables.” For example, the number of successful treatments out of 4 patients is discrete, because the random variable represent the number of success can be only 0, 1, 2,3 or 4. The probability of all possible occurrences: $P(0 \text{ successes})$, $P(1 \text{ success})$,..... $P(4 \text{ successes})$ constitutes the probability distribution for this discrete random variable. The example cited above (tossing a coin twice is also a case of discrete distribution).

Therefore a discrete probability distribution lists each possible value that a random variable can take, along with its probability. It has the following properties:

The probability of each value of the discrete random variable is between 0 and 1,

$$\text{So } 0 \leq p(x) \leq 1$$

The sum of all the probabilities is 1, so $\sum p(x) = 1$

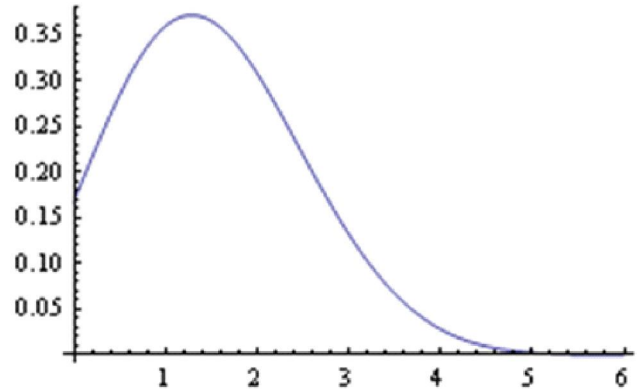
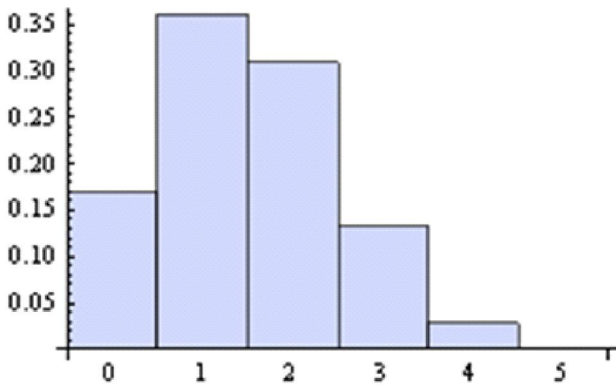
Example: Consider the table below:

X	-5	6	9
P(x)	05	.025	.025

This is a probability distribution, since all of the probabilities are between 0 and 1, and they add to 1.

Continuous probability distributions: It describes the probability distribution of a continuous variable. For example, the probability of a given weight (of an infant) can be anything from, say, two Kg to more than 6 Kg (or something like that). Thus, the random variable of weight is continuous, with an infinite number of possible points between any two values.

When moving from discrete to continuous distributions, the random variable will no longer be restricted to integer values, but will now be able to take on any value in some interval of real numbers. Graphically, we will be moving from the discrete bars of a histogram to the curve of a (possibly piecewise) continuous function.



In the discrete case, probabilities were given by a probability distribution function $P(X=x)$, and graphically displayed by using its value as the height of each bar. We might also observe that each of the bars had width 1, and therefore the height of each bar was equal to its area.

In the continuous case, the function $f(x)$ is called the **probability density function**, and probabilities are determined by the areas under the curve $f(x)$. So as we move from the discrete to the continuous case, we need to modify how we interpret the graph, so that we see probabilities as areas. And yet, the mathematics has not changed at all, since probabilities are areas in both cases.

For Example:

- Let an experiment consist of tossing a fair coin three times. Let X denotes the number of heads which appear. Then the possible values of X are 0, 1, 2, 3 and the Probability Distribution of getting heads is :

X	p	pX	
0	1/8	0 X 1/8	0
1	3/8	1 X 3/8	3/8
2	3/8	2 X 3/8	6/8
3	1/8	3 X 1/8	3/8
Total		$\Sigma pX = 12/8 = 3/2$	

$$E(X) = \Sigma pX = 3/2$$

- The probability distribution of X , the number of red cars John meets on his way to work each morning, is given by the following table. Find the number of red cars that John expects to run into each morning on his way to work.

X	f(X)
0	0.41
1	0.37
2	0.16
3	0.05
4	0.01

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This question is asking us to find the average number of red cars that John runs into on his way to work.

Since X is a discrete random variable, the expected value is given by $E(X) = \sum pX$

X	p	pX	
0	0.41	0 X 0.41	= 0
1	0.37	1 X 0.37	= 0.37
2	0.16	2 X 0.16	= 0.32
3	0.05	3 X 0.05	= 0.15
4	0.01	4 X 0.01	= 0.04
Total		$\sum pX$	= 0.88

$E(X) = \sum pX = 0.88$

You will not expect to run into 0.88 cars, because the number of cars will always be a whole number. It is only a theoretical concept and is the average in the long-run.

LESSON ROUND UP

- Probability refers to chance, i.e., chance of happening of some event. Probability theory has a central place in the theory and applications of statistics, since we are analyzing and interpreting data that involve an element of chance or uncertainty. The reliability of our conclusions is supported by accompanying probability statements.
- Sample Space: The set of all possible outcomes of an experiment is called the sample space of the experiment and is denoted by S. Each outcome is called an element or a sample point of the sample space. Sample space is also called universal set or event space or possibility set.
- The probability of the occurrence of any event always lies between 0 and 1 and these are the two limits of probability
- A probability distribution is a table or an equation that links each outcome of a statistical experiment with its probability of occurrence.
- Results on Probability:
 - $P(S) = 1$, S = complete sample space
 - $0 \leq P(E) \leq 1$
 - $P(j) = 0$
 - For any events A and B we have : $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
 - If A denotes (not-A), then $P(A) = 1 - P(A)$.

GLOSSARY

Experiment	An operation which can produce some well-defined outcomes is called an experiment.
Random Experiment	An experiment in which all possible outcomes are known and the exact output cannot be predicted in advance, is called a random experiment.

Sample Space	When we perform an experiment, then the set S of all possible outcomes is called the sample space.
Event	Any subset of a sample space is called an event (simple or compound).
Discrete Random Variables	A discrete random variable is one which may take on only a countable number of distinct values such as 0, 1, 2, 3, 4, ... Discrete random variables are usually (but not necessarily) counts. If a random variable can take only a finite number of distinct values, then it must be discrete.
Continuous Random Variables	A continuous random variable is one which takes an infinite number of possible values. Continuous random variables are usually measurements.

SELF-TEST QUESTIONS

- Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5? *(Answer: 9/20)*
- A bag contains 2 red, 3 green and 2 blue balls. Two balls are drawn at random. What is the probability that none of the balls drawn is blue? *(Answer: 10/21)*
- In a box, there are 8 red, 7 blue and 6 green balls. One ball is picked up randomly. What is the probability that it is neither red nor green? *(Answer: 1/3)*
- What is the probability of getting a sum 9 from two throws of a dice? *(Answer: 1/9)*
- Three unbiased coins are tossed. What is the probability of getting at most two heads? *(Answer: 7/8)*
- In a lottery, there are 10 prizes and 25 blanks. A lottery is drawn at random. What is the probability of getting a prize? *(Answer: 2/7)*
- A card is drawn from a pack of 52 cards. The probability of getting a queen of club or a king of heart is: *(Answer: 1/26)*
- A bag contains 4 white, 5 red and 6 blue balls. Three balls are drawn at random from the bag. The probability that all of them are red, is: *(Answer: 2/91)*
- One card is drawn at random from a pack of 52 cards. What is the probability that the card drawn is a face card (Jack, Queen and King only)? *(Answer: 3/13)*
- A bag contains 6 black and 8 white balls. One ball is drawn at random. What is the probability that the ball drawn is white? *(Answer: 4/7)*

Lesson 13

Time Series and Index Numbers Analysis

LESSON OUTLINE

- Time Series
- Components of a Time Series
- Measurements of Trend
- Fitting of a Linear Trend
- Forecasting
- Index Numbers
- Types of Index Numbers
- Precautions in Construction of Index Numbers
- Methods of Construction of Price Index Numbers
- Price Index Numbers
- Tests of Adequacy of Index Numbers Formulae
- Lesson Round Up
- Glossary
- Self-Test Questions

LEARNING OBJECTIVES

Due to rapidly changing economic environment and uncertain future, the need to understand the tools of time series and index numbers has increased manifolds to businessmen, policy makers and social scientists. These tools are used to forecast the values of observations taken over time and interpret the result in the form which facilitates effective decision making. These tools also help in forecasting of the future pattern and trends of variables which are used in all branches of economic activities. Companies forecast sales trend in order to determine appropriate production levels. The government forecasts unemployment trends and uses these forecasts in formulating its macroeconomic policies. In this lesson some of the basic methods of time series and index numbers are explained to provide students with the understanding of the subject matter which shall have a significant impact in day to day life as well as will enrich them professionally.

The most reliable way to forecast the future is to try to understand the present.

John Naisbitt

TIME SERIES

Introduction and Meaning

Time series is a series of observations observed or recorded at successive intervals of time. The successive intervals are usually equal time intervals, e.g., it can be a year, quarter, month, etc. some of the examples of time series data includes data relating to national incomes, industrial production (yearly data), population figures (10 years data), etc.

Definitions of Time Series

Time series is a set of numeric observation of the dependent variables, measured at specific points of time in chronological order, usually at equal intervals in order to determine the relationship of time to such variables.

Some of the important definitions of time series given by different experts are as under:

“A time series may be defined as a sequence of repeated measurement of a variables made periodically through time”.

Cecil H. Mayers

“A time series may be defined as a collection of readings belonging to different time period of same economic variable or composite of variables”.

Yu-lun Chao

“A time series consist of statistical data which are collected, recorded over successive increments”.

Patterson

“A time series is a set of observations taken at specified times, usually at ‘equally intervals’. Mathematically, a time series is defined by the values Y_1, \dots, Y_2, \dots of a variable Y (temperature, closing price of share etc.) at time t_1, t_2, \dots . Thus, Y is a function of t symbolised by $Y = f(t)$ ”.

Spiegel

Thus, it is clear from above definitions that time series consists of data which are arranged chronologically. It establishes a relationship between two variables in which one of the variable is independent variable i.e. the time and other variable Y is the dependent variable whose value changes with regards to time variable. e.g. total agricultural production in different years.

Objective of Time Series Analysis

By the analysis of time series, we mean the decomposition of Y_t in to various components that affect this value in a given period.

There are two main objectives of analysis of any time series:

- to study of past behaviour of data
- to forecast for future.

Significance of Time Series Analysis

Time series is an important statistical technique which is widely used by business executives, financial analysts, economists, scientists, sociologists, research workers, policy administrators in the government etc. because of following reasons :

- It helps to understand the past behaviour of data and enables the users to forecast the future behaviour.
- It enables the users to compare the actual performance with the expected performance and analyse the different causes of variation.
- It is helpful in planning the future operations.
- It enables us to evaluate the current accomplishments or performances and ascertain the causes in case of poor performance.

It is very useful in planning, state administration, businesses, social and other areas of human knowledge.

Components of a Time Series

An observed value of a time series Y_t is the net effect of many types of influences such as changes in population, techniques of production, seasons, level of business activity, tastes and habits, incidence of fire, floods, etc. It may be noted that different types of time series variables may be affected by different types of factors, e.g., factors affecting agricultural output may be entirely different from the factors affecting industrial output.

However, for the purpose of time series analysis, various factors can be classified into the following three general categories applicable to any time series variable.

- **Secular Trend or Simple Trend**
- **Periodic or Oscillatory Variations**
 - Seasons Variations
 - Cyclical Variations
- **Random or Irregular Variations**

- (i) *Secular Trend*: Secular trend is the tendency of data to increase or decrease or stagnate over a long period of time. Most of the business or economic time series would reveal a tendency to increase or decrease over a long period of time. The long-term changes are often caused by factors like population change, technology change, changes in government policies, changes in consumers' tastes and habits etc.

Trend Analysis fulfils the following purposes:

- Behaviour pattern of the variables can be visualised;
- The impact of residential forces of change, seasonal, cyclical and irregular can be ascertained;
- Forecasting;
- To make comparative analysis of two or more series over a period of time.

Some of the important examples of secular trend include long term changes in Agricultural Production and productivity, population growth, weather pattern, etc.

- (ii) *Periodic Variations*: These variations are of regular nature and repeat themselves after a fixed interval of time. This time interval is known as period of these variations.
- If the period of these variations is less than one year, then these are known as Seasonal Variations. For example, sale of sweets during Diwali, sale of woollen garments in the month of November, etc. occur every year because of seasonal effects.
 - If the period of variations is more than one year, then the variations are termed as cyclical variations. These variations, like boom, depression, recession and recovery are revealed by most of the business and economic time series.

- A time series data, where the interval between successive observations is less than one year, e.g. monthly, quarterly, etc., may have the effects of both the seasonal and cyclical variations. However, the seasonal variations are absent if the time interval between successive observations is greater than or equal to one year.
- (iii) *Random or Irregular Variations*: As the name suggests, these variations do not reveal any regular pattern of movements. These variations are caused by random factors such as strikes, floods, fire, war, famines, etc.

Analysis of Time Series

As mentioned earlier, the purpose of analysis of a time series is to decompose Y_t into various components. However, before doing this, we have to make certain assumptions regarding the manner in which these components have combined themselves to give the value Y_t .

(a) Additive Model

This model assumes that Y_t is the sum of four components, i.e.,

$Y_t = T_t + C_t + S_t + R_t$ where T_t , C_t , S_t and R_t are the values of trend, cyclical, seasonal and random components respectively at point of time t .

(b) Multiplicative Model

Here we assume that $Y_t = T_t \times C_t \times S_t \times R_t$

If various components are believed to be independent, then additive model is appropriate.

Measurements of Trend

The following methods are used for the measurement of trend:

- Graphic Methods
- Method of Semi-Averages
- Method of Moving Averages
- Method of Least Squares

- (i) *Graphic Methods*: Under this method, original data is plotted on a graph by taking time on X-axis and output on Y_t on Y-axis. A smooth freehand line or curve is drawn through the plotted points which represent the trend of given data. The trend line is drawn in such a way that the trend line must pass midway through the each peak and truly represent the time series. The main drawback of the method is that it is a subjective method.
- (ii) *Method of Semi-Averages*: Under this method, the given time series data are divided into two equal segments and the arithmetic mean of the values of each segment is computed. These are plotted as two points and joined with a straight line to get trend. The main limitation of the method is that we can get only linear trend. (See Illustration)

Illustration 13.1

Fit a trend by using the method of semi-averages to the following data.

Years	1990	1991	1992	1993	1994	1995	1996
Output (tonnes)	45	50	64	50	60	65	67

Solution:

Since the number of observations is 7, the two groups are obtained by leaving the middle observation, i.e., the observation corresponding to 1993

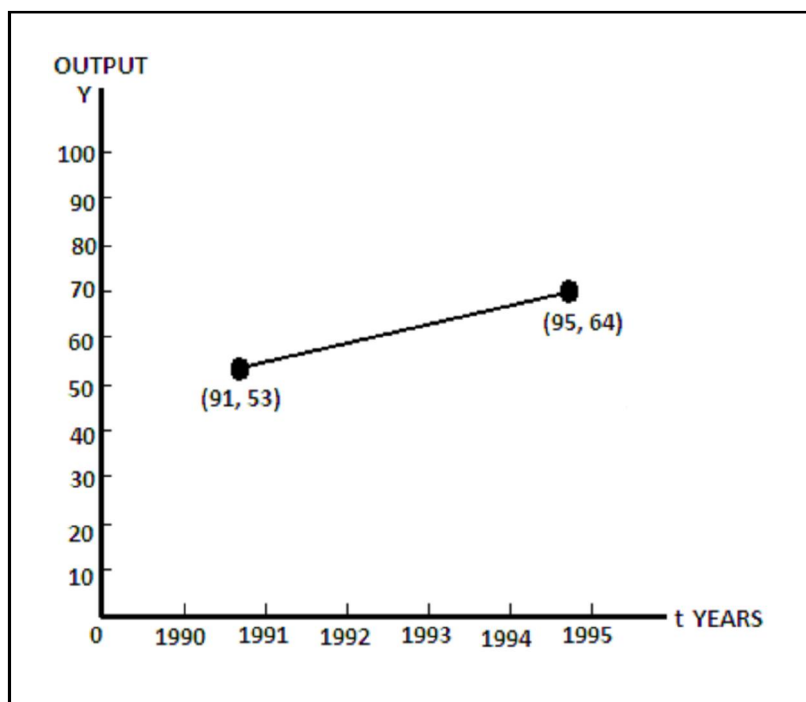
Mean of the 1st group of $\bar{Y}_t = \frac{45 + 50 + 64}{3} = \frac{159}{3} = 53$

Also, $\bar{t}^1 = \frac{1990 + 1991 + 1992}{3} = 1991$

Similarly, $\bar{Y}_2 = \frac{60 + 65 + 67}{3} = \frac{192}{3} = 64$

and $\bar{t}_2 = 1995$

The trend is shown in the following figure:



(iii) *Method of Moving Average:* This method is based upon the principle that the total effect of periodic variations at different points of time in its cycle get completely neutralised, i.e. $\sum S_t = 0$ in one year and $\sum OC_t = 0$ in the period of cyclical variations.

In the method of moving average, successive arithmetic averages are computed from overlapping groups of successive values of a time series. If the time series values are $Y_1, Y_2, Y_3, Y_4, Y_5, \dots$, then the successive three year moving averages are

$$\frac{Y_1 + Y_2 + Y_3}{3}, \frac{Y_2 + Y_3 + Y_4}{3} \text{ etc.}$$

It can be shown that if the trend is approximately linear, then moving averages with period equal to the period of cyclical or seasonal variations would eliminate these variations and reduce the effect of random variations.

Note that an annual time series consists of only trend, cyclical variations and random component. Thus, a moving average with a suitable period will eliminate cyclical variations and reduce the effect of random variations. Thus, the resulting figures can be regarded as trend values. (See Illustration 13.2)

Illustration 13.2

Determine the trend for the following data by taking (i) 3-yearly and (ii) 4-yearly moving averages.

YEAR	SALES	YEAR	SALES
1983	440	1988	405
1984	318	1989	515
1985	392	1990	723
1986	402	1991	432
1987	403	1992	417

Solution:

3-Year Moving Average

Year	Sales	3-Year Moving Totals	3-Year Moving Average
1983	440	1150	383.33
1984	318		
1985	392	1112	370.67
1986	402	1197	399.00
1987	403	1210	403.33
1988	405	1323	441.00
1989	515	1643	547.67
1990	723	1670	556.67
1991	432	1572	524.00
1992	417		

4-Year Moving Average

Year	Sales	4-Year Moving Totals	Centred Totals	4-Year Moving Average
1983	440	→ 1552	→ 3067	383.38
1984	318			
1985	392	→ 1515		
1986	402	→ 1602	→ 3117	389.63
1987	403	→ 1725	→ 3327	415.88
1988	405	→ 2046	→ 3771	471.38

1989	515	→2075	→4121	515.13
1990	723	→2087	→4162	520.25
1991	432			
1992	417			

(iv) **Method of Least Squares:** This method is used to fit a mathematical trend. A mathematical trend can be linear, exponential, parabolic, etc.

(a) Linear Trend

The general form of a linear trend is $Y = a + bt$, where a and b are constants.

The constant is interpreted as the trend value in the year of origin (i.e. when $t = 0$) and b is the absolute rate of change of Y . For example if $b = 5$, and t denotes year, then the successive values of Y change by 5 units every year.

(b) Exponential Trend

As opposed to Linear trend, the values of Y in this case change by a constant percentage. For example, if the successive values of Y change by 5%, we can write $Y_t = a(1.05)^t$. In general, we write an exponential trend by $Y_t = a.b^t$

(c) Parabolic Trend

When the absolute changes in Y values in successive years are not constant, then we can use a non-linear trend. A parabolic trend is a popular linear trend written as $Y_t = a + bt + ct^2$.

Fitting of a Linear Trend

The fitting of a linear trend $Y_t = a + bt$ to the given data (t, Y_t) , for n periods, implies the determination of the values of two constants a and b . By using the method of least squares, it can be shown that these values are obtained by solving the following equations simultaneously.

$$\sum Y = na + b\sum t$$

$$\sum tY = a\sum t + b\sum t^2$$

To simplify computations, we can write $X = t - A$ such that $\sum X = 0$. Thus, the above equations become

$$\sum Y = na \text{ or } a = \frac{\sum Y}{n}$$

$$\sum XY = b\sum t^2 \text{ or } b = \frac{\sum XY}{\sum t^2}$$

Illustration 13.3 (when n is odd)

Fit a trend line to the following data by the method of least squares. Calculate the trend values and predict the value for the year 2008.

Years	1995	1996	1997	1998	1999
Output (tonnes)	82	94	96	107	100

Solution:

Year (t)	Production (Y)	X=t-1997	XY	X ²	Trend Values (Y _t)
1995	82	-2	-164	4	86.0
1996	94	-1	-94	1	90.9
1997	96	0	0	0	95.8
1998	107	1	107	1	100.7
1999	100	2	200	4	105.6
Total	ΣY= 479	ΣX= 0	ΣXY= 49	ΣX²= 10	

Trend Equation; $Y_t = a + bX$

For calculating the values of a and b, we may use the following two normal equations —

$$\Sigma Y = na + b\Sigma X \quad (i)$$

$$\Sigma XY = a\Sigma X + b\Sigma X^2 \quad (ii)$$

substituting the available information in above two equations, we may get

$$479 = 5a,$$

$$49 = 10b \text{ or}$$

$$a = \frac{479}{5} = 95.8$$

$$b = \frac{49}{10} = 4.9$$

$Y_t = 95.8 + 4.9 X$ is the trend equation

$Y_t = 95.8$ (for 1997 when $X = 0$)

To obtain the trend values, we substitute the corresponding values of X in the above equation

To predict the value for 2008, we substitute $X = 11$, in the above equation

Thus, the trend for the 2000 is $Y_t = 149.7$ tons

Illustration 13.4 (when n is even)

Obtain a straight line trend of sales by using the method of least squares from the following data. Predict the level of sales for 1992.

Years	1985	1986	1987	1988	1989	1990
Sales(Rs'000)	40	42	50	46	54	58

Solution:

Filling of Straight line Trend by Using Least Square Method

Year (t)	Sales (Y)	X=t-1987.5	XY	X ²	Trend Values (y _t)
1985	40	-5	-200	25	39.63
1986	42	-3	-126	9	43.11

1987	50	-1	-50	1	46.59
1988	46	1	46	1	50.07
1989	54	3	162	9	53.55
1990	58	5	290	25	57.03
Total	ΣY= 290	ΣX= 0	ΣXY= 122	ΣX²= 70	

Trend Equation, $Y_t = a + bX$

Two normal equations

$$\Sigma Y = na + b\Sigma X \quad (i)$$

$$\Sigma XY = a\Sigma X + b\Sigma X^2 \quad (ii)$$

Substituting the available information in above two equations, we may get

$$290 = 6a,$$

$$122 = 70X^2$$

$$\text{or } a = \frac{290}{6} = 48.33$$

$$b = \frac{122}{70} = 1.74$$

∴ $Y_t = 48.33 + 1.74X$ is the trend equation with year of origin at 1st January 1988, and the unit of $X = 6$ months.

For sales of 1992, we put $X = 9$ in the above equation.

$$Y_t = 48.33 + 1.74 \times 9 = \text{Rs.}63.99$$

Conversion of an annual trend equation into quarterly (or monthly) equation

If $Y_t = a + bX$ denotes an annual trend equation,

then $Y_t = \frac{a}{4} + \frac{b}{4} X$ denotes a quarterly average equation and

$Y_t = \frac{a}{4} + \frac{b}{16} X$ (or $Y_t = \frac{a}{4} + \frac{b}{8} X$) denotes a quarterly equation when units of X is one (or half) year.

Similarly, $Y_t = \frac{a}{12} + \frac{b}{144} X$ (or $Y_t = \frac{a}{12} + \frac{b}{72} X$) denotes a monthly equation.

(The justification of dividing a and b by 12 and 144 is that data are sum of 12 months hence a and b must be divided by 12 and b is again divided by 12 so that the time units(X 's) will be in month as well i.e. 'b' would give monthly increments.)

FORECASTING

MEANING

Forecasting is a prediction or estimation of future values of a variable like sales, demand, price, profits, cost, investment, output, inventory, exports, imports, etc. for a firm, industry or the economy as a whole. The basic motive of forecasting is to assist the management to devise plan of action in respect of diverse fields viz. production, purchase, sales, inventory control, personnel, finance, etc.

It must be noted that the purpose of forecasting is not to provide future data with perfect precision. The purpose is just to bring out range of possibilities regarding future under a given set of assumptions. Such forecasts do not eliminate but only help to reduce the degree of risk and the uncertainties of future.

Methods of Forecasting

Broadly, there are two approaches to forecasting:

1. To forecast on the basis of collection of data or obtaining opinion of the experts. These methods are known as opinion polling or survey methods.
2. To forecast on the basis of past data. These methods are known as trend projection or extrapolation methods.

Opinion Polling or Survey Methods

These methods are often used for forecasting demand or sales of a product. Various methods under this category are discussed below:

1. **Complete Enumeration Method:** Under this method, a survey of all the individuals is undertaken to obtain the data. The forecasts are then made on the basis of collected information.

The main advantage of the method is that it is free from the bias of the investigator. This method, however, is cumbersome and costly particularly when the population is very large.

2. **Sample Survey Method:** A sample survey method is often undertaken when the population is very large. Here, information is collected by contacting a fraction or a sample of individuals. The forecasting is then done by applying sampling techniques to the collected information.

There are several variants of the sample survey method. Some of these are discussed below:

- **Test Marketing:** Test Marketing is often useful for forecasting the sales of a new product or the potential of the existing product in new geographical areas. In this method, we select a test area which is supposed to be the representative of the whole market. The product is introduced in test market area. If it is successful, the forecast is made regarding its success in the total market. Although this method has the advantage of having real life experience, it is very costly.
- **Experts' Opinion Poll:** In this method, the opinions of the experts are obtained. The simple or weighted average of these opinions can be regarded as the forecast value. The results of this method are highly of subjective nature.
- **Delphi Technique:** In this method, the experts are asked to give their opinions by post. These opinions are supplied to all the experts and their revised opinions, based on feed back, are obtained. This process is repeated unless divergent views of the experts are narrowed down and the final range of outcomes can be regarded as probabilistic forecasts.

Trend Projection Methods

These methods are based upon the analysis of past time series data. The basic assumption of these methods is that future events are a continuation of the past. These methods are cheaper than surveys because the necessary data is available from the past records as time series data.

1. **Fitting of Trend (Time Series Data):** We can fit a mathematical trend to the given data and use this to make forecasts. This method we have already discussed in the analysis of time series. The results of these methods are fairly accurate so long as the trend has a persistent tendency to move in the same direction. The analysis is more reliable for short-term forecasts.
2. **Smoothing Method:** Alternatively, we can determine trend by smoothing out the fluctuations due to other components. Two main smoothing methods are: (i) Method of Moving Average, (ii) Method of Exponential Smoothing.

- 3. Barometric Technique or Lead or Lag Technique:** This technique is based upon the idea that it is possible to predict future from certain currently occurring or already occurred events. To apply this technique, we find a time series variable X, known leading indicator, which has a close association with the forecast variable Y. Using statistical techniques, we can estimate a relationship (Linear, Quadratic, Exponential) between X and Y by considering various time lags. A relation with maximum value of coefficient of determination can be used for prediction.

REVIEW QUESTIONS



1. A time series consists of data arranged _____
2. The additive model of a time series is expressed as _____
3. Cyclical variations are caused by _____
(a) Waves (b) Strikes (c) floods (d) None of these
4. When we shift the trend, origin, the value of b remains same (True or False.)

Answers: 1. Chronologically 2. $Y=T+S+C+I$ 3. (d) 4. True

INDEX NUMBERS

Introduction and Meaning

An index number is a statistical measure used to compare the average level of magnitude of a group of distinct, but related, items in two or more situations. For example, the average changes in prices of a group of items of food, called price index. Similarly, we can find quantity index, value index etc.

An important feature of the index number is that it is an average change of various magnitudes expressed in different units. It should also be noted that index numbers are specialised type of averages that are used to measure a characteristics that is not capable of being measured directly. For example, it is not possible to measure the change in price level or the business activity level in a direct way.

Index numbers are often known as the barometers of economic activity as they help to get an idea of the present day situation with regard to changes in production, consumption, exports and imports, national income, business level, cost of living etc.

Definitions of Index Numbers

Some of the important definitions of index numbers are given as under:

“An index number is a special type of average that provides a measurement of relative changes from time to time or from place to place.” **Wessell, Wilett and Simone**

“Index number shows by its variations the changes in a magnitude which is not susceptible either of accurate measurement in itself or of direct valuation in practice.” **Edgeworth**

“An index number is a device for comparing the general level of magnitude of a group of distinct, but related, variables in two or more situations.” **Karmal and Pollasek**

“In its simplest form, an index number is the ratio of two index numbers expressed as a percent. An index number is a statistical measure — a measure designed to show changes in one variable or in group of related variable over time or with respect of geographic location or other characteristics.” **Patterson**

“Index numbers are devices for measuring differences in magnitude of a group of related variables.”

Croxton and Crowden

“An index number is a statistical measure designed to show changes in variable or a group of related variables with respect of time, geographical locations or other characteristic.”

Spiegel

Thus, it is apparent from above definitions that an index number is a statistical device which measures the extent to which a group of related variable changes over a period of time. Index number in fact relates a variable or group of variables in a given period to the same group of variables in some other period.

Some of the important characteristics of index numbers are:

- Index numbers are the specialised averages.
- Index numbers record the net changes in a group of related variables over a period of time.
- Index numbers are expressed in percentages.
- Index numbers have universal applications.
- Index numbers provide bases of comparison over different period.

Significance or Uses of Index Numbers

Index numbers are the most powerful tool in the hands of management executives, government officials and individuals to analyse the business and economic situations of a country. Some of the important uses or significance of index numbers to its users are listed as under:

- Index Numbers are used to measure level of economic and business activities in a country.
- They are helpful in planning and formulation of various policies.
- They are helpful to ascertain changes in standard of living.
- Index Numbers help social scientists to study trends and tendencies of important social, economic and business variables over a period of time i.e., population, agricultural production, import and exports, crime etc
- Index Numbers are also useful in deflation. In other words, they are used for adjusting the original data for price changes.
- They also help to measure purchasing power of money.

Types of Index Numbers

Broadly, index numbers are classified in the following categories:

1. **Price Index Number:** Price index numbers are most frequently used by different experts such as statistician, businessman, policy makers or researchers. These index numbers measure the general changes in the price level from one period to another. Index numbers are further divided into the following two categories.
 - **Wholesale Price Index Numbers:** It reflects the changes in general price level of the country such as wholesale price index number prepared by government.
 - **Retail Price Index Numbers:** These index numbers show general changes in retail prices of various commodities such as consumption goods, stock and shares, bank deposits, consumer price index etc.
2. **Quantity Index Numbers:** These index numbers study the changes in the volume of goods produced, consumed, distributed like the indices of industrial production, agricultural production, exports and imports

etc. over a period. These types of indices are useful for measuring the changes in level of physical output in an economy during some period, compared with other period.

- 3. Value Index Numbers:** It covers all those index numbers which measures the changes in total money worth during some period compared with other period.

Precautions in Construction of Index Numbers

Index numbers are very powerful and effective tools but its computation and construction require utmost care. In construction of index numbers, the following points need special attention:

- 1. Purpose of Index Numbers:** It is essential to be very clear about the purpose for which the index number is used. Every index number has its own particular uses. If it is used for measuring consumers' price, there is no need of including wholesale prices. Similarly, if it is employed for studying cost of living, there is no need of including the price of capital goods.
- 2. Selection of Base Period:** Base period is the period against which comparisons are made. One has to be very careful in selecting a base period. It may be a year, month or a day. Before selecting a base period the following points should be considered:
 - The base period should be a normal one i.e., it should not get affected by extra-ordinary events like war, earthquakes, famines, booms, etc.
 - It should be relatively current i.e., it should not be too distant in the past because we are interested in the changes relating to the present period only.
 - The base may be fixed, chain or average depending upon the purpose of constructing the index.
- 3. Selection of Number of Items:** This depends on the purpose of index. For example, in a general price index a larger number of commodities may be included; on the other hand, in a specific purpose index relatively a small number of items would be included.
- 4. Choice of an Average:** Arithmetic mean and geometric mean are used in its construction. Averages play a vital role in arriving at a single index number summarising a large volume of information. But theoretically, the geometric mean is preferred because it is less susceptible to variation; it gives equal weightage to equal ratio of change.
- 5. Selection of Weights:** 'Weights' imply the relative importance of the different variables. Due consideration should be given to the relative importance of each variable. It is essential to adopt a suitable method of weighting to avoid arbitrary and haphazard weights. For instance, in the computation of cost of living index, wheat should be given more importance compared to sugar.

Methods of Construction of Price Index Numbers

To illustrate the construction of an index number, we consider the following example:

Item	1995 Prices (₹)	1998 Prices (₹)
Wheat	800/Quintal	1000/Quintal
Rice	15/Kg	19/Kg
Milk	12/Litre	15/Litre
Eggs	10/Dozen	12/Dozen
Sugar	14/Kg	18/Kg

To find the average change in price level for the group in 1998 as compared with 1995:

Here, 1998 is termed as the current year and 1995 is the base year.

Current Year: It is the year for which we want to construct the index number.

Base Year: It is the year from which we want to compare the current year magnitudes of various items.

In the above table, the comparison of price of an item, say wheat, in 1998 with its price in 1995 can be done in following two ways:

- By taking the difference of prices in two years i.e. $1000 - 800 = 200$, one can say that the price of wheat has gone up by ₹200 per quintal in 1998 as compared with its price in 1995.
- By taking the ratio of the two prices i.e. $1000/800 = 1.25$, one can say that if the price of wheat in 1995 is taken to be equal to 1, then it has become 1.25 in 1998. A more convenient way of expressing this change as a percentage i.e. $1000 \times 100/800 = 125$, which is known as Price Relative of the item. Price relative of wheat equal to 125 shows that the price of wheat in 1998 is 125 when its price in 1995 is taken as 100. Further, the change in price of wheat in current year as compared with base year is $125 - 100 = 25\%$.

Out of the above two methods, we shall adopt the second method of comparison because it is independent of the units in which prices are quoted. Further, it is easier to grasp the percentage change rather than absolute change.

To construct an index number, we have to obtain average price change for the group in 1998. This can be done in following two ways :

- By taking suitable average of the price relative of different items. The methods of index number construction based on this procedure are termed as Average of Price Relatives Methods.
- By taking ratio of averages of the prices of different items in current and base years. These methods are known as aggregative methods. These methods may further be classified into simple averages and weighted averages.
- In addition to the above, a particular method would depend upon the type of average used. Although, geometric mean is more suitable for averaging ratios, arithmetic mean is often preferred because of its simplicity with regard to computations and interpretation.

A brief details of various types of Index Numbers are discussed as under:

Price Index Numbers

Let $P_{01}, P_{02}, \dots, P_{0n}$ be the prices of items in base year and be $P_{11}, P_{12}, \dots, P_{1n}$ be the respective prices in current year.

1. Simple Average of Price Relatives

- When we take arithmetic mean of prices relatives, the index number formula for current year, denoted by 1, as compared with base year, denoted by 0, is given by

$$P_{01} = \frac{\sum P_i}{n}; \quad \text{where } P_i = \frac{P_{1i}}{P_{0i}} \times 100$$

- When we take geometric mean of price relatives

$$P_{01} = (P_1 \times P_2 \times P_n)^{1/n}$$

$$= \text{Antilog} \left[\frac{\sum \log P_i}{n} \right]$$

Illustration 13.5

From the following data, construct index number by simple average of price relatives using (a) arithmetic mean and (b) geometric mean.

Item	1995 Prices (₹)	1998 Prices (₹)
Wheat	800/Quintal	1000/Quintal
Rice	15/Kg	19/Kg
Milk	12/Litre	15/Litre
Eggs	10/Dozen	12/Dozen
Sugar	14/Kg	18/Kg

Solution:

Calculation of Price Index Number

Item	P ₁	P ₂	P (Price Relative)	log P
Wheat	800	1000	1000×100/800 = 125	2.0969
Rice	15	19	19×100/15 = 126.67	2.1027
Milk	12	15	15×100/12 = 125	2.0969
Eggs	10	12	12×100/10 = 120	2.0792
Sugar	14	18	18×100/14 = 128.57	2.1091
Total			ΣP = 625.24	10.4848

– Using Simple Arithmetic Mean, we may get

$$P_{01} = 625.24 / 5 = 125.05$$

– Using Simple Geometric Mean, we may get

$$P_{01} = \text{Antilog} (10.4848/5) = \text{Antilog} (2.097) = 125.02$$

2. Weighted average of Price Relatives

Let W_i be the weight assigned to the i^{th} item, then

$$P_{01} = \frac{\sum P_i W_i}{\sum W_i} \text{ (using arithmetic mean) and}$$

$$P_{01} = \text{Antilog} \left[\frac{\sum W_i \log P_i}{\sum W_i} \right] \text{ (using geometric mean)}$$

Nature of Weights

While taking weighted average of price relatives, values are often taken as weights. These weights can be values of base year quantities valued at base year prices i.e. P_0Q_0 or current year quantities values at current year prices i.e. P_1Q_1 . (See illustration 13.5)

Illustration 13.6

Calculate the price index number of 1992 with 1990 as base from the following data by using (i) Weighted Arithmetic Mean and (ii) Weighted Geometric Mean of price relatives.

Item	Weights	Prices	
		1990	1992
A	22	250	620
B	48	330	440
C	17	625	1275
D	13	65	90

Solution :

Calculation of Price Index Number

Item	P ₀ (₹)	P ₁ (₹)	Price Relatives (P)(₹) (P ₁ /P ₀)	Weights (W)	PW	Log P	W log P
A	250	620	248.00	22	5456	2.3945	52.6779
B	330	440	133.33	48	6400	2.1249	101.9971
C	625	1275	204.00	17	3468	2.3096	39.2637
D	65	90	138.46	13	1800	2.1413	27.8373
Total				100	17124		221.7760

–Weighted Arithmetic Mean of Price Relatives

$$P_{01} = 17124 / 100 = 171.24 \text{ (using A.M.)}$$

– Weighted Geometric Mean of Price Relatives

$$P_{01} = \text{Antilog} (221.776/100) = \text{Antilog} (2.21776) = 165.1 \text{ (using G.M.)}$$

3. Simple Aggregative Method

Here, we take the ratio of the sample arithmetic means of the prices in current year to base year.

$$P_{01} = \frac{\sum P_{i0}/N}{\sum P_{0i}/N} \times 100 = \frac{\sum P_1}{\sum P_{0i}} \times 100$$

The following illustration helps us to understand the above discussed method.

Illustration 13.7

Calculate the price index for 1995 and 1996 using 1990 as base from the following data by using the simple aggregative method.

ITEM	PRICES (₹ per unit)		
	1990	1995	1996
A	8	9	7
B	10	13	10
C	11	15	9
D	50	47	36
E	150	200	180

Solution:

Calculation of Price Index Number

ITEM	PRICE (₹ per unit)		
	1990	1995	1996
A	8	9	7
B	10	13	10
C	11	15	9
D	50	47	36
E	150	200	180
Total	229	284	242

$$P_{1990, 1995} = 284 \times 100/229 = 133.3$$

$$P_{1990, 1996} = 242 \times 100/229 = 120.0$$

4. Weighted Aggregative Method

Here, the index number is defined as the ratio of weighted arithmetic mean of current year prices to base year prices.

$$P_{01} = \frac{\frac{\sum P_{1i} W_i}{\sum W_i}}{\frac{\sum P_{0i} W_i}{\sum W_i}} \times 100 = \frac{\sum P_{1i} W_i}{\sum P_{0i} W_i} \times 100$$

Omitting the subscript i, we can also write;

$$P_{01} = \frac{\sum P_1 W}{\sum P_0 W} \times 100$$

Nature of Weights

Under weighted aggregative price index numbers, quantities are often taken as weights. These quantities can be the quantities purchased in base year or in current year or an average of base year and current year quantities or any other quantity. Depending upon the choice of weights, some of the popular formulae for weighted aggregative index numbers can be written as follows:

1. Laspeyres Price Index

This index uses base year quantities as weights.

$$P_{01}^L = (\sum P_1 Q_0 / \sum P_0 Q_0) \times 100$$

2. Paasche Price Index

This index uses current year quantities as weights.

$$P_{01}^P = (\sum P_1 Q_1 / \sum P_0 Q_1) \times 100$$

3. Fisher Ideal Index

This index is basically Geometric Mean of Laspeyres and Paasche Index Numbers

$$P_{01}^F = \sqrt{P_{01}^L \times P_{01}^P}$$

Out of the various formulae discussed so far, the Laspeyres and Paasche formulae are generally preferred for the construction of index numbers. The main reason for this is that the values of these index numbers have simple interpretation. For example, the ratio, $\Sigma P_1 Q_0 / \Sigma P_0 Q_0$ in Laspeyres formulae, gives the change in the cost of purchasing the bundle Q_0 . Similarly, the ratio $\Sigma P_1 Q_1 / \Sigma P_0 Q_1$ in Paasche formula reflect the change in cost of purchasing the bundle Q_1 . However, Out of these two formulas, the Laspeyres index is preferred because weights do not change over different periods and hence the index numbers of various periods remain comparable. Because of fixed weights, it is easier to compute than Paasche Index. The main disadvantage of the Laspeyres index is that with passage of time, the relative importance of various items may change and, therefore, base year weights may become outdated.

The following illustration provides the better understanding of all the three methods, i.e. Laspeyres, Paasche and Fisher Price Index Numbers.

Illustration 13.8

From the following data, construct the Laspeyres, Paasche and Fisher indices of prices.

ITEM	Base Year		Current Year	
	P_0 (₹)	Q_0	P_1 (₹)	Q_1
A	4	20	10	15
B	8	4	16	5
C	2	10	4	12
D	10	5	20	6

Solution:

Calculation of Price Index Numbers

ITEM	Base Year		Current Year		$P_0 Q_0$	$P_1 Q_0$	$P_0 Q_1$	$P_1 Q_1$
	P_0 (₹)	Q_0	P_1 (₹)	Q_1				
A	4	20	10	15	80	200	60	150
B	8	4	16	5	32	64	40	80
C	2	10	4	12	20	40	24	48
D	10	5	20	6	50	100	60	120
Total					182	404	184	398

Laspeyres Price Index Number

$$P_{01}^L = \Sigma P_1 Q_0 / \Sigma P_0 Q_0 = 404/182 \times 100 = 221.98$$

Paasche Price Index Number

$$P_{01}^P = \Sigma P_1 Q_1 / \Sigma P_0 Q_1 = 398/184 \times 100 = 216.30$$

Fisher Price Index Number

$$P_{01}^F = \sqrt{\Sigma P_1 Q_0 / \Sigma P_0 Q_0 \times \Sigma P_1 Q_1 / \Sigma P_0 Q_1} = (\sqrt{221.98 \times 216.3}) \times 100 = 219.12$$

REVIEW QUESTIONS



1. The base period should be _____ period
2. The _____ is satisfied when $P_{ab} \times P_{bc} \times P_{ca} = 1$
3. Las beyres price index is based on _____ quantities.
4. The circular test is an extension of _____ test.
5. Weighted indices ought to be preferred over unweighted indices. (True or False)

Answers: 1. Normal 2. Circular Test 3. Base Year 4. Time Reversal 5. True.

Value Index Numbers

A value index numbers measures the change of value in current year as compared with base year.

Value Index number $V_{01} = \frac{\sum p_1 q_1}{\sum p_0 q_0} \times 100$:

Tests of Adequacy of Index Numbers Formulae

A number of formulae have been developed for the construction of index numbers. However, each one of them suffers from one or the other type of drawbacks. It was, therefore, suggested that a satisfactory index number formula should satisfy certain mathematical criteria. These criteria are known as tests of adequacy of index numbers.

1. **Unit Test:** This test requires that an index number formula should be independent of the units measurement of the prices and quantities. This test is satisfied by all the index number except simple aggregative formulae.
2. **Time Reversal Test:** This test requires that the formulae for calculating an index number should give consistent results in both the directions, i.e. forward and backward. Or in other words, the index of period 1 with period 0 base should be reciprocal of the index of period 0 with period 1 as base i.e. $P_{01} = 1/P_{10}$ or $P_{01} \times P_{10} = 1$. This test is satisfied by the Fisher Ideal Index only.

We can write,

$$P_{01}^{F1} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}}$$

$$P_{10} = \sqrt{\frac{\sum p_0 q_1}{\sum p_1 q_1} \times \frac{\sum p_0 q_0}{\sum p_1 q_0}}$$

$$\therefore P_{01}^{F1} \times P_{10}^{F1} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1} \times \frac{\sum p_0 q_1}{\sum p_1 q_1} \times \frac{\sum p_0 q_0}{\sum p_1 q_0}} = \sqrt{1} = 1$$

3. **Factor Reversal Test:** This test requires that the product of price index and the corresponding quantity index number should be equal to the value index number.

This test is also satisfied by the Fisher ideal index.

We can write,

$$P_{01}^{Fi} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}}$$

$$\text{and } Q_{01}^{Fi} = \sqrt{\frac{\sum q_1 p_0}{\sum q_0 p_0} \times \frac{\sum q_1 p_1}{\sum q_0 p_1}}$$

$$\therefore P_{01}^{Fi} \times Q_{10}^{Fi} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1} \times \frac{\sum q_1 p_0}{\sum q_0 p_0} \times \frac{\sum q_1 p_1}{\sum q_0 p_1}} = \sqrt{\left(\frac{\sum p_1 q_1}{\sum p_0 q_0}\right)^2} = \frac{\sum p_1 q_1}{\sum p_0 q_0} = V_{01}$$

4. Circular Test: This test is an extension of time reversal test to the case of more than two periods.

We can write,

$$P_{01} \times P_{12} \times P_{23} \dots P_{n-1,n} \times P_{n0} = 1$$

$$\text{Or } P_{0n} = P_{01} \times P_{12} \times P_{23} \dots \times P_{n-1,n} \quad (\because P_{n0} = 1/P_{0n})$$

It may be pointed out here that both the Laspeyres and Paasche index numbers do not satisfy time reversal, factor reversal and circular tests. In spite of this, these formulae are generally used by the majority because of their unambiguous interpretation.

Fixed Base Index Numbers

When the comparison of (prices or quantities etc.) various periods are done with reference to a particular or fixed period, we get an index number series with fixed base.

Chain Base Index Number

The main problem with a fixed base series arises when the current year becomes too far off from the base year. In such a situation, it may happen that the commodities which used to be very important in the base year are no longer so in current year. Furthermore, certain new commodities might be in use while some old commodities are dropped in current year. This problem is often solved by constructing Chain Base Index Numbers. A chain base index number is an index number with previous year as base. For example, we construct chain base index of 1991 with 1990 as base. Chain base index of 1992 with 1991 as base, Chain base of 1999 with 1998 as base as so on. These indices are multiplied to get chained index of 1999 with 1990 as base. This multiplication is based on the application of circular test.

$$P_{90,99}^{\text{Chained}} = P_{90,91}^{\text{Chain}} \times P_{91,92}^{\text{Chain}} \dots \times P_{98,99}^{\text{Chain}}$$

Limitations of Index Number

- The construction of an index number is based on sample which may not be a true representative of population.
- An index number does not take into account the all quality of items.
- Index number is an average and as such it suffers from all the limitations of an average.
- There is no unique index number that is acceptable to all.
- The index number can be manipulated by choice of base year and weighing system and thus are likely to be misused.
- There does not exist a scientific mechanism of assigning weights to most of the Index Numbers.

LESSON ROUND UP

- Time series is a set of numeric observation of the dependent variables, measured at specific points of time in chronological order, usually at equal intervals in order to determine the relationship of time to such variables.
- It is helpful in planning the future operations of the business, compare actual achievement with expected performance, and is useful in planning, state administration, business, social and other areas of human knowledge.
- The major components of time series analysis include Secular Trend, Periodic or Oscillatory Variations i.e. Seasonal Variations and Cyclical Variations and Random or Irregular Variations
- Forecasting is a prediction or estimation of future values of a variable like sales, demand, price, profits, cost, investment, output, inventory, exports, imports, etc. for a firm, industry or the economy as a whole. The basic motive of forecasting is to assist the management to devise plan of action in respect of diverse fields viz. production, purchase, sales, inventory control, personnel, finance, etc.
- An index number is a statistical measure used to compare the average level of magnitude of a group of distinct, but related, items in two or more situations.
- Index numbers are often known as the barometers of economic activity as they help to get an idea of the present day situation with regard to changes in production, consumption, exports and imports, national income, business; level, cost of living etc.
- Index Numbers are used to measure level of economic and business activities in a country and are helpful in planning and formulation of various policies.
- There are four test of adequacy of index numbers i.e. Unit Test, Time Reversal Test, Factors Reversal Test, and Circular Test

GLOSSARY

Base Year	The year that is used as a standard of comparison in a time series and index number
Current Year	The year with respect to which the comparison is drawn from base year.
Index Number	A number set equal to 100 in the base year, and used to measure changes in prices or quantities.
Time Series	A time series is a sequence of data which shows how the value of a variable changes over time. Normally such data are collected on a regular periodic basis.
Trend	Trend is a long term movement in a time series. It is the underlying direction (an upward or downward tendency) and rate of change in a time series, when allowance has been made for the other components.
Cyclical Component	In weekly or monthly data, the cyclical component describes any regular fluctuations. It is a non-seasonal component which varies in a recognizable cycle.
Seasonal Component	In weekly or monthly data, the seasonal component, often referred to as seasonality, is the component of variation in a time series which is dependent on the time of year. It describes any regular fluctuations with a period of less than one year.
Irregular Component	The irregular component is that left over when the other components of the series (trend, seasonal and cyclical) have been accounted for.

Smoothing	Smoothing techniques are used to reduce irregularities (random fluctuations) in time series data. They provide a clearer view of the true underlying behaviour of the series.
Forecasting	The use of historic data to determine the direction of future trends. Forecasting is used by companies to determine how to allocate their budgets for an upcoming period of time.
Delphi Technique	A forecasting method based on the results of questionnaires sent to a panel of experts. Several rounds of questionnaires are sent out, and the anonymous responses are aggregated and shared with the group after each round. The experts are allowed to adjust their answers in subsequent rounds.

SELF-TEST QUESTIONS

- Explain various components of a time series. What do you understand by the analysis of a time series?
- With which component would you associate each of the following statement and why ?
 - Constantly rising population of India
 - An era of prosperity
 - Heavy sales on the occasion of Diwali
 - Chechenia-war
 - Depressed business environment
- Determine the trend values by the method of moving average if the observations, given below, are known to have a business cycle of 4 years.

Years :	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Value :	41	61	55	48	53	67	62	60	67	73	78	76	84
- Given below are the figures of production of a sugar factory in thousand tons.

Years		1999	2000	2001	2002	2003	2004	2005
Production	77	88	94	85	91	98	90	

 - Fit a straight line trend by the method of least squares.
 - Calculate trend values and plot them on a graph paper.
 - Predict the production for 2008 and 2009.
- The trend equation for annual sales of a product is
 $Y = 120 + 36X$ with 1st January, 1990 as origin
 - Determine the monthly trend equation with 1st July 1992 as the origin
 - Compute the trend values of sales in August 1991 and October 1994.
- Define Index Number. How is it prepared?
- Explain different methods of construction of index numbers.
- Prices paid and quantities consumed of three commodities during two time periods are :

Commodity	Time Period I		Time period II	
	P_1	Q_1	P_2	Q_2
A	10	2	15	1
B	15	3	10	3
C	25	4	15	4

- (i) Keeping the quantity mix of period I as weights, what percentage change in price has occurred between the two periods?
- (ii) What is the percentage change in prices if quantity mix of periods II is used as weights?
- (iii) What is the percentage change in quantities between two periods when prices of period I are taken as weights?

9. An enquiry into the family budgets of middle class families gave the following informations :

	Food	Clothing	Fuel	Rent	Misc.
Percentage of Expenditure :	35	15	10	20	20
Prices in 1990 :	70	45	20	80	40
Prices in 1995 :	90	50	25	70	30

A weighted price index for 1995 with base 1990 is to be computed.

- (i) Which index number formulae is appropriate, why?
 - (ii) Compute the index.
10. The prices paid and quantities purchased by a house hold in base and current years are given below. Calculate the additional dearness allowance to be given to the household so as to fully compensate it for the price rise, using both the Laspeyres's and Paasche's index numbers.

Commodity	Base Period		Current Period	
	Price	Quantity	Price	Quantity
A	30	10	40	8
B	12	20	15	18

11. Convert the following fixed base index numbers into chain base index numbers.

Year :	1980	1981	1982	1983	1984
Fixed Base Index :	100	125	130	145	160

FOUNDATION PROGRAMME

BUSINESS ECONOMICS

PRACTICE TEST PAPER

(This Test Paper is for practice and self study only and not to be sent to the Institute)

1. Macroeconomics deals with _____.
 - (a) economic aggregates
 - (b) the behaviour of firms
 - (c) the activities of individual units
 - (d) the behaviour of the electronics industry
2. The meaning of Greek word 'oikonomikus' is
 - (a) Business Management
 - (b) Business Economics
 - (c) House Management
 - (d) Wealth Management
3. Who is assumed as father of Economics?
 - (a) Adam Smith
 - (b) Robinson
 - (c) Marshall
 - (d) George Bernard
4. In economics the central problem is:
 - (a) Money
 - (b) Consumption
 - (c) Allocation
 - (d) Scarcity
5. A recession is:
 - (a) a period during which aggregate output declines.
 - (b) a period of declining unemployment.
 - (c) a period of very rapidly declining prices.
 - (d) a period of declining prices.

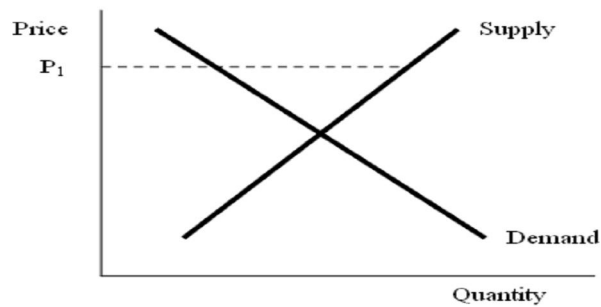
6. When we know the quantity of a product that buyers wish to purchase at each possible price, we know
 - (a) Demand
 - (b) Supply
 - (c) Excess demand
 - (d) Excess Supply
7. _____ and _____ do not directly affect the demand curve.
 - (a) the price of related goods, consumer incomes
 - (b) consumer incomes, tastes
 - (c) the costs of production, bank opening hours
 - (d) the price of related goods, preferences
8. An increase in consumer income will increase demand for a _____ but decrease demand for a _____.
 - (a) substitute good, inferior good
 - (b) normal good, inferior good
 - (c) inferior good, normal good
 - (d) normal good, complementary good
9. Education is
 - (a) Merit Goods
 - (b) Specific Goods
 - (c) Both
 - (d) None of the above
10. If the demand curve for a good is horizontal and the price is positive, then a leftward shift of the supply curve results in –
 - (a) A price of zero
 - (b) an increase in price
 - (c) A decrease in price
 - (d) no change in price
11. Which of the following is an example of a normative statement?
 - (a) A higher price for a good causes people to want to buy less of that good.
 - (b) A lower price for a good causes people to want to buy more of that good.
 - (c) To make the good available to more people, a lower price should be set.
 - (d) If you consume this good, you will be better off.
12. Which of the following are assumptions underlying the PPC?
 - (a) Only two goods are produced
 - (b) Technology, population, and capital are variable

- (c) Prices determine the position on the PPC
(d) All the above
13. If the price elasticity of demand for a good is .75, the demand for the good can be described as:
(a) Giffen
(b) Elastic
(c) Inferior
(d) Inelastic
14. Jawahar Rojgar Yojana has been restructured as _____.
(a) Jawahar Gram Udyog Yojana
(b) Jawahar Gramodyoga Yojana
(c) Jawahar Gram Samridhi Yojana
(d) None of the above
15. Equilibrium is defined as a situation in which –
(a) no government regulations exist
(b) neither buyers nor sellers want to change their behavior
(c) demand curves are perfectly horizontal
(d) suppliers will supply any amount that buyers wish to buy
16. The extra utility from consuming one more unit of a good is called.
(a) Marginal utility
(b) Additional utility
(c) Surplus utility
(d) Bonus utility
17. Marginal revenue is the _____ when output is _____.
(a) change in average revenue, increased
(b) change in total revenue, increased by one unit
(c) change in average revenue, increased by one unit
(d) change in total revenue, increased
18. Opportunity cost is –
(a) the additional benefit of buying an additional unit of a product.
(b) that which we forgo, or give up, when we make a choice or a decision.
(c) A cost that cannot be avoided, regardless of what is done in the future.
(d) the cost incurred in the past before we make a decision about what to do in the future.
19. The law of diminishing returns states that:
(a) as a firm uses more of a variable resource, given the quantity of fixed resources, the average product

of the firm will increase

- (b) as a firm uses more of a variable resource, given the quantity of fixed resources, marginal product of the firm will eventually decrease
 - (c) in the short run, the average total costs of the firm will eventually diminish
 - (d) in the long run, the average total costs of the firm will eventually diminish
20. An upward shift in marginal cost _____ output and an upward shift in marginal revenue _____ output
- (a) reduces, reduces
 - (b) reduces, increases
 - (c) increases, increases
 - (d) increases, reduces
21. Which is not a fixed cost?
- (a) monthly rent of Rs.1,000 contractually specified in a one-year lease
 - (b) an insurance premium of Rs.50 per year, paid last month
 - (c) an attorney's retainer of Rs.50,000 per year
 - (d) A worker's wage of Rs.15 per hour
22. A firm should close down if profits are zero.
- (a) true
 - (b) false
 - (c) may be
 - (d) depends on determinants of demand
23. Other things being equal, a fall in the price of milk will cause _____.
- (a) A decrease in the demand for milk and an increase in the supply of milk
 - (b) An increase in the quantity demanded of milk and a decrease in the quantity supplied of milk.
 - (c) A decrease in the quantity demanded of milk and an increase in the quantity supplied of milk
 - (d) An increase in the demand for milk and a decrease in the supply of milk
24. If the price of iPods increases and as a consequence, the demand for MP3s increases, then iPods and MP3s are –
- (a) Complementary products
 - (b) Independent products.
 - (c) Substitute products.
 - (d) Ceteris paribus products

25. Refer to the below supply and demand diagram. If the market price is at P_1 , then



- (a) a shortage will occur and the market price will fall.
 (b) a shortage will occur and the market price will rise.
 (c) a surplus will occur and the market price will fall.
 (d) a surplus will occur and the market price will rise.
26. If marginal utility is zero:
- (a) Total utility is zero
 (b) An additional unit of consumption will decrease total utility
 (c) An additional unit of consumption will increase total utility
 (d) Total utility is maximized
27. The price of an item drops 10% in such a way that the Price Elasticity of Demand of that item is unit-elastic. We would expect the quantity of the item demanded to
- (a) Drop by 5%
 (b) stay the same
 (c) increase by 5%
 (d) increase by 10%
28. The reason that the marginal cost curve eventually increases as output increases for the typical firm is because –
- (a) of diseconomies of scale
 (b) of minimum efficient scale
 (c) of the law of diminishing returns
 (d) normal profit exceeds economic profit
29. The phrase '*ceteris paribus*' is best expressed as
- (a) 'all else equal.'
 (b) 'everything affects everything else.'
 (c) 'scarcity is a fact of life.'
 (d) 'there is no such thing as a free lunch.'

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30. SEBI is a _____.
- (a) Statutory body
 - (b) Advisory body
 - (c) Constitutional body
 - (d) Non-statutory body
31. The central banking functions in India are performed by the
- (a) Central Bank of India
 - (b) Reserve Bank of India
 - (c) State Bank of India
 - (d) Punjab National Bank
32. Banks create money by
- (a) printing it
 - (b) issuing debit cards
 - (c) accepting cheques
 - (d) lending out part of their deposits
33. The money supply is _____.
- (a) the Bank of England Issue Department
 - (b) money + bank cards + credit cards
 - (c) Cheques + money + bank cards + credit cards
 - (d) Currency in circulation plus bank deposits
34. M4 is a _____ measure of money and includes deposits at both _____ and _____.
- (a) narrow, banks, building societies
 - (b) wide, banks, insurance companies
 - (c) narrow, banks, insurance companies
 - (d) wide, banks, building societies
35. The monetary base is _____ and _____.
- (a) bank deposits, building society deposits
 - (b) currency in circulation, banks' cash reserves
 - (c) retail sight deposits, building society deposits
 - (d) retail deposits, wholesale deposits
36. The variables affecting the demand for money are _____ and _____.
- (a) bank opening hours, the proportion of weekly paid employees, interest rates
 - (b) the price level, interest rates
 - (c) the time of year, bank opening hours, the price level

- (d) the proportion of weekly paid employees, the time of year, real income
37. A profit-maximizing firm in the short run will expand output _____.
- (a) until marginal cost begins to rise
 - (b) until total revenue equals total cost
 - (c) until marginal cost equals average variable cost
 - (d) as long as marginal revenue is greater than marginal cost
38. A non discriminating monopolist will find that marginal revenue _____.
- (a) exceeds average revenue or price
 - (b) is identical to price
 - (c) is sometimes greater and sometimes less than price
 - (d) is less than average revenue or price
39. Monopolistic competition is similar to perfect competition because of –
- (a) A large number of firms in the industry
 - (b) Standardized Product
 - (c) Difficult entry and exit in the industry by individual firms
 - (d) Price Discrimination
40. Should a consumer move upward along an indifference curve, his total utility –
- (a) First increases and then decreases
 - (b) First decreases and then increases
 - (c) Remains constant
 - (d) Increases
41. A distinguishing characteristic of monopolistic competition is –
- (a) Large number of firms
 - (b) Low entry barriers
 - (c) Product standardization
 - (d) Product differentiation
42. The price elasticity of demand for a textbook is estimated to be 1, no matter what the price or quantity demanded. In this case,:
- (a) a 10 percent increase in price will result in a 10 percent increase in the quantity demanded.
 - (b) a 10 percent increase in price will result in a 10 percent decrease in the quantity demanded.
 - (c) an increase in price will decrease the total revenue of sellers.
 - (d) A decrease in price will increase the total revenue of sellers.
43. Economics is the Science of Wealth” who gave this definition?
- (a) J. K. Mehta

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- (b) Marshall
 - (c) Adam Smith
 - (d) Robbins
44. Firms are assumed to _____ costs and to _____ profits.
- (a) incur, desire
 - (b) pay, make
 - (c) charge, earn
 - (d) minimize, maximize
45. Which is not a determinant of demand?
- (a) income
 - (b) the cost of inputs in production
 - (c) the prices of related goods
 - (d) future price expectations
46. If demand is _____ then price cuts will _____ spending.
- (a) perfectly inelastic, increase
 - (b) elastic, increase
 - (c) elastic, decrease
 - (d) None of the above
47. A positive cross elasticity of demand coefficient indicates that:
- (a) a product is an inferior good
 - (b) a product is a normal good
 - (c) two products are substitute goods
 - (d) two products are complementary good
48. In perfect competition, the marginal revenue curve
- (a) and the demand curve facing the firm are identical
 - (b) is always above the demand curve facing the firm
 - (c) is always below the demand curve facing the firm
 - (d) intersects the demand curve when marginal revenue is minimized
49. Which of the following is an example of economies of scale
- (a) As the computer industry has expanded, the number of professionally trained computer programmers has also increased, which has caused the salaries of computer programmers to increase
 - (b) To attract firms to locate in its state, the state government reduced the tax rate that businesses must pay on its profits, thus lowering the costs to firms who locate in the state
 - (c) A firm increases in size and is therefore able to lower its health insurance costs because as the size of the group insured increases the premium per person decreases substantially

- (d) As the demand for calculators increased, the price of calculators actually fell.
50. From society's point of view, society would be better off if a monopolist –
- (a) produced more and charged a higher price
 - (b) produced less and charged a higher price
 - (c) produced more and charged a lower price
 - (d) produced less and charged a lower price
51. The problem with barter economies is that they require –
- (a) less time and trouble to trade as compared with a money economy.
 - (b) a banking system from trade to occur.
 - (c) that there be a double coincidence of wants.
 - (d) that there be a single coincidence of wants.
52. In case of Perfect Competition, no of selling firm would be –
- (a) Large
 - (b) Single
 - (c) Varied but not too many
 - (d) None of the above
53. Utility is measured by –
- (a) wealth
 - (b) price
 - (c) value or worth
 - (d) income
54. If firms can neither enter nor leave an industry, the relevant time period is the –
- (a) Short run
 - (b) Intermediate run
 - (c) Long run
 - (d) Immediate run
55. The short run is a time period in which –
- (a) all resources are fixed
 - (b) the level of output is fixed
 - (c) the size of the production plant is variable
 - (d) some resources are fixed and others are variable
56. Two of the major factors contributing to growth are –
- (a) money and efficiency
 - (b) money and luck

- (c) resources and luck
 - (d) resources and a good climate
57. Which of the following is not correctly marked with respect to the year?
- (a) Reserve bank of India 1977
 - (b) Industries(Development and Regulation)Act 1951
 - (c) Bureau of Industrial and Financial Reconstruction 1987
 - (d) Third five year plan 1961
58. Homi J. Bhabha was the first chairman of –
- (a) Finance Commission
 - (b) Planning Commission
 - (c) Election Commission
 - (d) Atomic Energy Commission
59. The three annual plans from 1966-69 are also known as –
- (a) Plan Break
 - (b) Plan Holiday
 - (c) All the above
 - (d) None of the above
60. TRAI stands for –
- (a) Telecommunication Regulatory Authority of India
 - (b) Telecom Regulatory Authority of India
 - (c) Telecom Regulatory Area of India
 - (d) Telecom Regulatory Authority Institute
61. In the production function, equation expressed as $Q_x = f(L, K, T, \dots, n)$, L stands for –
- (a) land
 - (b) labour
 - (c) longlife
 - (d) luxury goods
62. Reasons for increasing returns in Stage I of law of variable proportions is _____.
- (a) Indivisibility
 - (b) Specialisation
 - (c) Both (a) and (b)
 - (d) None of the above
63. What are homogeneous products?
- (a) undifferentiated products

- (b) differentiated products
 - (c) Both (a) and (b)
 - (d) None of the above
64. Profits is denoted as, which of the following symbol?
- (a) Sigma (σ)
 - (b) Summation (Σ)
 - (c) Pie (π)
 - (d) alpha (α)
65. Which of the following is NOT price discrimination for a monopolist?
- (a) different price for different unit of good sold
 - (b) different price for different lot of good sold
 - (c) different price for different buyers/market
 - (d) None of the above
66. Which of the following is NOT objective of planning in India?
- (a) creation of capitalist economy
 - (b) Self- Reliance
 - (c) Increase in National Income
 - (d) All the above
67. "To attain 8% GDP growth per year" was the objective of which of the following plans –
- (a) First
 - (b) Fifth
 - (c) Tenth
 - (d) Eleventh
68. Agricultural Price Commission is now named as –
- (a) Commission for Agricultural Costs and Prices (CACCP)
 - (b) Costs and Prices Commission for Agricultural (CPCA)
 - (c) Agricultural Commission for Costs and Prices (ACCP)
 - (d) None of the above
69. In context of national family welfare programme, CPR stands for –
- (a) Crude Protection Rate
 - (b) Couple Protection Rate
 - (c) Couple Protection Ratio
 - (d) Crude Protection Ratio

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70. Prescribed norm for the availability of the school is within the radius of –
- (a) 5 Kilometers
 - (b) 1 Kilometers
 - (c) 3 Kilometers
 - (d) None of the above
71. If the amount of annuity for 25 years at 5% p.a. is ₹ 50000, then annuity will be ₹ _____.
- (a) 1406.90
 - (b) 1046.90
 - (c) 1146.90
 - (d) 1416.90
72. If $A=70$, $B=32$ and $A \cap B=22$ then, $A \cup B$ is –
- (a) 60
 - (b) 124
 - (c) 80
 - (d) 100
73. Which of these is not a method of data collection?
- (a) Questionnaires
 - (b) Interviews
 - (c) Experiments
 - (d) Observation
74. Find the compound amount for the deposit. (Round to the nearest decimal).
₹5000 at 7% compounded annually for 6 years.
- (a) ₹7012.76
 - (b) ₹7100.00
 - (c) ₹7503.65
 - (d) ₹6750.00
75. If $P(A) = 0.45$, $P(B) = 0.35$, and $P(A \text{ and } B) = 0.25$, then $P(A | B)$ is –
- (a) 1.4
 - (b) 1.8
 - (c) 0.714
 - (d) 0.556
76. The trend component is easy to identify by using –
- (a) Moving Averages

- (b) Exponential Smoothing
 - (c) Regression Analysis
 - (d) Delphi Approach
77. For computing a price index, method is used?
- (a) Simple aggregative
 - (b) Sampling
 - (c) Relative
 - (d) Delphi
78. Which of the following is not the part of statistical enquiry?
- (a) Collection of data
 - (b) Presentation of data
 - (c) Manipulation of data
 - (d) Interpretation of data
79. Mean of 0.3, 5, 6, 7, 9, 12, 0.2 is –
- (a) 4.9
 - (b) 5.6
 - (c) 8
 - (d) None of the above
80. “Statistics is both, a science and an art” is given by –
- (a) Keynes
 - (b) Tippets
 - (c) Bowley
 - (d) Spiegel
81. Which of the following terms best describes data that were originally collected at an earlier time by a different person for a different purpose?
- (a) Primary data
 - (b) Secondary data
 - (c) Experimental data
 - (d) Field note
82. The graphical representation of a cumulative frequency distribution is called –
- (a) Histogram
 - (b) Pie chart
 - (c) Ogive
 - (d) Historigram

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83. In order to compare two or more related series, we consider –
- (a) Multiple bar chart
 - (b) Grouped bar chart
 - (c) Line graph
 - (d) Both (a) or (b)
84. Which of the following statements is false?
- (a) Statistics is derived from the Latin word '*Status*'
 - (b) Statistics is derived from the Italian word '*Stato*'
 - (c) Statistics is derived from the French word '*Statista*'
 - (d) Statistics is derived from the German word '*Statistik*'
85. Consecutive rectangles in a Histogram have no space in between –
- (a) True
 - (b) False
 - (c) May or may not have space
 - (d) Must have space in between
86. For a normal curve, the mean, median and mode are –
- (a) All equal
 - (b) All zero
 - (c) All different
 - (d) The mean is always the largest and the mode always the smallest
87. Standard deviation is denoted by –
- (a) Square of sigma
 - (b) Sigma
 - (c) Square root of sigma
 - (d) None of these
88. Statistics can best be considered as –
- (a) an art
 - (b) a science
 - (c) both (a) and (b)
 - (d) neither (a) nor (b)
89. Which of the following is NOT a continuous variable?
- (a) height
 - (b) weight
 - (c) time

- (d) number of persons in a family
90. A frequency polygon has _____.
- two sides only
 - more than four sides
 - more than eight sides
 - five sides only
91. Census investigation is not preferred over simple investigation because –
- It is costlier
 - It is time consuming
 - It has greater possibilities of error
 - All of the above
92. The point of intersection of the 'less than' and the 'more than' ogives correlates to
- mean
 - mode
 - median
 - none of the above
93. Mean is affected by _____
- Change of scale
 - Origin
 - both (a) and (b)
 - none of the above
94. Determine 'X' for the following data when its mean is 115.86.

110	112	113	116	X	125	128	130
25	17	13	15	14	8	6	2

- 120
 - 119
 - 117
 - none of the above
95. Standard deviation can be calculated from _____ average.
- any
 - mean only
 - mean and median only
 - none of the above

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96. If $A = ₹ 1000$, $n = 2$ years, $R = 6\%$ p.a.; compound interest payable half yearly, then Principal (P) is –
- (a) ₹888.80
 - (b) ₹880
 - (c) ₹800
 - (d) ₹808
97. The standard deviation of 10, 16, 10, 16, 10, 10, 16, 16 is –
- (a) 4
 - (b) 6
 - (c) 3
 - (d) 0
98. If a card is drawn at random from a pack of 52 cards, what is the chance of getting a spade?
- (a) $4/13$
 - (b) $5/13$
 - (c) 0.25
 - (d) 0.25
99. The sum required for to earn monthly interest of ₹ 1200 @ 18% p.a. is –
- (a) 50000
 - (b) 60000
 - (c) 80000
 - (d) 100000
100. If the price of all commodities in a place has increased 125 times in comparison to the base period prices, the index number of prices for the place is now –
- (a) 100
 - (b) 125
 - (c) 225
 - (d) 440

ANSWERS

- | | | |
|---------|---------|----------|
| 1. (a) | 36. (b) | 71. (b) |
| 2. (c) | 37. (d) | 72. (c) |
| 3. (a) | 38. (d) | 73. (c) |
| 4. (d) | 39. (a) | 74. (c) |
| 5. (a) | 40. (c) | 75. (c) |
| 6. (a) | 41. (d) | 76. (a) |
| 7. (c) | 42. (b) | 77. (a) |
| 8. (b) | 43. (c) | 78. (c) |
| 9. (a) | 44. (d) | 79. (b) |
| 10. (d) | 45. (b) | 80. (b) |
| 11. (d) | 46. (b) | 81. (b) |
| 12. (a) | 47. (c) | 82. (a) |
| 13. (b) | 48. (a) | 83. (d) |
| 14. (c) | 49. (c) | 84. (c) |
| 15. (b) | 50. (c) | 85. (a) |
| 16. (a) | 51. (c) | 86. (a) |
| 17. (b) | 52. (a) | 87. (b) |
| 18. (b) | 53. (c) | 88. (c) |
| 19. (b) | 54. (a) | 89. (d) |
| 20. (b) | 55. (d) | 90. (b) |
| 21. (d) | 56. (a) | 91. (d) |
| 22. (b) | 57. (a) | 92. (c) |
| 23. (c) | 58. (d) | 93. (c) |
| 24. (c) | 59. (b) | 94. (a) |
| 25. (c) | 60. (b) | 95. (b) |
| 26. (d) | 61. (b) | 96. (a) |
| 27. (b) | 62. (c) | 97. (c) |
| 28. (c) | 63. (a) | 98. (a) |
| 29. (a) | 64. (c) | 99. (c) |
| 30. (a) | 65. (d) | 100. (c) |
| 31. (b) | 66. (a) | |
| 32. (d) | 67. (c) | |
| 33. (d) | 68. (a) | |
| 34. (d) | 69. (b) | |
| 35. (b) | 70. (b) | |