Sampling Design & Its Types

Unit: II

Semester: II

Paper Code: GIS 10

Name of Paper: Research Methodology and Application of Remote Sensing and GIS Techniques in Research

PG Diploma in RS & GIS

Dr. SHYAMA PRASAD MUKHERJEE UNIVERSITY, RANCHI

I. Meaning of Sampling

Sampling is the process of systematic selection of elements from a population of interest so that by studying the sample a researcher can fairly generalize the results about the population.

Size of population ranges from few individuals, for example, nuclear scientists in the country, to a very large number, for example, school going children in the country. In the first example, it is fairly less difficult for a researcher to identify the population for the study as the number of scientists specialised in nuclear science in the country is less. Given the resources and time, sometimes researcher might collect data from entire population. Operational, technical and material constraints of research may demand collection of data from a set of elements drawn from population instead. If data are collected from all the elements of population, it is referred to as census data. If data are collected from few select respondents, it is referred to as sample data. The important issue here is that how the researcher arrives at generalizations or explanations about population based on the data collected from a sample.

Sampling involves selection of some or all elements of population with an intention to explain the properties of population. Sampling, thus, pertains to selection of certain elements from a large or small population. The elements selected for systematic observation or data collection through various methods are referred to as sample. A sample is a finite part of a population whose properties are studied to explain about the whole. The size of the sample nee ed not be in proportion to the size of population.

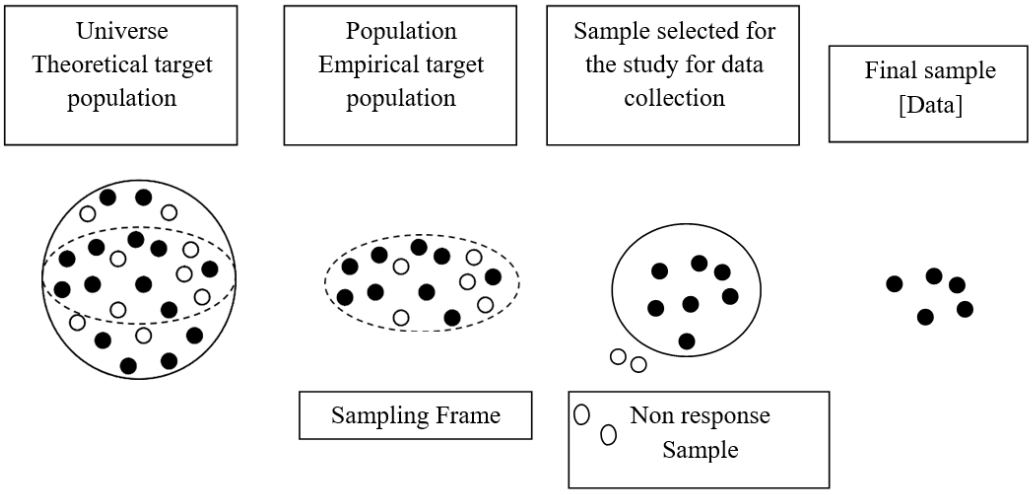

Fig. 1: Illustration of population - sample relation

Studying all the elements from a very large population is usually not possible for any researcher. At another level, social research does not necessarily demand data collection from entire population. In fact, it is considered as meaningless to collect data from entire population. When it is not useful to collect data from all elements in the population or it is impractical, or impossible to deal with all elements, then sampling is undertaken.

Sampling is not entirely new and unknown to us. In fact, in our day-to-day life we practice sampling in various contexts. Take the example of us when we go to buy rice or wheat from a grocery store. How do we judge the quality of grains in a bag of rice? Do we check the entire bag to know the quality of rice in the bag? We just take a handful of rice grains from the bag and decide the quality of rice in that particular bag. Here, rice in the particular bag can be considered as the population and few grains which we collect from the bag as the sample. Is sampling such a simple exercise? Just hold on. It is not that simple. Because how do we know that the handful of grains we collect from the bag represent the grains in the entire bag. If there are 10 bags of rice then can this handful of rice from one bag be used to determine the quality of rice in all the ten bags? The important question that emerges here is whether the sample we choose is representing the entire population. Because a sample is subjected to measurement assuming that it represents the entire population. A ‘representative sample’ is the one that represents the entire population.

What do we do with a sample study? Through data collected from the sample we arrive at an aggregate value called as statistic. Using the statistic we aim to estimate a population parameter. For example, average age of students in a college may be calculated by using a sample. The average age we calculate is used to make observations about age of students in the college as a whole. Such statements based on sample results are probability statements. They are probable statements because the average we arrive at is not a fact. If we collect data on age from all the students in the college, we would arrive at a factual figure. Thus, while the census value is a fact, the sample value is an estimate. We call sample value (statistic) as an estimate because the value is not based on the information from all the students in the college. Estimate also brings in the issue of its precision. How precise the estimate can take us close to the population value? Closeness to the correct population value (fact) is referred as accuracy. Since population value is seldom known to the researcher, the sample value gives us probable accuracy which is otherwise called as precision.

II. Some Important Terms Used in Sampling

- **Population:** The term population refers to a group of elements or units related to the problem of research. These elements or units in the population can be individuals, households, organizations, villages, states, nations, etc. Identification of relevant population is guided by factors like geographical area of the study and operational definition of the study. For example, a study on university students in the country, all the students enrolled in different are considered as population. Sometimes population can be enumerated. That means, elements or units in the population can be identified and listed. For example, the details of voters in a constituency are available in the form of voter list. In certain cases, it is not possible to enumerate the elements. The population elements that can be accessed by the researcher, in terms of geographical accessibility, is called 'accessible population'. When the findings of the study based on the sample drawn from the accessible population are generalized to the population beyond the accessible population, it is referred as 'theoretical population'. Consider the example of persons with disabilities in a district who form the accessible population and the

persons with disabilities in the country or state would become the theoretical population. Population size is denoted by the word 'N'.

- **Sample:** A sample is a finite part of a population whose properties are studied to explain about the whole. Sample consists of elements or units drawn from population. The elements can be individual persons, households, organizations, villages, states, nations, etc. It is important to note that the elements in the sample must possess the properties of the population. A sample also indicates the target elements from which data for the research study are collected. Sample size is denoted by the word 'n'.

- **Sampling error:** The error which arises because of studying only a part of the total population, i.e. sample, is called sampling error. When a sample is drawn from the population, only this part of the population is subjected to data collection and measurement assuming that the elements in the sample represent the entire population. From the sample the relevant statistic, for example, an average age, is calculated and this statistic is used as an estimate of the population parameter. However, due to certain factors like, natural variations among elements

  or units in the population, incorrect sampling procedure, inadequate sample size, and non- representativeness of the sample, the sample may not give the statistic that is equal to the population value. The degree of variations of sample values is measured by standard deviation and it is known as the standard error of the concerned statistic. Such an error is referred to as sampling error. As the sample size increases the magnitude of the error decreases. Sample size and sampling error are negatively correlated.

- **Statistic:** Statistic is the summary value of a variable calculated from a sample. The value may be average (mean), median, mode or any other statistical value. For example, average age of students from the sample.

- **Parameter:** Parameter is the summary value of the variable in the population that the researcher is trying to estimate. Again, the value may be average (mean),

median, mode or any other statistical value. For example, average age of students in a school.

- **Estimate:** An estimate is the value obtained by using the method of estimation for a specific sample. For example, mean age of the students from the sample (statistic) is an estimator for the age of students in a school. If the value of the estimator is equal to the population value (parameter), the estimator is called unbiased. If not, it is called biased. The difference between the expected value and the true population value is termed as bias.

- **Sampling Frame:** The sampling frame contains all the population elements or units. It is a list of the population elements from which the sample is drawn. Generally, in any research process researcher has to develop the sampling frame containing the list of units or elements of the population. In certain cases the sampling frame may be available or can be procured from different sources directly. For example, voter list in a polling booth is a sampling frame from which the researcher draws a sample of voters to be interviewed. However, in many cases, the researcher has to develop the sampling frame. For example, in a study on persons with disabilities in a district the researcher is expected to develop the sampling frame based on the sources like census, village records, etc. about their number and spread in the district.

III. Universe of study

As discussed in the initial part of this module, you are familiar with the fact that sample is drawn from a population located in a particular geographical setting. How to delimit the geographical area for a research study has been a big challenge to social science researchers. Gideon Sjoberg and Roger Nett (1992: 129) have observe that,

"most lay observers fail to appreciate many of the technical procedures involved in sampling, for some of these depart markedly from common-sense thinking. Perhaps, the greatest difficulty the scientist experiences in effectively utilizing the material collected by lay observers results from the failure of the latter to specify just how informants are chosen. For the more clearly the researcher envisions his universe and the more carefully

he selects its component parts, the more likely is his research to be successful and the more readily can others verify his findings".

These observations clearly state the significance of selection of universe and its units (elements) in any social research. Before we go into the criteria adopted in the selection of universe the terms working universe (also referred as special universe) and the general universe need to be clarified.

The 'working universe' is specific and amenable for empirical observation from which researcher draws the units for the study. The working universe is equal to that of population in survey research. On the other hand, the general universe is abstract universe to which the findings from the units selected will apply. For example, working universe could be a particular community from which respondents are drawn. Findings of the data collected from the respondents are generalized to the community in general which may range from a particular community located in a socio cultural context to global community. For example, women's studies, disability studies though study women or disabled in a particular context generalise the findings to women and disabled in general.

Selection of a working universe:

Sjoberg and Roger Nett (1992) suggest that the following factors influence the selection of working universe:

- ✓ Theoretical commitment: Researchers' original theoretical commitment determines the selection of universe.
- ✓ Availability of data: Generally existing data on a subject attract new research studies. Because of the availability of background data researchers raise new questions for empirical study.
- ✓ Resources and convenience: Resources available at the disposal of the researcher such as time, money and manpower influence the choice of a working universe.

IV. Sampling distribution

Sampling distribution refers to the distribution of mean values of different samples drawn from the same population from the mean of these means (average of averages). It may be said that the mean of the means (of different samples) is equal to the true population mean. Consider the following example. From a population of 4 students, data were collected

from a sample of two students. In all, six samples of equal size were drawn from the population.

Population – students	Age in years
A	15
B	17
C	18
D	22

Based on four samples of different combinations, we may draw the following table:

Samples	Respondents	Age in years	Mean ages of different samples
Sample 1	A & B	15 & 17	16.0
Sample 2	A & C	15 & 18	16.5
Sample 3	A & D	15 & 22	18.5
Sample 4	B & C	17 & 18	17.5
Sample 5	B & D	17 & 22	19.5
Sample 6	C & D	18 & 22	20.0
Total			108.0
Average of means			18.0

Here, the mean age of the population is 18 years. When we calculate the mean of mean ages, it is also 18 (108/6 = 18). This example shows that average of averages is equal to the population average. Then coming to the estimate's precision, samples 3 and 4 come close to the population mean. By taking a number of samples and calculating the mean of means one can arrive at a statistic which is closer to the population parameter. However, in practice a researcher does not draw several samples and instead tries to estimate the population parameter on the basis of only one sample.

Reasonably large samples provide us the values for different sampling distributions which approximates normal distribution. If a particular distribution approximated normal distribution, we can say that 68.26 percent of the sample estimates will lie between its mean and one standard deviate point, 95.44 percent and two standard deviate points and about 99.72 percent between its mean and 3 standard deviate points.

V. Sample Size

How big should be the sample size? Statisticians suggest that larger sample size overcomes the problem of error in estimate. The larger the sample size, the lower is the sampling error. However, sample size is also determined by other constraints such as budget, time and man power. The size of the sample depends on the characteristics of the population. If the population is homogenous, a sample of one element of the entire population is sufficient (for example, a single drop of blood in blood tests). The size of sample is also influenced by the precision of the results desired by the researcher. If the researcher decides for an intensive examination of population properties, then a large sample may be necessary. Researcher goes for a small sample when the errors associated with small sample studies do not undermine the findings of the study. Finally, sample size depends upon the level of confidence at which the researcher decides for the estimates. Higher level of confidence demands large sample size and vice-versa. Of course, size of sample varies with the method of data collection. Survey researchers place greater emphasis on calculation of sample size to make the data claims valid. They adopt mathematical calculations to arrive at a number for sample size. In survey research, the researcher has to answer certain questions about accuracy of the result (for example, how accurately the data finding should be?), level of confidence at which survey results are explained and the awareness of population mean or expectations. In survey research, sample size is calculated before the beginning of data collection. Using a formula one can calculate the sample size.

As far as the size of sample in qualitative research is considered, there are no defining rules to guide the selection. It depends on the objectives of the research project, nature of research questions, resources at disposal, researcher's familiarity with the field and time. We come across certain sociological studies on social phenomena with a smaller sample size conducted with great intensity. Often referred to as purposeful sampling, the sample is judged based on the purpose and rationale of the study rather than on statistical procedure. However, the validity of the insights of such research is based on the richness of data collected and analytical capability of the researcher and theoretical rendering to the findings.

VI. Sampling Techniques

As we have understood above, sampling means to pick units from the universe to form a sample (or samples, depending on the study) for conducting research. Sampling can be done using some techniques that have been developed over time by researchers. The various techniques that are known and used widely have been discussed as follows.

1. Simple Random Sampling

As the name suggests 'simple random sampling' refers to sampling done in a simple manner where sampling units are chosen randomly. In simple random sampling there is no procedure followed for sampling, thus it is called 'simple'. Also units are selected to be in the sample in a random fashion. There is no systematic choosing. Simple random sampling falls under the category of 'probability sampling'. There are various ways of doing simple random sampling. As already explained above, probability sampling requires that complete list of units in the universe must be known. Researcher may use a computer to make the list or make a manual list, before proceeding for selecting units for sample. Before proceeding for simple random sampling, the desired size of the sample must be finalised. Researcher can be innovative to create a manner of doing simple random sampling, as there is no system to be followed. However following are the most known methods of doing simple random sampling:

- ✓ **Lottery:**

Lottery means where lots are blindly picked, and it is a matter of chance that which lot gets picked. Lottery is the simplest way of conducting sampling. In this method a number is given to all the units in the universe. All these numbers are then written down on small pieces of paper, which are then put together. Since the desired size of sample is known, the requisite numbers of units are then picked out of the stack of paper. Whichever number appears in the picking, are the units to be included in the sample. The researcher may himself draw the chits of paper or may ask someone else to do it.

- ✓ **Tippet's Table:**

While the lottery method was popularly used for a long time for sampling, various scholars pointed out a fact that even though lottery method ensured a random way of sampling.

These researchers have come up with various tables consisting of random numbers. Of these, the table formed by a researcher and scholar named Tippet, is most widely used in social researches. Tippet has formed a table of 10,400 numbers having 4 digits. The method of sing this table is to first assign numbers to the complete list of units in the universe and the randomly select any number in the Tippet's table. Thereafter go on selecting the units from the list as per the numbers given in the table. A portion of Tippet's table is reproduced below to provide an understanding of how the table works:

2952	6641	3992	9792	7979	5911
3170	5624	4167	9525	1545	1396
7203	5256	1300	2693	2370	7483
3408	2769	3563	6107	6913	7691
0560	5246	1112	9025	6008	8126

For example a study is to be conducted on those rickshaw pullers who have migrated to battery run rickshaws, in the area of Noida, NCR of India. Let us assume the researcher has found out that there are 900 of them, and he wants a sample containing 500. Now since 200 is a 3 digit number, and Tippet's table contains 4 digits, the researcher shall assign four-digit numbers to the list of people to be studied, say from 3001 to 3900. Now all the researcher needs to do is to select any random number from the table, and there onward go on marking the units on the list as per the numbers in the table. Tippet's table is a random method of sampling and its advantage over lottery or blind method is that it can be used even for a large amount of population.

The advantages of using 'simple random sampling' are:

- ✓ It is hassle-free method of sampling population is homogeneous.
- ✓ There is no chance of personal bias of the researcher to influence sampling.
- ✓ This is a simple method requiring no computation of any sort.

The following are the disadvantages of using 'simple random sampling':

- ✓ It cannot be used in heterogeneous population.
- ✓ It does not make use of any special and particular circumstances that may be

present in a population.

- ✓ It cannot be used where researcher wants to conduct a mini-comparison within the universe by studying the sample in divisions.
- ✓ It requires basic knowledge of the universe, to make a list to be able to choose from.

2.Interval Sampling

This kind of sampling may be characterised by its systematic nature of sampling may be characterised by its systematic nature of uncertainty. Interval sampling is random in the sense that there is no basis for deciding the units to be chosen, yet it follows a systematic format of choosing the uncertain units. The prerequisite of interval sampling is to have a list of all units in the universe. The researcher randomly chooses one of the units that may or may not be the first one in the list. Thereafter the units following after an interval of a certain 'n' number will be chosen. That is to say, every 'n^{th}' unit will be chosen for the sample. This 'n' number may be any number of the researcher's choice.

Interval sapling is not purely Probability Sampling, as all the units do not stand an equal chance of being represented in the sample. Once the r searcher decides the gap, then the units falling in between the intervals straightaway lose their chance of being in the sample purely Probabilities. This is the reason Interval Sampling cannot be considered sampling. However, it is not Non-Probability also, as there is no discretion of the researcher to choose the units, except that the researcher chooses the number of interval after which the units shall be selected. Thus, Interval Sampling is a form of 'Mixed Sampling'.

Advantages of using interval sampling:

- ✓ This method is easy to understand and use.
- ✓ This method involves least number of steps.
- ✓ There is least chance of influence of personal bias of researcher.
- ✓ No knowledge of the universe is required before sampling.

Following are the disadvantages of using interval sampling:

- ✓ Every unit in the universe does not have equal chances of being selected in the sample as the selection depends on the 'n' number chosen.
- ✓ It is not an effective sampling method in case of heterogeneous population.

3. **Stratified Sampling**

The universe to be studied by the researcher is not always homogeneous. Heterogeneous population is often formed in such a way that it can be divided into different strata of homogeneous population. Stratified Sampling is helpful for doing drawing samples out of such a population. First the population is divided into different strata or layers and then samples are drawn out of each stratum. The units from each sample from the various strata form the final sample for carrying out the research.

Strata can be purposely formed by the researcher, by putting together the units having common characteristics. Thus each stratum will be a mini-universe composed of homogeneous population. Any technique may be used to draw out sample from the strata. Since the population in the strata is homogeneous, simple random sampling is also a or Interval Sampling is the most preferred choice. Stratified form of 'Mixed Sampling' as it is neither purely Probability Sampling nor purely Non-Probability Sampling'.

Samples from each stratum may be selected by the researcher proportionate to the strata or randomly. That is entirely the choice of the researcher. However, if samples are selected proportionately, the representation of each stratum in the final sample is more authentic. For example for a study of 1,000 persons, the population consists of persons belonging to four different religions in this manner: 400 people in Religion A, 300 people in Religion B, 200 people in Religion C and 100 people in Religion D. the researcher decides to create a sample of 200 people, that is 20% of the population. Now for the final sample to proportionately represent each stratum, the researcher must draw out 20% of sample from each stratum as well. Thus, there will be 80 persons from Religion A, 60 persons from Religion B, 40 persons from Religion C and 20 persons from Religion D. The researcher may also draw equal number of units from each strata-sample to form the

final sample. However, that would not represent the strata adequately. Thus, 'stratified sampling may be done in two ways:

- ✓ 'Stratified Random Sampling', and
- ✓ 'Stratified Proportional Sampling'.

Stratified Sampling is useful for population which is divisible into homogeneous sub-groups. The advantages of using Stratified Sampling are as follows:

- ✓ There is better representation of the different characteristics of the population.
- ✓ The researcher can use results from different strata to compare results within the universe.

However, a disadvantage of stratified sampling is that it involves more time as samples are to be taken out from each strata to form the final sample.

4.Purposive Sampling

Purposive sampling is also known as 'Judgment Sampling', as it relies entirely on the wish and judgment of the researcher. This is the purest form of Nonprobability Sampling. No unit in the universe stands any chance of being included in the sample except the ones that the researcher himself/herself chooses. That is to say all the units in the universe do not have an equal chance of being included in the sample. In purposive sampling the researcher purposely selects units to include in the sample. The basis for selection of the units is entirely the wish and judgment of the researcher.

Purposive sampling is generally used where the population is smaller. Purposive sampling also is useful where the results of the study depend less on empirical analysis and more on qualitative investigation. For example a researcher proposes to conduct a socio-legal study on drug abuse among children of divorced parents. The universe is all the children of divorced parent who are in custody of one of them. The researcher does not wish to obtain empirical results, but is more interested in investigating the sociological aspect of the problem, so the researcher may conduct study on any persons out of the universe, as he deems fit.

The advantages of purposive sampling are:

- ✓ It is easy on the pocket, as the researcher chooses the units himself/herself. There is no cost involved in selecting units for sample.
- ✓ No prior knowledge of the universe is required before embarking upon the sampling.
- ✓

However purposive sampling has the following disadvantages:

- ✓ Representativeness of the sample is questionable.
- ✓ It is not useful in cases of heterogeneous population.
- ✓ Sampling may be influenced by the personal bias of the researcher

5. **Convenience Sampling**

Convenience sampling is the most random of all techniques of sampling. This sampling is a pure form of Non-probability sampling, because all units do not have an equal chance of being included in the sample. It is only a matter of chance that a unit may be convenient for the researcher to sample and others are not. The most suitable example is the feedback surveys conducted for any product in the market, let us say a car. The researchers would not first demarcate the universe, next make a sample and then conduct study. Sample would be composed of any person who is most convenient to approach. The only knowledge required would be the nature of universe, and where the respondents would be found. Convenience sampling is similar to purposive sampling to some extent, as this also involves the judgment of the researcher to select or deselect a person for the sample. The only difference is that while the researcher employs some bit of judgment to base the selection in purposive sampling; in convenience sampling the researcher selects any unit in the universe out of pure convenience.

The advantages and disadvantages of convenience sampling are same as that of purposive sampling. Convenience sampling as well as purposive sampling is best suited for those researches which are preliminary or pilot projects, and which will be supplemented with further probability sampling research.

6. Cluster Sampling

Cluster sampling involves drawing samples from smaller clusters that the population is divided into. It should not be confused with stratified sampling. In cluster sampling, the population is either studied in multi-phase method, in different clusters, or samples are drawn from each cluster. This type of sampling is useful only where the population can be looked at, in a cluster. Unlike stratified sampling, cluster sampling does not require the population to be divided into homogeneous groups; that is to say the clusters may be heterogeneous. For example, an accrediting study is to be conducted on a private university in India. A university is a collection of students, teachers, visiting faculty, office staff, etc., and it cannot be divided into strata because it is best to be seen in its functional mode. But the University has various departments, which can be considered each as a cluster. The clusters may be studied one by one in multi-phase method or else samples may be formed out of each of the clusters, and studied together, just like we saw in

Stratified Sampling. Cluster sampling is part probability sampling and part non-probability sampling, so it may be classified as mixed sampling

Cluster sampling has the following advantages:

- ✓ It is useful where the population is divisible into clusters, even heterogeneous clusters.
- ✓ Cluster sampling is useful in large geographical areas.
- ✓ This sampling allows researcher some bit of flexibility, as division of clusters is not dependent on them being homogeneous. Therefore, more than one characteristic can be studied in one cluster.
- ✓ There is no need to have a prior knowledge of the population.

Cluster sampling has the following disadvantages:

- ✓ The clusters are not equal in size, so the final sample may not represent the population proportionately. Even if the study is conducted in multiphase manner, the clusters do not offer a comparative analysis.

- ✓ There is a possibility that a same person may form part of more than one cluster. This will lead to over representativeness.
- ✓ Formation of the clusters may or may not depend on the choice of the researcher, and thus, there is a possibility that some clusters may be homogeneous while other may be heterogeneous.

7. Sequential Sampling

Sequential sampling is also known as 'snowball sampling'. Snowball, as the name refers to, is the practice of doing a work in an on-going manner. Thus, sequential sampling does not end before the beginning of data collection. It is an ongoing process, wherein the researcher goes on collecting data even as s/he draws samples as required. For example for a study on access to human rights for the LGBT community in India the researcher may not be able to define the universe to draw out a sample, owing to the repressed state they live in India. The researcher may find out where he may be able to access the potential respondents and thereafter conduct sampling as he goes on with data collection. This is a non-probability sampling, as all units in the universe do not stand an equal chance of being included in the sample. This method of sampling is advantageous where it is difficult to demarcate the universe. Another advantage of this sampling is that it is cost-effective. It is useful where the nature of analysis is qualitative. A very big advantage of this sampling is the flexibility it offers to the researcher to adjust and correct the research as he goes on. However it is ineffective where the universe is huge and heterogeneous. An obvious disadvantage of sequential sampling is its failure to be representative of the entire population. The results obtained from the study cannot be generalised to the entire population.

8. **Quota Sampling**

Quota sampling is a very useful method of sampling where a large body of persons is to be studied. In quota sampling the population is divided into different categories on the basis of some characteristics, and selection of units in the sampling is done according to the proportion that group represents in the entire population. For quota sampling the researcher must first define the characteristics on the basis of which the population shall be divided into groups. The researcher must have knowledge about the proportion that each characteristic group possesses in the population. The sample drawn from the universe would proportionately represent the characteristics in the population.

Quota sampling is a non-probability sampling, because all units do not have the same chance of being included in the sample. The units to be chosen from each quota are the choice of the researcher. He may use purposive sampling or any technique of non-probability sampling. For example quota sampling can be used in a study of pre-teen and teenaged children of imprisoned parents in the state of Bihar. The universe is divided into boys and girls, and the researcher finds out that there are 750 boys and 500 girls. The researcher decides to draw a sample of 250 children. The researcher further divides the universe into age groups. Let us say the composition of the universe is the following:

Gender	Below6 yrs (Age Group I)	6 to 12 yrs (Age Group II)	13 to 19 yrs (Age Group III)	Total
Boys	250	300	200	750
Girls	150	200	150	500
Total	400	500	350	1250

Now that the proportion of each quota is found out, the sample can be drawn out according to the proportion each quota holds in the population. The researcher wants a sample of 250, which is 20% of the total population. So the researcher shall take 20% from each quota, i.e., 50 boys from age group I, 60 from age group II and so on...

Quota sampling is similar to stratified sampling, when it is done in proportional manner, i.e., Stratified Proportional Sampling. The only difference is that in Quota Sampling the focus is not to achieve groups of homogeneous groups, but only to divide the population into quotas, for comparison sake. The advantage of quota sampling is its cost and time efficacy. It is one of the most effective sampling, for small scale as well as large scale sampling.

9. **Multi-stage Sampling**

Multi stage sampling, as the name suggests, is sampling carried out in multiple stages. Different techniques at each stage may also be used. For example, for a study on the crime rate in India, the country is divided into different zones, North, West, South and East. This

is the first stage of sampling wherein stratified sampling is used, each zone being a stratum. The states in each zone serve as clusters, so the second stage of sampling is cluster sampling. Finally samples from each state are drawn out using purposive sampling. This is a simple example to illustrate the method of doing multi-stage sampling. Multi-stage sampling is a cost effective in large scale projects. It is not necessary to use different sampling techniques at each stage; it is entirely the judgment call of the researcher.

10. **Multi-phase Sampling**

Multi-phase sampling is quite similar to multi-stage sampling, barring some technical differences. The procedure for carrying out sampling is similar, but in multi-phase sampling, the aim is not to create a final sample. Study is done continually in various phases. Unlike multi-stage sampling, each sample is first studied as a sample, before further drawing sample out of it. An advantage of doing this sampling is that in-depth investigation is possible, as the universe is studied at different stages, and further samples are drawn out of it. This sampling has a high degree of representativeness. But a disadvantage of it is its lengthy process, which also escalates cost. This is often a preferred choice in large scale research studies that are institutionally sponsored.

11. **Volunteer Sampling**

Volunteer sampling is close to the convenience sampling, as in this type of sampling also the researcher chooses the respondents as per convenience. The only difference is that in this sampling, the researcher himself is a volunteer for the sample; that is to say, the researcher himself participates in the research as a sample. However, it is not considered an objective form of sampling, as personal bias of the researcher has access into the data collection. Also, representativeness of the sample is very questionable. This type of

sampling is only done in very small scale researches where empirical verifiability can be set free, so as to make way for qualitative conclusions.