Hypothesis & Its Types

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1. Introduction:

Hypothesis is usually considered as an important mechanism in Research. Hypothesis is a tentative assumption made in order to test its logical or empirical consequences. If we go by the origin of the word, it is derived from the Greek word- 'hypotithenai' meaning 'to put under' or to 'to suppose'. Etymologically hypothesis is made up of two words, "hypo" and "thesis" which means less than or less certain than a thesis. It is a presumptive statement of a proposition or a reasonable guess, based upon the available evidence, which the researcher seeks to prove through his study. A hypothesis will give a plausible explanation that will be tested. A hypothesis may seem contrary to the real situation. It may prove to be correct or incorrect. Hypothesis need to be clear and precise and capable of being tested. It is to be limited in scope and consistent with known or established facts and should be amenable to testing within the stipulated time. It needs to explain what it claims to explain and should have empirical reference.

2. Definition of Hypothesis:

"A hypothesis can be defined as a tentative explanation of the research problem, a possible outcome of the research, or an educated guess about the research outcome". Goode and Hatt have defined it as "a proposition which can be put to test to determine its validity". "Hypotheses are single tentative guesses, good hunches – assumed for use in devising theory or planning experiments intended to be given a direct experimental test when possible". According to Lundberg, "A hypothesis is a tentative generalisation, the validity of which remains to be tested. In its most elementary stage, the hypothesis may be any hunch, guess, imaginative idea, which becomes the basis for action or investigation".

Hence, a hypothesis is a hunch, assumption, suspicion, assertion or an idea about a phenomenon, relationship or situation, the reality or truth of which you do not know. A researcher calls these assumptions/ hunches hypotheses and they become the basis of an enquiry. In most studies the hypothesis will be based upon your own or someone else's observation. Hypothesis brings clarity, specificity and focus to a research problem, but is not essential for a study. You can conduct a valid investigation without constructing formal hypothesis. The formulation of hypothesis provides a study with focus. It tells you what specific aspects of a research problem to investigate. A hypothesis tells you what data to collect and what not to collect, thereby providing focus to the study. As it provides a focus, the construction of a hypothesis enhances objectivity in a study. A hypothesis may enable you to

add to the formulation of a theory. It enables you to specifically conclude what is true or what is false. Ludberg observes, quite often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable to some dependent variable.

3. Nature of Hypothesis:

The hypothesis is a clear statement of what is intended to be investigated. It should be specified before research is conducted and openly stated in reporting the results.

This allows to:

- ✓ Identify the research objectives.
- ✓ Identify the key abstract concepts involved in the research.
- ✓ Identify its relationship to both the problem statement and the literature review.
- ✓ A problem cannot be scientifically solved unless it is reduced to hypothesis form.
- ✓ It is a powerful tool of advancement of knowledge, consistent with existing knowledge and conducive to further enquiry.
- ✓ It can be tested – verifiable or falsifiable.
- ✓ Hypotheses are not moral or ethical questions.
- ✓ It is neither too specific nor to general.
- ✓ It is a prediction of consequences.
- ✓ It is considered valuable even if proven false.

Importance of Hypothesis:

Hypothesis though an important part of research may not be required in all types of research. The research which are based on fact finding (historical or descriptive research) do not need hypothesis. Hillway also says that "When fact-finding alone is the aim of the study, a hypothesis is not required". Whenever possible, a hypothesis is recommended for all major studies to explain observed facts, conditions or behaviour and to serve as a guide in the research process.

- ✓ Hypothesis facilitates the extension of knowledge in an area. They provide tentative explanations of facts and phenomena, and can be tested and validated. It sensitizes the investigator to certain aspects of the situations which are relevant from the standpoint of the problem in hand.

- ✓ Hypothesis provide the researcher with rational statements, consisting of elements expressed in a logical order of relationships which seeks to describe or to explain conditions or events, that have yet not been confirmed by facts. The hypothesis enables the researcher to relate logically known facts to intelligent guesses about unknown conditions. It is a guide to the thinking process and the process of discovery.

- ✓ Hypothesis provides direction to the research. It defines what is relevant and what is irrelevant. The hypothesis tells the researcher what he needs to do and find out in his study. Thus it prevents the review of irrelevant literature and provides a basis for selecting the sample and the research procedure to be used in the study.

- ✓ Hypothesis implies the statistical techniques needed in the analysis of data, and the relationship between the variables to be tested. It also helps to delimit his study in scope so that it does not become broad or unwieldy.

- ✓ Hypothesis provides the basis for reporting the conclusion of the study. It serves as a framework for drawing conclusions. In other word, we can say that it provides the outline for setting conclusions in a meaningful way.
- ✓

So, Hypothesis has a very important place in research although it occupies a very small place in the body of a thesis.

5. Sources of Hypothesis:

A good hypothesis can only be derived from experience in research. Though hypothesis should precede the collection of data, but some degree of data collection, literature review or a pilot study will help in the development and gradual refinement of the hypothesis. A researcher should have quality of an alert mind to derive a hypothesis and quality of critical mind of rejecting faulty hypothesis. The following sources can help the researcher in coming up with a good hypothesis:

- ✓ Review of literature.
- ✓ Discussion with the experts in the given field to understand the problem, its origin and objectives in seeking a solution.
- ✓ Intuition of the researcher also sometimes helps in forming a good hypothesis.
- ✓ Previous empirical studies done on the given area.

6. Understanding Types of Hypothesis:

Research Problems are too general by themselves to enable us to carryout meaningful analysis. They need to be specified in a more focussed way. Hypotheses are specific statements that relate to the problem, the answers to which are likely to be yes or no, depending upon what is uncovered from the research. Examples of Hypothesis can be:

- ✓ Suicide is related to general level of religiosity/secularisation of society.
- ✓ Alienation and political participation are negatively related.

Such statements specify links between different phenomena, in order to explain different patterns of behaviour that appear to occur. However, such patterns of association do not necessarily demonstrate that a causal relationship exists. We cannot for an instance say, ‘socio-economic deprivation causes suicide.’ If that was the case, then all those in Britain defined by various yardsticks as living in a state of relative poverty would inevitably commit suicide. This is very unlikely to happen.

7.1 Variable:

So, to understand the types of hypothesis, we need to understand the concept of variables first. The variables are empirical properties that take two or more values or in other words a variable is any entity that can take on different values. In simple terms, anything that can vary or that is not constant can be considered a variable. For instance, age can be considered a variable because age can take different values for different people or for the same person at different times. Similarly, country can be considered a variable because a person's country can be assigned a value.

A variable is a concept or abstract idea that can be described in measurable terms. In research, this term refers to the measurable characteristics, qualities, traits, or attributes of a particular individual, object or situation being studied. Variables differ in many respects, most notably in the role they are given in our research and in the type of measures that can be applied to them. The statement of problem usually provides only general direction for the research study. It does not include all the specific information. There is some basic terminology that is extremely important in how we communicate specific information about research problems and research in general. So, weight, height, income are all examples of variables.

In Research, there is a need to make a distinction between various kinds of variables. There are many classifications given for variables. We will try to understand only the Dependent Variable and Independent Variable.

7.1.1 Independent Variables:

The variables which are manipulated or controlled or changed. These are also known as manipulated variables. Researchers often mistake independent variable and assume that it is independent of any manipulation. It is called independent because variable is isolated from any other factor. In research, we try to determine whether there is a cause and effect relationship. In fact, when you are looking for some kind of relationship between variables you are trying to see if the independent variable causes some kind of change in the other variables, or dependent variables.

7.1.2 Dependant Variables:

Dependent variables are the outcome variables and are the variables for which we calculate statistics. The variable which changes on account of independent variable is known as dependent variable. It is something that depends on other factors. For example, a test score could be a dependent variable because it could change depending on several factors such as how much you studied, how much sleep you got the night before you took the test, or even how hungry you were when you took it. Usually when you are looking for a relationship between two things you are trying to find out what makes the dependent variable change the way it does.

As we have discussed that a variable is an image, perception or concept that can be measured, hence capable of taking on different values. The variables that you wish to explain are regarded as dependant variables or criterion variables. The other variable expected to explain the change in the dependant variable is referred to as an independent variable or predictor variable. The dependant variable is the expected outcome of the independent variable and independent variable produce dependant variables.

Variables can have three types of relationships among them.

- ✓ A positive relationship is one where an increase in one would lead to increase in the other.
- ✓ A negative relationship is one where an increase in one variable lead to decrease in the other.
- ✓ A zero relationship is one which shows no significant relationship between the two variables.
- ✓ Once we have understood variables, we can discuss the various types of hypothesis.

7.2 The Types of Hypothesis:

7.2.1 Research Hypothesis:

The Research Hypothesis could be understood in terms of Simple Research hypothesis and Complex Research Hypothesis. A simple research hypothesis predicts the relationship between a single independent variable and a single dependent variable. A Complex hypothesis predicts the relationship between two or more independent variables and two or more dependent variables. A research hypothesis must be stated in a testable form for its proper evaluation and it should indicate a relationship between variables in clear, concise and understandable language. Research Hypothesis are classified as being directional or non-directional.

- ✓ **Directional Hypotheses**: These are usually derived from theory. They may imply that the researcher is intellectually committed to a particular outcome. They specify the expected direction of the relationship between variables i.e. the researcher predicts not only the existence of a relationship but also its nature.
- ✓ **Non-directional Hypotheses:** Used when there is little or no theory, or when findings of previous studies are contradictory. They may imply impartiality. Do not stipulate the direction of the relationship.

Associative and causal Hypotheses:

- ✓ **Associative Hypotheses:** Propose relationships between variables - when one variable changes, the other changes. Do not indicate cause and effect.
- ✓ **Causal Hypothesise:** Propose a cause and effect interaction between two or more variables. The independent variable is manipulated to cause effect on the dependent variable. The dependent variable is measured to examine the effect created by the independent variable.

Statistical Hypothesis:

To test whether the data support or refute the research hypothesis, it needs to be translated into a statistical hypothesis. It is given in statistical terms. In the context of inferential statistics, it is statement about one or more parameters that are measures of the population under study. Inferential statistics is used for drawing conclusions about population values. To use inferential statistics, we need to translate the research hypothesis into a testable form, which is called the null hypothesis**.** A testable hypothesis contains variables that are measurable or able to be

manipulated. They need to predict a relationship that can be 'supported' or 'not supported' based on data collection and analysis.

- **Null Hypothesis:** These are used when the researcher believes there is no relationship between two variables or when there is inadequate theoretical or empirical information to state a research hypothesis. The null hypothesis represents a theory that has been put forward, either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved. Has serious outcome if incorrect decision is made. Designated by: Ho or Hn.

Null hypotheses can be:

- ✓ simple or complex
- ✓ associative or causal

- **The Alternative Hypothesis:** The alternative hypothesis is a statement of what a hypothesis test is set up to establish. Designated by: H1 or Ha. It is opposite of Null Hypothesis. It is only reached if Ha is rejected. Frequently “alternative” is actual desired conclusion of the researcher.

We give special consideration to the null hypothesis. This is due to the fact that the null hypothesis relates to the statement being tested, whereas the alternative hypothesis relates to the statement to be accepted if when the null is rejected. The final conclusion, once the test has been carried out, is always given in terms of the null hypothesis. We either 'reject Ho in favour of Ha' or 'do not reject Ho'; we never conclude 'reject Ha', or even 'accept Ha'. If we conclude 'do not reject Ho', this does not necessarily mean that the null hypothesis is true, it only suggests that there is not sufficient evidence against Ho in favour of Ha; rejecting the null hypothesis then, suggests that the alternative hypothesis may be true. For example:

Ha= the males visited cinema more than females.

Ho= the males and females do not differ in respect of the frequency of seeing cinema. So, Alternative hypothesis is usually the one which one wishes to prove and the Null

hypothesis is the one which one wishes to disapprove.

8.Formulating a Hypothesis:

There are no precise rules for formulating hypothesis and deducing consequences but there are some difficulties that arise in formulating the hypothesis. However, there are certain necessary conditions that are conducive to their formulation. They are:

-Richness of background knowledge: In the absence of knowledge concerning a subject matter, one can make no well founded judgement of relevant hypothesis. Background knowledge is essential for perceiving relationships among the variables and to determine what findings other researchers have reported on the problem under study. New knowledge, new discoveries and new inventions should always form continuity with the already existing corpus of knowledge and therefore it becomes all the more essential to be well versed with the already existing knowledge.

Hypothesis can be formulated correctly by persons who have rich experience and academic background, but they can never be formulated by those who have poor background knowledge.

Logical and Scientific approach: Formulation of proper hypothesis depends on one's experience and logical insight. Hypothesis does not have a clear cut and definite theoretical background. Partly, it is a matter of lifting upon an idea on some problem and it is not always possible to have complete information of, and acquaintance with the scientific methods for formulating hypothesis. This lack of scientific knowledge presents difficulty in formulation of hypothesis. A researcher may begin a study by selecting one of the theories in his own area of interest and deduce a hypothesis from this theory through logic which is possible only when the researcher has a proper understanding of the scientific method and has a versatile intellect. At times, conversations and consultations with colleagues and experts from different fields are also helpful in formulating important and useful hypothesis.

9. Characteristics of A Good Hypothesis:

Hulley says a good hypothesis must be based on a good research question. It should be simple, specific and stated in advance. So, a hypothesis could be called as a good hypothesis if it possesses the following characteristics:

- ✓ Hypothesis should be simple so that it is easily understood by everyone.
- ✓ Hypothesis should be clear, specific and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.
- ✓ Hypothesis should be capable of being tested.
- ✓ Hypothesis should state relationship between variables.
- ✓ Hypothesis should be consistent with most known facts. i.e. it must be consistent with a substantial body of established facts.
- ✓ The hypothesis must explain the facts that gave rise to the need for explanation. It must actually explain what it claims to explain.

10. Hypothesis Testing:

When the purpose of the research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of experimental design or the non-experimental design. Research in which the independent variable is manipulated is termed 'experimental hypothesis-testing research' and a research in which an independent variable is not manipulated is called 'non-experimental hypothesis testing research'.

As we have discussed the Null hypothesis (Ho) and Alternative Hypothesis (Ha) earlier so while testing hypothesis we generally proceed on the basis of Null hypothesis (Ho), keeping the Alternative hypothesis in view. We do so because on the assumption that Null hypothesis is true, one can assign the probabilities to different possible sample results, but this cannot be done if we proceed with the Alternative hypothesis. Hence the use of null Hypothesis is quite frequent. While testing the Hypothesis the following things to be kept in mind:

Level of significance: This is a very important concept in the context of hypothesis testing. It is always some percentage (usually 5%) which should be chosen with great care, thought and reason. In case we take the significance level at 5%, then this implies that Ho will be rejected when the sampling result (i.e observed evidence) has a less than 0.05 probability of occurring if Ho is true. In other words, the 5% level of significance means that researcher is willing to take as much as a 5% risk of rejecting the Null hypothesis when it happens to be

true. Thus, the significance level is the maximum value of the probability of rejecting Ho when it is true and is usually determined in advance before testing the hypothesis.

- ✓ The criteria for rejecting the null hypothesis may differ. Sometimes the Null hypothesis is rejected only when the quantity of the outcome is so large that the probability of its having occurred by mere chance is 1 times out of 100. We consider the probability of its having occurred by chance to be too little and we reject the chance theory of the Null hypothesis and take the occurrence to be due to genuine tendency. On the other occasions, we may reject the Null hypothesis even when the quantity of the reported outcome is likely to occur by chance 5 times out of 100. Statistically the former is known as the rejection of Null hypothesis at 0.1 level and the latter is known as the rejection at 0.5 level. It may be pointed out that if the researcher is able to reject the Null hypothesis, he cannot directly uphold the declarative hypothesis. If an outcome is not held to be due to chance, it does not mean that it is due to the very cause and effect relationship asserted in the particular declarative statement. It may be due to something else which the researcher may have failed to control.

- ✓ Declaration rule or test of hypothesis: Given a Null hypothesis (Ho) and Alternative hypothesis (Ha), we make a rule which is known as decision rule according to which we accept Ho (i.e reject Ha)or reject Ho(i.e accept Ha). For instance, if Ho is, that a certain lot is good (there are very few defective items in it) against Ha that the lot is not good (there are too many defective items in it), then we must decide the number of items to be tested and the criterion for accepting or rejecting the hypothesis. We might test 10 times in the lot and plan our decision saying that if there are none or only 1 defective item among the 10, we will accept Ho otherwise we will reject Ho (or accept Ha). This sort of basis is known as decision rule.

- ✓ Two-tailed and one-tailed test: In the context of hypothesis testing, these two terms are quite important and must be clearly understood. A two-tailed rejects the Null hypothesis if, say, the sample mean is significantly higher or lower than the hypothesized value of the mean of the population. Such a test is appropriate when the Null hypothesis is some specified value and the Alternative hypothesis is a value not equal to the specified value of Null hypothesis. In a two-tailed test, there are two rejection regions, one on each tail of the curve which can be illustrated as under:

- If the significance level is 5% and the two-tailed test is to be applied, the probability of the rejection area will be 0.005 (equally divided on both tails of the curve is 0.0025) and that of the acceptance region will be 0.95.

- But there are situations when only one-tailed test is considered appropriate. A one-tailed test would be used when we are to test, say, whether the population mean is either lower than or higher than some hypothesized value. We should always remember that accepting Ho, on the basis of sample information does not constitute the proof that Ho, is true. We only mean that there is no statistical evidence to reject it.

11. Errors in Testing of Hypothesis:

There are basically two types of errors we make in the context of testing of Hypothesis. These are called as Type-I error and the Type-II error. In type-I error, we may reject Null hypothesis when Null hypothesis is true. Type-II error is when we accept Null hypothesis when the Null Hypothesis is not true. In other words, Type-I error means rejection of hypothesis which should have been accepted and Type-II error means accepting the hypothesis which should have been rejected. Type-I error is denoted by alpha known as alpha error, also called the level of significance of test and Type-II error is denoted by beta known as beta error.

	Accept Null hypothesis	Reject Null hypothesis
Null hypothesis (true)	Correct decision	Type-I error (alpha error)
Null hypothesis (false)	Type-II error (beta error)	Correct decision

The probability of Type-I error is usually determined in advance and is understood as the level of significance of testing the hypothesis. If Type-I error is fixed at 5%, it means that there are about 5 chance in

100 that we will reject Null hypothesis when Null hypothesis is true. We can control Type-I error just by fixing at a lower level. For instance, if we fix it at 1%, we will say that the maximum probability of committing Type-I error would only be 0.01.

But with the fixed sample size, when we try to reduce Type-I error, the probability of committing Type-II error increases. Both types of errors cannot be reduced simultaneously. There is trade off between two types of errors which means that the probability of making one type error can only be reduced if we are willing to increase the probability of making the other type of error. One must set a very high level for Type-I error in one's testing technique of a given hypothesis. Hence, in the testing of hypothesis, one must make all possible efforts to strike an adequate balance between Type-I and Type-II errors.