

# Chapter 8

## Hypothesis Testing

### Objectives

*After completing this chapter, you will be able to:*

- Learn the difference between assumption, hypothesis and postulate
- Learn the functions and roles of a hypothesis
- Know the characteristics of a good hypothesis

### Introduction

A statistical hypothesis is a hypothesis that is testable on the basis of observed data modeled as the realised values taken by a collection of random variables.[1] A set of data (or several sets of data, taken together) are modelled as being realised values of a collection of random variables having a joint probability distribution in some set of possible joint distributions. The hypothesis being tested is exactly that set of possible probability distributions. A statistical hypothesis test is a method of statistical inference. An alternative hypothesis is proposed for the probability distribution of the data, either explicitly or only informally.

The comparison of the two models is deemed statistically significant if, according to a threshold probability -- the significance level -- the data is very unlikely to have occurred under the null hypothesis. A hypothesis test specifies which outcomes of a study may lead to a rejection of the null hypothesis at a pre-specified level of significance, while using a pre-chosen measure of deviation from that hypothesis (the test statistic, or goodness-of-fit measure). The pre-chosen level of significance is the maximal allowed "false positive rate". One wants to control the risk of incorrectly rejecting a true null hypothesis.

The process of distinguishing between the null hypothesis and the alternative hypothesis is aided by considering two conceptual types of errors. The first type of error occurs when the null hypothesis is wrongly rejected. The second type of error occurs when the null hypothesis is wrongly not rejected. (The two types are known as type 1 and type 2 errors.)

Hypothesis tests based on statistical significance are another way of expressing confidence intervals (more precisely, confidence sets). In other words, every hypothesis test based on significance can be obtained via a confidence interval, and every confidence interval can be obtained via a hypothesis test based on significance. Significance-based hypothesis testing is the most common framework for statistical hypothesis testing. An alternative framework for statistical hypothesis testing is to specify a set of statistical models, one for each candidate hypothesis, and then use model selection techniques to choose the most appropriate model.

### Assumption, Postulate And Hypothesis

- **Assumption:** Assumption means taking things for granted so that the situation is simplified for logical procedure. Assumptions are not the very ground of our activity as the postulates are. They merely facilitate the progress of an agreement a partial simplification by introducing restrictive conditions.
- **Postulate:** Postulates are the working beliefs of most scientific activity. A postulate is a statement assumed to be true without need of proof of any kind. A postulate states an assumption that we make about some relationship between objects.
- **Hypothesis:** A hypothesis is different from both of these. It is the presumptive statement of a proposition which the investigator seeks to prove. It is a condensed generalization. This generalization requires knowledge of principles of things or essential characteristics which pertain to entire class of phenomena. The theory when stated as a testable proposition formally and clearly and subjected to empirical or experimental verification is known as hypothesis.

### 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;
- the key abstract concepts involved in the research; and
- its relationship to both the problem statement and the literature review.
- The following are the main features of a hypothesis –
- It...
  - Is conceptual in nature.
  - Is a verbal statement in a declarative form.
  - Has the empirical referent.
  - Indicates the tentative relationship between two or more variables.
  - Is a powerful tool of advancement of knowledge, consistent with existing knowledge and conducive to further enquiry.
  - Can be tested, verifiable or falsifiable.
  - Is not moral or ethical questions.
  - Is neither too specific nor too general.
  - Is a prediction of consequences?
  - Is considered valuable even if proven false.

### FUNCTIONS / ROLES OF HYPOTHESIS

A hypothesis, which is a provisional formulation, plays significant role in empirical or socio-legal research. It not only navigates research in a proper direction but also contributes in testing or suggesting theories and describing a social or legal phenomenon. Role of hypothesis in navigating research: A hypothesis, regardless of its source, states what a researcher is looking for. It also suggests some plausible explanations about the probable relationships between the concepts or variables indicated therein. In fact, it navigates the research. Without it, no further step is possible

in empirical research or non-doctrinal legal research. The following are some of the important role and functions of the hypothesis -

- Helps in knowing the needs of the data.
- Explains social phenomena.
- Develops the theory.
- Also acts as a bridge between the theory and the investigation.
- Provides a relationship between phenomena in such a way that it leads to the empirical testing of
- the relationship.
- Helps in knowing the most suitable technique of analysis.
- Helps in the determination of the most suitable type of research.
- Provides knowledge about the required sources of data.
- Research becomes focused under the direction of the hypothesis.
- It is very helpful in carrying out an enquiry of a certain activity.
- Helps in reaching conclusions, if it is correctly drawn.

*There are five main functions of hypothesis in the research process suggested by Mc. Ashan*

1. It is a temporary solution of a problem concerning with some truth which enables an investigator
1. to start his/her research works.
2. It offers a basis in establishing the specifics what to study for and may provide possible
3. solutions to the problem.
4. Each hypothesis may lead to formulate another hypothesis.
5. A preliminary hypothesis may take the shape of final hypothesis.
6. Each hypothesis provides the investigator with definite statement which may be objectively tested and accepted or rejected and leads for interpreting results and drawing conclusions that is related to original purpose

### **IMPORTANCE OF HYPOTHESIS**

- Provide direction to research and prevent the review of irrelevant literature and the collection of useful or excess data.
- Sensitize the investigator certain aspects of situation which are irrelevant from the standpoint of the problem at hand.
- Enable the investigator to understand with greater clarity his/her problem and its ramification.
- Serve as a framework for the conclusive - in short a good hypothesis: (a) Gives help in deciding the direction in which he has to proceed. (b) It helps in selecting pertinent fact. (c) It helps in drawing conclusions.
- Van Dalen advocates the importance of hypothesis in the following ways -
- Hypotheses are indispensable research instrument, for they build a bridge between the problem and the location of empirical evidence that may solve the problem.
- A hypothesis provides the map that guides and expedites the exploration of the phenomena under consideration.

- A hypothesis pin points the problem. The investigator can examine thoroughly the factual and conceptual elements that appear to be related to a problem.
- Using hypothesis determines the relevancy of facts. A hypothesis directs the researcher's efforts into a productive channels.
- The hypothesis indicates not only what to look for is an investigation but how to obtain data. It helps in deciding research design. It may suggest what subjects, tests, tools, and techniques are needed.
- The hypothesis provides the investigator with the most efficient instrument for exploring and explaining the unknown facts.
- A hypothesis provides the framework for drawing conclusions.
- These hypotheses simulate the investigator for further research studies.

### **CHARACTERISTICS OF A GOOD HYPOTHESIS**

A good hypothesis must possess the following characteristics –

It...

- is never formulated in the form of a question.
- should be empirically testable, whether it is right or wrong.
- should be specific and precise.
- should not be contradictory.
- should specify variables between which the relationship is to be established.
- should describe one issue only. A hypothesis can be formed either in descriptive or relational form.
- does not conflict with any law of nature which is known to be true.
- guarantees that available tools and techniques will be effectively used for the purpose of verification.
- should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned.
- must explain the facts that gave rise to the need for explanation.
- should be amenable to testing within a reasonable time.

### **ORIGINS / SOURCES OF HYPOTHESIS**

Hypotheses are originated from essentially the same background that serves to reveal problem. These sources are namely theoretical background, knowledge, insight and imagination that come from instructional program and wide reading experiences, familiarity with existing practices. The major sources of hypotheses are given below-

- Specialization of an educational field.
- Published studies, abstracts research journals, hand books, seminars on the issue, current trends on the research area.
- Instructional programs persuaded.
- Analyze of the area studied.
- Considering existing practices and needs.
- Extension of the investigation.
- Offshoots of research studies in the field.

### **TYPES OF RESEARCH HYPOTHESIS**

Research hypotheses are of different types: simple, complex, directional, nondirectional, associative, causal, inductive & deductive, null, and alternative or research.

**Simple Hypothesis:** This predicts the relationship between a single independent variable (IV) and a single dependent variable (DV). For example: Lower levels of exercise postpartum (IV) will be associated with greater weight retention (DV).

**Complex Hypothesis:** This predicts the relationship between two or more independent variables and two or more dependent variables. Example of a complex multiple independent variable hypothesis - low risk pregnant women (IV) who •value health highly; •believe that engaging in health promoting behaviours will result in positive outcomes; •perceive fewer barriers to health promoting activities; are more likely than other women to attend pregnancy-related education programs (DV). Another example of a complex multiple dependent variable hypothesis - the implementation of an evidence based protocol for urinary incontinence (IV) will result in (DV) •decreased frequency of urinary incontinence episodes; •decreased urine loss per episode; •decreased avoidance of activities among women in ambulatory care settings.

**Directional Hypothesis:** This 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. Scientific journal articles generally use this form of hypothesis. The investigator bases this hypothesis on the trends apparent from previous research on this topic. Considering the example, a researcher may state the hypothesis as, 'High school students who participate in extracurricular activities have a lower GPA than those who do not participate in such activities.' Such hypotheses provide a definite direction to the prediction.

**Nondirectional Hypothesis:** This form of hypothesis is used in studies where there is no sufficient past research on which to base a prediction. Do not stipulate the direction of the relationship. Continuing with the same example, a nondirectional hypothesis would read, 'The academic performance of high school students is related to their participation in extracurricular activities.'

**Associative Hypothesis:** Associative hypotheses propose relationships between variables, when one variable changes, the other changes. Do not indicate cause and effect

**Causal Hypothesis:** Causal hypotheses 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. For the example mentioned, the causal hypothesis will state, 'High school students who participate in extracurricular activities spend less time studying which leads to a low GPA.' When verifying such hypotheses, the researcher needs to use statistical techniques to demonstrate the presence of a relationship between the cause and effect. Such hypotheses also need the researcher to rule out the possibility that the effect is a result of a cause other than what the study has examined.

**Inductive and Deductive Hypotheses:** Inductive hypotheses are formed through inductively reasoning from many specific observations to tentative explanations. Deductive hypotheses are formed through deductively reasoning implications of theory.

**Null Hypothesis:** This is a hypothesis that proposes no relationship or difference between two variables. This is the conventional approach to making a prediction. It involves a statement that says there is no relationship between two groups that the researcher compares on a certain variable. The hypothesis may also state that there is no significant difference when different groups are compared with respect to a particular variable. For example, 'There is no difference in the academic performance of high school students who participate in extracurricular activities and those who do not participate in such activities' is a null hypothesis. It asserts that there is no true difference in the sample statistic and population parameter under consideration (hence the word 'null' which means invalid, void, or amounting to nothing) and that the difference found is accidental arising out of fluctuations of sampling. It is denoted as  $H_0$

Table 4.1

*States of Nature and Decisions on Null Hypothesis*

Decision on Null Hypothesis	States of Nature	
	Null Hypothesis True	Null Hypothesis False
Accept	Correct Decision Probability = $1 - \alpha$	Type II error Probability = $\beta$
Reject	Type I error Probability = $\alpha$ ( $\alpha$ is called significance level)	Correct Decision Probability = $1 - \beta$ ( $1 - \beta$ is called power of a test)

The rejection of the null hypothesis indicates that the differences have statistical significance and the acceptance of the null hypothesis indicates that the differences are due to chance.

**Alternate or Research Hypothesis:** This hypothesis proposes a relationship between two or more variables, symbolized as  $H_1$ . For example, if a researcher was interested in examining the relationship between music and emotion, s/he may believe that there is a relationship between music and emotion.  $H_1$  (the research/alternate hypothesis): Music at a fast tempo is rated by participants as being happier than music at a slow tempo.  $H_0$  (the null hypothesis): Music at a fast tempo and at a slow tempo is rated the same in happiness by participants. The two hypotheses we propose to test must be mutually exclusive; i.e., when one is true the other must be false. And we see that they must be exhaustive; they must include all possible occurrences.

**Statistical Hypothesis:** Statistical hypothesis is an assumption about statistical populations that one seeks to support or refute. The null hypothesis and alternative hypothesis together are called statistical hypothesis.

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**Video Links:*****Hypothesis Testing***

- <https://www.youtube.com/watch?v=VK-rnA3-41c>
- [https://www.youtube.com/watch?v=\\_Qlxt0HmuOo](https://www.youtube.com/watch?v=_Qlxt0HmuOo)
- <https://www.youtube.com/watch?v=e6HslWQJjdM>

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**References**

- <file:///C:/Users/Jhoy/Downloads/FormulatingandTestingHypothesis.pdf>
  - [https://en.wikipedia.org/wiki/Statistical\\_hypothesis\\_testing](https://en.wikipedia.org/wiki/Statistical_hypothesis_testing)
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