

Null hypothesis and alternative hypothesis philosophy essay



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In order to survive in the business world, business units today are forced to innovate and launch the products immediately in the market. But this is easier said than done. Numerous factors come into the picture for this to materialise. Notably among them is the fact that too much cost factor which comes into the picture. For the product launching is well planned and thought off activity.

The activities include conducting market surveys which in plain sense means that the business units are required to conduct or determine the feasibility of the new product within a limited area and then based on the results they take further course of action i. e. go ahead with the launch of the product or to drop the project altogether.

In other words, business units conduct sample surveys i. e. obtaining the response on a small piece of the larger picture and then based on the results of the small piece, estimate the likely response on the larger piece of the picture. The small piece is known as the sample and the larger piece is known as the population.

Thus the concept of sample and population plays a vital role and assists the management in taking core decisions which may or not prove fruitful in the survival of the business. In order, to take decisions based on the sample and to estimate the population parameters business units are required to start with some of the assumptions or the hypothesis. And, based on assumptions or hypothesis about the population it is tested meaning that whatever the assumption that they started with, whether the assumption was correct or incorrect. Thus we have hypothesis testing.

Let us take an example to illustrate what has been said above. Suppose, the business units want to bring in a new product in the market which will increase the market share and hence the profitability of the business unit. In this case, the hypothesis would be introduction of new product will increase the profitability and based on this the survey would be conducted. The results of analysis of the data will reveal whether the hypothesis was correct or incorrect.

This unit will cover the basics of hypothesis and its testing; the steps required to test the hypothesis. This unit will also cover the types and characteristics of hypothesis and the like.

Objectives

After studying this unit, the reader will be able to:

Understand the basic concepts of hypothesis

Understand the various types and the characteristics of hypothesis

Understand the steps involved in the testing of hypothesis

Understand the two tailed and the one tailed tests involved in the testing of hypothesis

Understand the criterion when to accept or when to reject the hypothesis

Understand the manner in which decisions are to be taken on the basis of the results arrived during the process of testing of hypothesis

6. 2 Defining Hypothesis

In order to discuss the basics of hypothesis testing in detail let us now, define what is meant by hypothesis.

Simply speaking, hypothesis is a unit of the inferential statistics (i. e. the branch of statistics which is used to infer information on the collected data) which is used to test a claim about the larger portion (which is called population) based on the data collected from the smaller part known as sample. In other words hypothesis testing is the process of staking claim based on the values obtained from the sample.

Let us take an example in order to drive home the point illustrated above.

A manufacturer involved in the manufacturing of tires claims that the average life of their tires will last at least 70, 000 kms. We want to test the claim made by the manufacturer. The process we will adopt is to take a sample of tires, run them until they see how many kms. on average they have lasted. If the sample has lasted over 70, 000 kms, then we do have the reason to believe that the claim is correct and that all the other tires they produce will also last 70, 000 kms. miles.

In arriving at this conclusion, we may commit the following

We may incorrectly say “ the tires do not last at least 70, 000 kms” when in fact they do last

We may incorrectly say “ the tires do last at least 70, 000 kms” when in fact they do not

Thus, we may commit some errors during the process of staking the claim to the hypothesis we have formulated.

This aspect will be covered in next section

Self Assessment Questions

True or False

Managers are required to make decisions

Hypothesis is an assumption about something which is taken to be true

We may commit some errors in the process of testing of hypothesis

6. 3 Characteristics of Hypothesis

Having understood the definition of hypothesis, let us now understand the characteristics of hypothesis. The following are the characteristics of hypothesis.

A hypothesis is based on reasoning which appears to be justified

This simply means that the hypothesis we have formulated should be based on the previous research and the hypothesis should follow the most likely outcome not the exceptional outcome. For example, we should form the hypothesis regarding the launching of new product on the basis of the previous data which was analysed and which prompted us to take further steps such as market research and the like

A hypothesis should provide a reasonable explanation for the outcome which is to be predicted

This means that the hypothesis formulated should not focus on the unrealistic outcome i. e. the hypothesis should be based on the realistic scenario. For example, an hypothesis such as our new software will surpass the sales of the software dealer who is leading the software market or that our software will sell very well on the surface of the moon. All these are unrealistic.

A hypothesis should clearly state the relationship between the variables that are defined

This simply means that the hypothesis should not be vague. It should be in plain simple terms and in a language which is simple to understand. For example, the hypothesis that the MIS report will be printed somewhat in 3 to 4 minutes is ambiguous and confusing.

A hypothesis defines the variables measurable terms

This means that the hypothesis focus on the aspects such as who all would be affected; who are the players in the process and the like. For example, hypothesis, that the product will work correctly for 2 months for small children.

A hypothesis is testable in a given or sufficient amount of time

This means that the hypothesis is tested within a finite amount of time. An hypothesis which cannot be tested within the finite amount of time will never be tested nor accepted

Self Assessment Questions

Fill in the blanks

A hypothesis is _____ in a given period of _____

Hypothesis defines _____ in measurable terms

Hypothesis should define the _____ between the variables

6. 4 Types of Hypothesis

Having understood the basic terminology of hypothesis let us now discuss the types of hypothesis. Though we have just scratched the types of hypothesis, let us now go deeper into the detail of types of hypothesis.

Hypothesis are of various types. Some of them are discussed below

Null hypothesis

Alternate hypothesis

Simple Hypothesis

Complex hypothesis

Null Hypothesis

This hypothesis is formulated when the statistician believes that there is no relationship between two variables or when there is insufficient information to formulate a state a research hypothesis. It is denoted by H_0

Alternate hypothesis

This hypothesis is the opposite of Null hypothesis. It is formulated when the researcher believes that there is sufficient information to believe that there is a relationship between the variables. It is represented as H_1 or H_a .

Simple hypothesis

This hypothesis predicts the relationship between an independent variable and a dependent variable. Both the variables must be single variables.

Complex hypothesis

This hypothesis is used to predict the relationship between two or more independent variables and two or more dependent variables.

Examples of different types of Hypothesis

Health related education programmes influence the number of people who smoke

Newspapers affect people's living standards

Absenteeism in classes affects exam scores

Lower levels of exercise are responsible for an increase in weight

Self Assessment Questions

True or False

Complex hypothesis is used to predict the relationship between two or more independent variables with two or more dependent variables

Alternate hypothesis is opposite to null hypothesis

6.5 Hypothesis Testing

Having understood the various types of hypothesis let us dwell on the important point of hypothesis testing. As stated above hypothesis means that we verify the claim on the larger unit based on the data and the results obtained by performing statistical tests on the data. let us now look at the steps involved in the testing of hypothesis. the following are the steps :

Describe in a statement about the population characteristic for which the hypotheses is to be tested

State the null hypothesis and depict as H_0

State the alternative hypothesis depict it as H_1 or H_a

Identify and display the test statistic that will be used

Identify the region of rejection region

Is it on the upper, lower, or on the two-tailed test

Determine the critical value that will be associated as α , the level of significance at which the test is to be conducted

Compute the quantities in the test statistic

State the conclusion based on the computed statistics meaning that it is now to be decided as to whether reject the null hypothesis, H_0 , or accept the alternate hypothesis. The conclusion is dependent on the level of significance of the test.

Figure 1 provides a graphical view of the steps involved in the testing of hypothesis

Figure 1 Steps involved in the testing of hypothesis

6. 6 Difference between Null Hypothesis and Alternative Hypothesis

In the previous units we have understood the basics of null hypothesis and alternative hypothesis, let us now discuss the difference between these types of hypothesis. the following are the differences

Null hypothesis is used to describe the prediction while alternative hypothesis describes other possible outcomes. For example, if we predict A is related to B which is null hypothesis while the alternative hypothesis will be A is not related to B meaning that A can be teacher of B, A can be mentor of B and so on

The alternative hypothesis can be negative but it does not necessarily mean a negation of null hypothesis but rather that it is a measure of finding out whether the null hypothesis is true or not meaning that whether it should be accepted or it should be rejected

Alternative hypothesis provides an opportunity to look at other things and other possibilities where as null hypothesis provides the presence or absence

of the same meaning that when we deal with null hypothesis our focus becomes restricted while in the case of alternative hypothesis our focus needs to be wider

6.7 Decision Rule

Decision rules are the procedures that enable us to determine whether the findings of the observed samples are in sharp contradiction i. e. there is significant difference from the results that were expected and which will thus help us to decide whether to accept or reject hypotheses are called rules of decision or simply decision rules.

Let us take an example in order to illustrate what has been said with regard to decision rule. Suppose that we toss a coin 50 times and get head 42 times and if we had the null hypothesis that the coin is fair. Now in this scenario, there is sufficient reason to believe that the coin is biased based on the output obtained although we may be wrong in this manner. In the current scenario, the observations are saying something else in comparison to our hypothesis, hence, we are in a dilemma as to accept or reject the hypothesis. Procedures, which assist us in deciding whether to accept or reject the hypothesis when there is significant difference between the observed and the stated are known as Decision Rules.

Type I and Type II errors

It is in situations like the above, that we may commit errors or mistakes which are classified as

Type I or Type II errors.

Type I error is when we reject the hypothesis when it should have been accepted

Type II error is when we accept a hypothesis when it should have been rejected

From the above definitions, in both the cases a wrong decision has been made. Hence, it becomes imperative that we need to minimize the errors while making decisions.

Level of Significance

While testing the given hypothesis the maximum risk that we can take for Type I error is called the level of significance of the test. This is denoted by Greek letter Alpha α . It is decided before hand so that they do not influence the choice of our decisions.

6.8 Two tailed and one tailed tests

In order to understand the concept of two tailed and one tailed tests, consider the following scenario. Let us have a null hypothesis H_0 and an alternative hypothesis H_1 . We want to conduct the test and determine whether we should reject the null hypothesis in favour of alternative hypothesis.

Thus, we have two different types of test which can be performed viz. One Tailed test and Two Tailed test

One-tailed test seeks to look for an increase or decrease in the parameter under consideration while two-tailed test seeks to look for any change in the parameter

We can carry out the test at any level 1%, 5% or 10% are the common levels. For example, when we perform the test at a 5% level it means that there is a 5% chance of wrongly rejecting H_0 that is null hypothesis on the other hand If we perform the test at the 5% level and decide to reject the null hypothesis, we say that there is a significant evidence at 5% to suggest that the hypothesis is false".

One-Tailed Test

For the one tailed test we choose a critical region. In a one-tailed test, the critical region will have one part. If the sample value lies in this region, we will reject the null hypothesis in favour of the alternative

On the other hand , if we want to look for definite decrease. Then the critical region will be to the left.

Example

Suppose we are given that in a Poisson distribution and we want to test hypothesis on the mean, based upon a sample of observation 3.

Suppose the hypotheses are:

$$H_0: \lambda = 9$$

$$H_1: \lambda < 9$$

We want to test if it is “reasonable” for the value observed to be 3 to have been derived from Poisson distribution with having a parameter value of 9. What is the probability that the value as low as 3 has come from a Poisson distribution have the value 9?

$P(X \leq 3) = 0.0212$ (this has been obtained from Poisson table)

The probability is less than 0.05, which means that there is less than a 5% chance that the value has come from a Poisson(3) distribution. The null hypothesis should be rejected in favour of the alternative at the 5% level.

Two-Tailed Test

In a two-tailed test, we look for either an increase or a decrease. Hence, for example, H_0 might be that the mean is equal to 9 (as before). This time, however, H_1 would be that the mean is not equal to 9. So, In this case, therefore, the critical region has two parts:

Example

Lets test the parameter p of a Binomial distribution at the 10% level.

Suppose a coin is tossed 10 times and we get 7 heads. We want to test whether or not the coin is fair. If the coin is fair, $p = 0.5$. Put this as the null hypothesis:

$H_0: p = 0.5$

$H_1: p \neq 0.5$

Because this is a 2-tailed test, the critical region also has two parts. Half of the critical region is to the right and other half is in the left. So the critical region contains both the top 5% of the distribution and the bottom 5% of the distribution (as we are testing at the 10% level).

If H_0 is true, $X \sim \text{Bin}(10, 0.5)$.

If the null hypothesis is true, what is the probability that X is 7 or above?

$$P(X \geq 7) = 1 - P(X < 7) = 1 - P(X \leq 6) = 1 - 0.8281 = 0.1719$$

Is this in the critical region? No- because the probability that X is at least 7 is not less than 0.05 (5%), which is what we need it to be.

So there is no significant evidence to reject the null hypothesis at 10% level of significance

6.9 Procedure of Hypothesis testing

Having understood the basics of hypothesis, let us now dwell on the procedure which is to be followed in the testing of hypothesis. The following are the steps that are to be followed.

State null hypothesis and alternative hypothesis

State the level of significance. This gives us the tabulated values

Select the appropriate test

Calculate the required values for the test

Conduct the test

Draw the conclusions

6. 10 Summary

A hypothesis is necessary in today's business world as the managers are required to take decisions and they need to have a starting point

Hypothesis is widely used in the conduct of market surveys

The concept of sample and population is widely used in the testing of hypothesis

Hypothesis is a unit of inferential statistics

Hypothesis is based on reasoning which appears to be justified

Null hypothesis is formed when there is no relationship between the variables

Alternative hypothesis is the reverse of null hypothesis

Decision rules provide the basis for accepting or rejecting the hypothesis

Type I error is when we reject the hypothesis when it should have been accepted

Type II error is when we accept the hypothesis when we should have rejected it

6. 11 Terminal Questions

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What is the significance of hypothesis testing?

What is meant by Type I and Type II errors? Explain with examples

What is the difference between Null hypothesis and Alternative hypothesis?

Explain the steps involved in the testing of hypothesis.

6. 12 Answers Self Assessment Questions

True

False

True

Testable Time

Variables

Relationship

True

True

6. 13 Suggested Reading

Books

Testing statistical hypothesis, Lehmann, Joseph

Hypothesis testing with SPSS, Jim Mirabella

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Fundamentals of Statistics, Michael Sullivan

Fundamentals of Statistics, S. C. Gupta

Fundamentals of Statistics, Trueman Lee Kelly

Introductory Probability And Statistical Applications, Meyer

Fundamental of Statistics, Vol II, Goon, Gupta and Dagupta

An Outline of Statistical Theory, Vol I, Goon, Gupta and Dagupta

A Basic Course in Statistics, Clarke, Geoffrey and Cooke, John Wiley & Sons

Basic Statistics, Nagar & Das

Quantitative Techniques for Decision Making, Anand Sharma

Statistics for economists: A beginning, John E. Floyd

The Elements of Statistical Learning, Trevor Hastie, Jerome Friedman.

Introduction to Statistical Thought, Michael Lavine

Web Resources

[en. wikipedia. org/wiki/Statistical_hypothesis_testing](https://en.wikipedia.org/wiki/Statistical_hypothesis_testing)

[www. slideshare. net/vikramlawand/test-of-hypothesis](http://www.slideshare.net/vikramlawand/test-of-hypothesis)

[www. sagepub. com/upm-data/40007_Chapter8. pdf](http://www.sagepub.com/upm-data/40007_Chapter8.pdf)

[www. iasri. res. in/ebook/.../2.../4-TEST%20OF%20HYPOTHESIS. pdf](http://www.iasri.res.in/ebook/.../2.../4-TEST%20OF%20HYPOTHESIS.pdf)

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www.math.uah.edu/stat/hypothesis/index.html

www.angelfire.com/wv/bwhomedir/notes/z_and_t_tests.pdf

www.20bits.com/article/hypothesis-testing-the-basics

www.amstat.org/publications/jse/v11n3/java/Hypothesis/

math.bu.edu/people/nkatenka/MA113/Lecture_10_Notes.pdf

www.pstcc.edu/facstaff/jwlamb/Math1530/7.2rvsd.ppt

6. 14 Glossary

Aggregate It is the collection of small units which results in one complete entity. For example the aggregation of the total inhabitants of towns and villages and mega cities results in the population of the country

Alpha Level The probability that the statistical test will find difference between the groups which is significant when there are none. This is also termed as the probability of making a Type I error or as the significance level of statistical test.

Alternative Hypothesis The hypothesis that states that there is some difference between two or more groups. It is the alternative to null hypothesis, which states that there is no difference among the groups.

Analysis of Variance (ANOVA) A test that determines whether the means of two or more groups is significantly different.

Association It is a type of relationship between objects or variables.

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Average A single value which may be mean, median or mode and represents the typical, normal, or the middle value of a given set of data.

Axiom A statement widely accepted as truth.

Bell-Shaped Curve A curve which is the characteristic of a normal distribution, which is symmetrical about the mean. The area under the normal curve is 1.0.

Beta Level It is the probability of making an error due to the result of the chance variations when in actuality they are due to the differences of the result of the experimental manipulation or intervention. It is also referred to as the probability of making a Type II error.

Bias They are the influences that contribute to the distortions of the results

Categorical Data They are also referred to as the nominal data. They are for indicative purpose only

Causal Analysis An analysis that seeks to establish the cause and effect relationships between variables.

Central Tendency A measure that describes the central characteristic of the distribution.

Comparability It is the quality of two or more entities that are to be evaluated for their similarity and differences.

Confidence Interval A range of estimated values that provides the best estimate regarding the population's values.

Confidence Level It is the percentage which represents the number of times that a confidence interval will include the true population value.

Consistency It is the process in which similar responses are demonstrated throughout the activity / event.

Constant It is the value which does not change

Descriptive Statistics It is the basic statistics that is used to describe and summarize data.

Focus Group An interview conducted with a small group of people, all at one time, to explore ideas on a particular topic.

Multivariate Analysis It is the analysis of several independent variables on the dependent variable.

Mutually Exclusive It is when the happening of an event does not disturb or alters the happening of another event. For example, in tossing of a coin, the appearance of head is mutually exclusive to the appearance of tail as any one of them say head, does not allow the other to happen simultaneously.

Nominal Scale It is a scale that allows for classifying of elements into several mutually exclusive categories which are based on defined features but not numeric. They are just used for identification purposes. For example, the shirts worn by players in a football match. The number on the shirts represent the identification of the player only.

Normal Curve It is the curve, which is bell shaped in structure. It is formed when the data having normal distribution is plotted.

Normal Distribution It is the distribution that describes a frequency distribution comprising of data points which resembles a bell shape structure. The normal distribution shows important properties that are necessary for performing various statistical tests for different types of applications.

Null Hypothesis It is the hypothesis that states that there is no difference among and between the groups. It is in sharp contrast to alternative hypothesis that states that between two or more groups there is some difference

Observation Unit It is the actual unit which is subjected to observation during the course of study.

6. 15 Case study

Let us assume that a manufacturer of the light bulbs wants to produce bulbs with a mean life of 1000 hours

If the lifetime is shorter, he/ she will lose customers to his / her competitors; if the lifetime is longer, he / she will have a very high production cost because the filaments will be excessively thick.

In order to see whether the production process is working properly a sample of the output is taken to test the hypothesis

A two-tailed test is used because he / she does not want to deviate significantly from 1000 hours in either direction. Therefore the null hypothesis is rejected.