Concept of Hypothesis and its Application in Research

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Abstract

The conventional approach to hypothesis testing is not to construct a single hypothesis about the population parameter, but rather to set uo two different hypothesis. These hypothesis must be so constructed that if one hypothesis is ,the other is rejected and vice versa. The two hypothesis in a statistical test are normally referred to as:

(i) Null Hypothesis
(ii) Alternative Hypothesis

Statistical inference is that branch of statistics which is concerned with using probability concept to deal with uncertainty in decision making. It refer to the process of selecting and using a sample statistic to draw inference about a population parameter based on a subset of it- the sample drawn from the population.

Introduction

Statistics inference treats two different classes of problems

1. Hypothesis Testing
2. Estimation

Hypothesis testing is an act in statistics whereby an analyst **tests** an assumption regarding a population parameter. **Hypothesis testing** is used to infer the result of a **hypothesis** performed on sample data from a larger population. A statistical hypothesis, sometimes called confirmatory data analysis, is a hypothesis that is testable on the basis of observing a process that is modeled via a set of random variables. A statistical hypothesis test is a method of statistical inference.

The 7 Step Process of Statistical Hypothesis Testing

- Step 1: State the Null Hypothesis. ...
- Step 2: State the Alternative Hypothesis. ...
- Step 3: Set α ...
- Step 4: Collect Data. ...
- Step 5: Calculate a test statistic. ...
- Step 6: Construct Acceptance / Rejection regions. ...
- Step 7: Based on steps 5 and 6, draw a conclusion about H_0

The six most common forms of hypotheses are:

- Simple Hypothesis.
- Complex Hypothesis.
- Empirical Hypothesis.
- Null Hypothesis (Denoted by "HO")

- Alternative Hypothesis (Denoted by "H1")
- Logical Hypothesis.
- Statistical Hypothesis.

Definition of Null Hypothesis

A null hypothesis is a statistical hypothesis in which there is no significant difference exist between the set of variables. It is the original or default statement, with no effect, often represented by H_0 (H-zero). It is always the hypothesis that is tested. It denotes the certain value of population parameter such as μ, s, p. A null hypothesis can be rejected, but it cannot be accepted just on the basis of a single test.

Definition of Alternative Hypothesis

A statistical hypothesis used in hypothesis testing, which states that there is a significant difference between the set of variables. It is often referred to as the hypothesis other than the null hypothesis, often denoted by H_1 (H-one). It is what the researcher seeks to prove in an indirect way, by using the test. It refers to a certain value of sample statistic, e.g., x¯, s, p. The acceptance of alternative hypothesis depends on the rejection of the null hypothesis i.e. until and unless null hypothesis is rejected, an alternative hypothesis cannot be accepted.

About the **null and alternative hypotheses**. ... The **alternative hypothesis** states that a population parameter is smaller, greater, or different than the hypothesized value in the **null hypothesis**. The **alternative hypothesis** is what you might believe to be true or hope to prove true.

Key Differences between Null and Alternative Hypothesis

The important points of differences between null and alternative hypothesis are explained as under:

1. A null hypothesis is a statement, in which there is no relationship between two variables. An alternative hypothesis is a statement; that is simply the inverse of the null hypothesis, i.e. there is some statistical significance between two measured phenomenons.
2. A null hypothesis is what, the researcher tries to disprove whereas an alternative hypothesis is what the researcher wants to prove.
3. A null hypothesis represents, no observed effect whereas an alternative hypothesis reflects, some observed effect.
4. If the null hypothesis is accepted, no changes will be made in the opinions or actions. Conversely, if the alternative hypothesis is accepted, it will result in the changes in the opinions or actions.
5. As null hypothesis refers to population parameter, the testing is indirect and implicit. On the other hand, the alternative hypothesis indicates sample statistic, wherein, the testing is direct and explicit.
6. A null hypothesis is labeled as H_0 (H-zero) while an alternative hypothesis is represented by H_1 (H-one).

7. The mathematical formulation of a null hypothesis is an equal sign but for an alternative hypothesis is not equal to sign.
8. In null hypothesis, the observations are the outcome of chance whereas, in the case of the alternative hypothesis, the observations are an outcome of real effect.
9. Usually, the **null hypothesis** is a statement of 'no effect' or 'no difference'." It is often symbolized as H_0. The statement that is being tested against the **null hypothesis** is the **alternative hypothesis**. **Symbols** include H_1 and H_a.

Type I and **type** II **errors**. ... In **statistical** hypothesis testing, a **type** I **error** is the rejection of a true null hypothesis (also known as a "false positive" finding), while a **type** II **error** is failing to reject a false null hypothesis (also known as a "false negative" finding).

Hypothesis Testing-The null and alternative hypothesis

In order to undertake hypothesis testing you need to express your research hypothesis as a null and alternative hypothesis. The null hypothesis and alternative hypothesis are statements regarding the differences or effects that occur in the population. You will use your sample to test which statement (i.e., the null hypothesis or alternative hypothesis) is most likely (although technically, you test the evidence against the null hypothesis). So, with respect to our teaching example, the null and alternative hypothesis will reflect statements about all statistics students on graduate management courses. The null hypothesis is essentially the "devil's advocate" position. That is, it assumes that whatever you are trying to prove did not happen (*hint:* it usually states that something equals zero). For example, the two different teaching methods did not result in different exam performances (i.e., zero difference). Another example might be that there is no relationship between anxiety and athletic performance (i.e., the slope is zero). The alternative hypothesis states the opposite and is usually the hypothesis you are trying to prove (e.g., the two different teaching methods did result in different exam performances). Initially, you can state these hypotheses in more general terms (e.g., using terms like "effect", "relationship", etc.), as shown below for the teaching methods example:

Null Hypotheses (H_0):	Undertaking seminar classes has no effect on students' performance.
Alternative Hypothesis (H_A):	Undertaking seminar class has a positive effect on students' performance.

Depending on how you want to "summarize" the exam performances will determine how you might want to write a more specific null and alternative hypothesis. For example, you could compare the **mean** exam performance of each group (i.e., the "seminar" group and the "lectures-only" group). This is what we will demonstrate here, but other options include comparing the **distributions**, **medians**, amongst other things. As such, we can state:

Null Hypotheses (H_0):	The mean exam mark for the "seminar" and "lecture-only" teaching methods is the same in the population.
Alternative Hypothesis (H_A):	The mean exam mark for the "seminar" and "lecture-

only" teaching methods is not the same in the population.

Now that you have identified the null and alternative hypotheses, you need to find evidence and develop a strategy for declaring your "support" for either the null or alternative hypothesis. We can do this using some statistical theory and some arbitrary cut-off points. Both these issues are dealt with next significance level.

Significance levels

The **level of statistical significance** is often expressed as the so-called ***p*-value**. Depending on the statistical test you have chosen, you will calculate a probability (i.e., the *p*-value) of observing your sample results (or more extreme) **given that the null hypothesis is true**. Another way of phrasing this is to consider the probability that a difference in a mean score (or other statistic) could have arisen based on the assumption that there really is no difference. Let us consider this statement with respect to our example where we are interested in the difference in mean exam performance between two different teaching methods. If there really is no difference between the two teaching methods in the population (i.e., given that the null hypothesis is true), how likely would it be to see a difference in the mean exam performance between the two teaching methods as large as (or larger than) that which has been observed in your sample?

So, you might get a *p*-value such as 0.03 (i.e., $p = .03$). This means that there is a 3% chance of finding a difference as large as (or larger than) the one in your study given that the null hypothesis is true. However, you want to know whether this is "statistically significant". Typically, if there was a 5% or less chance (5 times in 100 or less) that the difference in the mean exam performance between the two teaching methods (or whatever statistic you are using) is as different as observed given the null hypothesis is true, you would reject the null hypothesis and accept the alternative hypothesis. Alternately, if the chance was greater than 5% (5 times in 100 or more), you would fail to reject the null hypothesis and would not accept the alternative hypothesis. As such, in this example where $p = .03$, we would reject the null hypothesis and accept the alternative hypothesis. We reject it because at a significance level of 0.03 (i.e., less than a 5% chance), the result we obtained could happen too frequently for us to be confident that it was the two teaching methods that had an effect on exam performance.

Whilst there is relatively little justification why a significance level of 0.05 is used rather than 0.01 or 0.10, for example, it is widely used in academic research. However, if you want to be particularly confident in your results, you can set a more stringent level of 0.01 (a 1% chance or less; 1 in 100 chance or less).

One- and two-tailed predictions

When considering whether we reject the null hypothesis and accept the alternative hypothesis, we need to consider the direction of the alternative hypothesis statement. For example, the alternative hypothesis that was stated earlier is:

Alternative Hypothesis (H_A): Undertaking seminar classes has a positive effect on students' performance.

The alternative hypothesis tells us two things. First, what **predictions** did we make about the effect of the independent variable(s) on the dependent variable(s)? Second, what was the predicted **direction** of this effect? Let's use our example to highlight these two points.

Sarah predicted that her teaching method (independent variable: teaching method), whereby she not only required her students to attend lectures, but also seminars, would have a positive effect (that is, increased) students' performance (dependent variable: exam marks). If an alternative hypothesis has a direction (and this is how you want to test it), the hypothesis is one-tailed. That is, it predicts direction of the effect. If the alternative hypothesis has stated that the effect was expected to be negative, this is also a one-tailed hypothesis.

Alternatively, a two-tailed prediction means that we do not make a choice over the direction that the effect of the experiment takes. Rather, it simply implies that the effect could be negative or positive. If Sarah had made a two-tailed prediction, the alternative hypothesis might have been:

Alternative Hypothesis (H_a): Undertaking seminar classes has an effect on students' performance.

In other words, we simply take out the word "positive", which implies the direction of our effect. In our example, making a two-tailed prediction may seem strange. After all, it would be logical to expect that "extra" tuition (going to seminar classes as well as lectures) would either have a positive effect on students' performance or no effect at all, but certainly not a negative effect. However, this is just our opinion (and hope) and certainly does not mean that we will get the effect we expect. Generally speaking, making a one-tail prediction (i.e., and testing for it this way) is frowned upon as it usually reflects the hope of a researcher rather than any certainty that it will happen. Notable exceptions to this rule are when there is only one possible way in which a change could occur. This can happen, for example, when biological activity/presence in measured. That is, a protein might be "dormant" and the stimulus you are using can only possibly "wake it up" (i.e., it cannot possibly reduce the activity of a "dormant" protein). In addition, for some statistical tests, one-tailed tests are not possible.

Rejecting or failing to reject the null hypothesis

Let's return finally to the question of whether we reject or fail to reject the null hypothesis.

If our statistical analysis shows that the significance level is below the cut-off value we have set (e.g., either 0.05 or 0.01), we reject the null hypothesis and accept the alternative hypothesis. Alternatively, if the significance level is above the cut-off value, we fail to reject the null hypothesis and cannot accept the alternative hypothesis. You should note that you cannot accept the null hypothesis, but only find evidence against it.

Hypothesis Testing Play Important role in following Articles

Basics:

1. What is Ad Hoc Testing?
2. What is a Rejection Region?
3. What is a Two Tailed Test?
4. How to Decide if a Hypothesis Test is a One Tailed Test or a Two Tailed Test.
5. How to Decide if a Hypothesis is a Left Tailed Test or a Right-Tailed Test.
6. How to State the Null Hypothesis in Statistics.
7. How to Find a Critical Value.
8. How to Support or Reject a Null Hypothesis.

Specific Tests:

1. ANOVA.
2. Chi Square Test for Normality
3. Cochran-Mantel-Haenszel Test
4. F Test
5. Granger Causality Test.
6. Hotelling's T-Squared
7. KPSS Test.
8. What is a Likelihood-Ratio Test?
9. Log rank test.
10. MANCOVA
11. Sequential Probability Ratio Test
12. How to Run a Sign Test.
13. T Test: one sample.
14. T-Test: Two sample.
15. Welch's ANOVA.
16. Welch's Test for Unequal Variances.
17. Z-Test: one sample.
18. Z Test: Two Proportion
19. Wald Test.

Power of a Hypothesis testing :
It is quite important to know how will a hypothesis test is working. The measure of how well the test is working is called power of test. In hypothesis testing α, and β (the probabilities of type I and type II errors) should both be small. The standard deviation of the sampling distribution is called the standard error.

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