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1. **What is Hypothesis Testing?**

A statistical hypothesis is an assumption about a population parameter. This assumption may or may not be true. Hypothesis testing refers to the formal procedures used by statisticians to accept or reject statistical hypotheses.

**Statistical Hypotheses**

The best way to determine whether a statistical hypothesis is true would be to examine the entire population. Since that is often impractical, researchers typically examine a random sample from the population. If sample data are not consistent with the statistical hypothesis, the hypothesis is rejected.

**Types of statistical hypotheses.**

* **Null hypothesis**: The null hypothesis, denoted by Ho, is usually the hypothesis that sample observations result purely from chance.
* **Alternative hypothesis:** The alternative hypothesis, denoted by H1 or Ha, is the hypothesis that sample observations are influenced by some non-random cause.

For example, suppose we wanted to determine whether a coin was fair and balanced. A null hypothesis might be that half the flips would result in Heads and half, in Tails. The alternative hypothesis might be that the number of Heads and Tails would be very different. Symbolically, these hypotheses would be expressed as

Ho: P = 0.5

Ha: P ≠ 0.5

Suppose we flipped the coin 50 times, resulting in 40 Heads and 10 Tails. Given this result, we would be inclined to reject the null hypothesis. We would conclude, based on the evidence, that the coin was probably not fair and balanced.

Statisticians follow a formal process to determine whether to reject a null hypothesis, based on sample data. This process, called hypothesis testing, consists of four steps.

* **State the hypotheses**: This involves stating the null and alternative hypotheses. The hypotheses are stated in such a way that they are mutually exclusive. That is, if one is true, the other must be false.
* **Formulate an analysis plan**: The analysis plan describes how to use sample data to evaluate the null hypothesis. The evaluation often focuses around a single test statistic.
* **Analyze sample data:** Find the value of the test statistic (mean score, proportion, t statistic, z-score, etc.) described in the analysis plan.
* **Interpret results:** Apply the decision rule described in the analysis plan. If the value of the test statistic is unlikely, based on the null hypothesis, reject the null hypothesis.

**Decision Errors**

Two types of errors can result from a hypothesis test.

Type I error: A Type I error occurs when the researcher rejects a null hypothesis when it is true. The probability of committing a Type I error is called the significance level. This probability is also called alpha, and is often denoted by α.

Type II error: A Type II error occurs when the researcher fails to reject a null hypothesis that is false. The probability of committing a Type II error is called Beta, and is often denoted by β. The probability of not committing a Type II error is called the Power of the test.

**2. Difference between classical and p-value approaches**

**Classical Approach**

The Classical Approach to hypothesis testing is to compare a test statistic and a critical value. It is best used for distributions which give areas and require you to look up the critical value (like the Student's t distribution) rather than distributions which have you look up a test statistic to find an area (like the normal distribution).

The Classical Approach also has three different decision rules, depending on whether it is a left tail, right tail, or two tail test.

One problem with the Classical Approach is that if a different level of significance is desired, a different critical value must be read from the table.

**P-Value approach**

The P-Value Approach, short for Probability Value, approaches hypothesis testing from a different manner. Instead of comparing z-scores or t-scores as in the classical approach, you're comparing probabilities, or areas.

The level of significance (alpha) is the area in the critical region. That is, the area in the tails to the right or left of the critical values.

The p-value is the area to the right or left of the test statistic. If it is a two tail test, then look up the probability in one tail and double it.

If the test statistic is in the critical region, then the p-value will be less than the level of significance. It does not matter whether it is a left tail, right tail, or two tail test. This rule always holds.

**3. Importance of hypothesis in research**

In various qualitative as well as quantitative studies, hypothesis is developed to talk about the research problem or to address any phenomenon. It aims to encourage critical approach. It enables the researcher to develop a specific direction as well as better understanding about the subject matter of the study. It further assists in the careful and focused analysis of data collected. There are different types of hypotheses. The two that are more basic involve those used in scientific researches and the other one in sociological studies. In scientific researches, hypotheses are developed keeping in view the experimentation and observation drawn from the past. Such hypotheses are tested according to the current theories. Science fair projects involve these forms of hypotheses. For example, if water temperature rises then sugar/ salt will be dissolved at higher rate.

On the other hand, working hypotheses are based on the widely accepted suppositions in order to carry out further research. For example, if I start the consumption of more vegetables and fruits then I will prone to faster weight loss or if I start adding pesticides to the growth of my plants then these will grow safer.