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Matric no: 17/MHS01/112

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Level: 300

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1. Hypothesis Testing

Hypothesis testing is an act in statistics whereby an analyst tests an assumption regarding a population parameter. The methodology employed by the analyst depends on the nature of the data used and the reason for the analysis. Hypothesis testing is used to assess the plausibility (the quality of seeming reasonable or probable) of a hypothesis by using sample data. Such data may come from a larger population, or from a data-generating process. **Hypothesis testing** was introduced by Ronald Fisher, Jerzy Nyman, J, Karl Pearson and Pearson's son, Egon Pearson.

How Hypothesis Testing Works
In hypothesis testing, an analyst tests a statistical sample, with the aim of providing evidence on the plausibility of the null hypothesis (the hypothesis that there is no significant difference between specified populations, any observed difference being due to sampling or experimental error).

Statistical analysts test a hypothesis by measuring and examining a random sample of the population being analyzed. All analysts use a random population sample to test two different hypotheses: the null hypothesis and the alternative hypothesis.

The null hypothesis is usually a hypothesis of equality between population parameters; e.g., a null hypothesis may state that the population mean return is equal to zero. The alternative hypothesis is effectively the opposite of a null hypothesis; e.g., the population mean return is not equal to zero. Thus, they are mutually exclusive and only one can be true. However, one of the two hypotheses will always be true.

Four Steps of Hypothesis Testing
All hypotheses are tested using a four-step process:

1. The first step is for the analyst to state the two hypotheses so that only one can be right.
2. The next step is to formulate an analysis plan, which outlines how the data will be evaluated.
3. The third step is to carry out the plan and physically analyze the sample data.
4. The fourth and final step is to analyze the results and either reject the null hypothesis, or state that the null hypothesis is plausible, given the data.

Example of Hypothesis Testing

- If, for example, a person wants to test that a penny has exactly a 50% chance of landing on heads, the null hypothesis would be yes, and the alternative hypothesis would be no (it does not land on heads). Mathematically, the null hypothesis would be represented as Ho: P = 0.5. The alternative hypothesis would be denoted as "Ha" and be identical to the null hypothesis, except with the equal sign struck-through, meaning that it does not equal 50%.
- A random sample of 100 coin flips is taken, and the null hypothesis is then tested. If it is found that the 100 coin flips were distributed as 40 heads and 60 tails, the analyst would assume that a penny does not have a 50% chance of landing on heads and would reject the null hypothesis and accept the alternative hypothesis.
- If, on the other hand, there were 48 heads and 52 tails, then it is plausible that the coin could be fair and still produce such a result. In cases such as this where the null hypothesis is "accepted," the analyst states that the difference between the expected results (50 heads and 50 tails) and the observed results (48 heads and 52 tails) is "explainable by chance alone."

1. Difference between p-value and the classical approach for hypothesis testing.

The classical approach: The first approach of hypothesis testing is a classical test statistic approach, which computes a test statistic from the empirical data and then makes a comparison with the critical value. If the test statistic in this classical approach is larger than the critical value, then the null hypothesis is rejected. Otherwise, it is accepted.

P-Value: In statistics, the p-value is the probability of obtaining results as extreme as the observed results of a statistical hypothesis test, assuming that the null hypothesis is correct. The p-value is used as an alternative to rejection points to provide the smallest level of significance at which the null hypothesis would be rejected. A smaller p-value means that there is stronger evidence in favor of the alternative hypothesis.

2. Importance of hypothesis testing in Research

Hypothesis testing is common in statistics as a method of making decisions using data. In other words, testing a hypothesis is trying to determine if your observation of some phenomenon is likely to have really occurred based on statistics. Statistical

hypothesis testing, also called confirmatory data analysis, is often used to decide whether experimental results contain enough information to cast doubt on conventional wisdom. For example, at one time it was thought that people of certain races or color had inferior intelligence compared to Caucasians.

A hypothesis was made that intelligence is not based on race or color. People of various races, colors and cultures were given intelligence tests and the data was analyzed. Statistical hypothesis testing then proved that the results were statistically significant in that the similar measurements of intelligence between races are not merely sample error.