

Statistics-Hypothesis Testing

What is Hypothesis Testing?

Hypothesis testing is a statistical technique used to test a specific claim or assumption about a population parameter. It involves making an educated guess (or "hypothesis") about the value of a parameter and then using sample data to determine whether this hypothesis is likely to be true.

The Components of Hypothesis Testing:

1. **Null Hypothesis (H₀):** This is the claim or assumption that we want to test. It's usually a statement of no effect or no difference.
2. **Alternative Hypothesis (H₁):** This is the opposite of the null hypothesis, and it represents what we hope to prove.
3. **Test Statistic:** This is a numerical value calculated from sample data that helps us determine whether H₀ should be rejected.
4. **P-Value:** This is the probability of observing a test statistic at least as extreme as the one observed, assuming that H₀ is true.

The Hypothesis Testing Procedure:

1. **Specify the Null and Alternative Hypotheses:** Clearly state the hypotheses to be tested.
2. **Collect Sample Data:** Gather data from a representative sample of the population.
3. **Calculate the Test Statistic:** Use the sample data to calculate a numerical value that helps us determine whether H₀ should be rejected.
4. **Determine the P-Value:** Calculate the probability of observing a test statistic at least as extreme as the one observed, assuming that H₀ is true.
5. **Compare the P-Value to the Significance Level (α):** If the p-value is less than α (usually 0.05), reject the null hypothesis; otherwise, fail to reject it.

Example:

Suppose we want to test whether a new exercise program improves cardiovascular health in adults. Let's say we collect data from a random sample of 100 adults and measure their resting heart rates before and after participating in the exercise program.

Null Hypothesis (H₀): The exercise program has no effect on resting heart rate (i.e., the mean difference is zero).

Alternative Hypothesis (H₁): The exercise program reduces resting heart rate (i.e., the mean difference is less than zero).

We calculate the test statistic to be $t = -2.5$, which corresponds to a p-value of 0.006.

Assuming an α of 0.05, we would reject H_0 and conclude that the exercise program significantly reduces resting heart rate in adults.

Keep in mind that this is just one example, and there are many other types of hypothesis testing problems that can arise in statistics!

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