

Assignment no. 4&6

Aim: Implementation of Z test, T test and ANOVA.

Theory:

a. What is Hypothesis Testing?

Hypothesis testing is a statistical method used to determine whether there is enough evidence to support or reject a given assumption (hypothesis) about a population based on sample data. It helps in making data-driven decisions by evaluating the significance of observed differences or relationships.

b. Z-Test, T-Test, and ANOVA:

1. **Z-Test** ○ Used when the sample size is large ($n > 30$) and population variance is known. ○ It tests whether the sample mean significantly differs from the population mean. ○ Example: Checking if the average weight of students in a university matches the national average.
2. **T-Test** ○ Used when the sample size is small ($n \leq 30$) and population variance is unknown. ○ Types of T-Tests:
 - **One-Sample T-Test:** Compares the mean of a single sample to a known population mean.
 - **Two-Sample T-Test (Independent T-Test):** Compares the means of two independent groups. Example: Comparing test scores of students from two different schools.
 - **Paired T-Test:** Compares the means of the same group before and after treatment. Example: Measuring the impact of a training program on employees' performance.
3. **ANOVA (Analysis of Variance)** ○ Used to compare means across multiple groups (more than two). ○ **One-Way ANOVA:** Tests differences between the means of three or more independent groups based on one factor. Example:
Comparing sales performance across three different regions. ○ **Two-Way ANOVA:** Examines the effect of two independent variables on a dependent variable. Example: Analyzing the impact of diet and exercise on weight loss.

c.Steps in Hypothesis Testing

4. **Define the Hypotheses** ○ **Null Hypothesis (H_0)**: Assumes no effect or no difference. ○ **Alternative Hypothesis (H_1)**: Suggests an effect or difference exists.
5. **Select the Significance Level (α)** ○ Commonly set at 0.05 (5% risk of rejecting H_0 when it is true).
6. **Choose the Appropriate Test** ○ Based on sample size, variance, and number of groups.
7. **Calculate the Test Statistic** ○ Compute Z, T, or F statistic based on the chosen test.
8. **Determine the Critical Value or P-Value**

Compare the test statistic with the critical value or check if $p\text{-value} < \alpha$.

9. **Make a Decision**
 - If $p\text{-value} < \alpha$, reject H_0 (significant result).
 - If $p\text{-value} \geq \alpha$, fail to reject H_0 (no significant evidence).
10. **Draw a Conclusion** ○ Interpret results in the context of the problem and take necessary actions.

LO Mapped: LO2

Conclusion:

In hypothesis testing, the decision to accept or reject the hypothesis depends on the pvalue. If the p-value is less than the significance level (α), we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1), indicating that there is significant evidence for the effect or difference. If the p-value is greater than or equal to α , we fail to reject the null hypothesis, meaning there is insufficient evidence to support the alternative hypothesis.