Pabna University of Science and Technology

PRESENTATION

Information and Communication Engineering

Course Title : Engineering Statistics

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Test of Single Mean and Single Variance

This presentation introduces the fundamentals of statistical tests used to evaluate a single population mean and variance. These tests help determine if sample data conforms to hypothesized values about a population parameter, providing critical insight for decision-making under uncertainty.

We will explore the key concepts, hypotheses, assumptions, test statistics, and interpretation of results for single mean and single variance tests. The goal is to equip you with the knowledge to properly apply these tests and understand their outcomes across various fields such as quality control, economics, and scientific research.

Testing a Single Population Mean

Concept and Purpose

A test of a single mean evaluates if the average value of a population matches a specified hypothesized value. This is useful for validating manufacturing standards or verifying survey outcomes.

The null hypothesis typically states the population mean equals the specified value, while the alternative challenges this with either directional or non-directional differences.

Test Statistic and Assumptions

The t-test statistic is calculated by comparing the sample mean to the hypothesized mean, standardized by the sample standard deviation and size.

Key assumptions include normal distribution of the variable or large sample size (central limit theorem), independence of observations, and random sampling.

Hypothesis Framework for a Single Mean

1   **Step 1: Define Hypotheses**

Null Hypothesis H0: $\mu = \mu_0$, stating the population mean equals the hypothesized mean.

2   **Step 2: Specify Alternative**

Alternative Hypothesis Ha can be:

- Two-tailed: $\mu \neq \mu_0$

- One-tailed (greater): $\mu > \mu_0$

- One-tailed (less): $\mu < \mu_0$

3   **Step 3: Decision Rule**

Determine significance level (commonly 0.05) and critical t-value(s) to decide whether to reject H0 based on sample data.

Testing a Single Population Variance

Purpose and Application

Variance tests assess whether the spread or variability of a population matches a predetermined value. This is crucial in quality control for consistent product output.

The null hypothesis assumes the population variance equals a target variance; the alternative challenges this equality.

Test Statistic and Assumptions

The Chi-square statistic is used, calculated by scaling the sample variance by degrees of freedom and hypothesized variance.

Assumptions require the data to be normally distributed and samples collected independently and randomly.

Interpreting Results and Practical Considerations

1 **Significance and p-Values**

A lower p-value than the chosen alpha implies rejection of the null, indicating sufficient evidence against the hypothesized parameter.

2 **Type I and Type II Errors**

Understand risks of false positive (Type I) and false negative (Type II) conclusions which affect decision reliability.

3 **Sample Size and Power**

Larger samples increase test power, making it easier to detect meaningful differences from hypothesized values.
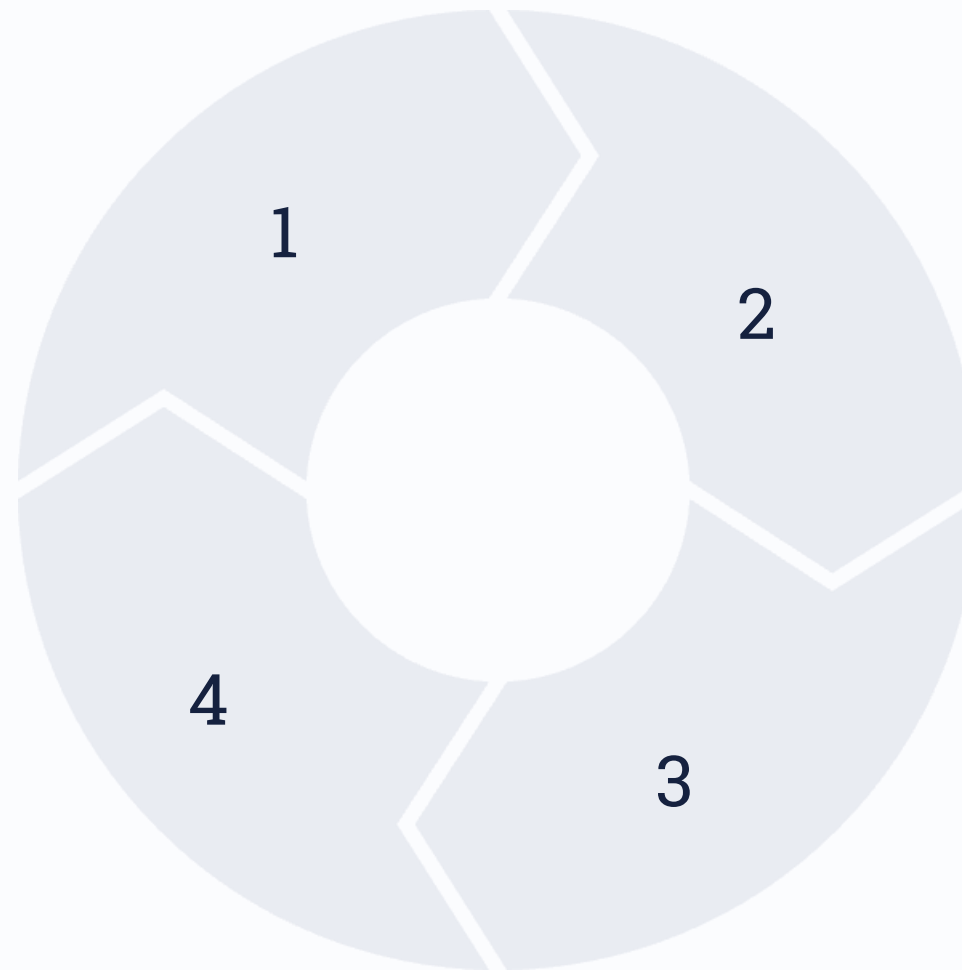
Key Takeaways and Next Steps

Identify Appropriate Test

Choose a mean or variance test based on your parameter of interest and study design.

1

Check Assumptions

Verify normality and independence to ensure valid test results.

2

Conduct and Interpret Carefully

Apply correct hypotheses, calculate test statistic, and base decisions on significance and practical context.

3

Further Learning

Explore software tools and advanced tests for more complex data scenarios.

4