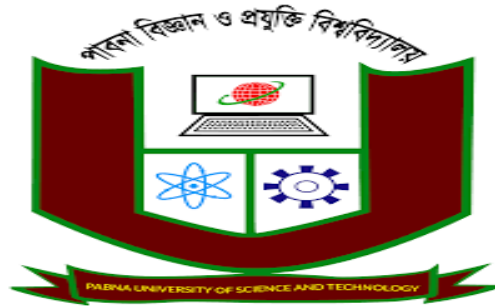




WELCOME TO

My

Presentation



Topic Name: Bartlett's test for homogeneity of variances

Course Name: Engineering Statistics
Course Code: STAT - 2201

Presented to ,

Dr. Md. Sarwar Hosain

Associate Professor

Department of ICE

**Pabna University of Science and
Technology, Pabna.**

Presented by ,

Mahmudul Islam

Roll : 220639

Session :2021 – 2022

2nd Year 2nd Semester

Department of ICE, PUST

Introduction

What is Bartlett's Test?

- Bartlett's test is a parametric statistical test.
- A statistical test used to check if multiple samples have equal variances.
- Used to test homogeneity of variances across multiple groups.

What is Homogeneity of Variances?

- The assumption that different samples have the same variance.
- Importance in statistical analysis.

Why Test for Equal Variance?

- Many statistical methods assume equal variance across groups.
- Unequal variances can affect the validity of results.
- Bartlett's test provides a way to verify this assumption before proceeding.

When to Use Bartlett's Test

1. Comparing three or more groups.
2. When data is normally distributed.
3. Use Cases:
 - When comparing variances across multiple groups.
4. Assumptions:
 - Samples are independent.
 - Samples are normally distributed.
5. Alternative tests for non-normal data:
 - Levene's Test
 - Brown-Forsythe Test

Hypotheses in Bartlett's Test

- Null Hypothesis (H_0):
 - All group variances are equal.
- Alternative Hypothesis (H_1):
 - At least one group variance is different.
- Significance:
 - If the p-value of the test is less than the chosen significance level (e.g., 0.05), the null hypothesis is rejected, indicating that the variances are not all equal.
- Use in ANOVA:
 - Bartlett's test is often used as a prerequisite to one-way ANOVA, which assumes that the variances of the groups being compared are equal.

Test Statistic (χ^2)

- The Bartlett's test statistic is:

$$\chi^2 = \frac{(N - k) \ln(S_p^2) - \sum_{i=1}^k (n_i - 1) \ln(S_i^2)}{1 + \frac{1}{3(k-1)} \left(\sum_{i=1}^k \left(\frac{1}{n_i - 1} \right) - \frac{1}{N - k} \right)}$$

Where :

s_p^2 : pooled variance

s_i^2 : variance of the i-th group

n_i : sample size of the i-th group

k: number of groups

N: total number of observations

How It Works – Steps

- Calculate variances of all groups.
- Compute pooled variance.
- Plug into test statistic formula.
- Compare test statistic with chi-square distribution.
- Determine p-value and make decision.

Example Problem

Data:

- Group A: 5, 7, 6 (Variance = 1)
- Group B: 10, 12, 11 (Variance = 1)
- Group C: 20, 18, 19 (Variance = 1)
- Since all variances are equal:
- Bartlett's test should give high p-value.
- Fail to reject $H_0 \rightarrow$ Variances are equal
- ▶ Now change Group C to: 20, 25, 30 (Variance = 25)
- ▶
 - Now you may get low p-value \rightarrow Reject H_0

- **Degrees of Freedom:**

- ($df = k - 1$)
- Where (k) is the number of groups

- **Critical Value:**

- Compare the test statistic to the chi-squared distribution.

- **Decision Rule:**

- If $\text{chi-squared} > \text{critical value}$, reject H_0 (evidence of unequal variances).

Interpretation of Results

- **$p > 0.05$** → Fail to reject H_0 → No significant difference in variances.
- **$p < 0.05$** → Reject H_0 → At least one group has a different variance.

Limitations of Bartlett's Test

- Very sensitive to departures from normality.
- Outliers can make the test misleading.
- Not robust with small sample sizes.

Alternatives to Bartlett's Test

Alternative Tests:

- Levene's Test: More robust to non-normality.
- Brown-Forsythe Test: Variation of Levene's Test.

Conclusion

- Bartlett's test checks if variances are equal.
- Importance of testing for homogeneity of variances.
- Bartlett's Test as a tool for statistical analysis.
- Sensitive to non-normality and outliers.
- Consideration of assumptions and limitations.
- Know when to use alternatives.



THANK YOU!