

[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 8140

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Unique Paper Code : 2373570008 (NEP-UGCF)

Name of the Paper : Introduction to Non-Parametric Methods (DSE)

Name of the Course : B.A. (P) / B.Sc. (P)

Semester : VIII

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **SIX** questions out of **EIGHT**.
3. Each question carries **15** marks.
4. Use of nonprogrammable scientific calculator is allowed.
5. All necessary critical values are provided at the end of each numerical part.

1.(a) State the Kolmogorov-Smirnov one-sample test. Explain the concept of the empirical distribution function. Discuss the assumptions of this test. Under what conditions is the K-S test preferred over the Chi-Square Goodness of Fit test?

(b) The following 7 observations are obtained: 4, 9, 15, 22, 28, 35, 43.

Test at the 5% level whether these come from a Uniform distribution on [0, 50].

[Critical Value: $D(0.05, n=7) = 0.483$]

2. (a) Explain the Sign Test for testing the median of a population. What are the advantages of the Sign Test over parametric alternatives?

(b) The weekly expenses (in ₹ hundreds) of 11 families are: 32, 45, 28, 51, 37, 40, 55, 33, 47, 30, 42.

Test at the 5% level whether the median weekly expense is ₹3800 (i.e., 38 hundreds).

[Critical Value: For $n = 11$, two-tailed at $\alpha = 0.05$, reject H_0 if $\min(S^+, S^-) \leq 1$]

3.(a) Define the Spearman Rank-Order Correlation Coefficient and write its formula. Explain the step-by-step procedure for computing it. What does the value of the coefficient indicate about the relationship between two variables? Discuss the assumptions required and the level of measurement needed for this test.

(b) Ten students are ranked by two examiners in a viva-voce examination as follows:

Student	1	2	3	4	5	6	7	8	9	10
Examiner A	1	3	5	2	7	4	9	6	10	8
Examiner B	2	1	4	3	8	5	10	7	9	6

Compute the Spearman Rank Correlation Coefficient and test its significance at the 5% level.

[Critical Value: $r_s(0.05, n=10, \text{two-tailed}) = 0.648$]

4. (a) Explain the Median Test for comparing two independent samples. Why is the Chi-Square test with Yates' correction used when the sample sizes are small? What are the limitations of the Median Test compared to the Mann-Whitney U Test?

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- (b) Two groups of students scored the following marks in an aptitude test:

Group A: 56, 72, 48, 65, 80

Group B: 62, 45, 70, 58, 75, 50

Using the Median Test, test at the 5% level whether the two groups have the same median.

[Critical Value: $\chi^2(0.05, 1) = 3.841$]

- 5.(a) Describe the Mann-Whitney U Test. State the formula for the normal approximation.

- (b) The reaction times (in milliseconds) for two groups of subjects are:

Group 1: 120, 145, 132, 158, 110

Group 2: 135, 160, 125, 150, 140, 170

Test at the 5% level whether the two groups differ in median reaction time.

[Critical Value: $U(0.05, n_1=5, n_2=6, \text{two-tailed}) = 5$]

- 6.(a) Describe the Kruskal-Wallis one way analysis of variance rank test:

- (b) Three groups of patients receive different treatments and their recovery times (in days) are:

Treatment 1: 12, 15, 10, 14

Treatment 2: 8, 11, 7, 9

Treatment 3: 18, 20, 16, 22

Test at the 5% level whether the treatments have different median recovery times.

[Critical Value: $\chi^2(0.05, 2) = 5.991$]

- 7.(a) Define the Chi-Square Goodness of Fit test. Explain the difference between a one-tailed and two-tailed application of this test. Why is the Chi-Square Goodness of Fit test always right-tailed?

- (b) A survey of 100 people on their preferred season gives:

Season	Spring	Summer	Autumn	Winter
Observed	30	22	28	20

Test at the 5% level whether the preferences are equally distributed across the four seasons.

[Critical Value: $\chi^2(0.05, 3) = 7.815$]

- 8.(a) Describe the One-Sample Runs Test. Explain how this test can be used to test the randomness of a sample.

- (b) The signs of residuals from a fitted regression model, in order, are:

+ + - - + - + + + - - - + -

Test at the 5% level whether the residuals are randomly distributed.

[Critical Value: For $n_1 = 7, n_2 = 7$ at $\alpha = 0.05$ (two-tailed), reject H_0 if $R \leq 3$ or $R \geq 13$]