

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7458

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Unique Paper Code : 2373010018

Name of the Paper : Non-Parametric Testing

Name of the Course : DSE (NEP)

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 6 Questions in all.
3. Question 1 is compulsory.
4. Attempt 5 more questions from the remaining questions.
5. Use of a non-programmable Scientific calculator is permitted.
6. Please write Null and Alternative Hypotheses wherever required.
7. Use 5% level of significance for testing.

Q1. Attempt all the 3 parts. All parts carry equal marks.

(a) Fill in the blanks

- (i) The sampling distribution of test statistic of Median test for two independent samples under H_0 follow.....distribution with.....d.f.
- (ii) If $n_1 = 10$, $n_2 = 7$ and $U_1 = 36$ for U test then $U_2 =$
- (iii) Paired sign test is equivalent to parametrictest.
- (iv) We perform K-S test for two independent samples to test H_0 :against two tailed alternative H_1 :

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- (v) The rating of the service is an example ofscale of measurement. (5)

(b) State True or False. If False, provide the correct statement.

- (i) Non parametric tests require assumptions about the form of the population distribution.
- (ii) The Kruskal–Wallis test is used only for two samples.
- (iii) Empirical distribution function is a biased estimator of $F_X(x)$.
- (iv) Sampling distribution of Spearman's correlation coefficient under H_0 follows the F distribution when the sample is small.
- (v) One-sample K-S test compares the sample observations with a theoretical c.d.f. F_0 . (5)

(c) Solve the following questions:

- (i) For the following data, obtain Spearman's rank correlation coefficient:

Subjects	A	B	C	D	E
Ranks of X	1	5	2	3	4
Ranks of Y	2	4	3	1	5

- (ii) If X follows exponential distribution with parameter 5 then obtain quantile function $Q_X(p)$. Hence, find the value of 40th percentile of X (2.5, 2.5)

Q2. (a) Obtain the $100(1 - \alpha)\%$ confidence interval of the unknown population median when the sample size is small.

- (b) Consider a large sample of size $n=45$. state the rejection region for testing $k_{0.8} = 500$ against $H_1: k_{0.8} > 500$ with $\alpha = 0.05$. What do you infer if the number of positive differences of $(X_i - 500)$ is 25. (7, 8)

Q3. (a) Discuss the sign test based on a single sample for testing $H_0: M = M_0$ where M_0 is the population median. Obtain the rejection regions for the test with the upper-tailed, lower-tailed and two-tailed alternatives.

- (b) For the two independent sample of large sizes $n_1 = n_2 = 21$, it was found that number of runs is 12. Check whether the two samples come from the same population using Wald Wolfowitz test. (10, 5)

Q4. (a) State the underlying assumptions for the application of Wald Wolfowitz runs test. Discuss the Wald Wolfowitz runs test for small as well as large samples. How do you proceed when there are tied observations in the samples?

(b) Establish that D_n , D_n^+ and D_n^- are completely distribution-free for any specified continuous c.d.f. F_0 . (9,6)

Q5. (a) Discuss the Kruskal-Wallis test for $k (>2)$ independent samples? What happens when there are tied observations?

(b) Use the Mann-Whitney U Test to test whether there is a significant difference between the average lifetimes of two models of bulbs based on the following lifetimes (in 100 hrs.):

Brand A	9.9	15	17.0	16.2	12.1	16.9	19.1	13.1	5.4
Brand B	18.5	14.1	19.0	18.8	21.2				

(Use the critical value of $U = 6$ when $n_1 = 5, n_2 = 9$.) (9, 6)

Q6. (a) 12 Independent observations were taken on the pouring times in a day. Six observations were taken before lunch and six after lunch as:

Before lunch	15.6	14.4	16.2	14.2	12.4	15.0
After lunch	19.4	17.1	16.4	18.4	17.0	14.3

Does the data suggest that the mean pouring time before lunch is less than after lunch using the Wilcoxon Rank-Sum test?

Note: Use the following portion from the **Table J** for the p-value of the Wilcoxon Rank-Sum test.

Table J:

m=6, n=6					
Left tailed	24	25	26	29	30
p-value	0.008	0.013	0.021	0.066	0.09
Right tailed	54	53	52	49	48

(b) let $X_1, X_2, \dots, X_N$ be the rankings of random variable X and $Y_1, Y_2, \dots, Y_N$ be the rankings of random variable Y of the N subjects. Obtain the expression of the Spearman's rank order correlation coefficient r_s . Further obtain the expression of r_s when there are tied scores in the samples.

(7,8)

P.T.O.

Q7. Write short notes on the following:

- (a) Scales of Measurement for quantitative data.
- (b) Empirical quantile function.
- (c) Wilcoxon Signed Ranks test when the sample size is large. (5, 5, 5)