



# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc. DEGREE EXAMINATION – STATISTICS**

**THIRD SEMESTER – NOVEMBER 2022**

**PST 3602 – NON-PARAMETRIC METHODS**

Date: 02-12-2022

Dept. No.

Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

## PART - A

Answer ALL the questions.

(10 x 2 = 20 Marks)

1. When do we prefer non parametric test?
2. Define categorical data and ordinal data with examples?
3. State the assumptions of one sample sign test?
4. Write the mean and variance formula for wilcoxon signed rank test to large sample.
5. In what situation, we use Kolmogorov– one sample test
6. When do you recommend Mann Whitney – U test?
7. Write the use of Kruskal – Wallis test.
8. Distinguish between U – test and Wilcoxon signed rank test.
9. State the situation for using Theil’s test.
10. Write the test statistic for Friedman’s test.

## PART - B

Answer any FIVE questions.

(5 x 8 = 40 Marks)

11. The following is an arrangement of 25 men, (M), and 15 women, (W) lined up to purchase tickets for a premier picture show:

1	2	3	4	5	6	7	8	9	10
M	W	W	M	M	M	W	M	M	W
11	12	13	14	15	16	17	18	19	20
M	W	M	W	W	W	M	M	M	M
21	22	23	24	25	26	27	28	29	30
W	M	M	W	W	W	M	M	M	M
31	32	33	34	35	36	37	38	39	40
M	M	W	W	W	M	M	M	M	M

Test for randomness at 5% level of significance. ( $Z_{0.05} = 1.96$ )

12. The following data represent lifetime (in hours) of batteries for two different brands A and B:

Brand A	40	30	55	40	40	35	30	40	50	45
Brand B	45	60	50	60	35	50	55	60	50	50

Examine by the Kolmogorov-Smirnov two-sample test, is the average life of two brands is same at 5% level of significance?

13. A group of 12 children was tested to find out how many digits they would repeat from memory after hearing them once. They were given practice session for this test. Next week they were retested. The results obtained were as follows:

Child No.	1	2	3	4	5	6	7	8	9	10	11	12
Recall before	6	4	5	7	6	4	3	7	8	4	6	5
Recall after	6	6	4	7	6	5	5	9	9	7	8	7

Assuming that the distribution of the differences of the scores before and after the practice session is symmetrical about its median, can the memory practice session improve the performance of children at 5% level of significance.

14. Explain general procedure of Binomial Sign Test for two dependent Samples.
15. Twelve male marines are administered a test of physical fitness which requires that an individual achieve the minimum criterion noted for the following three tasks: a) Climb a 100 ft. rope; b) Do 25 chin-ups; and c) Run a mile in under six minutes. Within the sample of 12 subjects, the order of presentation of the three tasks is completely counterbalanced (i.e., each of the six possible presentation orders for the tasks is presented to two subjects). For each of the tasks a subject is assigned a score of **1** if he achieves the minimum criterion and a score of **0** if he does not. The following table summarizes the results of the testing.

Subject	1	2	3	4	5	6	7	8	9	10	11	12
Rope climb	1	0	1	0	0	0	0	0	1	0	0	0
Chin-ups	1	1	1	1	1	1	0	1	1	1	0	0
Mile run	0	0	1	0	0	1	0	0	0	0	0	1

Do the data indicate there is a difference between the three tasks with respect to subjects achieving the criterion?

16. Two psychiatrists, Dr. X and Dr. Y, rank-order ten patients with respect to their level of psychological disturbance (assigning a rank of 1 to the least disturbed patient and a rank of 10 to the most disturbed patient). The rankings of the two psychiatrists are presented in the following table. Is there any significant correlation between the rank-orders assigned to the patients by the two doctors? Use Kendall's tau coefficient and give your interpretation.

Patient	1	2	3	4	5	6	7	8	9	10
R <sub>X</sub>	7	1	8	10	9	6	5	3	2	4
R <sub>Y</sub>	10	2	6	8	7	4	9	3	1	5

17. Describe in brief the procedure of fitting a regression line through non parametric approach.
18. Four technicians determined the percent moisture content of a powder manufactured by five different companies. Their determinations of moisture contents were as follows

Technicians	Moisture content (%) Companies				
	1	2	3	4	5
<b>A</b>	9	10	8	11	12
<b>B</b>	10	11	9	7	12
<b>C</b>	9	10	8	12	11
<b>D</b>	8	11	7	14	12

Apply the Friedman test to test whether the percent moisture content in the powder of five companies is same.

**PART - C**

Answer any TWO questions

(2 x 20 = 40 Marks)

19. a) The following data shows the weight (in kg) of a random sample of 30 students of a college:

S.No	1	2	3	4	5	6	7	8	9	10
Weight	49	46	57	37	45	57	50	65	34	50
S.No	11	12	13	14	15	16	17	18	19	20
Weight	58	46	47	42	53	67	40	52	49	66
S.No	21	22	23	24	25	26	27	28	29	30
Weight	53	48	68	40	53	49	61	54	48	38

Assume that the distribution of the weight of the students is symmetric about its median, test to examine whether the median weight of all the students of the college is 50 kg by using Wilcoxon signed-rank test at 5% level of significance.

b) A market research firm is hired to determine whether or not a debate between the two candidates who are running for the office of Governor influences voter preference. The gubernatorial preference of 200 randomly selected voters is determined before and after a debate between the two candidates, Edgar Vega and Vera Myers. The table below summarizes the results of the voter preference survey. Do the data indicate that the debate influenced voter preference?

		Voters preference before debate	
		Edgar Vega	Vera Myers
Voters Preference after debate	Edgar Vega	35	46
	Vera Myers	55	64

(12 + 8)

20. a) A Statistics professor taught two special sections of a basic course in which students in each section were considered outstanding. He used a “traditional” method of instruction (T) in one section and an “experimental” method of instruction (E) in the other. At the end of the semester, he ranked the students based on their performance from 1 (worst) to 20 (best).

T	1	2	3	5	8	10	12	13	14	15
E	4	6	7	9	11	16	17	18	19	20

Apply Mann Whitney U – test and test whether there is any evidence of a difference in performances based on the two methods at 5% level of significance.

b) A librarian wishes to determine if it is equally likely that a person will take a book out of the library each of the six days of the week the library is open (assume the library is closed on Sundays). She records the number of books signed out of the library during one week and obtains the following frequencies: Monday, 30; Tuesday, 24; Wednesday, 28; Thursday, 27; Friday, 32; and Saturday, 39. Assume that no person is permitted to take out more than one book during the week. Do the data indicate there is a difference with respect to the number of books taken out on different days of the week?

(10 + 10)

21. Below are the plasma testosterone (ng/ml) level (Y) and seminal citric acid (mg/ ml) levels in a sample of 6 adult males. Compute the estimate of population regression slope coefficient by Theil's method. Subsequently, compute the estimator of the intercept coefficient.

Y	230	175	315	290	275	150
X	421	278	618	482	465	105

22. a) A company trainer is randomly assigned to groups which are taught certain industrial inspection procedure by three different methods. At the end of the instructing period they are tested for inspection performance quality. The following are their scores

Method A : 80, 83, 79, 85, 90, 68.

Method B : 82, 84, 60, 72, 86, 67, 91.

Method C : 93, 65, 77, 78, 88.

Use H – test to determine at the 5% level of significance whether three methods equally effective.

b) Explain the general Procedure for Spearman's Rank-Order Correlation Coefficient

**(12 + 8)**

\*\*\*\*\*