LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – NOVEMBER 2016

ST 3958 - NON PARAMETRIC INFERENCE

Date: 11-11-2016   Dept. No.   Max. : 100 Marks
Time: 09:00-12:00

Section A

Answer ALL questions.   **(2 X 10 = 20)**

1. Define categorical data with an example.

2. Differentiate between parametric and non parametric inference.

3. Write down the assumptions of non parametric methods.

4. Distinguish the terms parameter and statistic.

5. State the assumptions on which Binomial sign test is based.

6. State the situation for using Mann-Whitney U test.

7. When is Bowker's test of symmetry used?

8. State some tests that can be used when we have more than two dependent samples.

9. Name two non parametric tests that can be used to measure association or correlation.

10. Write a short note on Friedman's analysis of variance by ranks.

Section B

Answer ANY FIVE questions.   **(5 X 8 = 40)**

11. A physician states that the median number of times he sees each of his patients during the year is five. In order to evaluate the validity of this statement he randomly selects 13 of his patients and determines the number of office visits each of them made during the past year. He obtains the following values for the 13 patients in his sample: 5, 9, 10, 8, 4, 8, 5, 3, 0, 10, 15, 9, 5. Do the data support his contention that the median number of times he sees a patient is five?

12. A country in which four ethnic groups make up the population establishes affirmative action guidelines for medical school admissions. The country has one medical school, and it is mandated that each new class of medical students proportionally represents the four ethnic groups that comprise the country's population. The four ethnic groups that make up the population and the proportion of people in each ethnic group are: Balzacs (.4), Crosacs (.25), Murads (.3), and Isads (.05) The number of students from each ethnic group admitted into the medical school class for the new year are: Balzacs (300), Crosacs (220), Murads (400), and Isads (80). Find if there is a significant discrepancy between the proportions mandated in the affirmative action guidelines and the actual proportion of the four ethnic groups in the new medical school class using chi-square goodness of fit test.

13. A meteorologist conducts a study to determine whether humidity levels recorded
at 12 noon for 20 consecutive days in July 1995 are distributed randomly with respect to whether they are above or below the average humidity recorded during the month of July during the years 1990 through 1994. Recorded below is a listing of whether the humidity for 20 consecutive days is above (+) or below (–) the July average.
+ + + – – – + + – – + – + – + – – – + +.
Do the data indicate that the series of temperature readings is random?

14. In order to assess the efficacy of a new antidepressant drug, ten clinically depressed patients are randomly assigned to one of two groups. Five patients are assigned to Group 1, which is administered the antidepressant drug for a period of six months. The other five patients are assigned to Group 2, which is administered a placebo during the same six-month period. Assume that prior to introducing the experimental treatments, the experimenter confirmed that the level of depression in the two groups was equal. After six months elapse all ten subjects are rated by a psychiatrist (who is blind with respect to a subject's experimental condition) on their level of depression. The psychiatrist's depression ratings for the five subjects in each group follow (the higher the rating, the more depressed a subject): **Group 1**: 11, 1, 0, 2, 0; **Group 2**: 11, 11, 5, 8, 4. Test for median if the data indicates that the antidepressant drug is effective?

15. Explain the test procedure for Kolmogorov-Smirnov test for two independent samples.

16. In order to evaluate whether or not two teaching methods result in different degrees of variability with respect to performance, a mathematics instructor employs two methods of instruction with different groups of students. Prior to initiating the study it is determined that the two groups are comprised of students of equal math ability. Group 1, which is comprised of five subjects, is taught through the use of lectures and a conventional textbook (Method A). Group 2, which is comprised of six subjects, is taught through the use of a computer software package (Method B). At the conclusion of the course the final exam scores of the two groups are compared. The final exam scores follow (the maximum possible score on the final exam is 10 points and the minimum 0): **Group 1**: 7, 5, 4, 4, 3; **Group 2**: 13, 12, 7, 7, 4, 3. The researcher elects to rank-order the scores of the subjects, since she does not believe the data are normally distributed in the underlying populations. If the Siegel–Tukey test for equal variability is employed to analyze the data, is there a significant difference in within-groups variability?

17. A researcher conducts a study in order to evaluate the effect of noise on altruistic behavior. Each of the 200 subjects who participate in the experiment is randomly assigned to one of two experimental conditions. Subjects in both conditions are given a one-hour test which is ostensibly a measure of intelligence. During the test the 100 subjects in Group 1 are exposed to continual loud noise, which they are told is due to a malfunctioning generator. The 100 subjects in Group 2 are not exposed to any noise during the test. Upon completion of this stage of the experiment, each subject on leaving the room is confronted by a middle-aged man whose arm is in a sling. The man asks the subject if she would be willing to help him carry a heavy package to his car. In actuality, the man requesting help is an experimental confederate (i.e., working for the experimenter). The number of subjects in each group who help the man is recorded. Thirty of the 100 subjects who were exposed to noise elect to help the man, while 60 of the 100 subjects who were not exposed to noise elect to help the man. Do the data indicate that altruistic behavior is influenced by noise?

	Helped the confederate	Did not help the confederate		Row sums
Noise	30	70		100
No noise	60	40		100
			Total	
Column sums	90	110	observations	200

18. Doctor Radical, a math instructor at Logarithm University, has four classes in advanced calculus. There are six students in Class 1, seven students in Class 2, eight students in Class 3, and six students in Class 4. The instructor uses a programmed textbook in Class 1, a conventional textbook in Class 2, his own printed notes in Class 3, and no written instructional material in Class 4. At the end of the semester, in order to determine if the type of instruction employed influences student performance, Dr. Radical has another math instructor, Dr. Root, rank the 27 students in the four classes with respect to math ability. The rankings of the students in the four classes follow: **Class1:** 1, 2, 4, 6, 8, 9; **Class2:** 10, 14, 18, 20, 21, 25, 26; **Class3:** 3, 5, 7, 11, 12 16, 17, 22; **Class4:** 13, 15, 19, 23, 24, 27 (assume the lower the rank, the better the student) Test for equality of medians.

Answer ANY TWO questions. (2 X 20 = 40)

19. The results of an intelligence test administered to 30 students are evaluated with
respect to goodness-of-fit for a distribution with the following parameters: $\mu = 90$ and $\sigma = 35$. The IQ scores
of the 30 students are noted below.
21, 32, 38, 40, 48, 55, 63, 66, 70, 75, 80, 84, 86, 90, 90, 93, 95, 98, 100, 105, 106, 108, 115, 118, 126, 128, 130, 142, 145, 155.
Do the data conform to a normal distribution with the specified parameters?

20. (i) Assume that the median blood cholesterol level for a healthy 30-year-old male is 200 mg/100 ml. Blood cholesterol readings are obtained for a group consisting of eleven 30year-old men who have had a heart attack within the last month. The blood cholesterol scores of the eleven men are: 230, 167, 250, 345, 442, 190, 200, 248, 289, 262, 301. Can one conclude that the median cholesterol level of the population represented by the sample (i.e., recent male heart attack victims) is some value other than 200?

(ii) Explain the test procedure, calculation and interpretation of Wilcoxon matched pairs sign rank test.
(10 + 10)

21. (i) Explain Moses test for equality of variance.

(ii) In order to assess the efficacy of electroconvulsive therapy (ECT), a psychiatrist evaluates six clinically depressed patients who receive a series of ECT treatments. Each patient is evaluated at the following three points in time: a) One day prior to the first treatment in the ECT series; b) The day following the final treatment in the ECT series; and c) Six months after the final treatment in the ECT series. During each evaluation period a standardized interview is used to operationalize a patient's level of depression, and on the basis of the interview a patient is assigned a score ranging from 0 to 10. The higher a patient's score, the more depressed the patient. The depression scores of the six patients during each of the three time periods follow: **Patient 1** (9, 7, 4); **Patient 2** (10, 8, 7); **Patient 3** (7, 5, 3); **Patient 4** (10, 8, 7); **Patient 5** (7, 5, 2); **Patient 6** (8, 6, 6). Test if the data indicates that the ECT is effective using Friedman's Analysis of variance by ranks. (10 + 10)

22. (i) In order to assess the efficacy of a drug which a pharmaceutical company claims is effective in treating hyperactivity,12 hyperactive children are evaluated during the following three time periods: a) One week prior to taking the drug; b) After a child has taken the drug for six consecutive months; and c) Six months after the drug is discontinued. The children are observed by judges who employ a standardized procedure for evaluating hyperactivity. The procedure requires that during each time period a child be assigned a score of 1 if he is hyperactive and a score of 0 if he is not hyperactive. During the evaluation process, the judges are blind with respect to whether a child is taking medication at the time he or she is evaluated. The following table summarizes the results of the study. Do the data indicate the drug is effective? Use Cochran's Q test.

	Time Period		
	Time 1	Time 2	Time 3
Child 1	1	0	1
Child 2	1	0	1
Child 3	1	0	1
Child 4	1	0	0
Child 5	1	0	0
Child 6	1	0	1
Child 7	1	1	1
Child 8	1	0	1
Child 9	1	0	1
Child 10	1	0	1
Child 11	1	1	1
Child 12	1	1	1

(ii) Explain the test procedure, calculation and interpretation of Van der Waerden normal scores test.
(10 + 10)

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