LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – NOVEMBER 2015

ST 3958 - NON PARAMETRIC INFERENCE

Date : 11/11/2015 Dept. No. Max. : 100 Marks

Time : 09:00-12:00

Section A

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

1. Write down the assumptions of non parametric methods.
2. Explain ordinal data with an example.
3. Distinguish between the terms parameter and statistic.
4. State any two advantages of non parametric testing methods.
5. State the assumptions on which Wilcoxon signed ranks test is based.
6. State the situation for using Mann-Whitney U test.
7. In which situation is chi square goodness of fit test used?
8. Name two non parametric tests that can be used to measure association or correlation.
9. Write a short note on Cochran's Q test.
10. State the assumptions of 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 ten 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 ten patients in his sample: 9, 10, 8, 4, 8, 3, 0, 10, 15, 9. Do the data support his contention that the median number of times he sees a patient is five?

12. 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, 20; Tuesday, 14; Wednesday, 18; Thursday, 17; Friday, 22; and Saturday, 29. Assume 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? Check using chi-square goodness of fit test.

13. A quality control study is conducted on a machine that pours milk into containers. The amount of milk (in liters) dispensed by the machine into 21 consecutive containers follows: 1.90, 1.99, 2.00, 1.78, 1.77, 1.76, 1.98, 1.90, 1.65, 1.76, 2.01, 1.78, 1.99, 1.76, 1.94, 1.78, 1.67, 1.87, 1.91, 1.91, 1.89. Are the successive increments and decrements in the amount of milk dispensed 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 assess the effect of two antidepressant drugs, 12 clinically depressed patients are randomly assigned to one of two groups. Six patients are assigned to Group 1, which is administered the antidepressant drug Elatrix for a period of six months. The other six patients are assigned to Group 2, which is administered the antidepressant drug Euphryia 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 12 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 six subjects in each group follow (the higher the rating, the more depressed a subject): **Group 1**: 10, 10, 9, 1, 0, 0; **Group 2**: 6, 6, 5, 5, 4, 4. Do the data indicate there is a significant difference between the variances of the two groups?

17. In order to assess the effect of two antidepressant drugs, 12 clinically depressed patients are randomly assigned to one of two groups. Six patients are assigned to Group 1, which is administered the antidepressant drug Elatrix for a period of six months. The other six patients are assigned to Group 2, which is administered the antidepressant drug Euphryia 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 12 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 six subjects in each group follow (the higher the rating, the more depressed a subject): **Group 1**: 10, 10, 9, 1, 0, 0; **Group 2**: 6, 6, 5, 5, 4, 4. The researcher decides to contrast the variability within the two groups through use of the Moses test for equal variability. Do the data indicate there is a significant difference between the variances of the two groups?

18. A psychologist conducts a study to determine whether or not noise can inhibit learning. Each of six subjects is tested under three experimental conditions. In each of the experimental conditions a subject is given20 minutes to memorize a list of 10 nonsense syllables, which the subject is told she will be tested on the following day. The three experimental conditions each subject serves under are as follows: Condition1, the nonoise condition, requires subjects to study the list of nonsense syllables in a quiet room. Condition2, the moderate noise condition, requires subjects to study the list of nonsense syllables while listening to classical music. Condition3, the extreme noise condition, requires subjects to study the list of nonsense syllables while listening to rock music. Although in each of the experimental conditions subjects are presented with a different list of nonsense syllables, the three lists are comparable with respect to those variables that are known to influence a person's ability to learn nonsense syllables. To control for order effects, the order of presentation of the three experimental conditions is completely counterbalanced. The number of nonsense syllables correctly recalled by the six subjects under the three experimental conditions follow. (Subjects' scores are listed in the order Condition1, Condition2, Condition3.) Subject1: 9, 7, 4; Subject2: 10, 8, 7; Subject3: 7, 5, 3; Subject4: 10, 8, 7; Subject5: 7, 5, 2; Subject6: 8, 6, 6. Do the data indicate that noise influenced subjects' performance? Test for equality of median.

Section C

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

19. A researcher conducts a study to evaluate whether the distribution of the length of time it takes migraine patients to respond to a 100 mg. dose of an intravenously administered drug is normal, with a mean response time of 90 seconds and a standard deviation of 35 seconds (i.e.,$\mu = 90$ and $\sigma = 35$). The amount of time (in seconds) that elapses between the administration of the drug and cessation of a headache for 30 migraine patients is recorded below. The 30 scores are arranged ordinally (i.e., from fastest response time to slowest response time). 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 distributions with the specified parameters?

20. (i) A researcher conducts a study to investigate whether or not a weekly television series that is highly critical of the use of animals as subjects in medical research influences public opinion. One hundred randomly selected subjects are administered a pretest to determine their attitude concerning the use of animals in medical research. Based on their responses, subjects are categorized as pro-animal research or anti-animal research. Following the pretest, all of the subjects are instructed to watch the television series (which last two months). At the conclusion of the series each subject's attitude toward animal research is reassessed. The results of the study are summarized in the following table. Use McNemar test to test if the data indicates that a shift in attitude toward animal research occurred after subjects viewed the television series?

		Posttest		
		Anti	**Pro**	**Row sums**
Pretest	**Anti**	10	13	**23**
	Pro	41	36	**77**
	Column sums	**51**	**49**	**100**

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

(10 + 10)

21. (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)

22. (i) A researcher conducts a study to investigate whether or not a weekly television series that is highly critical of the use of animals as subjects in medical research influences public opinion. One hundred randomly selected subjects are administered a pretest to determine their attitude concerning the use of animals in medical research. Based on their responses, sub-jects are categorized as pro-animal research or anti-animal research. Following the pretest, all of the subjects are instructed to watch the television series (which last two months). At the conclusion of the series each subject's attitude toward animal research is reassessed. The results of the study are summarized in the following table. Use McNemar test to test if the data indicates that a shift in attitude toward animal research occurred after subjects viewed the television series?

		Posttest		
		Anti	Pro	Row sums
Pretest	Anti	10	13	23
	Pro	41	36	77
	Column sums	51	49	100

(ii) A social scientist conducts a study assessing the impact of a federal gun control law on rioting in large cities. Assume that as a result of legislative changes the law in question, which severely limits the publics' access to firearms, was not in effect between the years 1985–1989, but was in effect during the five years directly preceding and following that time period (i.e., the gun control law was in effect during the periods 1980–1984 and 1990–1994). In conducting the study, the social scientist categorizes 12 large cities with respect to whether or not there was a major riot within each of the three designated time periods. Thus, each city is categorized with respect to whether or not a riot occurred during: a) 1980–1984, during which time the gun control law was in effect (Time 1); b) 1985–1989, during which time the gun control law was not in effect (Time 2); and c) 1990–1994, during which time the gun control law was in effect (Time 3). A code of **1** is employed to indicate the occurrence of at least one major riot during a specified five-year time period, and a code of **0** is employed to indicate the absence of a major riot during a specified time period. The following table summarizes the results of the study. Do the data indicate the gun control law had an effect on rioting?

	Time period		
	Time 1 (1980–1984)	Time 2 (1985–1989)	Time 3 (1990–1994)
New York	1	1	0
Chicago	0	1	0
Detroit	1	1	1
Philadelphia	0	1	0
Los Angeles	0	1	0
Dallas	0	1	1
Houston	0	0	0
Miami	0	1	0
Washington	1	1	0
Boston	0	1	0
Baltimore	0	0	0
Atlanta	0	0	1

(10 + 10)

****