LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – STATISTICS

THIRD SEMESTER – APRIL 2017

ST 3958- NON PARAMETRIC INFERENCE

Date: 26-04-2017
09:00-12:00   Dept. No.   Max. : 100 Marks

Section A

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

1. What are the assumptions of non parametric testing methods?

2. Explain ordinal data with an example.

3. Distinguish 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. What tests are used to test equality of variance of two independent samples?

7. In which situation is chi square goodness of fit test used?

8. What two non parametric tests are used to measure association or correlation?

9. What is the similarity or difference between McNemar test and 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 college English instructor reads in an educational journal that the median number of times a student is absent from a class that meets for fifty minutes three times a week during a 15 week semester is 5. During the fall semester she keeps a record of the number of times each of the 10 students in her writing class is absent. She obtains the following values: 9, 10, 8, 4, 8, 3, 0, 10, 15, 9. Do the data suggest that the class is representative of a population that has a median of 5?

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 that there is a difference with respect to the number of books taken out on different days of the week?

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 allten subjects are rated by a psychiatrist (who is blind with respect to a subject's experimentalcondition) on their level of depression. The psychiatrist's depression ratings for the five subjectsin 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.A physician who specializes in genetic diseases develops a theory which predicts that two-thirds of the people who develop a disease called cyclomeiosis will be males. She randomly selects 300 people who are afflicted with cyclomeiosis and observes that 140 of them are females. Is the physician's theory supported?

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 sixpatients are assigned to Group 2, which is administered the antidepressant drug Euphryia duringthe same six-month period. Assume that prior to introducing the experimental treatments, theexperimenter confirmed that the level of depression in the two groups was equal. After sixmonths elapse, all 12 subjects are rated by a psychiatrist (who is blind with respect to a subject'sexperimental condition) on their level of depression. The psychiatrist's depression ratings forthe 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 testfor 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 inhibitlearning. Each of six subjects is tested under three experimental conditions. In each of theexperimental conditions a subject is given20 minutes to memorize a list of10 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, requiressubjects to study the list of nonsense syllables in a quiet room. Condition2, the moderatenoisecondition, requires subjects to study the list of nonsense syllables while listening to classicalmusic. Condition3, the extremenoise condition, requires subjects to study the list of nonsensesyllables while listening to rock music. Although in each of the experimental conditions subjectsare presented with a different list of nonsensesyllables, the three lists are comparable withrespect to those variables that are known to influence a person's ability to learn nonsensesyllables. To control for order effects, the order of presentation ofthe three experimentalconditions is completely counterbalanced. The number of nonsense syllables correctly recalledby the six subjects under the three experimental conditions follow. (Subjects' scores are listedin 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 dataindicate 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 lengthof 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 administrationof the drug and cessation of a headache for 30 migraine patients is recorded below. The 30scores 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) In order to determine whether or not a group of 10 people exhibit extrasensory ability, a researcher employs as test stimuli a list of 200 binary digits (specifically, the values 0 and 1) which have been randomly generated by a computer. The researcher conducts an experiment in which one of his assistants concentrates on each of the digits in the order it appears on the list. While the assistant does this, each of the 10 subjects, all of whom are in separate rooms, attempts to guess the value of the number for each of 200 trials. The number of correct guesses in 200 trials for each of the subjects follows: 102, 104, 100, 98, 96, 80, 110, 120, 102, 128. Does the group as a whole exhibit evidence of extrasensory abilities?

(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 claimsis effective in treating hyperactivity,12 hyperactive children are evaluated during the followingthree time periods: a) One week prior to taking the drug; b) After a child has taken the drug forsix consecutive months; and c) Six months after the drug is discontinued. The children areobserved by judges who employ a standardized procedure for evaluating hyperactivity. Theprocedure requires that during each timeperiod a child be assigned a score of 1 if he ishyperactive and a score of 0 if he is not hyperactive. During the evaluation process, the judgesare 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) In a study on the efficacy of an antidepressant drug, each of 20 clinically depressed patients is randomly assigned to one of two treatment groups. For 6 months one group is given the antidepressant drug and the other group is give a placebo. After 6 months have elapsed, subjects in both groups are rated for depression by a panel of psychiatrists who are blind with respect to group membership. Each subject is rated on a 100 point scale (the higher the rating, the greater the level of depression). The depression ratings for the two groups follow.
  Drug group: 20, 25, 30, 48, 50, 60, 70, 80, 95, 98
 Placebo group: 35, 40, 42, 52, 55, 62, 72, 85, 87, 90
Do the data indicate there is a difference between the groups?

(ii) A researcher conducts a study to investigate whether or not a weekly televisionseries that is highly critical of the use of animals as subjects in medical research influencespublic opinion. One hundred randomly selected subjects are administered a pretest to determinetheir 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, allof the subjects are instructed to watch the television series (which last two months). At theconclusion of the series each subject's attitude toward animal research is reassessed. The resultsof 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

(10 + 10)

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