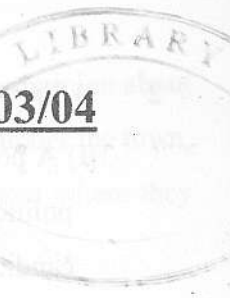


EASTERN UNIVERSITY, SRILANKA

SECOND EXAMINATION IN SCIENCE 2003/04

FIRST SEMESTER (Nov/Dec' 2004)

ST 205- STATISTICAL METHODS



Answer all questions

Time: Three hours

1. i) The Kruskal-Wallis Statistic for testing equality of medians is given by,

$$H = \frac{12}{N(N+1)} \sum_{i=1}^k n_i \left(\bar{R}_i - \bar{R} \right)^2 ;$$

where \bar{R}_i = average rank of the i^{th} group, \bar{R} = grand average of the overall ranks and k = number of groups.

Show that the above equation can be simplified as,

$$H = \left(\frac{12}{N(N+1)} \sum_{i=1}^k n_i \bar{R}_i^2 \right) - 3(N+1).$$

- ii) The internal revenue service wishes to compare the average time it takes to complete four different versions of the short form that it has developed. Twenty-four taxpayers who file short form are selected and each is randomly assigned to one of the four forms. The amount of time it takes to complete the form (in minutes) is as follows:

Forms			
A	B	C	D
19	15	31	42
24	22	34	39
26	28	29	48
18	17	36	50
21	12	25	41
23	16	32	43

Check whether the four versions of forms require the same average time to complete and identify significantly different medians if any.

- 2 i) Show that Spearman's rank correlation coefficient (r_s) lies between -1 and +1.
- ii) A political scientist wished to examine the relationship of the voter image of a conservative political candidate and the distance in miles between the residences of the voter and the candidate. Each of 12 voters rated the candidate on the scale of 1 to 20.

Voter	Rating	Distance
1	12	75
2	7	165
3	5	300
4	19	15
5	17	180
6	12	240
7	9	120
8	18	60
9	3	230
10	8	200
11	15	130
12	4	132

- i) Calculate the Spearman's rank correlation coefficient (r_s).
- ii) Do the data provide sufficient evidence to indicate a negative correlation between rating and distance?

3. a) A medical researcher investigated the blood type found in 1500 people. He chose 300 families each with five people and recorded the number of people with type-O blood in each family. The results are shown in the table below:

No. of people with type O	0	1	2	3	4	5
No. of families	18	81	85	70	38	8

Suppose if 45% of world's population have blood of type-O. Conduct an appropriate hypothesis test at the 5% level of significance to check whether a binomial distribution is an appropriate model.

3. b) A survey was conducted among 300 randomly-selected people in a town to gauge opinion about diverting traffic from the town. Three options are offered: a tunnel taking traffic under the town, a new surface dual carriageway, to do nothing. The interviewees were also asked where they lived: in the town, on the outskirts, elsewhere. The results are shown in the table.

		Option		
		Tunnel	Surface	No change
Living	In town	31	20	49
	Outskirts	34	34	32
	Elsewhere	72	25	3



Investigate these data to determine if the preferred option is associated with home location.

4. a) Write the definition of a run.
 b) A true-false examination was constructed with the answers running in the following sequence.

T F F T F T F T T F T F F T F T F T T F

Does this sequence indicate a departure from randomness in the arrangement of T and F answers?

- c) A researcher was interested in ascertaining whether the arrangement of men and women in the queue in front of the box office of a theater was a random arrangement. The data were obtained by simply tallying the sex of each of a succession of 50 people as they approached the box office.

M F M F M M M F F M F M F M F M M M M F M F M F M
 M F F F M F M F M F M M F M M M M F M F M M

Test the randomness of the arrangement of men and women at 5% significance level.

5. a) What are the advantages and disadvantages of a non-parametric test
 b) To investigate the effect of alcohol on reaction time, 10 subjects were given a stimulus and their reaction time to that stimulus was recorded. On one occasion the stimulus followed the consumption of alcohol and on another the stimulus was given when alcohol had not previously been consumed.

Subject	1	2	3	4	5	6	7	8	9	10
No alcohol	5.1	3.1	3.0	3.3	3.6	3.8	5.3	4.9	6.4	1.7
After alcohol	4.7	3.6	2.8	3.0	4.3	4.7	5.9	6.1	6.5	2.5

Question 5) cont...

Stating clearly your hypothesis, carry out

- a) a sign test
- b) a Wilcoxon signed rank test.

to ascertain whether or not alcohol increases reaction time. In both cases significance level. Comment on your results.

6. a) In order to study the efficiency of a drug to control hyperactivity in children and ten children chosen randomly were given the drug and 10 different children also chosen randomly (and independent of the first group) were given a placebo. All 20 were then given a test which was scored on a scale (higher score indicates higher level of activity).

Drug group	10	15	8	9	7	11	6	14	11	4
Placebo group	7	18	16	9	11	6	14	12	10	18

Using the median test, check whether there is any evidence to indicate that the drug is effective in controlling hyper activity?

- b) At the end of an interview each of six management consultants is independently asked to place five candidates in order of suitability for appointment to a top executive position. A selection committee chairman wishes to find out whether or not there is a significant bias towards one particular candidate on the part of the selectors. The data are given below.

Management consultants	Candidates				
	L	M	N	O	P
A	2	4	5	1	3
B	1	5	3	2	4
C	3	2	1	4	5
D	2	4	3	1	5
E	3	5	1	2	4
F	2	3	4	1	5

Use Friedman's two-way analysis of variance by ranks test to check whether there is a significant bias towards one particular candidate.