



# **MAASAI MARA UNIVERSITY**

## **REGULAR UNIVERSITY EXAMINATIONS 2022/2023 ACADEMIC YEAR FOURTH YEAR SECOND SEMESTER**

### **SCHOOL OF SCIENCE BACHELOR OF APPLIED STATISTICS**

**COURSE CODE: STA 4249**

**COURSE TITLE: NON-PARAMETRIC AND ROBUST METHODS**

**DATE: .....**

**TIME:**

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#### **INSTRUCTIONS TO CANDIDATES**

- **Question One is Compulsory**
- **Answer Any Other Two**

*This paper consists of 4 printed pages. Please turn over.*

**Answer question ONE and any other TWO questions**

**QUESTION ONE (30 MARKS)**

- a) Give examples of parametric methods (4marks)
- b) What is the advantage of using Wilcoxon signed rank test over the sign test? (2marks)
- c) In a controlled experiment to test diet, 12 persons were used. The following figures were used before and after:

Weight Before 138 158 160 172 210 185 245 182 172 132 250 176

Weight After 143 148 150 180 192 170 205 180 163 157 247 180

Use signed test to test the hypothesis that the diet is not effective in reducing a person's weight. Use  $\alpha = 0.05$  level of significance. (5marks)

- d) State the advantages and disadvantages of non-parametric methods. (4marks)
- e) In a group of 12 students of equal ability, 6 are with instructor X while the rest are trained by instructor Y, after a certain period of time, all students are ranked with the following results

Instructor (x) 7 12 4 10 8 3

Instructor (y) 5 2 6 1 9 11

Using an appropriate test at 5% level of significance, test the effectiveness of the training. (4marks)

- f) In 100 tosses of a coin, 65 heads and 35 tails were observed. Use a  $\chi^2$ -test at 5% level of significance to test the hypothesis that the coin is fair. (4Marks)

- g) The recorded high temperature in a certain town for each of 11 consecutive days during the month of January of this year is compared with the historical average high for the same days in previous years and noted as either above historical average (A) or below average (B). For the data:

AABABBAABAB,

Test the null hypothesis of random direction of deviation from average high temperature, using  $\alpha = 0.05$ . (7marks)

**QUESTION TWO (20 MARKS)**

- a) State 3 conditions that the Chi-square goodness of fit test must meet. (3marks)
- b) A product is made in 2 different production lines  $L_1$  and  $L_2$  and there are 3 different kinds of faults  $V_1$ ,  $V_2$ , and  $V_3$ . The obtained contingency table is

	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	Total
L <sub>1</sub>	20	35	45	100
L <sub>2</sub>	30	35	35	100
Total	50	70	80	200

Test at 5% level of significance whether the distribution of faults in terms of fault types and production lines are independent. (8marks)

- c) The time in seconds that took 10 employees to perform a certain task are listed below:  
 5.5, 7.3, 8.7, 7.1, 6.8, 8.7, 9.0, 9.3, 6.4, 7.2,  
 Use Kolmogorov-Smirnov Test at  $\alpha = 0.05$  to test the hypothesis that the time required to perform the task is  $\approx N(7.7, 2.2)$ . (9marks)

**QUESTION THREE (20 MARKS)**

- a) Suppose that a student scored the following marks in two consecutive sets of examination.  
 Exam1 76 55 46 65 70 48 93 74  
 Exam2 70 51 44 69 65 54 88 80  
 Use sign test at 0.1 level of significance to test the hypothesis that  $H_0: M=3$  vs  $H_a: M \neq 3$   
 (4marks)
- b) In a company, the average number of hours employees spend in a month is found to be 120 hours in the field. Suppose that in a random sample of 12 employees the following data was obtained:- 135, 105, 98, 123, 100, 140, 144, 130, 126, 119, 115, 125. State the hypothesis and use Wilcoxon sign rank test to test at 5% significant level. (5marks)
- c) Suppose we have 5 salesmen from a company A and 6 from company B with the following income:  
 A 7600 10100 12500 7300 8400  
 B 8800 9200 10400 8300 6000 8500  
 Use Mann-Whitney-Wilcoxon rank sum test to check whether the median income for the 2 companies is the same. Use  $\alpha = 0.05$  (5marks)

- d) School children taking coaching in 3 private schools secured the following marks out of 100
- |         | Child |    |    |    |    |    |    |    |    |    |
|---------|-------|----|----|----|----|----|----|----|----|----|
| Subject | 1     | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| 1       | 33    | 38 | 39 | 48 | 58 | 70 | 61 | 41 | 45 | 49 |

2	32	15	87	32	22	63	56	57	44
3	55	68	27	88	46	52	76	37	

Use Friedman test to test the hypothesis that the students in 3 private schools have identical distribution marks at 10% level of significance. (6marks)

**QUESTION FOUR (20 MARKS)**

- a) State 4 criteria that a good measure of association must satisfy. (2marks)
- b) State 2 assumptions of Friedman Two-way ANOVA by ranks test for several dependent samples. (2marks)
- c) Outline the procedure for carrying out Mann-Whitney-Wilcoxon rank sum test. (4marks)
- d) The ranks of 12 students according to their marks in Maths and Statistics is shown below

Student	1	2	3	4	5	6	7	8	9	10	11	12
Maths	5	2	1	6	8	11	12	4	3	9	7	10
Statistics	4	3	2	7	6	9	10	5	1	11	8	12

Use Spearman rank correlation to check if students who are good in Maths also excel in Statistics. (6marks)

- c) The 12 observations below were chosen randomly from a uniform distribution with mean 0 and variance 1.

0.0123	0.1039	0.1954
0.3217	0.3645	0.3919
0.5139	0.5840	0.6275
0.7621	0.8320	0.8871

Use Kolmogorov-Smirnov test to test the hypothesis that the square roots of these numbers are also uniformly distributed over (0,1). Use  $\alpha = 0.05$ . (6marks)