



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF MASTER OF SCIENCE**

**IN APPLIED STATISTICS**

**1<sup>ST</sup> YEAR 1<sup>ST</sup> SEMESTER 2019 ACADEMIC YEAR**

**MAIN CAMPUS**

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**COURSE CODE: SAS 812**

**COURSE TITLE: NON PARAMETRIC METHODS**

**EXAM VENUE:**

**STREAM: (MSc. Applied Statistics )**

**DATE: 30/4/19**

**EXAM SESSION: 2.00 – 5.00pm**

**TIME: 3.00 HOURS**

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**Instructions:**

- 1. Answer ANY 3 questions**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

### QUESTION ONE (20 MARKS)

- a) The median age of the onset of diabetes is thought to be 45 years. The ages at onset of a random sample of 16 people with diabetes are:

26.2	30.5	35.5	38.0	39.8	40.3	45.0	45.6
45.9	46.8	48.9	51.4	52.4	55.6	60.9	65.4

Perform Wilcoxon signed rank test at 5% to determine if there is any evidence to conclude that the median age of the onset of diabetes differs significantly from 45 years. (8Marks)

- b) What is the difference between binomial test and sign test? Develop the binomial test to classify a group of sample observations. (8 Marks)
- c) Describe the median test when there are k independent samples (4 Marks)

### QUESTION TWO (20 MARKS)

- a) Recent studies on physicians who saw patients suggested that the median length of each patients visit was 22 minutes. It is believed that the median visit length is shorter than 22 minutes for Physicians with a big load of patients. A random sample of 20 visits to physicians assumed to have a big load of patients yielded visit times as follows:

9.4	13.4	15.6	16.2	16.4	16.8	18.1	18.7	18.9	19.1
19.3	20.1	20.4	21.6	21.9	23.4	23.5	24.8	24.9	26.8

- i. Use the large sample approximation of the sign test to determine if there is sufficient evidence to conclude, at 1% level of significance, that the average visit length is shorter than 22 minutes? (8 Marks)
- ii. Based on the sign test, construct a 95% confidence interval for the median visit length. (5 marks)
- b) Analysis of the rate of turnover of employees by a personnel manager produced the following table showing the length of stay of 200 people before they left the company for other employment.

		Length of stay at the company (years)		
		0-2	2-5	Over 5
Grade	managers	4	11	6
	Skilled worker	32	28	21
	Unskilled worker	25	23	50

- i. State a hypothesis for this problem.
- ii. Test this hypothesis at 1% level of significance. (7 marks)

### QUESTION THREE (20 MARKS)

- a) A researcher found that 66% of a sample of 14 infants had completed the hepatitis B vaccine series. Can one conclude on the basis of this data that, in the sampled population, more than 60% have completed the series? Test at 1% level of significance. (5 Marks)
- b) In a certain university, the proportion of students who have a fee balance greater than three quarters the required amount is  $p$ . Out of 600 students selected at random from the university, 12 had a fee balance greater than three quarters the required amount.
- Find a point estimate of  $p$
  - Construct a 90% confidence interval for  $p$  (5 Marks)
- c) Five patients went to a diagnostic center to check their fasting blood sugar levels. After the first test they were not satisfied and so they decided to visit three other centers for confirmatory tests. The outcomes were recorded as follows

Patient	Fasting blood sugar levels in 4 centres			
	1	2	3	4
1	150	145	160	155
2	190	190	180	190
3	120	130	130	115
4	140	140	150	140
5	110	110	120	120

Apply Quade's test to check the similarities of the test centre results. (10 Marks)

### QUESTION FOUR (20 MARKS)

- a) The following data shows the average performance index of a company per month for a period of 15 months. Apply the run test at 5% level to this data. Compare your results with the Cox-Stuart test.

28	27	26	27	28	29	29	27	26	25	28	24	25	26	28
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(12 marks)

- b) A survey was carried out on salaries of top management officers of two companies and the amounts earned per month for some officers of the companies noted as follows in thousands of shillings.

Company A	65	58	55	50	59	30	65	90
Company B	76	66	48	49	62	45	55	88

Do the two companies pay their managers the same salaries? Apply Mann-Whitney U-Test. (8 Marks)

**QUESTION FIVE (20 MARKS)**

- a) Distinguish between tolerance limits and confidence limits (4 marks)
- b) Three treatments were replicated six time each in an experiment and the yields per treatment recorded in thousands of kilograms recorded as follows;

Treatment	Observation					
A	2.7	4.6	2.6	3.0	3.2	3.8
B	4.9	4.6	5.0	4.2	3.6	4.2
C	4.6	3.4	2.9	3.5	4.1	5.1

Use the Kruskal-Wallis procedure at 5% to test the differences between treatments. (10 marks)

- c) Perform a Chi- square test to investigate whether the following is drawn from a binomial distribution with parameter  $p = 0.3$ . Use a 5% level of significance. (6 marks)

x	0	1	2	3	4	5
f(x)	12	39	27	15	4	3