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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2023/2024 ACADEMIC YEAR
FIRST YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE
(MATHEMATICS)

Date: 13th December, 2023
Time: 8.30am –10.30am

KMA 102 - INTRODUCTION TO PROBABILITY AND STATISTICS

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

- a) The following are the marks (out of 100) of 60 students in mathematics.
16, 13, 5, 80, 86, 7, 51, 48, 24, 56, 70, 19, 61, 17, 16, 36, 34, 42, 34, 35, 72, 55, 75, 31, 52, 28, 72, 97, 74, 45, 62, 68, 86, 35, 85, 36, 81, 75, 55, 26, 95, 31, 7, 78, 92, 62, 52, 56, 15, 63, 25, 36, 54, 44, 47, 27, 72, 17, 4, 30.
- i) Using class interval of 10 i.e. 0-9, 10-19 etc. construct a grouped frequency distribution table (3 marks)
- ii) Construct a histogram for the data (3 marks)
- b) Given the following data
 $\sum X = 50, \sum Y = -30, \sum X^2 = 290, \sum Y^2 = 300, \sum XY = -115$ and $n=10$.
- i) Find the equation of the regression of Y on X (3 marks)
- ii) Calculate the coefficient of correlation between X and Y (3 marks)
- c) In a city there are 3 stores each having 20 pieces of an item. Let these stores be denoted by S_1, S_2 and S_3 . The stores S_1, S_2 and S_3 , have 10%, 20% and 30% defective items, respectively. A customer first chooses a store randomly and then selects an item randomly from the store. Find the probability that the selected item is defective. (3 marks)
- d) Let X be a continuous random variable. Show that the function
 $f(x) = \frac{1}{2}x, 0 \leq x \leq 2$
0, otherwise
is a p.d.f of X. Hence calculate $P\left(\frac{1}{2} \leq X \leq 1\right)$ (3 marks)

e) Given the on marks of students in the following data.

Marks	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Number of Students	7	10	10	20	20	15	8

Obtain:

- i) Mean (3 marks)
 - ii) Mode (2 marks)
 - iii) Median (2 marks)
 - iv) Standard deviation (2 marks)
- f) The probability of the number of events occurring in a given period of time is known as poisson distribution. Telephone calls enter a college switchboard on the average of two every three minutes. What is the probability of 5 or more calls arriving in a 9-minute period? (3 marks)

QUESTION TWO (20 MARKS)

a) Consider the following data for a group of ten students showing the number of minutes each was late for Mathematics lectures in a semester

6 7 5 8 14 6 5 4 6 9

- i) Calculate the second, third and fourth central moments. (5 marks)
 - ii) Using the results in (i) above obtain the Skewness and Kurtosis of this data and comment on your results. (5 marks)
- b) The data given below represents the frequency distribution of the various shoe sizes purchased by customers during the first quarter of the year 2023

Class interval	5-6	6-7	7-8	8-9	9-10	10-11
frequency	40	56	60	96	84	68

Compute the

- i) 20th percentile, P_{20} , (3 marks)
- ii) The coefficient of quartile deviation (5 marks)
- iii) Interpret the value obtained in (ii) above (2 mark)

QUESTION THREE (20 MARKS)

a) A mathematics lecturer recorded the length of time (y) minutes , taken to travel to school when leaving x minutes after 6 am on seven selected mornings. The result are as follows.

x	0	10	20	30	40	50	60
y	16	27	28	39	39	48	51

- i) Plot a scatterplot of length of time, y, against leaving x minutes after 6am (3 marks)

- ii) Calculate the equation of the least square regression line of y on x . (6 marks)
- iii) Estimate the length of time in y minutes given $x = 35$ (2 marks)
- b) Let X be a discrete random variable whose probability distribution is given by
 $f(x) = kx, x = 2,3,4,5,6$
 $0, \text{ Otherwise}$
- i) Obtain the value of the constant k . (3 marks)
- ii) Calculate $P(3 \leq X \leq 6)$. (3 marks)
- iii) Compute $E[5X]$. (3 marks)

QUESTION FOUR (20 MARKS)

The mean of the following frequency distribution is 52 and the frequency for the class interval 30 - 40 is f .

Class interval	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
Frequency	5	3	f	7	2	6	13

Find :

- i) Show that the value of f is 4. (2 marks)
- ii) The Mode (3 marks)
- iii) The Standard deviation (5 marks)
- iv) The 7th decile (3 marks)
- v) The 72nd percentile (3 marks)
- vi) Semi-interquartile range (4 marks)

QUESTION FIVE (20 MARKS)

- a) Let A and B be events with $P(A) = \frac{1}{3}, P(B) = \frac{1}{4}$ and $(A \cup B) = \frac{1}{2}$.

Find

- i) $P(A|B)$, (3 marks)
- ii) $P(B|A)$, (2 marks)
- iii) $P(A|B^c)$. (4 marks)
- b) Given a set of data; 2, 9, 8, 4, 7, 6, 8
 calculate the harmonic and the geometric mean for the data. (6 marks)
- c) A bag contains 5 red balls and 3 black balls. If 3 balls are drawn without replacement, what is the probability that
- i) no black balls will be selected, (2 marks)
- ii) exactly one red ball will be selected. (3 marks)