KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS, 2022/2023 ACADEMIC YEAR
SECOND YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF BUSINESS INFORMATION TECHNOLOGY

KMA 2213 - MATHEMATICAL STATISTICS

Date: 11th April 2022
Time:2.30pm-4.30pm

INSTRUCTIONS TO CANDIDATES
ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE COMPULSORY (30 MARKS)

a) Differentiate between the following terms as used in probability and statistics

    i) Primary and secondary sources of data. (2 marks)

    ii) Parameter and statistic. (2 marks)

    iii) Sampling and census. (2 marks)

b) What do you understand by "third kind of lie" and how is it minimized? (2 marks)

c) At a certain assembly plant, three machines A, B and C make 30%, 45%, and 15%, respectively, of the products. It is known from the past experience that 1%, 3% and 1% of the products made by each machine, respectively, are defective. Now, suppose that a finished product is randomly selected.
    i) What is the probability that it is defective?

        (3 marks)
    ii) If a product were chosen randomly and found to be defective, what is the probability that it was made by machine C?

        (3 marks)

d) The data on marks given by the table below

Marks Obtained	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of Students	6	12	22	24	16	12	8

Compute:

    i) Mode. (2 marks)
    ii) Median. (3 marks)
    iii) Mean. (2 marks)

e) Let X be a random variable with probability mass function given by

x	0	1	2	3	4
P(X=x)	0.10	0.30	0.30	0.20	0.1

Compute the mean, median and variance of X.   (5 marks)

f) Suppose that 5% of the electric bulbs manufactured by a company are defective. Let X be the number of bulbs from a sample of 50 bulbs. Identify the distribution of X hence find the probability that exactly 5 bulbs are defective.   (4 marks)

g) If calls to your cell phone are a Poisson process with a constant rate $\lambda=0.5$ calls per hour. If you forget to turn your phone off in a 3-hour lecture;

    i)   What's the probability that your phone rings during that time?   (4 marks)

    ii) How many phone calls do you expect to get during this lecture?   (3 marks)

QUESTION TWO (20 MARKS)

a) Presume that A fair coin is tossed three times. Let X be the number total number of tails and Y be the number heads in the last two tosses. Determine

    i)   Joint probability distribution of X and Y.   (3 marks)

    ii) Marginal distributions of X and Y.   (2 marks)

    iii) Mean Vector.   (3 marks)

    iv) Covariance matrix.   (6 marks)

    v) Correlation between X and Y.   (2 marks)

b) In New York City at rush hour, the chance that a taxicab passes someone and is available is 15%.

i) What is the probability that 10 cabs pass you before you find one that is free?
                                    (2 marks)

ii) How many cabs can you expect to pass you for you to find one that is free.
                                    (2 marks)

QUESTION THREE (20 MARKS)

a) Let X be a continuous random variable with pdf $f(x) = \begin{cases} \frac{x}{5} + k, & 0 \le x \le 3 \\ 0, & otherwise \end{cases}$

Find

   i) the value of K.   (3 marks)

   ii) The Expected value of X.   (3 marks)

iii) Variance of X. (4 marks)

b) Family income is believed to be normally distributed with a mean of $25000 and a standard deviation on $10000.

    i) If the poverty level is $10,000 and below, what percentage of the population lives in poverty?

                (3 marks)

    ii) A new tax law is expected to benefit "middle income" families, those with incomes between $20,000 and $30,000. What percentage of the population will benefit from the law?

                (3 marks)

c) Suppose that the length of a phone call, in minutes, is an exponential random variable with decay parameter = 1/12. If another person arrives at a public telephone just before you, find the probability that you will have to wait more than 5 minutes.

                (5 marks)

QUESTION FOUR (20 MARKS)

The data below shows the sales unit for a salesman in 50 days.

      140 110 120 160 150 195 130 170 185 125 165 195 105

      130 150 110 120 110 130 117 150 165 130 110 140 145

      125 180 175 115 115 135 145 150 115 110 195 140 140

      125 160 110 190 160 130 190 110 130 185 160

a) Using the smallest value as the lower class limit of the first class and class width of 10, obtain a grouped frequency distribution. (3 marks)

b) Estimate;

    i) Mode. (2 marks)

    ii) Median. (3 marks)

    iii) Quartile deviation. (3 marks)

    iv) Mean. (3 marks)

    v) Mean Absolute deviation. (3 marks)

c) Represent the data in a histogram with a frequency polygon. (3 marks)

QUESTION FIVE (20 MARKS)

a) Define;

    i) Estimation. (1 mark)

    ii) Interval estimation. (2 marks)

    iii) Hypothesis. (1 mark)

    iv) Estimator. (2 marks)

b) Let X be normally distributed with mean unknown mean and variance 625. In order to estimate μ, it a random sample of 10 units was selected and measured. The results are as follow; 49 57 38 73 81 74 59 76 65 69 54.

   i) Test at $\alpha = 0.05$ whether the population mean is 50.   (5 marks)

   ii) Determine 95% confidence interval of the population mean.   (4 marks)

c) A random sample of 10 ECD teachers in Nairobi county has a mean annual income of $5,800 and a standard deviation of $7,800. In Kwale county, a random sample of 15 secondary teachers has a mean annual income of $6,100 and a standard deviation of $7,375. Due to housing cost in Nairobi, it is believed that teachers in Nairobi county earn more than those in Kwale county. Assuming the population variances are equal, Test the claim at $\alpha = 0.01$ level of significance.

            (6 marks)