



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONIC ENGINEERING)

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECU201: ENGINEERING MATHEMATICS VI

DATE: 8/12/2021

TIME: 11:00 – 1:00 PM

INSTRUCTIONS: Attempt Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

- a) State two methods of classifying data according to class intervals. (2 marks)
- b) Given the frequency table below adjust the class intervals so that it ensures continuity of data. (2 marks)

Score	Frequency
1000-2999	10
3000-4999	9
5000-6999	11

- c) Given the data below, represent the information in a Bar chart. (4 marks)

Year	2010	2011	2012	2013	2014
Graduates	1000	1500	3000	2000	1500

- d) Sketch a scatterplot for the correlation coefficient, $r = -1$ giving at least 5 data points. (2 marks)

- e) A city's telephone book lists 100,000 people. If the telephone book is the frame for a study, how large would the sample size be if systematic sampling were done on every 200th person? (2 marks)
- f) How does sampling error occur? (1 mark)
- g) Give any four reasons for taking a sample instead of conducting a census. (4 marks)
- h) Differentiate between discrete random variables and continuous random variables. (2 marks)
- i) Let x have the pmf $p(x) = \begin{cases} x/6, & x = 1, 2, 3 \\ 0, & \text{elsewhere} \end{cases}$. Find $E(x^3)$ (2 marks)
- j) Are the following valid probability distributions? Explain? (4 marks)

x	$P(x)$
0	0.15
1	0.25
2	0.35
3	0.45

x	$P(x)$
0	0.16
1	1.25
2	0.45
3	0.25

- k) Determine whether the random variables for the following experiments are continuous or discrete.
- i. A coin is tossed 3 times, and the number of heads is recorded. (1 mark)
- ii. A 6-month-old baby girl is selected at random, and her weight is recorded. (1 mark)
- l) In an industry consisting of 60 women and 40 men it is observed that 24 women and 15 men wear safety boots. What is the probability that a worker picked at random wears safety boots given that the worker is a man? (3 marks)

QUESTION TWO (20 MARKS)

- a) Briefly explain any three methods of data collection giving an example in each case. (6 marks)
- b) Obtain a frequency table for the data below. 18, 12, 9, 11, 12, 11, 6, 18, 19, 11, 12, 9, 3, 11, 8, 9, 11, 9, 8, 12. (2 marks)
- c) Give the five stages in statistical investigation. (5 marks)

d) Given the data below;

Class	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	7	15	18	23	30	13	8	6

i. Represent the data in an ogive curve ('less than' & 'more than')

(6 marks)

ii. Estimate the Median from the graph

(1 mark)

QUESTION THREE (20 MARKS)

a) The record of two machines were recorded at five intervals as shown below.

Runs	1	2	3	4	5
Machine 1	83	86	76	92	71
Machine 2	82	84	63	83	55

i. Find the correlation coefficient for these two variables giving a comment.

(7 marks)

ii. Calculate the coefficient of determination and comment on the value.

(2 marks)

iii. Find the equation of the regression line.

(3 marks)

iv. Predict the value of Machine 2 for a run in which the record of machine 1 is 50.

(1 mark)

b) Diagrammatically differentiate mutually exclusive event from a non-mutually exclusive event.

(2 marks)

c) Suppose that 10 percent of the probability for a certain distribution that is $N(\mu, \sigma)$ is below 60 and that 5 percent is above 90. What are the values of μ and σ ?

(5 marks)

QUESTION FOUR (20 MARKS)

a) Given the pdf of a random variable x $f(x) = \begin{cases} me^{-x}, & 0 < x \\ 0, & \text{otherwise} \end{cases}$

i. What is the value of m for this function to serve as a pdf?

(2 marks)

ii. What is the moment generating function (mgf) of x?

(3 marks)

iii. Use the mgf obtained in (ii) above to compute the mean and variance of x.

(4 marks)

- b) If a random variable x had a pdf $f(x) = \begin{cases} \frac{1}{2}, & -1 < x < 1 \\ 0, & \text{otherwise} \end{cases}$
- Can the function be really treated as a pdf? (2 marks)
 - Find the cdf of the random variable x . (2 marks)
 - Find the $\text{pr}(-0.5 < x < 0.3)$. (2 marks)
- c) If a random variable x has a pdf given by $p(x) = \begin{cases} 0.81^x (1 - 0.81)^{1-x}, & x = 0, 1 \\ 0, & \text{otherwise} \end{cases}$
- What is the distribution called? (1 mark)
 - Identify the parameter in this distribution. (1 mark)
 - Obtain the mean and the variance of x . (2 marks)
- d) Let x be $N(2, 25)$, compute $\text{pr}(0 < x < 10)$. (2 marks)

QUESTION FIVE (20 MARKS)

- a) Explain the four random sampling techniques. (8 marks)
- b) Complete the following probability distribution, and calculate its mean and standard deviation. (6 marks)

X	P(x)
0	0.03125
1	0.15625
2	0.3125
3	
4	0.15625
5	0.03125

- c) For two event A and B, $P(A') = 3/10$, $P(B) = 13/20$. If $P(A \cap B) = 9/20$. Find:
- $P(A \cup B)$ (2 marks)
 - $P(A' \cap B)$ (2 marks)
 - $P(A \cup B')$ (2 marks)