



UNIVERSITY OF EMBU

2018/2019 ACADEMIC YEAR

SECOND SEMESTER EXAMINATIONS

SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN
STATISTICS

STA 224: COMPUTATIONAL METHODS AND DATA ANALYSIS 11

DATE: APRIL 9, 2019

TIME: 8:30 AM – 10:30 AM

INSTRUCTIONS:

Answer Question ONE and ANY other two Questions

QUESTION ONE (30 MARKS)

i) Explain the following two terms:

i) Eigen vectors (2 marks)

ii) Simpson's 1/3 rule newton codes (2 marks)

ii) Outline the characteristics of a good random number generator (4 marks)

iii) Decompose the Matrix A into LU factorization,

$$A = \begin{vmatrix} 4 & 12 & 8 & 4 \\ 1 & 7 & 18 & 9 \\ 2 & 9 & 20 & 20 \\ 3 & 11 & 15 & 14 \end{vmatrix}$$

(5 marks)

iv) Explain the advantages of using R in data analysis as a platform for statistical programming

(4 marks)



ISO 27001:2013 Certified

Knowledge Transforms



ISO 9001:2015 Certified

v) If x is random variable with cumulative distribution function $f(x)$ and the generalized inverse function $f^{-1}(y) = \ln f(x: f(x) \geq y) \quad 0 \leq y \leq 1$ prove that if U is uniformly distributed over $(0,1)$ then $x=f^{-1}(U)$ is distributed like x . (4 marks)

vi)

i) Differentiate between forward and backward difference in numerical differentiation (2 marks)

ii) Consider the table below

x	1.8	1.9	2.0	2.1	2.2
f(x)	10.889365	12.703199	14.778112	17.148957	19.855030

Compute: f'' (2.0) (3 marks)

vii) Distinguish between analysis of variance and t-test (4 marks)

QUESTION TWO (20 MARKS)

a) Write an algorithm to decompose a $n \times n$ matrix A into LU , where $A=LU$ (4 marks)

b) Use LU decomposition methods to solve for the equation:

$$\begin{aligned} X_1 - X_2 + X_3 &= 1 \\ 4X_1 + X_2 - X_3 &= -1 \\ 2X_1 + 3X_2 + 5X_3 &= 2 \end{aligned} \quad (8\text{marks})$$

c)

i) Integrate the function $f(x) = xe^x$ using Simpson's 3/8 rule for $x=0$ to $x=0.8$ (4 marks)

ii) Write an R code to integrate $f(x)$ using Simpson's rule (4 marks)



QUESTION THREE (20 MARKS)

a)

- i) What is an eigenvalue? (2 marks)
- ii) Using the power method, find numerically the dominant eigenvalue and associated eigenvector of matrix A:

$$A = \begin{pmatrix} 3 & -1 & 0 \\ -2 & 4 & -3 \\ 0 & -1 & 1 \end{pmatrix} \quad (6 \text{ marks})$$

- iii) Explain the short comings associated with power method for determining eigenvalue and eigenvector (3 marks)

b)

- i) Differentiate between standard error of the mean and confidence interval for the mean (4 marks)
- ii) Write computer code to generate Standard error of the mean and confidence interval for the mean (5 marks)

QUESTION FOUR (20 MARKS)

a)

- i) Given Y is a random variable taking values in $f(y_k ; k < N)$, such that

$$P(Y = y_k) = p_k$$

Define a random variable X with the same distribution as Y if U is a uniform random variable on [0; 1] (2 marks)

- ii) Write R code to generate uniformly distributed random integers in the range 1 to 10 (inclusive). (2 marks)
 - iii) Write R cord to simulate a Binomial distribution with parameter N and P. (N = 5 and p = 0:25) (8 marks)
- b) Find the real root of $f(x) = 2x - \log_{10}x - 7$ correct to four decimal places using the iteration method. (5 marks)
 - c) Explain the meaning of statistical inference as used in scientific research field (3 marks)



QUESTION FIVE (20 MARKS)

a)

- i) Distinguish between null hypothesis (H_0) and Alternative hypothesis (H_a) (2 marks)
- ii) Interpret p-value at 95% level of confidence (4 marks)
- iii) Write a computer code to plot the individual sample and to generate the mean, and standard error (4 marks)

b) Consider the system of three equations in three unknowns:

$$X_1 + X_2 + X_3 = 1$$

$$3X_1 + 3X_2 + 5X_3 = 0$$

$$3X_1 + 6X_2 + 10X_3 = 0$$

Write an R code to find/solve the above system of equations (5 marks)

c) Differentiate between Stacks and Queues in terms of operation orders (5 marks)

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