



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FOURTH YEAR SEMESTER EXAMINATIONS FOR

BACHELOR OF SCIENCE (MATHEMATICS)

SST 406 / SMA 468: STATISTICAL COMPUTING

DATE:

TIME:

INSTRUCTION: Answer Question **ONE** which is compulsory and any other **TWO** Questions
Question one (30 marks)

QUESTION ONE (COMPULSORY)(30 MARKS)

- a) Highlight three basic data types in R; (3 marks)
- b) If three students enters the University library per minute on average, write the R-script to determine the probability of having six or more students enter the library in a particular minute (3 marks)
- c) Write the R script for creating the following
 - i. A sample of 50 numbers starting at 10 which are incremented by 5.
 - ii. A random sample of 20 numbers from 70 to 120 with replacement(4 marks)
- d) The probability distribution of a continuous variable x is defined by

$$f(x) = \begin{cases} \frac{1}{40}(2x+3), & 0 \leq x \leq 5 \\ 0 & \text{elsewhere} \end{cases}$$

Write the R script for determining;

- i. The expected value of x
 - ii. Variance of x
 - iii. The Standard deviation of x
- (6 marks)

- e) Given the set $M=\{32,48,75,62,46,25,85,41,35\}$.

Write the R Scripts for;

- i. Constructing a 3 by 3 matrix M1 with first column elements; 32, 48, 75.
Determining;
 - ii. The inverse of M1
 - iii. The transpose of M1
 - iv. The determinant of M1
 - v. The eigen values of M1 (6 marks)
- f) Suppose there are ten multiple choice questions in a mathematics quiz with each question having four possible answers, but only one of them is correct. Write the R-script for determining the probability of having three or less correct answers if a student attempts to answer every question at random. (4 marks)
- g) Assuming a coin is faulty so that it show up heads 70% of the time. Write the R-script to determine the probability that one will obtain 20 or more heads after 50 flips (4 marks)

QUESTION TWO (20 MARKS)

- a) Differentiate the following R-functions as they apply in data analysis
- i. *data.frame()* and *cbind()*
 - ii. *seq()* and *rep()*
 - iii. *is.()* and *as.()*
 - iv. *head()* and *tail()*, (8 marks)
- b) Write the R-script for
- i. Sampling 10 unique numbers out of 35 items
 - ii. Determining the probability of getting at most 25 Heads after flipping a fair coin 50 times.
 - iii. Determining the 90th percentile of the F distribution with (3, 10) degrees of freedom. (5 marks)
- c) Suppose the visitors average clearance time at the University gate is three minutes. Write the R-script for determining the probability of a visitor being cleared in less than two minutes. (4 marks)
- d) Write the R-script for the logical operators
- i. AND
 - ii. OR
 - iii. NOT (3 marks)

QUESTION THREE (20 MARKS)

- a) A calculus examination results fits a normal distribution. If the examination mean was 72 and the standard deviation is 15. Write the R-script for determining the percentage of students scoring 84 or more in the exam (4 marks)
- b) Interpret the following probability distribution R functions statements
- i. `rpois(n = 10, lambda = 15)`
 - ii. `dbinom(n = 8, size = 1, p = 0.5)`
 - iii. `rhyper(n=1000,15,5,5)`
 - iv. `pnorm(3,6,4)-pnorm(-1,6,4)` (8 marks)
- c) Briefly discuss the following terms as they apply in statistical computing
- i. Optimization Criteria Efficiencies
 - ii. Response Surface Methodology (RSM)
 - iii. Exploratory data analysis (EDA)
 - iv. Graphical representation (Visualization) (8 marks)

QUESTION FOUR (20 MARKS)

- a) Write the R-script for the relational operators
- i. Equality
 - ii. Inequality
 - iii. Greater than or equal to (6 marks)
- b) Given the vectors $A < -c(1, -4, 2, -1, 9)$ and $B < -c(2, -5, 7, 0, 1)$. Write down the output after executing the following R functions;
- i. `order(B)`
 - ii. `tail(A,3)`
 - iii. `rep(c(B),2)`
 - iv. `append(A,B)` (4 marks)
- c) A fair coin was tossed twice. Write R script for determining;
- i. A binomial distribution table for head showing up after tossing the coin two times
 - ii. Probability of no head in the first toss
 - iii. Expected value
 - iv. Variance
 - v. Cumulative distribution (10 marks)

QUESTION FIVE (20 MARKS)

- a) Assume that a light bulb has a mean lifetime of 800 hours. Write the r-script to determine the probability that
- i. The light bulb survives to 1000 hours
 - ii. The light bulb doesn't survive 500 hours (4 marks)
- b) Distinguish the following conditional statements as they apply in statistical computing
- i. ELSE IF and A loop
 - ii. `lapply()` and `sapply()`
 - iii. `Mutate()` and `relocate()`.
 - iv. `getwd()` and `setwd()` (8 marks)
- c) Given the R-code statement `data <- data.frame(x = 1:4, y = 5:8, z = 10:13)`
And `apply(data[c(1, 2), ], 1, sum)`, Write the output;
- i. data
 - ii. `apply(data, 2, sum)`
 - iii. `apply(data[, c(1, 3)], 2, sum)`
 - iv. `apply(data, 2, range)` (8 marks)