
CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

**FIRST YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF
SCIENCE IN ACTUARIAL SCIENCE**

ACMT 111: COMPUTATIONAL METHODS AND DATA ANALYSIS I

STREAMS: BSC (ACTUARIAL SCIENCE)

TIME: 2 HOURS

DAY/DATE: TUESDAY 16/04/2019

11.30 A.M. – 1.30 P.M.

INSTRUCTIONS:

- Answer question **ONE** and **TWO** other questions
- Sketch maps and diagrams may be used whenever they help to illustrate your answer
- Do not write anything on the question paper
- This is a **closed book exam**, No reference materials are allowed in the examination room
- There will be **No** use of mobile phones or any other unauthorized materials
- Write your answers legibly and use your time wisely

QUESTION ONE (30 MARKS)

a) Define the following terms

- | | | |
|------|------------|----------|
| i) | Algorithm | (1mark) |
| ii) | Debugging | (1 mark) |
| iii) | Program | (1 mark) |
| iv) | Data frame | (1 mark) |
| v) | Vectors | (1 mark) |

b) Name **FOUR** components of the flow control in statistical computing (4 marks)

- c) State what the following command does

(3 marks)

$$X \leq -3 \text{ if } (x > 2) \quad y \leq -2^i \quad x \text{ else } y \leq -3^i$$

- d) State and describe **five** types of data representation in a computer (5marks)
- e) Write an algorithm for computing the variance given by the equation below (4marks)

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

- f) Describe a general algorithm for determining the largest representable number without producing overflow (5 marks)
- g) Consider the continuous function

$$f(x) = \begin{cases} x^2 + 2x + 3 & \text{if } x < 0 \\ 2x - 0.5x^2 & \text{if } 0 \leq x < 2 \\ x^2 + 4x - 7 & \text{if } 2 \leq x \end{cases}$$

Write a function tmpFn, which takes a single argument xVec. The function should return the vector of values of the function f(x) evaluated at the values in xVec. Hence, plot the function f(x) for $-3 \leq x \leq 3$

(4 marks)

QUESTION TWO (20 MARKS)

- a) State a step process of plotting the pie chart of a continuous variable called eruptions duration in faithful dataset of **R** (4 marks)
- b) Discuss the **three** sources of errors in computational methods (6 marks)
- c) Find the smaller root of the equation $x^2 - 32x + 1 = 0$ correct to **four** significant figures. (3 marks)

- d) Find the number of terms of the exponential series such that sum gives the value of e^2
 Correct to six decimal places at $x=1$ (3 marks)
- e) Describe the four features of algorithm (4 marks)

QUESTION THREE (20 MARKS)

- a) Highlight the consequences of violating exploratory data assumptions (5 marks)
- b) Discuss a step by step procedure of importing data from (4marks)
- i) SPSS
 ii) EXCEL
- into R.

- c) Define the term exploratory data analysis and state its attributes (5 marks)
- d) With examples, explain what the following programming terms mean in R (6 marks)
- i) if ()
 ii) while ()
 iii) ifelse ()

QUESTION FOUR (20 MARKS)

- a) Describe major data representation in the computer (6 marks)
- b) Find the smaller root of the equation $x^2 - 400x + 1 = 0$ using four digit arithmetic (4 marks)
- c) Define the term normalized floating point and give an example (4 marks)
- d) Clearly describe three philosophies of data analysis (6 marks)

QUESTION FIVE (20MARKS)

- a) Identify and describe five errors encountered in numerical computation (5marks)
- b) State the four major assumptions of exploratory data analysis (5 marks)
- c) Suppose $x_0=1$ and $x_1=2$ and

$$x_j = x_{j-1} - \frac{1}{x_{j-1}} \text{ for } j=1,2,\dots$$

Write a function **testloop** which takes the single argument n and returns the first $n-1$ values of the sequence $(x_j)_{j \geq 0}$ that means the values of $x_0, x_1, x_2, \dots, x_{n-2}$ (5 marks)

- d) Write a program that calculates the sum of cubes of positive integers from 1 to n for a given value of n , i.e.,

$$\sum_i^n i^3$$

Check your code against the direct formula

$$\frac{n(n+1)}{2} i^2$$

$$\sum_i^n i^3 = i$$

For different values of n , such as $n=3$, $n=30$, and $n=30$ (5 marks)
