

CHUKA**UNIVERSITY****UNIVERSITY EXAMINATIONS****EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN
ACTUARIAL SCIENCE****ACMT 311: COMPUTATIONAL METHODS AND DATA ANALYSIS****STREAMS: BSC****TIME: 2 HOURS****DAY/DATE: TUESDAY 29/08/2023****2.30 P.M. – 4.30 P.M****QUESTION ONE**

- a) Briefly give 3 applications/uses of Random Numbers. (3 marks)
- b) Differentiate between a variable and an identifier. (4 marks)
- c) What functions do the following commands on R language perform.
- i) `ls()` (2 marks)
 - ii) `getwd()` (2 marks)
 - `file.info("student")` (2marks)
- d) List 5 features of R. (5 marks)
- e) let $m = 2$, $a = c = 3$ and $X_0 = 2$. Use The linear congruential method to produces a sequence of the next 4 integers. show your workings. (6 marks)
- f) The treasurer of SACHUS is carrying out an estimate of the expected funds in the club account in 3 years' time. She needs to know that the expected level is to be within Kshs 150,000 and she wants to be 95% confident of this. Preliminary projections based on 1000 simulations suggest that the standard deviation is 100,000. How many simulations does she need to run?(6 marks)

QUESTION TWO

- a) List any three randomizing devices that you can use to generate uniform random numbers. (3 marks)
- b) Explain two shortcomings of the test for autocorrelation. (4 marks)

- c) Discuss 3 Characteristics of a good Linear Congruent Generator. (6 marks)
- f) Using Lagrange's interpolation formula find $y(10)$ from the following table. (7 marks)

X	5	6	9	11
Y	12	13	14	16

QUESTION THREE

- a) List six data structures in R. (6 marks)
- b) Give the description of the below Operators in R
- %% (2 marks)
 - || (2 marks)
 - && (2 marks)

c) Find x , $x = F^{-1}(r)$ for generating random variates from a uniform distribution using the inverse transform method. (8 marks)

QUESTION FOUR

- a) List 5 relational operators in R providing their description. (5 marks)
- b) With the appropriate formulae explain the algorithm for generating Normal random variates using polar method. (7 marks)
- b) Generate 4 random variates using the inverse transform method from an $\text{Exp}(2)$ distribution, using the random numbers $20/22$, $12/22$, $09/22$ and $16/22$ (8 marks)

QUESTION FIVE

- a) Differentiate between Theoretical tests and Empirical tests. (4 marks)
- b) Consider the two vectors below on R:

```
> x <- c(TRUE,FALSE,0,6)
> y <- c(FALSE,TRUE,FALSE,TRUE)
```

What output will be displayed from the below operators

- `> !x` (2 marks)
- `> x&y` (2 marks)
- `> x|y` (2 marks)

c) Using the random numbers 0.802 and 0.450 from $U(0,1)$, generate a pair of standard normal variates (a) using the Box-Muller algorithm (b) using the polar method. How would you use these methods to generate values from a $N(3,8)$ distribution? (10 marks)
