



# KENYA METHODIST UNIVERSITY

## END OF 2<sup>ND</sup> TRIMESTER 2010 EXAMINATIONS

**FACULTY** : **SCIENCE AND TECHNOLOGY**  
**DEPARTMENT** : **COMPUTER SCIENCE & BUSINESS INFORMATION**  
**UNIT CODE** : **CISY 403**  
**UNIT TITLE** : **SIMULATION AND MODELLING**  
**TIME** : **2 HOURS**

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### Instructions

- Answer question 1 and any other two questions.
- Marks will be awarded to clearly and concisely explained points.

### Question 1

- a) Define the term computer simulation.(2Mks)
- b) A designer recorded the time in minutes taken to assemble 36 systems simulations as follows: (10Mks)
- 22, 26, 23, 24, 20, 08, 17, 17, 21, 32, 18, 25  
16, 10, 22, 19, 14, 30, 22, 12, 24, 28, 11, 20  
15, 21, 28, 16, 22, 29, 21, 17, 19, 18, 13, 17
- Determine the mean time
  - Determine the standard deviation
  - Construct a 99% confidence interval for the mean time
- c) Explain what is meant by pseudo-random. (2Mks)
- d) Explain the four desired properties of a random number generator. (4Mks)
- e) Consider linear congruential generator defined by  $Z_0=27$ ,  $a=8$ ,  $c=47$  and  $m=100$ . Generate a sequence of five two-digit random numbers. (5Mks)
- f) State five advantages of programming a simulation model in a simulation language rather than a general purpose language. (5Mks)
- g) Explain why simulation is more desirable than direct experimentation. (4Mks)

### Question 2

- a) You have collected data on the number of hours per day employees in your organization surf the web. The data are as follows:

Status	Frequency
Do not surf	40
Surf for one hour	100
Surf for two hours	40

Surf for three hours	20
<b>Total</b>	<b>200</b>

Let the random variable  $X$  equal the number of hours of surfing for an employee and probability( $X=x$ ) = ratio of employees that surf for  $x$  hours. Calculate:

- i. Mean of  $X$ . (3Mks)
  - ii. Standard deviation of  $X$ . (3Mks)
  - iii. Plot the pdf and PDF for  $X$ . (4Mks)
- b) Explain the main steps followed in a simulation study. (10Mks)

### Question 3

- a) Explain the methods used to test the suitability of random numbers generated. (6Mks)
- b) A computer repair person is 'beeped' each time there is a call for service. The number of beeps per hour has a poisson distribution with mean 2 beeps per hour. Calculate the probability that there will be: (8Mks)
- i. At least two beeps in an hour.
  - ii. One beep in next three hours.
  - iii. No beep in 45 hours.
- c) Consider an M/M/1 queuing system with an arrival rate  $\lambda=0.4$  and service rate  $\mu=0.5$ .
- i. Compute the system load and remark about the systems stability. (2Mks)
  - ii. Compute the average number of customers in the system. (2Mks)
  - iii. If a simulation run gave the average number of customers is equal to 6.32. List two possible reasons that explain the difference between simulation and analytical results. (2Mks)

### Question 4

- a) The main highway that runs from Nairobi to Thika, otherwise called Thika Road is currently being prepared for expansion. The work has been awarded to various contractors and each contractor is supposed to work on a particular section of the highway. Assume you have been asked to design a model that will provide a picture of how the highway is supposed to look like when the expansion exercise is finally completed.
- Required:
- i. State with a reason whether this kind of model will be deterministic or stochastic. (2Mks)
  - ii. Various inputs may be needed in the design and implementation of this model. Briefly explain three of them stating why and where they should be considered as inputs. (6Mks)
  - iii. Explain why animation would be appropriate in explaining the behavior of this model when it is completed. (3Mks)
- b) Highlight any six application areas of simulation and modeling. (6Mks)
- c) Explain at least three classifications of simulation models. (3Mks)