



MERU UNIVERSITY COLLEGE OF SCIENCE & TECHNOLOGY

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University Examinations 2012/2013

THIRD YEAR, SECOND SEMESTER, EXAMINATION FOR THE DEGREE OF BACHELOR
OF SCIENCE IN COMPUTER SCIENCE AND COMPUTER TECHNOLOGY
AND
FOURTH YEAR, FIRST SEMESTER, EXAMINATION FOR THE DEGREE OF BACHELOR OF
BUSINESS INFORMATION TECHNOLOGY

ICS 2307: SIMULATION AND MODELING

DATE: DECEMBER 2012

TIME: 2 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

QUESTION ONE – 30 MARKS

- a. What are the advantages of using simulation other than experimenting with real life systems? (5 Marks)
- b. Explain how Monte Carlo techniques can be used to simulate the output when a fair coin is tossed 100 times. (4 Marks)
- c. Differentiate between the following:
- Static and dynamic models. (2 Marks)
 - Physical and mathematical models. (3 Marks)
- d. Use the mixed congruential method to generate a sequence of 5 random numbers between 0 and 31 such that: (5 Marks)
- $$\gamma_{n+1} = (13\gamma_n + 15) \bmod m \text{ given } \gamma_0=11$$
- e. The following sequence of random numbers have been generated:
- 0.65, 0.50, 0.64, 0.41, 0.86, 0.23, 0.61, 0.11, 0.89, 0.24
- Use the Kolmogorov Smirnov test with $\alpha=0.01$ to determine if these numbers are uniformly distributed over the interval 0 to 1. (6 Marks)
- f. Explain how random variates can be generated from the following functions:
- $f(x) = \frac{1}{b-a}$ for $a < b < \alpha$ (3 Marks)
 - $f(x) = 1 - e^{-x}$ for $x > 0$ (2 Marks)

QUESTION TWO – 20 MARKS

- a. What is the meaning of system simulation? (2 Marks)
- b. i. Why are random numbers generated by computers called pseudo-random numbers? (3 Marks)
- ii. Discuss the congruential method of generating random numbers. (5 Marks)
- c. Given below is a sequence of random numbers. Perform the Chi-squared tests to check the numbers for uniform distribution and serial auto correlation. (10 Marks)

07 05 96 14 10 90 21 15 84 28 20 78 35 25
 72 42 30 66 49 35 60 56 40 54 63 45 48 70
 50 42 77 55 36 84 60 30 91 65 24 98 70 18
 07 75 12 14 80 06 21 85 96 28 90 90 35 95
 84 42 05 78 49 10 72 56 15 66 63 20 60 70
 25 54 77 30 48 84 35 42 91 40 36 98 45 30
 07 50 24 14 55 18 21

QUESTION THREE – 20 MARKS

- a. A random variable x has the following empirical distribution.

x	1	2	4	6	8	10
f(x)	0.10	0.20	0.25	0.20	0.15	0.10

Plot the cumulative distribution and find the values of x corresponding to the following two digit random numbers: 05, 45, 62, 93 (8 Marks)

- b. The distribution of inter arrival times in a single server model is:

T : 1 2 3
 f(t) : ¼ ½ ¼

and the distribution service time is:

S : 1 2 3
 f(s) : ½ ¼ ¼

Develop a simulation table using the two digit random numbers 12, 40, 48, 93, 61, 17, 55, 21, 85, 88 to generate arrivals and 54, 90, 18, 38, 16, 87, 91, 41, 54, 11 to generate the corresponding service time. Compute the average waiting time in queue. (12 Marks)

QUESTION FOUR – 20 MARKS

- a. A bakery keeps stock of a popular brand of coke. Daily demand based on the past experience is given below:

Daily demand	0	15	25	35	45	50
Probability	0.01	0.15	0.20	0.50	0.12	0.02

Using the following sequence of random numbers, simulate the demand for the next 10 days:
48,78, 09, 87, 99, 77, 15, 14, 68 and 89

Find out the stock situation if the owner of the bakery decides to make 35 cakes every day. The unmet demand on any day is lost. (10 Marks)

What is the average stock required? (2 Marks)

- b. What is the importance of verification and validation of simulation models? (2 Marks)
- c. Differentiate between verification and validation as used in the context of simulation. (2 Marks)
- d. Highlight:
- i. Merits of simulation languages. (2 Marks)
 - ii. Merits of general purpose languages. (2 Marks)