

BE4-R3: PRINCIPLES OF MODELLING AND SIMULATION

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

Time: 3 Hours

Total Marks: 100

1.
 - a) Give two examples of large-scale applications of simulation of real-life systems.
 - b) What is a model? Differentiate between deterministic and stochastic simulation models.
 - c) What do you mean by next event incrementing in discrete event simulation? Why is it needed?
 - d) What are the different tests for randomness in pseudorandom numbers? Name four of them.
 - e) In a bank with a single server, there are two chairs for waiting customers. On an average, one customer arrives every 10 minutes and each customer takes 5 minutes for getting served. Assuming that the queuing system has Poisson arrival and exponential service time, find the probability that there is no customer in the system.
 - f) What are the advantages and disadvantages of using a special-purpose simulation language over a general-purpose language such as C++?
 - g) What do you mean by verification of a discrete event simulation model? Why is it required?

(7x4)

2.
 - a) What do you mean by discrete event systems? Give some examples.
 - b) What are the steps involved in the simulation of a discrete event system?
 - c) Describe some considerations in sensitivity estimation and optimization of the simulation model?

(6+6+6)

3.
 - a) What are pseudorandom numbers? Why are they called so?
 - b) Discuss the uniformity and independence statistical properties of a sequence of random numbers.
 - c) Using Monte-Carlo Simulation, outline a procedure to estimate the area of the circle. Also comment on how this method can be utilized to estimate the value of π .

(6+6+6)

4. An important inventory item is required every month. Accordingly, the purchase section procures the item every month. Procurement and consumption of the item follow the probabilities as given below:

Monthly Procurement	Probability	Monthly Consumption	Probability
4	0.20	4	0.30
5	0.30	6	0.40
7	0.50	9	0.30

- a) Using random numbers, simulate the stock held of the inventory item for the next 10 months. The beginning stock of the item is 10 units. Always assume that the procurements precede the consumption of the item. In case of stockout, the items parts that could not be consumed will not be issued next month.

Random Numbers for monthly procurements: 40, 57, 19, 48, 34, 45, 71, 74, 26, 24
Random Numbers for monthly consumption : 32, 34, 05, 90, 50, 21, 88, 17, 71, 27

- b) Find out the stock of the item at the end of 10 months. What is the lowest closing stock during the period? What is the average stock? Is there any stockout?

(12+6)

5. A railway enquiry counter receives Poisson-distributed incoming customers at a rate of 20 per hour. At the same place, a ticket-booking counter receives Poisson-distributed incoming customers at a rate of 40 per hour. The exponentially distributed service time in each of the counters is 1 minute per customer.

- a) Find the average time spent by a customer in the system at the enquiry counter as well as at the ticket-booking counter.
b) Find the average time spent by a customer in the system again when the resources are pooled (That is enquiry and ticket-booking is now possible at both the counters).
c) What do you mean by pooling of resources in the context of queuing? Is there any improvement with the pooling of resources?

(7+7+4)

6.

- a) Why is it necessary to carry out output analysis of simulation models?
b) Are the output data from simulation normally distributed? Justify your answer with an example.
c) Discuss briefly some useful Variance-reduction techniques for carrying out output analysis.

(5+5+8)

7.

- a) As an aid in the validation process, a three-step approach has been widely used,
i) Build a model that has high face validity,
ii) Validate model assumptions,
iii) Compare the model input-output transformation to corresponding input-output transformations for the real system.

Describe above mentioned three steps in detail.

- b) When analyzing simulation output data, a distinction is made between transient simulation and steady-state simulations. Distinguish between two types of simulation.

(12+6)