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18CS645

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
System Modeling and Simulation

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Specify the situations when simulation is an appropriate tool. **(10 Marks)**

b. Simulate a single server queuing system for 10 customers and find i) Average waiting time ii) Probability that a customer has to wait iii) Average service time iv) Average system time Interarrival time and service time distribution are given as follows :

Interarrival time (min)	1	3	5
Probability	0.5	0.3	0.2
Random Numbers	8, 5, 2, 1, 0, 9, 6, 7, 5		

Service time (min)	1	2	3	4
Probability	0.30	0.35	0.15	0.20
Random Numbers	21, 10, 94, 76, 43, 19, 69, 17, 86, 38			

(10 Marks)

OR

2 a. Define the concepts used in discrete event simulation with an example for each. **(10 Marks)**

b. Write event scheduling algorithm. Illustrate the execution of arrival event and departure event in event scheduling approach using flowchart. **(10 Marks)**

Module-2

3 a. Explain Poisson distribution and its properties. **(05 Marks)**

b. A production process manufactures computer chips on the average at 3% defective. Every day, a random sample of size 50 is taken from the process. If the sample contains more than two defective chips the process will be stopped. Compute the probability that the process is stopped by the sampling scheme. **(05 Marks)**

c. Highlight the characteristics of a queuing system to be observed while applying simulation as a tool to solve. **(10 Marks)**

OR

4 a. A bus arrives every 15 minutes at a specified stop beginning at 6.45am and continuing until 9.00am. A certain passenger does not know the schedule, but arrives randomly (uniformly distributed) between 7.00am and 7.30am every morning. What is the probability that the passenger waits for more than 5 minutes for a bus? **(10 Marks)**

b. Illustrate with an example, the Kendall's queuing notation. **(04 Marks)**

c. Given the number of customers in the system at time't', how do you compute the long, run time average number of customers in system and in queue? Justify with an example. **(06 Marks)**

Module-3

5 a. Define pseudo random numbers. What are the problems that occur while generating pseudo random numbers? **(06 Marks)**

b. Use mixed congruential method to generate a sequence of four two digit random integers between 0 and 24 and corresponding random numbers with $x_0 = 13$, $a = 19$ and $c = 35$. **(04 Marks)**

c. The sequence of numbers 0.54, 0.76, 0.98, 0.11 and 0.68 has been generated. Use Kolmogorov – Smirnov test with $\alpha = 0.05$ to learn whether the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected, Consider $D_\alpha = 0.565$. **(10 Marks)**

OR

6 a. Test whether the following numbers are uniformly distributed using chi-square test at $\alpha = 0.05$. Consider 10 intervals and $\chi^2_{0.05,9} = 16.9$.

0.59, 0.92, 0.51, 0.05, 0.50, 0.35, 0.26, 0.79, 0.78, 0.44, 0.09, 0.79, 0.22, 0.12, 0.47, 0.82, 0.07, 0.18, 0.92, 0.85, 0.03, 0.87, 0.45, 0.34, 0.12, 0.98, 0.45, 0.90, 0.83, 0.01, 0.32, 0.98, 0.43, 0.3, 0.21, 0.12, 0.01, 0.7, 0.43, 0.12, 0.78, 0.76, 0.32, 0.54, 0.65, 0.43, 0.21, 0.56, 0.43, 0.86. **(10 Marks)**

b. Test whether the 2nd, 6th and 10th and so on numbers are autocorrelated at $\alpha = 0.05$ in the following sequence. Consider $z_{0.025} = -1.96$

0.59, 0.92, 0.51, 0.05, 0.50, 0.35, 0.26, 0.79, 0.78, 0.44, 0.09, 0.79, 0.22, 0.12, 0.47, 0.85, 0.07, 0.18, 0.92, 0.85. **(10 Marks)**

Module-4

7 a. What are the steps in the development of a useful model of input data? What is the importance of histogram in this process? How is a histogram constructed? **(10 Marks)**

b. Which are the measures of performance of a simulated system? How do you estimate them? **(10 Marks)**

OR

8 a. How do you estimate the parameters of the following distributions? Highlight the features of these distributions.

i) Poisson ii) Exponential iii) Gamma iv) Normal v) Lognormal. **(10 Marks)**

b. Highlight the features of the types of simulations with respect to output analysis with examples for each. **(10 Marks)**

Module-5

9 a. Explain model building, verification and validation with respect to simulation models. **(10 Marks)**

b. Explain Naylor and Finger 3 steps approach to aid in the validation process. **(10 Marks)**

OR

10 a. Differentiate between verification and validation of simulation models. Suggest the techniques which help in verification. **(10 Marks)**

b. Illustrate the calibration technique for simulator model. **(10 Marks)**

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