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10CS82

Eighth Semester B.E. Degree Examination, Aug./Sept. 2020
System Modeling & Simulation

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. With a neat flow diagram, explain the steps in simulation study. **(10 Marks)**

b. A small shop has one checkout counter. Customers arrive at this checkout counter at random time from 1 to 10 minutes apart. Each possible value of inter arrival time has the same probability of occurance equal to 0.10. Service time varies from 1 to 6 minutes with distribution as shown in table Q1 (b).

Table Q1 (b) – Service distribution

Service Time (Minutes)	1	2	3	4	5	6
Probability	0.05	0.10	0.20	0.30	0.25	0.10

Develop simulation table for 10 customers. Find average waiting time, average service time, and average time. Customer spends in system. Consider random digits for arrivals as 91, 72, 15, 94, 30, 92, 75, 23 and 30 for services as 84, 10, 74, 53, 17, 79, 91, 67, 89 and 38 sequentially. **(10 Marks)**

2 a. Explain the terms : System, Model, System state, List, Event notice, Event list. **(06 Marks)**

b. Six dump trucks are used to haul coal from the entrance of a mine to the railroad. There are two loaders and one weighing scale. Each truck is loaded by one of the two loaders. After a loading, the truck immediately moves to the scale to be weighed. The queue system at the loaders and weigh scale are ordered on a first-come-first-served basis. After being weighed a truck begins a travel time and then afterward returns to the loader queue. Model and construct the simulation table. Estimate the average loader utilization and average scale utilization. The stopping time of simulation is completion of four weighing from the scale or after 10 iterations? Assume four trucks are at the loaders and two are at the scale at time t = 0. The activity times are given in Table Q2 (b). **(14 Marks)**

Table Q2 (b)

Loading time (minutes)	10	5	5	10	15	10	10	15
Weighing time (minutes)	8	12	8	16	12	8		
Travel time (minutes)	30	60	80	40	50	70		

3 a. Explain the following discrete distributions:
(i) Binomial distribution (ii) Negative Binomial distribution. **(06 Marks)**

b. Explain the following continuous distributions:
(i) Uniform distribution (ii) Exponential distribution. **(06 Marks)**

c. Suppose that the life of an industrial lamp, in thousand of hours, is exponentially distributed with failure rate $\lambda = \frac{1}{3}$ (one failure every 3000 hours, on the average). Find (i) The probability that the lamp will last longer than its mean life. (ii) The probability that the lamp will last between 2000 and 3000 hours (iii) The probability that the lamp will last another 1000 hours; given that it is operating after 2500 hours. **(08 Marks)**

4 a. Explain the characteristics of queuing system. **(05 Marks)**

b. List the different queuing notation for parallel server systems and the steady state parameters of the M/G/1 queue. Explain very briefly. **(10 Marks)**

c. Malfunctioning of machines occurs according to a Poisson process, at the rate $\lambda = 1.5$ per hour. Repair by a single mechanic take an average time of 30 minutes, with a standard deviation of 20 minutes. Find the average broken machines over the long run. **(05 Marks)**

PART – B

5 a. Explain linear congruential method/technique for generating random numbers. How maximal period can be achieved? Explain. **(05 Marks)**

b. The sequence of numbers 0.44, 0.81, 0.14, 0.05 and 0.93 are generated. Use the 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? Take $D_{0.05} = 0.565$. **(05 Marks)**

c. Buses arrive at the bus stop according to a Poisson process with a mean of one bus per 15 minutes. Generate a random variate, N, which represents the number of arriving buses during a 1-hour time slot. Random numbers are 0.4375, 0.4146, 0.8353, 0.9952, 0.8004, 0.7945, 0.1530 **(10 Marks)**

6 a. Explain different steps in the development of a useful model of input data. **(06 Marks)**

b. List any four suggested estimators for distributions often used in simulation. **(04 Marks)**

c. The number of vehicles arriving at the northwest corner of an intersection in a 5-minute period between 7.00 AM and 7.05 AM was monitored for five workdays over 20 week period. The following Table Q6 (b) shows the resulting data and appear to follow Poisson distribution. Apply Chi-square Goodness of fit test at 0.05 level of significance. The critical value $\chi^2_{0.05,5}$ is 11.1. **(10 Marks)**

7 a. Explain the types of simulation with respect to output analysis. Give examples. **(10 Marks)**

b. Explain the replication method for steady-state simulation. **(10 Marks)**

8 a. Explain with a neat diagram, the model building verification and validation. **(10 Marks)**

b. With a neat diagram, explain the iterative process of calibrating a model. **(10 Marks)**

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