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10CS82

Eighth Semester B.E. Degree Examination, Dec.2014/Jan.2015
System Modeling and Simulation

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Use of statistical tables is permitted.

PART – A

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

b. A computer technical support center is staffed by two people, Able and Baker, who take calls and try to answer questions and solve computer problems. The time between calls ranges from 1 to 4 minutes with the distribution as shown in Table 1b(1). Able is more experienced and can provide service faster than Baker, which means that, when both are idle, Able takes the call. The distribution of their service times are shown in Table 1b(2) and Table 1b(3) respectively.

Table 1b(1) Interarrival time distribution

Interarrival time (minutes)	1	2	3	4
Probability	0.25	0.40	0.20	0.15

Table 1b(2) Service time distribution of Able

Service time (minutes)	2	3	4	5
Probability	0.30	0.28	0.25	0.17

Table 1b(3) Service time distribution of Baker

Service time (minutes)	3	4	5	6
Probability	0.35	0.25	0.20	0.20

Random digits for inter-arrival times are: 26, 98, 90, 26, 42, 74, 80, 68, 22, 48, 34, 45, 24, 34
Random digits for service times are: 95, 21, 51, 92, 89, 38, 13, 61, 50, 49, 39, 53, 88, 01, 81
Simulate this system for 10 customers, by finding (i) Average inter arrival time (ii) Average service time of Able (iii) Average service time of Baker (iv) Average waiting time of all the customers (v) Average waiting time of those who wait. **(10 Marks)**

2 a. Explain the following terms used in discrete event simulation: (i) List (ii) Event notice (iii) Delay (iv) Clock **(04 Marks)**

b. Explain Event scheduling/Time Advance algorithm by generating system snapshots at clock = t and clock = t_1 . **(06 Marks)**

c. Six dump trucks are used to haul coal from a mine to railroad. Each truck is loaded by one of two loaders. After loading, the truck immediately moves to scale for weighing. Both loaders and scale have First In First Out queue discipline. After being weighed, the truck travels to the rail road (begins travel time), unloads and later returns to the loader queue. The distribution of loading time, weighing time and travel time are given in Table 2c(1), Table 2c(2) and Table 2c(3) respectively. It is assumed that 5 trucks are at the loaders and one is at the scale at time t = 0.

Table 2c(1)

Loading time	Probability
5	0.3
10	0.5
15	0.2

Table 2c(2)

Weighing time	Probability
12	0.7
16	0.3

Table 2c(3)

Travel time	Probability
40	0.4
60	0.3
80	0.2
100	0.1

The activity times are given in Table 2c(4)

Table 2c(4)

Loading time	10	5	5	10	15	10	10
Weighing time	12	12	12	16	12	16	
Travel time	60	100	40	40	80		

Simulate the system for 25 minutes to estimate the loader and scale utilization. **(10 Marks)**

3 a. Define random variable. What are the different types of random variables? Explain with at least one example in each case. **(05 Marks)**

b. A production process manufactures computer chips one the average at 2% nonconforming. Everyday a random sample of size 50 is taken from the process. If the sample contains more than 2 nonconforming chips, the process will be stopped. Compute the probability that the process is stopped by the sampling scheme. Also find the mean and variance. **(08 Marks)**

c. Find the mean and variance of exponential distribution. Suppose that the life of an industrial lamp, in thousands of hours, is exponentially distributed with failure rate $\lambda = 1/3$ (one for every 3000 hours, on the average). Find the probability that the lamp will last longer than its mean life. **(07 Marks)**

4 a. Explain the characteristics of queuing system. Also explain the queuing notation in general. **(10 Marks)**

b. Explain the steady state parameters of M/G/1 queue. **(10 Marks)**

PART – B

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

b. Consider the sequence of random numbers 0.12, 0.01, 0.23, 0.28, 0.89, 0.31, 0.04, 0.28, 0.83, 0.93, 0.99, 0.15, 0.33, 0.35, 0.41, 0.6, 0.27, 0.75, 0.88, 0.68, 0.49, 0.05, 0.43, 0.95, 0.58, 0.19, 0.36, 0.69, 0.87.
Test whether 3rd, 8th, 13th and so on numbers in the above sequence are auto correlated. At significance level $\alpha = 0.05$, normal table value is given as 1.96. **(08 Marks)**

c. Explain inverse transform technique for exponential and uniform distributions. **(06 Marks)**

6 a. List the steps involved in development of a useful model of input data. **(04 Marks)**

b. Records pertaining to the monthly number of job related injuries at an underground coal mine were being studied by a federal agency. The values for the past 100 months were as follows:

Injuries per month	0	1	2	3	4	5	6
Frequency of occurrence	35	40	13	6	4	1	1

Apply the chi-square test to these data to test the hypothesis that the underlying distribution is Poisson. Take $\alpha = 0.05$. **(08 Marks)**

c. Let X_1 represent the average lead time (in months) to deliver and X_2 the annual demand, for industrial robots. The following data are available on demand and lead time for the last ten years.

Lead time	6.5	4.3	6.9	6.0	6.9	6.9	5.8	7.3	4.5	6.3
Demand	103	83	116	97	112	104	106	109	92	96

Find the dependency between lead time and demand. **(08 Marks)**

7 a. Explain the replication method for steady-state simulations. **(10 Marks)**

b. Differentiate between point estimation and interval estimation. **(05 Marks)**

c. Differentiate between terminating and steady state simulations by giving one example each. **(05 Marks)**

8 a. With a neat flow diagram, explain the concept of model building, verification and validation of simulation models. **(10 Marks)**

b. Describe the three step approach of Naylor and Finger in the validation process. **(10 Marks)**

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