Solutions of Assignment-8

Q1.Monte carlo simulation is used for solving

(a) Stochastic problems where passage of time plays no substantive role.
(b) Deterministic problems where passage of time plays substantive role.
(c) Stochastic problems where passage of time plays substantive role.
(d) All of the above

Q2. Monte Carlo simulation is generally

(a) Static
(b) Dynamic
(c) Static or dynamic
(d) None of these

Solutions of questions from 3 to 15 age given below

Refer the following for Q3-Q6.

A store has one counter. The probability of inter-arrival time and service time of customers are given in the following table.

Inter-arrival time (min)	Probability	Service time (min)	Probability
1	0.2	3	0.2
2	0.3	5	0.5
3	0.3	7	0.3
4	0.1		
5	0.1		

Random numbers used for prediction of inter-arrival time and service time are as per the table given below:

Customer	1	2	3	4	5	6	7	8	9	10	11	12
R.n. for Arrival		61	55	1	33	19	25	79	93	18	49	92
R.n. for service	28	1	61	85	67	53	62	79	66	63	33	77

It is assumed that first customer comes at 0 time. Random numbers used are from the set of 100 random numbers from 00 to 99. Simulation is to be carried out to find the performance measures of a queueing system.

Q3. The service start time for 10^{th} customer will be at
(a) 57 min.
(b) **47** min.
(c) 42 min.
(d) 52 min.

Q4. Waiting time in queue by 6^{th} customer will be (in minutes)
(a) 11
(b) **15**
(c) 6
(d) 18

Q5. The arrival time of 7th customer will be at
(a) **12** min.
(b) 15 min.
(c) 21 min.
(d) 20 min.

Q6. The time spend by 5th customer in the system will be (in minutes)
(a) 5
(b) 7
(c) **16**
(d) 23

Refer the following for Q7 to Q10.
A store has one counter. The probability of inter-arrival time (in min) and service time (in min.) of customers are given in the following table.

Interarrival time	**Probability**	**Service time**	**Probability**
1	0.2	1	0.2
2	0.3	3	0.5
3	0.3	5	0.3
4	0.1		
5	0.1		

Random numbers used for prediction of interarrival time and service time as per the table given below:

Customer	1	2	3	4	5	6	7	8	9	10	11	12
R.n. for arrival		61	55	1	33	19	25	79	93	18	49	92
R.n. for service	28	1	61	85	67	53	62	79	66	63	33	77

It is assumed that first customer comes at 0 time. Random numbers used are from the set of 100 random numbers from 00 to 99. Simulation is to be carried out to find the performance measures of a queueing system.

Q7. The service start time for 11th customer will be at
(a) 3 min.
(b) 5 min.
(c) 31 min.
(d) **34** min.

Q8. Waiting time in queue by 5th customer will be (in minutes)
(a) 0
(b) **5**
(c) 7
(d) 8

Q9. The arrival time of 4th customer will be at
(a) 5 min.
(b) 6 min.
(c) **7** min.
(d) 9 min.

Q10. The time spend by 9th customer in the system will be (in minutes)

(a) 10
(b) **11**
(c) 13
(d) 14

For Q 11-13:

For a particular shop, the daily demand of an item with associated probabilities is given below:

Daily demand	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0.02

If random number stream (X_1, X_2 ….. X_{10}) is generated using linear congruential generator ($X_i = a*X_{i-1} + c$)mod m with $X_0 = 27$, a = 17, c = 4, and m = 100,

Q11. Average daily demand for first four days will be

(a) 25
(b) **30**
(c) 35
(d) 27

Q12. Average daily demand for first ten days will be

(a) 25
(b) 30
(c) 35
(d) **27**

Q13. Demand on 5th day is expected to be

(a) **10**
(b) 20
(c) 30
(d) 40

For Q 14-15:

For a particular shop, the daily demand of an item with associated probabilities is given below:

Daily demand	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0.02

Q14. For the sequence of random numbers (out of 100 random numbers generated between 00-99) used are as 25, 39, 65, 76, 12, 05, 73, 89, 19, 49 the average daily demand will be

(a) 25
(b) 30

(c) 35
(d) **24**

Q15. For the sequence of random numbers (out of 100 random numbers generated between 00-99) used are as 40,19, 87,83,73,84,29,09,02,20,the average daily demand will be

(a) 25
(b) 30
(c) **22**
(d) 27

Solutions

For Q3-6

Customer	R.n. (arrival)	Int arr time	R.n. for serv	Arr time	Serv time	Time ser beg	Wait time-queue	Time serv ends	Time cust in syst
1			28	0	5	0	0	5	5
2	61	3	1	3	3	5	2	8	5
3	55	3	61	6	5	8	2	13	7
4	1	1	85	7	7	13	6	20	13
5	33	2	67	9	5	20	11	25	**16**
6	19	1	53	10	5	25	**15**	30	20
7	25	2	62	**12**	5	30	18	35	23
8	79	3	79	15	7	35	20	42	27
9	93	5	66	20	5	42	22	47	27
10	18	1	63	21	5	**47**	26	52	31
11	49	2	33	23	5	52	29	57	34
12	92	5	77	28	7	57	29	64	36
13	83	4	71	32	7	64	32	71	39
14	61	3	86	35	7	71	36	78	43
15	28	2	79	37	7	78	41	85	48
16	78	3	88	40	7	85	45	92	52
17	21	2	43	42	5	92	50	97	55
18	32	2	7	44	3	97	53	100	56

For Q7-10

Customer	R.n. (arrival)	Int arr time	R.n. for serv	Arr time	Serv time	Time ser beg	Wait time-queue	Time serv ends	Time cust. in syst.
1			28	0	3	0	0	3	3
2	61	3	1	3	1	3	0	4	1
3	55	3	61	6	3	6	0	9	3
4	1	1	85	**7**	5	9	2	14	7
5	33	2	67	9	3	14	**5**	17	8
6	19	1	53	10	3	17	7	20	10
7	25	2	62	12	3	20	8	23	11
8	79	3	79	15	5	23	8	28	13
9	93	5	66	20	3	28	8	31	**11**
10	18	1	63	21	3	31	10	34	13
11	49	2	33	23	3	**34**	11	37	14
12	92	5	77	28	5	37	9	42	14
13	83	4	71	32	5	42	10	47	15
14	61	3	86	35	5	47	12	52	17
15	28	2	79	37	5	52	15	57	20
16	78	3	88	40	5	57	17	62	22
17	21	2	43	42	3	62	20	65	23
18	32	2	7	44	1	65	21	66	22

For Q11-13

Daily Demand	Probability	Cumulative probability	Random number interval
0	0.01	0.01	00
10	0.20	0.21	01-20
20	0.15	0.36	21-35
30	0.50	0.86	36-85
40	0.12	0.98	86-97
50	0.02	1.00	98-99

Rand no LC generator LCG(a=17,c=4, X0=27, m=100)

S. No.	X_{i-1}	X_i
1	27	63
2	63	75
3	75	79
4	79	47
5	47	3
6	3	55
7	55	39
8	39	67
9	67	43
10	43	35

Days	Random numbers	Demand
1	63	30
2	75	30
3	79	30
4	47	30
5	3	10
6	55	30
7	39	30
8	67	30
9	43	30
10	35	20

Avg demand for first four days= **30**
Avg. daily demand for first 10 days= 270/10=**27**
Demand on 5th day= **10**

Q14

Daily Demand	Probability	Cumulative probability	Random number interval
0	0.01	0.01	00
10	0.20	0.21	01-20
20	0.15	0.36	21-35
30	0.50	0.86	36-85
40	0.12	0.98	86-97
50	0.02	1.00	98-99

Days	Random numbers	Demand
1	25	20
2	39	30
3	65	30
4	76	30
5	12	10
6	05	10
7	73	30
8	89	40
9	19	10
10	49	30

Avg. daily demand 240/10=24

Q15.

Days	Random numbers	Demand
1	40	30
2	19	10
3	87	40
4	83	30
5	73	30
6	84	30
7	29	20
8	09	10
9	02	10
10	20	10
Avg. daily demand 220/10=22		