بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

Lecture: 03

Monte-Carlo Simulation Technique

- It is an experiment of a chance.
- Uses random number and requires decision making under uncertainty

To understand the Technique, it breaks down in 5 Steps

1. Establishing probability distribution
2. Cumulative probability distribution
3. Setting random number intervals
4. Generating random number
5. To find the answer of the question asked using the above 4 steps

Problem Statement:

John is a dentist who schedule all his patients for 30 minutes appointments. Some of the patients take more than 30 minutes depending on the type of dental work to be done. The following summery shows the various categories of work, their probabilities and the time actually needed to complete the work

Category	Time Required	No. of Patients	Probability
Filling	45 min	40	0.40
Crown	60 min	15	0.15
Cleaning	15 min	15	0.15
Extracting	45 min	10	0.10
Checkup	15 min	20	0.20
	Total = 100		

Simulate the dentist clinic for four hours and find out the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic exactly their scheduled, arrival time starting at 08:00 am. Use the following random number to handle the above situation:

40, 82, 11, 34, 25, 66, 17, 79

Created by
Shahadat Hossain
Lecturer, Dept of CSE
City University

Solution:

Table-1

Category	Probability	C. Probability	Random Number
Filling	0.40	0.40	00-39
Crown	0.15	0.55	40-54
Cleaning	0.15	0.70	55-69
Extracting	0.10	0.80	70-79
Checkup	0.20	1.00	80-99

Table-2

Patients	Scheduled Arrival	Random Number	Categories	Service time needed
1	08:00 am	40	Crown	60 min
2	08:30 am	82	Checkup	15 min
3	09:00 am	11	Filling	45 min
4	09:30 am	34	Filling	45 min
5	10:00 am	25	Filling	45 min
6	10:30 am	66	Cleaning	15 min
7	11:00 am	17	Filling	45 min
8	11:30 am	79	Extracting	45 min

Table-3

Patients	Arrival	Service Start	Service Durations	Service Ends	Waiting Time	Idle Time
1	08:00 am	08:00 am	60 min	09:00 am	00:00	00:00
2	08:30 am	09:00 am	15 min	09:15 am	30 min	00:00
3	09:00 am	09:15 am	45 min	10:00 am	15 min	00:00
4	09:30 am	10:00 am	45 min	10:45 am	30 min	00:00
5	10:00 am	10:45 am	45 min	11:30 am	45 min	00:00
6	10:30 am	11:30 am	15 min	11:45 am	60 min	00:00
7	11:00 am	11:45 am	45 min	12:30 pm	45 min	00:00
8	11:30 am	12:30 pm	45 min	01:15 pm	60 min	00:00
Total					**285min**	**0 min**

Average Waiting Time of Patients: $\frac{85}{8} = 35.625\ min \sim$ **36 *min*** Idle Time: **0 min**

Created by
Shahadat Hossain
Lecturer, Dept of CSE
City University

Problem-2:

A bakery keeps stock of popular brand cake. Daily demand on past experience is given below:

Daily Demand	Probability
0	0.01
15	0.15
25	0.20
35	0.50
45	0.12
50	0.02

Consider the following sequence of random number: 48, 78, 09,51,56,77,15,14,68 & 9

1. Using this sequence simulate the demand for next 10 days.
2. Find the stock situation if the owner of the bakery decides to make 35 cakes every day.

Solution:

Daily Demand	Probability	Cumulative Probability	Random Number Intervals
0	0.01	0.01	00- <0.01 or 00
15	0.15	0.01+0.15=0.16	01-15
25	0.20	0.16+0.20=0.36	16-35
35	0.50	0.36+0.50=0.86	36-85
45	0.12	0.86+0.12=0.98	86-97
50	0.02	0.98+0.02=1.00	98-99

Created by
Shahadat Hossain
Lecturer, Dept of CSE
City University

Day	Number of Cake made per day	Random Number	Daily Demand	Stock Situation
1	35	48	35	0
2	35	78	35	0
3	35	09	15	0+20=20
4	35	51	35	0+20=20
5	35	56	35	0+20=20
6	35	77	35	0+20=20
7	35	15	15	20+20=40
8	35	14	15	20+40=60
9	35	68	35	0+60=60
10	35	09	15	20+60=80
Total			**270 pcs**	**80 pcs**
Average Demand			**270/10= 27 pcs/day**	
Average Stock of Cake				**80/10= 8 pcs/day**

Created by
Shahadat Hossain
Lecturer, Dept of CSE
City University