Simulation

Simulation is a representation of reality through the use of a model or other device, which will react in the same manner as reality under a given set of conditions.

Simulation is also defined as the use of a model that has the designed characteristics of reality, in order to produce the essence of an actual operation.

Types of Simulation :

Simulation is mainly of two types :

(i) Analogue (environmental) Simulation

(ii) Computer (System) simulation.

Some examples of Simulation :

(i) Testing a model

(ii) Model of a traffic system.

Random Variable :

The random variable is a real-valued function, defined over a sample space associated with the outcome of a conceptual chance experiment. Random variables are classified according to their probability density function.

Random Number

It is a number in a sequence of number, whose probability of occurence is same as that of any other number in that sequence.

Pseudo-random Number

Random numbers are called pseudo-random number where they are generated by some deterministic process, but have already qualified the pre-determined statistical test for randomness.

MONTE-CARLO TECHNIQUE OR MONTE-CARLO SIMULATION

Monte-carlo simulation yields a solution very close to the optimal solution, but not necessarily the exact solution. The Monte-carlo simulation procedure can be summarized in the following in the following six steps.

Step-1 : Clearly define the problem.

(a) Identify the objectives of the problem.

(b) Identify the main factor which have the greatest effect on the objectives of the problem.

Step-2 : Construct an appropriate model

(a) Specify the variables and parameters of model

(b) State the conditions under which the experiment is to be performed.

(c) Define the relationship between the variables & parameter.

Step-3 : Prepare the model for experiment.

(a) Define the starting conditions for the simulation.

(b) Specify the number of runs of simulation to be made.

Step-4 : Using step 1 to 3, experiment with the model.

(a) Define a coding system that will correlate the factors define in step 1 with the random no. to be generated for the simulation.

(b) Select a random no. generator and create the random no. to be used in the simulation.

(c) Associate the generated random no.s with the factors identified in step 1 and coded in the step 4(a).

Step-5 : Summarize the examine the results obtained in (4)

Step-6 : Evaluate the results of the simulation.

* Random numbers may be found through a computer using random tables or manually. The most common method to obtained random no. is to generate them through a computer program.

Q:1 A tourist car operator finds that during the past few months, the car's use has varied so much that the cost of maintaining the car varied considerably. During the past 200 days the demand for the car fluctuated as below.

Trips per week	frequency
0	16
1	24
2	30
3	66
4	40
5	30

Simulate the demand for a 10-week period.

Use the random no.s, 82, 96, 18, 96, 20, 84, 56, 11, 52, 03.

Solution: Using random numbers, simulate the demand for a 10-week period.

Trips/week or demand/week	frequency	probability	Cummulative probability	Tag-numbers.
0	16	16/200 = 0.08	0.08	00 – 07
1	24	24/200 = 0.12	0.20	08 – 19
2	30	30/200 = 0.15	0.35	20 – 34
3	60	60/200 = 0.30	0.65	35 – 64
4	40	40/200 = 0.20	0.85	65 – 84
5	30	30/200 = 0.15	1.00	85 – 99

The tags numbers allocated for the various demand levels are shown in the table ~~above~~ below above.

Week	Random number	Demand
1	82	4
2	96	5
3	18	1
4	96	5
5	20	2
6	84	4
7	56	3
8	11	1
9	52	3
10	03	0

Total = 28

The simulated demand for the car for the next 10 weeks period is given in the table.

Total demand = 28

Average demand $= \frac{28}{10}$

$= 2.8$ cars / week.

Q-2 : An automobile production line turns out about 100 cars a day but deviations occur owing to many cause. The production is more accurately describe by the probability distribution given below.

Production / day	Probability
95	0.03
96	0.05
97	0.07
98	0.10
99	0.15
100	0.20
101	0.15
102	0.10
103	0.07
104	0.05
105	0.03

finished cars are transported across the bay at the end of each day by a ferry. If ferry has space for only 101 cars, what will be the average no. of cars waiting to be shipped and what will be the average no. of empty space on the ship.

Use the random : 97, 02, 80, 66, 96, 55, 50, 29, 58, 51, 04, 86, 24, 39, 47

The tag-numbers are established in the table below.

Production/day	probability	Cummulative probability	Tag-numbers
95	0.03	0.03	00 – 02
96	0.05	0.08	03 – 07
97	0.07	0.15	08 – 14
98	0.10	0.25	15 – 24
99	0.15	0.40	25 – 39
100	0.20	0.60	40 – 59
101	0.15	0.75	60 – 74
102	0.10	0.85	75 – 84
103	0.07	0.92	85 – 91
104	0.05	0.97	92 – 96
105	0.03	1.00	97 – 99

The simulated production of cars for the next 15 days is given in the following table.

Days	Random numbers	production per day	No. of cars waiting	No. of empty space in ship
1	97	105	4	–
2	02	95	–	6
3	80	102	1	–
4	66	101	–	–
5	96	104	3	–
6	55	100	–	1
7	50	100	–	1
8	29	99	–	2
9	58	100	–	1
10	51	100	–	1
11	04	96	–	5
12	86	103	2	–
13	24	98	–	3
14	39	99	–	2
15	47	100	–	1

Average number of cars waiting to be shipped $= \frac{10}{15} = 0.67$ per day

Average no. of empty space on the ship. $= \frac{23}{15} = 1.53$ per day