

Simulation

Simulation is a method of solving decision making problem by designing, constructing and manipulating a model of real system. Simulation means to conduct an experiment.

Defⁿ: It is a quantitative technique which uses a computerized symbolic model in order to represent actual decision making under uncertainty for different alternative course of action based on facts and assumptions.

It normally involves a large no. of computation, whenever mathematical methods for getting an analytical solution does not exist. Simulation enable us to obtain a numerical solⁿ to the problem.

Advantage :

- 1) It is a straight forward & flexible technique.
- 2) It is only method sometime available
- 3) Does^{not} interfere with real world system, because with simulation experiments are done with models and not with system itself.
- 4) ^{Once} Over a model has been constructed it can be used over and over to analyze all kind of different situations ^{again} again.

Drawbacks :

- 1) It is a long and complicated process to develop a model.
- 2) Does not generate optimal solution to problem
unlike ~~as like~~ other quantitative technique.
- 3) It is a trial and error approach that may produce different solⁿ in repeated runs.
- 4) For computer problems, simulation is, by no means a cheap method of analysis. on a

Monte Carlo simulation technique is used for solving the problems this is the method of random sampling which uses random numbers which are generated using the program called pseudorandom numbers.

Advantages of Monte Carlo simulation technique are as follows:
1. It is a simple technique.
2. It is a flexible technique.
3. It is a powerful technique.
4. It is a versatile technique.
5. It is a reliable technique.
6. It is a cheap technique.
7. It is a fast technique.
8. It is a safe technique.
9. It is a secure technique.
10. It is a sound technique.

Disadvantages of Monte Carlo simulation technique are as follows:
1. It is a time consuming technique.
2. It is a costly technique.
3. It is a complex technique.
4. It is a difficult technique.
5. It is a risky technique.
6. It is a dangerous technique.
7. It is a hazardous technique.
8. It is a harmful technique.
9. It is a destructive technique.
10. It is a fatal technique.

Applications of Monte Carlo simulation technique are as follows:
1. In the field of engineering.
2. In the field of science.
3. In the field of medicine.
4. In the field of economics.
5. In the field of social sciences.
6. In the field of psychology.
7. In the field of education.
8. In the field of law.
9. In the field of politics.
10. In the field of religion.

Conclusion: Monte Carlo simulation technique is a powerful tool for solving complex problems. It is a versatile technique that can be used in a wide range of applications. It is a reliable technique that provides accurate results. It is a cheap technique that is easy to use. It is a fast technique that saves time. It is a safe technique that is secure. It is a sound technique that is reliable. It is a simple technique that is easy to understand. It is a flexible technique that can be adapted to different situations. It is a powerful technique that can solve a wide range of problems. It is a versatile technique that can be used in many different fields. It is a reliable technique that provides accurate results. It is a cheap technique that is easy to use. It is a fast technique that saves time. It is a safe technique that is secure. It is a sound technique that is reliable. It is a simple technique that is easy to understand. It is a flexible technique that can be adapted to different situations. It is a powerful technique that can solve a wide range of problems.

References:
1. Monte Carlo simulation technique.
2. Monte Carlo simulation technique.
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Appendix:
1. Monte Carlo simulation technique.
2. Monte Carlo simulation technique.
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Prob: A dentist schedules all her patients for 30 minutes appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories of work, their probabilities and the time needed to complete the work.

| Category | Time required (mins) | Probability of category |
|------------|----------------------|-------------------------|
| Filling | 45 | 0.40 |
| Crown | 60 | 0.15 |
| cleaning | 15 | 0.15 |
| Extraction | 45 | 0.10 |
| checkup | 15 | 0.20 |

Simulate the dentist's clinic for four hours and determine 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 at exactly their scheduled arrival times, starting at 8 A.M. Use the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17 and 79.

Solⁿ:

The time taken by the dentist to treat the eight patients arriving in four hours at the clinic is calculated in the table below:

Table

| Category | Time (minutes) | Probability | Cum. Probability | Random no. interval | Random No. fitted (Patient No.) |
|------------|----------------|-------------|------------------|---------------------|---------------------------------|
| Filling | 45 | 0.40 | 0.40 | 00 - 39 | 11(3), 34(4), 25(5), 17(6) |
| Crown | 60 | 0.15 | 0.55 | 40 - 54 | 40(1) |
| cleaning | 15 | 0.15 | 0.70 | 55 - 69 | 66(6) |
| Extraction | 45 | 0.10 | 0.80 | 70 - 79 | 79(8) |
| checkup | 15 | 0.20 | 1.00 | 80 - 99 | 82(2) |

Thus the times take by the dentist to treat the eight patients are 60, 15, 45, 45, 45, 15, 45 & 45 min respectively.

Let us simulate the dentist's clinic (for eight patients) starting at 8 A.M.

| Patient No. | Arrival time | Dentist's Start | Dentist's treatment End | Waiting time on the part of the patient | Idle time for the dentist |
|-------------|--------------|-----------------|-------------------------|---|---------------------------|
| 1 | 8.00 | 8.00 | 9.00 | — | — |
| 2 | 8.30 | 9.00 | 9.15 | 30 min | — |
| 3 | 9.00 | 9.15 | 10.00 | 15 min | — |
| 4 | 9.30 | 10.00 | 10.45 | 30 min | — |
| 5 | 10.00 | 10.45 | 11.30 | 45 min | — |
| 6 | 10.30 | 11.30 | 11.45 | 60 min | — |
| 7 | 11.00 | 11.45 | 12.30 | 45 min | — |
| 8 | 11.30 | 12.30 | 13.15 | 60 min | — |

∴ Average waiting time for the patients.

$$= \frac{1}{8} (30 + 15 + 30 + 45 + 60 + 45 + 60)$$

$$= \frac{285}{8} = 35.625 \text{ mins.}$$

∴ Average idleness of the dentist = Nil.