**Notes**

**Simulation**

**1.** **Monte Carlo Simulation**: this method is widely used in design of simulation programs. Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted. It is a technique used to understand the impact of risk and uncertainty in prediction and forecasting models.

**2. Simulation:** a simulation is an approximate imitation of the operation of a process or system that represents its operation over time. It is performed outside of the “real-life” setting. Simulation is used in many contexts, such as simulation of technology for performance tuning or optimizing, safety engineering, testing, training, education. Simulations require building mathematical models which are unique and specific to a one “real-life” situation that is examined. The attempt to duplicate the features, appearance, and characteristics of a real system, usually via a computerized model.

**3. System Simulation:** is a model dealing with the dynamics of large organizations or governments.

**4. Random Numbers:** a variable that assigns a numerical value to each outcome of a random experiment or trial. These numbers are randomly generated to ensure that there is no built-in bias. Used in Monte Carlo simulation. Random numbers can be generated in two ways:

a) if the problem is large and the process involves may simulation trials. Computer based Random Numbers Generators are best to use.

b) if the simulation is done by hand, the numbers may be selected from a table of random numbers.

**5. Decision Making:** all major business decisions should be made only after a simulation program is run and the output of that program isanalyzed. Nobody can predict the future and humans have difficulty dealing with ambiguity.

**6. The Idea behind simulation is threefold:**

* To imitate a real-world situation using mathematics
* Study the properties and operating characteristics of the model
* Draw conclusions and make action decisions based on the results of the simulation

**7. Steps in the Simulation Process:**

* Define the problem
* Introduce the important variables associated with the problem
* Construct a numerical model
* Set-up possible courses of action for testing by specifying values of variables
* Run the experiment
* Consider the results and iterate by modifying the model (and or ) changing the data inputs
* Based on the outcomes of the simulation decide what course of action to take

**8. The Main Advantages of Simulation:**

* It can be used to analyze large and complex real-world situations that cannot be solved using conventional operations management techniques.
* Real-world situations and not only theoretical assumptions can be tested. For example, simulations can use any probability distributions that user defines; it does not have to be the standard distribution.
* “Time compression” is possible. The effects of Operation Management decisions over many months or years can be obtained by computer simulation is a short time.
* Simulations allow “what-if” analysis to be performed. Managers like to know in advance what options are most beneficial. With a computerized models, managers can test, within a matter of minutes, many possible courses of action.
* Simulations do not interfere with real-world systems. It may be too disruptive, for example, on the system that is in operations and serves real customers.

**9. The Main Disadvantages of Simulation :**

* Good simulation models can be very expensive, they may take many months to develop.
* It is a repetitive approach that may produce different solutions in repeated runs due to the use of random numbers.
* It does not point to the optimal solution to problem. It can assess the probability of the optimal outcome.
* Manages must generate all the conditions and constraints for solutions that they want to examine. The simulation model does not produce good answers without good inputs.
* Each simulation is unique. Its solutions and inferences are not usually transferable to other problems.

**10. Steps in the Monte Carlo Simulation**:

* Set-up a probability distribution for key variables
* Build a cumulative probability distribution for each of these variables
* Select an interval of random numbers for each of the key variables
* Generate random numbers
* Simulate the outcomes

**11. Probability Distribution for Monte Carlo Analysis:**

One common way to establish a probability distribution for a given variable is to examine historical time-series datasets.