Chapter XI

The Role Of Simulation And Modern Business Games

Probabilistic or Stochastic Process

“Probability or stochastic process” is a name used to designate mathematical models that represent the behavior of phenomena described by probability theory, ranging from a simple game of coin tossing up to more complex phenomenon like “Brownian motion theory”, “investment analysis”, etc. Stochastic process uses mathematical models to represent phenomena ruled by the probabilistic variation of some variable over time.

Simulation methods, also known as Monte Carlo methods, are stochastic processes that use mathematical models that have similar behavior of real problems, feeding these models with random values generated according to some probability distribution. The term Monte Carlo is used as a synonym for simulation since in some problems the generation of probabilistic values was historically linked to the use of the roulette wheel.

In this chapter we show how simulation method can be used to evaluate complex decision problems involving uncertainty. This kind of problem involves
knowledge of probability distribution (such as uniform, Poisson, or Normal distribution) used to represent the probabilistic process and the value of respective parameters (such as the average value and the standard deviation). Simulation is the most appropriate tool for visualizing, testing, and evaluating the parameters and the dynamic behavior of a probabilistic process. Simulation uses algorithms that generate a population of probabilistic events which makes possible the estimation of the values of parameters of the problem. The results of a simulation can be proven to be valid approximations of the values of the real phenomenon which they simulate.

### Using Simulation to Compare Multiple-Stage Strategic Decisions

In previous chapters, several aspects of decision problems, involving the choice of the best alternative, uncertainties, multiple scenarios, multiple goals, etc., have been studied. However those were cases of decision for only one stage. Many complex strategic-decision problems are formed by a dynamic sequence of decision problems involving multiple stages of decisions. These problems are more appropriately represented using a decision tree, and simulation is used to make comparisons of different strategies along the decision tree.

Let us consider the following two-stage strategies:

**Strategy A**

**Stage one:** Invest in a high-risk stock whose payoff (Payoff-A) can be negative or positive values. Past data show that the payoff value varies from -$100 (maximum loss) to +$100 (maximum profit);

**Stage two:**

a. if Payoff-A is a positive value less than $50, then the investor must pay $30 as expenses, or if Payoff-A is a positive value greater than $50, then the investor must pay $50 as expenses;

b. if Payoff-A is a negative value between $0 and (-$50), then the investor must pay $20 as expenses, or if Payoff-A is a negative value less than (-$50), then the investor pays $0 as expenses.
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