What practitioners need to know about Monte Carlo Simulation

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Two kinds of models are used in risk management -Deterministic and Stochastic.

Deterministic models assume a fixed relationship between the inputs and the output. In a deterministic model, we assign a single value to a variable. In a stochastic model, we assign a distribution of possible values to a random variable.

Deterministic models are solved analytically using a mathematical formula. Stochastic models are solved numerically.

In numerical methods, we try out various values for the model's parameters and variables. When the values we use come from a succession of random numbers, the numerical method is called Monte Carlo simulation.

We need access to a sequence of numbers that are distributed uniformly and are independent of each other. Ideally, the numbers should be random. Unfortunately, truly random numbers are almost impossible to obtain except by some mechanical process that may be very costly or time-consuming. Instead, we work with pseudo random numbers. As long as the numbers are uniform and independent, however, they will suffice for most Monte Carlo simulations. Uniform means that all the numbers have an equal chance of occurrence. Independence implies that the numbers are unrelated to one another.

In many financial analysis applications, the random variables of interest are not distributed uniformly. In order to perform a Monte Carlo simulation of a model in which the random variables are normally distributed, we must transform our sequence of uniformly distributed random numbers into a sequence of normally distributed random numbers. There is a convenient way to accomplish this transformation. According to the Central Limit Theorem, if we sum or average a group of independent random variables, which themselves are not normally distributed, the sum or average will be normally distributed if the group is sufficiently large. We can generate a sequence of random numbers that are normally distributed simply by averaging together many sequences of random numbers that are uniformly distributed.

Monte Carlo simulation is a valuable tool for forecasting events when the problems are too complex to be described by equations. But the simulation must be repeated a large number of times to obtain reliable results.