Monte Carlo Simulations: Pulling Back the Curtain on Monte Carlo Valuations

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Often Monte Carlo is seen as a more sophisticated method for valuing an asset or liability with a level of complexity that traditional valuation approaches or methods seemingly are unable to capture. However, the first step in implementing Monte Carlo is to understand that it is NOT a valuation approach or method and does not offer a solution to valuing any asset or liability unless the underlying economics are well understood. Rather than being a valuation approach or method, Monte Carlo is a technique for performing a set of calculations for the general purpose of understanding/measuring the impact of one or more uncertain variables on the outcome of those calculations, which may represent either a final output or an input into further calculations.

In the implementation of a Monte Carlo simulation, certain distribution and/or correlation assumptions are applied to one or more variables of a calculation. Then, hundreds, thousands, or millions of trials are conducted in which a different combination of input variables is selected based on the distribution and/or correlation assumptions. The outcomes are recorded for each trial, enabling a statistical analysis of all the trials of the simulation.

For example, a company's potential future cash flow could be analyzed by applying certain distribution and correlation assumptions to the variables impacting its financial performance, such as product price, quantity sold, fixed and variable costs, etc. Taken a step further, an appraiser could introduce discounted cash flow calculations into the simulation to understand the uncertainty of the cash flows and/or derive a value of the subject company.

While a Monte Carlo simulation is an extremely powerful tool for measuring and obtaining insight into uncertainty, the above example can also be illustrative of the limitations of this technique.

I. First, the statistics (outputs) produced by the simulation are meaningless if the distributions and correlations of the variables (inputs) are not well supported. Garbage in, garbage out as the proverb goes.

II. Second, the Monte Carlo simulation and the resulting statistics may provide a false sense of accuracy or ability to capture risk and potentially not be any more insightful than a simple data table or scenario–based analysis (both easily accomplished with tools available in a standard spreadsheet application).

III. Finally, the mean statistics (typically utilized for estimating the value of an asset or liability) produced for any given outcome/result may not be meaningfully different than would be produced by using static calculations based on the mean of the underlying inputs/variables. This is particularly true when the outcome/result varies linearly without any upper or lower bounds. Thus, a Monte Carlo simulation may not be as beneficial for certain calculations, particularly when considering the relatively complex and time–intensive nature of implementation.

The situations in which Monte Carlo is most useful – and often required – are when attempting to analyze/value an asset or liability with outcomes that are path–dependent, contingent, conditional, and/or non–linear (e.g., fixed outcomes conditional on a variable underlying metric, outcomes with minimums or maximums, etc.). Below is a brief description of each condition.

- Path–dependent outcomes are dependent on the measurement of certain results or performance over time. For

example, a restricted stock award may vest only when the underlying stock price reaches a defined threshold during a defined period; thus, the stock prices through time and not just at maturity dictate the value of the award.

- Contingent and/or conditional outcomes are dependent on the occurrence of certain circumstances or results. For example, an acquiring company may offer a fixed earn–out payment to a target company based on the future achievement of a minimum earnings target.

- Non–linear outcomes are those in which the outcome is not proportional to the underlying asset/liability. For example, a typical stock option only provides a positive payoff if the underlying stock price exceeds the exercise price at maturity and results in zero value in all other scenarios – the payoff is non–linear with respect to the underlying stock price.

These conditions are most often encountered in the valuation of equity or debt derivatives (such as restricted stock, options, and warrants with anti–dilution provisions) and other complex financial instruments in which the outcomes or payoffs generally meet one or more of these criteria. Occasionally, a Monte Carlo simulation is employed even in the absence of these conditions, when implementation into a standard closed–form solution, such as a binomial lattice model, may be too complex and difficult with standard spreadsheet software.

In short, Monte Carlo should not be considered a magical solution to valuing an asset or liability. The variables determining the outcome or payoffs need to be understood; then it should be determined whether the outcome or payoff has any path–dependent, contingent, conditional, or non–linear outcomes that cannot be properly measured using closed–form or other numerical solutions. Once these questions have been answered, it may then be appropriate to consider a Monte Carlo solution.

Our next installment will include an in–depth illustrative example of a valuation of a typical restricted stock award using a Monte Carlo simulation.

This article originally appeared in a **BVR Special Report** [2].

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