

CAPITAL IDEAS

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Understanding the Basics of Monte Carlo Simulation

Using Monte Carlo simulation in the world of financial planning has increased during recent years. Monte Carlo simulation, however, is not a new concept to the world of science. It was used as early as the Manhattan Project to model potential outcomes of a nuclear chain reaction. In this article, we will discuss what Monte Carlo simulation is and how it differs from the traditional straight-line method.

Monte Carlo simulation is a statistical method for analyzing random phenomena such as market returns. The computer will randomly select annual returns based upon the given statistical parameters of return, volatility and correlation. This process is then repeated thousands of times, allowing one to see the range of possible outcomes. We believe this is the best way to evaluate issues such as acceptable spending rates in retirement or wealth values at retirement.

Traditionally, practitioners have used what are known as straight-line estimates of returns to calculate future wealth. This method has three key flaws.

- It ignores the importance of the sequence of returns. Below-average returns in the early years of retirement combined with portfolio withdrawals can have a devastating effect on portfolio survival.
- Actual annualized returns may be less than the estimated return.
- Straight-line estimates, by definition, assume no volatility. But in reality, returns vary from year to year. Monte Carlo analysis assumes that returns are volatile. This causes the annualized return - or the portfolio growth rate - to be lower than the expected annual return.

Monte Carlo analysis helps eliminate all of the above problems. Instead of using a single point estimate to calculate future wealth, it uses a *range* of possible returns, and, therefore, it produces a *range* of wealth values instead of a singular value. This seems a more realistic way of evaluating the likelihood of achieving a goal, whether that goal is being able to spend a certain amount in retirement or achieving a specific college savings value 15 years into the future. Monte Carlo analysis also accounts for the sequence of returns. Some of the

Monte Carlo runs will include scenarios where returns were below average in the early years of retirement. It will also have runs where the annualized returns during the entire time period are less than expected.

Let's look at a simple example. Suppose a couple had \$2 million of total wealth invested completely in an S&P 500 Index fund in a taxable account. Further, let's assume an expected return of 7.2 percent (our current estimate for the S&P 500), volatility of 20 percent, and a 20-year time horizon. The couple wants to evaluate their ability to spend an inflation-adjusted annual amount of \$80,000 when they retire in 20 years. The following table demonstrates the probabilities of success, expressed as percentage, using the traditional method versus the Monte Carlo method.

Straight-Line	Monte Carlo
100 percent	84 percent

The difference is noticeable. More than 15 percent of the time, Monte Carlo analysis finds that this couple runs out of money, while the straight-line analysis shows 100 percent success. Using the straight-line method, this couple might retire with absolute, but potentially erroneous confidence of being able to achieve their spending goal. The Monte Carlo analysis shows them that their confidence might be misplaced. Using the couple's desired withdrawal rate, the Monte Carlo simulation creates awareness that, under certain circumstances, they could run out of money. While they may still be comfortable with an 84 percent chance of success, they will also understand that they must be vigilant to adverse circumstances that could result in financial disaster.

Providing clients with a more realistic lens to view an uncertain future is important. The results of a Monte Carlo simulation analysis are perhaps not quite as "user friendly" as a straight-line retirement planning approach, and thus they typically require the assistance of an investment advisor for accurate interpretation. But when it comes to helping investors achieve the objectives of greatest importance to them (such as paying for college, enjoying retirement or leaving a legacy) the added complexity seems a price well worth paying for the significant benefit of added accuracy.

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