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Understanding the Basics of Monte Carlo Simulation

Overview: Using Monte Carlo simulation in the world of financial planning has increased during recent years. 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. While not a perfect tool, we believe this is the best way to evaluate issues such as acceptable spending rates in retirement, wealth values at retirement and appropriate asset allocations.

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 returns sequence. Below-average returns in the early retirement years 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 simulation 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 simulation helps eliminate 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, not just whether or not you will run out of money in retirement.

Furthermore, Monte Carlo simulations allow investors to see the trade-offs that occur when creating specific goals for their retirement plans. Many people have more than one retirement goal. For example, an investor could plan to spend a certain amount of money during retirement and also leave an inheritance to his or her children. Monte Carlo simulations can help estimate the odds of success for achieving both of those goals. In addition, these simulations can also estimate how increasing the odds of success for one goal may decrease the odds of success for the second goal.

Monte Carlo simulation also accounts for the sequence of returns. Some Monte Carlo simulations will include scenarios where returns are below average or even negative in the early years of retirement, which has a significant impact on the success of a portfolio. 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 equity in a taxable account. Further, let's assume an expected return of 7.8 percent, volatility of 18.3 percent and a 20-year time horizon. The couple wants to evaluate their ability to spend an inflation-adjusted annual amount of $100,000 over a 20-year retirement. 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	82 percent

The difference is noticeable. About 18 percent of the time, Monte Carlo simulation 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 simulation shows them that their confidence might be misplaced. Using the couple's desired withdrawal rate, the Monte Carlo simulation creates awareness that they could run out of money under certain circumstances. While they may still be comfortable with an 82 percent chance of success, they will also understand that there is an 18 percent chance of running out of money and that they must be vigilant to adverse circumstances that could result in financial disaster.

Having a more realistic lens to view an uncertain future is important. The results of a Monte Carlo simulation 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 achieving the objectives of greatest importance (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 a more accurate estimate of odds of success.