



Ruminations on Monte Carlo Simulations

We use Monte Carlo Simulations (MCS) in financial planning. For the uninitiated, MCS is a math technique used to model situations that involve uncertainty and thus cannot be modeled deterministically but can be described statistically (the technical term would be modeled “stochastically”). For example, while you may estimate a portfolio return to be 7% per year on *average*, it certainly will not be 7% *each* year. Thus, a financial plan that works *on average* can be disastrous a high percentage of the time. Remember, a statistician is a person with his feet in ice water and his head in the oven and who *on average* is very comfortable.

The term “Monte Carlo Simulation” was coined during the technique’s use in the Manhattan Project just after World War II. According to Heisenberg’s uncertainty principle, you can either know where a sub-atomic particle is (location) or how it is moving (momentum) but you cannot know both at the same time. Increasing precision of information about one is balanced by decreasing information about the other. Note that this is not a measurement problem, it is inherent in the nature of quantum particles. (If that seems bizarre to you, it may be comforting that it seems bizarre to the physicists too. As Nobel prize-winning physicist Richard Feynman said, “Nobody understands quantum mechanics.”)

It turns out that MCS is useful in a variety of fields outside quantum mechanics too. Any area where relationships can be described statistically, but not mechanically, may be illuminated through use of MCS. Examples include weather forecasting and modeling the spread of infectious disease. MCS is also useful in testing the reasonableness of a financial plan – especially one with irregular cash flows where rules of thumb (such as a 4% withdrawal rate being “safe”) can’t be applied easily.

MCS expresses financial plan results as a percentage chance of success rather than a simple expected value. For example, it is better to know there is a 95% chance that a portfolio’s resources won’t be depleted in retirement than to know the median portfolio value at the end (death) is \$1,000,000. That’s because you could have a plan that has a median ending value of \$1,000,000 that still has a 40% chance of being zero!

Many people confuse precision with accuracy. In many respects it would be better if financial planning software rounded the results off to the nearest hundred thousand dollars so people would realize that they are estimates. In financial planning you can be accurate (“This is a prudent plan.”) even when you can’t be precise (“You will have \$2,057,387 in your portfolio at age 65.”). You can’t have precise results when most of the inputs are estimates of the unknown. We can, however, determine which plans are more likely to be successful.

A successful plan uses MCS (or a similar tool) to determine how to balance maximizing spending and not running out of money. These two goals are obviously in tension – the more you spend the more likely you are to run out of money, and vice-versa. A plan 5,000 simulations (which is what we use) and 100% chance of success is probably too conservative – it would withstand scenarios much worse than the great depression *with no changes in spending*. For most retirement plans 90-95% success rates at age 100 (younger spouse) are probably optimal. The percentages are much higher than 50% because it’s worse to run out of money than it is to have money left over (i.e. spending was less than it could have been). It depends on the specific client situation, but almost always maximum long-term happiness comes from steering a prudent middle course with *both* goals in mind.

Notes:

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