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# Piercing the Monte Carlo Mystique in Retirement Income Planning

Most builders of financial models for retirees use Monte Carlo analysis.[*] Most of the rest of us are mystified by how these models work, leading some to marvel at the mathematics, and others to be skeptical of what's inside the "black box." Both the marveling and skepticism are justified. These tools are impressive, but their complexity is unnecessary, and actually impedes more helpful forms of advice.

## A one-legged argument for Monte Carlo models

The case in favor of Monte Carlo models is not entirely specious, but it sounds compelling only because it is incomplete. It goes like this: in the old days, we determined retirement needs by assuming average life expectancy and investment performance. But this analysis neglected the fact that some people would live longer and/or receive inferior investment returns, and therefore perhaps half or more retirees would outlive their funds. Since the future is unpredictable, it is improper to use methods that make hard and fast assumptions. *Instead, we need a model that reflects the randomness of the future, and the range of possible outcomes, not just a single result. Monte Carlo does that, and therefore it is the right method to use.*

**Other solutions do exist. You might still prefer Monte Carlo, but you need a more detailed consideration of that method and the alternatives first.**

The part in italics is where this argument goes astray, because it ignores the faults and limitations of Monte Carlo models, and it leaps to a single solution as if there are no others available. But other solutions do exist, and they have important advantages over Monte Carlo. In the end, you might still prefer Monte Carlo, but you need a more detailed consideration of that method and the alternatives first.

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[*] In this paper, we will use the term "Monte Carlo" to stand in for all forms of "stochastic" modeling. "Stochastic" simply means that randomization is used in the model. There is more than one way to do this, but the so-called "Monte Carlo" technique is easily the most common. In a Monte Carlo analysis, one or more calculation factors (such as rate of return, or date of death) are assigned a random value rather than a fixed value. The calculations are then performed repetitively, usually hundreds or thousands of times, with the randomized inputs producing an array of different results. These results are then analyzed statistically, and are presented in a way intended to reveal the amount of risk being taken.

## Going to Monte Carlo? Don't forget your baggage!

There are fundamental conceptual flaws with the Monte Carlo approach. There are also practical problems, some of them not apparent to non-mathematicians.

***The inherent, conceptual problems:***

- Life is not random. Monte Carlo models use randomization as a way to imitate life's uncertainty. But life is not, in fact, random: when we look at the past, we never say that it happened randomly. Rather, we see trends, patterns, cause-and-effect. The future will contain these, too – we just don't foresee all of them. Using randomness, while better than ignoring uncertainty, is a weak way to model it.

  Monte Carlo models might be good enough in this respect if we knew that reality's dice were not loaded. But they are. We can be almost certain that the retirement of tens of millions of Baby Boomers will have vast consequences for our society and our economy. With some thought, we can make guesses about what those might be. The same is true about global warming, or the rise of China and India as potentially dominant economic powers. Monte Carlo models assume that such foreseeable factors actually have no effect, or rather, that their effects will be random, which is surely false.

- Future probabilities cannot be known. Most Monte Carlo models are essentially investment models. They assume certain ranges of return for various categories of investment. In order to be useful, these need to reflect *future* returns, that is, if we look back in thirty or forty years, what will the average returns have been (and how do these correlate with each other, and how much volatility was there)? Monte Carlo models presume that these future statistics will be the same as past ones. This almost certainly will not be true.

  It may not even be roughly true. These models have to project 30 or 40 years out, yet they have only about 80 years of past data to work from. This is way too small a sample. It's the equivalent of moving to a new city, driving to work your first two or three days, and then trying to predict *with confidence* what your odds are of getting to work on time the next day – without taking account of whether there were accidents on the road, whether it was a school-day, what the weather was like, or any other external factors. Monte Carlo model builders are doing the best they can, but they simply don't have the data they need to estimate future investment risks. Having built Monte Carlo models ourselves, we know this.

- The probabilities of success are not the *client's* probability of success. Monte Carlo models usually say to a retiree, "Under these circumstances, you have an X% probability of success." For this to be accurate, (1) the model must be a near-perfect reflection of future reality, and (2) it must be a near-perfect reflection of the client's situation. We have already seen two reasons (and soon will see two more) why the first of these conditions cannot be met. But the second also fails.

  Monte Carlo models almost always assume steady rates of withdrawal (either level, or increasing with inflation). Yet virtually no retiree will need a steady rate of withdrawal. Changes in cash needs, apart from inflation, are sometimes highly

predictable (e.g., when a fixed mortgage is paid off), sometimes less so (when and how much a pension might change when one spouse dies), and sometimes hardly at all (whether a grandchild might have to move in). We can be quite sure that the withdrawal need will not reflect some kind of straight line. Changing the cash flow assumptions radically changes the viability of a retirement nest-egg, but the Monte Carlo models ignore most of that, and sometimes all of it. They do not represent the retiree's situation, so they cannot even approximately estimate the chances of success or failure.

The model's results, therefore, reflect only a set of rather arbitrary calculations going on inside the model. They do not illustrate what they appear to illustrate, which is the *client's* probability of success or failure. *The principal output from the model is therefore not what it says it is, and in fact cannot be used to provide useful guidance for any particular retiree.*

***Practical problems:***

- Most risk factors are ignored. Monte Carlo models, as they exist today, try to deal with future uncertainty, but only the uncertainties the model builders choose to deal with. These usually include investment risk and mortality risk. Occasionally one or two other risks are included. The Society of Actuaries a few years ago identified *fifteen* financial risks to retirees.[*] The models ignore most of these, or treat them in the old-fashioned way as fixed assumptions.

  You can't give a meaningful estimate of the risk of success of failure if you are not going to take all relevant risks into account.

- The models are too inefficient to give advice. If you flip a coin a hundred times, you probably won't get exactly 50 heads and 50 tails – you'll be off a little, and occasionally a lot. Using random processes means that you need to repeat the process many times in order to get a reliable result.[**] Our experience is that about 2000 iterations are needed to get a decent level of stability in Monte Carlo results. Doing calculations this many times means chewing up a lot of computer time. On a web server, this can be a serious problem.

  As a result, these models are best used to *evaluate* a proposed action (e.g., withdrawing a certain amount of money annually from a fund invested in a certain mix of assets). But it is hard for such a model to *recommend* an action (e.g., what level of withdrawal to make, or what kind of asset allocation to make), if these have to be calculated on the fly. The consequence is that some Monte Carlo models do not calculate on the fly – they give you a limited number of choices in a limited number of categories, and all the possible combinations have been calculated in advance. This is a good way to provide bad advice, but it is too inflexible to provide good advice. Monte Carlo calculators that do try to provide live advice, even with overly simplistic assumptions, are usually too hoggish of com-

[*] Their report can be found at: http://www.soa.org/research/files/pdf/post-retirement-charts.pdf

[**] Monte Carlo models can appear to be reliable in this way, even when they are not. That is because computers can be set up to use the exact same "random" numbers every time you run a case. If you get the exact same answer from your Monte Carlo model when you do repetitive re-runs, it is set up in this way. This does not mean it is accurate. It means that you cannot tell how inaccurate it is.

puter resources to be usable in the ways we would like to use them.

- People don't get what they want from Monte Carlo models. What people mostly want is advice. Retirees need advice on many financial issues, and the Monte Carlo models do not even try to address most of them. And as we saw just above, even on the issues the models do address, they aren't very good at advice.

  Furthermore, what the models do produce is largely mysterious to both the retiree and the financial professional who may be called upon to explain it. What do the results really mean? Unless you are comfortable with statistical concepts, they are hard to grasp correctly. Where did they come from? Even if you *are* comfortable with statistics, this is virtually impossible to explain. What should the retiree do about them? Who knows?

No financial model can be perfect, or even close to it. But Monte Carlo models usually answer only one or two questions, do so in a way that is neither understandable nor particularly helpful, using analyses that are flawed in concept and limited in execution. We do need to deal with the risks that retirees face, but there ought to be a better way.

## Alternatives to Monte Carlo models

When people talk about using Monte Carlo models to deal with risk, you'd think no one ever had to make decisions in the face of uncertainty before. But people do so all the time, in the their personal lives and in their work, and almost always without the aid of Monte Carlo models. They do it in other ways. We can use those other ways to deal with risk in retirement income planning, too. Here are four approaches:

***Risk reduction:***

Monte Carlo models tend to produce recommendations that result in low levels of spendable income and, if implemented, would lead many retirees to die with considerable wealth, while a few would die broke. For most retirees, this runs against their common sense. They would rather reduce their risks and live with less uncertainty, even if it means living a little less well. For people already facing old age, loss of productivity, loss of loved ones through death, illness, and ultimately their own death – all risks that cannot be reduced – reducing financial risks (which *can* be done) often makes the most sense. So they are inclined to invest conservatively and control their expenses.

Such strategies do not benefit money managers, but they enable retirees to sleep well. That is their advantage. As a risk-management strategy, however, risk reduction cannot be the complete answer. At least some degree of planning is needed to understand how much the risks can actually be reduced, and whether the trade-offs are worth it. There are also risks that cannot be reduced, and alternative strategies are needed to deal with those. Still risk reduction can be, and usually is, part of the answer for most retirees.

***Contingency planning:***

This is the normal way of dealing with risk. We all do it, all the time. "If the interstate is backed up, I'll take the county road." "The weather could turn bad, so we'll bring our umbrellas." "If the project A gets out of hand, we'll pull someone from project B."

In connection with retirement planning, retirees are already using this method all the time. This mainly happens in three ways:

- Insuring against risk. People buy life insurance in case they die too soon, annuities in case they live too long, and medical and long-term care coverage in case they have health problems not covered by Medicare.
- Establishing reserve funds. For most retirees, this means their home equity. Retirees often plan to meet normal life needs through pension and Social Security income, and by tapping their savings. But their house is their asset of last resort. If they live much longer than expected, if they require long-term care, if inflation zooms out of control, if some other major upset occurs, they can use their home equity. For retirees who rent or live with others, their savings (or some part of it) is their reserve fund – they will spend only the interest, and keep the principal intact to cover the big risks, happily leaving it to their kids or other heirs if such risks do not materialize. The reason this solution works so well is that reserve funds, whether in cash or any other form, can be used to cover just about any risk, not just investment risk, mortality risk, and inflation risk.
- Lifestyle changes. The last resort for many retirees, if they start running out of money, is to scale way back on their lifestyle, to move in with a sibling or a child or a lifelong friend, or even to rely on governmental, church, or charitable aid. For financial professionals, such "solutions" are anathema, but for real people in real life, these can be quite viable fall-back positions. And often the fall-back is even less ominous: selling the summer cottage or the family heirlooms, or spending some of the money that had been intended as a bequest to others. The prospect of *possibly* making a sacrifice down the road is often more appealing than making financial sacrifices, or taking investment risks, today.

As with risk reduction, though, contingency planning is usually not enough. At the least, the risks one is planning against must be identified and quantified. For retirees, this can be a difficult analysis. Is insuring against risks affordable? Are there enough resources in the household to provide both for normal expenses and some kind of reserve? Are acceptable lifestyle alternatives available? Some kind of analytical tool is still needed.

***Conservative assumptions:***

Monte Carlo models have gained adherents mainly by their ability to deal with scenarios other than the "expected" one, and by now everyone in the business agrees that this is necessary. But such models are the hard way to do it. The easy way is to perform a single analysis that uses conservative (adverse) assumptions. Assume, say, that people will live to age 90, that they earn 5% on their investments, that moderately high inflation occurs, that they will spend their last two years in a nursing home. And if assuming all that, they still appear solvent, their plan is probably taking good enough account of risk.

The advantage that Monte Carlo models have is that they claim to be able to *measure* the likelihood of adverse results, an ability that potentially lets you fine-tune your plan, so that you are left with just the right trade-off between what you give up in current income vs. what you might need for a rainy day. But as we saw earlier, these models cannot actually do that, and if anything provide false measures of confidence.

A planning model that uses simple, understandable, but conservative assumptions, and that applies its mathematical genius to a fuller understanding of each retiree's specific financial situation, and of the other kinds of risks that the Monte Carlo models usually ignore, would be a much more useful tool.

We think we can go one step better, though.

***Realistic scenario testing:***

A better model, we at Still River believe, would expand on this. After devising a retirement strategy built around a conservative analysis, test it against certain definable scenarios – not the hundreds or thousands of *random* scenarios that Monte Carlo models use, but against *realistic* scenarios that people can actually understand, and ones that they actually worry about.

For example: What if, despite conservative investment assumptions, the return averages 100bp lower (and if there are some big negative returns early on)? What if medical expenses are twice normal, plus there is a need for extended home health or nursing care at the end? What if inflation is two or three times normal? What if everyone in the household lives 10 years more than expected? What if more than one of these issues arise?

By devising a plan around somewhat conservative assumptions, and testing it against specific adverse scenarios, retirees can get more than a phony "percent likelihood of success or failure" coming out of a black box. They can see year by year how scenarios they worry about might play out. They can feel comfortable that they have a plan that is probably going to take care of them for the rest of their lives, and they can see whether it is vulnerable to specific kinds of risks that they may be worrying about. If it is, they can make further adjustments. And even if it isn't, as long as they review the plan once a year or so, and especially when a major change occurs in their lives, they can prevent even unusually adverse contingencies from spiraling out of control.

## Why settle for Monte Carlo?

Monte Carlo was definitely an advance over the old models that assumed everyone received level investment returns until life expectancy, then died. But that is a very low standard to beat. Today we can perform analyses of retiree finances that are much deeper, broader, and more attuned to risks, including risks that Monte Carlo models generally don't deal with.

Monte Carlo was impressive technology in 1999. Today, it can be seen more clearly as an overly-complicated and mysterious technology that doesn't do what it claims to do, while alternative approaches are both more useful and more understandable.