Retirement Planning Software, Inc

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Retirement Income Planning, Part 10*: Risk Analysis and Calculation Methods

How should we compute and illustrate the financial risks that retirees face? The tendency is to think about this in terms of deterministic vs. Monte Carlo models. That's a good start, but it's only a start. This paper may broaden your horizons.

Three categories, but only two real choices

We can divide retirement models into three categories: deterministic, stochastic, and mixed:

- Deterministic models use fixed ("determined") assumptions. The assumptions may be determined by the model developer, or by the user, or some of both.
- Stochastic models do not use fixed assumptions. Instead, elements in the model that can vary in real life are also allowed to vary in the model. Statistical techniques are used to account for this variability, and the result is therefore not a single answer, but a range of answers – usually with some measure of probability for success or failure.
- Mixed models use some fixed (determined) assumptions, and some that are allowed to vary. Since one or more assumptions vary, mixed models may also attempt to measure the probability of success and failure.

The choice among these is simplified by the fact that pure stochastic models for retirement planning do not exist – and although it would be possible to build one, it would not be possible to build a good one.

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* Part 1 of this series discussed in general form the urgent and wide-ranging planning needs of people facing retirement. In Part 2 we further explored the follow-up question: can a comprehensive financial planning approach really work for retirees and, if so, how? Part 3 examined investment risks and strategies, and argued that most retirees should be investing conservatively rather than for asset growth. Part 4 identified serious problems with the use of Monte Carlo models in retirement income planning, and suggested an alternative approach. Part 5 discussed the optimal time to annuitize. Part 6 dealt with the question of what retirees need from the planning process, suggesting inadequacies in current approaches. Part 7 outlined what "holistic" planning should mean for retirees. Part 8 set as its goal to define what Income Planning will look like in 2010. Part 9 discussed new product developments in this area, and weighed their importance and their limitations.

Models currently marketed as "stochastic" are actually mixed models. They use stochastic techniques for certain elements of the analysis (typically investment performance and mortality, sometimes one or two others as well). But they do not try to take into account other kinds of risks or variations in life. They do not, for example, use stochastic techniques to deal with future income tax laws – they either assume no change in future laws, or they simply omit income taxes from the model (both of which alternatives are "deterministic"). They also do not use stochastic techniques to model the possibility of one's pension plan going under, or of the possibility that a personal problem in the family will bring a child or grandchild back home as a dependent. This list could be extended indefinitely, because life is so full of variety.

If we did have a complete list of life's possible surprises, we'd find that current models either ignore most of the items, or treat them in a deterministic way. The current "stochastic" models are therefore not just *partly* deterministic, they are *primarily* deterministic. (Our own stochastic models are no exception, by the way.)

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There is probably no getting around this. We don't have enough data to handle most of life's risks stochastically. Yes, you *could* build a model in which future income tax structures were dealt with stochastically, but there is no legitimate basis for even identifying all the future possibilities, let alone their respective probabilities. A model that pretended to do so could not claim validity for this portion of its process, so adding it would be of dubious benefit. This is true of most of the largest risks in life.

So even if you could buy or build a truly stochastic model, you wouldn't be helping yourself or your clients. You are stuck with either deterministic or mixed models.

Should you rule out deterministic models altogether?

By way of full disclosure, Still River does not offer any purely deterministic models for this market. Still, we are not doctrinaire on the issue.

While many people assume that deterministic models cannot account for risk, this is untrue. There are two methods by which these models can do so:

1. Permit the user to run the model more than once, illustrating different scenarios manually.
2. Require the user to illustrate adverse assumptions instead of just "normal" or optimistic ones. A model could force the use of a conservative rate of return (and/or a pattern of returns illustrating "point in time" risk), and could make pessimistic assumptions about mortality, morbidity, inflation, and any number of other factors. In fact, this simple technique can be used to deal with almost any kind of risk (including higher tax rates, pension reductions, and sudden future increases to household expenses) – which stochastic analysis cannot validly do.

Some would instead criticize deterministic models by saying they can only *illustrate* risk, but not *measure* it. It is true that deterministic models cannot measure risk well – but neither can mixed models – or at least they cannot do so with real accuracy. We dealt with some of the technical reasons for this in Part 4 of this series, and will not repeat them here. We can add, though, that in principle only a *fully* stochastic model (and a perfect one, at that) could tell a retiree the overall likelihood of financial success or failure. If a mixed model claims to do that, someone is fudging the truth.

No, the real problem with deterministic models is that they tend to be either too rigid or too flexible. If the model is rigid and forces the use of adverse assumptions, then the results will be adverse as well, leading people to make decisions that are inappropriate (too conservative, too aggressive, or too despairing, depending on their emotional reaction). But if the user is given flexibility in setting assumptions, the temptation can be irresistible to "solve" problems by using optimistic assumptions rather than by making unpleasant life choices.

It is true that deterministic models cannot measure risk – but it is also true that stochastic models cannot measure risk, or at least cannot do so accurately. If a model claims otherwise, someone is fudging the truth.

For these reasons, mixed models, instead of deterministic ones, are generally preferred for retirement income planning. There are three sub-varieties of mixed models, each explained below. Again by way of disclosure, Still River offers all three of these kinds of mixed models, so we do not have a particular axe to grind in evaluating them.

Mixed model type #1: Monte Carlo models

Monte Carlo models generate hundreds or thousands of *random scenarios* to estimate the likely range and distribution of results. These models have acquired a certain mystique, but the idea is simple and, frankly, building a Monte Carlo model is not all that hard. (To give you an idea: here at Still River, it took 2½ years to build a non-stochastic model, and then only one week to add a Monte Carlo option to it – but then we've built stochastic models before, and this might not work as easily for you at home.)

The combination of mystique and mathematical simplicity has made Monte Carlo models the most common in this market. Their main advantage is that they can deal with certain risks – especially investment and mortality risks – in a relatively rigorous fashion. They are also good at dealing with multiple categories of risk simultaneously. They are particularly powerful in answering simplified mathematical questions such as: how much money could a person safely withdraw every year from a retirement nest egg?

Monte Carlo models are poor at dealing with risks that are not well understood mathematically, such as the overall financial prospects of a retiree.

This question is a good one for Monte Carlo, because it is abstracted from reality and involves only a few variables. By assuming a level (or smoothly increasing) cash flow out of the retiree's savings, most of life's vagaries are simply ignored, meaning the problem has only slight practical import. But for that same reason, Monte Carlo modeling is relatively good at analyzing it.

Add less measurable risks to the situation, though, and Monte Carlo models start to fail.

They are poor at dealing with factors that are not well understood mathematically (as noted before, future changes in income tax rates, for example). For this reason, they are *in principle* not particularly good at answering real-life – that is, complex – questions, such as: is the retiree in good financial shape, or not?

They also need a lot of computer time to process all the scenarios, so they are relatively ill-suited for web applications unless they are simplified in ways that reduce their validity.

Mixed model type #2: Partly-stochastic non-Monte Carlo models

That's a mouthful, but it simply means that these models use statistical techniques *other* than randomization to analyze the range of possible future outcomes.

Users of partly-stochastic models usually don't need to worry much about whether Monte Carlo analysis is happening or not. A model can look the same either way, the only difference being what is going on inside the "black box" where calculations are done.

What you do need to know: simple models of this kind (i.e., those that deal with only one or two kinds of risk) can generate results similar in quality to Monte Carlo models with much less strain on the computer – making them more supportable on the internet. But this efficiency degrades as more kinds of risk have to be dealt with. Computing multiple kinds of risks means also computing the interplay between them. And this can be hard. For example, there is clearly a relationship between inflation rates and investment returns. But our historical experience is so limited, and this relationship is so influenced by politics and personalities (especially the chairmanship of the Fed) that projecting the connection mathematically necessarily involves a lot of guesswork.

In practice, then, where multiple risks are being modeled, it can make sense to treat some of them with Monte Carlo modeling, and some without.

Mixed model type #3: Non-Stochastic models

Here's an idea: what if we use a mixed model to obtain the best benefits of both the deterministic models and the ones that employ Monte Carlo or other stochastic techniques? What if we could use *specific and understandable scenarios*, rather than random ones, to illustrate retiree risks in a way that has real explanatory power, like a deterministic model. And what if we then use these multiple scenarios to *evaluate* the overall adequacy of the retiree's financial situation, as stochastic models try to do?

Not everyone likes this plan. You do lose the ability to produce a rigorous analysis of the *likelihood* of a favorable outcome. But as mentioned before, Monte Carlo and other stochastic models cannot legitimately do that anyway – so giving it up is not much of a loss.

Furthermore, our own experiments suggest that the overall evaluation of a retiree's financial situation can be done using *any* of these three mixed-model techniques and produce similar results, once the models are calibrated to one another. That is, a high-rated situation or plan is highly rated under all three kinds of models, and a low-rated one is rated low under all three. The evaluations do not precisely match, but the matches are surprisingly close (and could be made closer, if that were a key objective.)

To put it another way, the agreement of results between our own stochastic and non-stochastic models is probably at least as good as the agreement between two stochastic models from totally separate sources. So who can say which model is more valid?

All three kinds of mixed models can produce similar evaluations of a retiree's situation or plan, once the models are calibrated to one another.

What non-stochastic models can do particularly well, however, is to educate and motivate the consumer. They educate well because they can illustrate with a high degree of specificity what a "normal expectation" might look like, and then show what the impact of specific adverse circumstances looks like.

Of course, neither stochastic nor non-stochastic models can actually predict the future. The advantage of non-stochastic models is that they present scenarios that can be specified, that can be illustrated in detail, and that reflect real-life concerns. Since their assumptions can be identified and illustrated, it is possible to monitor them as the future unfolds, and to understand what is happening as the future diverges (as it inevitably will) from what was illustrated. This understanding can lead to intelligent course corrections. Stochastic models, with a large number of statistically-generated scenarios, are inevitably opaque, and cannot serve this function.

Non-stochastic models also run very efficiently, providing near-instantaneous calculations, and are therefore highly suitable to web-based offerings.

Multiple choice

Here's a dirty little secret: all of these models rely on art as well as math. They involve unproven assumptions, guesswork, incomplete data, simplifications, trust that the future will resemble the past, and a lot of crossing of the fingers. Any conscientious person who has ever built a model knows this, but we rarely talk about it. When choosing *any* method or any specific model, therefore, don't assume you are buying a preview of reality. It's just a model, and inevitably a highly imperfect one.

More than one kind of model can be used to deal with retiree risks. In the end, the *way* a model handles risk is probably much less important than *that* it handles it. Other characteristics of a model are much more important. This gives you, as a potential purchaser or user, more choices than you might have thought.

Still River Retirement Planning Software, Inc., provides both web-based and desktop software offering specialized calculations related to retirement plans and retirement planning.

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