

## *Uncle Joe's Plan to Retire*

*a short story on the Retirement Income Calculator  
by William Leslie*

At a family gathering a few months ago, my Uncle Joe, who's 65 years old and has been working for about 40 years, pulled me to the side and gave the big news, "I think I'm ready to retire." He didn't want to tell his wife and children, though, until he first ran his calculations by me, the math-guy of the family. Here's some of the information about my Uncle Joe. He's 65 and has saved \$600,000. He expects a \$20,000 Social Security benefit, but has no Pension. He wants to have \$50,000 of income each year during retirement.

His calculation was fairly simple. He said, "I need \$50,000 but will receive \$20,000 from Social Security. So, all I need to use of my own money is \$30,000. If I use \$30,000, that leaves me with \$570,000. I figure I can earn an average of 7% on my assets, so the \$570,000 will grow to \$610,000 which is more than what I started with. The next year I take out another \$30,000 leaving me with \$580,000. This grows at 7% again to \$620,500. I keep doing this and my assets keep growing, so I'll never run out!" I said, "Well, I see what you're doing, but...", I brought up the notion of inflation because he was missing it from his calculation. He replied that inflation is pretty low, and you even hear about deflation once in a while, so why would he really need to worry about that? I pointed out that in some years inflation has been and can be very high, especially for health care costs and perhaps fuel costs, and that it is something we really ought to figure in.

We both decided to incorporate some measure of inflation. I shared that I had recently looked at both CPI-U data from the U.S. Department of Labor's Bureau of Labor Statistics and interest rate projections from the American Academy of Actuaries' Life Capital Adequacy Subcommittee and feel that 3.7% would be a reasonable projection of future inflation. As I started sounding technical, he began looking away and caught our cousin's eye. While she walked over to chat, I suggested he let me step aside to do a quick calculation and that he'd be able to tell how it went by looking over to the computer monitor through the doorway. "If you see blue, you're okay, if red, you're not." Before leaving, I quietly whispered in his ear, "How long do you think you'll live in retirement?" He whispered back, "To 87."

Over at the computer, I grew his assets at 7% for the 22 years it will take him to reach age 87. At the same time, I drew out the \$30,000 per year, growing by inflation. The monitor came up blue – he smiled.



When we joined up again, I asked him, "Where do you think you'll find a 7% return?"

Joe replied, "From what I gather, that's a reasonable average over the next 22 years."

"That might be so, but we should consider that asset performances can be better or worse than 7%. Not only that, but if you're continually withdrawing money out from your assets, then the pattern of year by year returns over the 22-year period is also very important."

Having performed recent analysis with stochastic (a.k.a. random) asset performance, I suggested to Joe, "Go grab us another refreshment. I'll do a little work, and will come up with 10 representative outcomes for your 22 year retirement, but based on random asset performances rather than just using 7%."

I tied my stochastic asset performance projections to my first calculation and formed output of 10 squares. I actually used many asset performance projections, but chose 10 representative ones from bad to good for Uncle Joe. Here's what I came up with by the time he had come back.



Of the 10 results, one was red, and nine were blue, which meant that in nine of the 10 scenarios I came up with, Uncle Joe would have enough money to realize his \$50,000 of income each year. In the red one he did not. As happy as he first seemed, I cautioned that we should make one more adjustment at this point: Inflation changes year by year in the same way that asset performances do. Periods of high inflation would cause my uncle to withdraw more income from his assets than he anticipated due to increasing prices. This was a quick adjustment for me to implement so I did and here were the revised results.



Of the 10 results, two were red, and eight were blue, which means that in eight of the 10 these scenarios, sure enough, Uncle Joe would have enough money to realize his \$50,000 of income each year. In the two red ones he did not.

Knowing my Uncle, I thought this "8 out of 10" information alone might be enough for him to justify his retirement. Instead, I was very happy to hear him ask this next question, "I suppose I could think of this as my having an 80% chance of success which seems pretty good, but in those two red scenarios, will I miss a dinner a week, or will I lose my house? How bad are the bad ones?"

"That's an excellent question! Let's look at what the dollars are rather than just whether or not there is enough." We both agreed we have to figure out some way to measure how close or far

he would be from reaching his goal: "Let's look at what your final balance would be at the end of 22 years when you reach 87. How much money will you have left over? Well, if we find you'd end up with \$1 million, then you'd have had plenty of money to spare. If you find you'd be short \$1 million, then you wouldn't even be close." That's what we did. We looked at the final balance at age 87.

One other thing we decided to do, though, was not to look at it in terms of the dollars of 22 years from now, but in terms of today's dollars. If the amount of money left over came out to be \$300,000 in terms of today's dollars, you know what that can buy. That can buy a house, for example. So, we changed those 10 colored squares into 10 final balances in terms of today's dollars, showing them as thousands of dollars.

| Investment Performance, relative to Inflation, is... |         |   |     |     |     |     |     |       |       |
|--|---------|---|-----|-----|-----|-----|-----|-------|-------|
| Worst  | Average |   |     |     |     |     |     |       | Best  |
| -200   | -100    | 0 | 100 | 200 | 300 | 400 | 700 | 1,100 | 2,000 |

This distribution looked appealing to Uncle Joe – a range from \$200,000 short to \$2,000,000 extra. Eight of ten results were good, two or three were great (a lot of money to leave to heirs!), and the two in ten bad scenarios were not that bad... If asset performance is poor, he believes he could comfortably adjust his style of living enough to be okay.

I asked, "Why do you expect to live to age 87?" He mentioned family history and some articles that he read that led him to the idea that he'd live to about 87. That seemed pretty reasonable. But I continued, "Suppose you only live a few years, or you live many years? Should we take a look at those?" He agreed. Using mortality table data, I came up with 10 representative ages to which he could expect to live:

69 75 78 81 84 87 89 92 95 101

In other words, based on the mortality data, I'm projecting that he has a 1 in 10 chance of living to 69, a 1 in 10 chance of living to 75, ... and a 1 in 10 chance of living to 101. Of course, he could live to other ages in between, but I explained that if he lives to any age from 65 through 72, then we'll call it age 69.

I went back to performing another calculation using a single asset growth return and a single inflation rate, but instead of only modeling 22 years out to age 87, I modeled 10 different lengths of retirement: 4 years to age 69, 10 years to age 75, 13 years to age 78, etc. all the way up to 36 years for age 101. Here's what I came up with:

| Live to Age |      |
|-------------|------|
| 69          | 600  |
| 75          | 500  |
| 78          | 400  |
| 81          | 300  |
| 84          | 200  |
| 87          | 200  |
| 89          | 100  |
| 92          | 0    |
| 95          | -100 |
| 101         | -300 |

So, for average asset performance and inflation, he has a one in ten chance of living to 69 and having \$600,000 in today's dollars left over, a one in ten chance of living to 75 and having \$500,000 in today's dollars left over, etc. "Hey, this looks pretty good. There are only two out of 10 scenarios in which you would live long enough to run out of money and like before, these two scenarios are not too severe."

"Right... so if I live to 87, we've determined that I should have enough, or almost enough, money to reach my goals regardless of asset performance and inflation. And, we also determined that for average asset performance and inflation, I should have enough, or almost enough, money regardless of how long I live."

Then a Eureka moment: At the same time we both said, "Can we put those two together?" And we did. We drew a grid with asset performance going from worst on the left to best on the right and then put the different ages he could expect to live to going up and down with the shortest time up top and longest at the bottom.

| Live to Age | Investment Performance, relative to Inflation, is... |  |         |  |  |  |  |  |      |  |
|-------------|--|--|---------|--|--|--|--|--|------|--|
|             | Worst  |  | Average |  |  |  |  |  | Best |  |
| 69          |  |  |         |  |  |  |  |  |      |  |
| 75          |  |  |         |  |  |  |  |  |      |  |
| 78          |  |  |         |  |  |  |  |  |      |  |
| 81          |  |  |         |  |  |  |  |  |      |  |
| 84          |  |  |         |  |  |  |  |  |      |  |
| 87          |  |  |         |  |  |  |  |  |      |  |
| 89          |  |  |         |  |  |  |  |  |      |  |
| 92          |  |  |         |  |  |  |  |  |      |  |
| 95          |  |  |         |  |  |  |  |  |      |  |
| 101         |  |  |         |  |  |  |  |  |      |  |

Filling in the results we came up with so far:

| Live to Age | Investment Performance, relative to Inflation, is... |      |         |     |     |     |     |     |       |       |
|-------------|--|------|---------|-----|-----|-----|-----|-----|-------|-------|
|             | Worst  |      | Average |     |     |     |     |     | Best  |       |
| 69          |  |      |         |     |     |     |     |     |       |       |
| 75          |  |      |         |     |     |     |     |     |       |       |
| 78          |  |      |         |     |     |     |     |     |       |       |
| 81          |  |      |         |     |     |     |     |     |       |       |
| 84          |  |      |         |     |     |     |     |     |       |       |
| 87          | -200   | -100 | 0       | 100 | 200 | 300 | 400 | 700 | 1,100 | 2,000 |
| 89          |  |      |         |     |     |     |     |     |       |       |
| 92          |  |      |         |     |     |     |     |     |       |       |
| 95          |  |      |         |     |     |     |     |     |       |       |
| 101         |  |      |         |     |     |     |     |     |       |       |

He kept going... "I can see what happens if assets perform poorly, and I can see what happens if I live a long time. What happens if both of those happen at the same time?" That would be the lower left-hand part of this table: long life and poor asset performance. I went ahead and calculated it.

We paused at the sight.

| Live to Age | Investment Performance, relative to Inflation, is... |      |      |      |         |     |     |     |       |       |
|-------------|--|------|------|------|---------|-----|-----|-----|-------|-------|
|             | Worst  |      |      |      | Average |     |     |     |       |       |
| 69          |  |      |      |      | 600     |     |     |     |       |       |
| 75          |  |      |      |      | 500     |     |     |     |       |       |
| 78          |  |      |      |      | 400     |     |     |     |       |       |
| 81          |  |      |      |      | 300     |     |     |     |       |       |
| 84          |  |      |      |      | 200     |     |     |     |       |       |
| 87          | -200   | -100 | 0    | 100  | 200     | 300 | 400 | 700 | 1,100 | 2,000 |
| 89          | -300   | -200 | -100 | 0    | 100     |     |     |     |       |       |
| 92          | -400   | -300 | -100 | -100 | 0       |     |     |     |       |       |
| 95          | -600   | -400 | -300 | -200 | -100    |     |     |     |       |       |
| 101         | -900   | -700 | -500 | -400 | -300    |     |     |     |       |       |

Red numbers – and many of them. And some of them were uncomfortably large.

Looking for cheerier news, we checked out the results given a long life and strong asset performance – the bottom right of this table.

| Live to Age | Investment Performance, relative to Inflation, is... |      |      |      |         |      |     |     |       |       |
|-------------|--|------|------|------|---------|------|-----|-----|-------|-------|
|             | Worst  |      |      |      | Average |      |     |     |       |       |
| 69          |  |      |      |      | 600     |      |     |     |       |       |
| 75          |  |      |      |      | 500     |      |     |     |       |       |
| 78          |  |      |      |      | 400     |      |     |     |       |       |
| 81          |  |      |      |      | 300     |      |     |     |       |       |
| 84          |  |      |      |      | 200     |      |     |     |       |       |
| 87          | -200   | -100 | 0    | 100  | 200     | 300  | 400 | 700 | 1,100 | 2,000 |
| 89          | -300   | -200 | -100 | 0    | 100     | 200  | 400 | 600 | 1,100 | 2,100 |
| 92          | -400   | -300 | -100 | -100 | 0       | 100  | 300 | 600 | 1,100 | 2,200 |
| 95          | -600   | -400 | -300 | -200 | -100    | 0    | 200 | 500 | 1,200 | 2,900 |
| 101         | -900   | -700 | -500 | -400 | -300    | -100 | 100 | 400 | 1,400 | 4,000 |

Yes, these were better results. We could see that it is possible to accumulate quite a bit of money. If Uncle Joe lives from age 65 to 101, that's 36 years – a long time for asset performance to have an impact. Finally, we figured to fill in the rest of the grid seeing what would happen if his retirement years were short. As we expected, we found that asset performance isn't as important over a short horizon – results were not as spread out at the younger ages as they were at the older ages.

| Live to Age | Investment Performance, relative to Inflation, is... |      |      |      |         |      |     |     |       |       |
|-------------|--|------|------|------|---------|------|-----|-----|-------|-------|
|             | Worst  |      |      |      | Average |      |     |     |       |       |
| 69          | 300  | 400  | 500  | 500  | 600     | 600  | 700 | 700 | 800   | 900   |
| 75          | 200  | 300  | 300  | 400  | 500     | 600  | 700 | 800 | 900   | 1,200 |
| 78          | 0  | 200  | 300  | 300  | 400     | 500  | 600 | 800 | 1,000 | 1,600 |
| 81          | -100   | 100  | 200  | 200  | 300     | 400  | 600 | 800 | 1,000 | 1,800 |
| 84          | -100   | 0    | 100  | 200  | 200     | 300  | 500 | 700 | 1,100 | 1,800 |
| 87          | -200   | -100 | 0    | 100  | 200     | 300  | 400 | 700 | 1,100 | 2,000 |
| 89          | -300   | -200 | -100 | 0    | 100     | 200  | 400 | 600 | 1,100 | 2,100 |
| 92          | -400   | -300 | -100 | -100 | 0       | 100  | 300 | 600 | 1,100 | 2,200 |
| 95          | -600   | -400 | -300 | -200 | -100    | 0    | 200 | 500 | 1,200 | 2,900 |
| 101         | -900   | -700 | -500 | -400 | -300    | -100 | 100 | 400 | 1,400 | 4,000 |

“This is far different from my original calculation, and not just because I left out inflation. Rather than looking at just average asset returns over an average lifetime, this considers random asset returns and inflation and different ages to live to. And, it shows how close or far I’d be from reaching my income goals. When I look at this grid, are the outcomes in the middle more likely than the ones on the outside?”

“Imagine 100 ping pong balls in a bucket with these 100 numbers, one of which will be chosen from the bucket. In reality, there would be many more than 100 ping pong balls, with values in between the 100 here and greater and less than these 100. But, these 100 are meant to paint the same picture as if you really had all the ping pong balls.”

“Well, this doesn’t look as good as I hoped. Sure, the center is good as I expected, but the big red negative numbers are a concern to me.”

“First of all, before making a firm plan, you should meet with someone who’s really qualified to give advice. This grid is good for painting a picture of potential retirement incomes, but more details should be included to come up with a reliable plan. Also, an advisor would incorporate taxes and specific financial services product information.

“What do I think about these outcomes? There are strategies you can employ which can make the bad scenarios less severe. See all the great big blue positive numbers? You may not really need that much money. You can give up the chance at getting some of those great outcomes in exchange for protection against the poor outcomes. Two means readily available to do so are: 1) using fixed interest assets rather than variable ones, and 2) purchasing an income annuity to provide income for life no matter how long you live. The first one of these is a transfer of asset performance risk, the second one is a transfer of longevity risk. You can do either one or both of these and can do so in varying levels. For example, here are the outcomes if doing a little of both:

| Live to Age | Investment Performance, relative to Inflation, is... |      |      |      |         |      |     |     |       |       |
|-------------|--|------|------|------|---------|------|-----|-----|-------|-------|
|             | Worst  |      |      |      | Average |      |     |     |       | Best  |
| 69          | 300  | 400  | 500  | 500  | 600     | 600  | 700 | 700 | 800   | 900   |
| 75          | 200  | 300  | 300  | 400  | 500     | 600  | 700 | 800 | 900   | 1,200 |
| 78          | 0  | 200  | 300  | 300  | 400     | 500  | 600 | 800 | 1,000 | 1,600 |
| 81          | -100   | 100  | 200  | 200  | 300     | 400  | 600 | 800 | 1,000 | 1,800 |
| 84          | -100   | 0    | 100  | 200  | 200     | 300  | 500 | 700 | 1,100 | 1,800 |
| 87          | -200   | -100 | 0    | 100  | 200     | 300  | 400 | 700 | 1,100 | 2,000 |
| 89          | -300   | -200 | -100 | 0    | 100     | 200  | 400 | 600 | 1,100 | 2,100 |
| 92          | -400   | -300 | -100 | -100 | 0       | 100  | 300 | 600 | 1,100 | 2,200 |
| 95          | -600   | -400 | -300 | -200 | -100    | 0    | 200 | 500 | 1,200 | 2,900 |
| 101         | -900   | -700 | -500 | -400 | -300    | -100 | 100 | 400 | 1,400 | 4,000 |

“See how the bad scenarios are so much better? Well, you’ll also see that the good scenarios are lower. As a matter of fact, the average of all 100 scenarios is now lower than before, however, the number and magnitude of the bad scenarios is much better. Basically, you’ve traded away risk by giving up potential reward.”

“Which of these two is better? Are either of these optimal?”



“Neither and no! These are trade-offs of risk and reward. Let me give you an example. You may be able to increase your proportion of good outcomes, or chance of success, by investing in risky assets with high expected returns. That may be good news. However, you need to know that while most of the outcomes may be better by doing this, a lot of them would become worse... investing in risky assets means you’re retaining risk. You’d have the potential for higher rewards, but at the cost of potentially having far worse outcomes! Strategies are trade-offs – there is no free lunch. Conversely, if you give away a lot of risk, for example purchasing a large fixed annuity, you’ll give up the potential for large positive outcomes.

“Which of these two is better? Are either of these optimal? You tell me – it’s up to you! **The strategy that offers the risk and reward combination most appealing to you is the optimal solution – ‘optimal’ is in the eye of the beholder.**”

“Then do you mind if I play around with this calculator for a while? I’d like to see what happens to this grid of potential outcomes under other strategies. I’m more concerned about the running-out-of-money scenarios than the get-rich ones, but at the same time, I don’t want to give away all of the potential rewards to protect too much on the downside.”

“Go ahead, please. Try different strategies including fixed and variable investments, annuities, different retirement ages, etc., and see how the picture of potential outcomes changes. Good luck, Uncle Joe!”

### The Retirement Income Calculator as Used for Uncle Joe

Beta Version
RETIREMENT INCOME CALCULATOR
v Beta 2.0

Quick Start
FYI
FAQ
Add Info

**1. Enter General Information:** Info

**Personal Information**

|                |        |       |
|----------------|--------|-------|
|                | Single | Joint |
| Current Age    | 65     |       |
| Retirement Age | 65     | -     |
| Gender         | M      | F     |

**Social Security:**

|        |      |      |
|--------|------|------|
| Age    | 65   | 70   |
| Amount | \$20 | \$25 |

**Pension:**

|            |  |
|------------|--|
| Age        |  |
| Amount     |  |
| COLA       |  |
| Survivor % |  |

**Current Nestegg:**

|         |       |
|---------|-------|
| Nestegg | \$600 |
|---------|-------|

**Annual Pre-Retirement Savings:**

|     |         |
|-----|---------|
| Age | Savings |
| 65  |         |

**Annual Target Retirement Income:**

|     |        |
|-----|--------|
| Age | Income |
| 65  | \$50   |

**Inflation & Asset Class Returns**

|                         |        |         |
|-------------------------|--------|---------|
|                         | Return | Default |
| Fixed                   | 4.7%   | 4.7%    |
| Equity                  | 8.6%   | 8.6%    |
| Bonds                   | 5.9%   | 5.9%    |
| CPI Bond: Real Int Rate | 1.0%   | 1.0%    |
| Inflation               | 3.7%   | 3.7%    |

**2. Enter Longevity Risk Strategy:** Info

|                                   |       |
|-----------------------------------|-------|
| Purchase an Income Annuity (Y/N)  | N     |
| Age to Purchase Annuity           | 65    |
| Age for Income to Start           | 65    |
| Initial Annual Income Amount      | \$10  |
| Purchase Price for Income Annuity | \$132 |
| Fixed/Variable Income (F/V)       | F     |
| If Fixed, COLA                    | 0.0%  |
| If Fixed, Cash Refund (Y/N)       | N     |

**4. Observe Outcomes** Live to Age

View this table of 100 representative outcomes, each being the amount of assets left at the end of retirement.

Imagine 100 ping pong balls with these 100 numbers in a bucket, one of which will be chosen from the bucket.

| Live to Age | Worst | 400  | 500  | 500  | 600  | 600  | 700 | 700 | 800   | 900   |
|-------------|-------|------|------|------|------|------|-----|-----|-------|-------|
| 69          | 300   | 400  | 500  | 500  | 600  | 600  | 700 | 700 | 800   | 900   |
| 75          | 200   | 300  | 300  | 400  | 500  | 600  | 700 | 800 | 900   | 1,200 |
| 78          | 0     | 200  | 300  | 300  | 400  | 500  | 600 | 800 | 1,000 | 1,600 |
| 81          | -100  | 100  | 200  | 200  | 300  | 400  | 600 | 800 | 1,000 | 1,800 |
| 84          | -100  | 0    | 100  | 200  | 200  | 300  | 500 | 700 | 1,100 | 1,800 |
| 87          | -200  | -100 | 0    | 100  | 200  | 300  | 400 | 700 | 1,100 | 2,000 |
| 89          | -300  | -200 | -100 | 0    | 100  | 200  | 400 | 600 | 1,100 | 2,100 |
| 92          | -400  | -300 | -100 | -100 | 0    | 100  | 300 | 600 | 1,100 | 2,200 |
| 95          | -600  | -400 | -300 | -200 | -100 | 0    | 200 | 500 | 1,200 | 2,900 |
| 101         | -900  | -700 | -500 | -400 | -300 | -100 | 100 | 400 | 1,400 | 4,000 |

Investment Performance, relative to Inflation, is...

Portion ≥ \$0: 78%    Portion < \$0: 22%    Average of the 100: \$500

**3. Enter Investment Risk Strategy:** Info

Asset Allocation

| Age                | Fixed | Equity | Bond | CPI-Bnd |
|--------------------|-------|--------|------|---------|
| pre-retirement:    |       |        |      |         |
| 65                 | 0%    | 75%    | 25%  | 0%      |
| during retirement: |       |        |      |         |
| 65                 | 0%    | 100%   | 0%   | 0%      |

**5. Repeat Steps 1 - 5**

Observe how the outcomes change when various inputs are changed.

Developed by William Leslie under a grant from the Society of Actuaries