The Vital Signs of Retirement Income

By James B. Sandidge, JD
every bit as violent as a waterfall.” Despite the complexity of wealth distribution, the essence of successful retirement income is quite simple: Manage the negative momentum created by market losses and withdrawals.

Mental dazzle is the tendency for superfluous information or “noise” to distract you from the essence of a problem, making it harder to solve (Katz 1950). Failure to focus on the essence is one reason the financial services industry has struggled to develop innovative retirement-income solutions that resonate with investors. However, creative thinkers have a talent for “distinguishing the forest from the trees and thereby recognizing which questions are important and which ones are not” (Sternberg and Lubart 1999).

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Along with mental dazzle, the tendency to see illusory patterns or spurious correlations has caused some, especially experts, to miss the genuine patterns that make up the essence of retirement income (Sandidge 2022). The patterns advisors should focus on are the ones between the vital signs and retirement-income success.

In addition to simplifying problem-solving, the elimination of noise is also the key to messaging that resonates. This requires you to become a “master of exclusion.” You must relentlessly prioritize and strip out superfluous elements that may seem important but are not the most important (Heath and Heath 2007). This is because most people can hold only three to five chunks of information in their working memory and exceeding that amount leads to confusion (Cowan 2010). Because working memory declines with age (Gazzaley et al. 2005), advisors...
should limit their retirement-income presentations to three main chunks of information. They must exclude superfluous information and focus on the essential.

Finding the essential and anchoring it to the knowledge that people already have preserves limited working memory. Managing market losses is the essence of solving retirement income. Many investors already understand the concept of market losses, so advisors should talk about their plans to manage losses by focusing on the four vital signs—negative returns, annualized erosion rate, changes in the account value, and the distribution rate—to actively manage risk and cash-flow allocation. Advisors also should avoid unnecessary jargon such as “sequence risk” or “drawdown” that will occupy limited working memory.

LAMINAR VS. TURBULENT RETIREMENT INCOME

Accumulating wealth is a linear process, but distributing wealth is a nonlinear process governed by the laws of chaos theory (Sandidge 2019). Turbulence is an aspect of chaos that describes how a fluid or gas transitions from smooth, consistent flow known as “laminar” to disorderly unpredictable flow labeled “turbulent.” Predicting when this transition will occur is something scientists have struggled with for years.

Figure 1 shows the year-by-year percentage changes in account value (CAV) for a hypothetical retirement-income portfolio that withdraws 5 percent initially, increases that dollar amount 3 percent annually, and pays a 1.5-percent annual fee. (These are the assumptions that I use as my “systematic approach” throughout this article). Figure 1 also assumes you earn 10 percent in each positive return year and lose 2 percent in each of years 1, 4, 7, 10, and 13.

Note that the red line connects the CAV following the negative return years and shows a relatively smooth decline in values until the fifth loss, after which you begin to see daylight between the blue line and the red line. The blue line then accelerates downward, doing so dramatically around the 20th year.

Given the consistency of returns in figure 1—every positive year is 10 percent and each negative year is -2 percent—coupled with a systematic withdrawal, you might expect declines in account value to exhibit a more linear path. However, figure 1 illustrates how market losses and withdrawals produce negative momentum that drains the energy generated by positive returns and creates drag that leads to turbulence and accelerated principal erosion.

Figure 2 shows the year-by-year CAV for 23 historical retirement-income portfolios that began between 1900 and 1925 and failed after employing the same systematic approach.
shown in figure 1. I would argue that the first 19 years or so represent a laminar flow with CAV constrained to the upside and downside as if flowing through a pipe. But then the CAV become turbulent, leading to accelerated principal erosion.

Figure 3 shows the same portfolios in figure 2 but assumes they are accumulating wealth. Without withdrawals exacerbating market losses, the portfolios are able to absorb the negative energy of those losses and stay within a consistent band, never transitioning to turbulence.

Note, during the early years in figure 2 the portfolios never reach the 20-percent upside mark, but several exceed -30 percent on the downside. By comparison, several portfolios in figure 3 exceed 20-percent upside and none ever exceed -30 percent. Those are not glaring differences, but I would argue they represent telltale signs that negative momentum and drag are building in the figure 2 portfolios.

Predicting the timing of the transition from laminar to turbulent has proven difficult. The Navier–Stokes equations, developed in the early 1800s, are partial differential equations that attempt to describe a range of fluid behavior, but their mathematical validity has never been proven, despite the efforts of some of the brightest minds of the past 200 years. The equations have proven so intractable that in 2000 the Clay Mathematics Institute offered $1 million to anyone who can solve them. Twenty-two years later, they remain unsolved.

Mandelbrot and Hudson (2004) put forth concepts of the Noah and Joseph effects to describe how the buildup of negative momentum leads to turbulence in financial markets, and I believe these effects describe the CAVs shown in figures 1 and 2. The Noah effect is about abrupt change or discontinuity where the magnitude of change is critical. The Joseph effect refers to dependence, persistence, long-term memory, momentum, and the importance of the order of events. Note how abruptly the account values in figure 2 break out of the defined range with large decreases (Noah). This is due to the negative momentum that accumulates from the early losses and withdrawals, eventually building to a critical point, illustrating the portfolio’s memory (Joseph).

Lacking a mathematical solution for turbulence, retirement-income researchers should look for early patterns that are likely to influence later outcomes. Mandelbrot developed fractal geometry as much by visually spotting patterns as by formal math proofs. “Some of his most important insights came, not from elaborate mathematical reasoning, but from a flash recognition of kinship between disparate images” (Mandelbrot and Hudson 2004).

Chaos is about randomness and disorder, but it’s also about underlying patterns—order within disorder. So, you should look for patterns within retirement-income portfolios that represent subtle signs of approaching turbulence. For example, the portfolio in figure 1 still had 64 percent of its principal after the 13th year, which projects 35 years of longevity—but the signs of negative momentum suggest it would be difficult to maintain that pace.

The signs of negative momentum include the fact that the portfolio has two losses through four years, four losses through 10 years, and five losses through 13 years. Historical portfolios with that many losses in those years had failure rates of 77 percent, 71 percent, and 92 percent. Additionally, the portfolio had a 9-percent distribution rate in the 11th year, and failed historic portfolios averaged 9.2 percent in that year versus 5.3 percent for successful portfolios.
Collectively, patterns related to the four vital signs of negative returns, annualized erosion rates, CAV, and distribution rates create a picture of a potentially failing portfolio versus a successful one. These vital signs help advisors recognize the need for a cash-flow adjustment before that need is obvious.

**WORST-CASE LOSSES ROLLING 25 YEARS**

Years 11–15

18/61 (30%)

Years 6–10

1/12 (8%)

Years 1–5

20/41 (49%)

Years 21–25

1/1 (100%)

3/3 (100%)

Thus, threshold values are zero during the first five years, one cumulative during years 6–10, and two cumulative at any point after the 10th year. Exceeding those thresholds resulted in failure rates of 72 percent, 69 percent, 92 percent, 88 percent, and 100 percent (red numbers).

Table 1 summarizes the connection between failed portfolios and the timing of worst-case losses. For example, the first column (WCL) denotes the number of worst-case losses. The “Years 1–5” column shows that 61 of my historical portfolios had no large losses in the first five years and only 18 of those (30 percent) eventually failed. The next row (red numbers) shows that 72 percent of the 29 portfolios that had one large loss failed. So, zero losses the first five years is the goal, and one loss is a major warning sign signaling the odds have turned against you.

The “Years 6–10” column shows that one large loss cumulative through 10 years is a caution sign (52-percent failure) and two or more are a warning sign.

Two large losses through the 15th year are a caution sign and three or more are a warning. Note the last two columns show that the later you have two losses, the better your odds.

When I applied a 50/50 portfolio, withdrew 5 percent initially, increased that dollar amount 3 percent annually, and paid a 1.5-percent annual fee—the systematic approach—to rolling 25-year periods since 1900, 27 portfolios ran out of money by the 25th year. However, I decided to deem a portfolio as “failed” if it finished the 25th year with less than 40 percent of the original principal still available. That higher standard resulted in 47 failed portfolios, with only one of those finishing the 25th year with less than 4 percent of the original investment.

Most failed portfolios had a higher-than-average number of negative returns, especially losses of 5 percent or more, which happened eight out of 42 years (19 percent) during 1900–1941 and only four of the next 80 years (5 percent). This article refers to losses of that magnitude or worse as “worst-case losses” (WCL).

**WORST-CASE LOSSES**

Figure 4 shows the number of worst-case losses over rolling 25 years, except for the five bars at the far right that show losses over 20 years. For example, the first bar shows that the portfolio that began in 1900 had four worst-case losses over its 25 years. When I applied a systematic approach, portfolios that began in years marked by the red bars failed. Twenty-nine of 32 portfolios (91 percent) with more than two worst-case losses failed. Thirty-one of 48 portfolios (65 percent) with exactly two large losses, and 21 of 22 portfolios (95 percent) with fewer than two large losses, were successful. Thus, two losses constitute a threshold value; a portfolio with two losses is a caution sign, and a portfolio with more than two losses is a warning.

<table>
<thead>
<tr>
<th>WCL</th>
<th>Years 1–5</th>
<th>Years 6–10</th>
<th>Years 11–15</th>
<th>Years 16–20</th>
<th>Years 21–25</th>
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<tr>
<td>0</td>
<td>18/61 (30%)</td>
<td>7/40 (18%)</td>
<td>3/30 (10%)</td>
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<td>1</td>
<td>21/29 (72%)</td>
<td>12/23 (52%)</td>
<td>2/12 (17%)</td>
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<td>1/12 (8%)</td>
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<td>2</td>
<td>8/12 (67%)</td>
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<td>3</td>
<td>3/3 (100%)</td>
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When I applied a systematic approach, portfolios that began in 1900 had four large losses, and 21 of 22 portfolios (90 percent) failed. Thirty-two portfolios (90 percent) began in years marked by the red bars failed. Thus, threshold values are the most important because of the risk that investors may panic and abandon their plans.

**VITAL SIGN #1: NEGATIVE RETURNS**

Negative returns are the first vital sign of portfolio longevity. Within negative returns, there are three signals that require an advisor’s vigilance: (1) worst-case losses, (2) multiple years of negative returns, and (3) the portfolio’s downside risk, also known as semi-deviation. Of these, worst-case losses are the most important because of the risk that investors may panic and abandon their plans.

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Table 1 summarizes the connection between failed portfolios and the timing of worst-case losses. For example, the first column (WCL) denotes the number of worst-case losses. The “Years 1–5” column shows that 61 of my historical portfolios had no large losses in the first five years and only 18 of those (30 percent) eventually failed. The next row (red numbers) shows that 72 percent of the 29 portfolios that had one large loss failed. So, zero losses the first five years is the goal, and one loss is a major warning sign signaling the odds have turned against you.

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Figure 5 shows the number of rolling 25 years a 50/50 portfolio gained 15 percent or more, and the number of years a 50/50 portfolio lost 5 percent or more for each portfolio. Note, the 1914 and 1975 portfolios each had 11 years with gains of more than 15 percent; however, the 1975 case had no losses greater than 5 percent, and the 1914 case had five such losses, many more than the target of two shown in table 1. Using a systematic approach, these portfolios finished respective 25th years with 18 percent of the investment (1914) versus 697 percent (1975).

Portfolios beginning after 1939 had higher average annual returns (9 percent versus 7.1 percent) because they had fewer bad years, not because they had more good years. Portfolios beginning 1900–1939 had an average positive return of 12.4 percent compared with the 11.9–percent average for those beginning post–1939. However, the earlier portfolios averaged 3.7 worst-case losses (recall the target is two or fewer) compared with 1.5 worst-case losses for the later portfolios, and they had an average negative return of –8.7 percent versus –4.5 percent for the later portfolios.

This disparity may be due in part to the dramatic reduction of bank panics after the Great Depression. Such panics were a common, persistent, and severe source of economic and financial instability in the late 19th and early 20th centuries (Jalil 2015).

Banking reforms brought on by the Great Depression practically eliminated such panics, with the notable exceptions of the savings and loan crisis of the 1980s and the 2008 financial crisis. In my analysis of the 102 portfolios beginning 1900–2001, the systematic approach caused 47 to fail, suggesting a 46-percent failure rate. However, the 82 percent failure rate of the pre–1940 portfolios skews that number, and there may be reason to be optimistic that our current environment is closer to the post–1939 period and its 22-percent failure rate. The failure to capture this cyclical nature of markets is one of the many flaws that severely limit the practical application of Monte Carlo analysis (Sandidge 2020).

Although there are fewer worst-case losses after 1941, the very worst losses are comparable in magnitude to all but the Great Depression losses before 1942. For example, the 2008 systematic portfolio had an account value of $809,475 after the first year, ranking it fourth–worst behind 1931 ($705,075), 1937 ($760,100), and 1917 ($804,900).

After two years the 1973 portfolio had the third–worst account value ($724,044), behind 1930 ($752,400) and 1931 ($643,299). Despite the severity of the 1973–74 correction, those who retired in 1973 and stayed invested did well because post–1974 was a period of few negative returns. Conversely, 10 of the 12 portfolios beginning 1955–1966 failed because they sustained multiple losses leading into the 1973–74 correction.

After three years, the account value for the portfolio beginning in 2000 ($730,200) was third worst, behind 1929 ($510,835) and 1930 ($511,012), but portfolios beginning 1998–2001 failed because their bad early years were compounded by the 2008 correction. Conversely, people who retired in 2008 finished the 13th year with 90 percent of their principal intact because 2008 was followed by positive returns in 11 of 12 years, with the one exception being a 2.3–percent loss.

As noted, investors who retired at the start of corrections in 1973–74 or 2008 did well because they benefited from subsequent positive returns, but those same corrections proved fatal for portfolios that included multiple negative returns leading into them. Even severe corrections did not deplete portfolios unless accompanied by multiple negative years. Four of the 47 failed portfolios had four negative years each, and the remaining 43 all had at least five negative return years.

**MULTIPLE SMALL LOSSES (NN)**

Multiple small losses may be less likely to panic an investor, but they can be just as detrimental to portfolio longevity as larger single losses. For example, the year–by–year account values in figure 6 represent scenarios where both portfolios earned 10 percent in each positive return year. The blue line...
lost 25 percent the first year and finished the 26th with $28,365, and the red line lost 2 percent in each of years 1, 4, 7, 10, and 13 and ran out of money. Although the single large loss has more potential to cause investors to panic and abandon their strategy, multiple small losses are more pernicious financially because the need to adjust cash flow is less obvious. This is where the portfolio’s four vital signs are most important because they indicate the level of negative momentum and the need for adjustment before it is apparent.

Table 2 shows how many portfolios through each block of five years had an amount less than, equal to, or more than one negative return per five-year block, and how many of those portfolios failed. The targets are one negative year of any size in the first five years, two cumulative losses in the first 10 years, and so forth, so that the targets are one, two, three, four, and five.

The first column denotes the number of negative years (NN). The “Years 1–5” column shows that 46 portfolios had one negative year during the first five and 48 percent of those failed, and the 26 portfolios that had two losses had a 77–percent failure rate.

Portfolios that had fewer than the threshold values one, two, three, four, and five had low failure rates, those with more than the targets had high failure rates, and those with exactly the threshold values had failure rates of 50 percent or less. Note that these are firm thresholds because exceeding them by one year left you with failure rates of 77 percent, 70 percent, 73 percent, 81 percent, and 74 percent (red numbers) in five-year blocks of time.

**SEMI-DEVIAITON (S-D)**

Figure 7 shows the semi-deviation (S-D), or measurement of downside risk, after 25 years or at the point my historical portfolios ran out of money, with red bars again signifying those that failed.

Forty-nine of 60 portfolios (82 percent) with an S-D of less than 3 percent were successful, with 10 of the 11 failures occurring in the 12 portfolios beginning 1955–1966. Conversely, only six of 42 (14 percent) of those at 3 percent or above were successful. Thus, a 3–percent S-D is a threshold. Approaching a 3–percent S-D is a caution sign, and exceeding it is a major warning sign that may call for a cash-flow adjustment depending on the client’s goals.

I would note that multiple small losses did not drive the S-D as much as a single large loss, which is why it is important to count the number of negative years.

Figure 8 shows the number of portfolios with a 3–percent or greater S-D by year. The bars show all portfolios meeting that criterion, and the line shows the percentage of those failed.
For example, 14 portfolios had a 3-percent or higher S-D after the first year (bar) and eight (57 percent) eventually failed. After the first year, the failure rate was consistently around 70 percent, so a 3-percent S-D in any year is a warning sign, and any S-D below that can be a caution sign when it’s accelerating toward 3 percent.

**VITAL SIGN #2: ANNUALIZED EROSION RATE (AER)**

People know how much money they have the day they retire. If they have less money one year later, it is human nature to project that rate of principal erosion into the future, making the annualized erosion rate (AER) the second vital sign. For example, with 5 percent less, they are likely to note that their money will last only 20 years. Advisors should manage to an annualized erosion rate projecting to an acceptable number of years for the investor. I have found that even the systematic portfolios often were able to carry a higher AER early and then cut back on that rate over time.

Figure 9 shows the highest annualized erosion rate by year for any of the successful historical portfolios. For example, one portfolio (1974) had an AER of -16.9 percent after the first year but was able to recover on the strength of several positive years.

Using this data, I set AER thresholds of -4 percent, -3.5 percent, -3 percent, -2.5 percent, and -2 percent per five-year block of time; accelerating toward those thresholds is a caution and exceeding them is a warning.

**Forty portfolios had no erosion after 20 years, illustrating that one should not assume managing a retirement-income portfolio automatically means working with a declining asset value.**

A -2-percent AER over 25 years projects to 50 years of longevity, and 50 percent of principal remaining after 25 years, but a -2.4-percent AER projects to the 40 percent remaining I require to be deemed “successful.” I believe the more conservative target is appropriate given the tendency toward accelerated principal erosion I observed in the later years of several portfolios. That also would be appropriate for someone with a higher legacy goal.

The bars in Figure 10 show how many of the 102 historical portfolios finished each year with no principal erosion. For example, the first bar shows that 59 portfolios had no erosion after the first year, and the teal line shows that 64 percent of those ultimately were successful. The line climbs quickly with portfolios showing no erosion after the ninth year having an 89-percent success rate. Forty portfolios had no erosion after 20 years, illustrating that one should not assume managing a retirement-income portfolio automatically means working with a declining asset value.

**VITAL SIGN #3: CHANGES IN ACCOUNT VALUE (CAV)**

CAV is the third major vital sign because any falling values are an early warning. Figure 11 shows the average percentage change in account value by year for successful portfolios and the ones that failed. For example, the successful portfolios’ account values increased an average of 4.4 percent in the first year compared with failed portfolios, which were flat. Note that the failed portfolios averaged falling account values beginning in the second year and the successful ones averaged appreciating values until the 20th year. This further supports my point...
that one should not assume declining account values for retirement-income portfolios. Thus, falling account values are a caution sign.

Figure 12 returns to the hypothetical scenario from figure 1, with the bars showing the percentage change in account value from year to year. You expect the account value to fall in negative return years (red bars) 1, 4, 7, 10, and 13. But note the changes in positive years, especially following negative years. The CAV was 2.9 percent, 2.1 percent, and 1.0 percent following the first three negative return years, then turned negative (~0.5 percent) the year after the fourth loss, as negative momentum drags the CAV down. Falling account values in general are a warning sign, especially when they start falling in positive return years.

Note in the six years after the fifth loss the account value drops 3 percent, 4 percent, 5 percent, 6 percent, 7 percent, and 8 percent, then accelerates, dropping 11 percent, 14 percent, 18 percent, 24 percent, 36 percent, 63 percent, and 100 percent despite earning 10 percent in each of those 13 years. The accelerating declines after the fifth loss are a caution sign, a 10–percent drop is a threshold value, and exceeding ~10 percent is a major warning sign.

Figure 13 shows the average and most number of years account values fell in positive return years per five–year block of time for my successful historical portfolios. For example, the successful portfolios averaged one such year during the first five, and none of the successful portfolios had more than two during that time. The blue bars create threshold values of 1, 2, 3, 4, and 6.

Figure 14 shows how often historical portfolios fell 10 percent or more and what percentage of those failed. For example, 12 portfolios fell 10 percent in the first year with 50 percent of those running out of money. Note, portfolios with 10–percent declines peaked in the 22nd year. The declining numbers after that are partly due to survivor bias, because portfolios that had run out of money by then were no longer part of the calculations. The overall failure rate for portfolios experiencing 10–percent declines in account value was 71 percent, but between the second and 22nd years it was 75 percent.

Thus, falling account values are an early caution sign, especially when falling in positive return years. Accelerating declines also are a red flag, and declines of 10 percent or more are a major warning likely requiring a cash flow adjustment.

**VITAL SIGN #4: DISTRIBUTION RATES (DR)**

Much of the industry research around retirement income focuses on the first–year distribution rate (DR) of the portfolio. I have found, however, that the year–by–year distribution rate is the fourth vital sign. Figure 15 shows the number of
portfolios with distribution rates of 10–percent or more by year (bars) and the percentage of those that failed (line). For example, no portfolio had a distribution rate that high during the first three years, and only a handful did through eight years; however, 100 percent of portfolios that reached that level during the first 11 years failed. The number of portfolios with 10–percent* DRs peaked in the 21st year then declined, reflecting survivor bias.

Of the 59 portfolios with no DRs of 10 percent or more during the first 15 years, 52 (88 percent) were successful. Thirty-seven of the 47 (79 percent) failed portfolios had at least one year in the first 15 in which the DR was 10 percent or higher.

Every failed portfolio had at least two years in the first 20 in which it had DRs of 10 percent or more, but 82 percent of successful portfolios had no such years in the first 20. Thus, a DR trending toward 10 percent should be a caution to the advisor about the possible need to adjust cash flow, and a DR that exceeds 10 percent is a warning. I did observe scenarios where portfolios had early losses followed by a long series of gains that made it possible to carry double-digit distribution rates for several years in the later years, but in those scenarios the DR typically was the only vital sign flashing a warning.

Figure 16 shows that the average DR by year for failed portfolios reached 10 percent by the 12th year, but successful portfolios were at 5.4 percent by that point. Note that on average the successful portfolios never reached 10 percent, although as noted above, some successful portfolios were able to maintain a double-digit DR in the later years.

In addition to the absolute values for the distribution rate, I wanted to see how many years the distribution rate plus fee percentage was greater than the portfolio return. In other words, I wanted to see how often the systematic approach withdrew more than it earned.

Figure 17 shows the average number of years in which the systematic approach withdrew more than the portfolio return. Based on the average number for the successful portfolios, I set cumulative threshold values of 2, 4, 6, 8, and 10 overdraw years per five-year blocks of time.

The “Years 1–5” column of table 3 shows 34 portfolios overdrew in two of the first five years and 12 of those (35 percent) eventually failed, and 68 percent of the 25 portfolios with three such years (red numbers) in the first five failed.

Note that the threshold values during the first two blocks of time are firm, because exceeding those thresholds turned the odds against you with failure rates of 68 percent the first five years and 67 percent the second five. Conversely, exceeding the threshold of six by one during the third block left you with a 42-percent failure rate, and the odds did not turn until you exceeded that target by one more, leaving a 64-percent rate.

The threshold of eight overdraws in the fourth block comes from the average number of overdraws shown in figure 17; however, table 3 shows you were able to surpass that number by two and still have an attractive failure rate (33 percent).

The final column shows an even softer threshold of 10 in years 21–25, with portfolios having as many as 14 overdraw years still having attractive failure rates. Thus, the thresholds early should be viewed strictly, with more flexibility in later years.

VITAL SIGNS COLLECTIVELY

Figure 18 shows the average number of vital-sign warnings for historical portfolios. I’ve included all six signals: the three that describe negative returns (WCL, NN, and S-D), plus the
three that describe AER, CAV, and DR, respectively. Failed portfolios averaged one warning by the second year, two by the eighth, three by the 12th, four by the 15th, and almost five in the 18th. Successful portfolios averaged one-half to one warning through 19 years, rising to one-and-a-half warnings in later years. Thus, the number of warnings is itself a warning.

The bars in figure 19 show year-by-year how many portfolios had two warnings, and the red line shows the failure rate for those portfolios. For example, six portfolios had two warnings after the second year, with 67 percent of those eventually running out of money.
The failure rate peaks in the eighth year and then steadily declines from there. After similar analysis of portfolios with zero, one, three, four, five, and six warnings, I set goals of no warnings in the first 10 years, one or fewer in years 11–15, two in years 16–20, and three in years 21–25. Thus, two warnings are a major concern in the early years, but the same number is not as alarming in the later years.

Table A1 in the appendix provides an example of how the warning signs might appear with no adjustments.

Of the historical systematic portfolios that began after 1939, the only ones that failed are 10 of the 12 beginning 1955–1966 and the four that began 1998–2001. Each failure had multiple losses leading into at least one worst-case loss, generating multiple warnings.

For example, figure 20 shows someone retiring in 1966 had 69 percent of principal ($689,843) remaining after 11 years, a pace that would project 35 years total longevity. However, at that same point, four warning signs suggest that will be a difficult pace to maintain without adjustments. That includes the DR at 10.3 percent, the S–D at 3.8 percent, two worst-case losses back-to-back (the seventh- and tenth-worst since 1900), and four total losses at that point, as well as the fact that four warnings are a warning, so it is not surprising that the portfolio did not last 35 years.

Figure 20 also shows why someone retiring in 1973 was able to recover from that loss and finish with two times the investment due to the string of positive returns after that initial loss.

Figure 21 shows the returns (bars) and account values (line) for the portfolio beginning in 2000. Recall that it had the third-worst account value after three years of my historical portfolios. It began with a low return followed by back-to-back negatives, including the ninth-worst loss since 1900. A low return adjacent to a loss is a caution sign, as are back-to-back losses. The two losses in the first five years are a warning, as are the large losses. Recall, the goal is no warnings through 10 years, yet after three years the portfolio already has five warnings including one worst-case loss, two total losses, an S–D of 4.4 percent, a –9 percent annualized erosion rate, and a –14.1 percent change in account value.

Note, after the third loss the account value line is sloping downward and accelerating despite several years of positive returns.

Figure 21 also makes it easy to see why someone retiring in 2008 was able to recover from that loss on the strength of several subsequent positive return years. Conversely, the 2000 retiree had multiple losses leading into the 2008 correction and was unable to recover.

WARNING-SIGN CHECKLIST

Table 4 provides a 16-item checklist based on the four vital signs for retirement-income portfolios and the discussion to this point. Items 1, 2, and 3 cover negative returns. Item 4 covers annualized erosion rate. Items 5 and 6 include falling account values in positive return years and changes in account value, and items 7 and 8 cover distribution rate and the number of overdraft years. Item 9 is the number of warnings. Items 10–16 cover seven trends to watch for—any answer of “yes” to any of these questions signals the need for additional caution.

Exceeding any of the thresholds in table 4 should be viewed as a major warning sign that requires immediate action such as skipping multiple cash-flow increases or even reducing cash flow. Questions 10–16 function as caution signs that might trigger an earlier adjustment that may prevent the need for a larger adjustment later.

The tendency of someone who has accumulated a significant level of knowledge around a topic to fail to appreciate how difficult the material is for someone new to it is variously known as expert blindness, knowledge blindness, or the curse of knowledge. One key to messaging that resonates is that it needs to be concrete, and too often highly knowledgeable people speak abstractly and use unnecessary jargon. “Abstraction is the luxury of the expert,” (Heath and Heath 2007).
Note that much of the industry research focuses on the probability of spending all your principal but misses an important nuance, which is that retirees do not want to spend any principal. So advisors need to be able to articulate a goal for how much principal erosion investors might reasonably expect each year, which is precisely what the annualized erosion rate speaks to.

Also note that much of the financial services industry tends to focus on the predictability of income (M3). Perhaps they overestimate the demand for predictability, but more likely they find that predictability is the easiest piece to solve for given the investment products available.

To create a brand as a retirement-income thought leader, advisors must be able to speak to maximizing any of the goals. The key to solutions that are personalized and comprehensive is for the advisor to determine how important each goal is to a particular investor and have strategies for all goals.

The day you put your plan into action you must be prepared to adapt to changes in the environment, and as discussed, retirees face an infinite number of possible paths and outcomes. As Gleick (1987) noted, trying to solve a nonlinear problem such as the Navier–Stokes equations of fluid dynamics is “like walking through a maze whose walls rearrange themselves with each step you take.” This puts a premium on active management.

The checklist focuses on very specific signs to watch for when managing a retirement-income portfolio. It allows the advisor to move the annual review discussion from the type of high-level abstraction found with Monte Carlo to a concrete checklist with specific events to watch for and defined action steps to take depending on client goals.

This checklist can serve as a diagnostic tool regarding the health of a retirement-income portfolio and provide the basis for any cash-flow recommendations. It also can make for efficient retirement-income conversations by providing structure and concrete numbers.

**STRATEGY AND TACTICS**

Advisors can manage negative momentum preemptively with the risk and cash-flow allocations, and they can manage after the fact by adjusting cash flow. The strategy chosen depends on a retiree’s goals, and tactical adjustments are used to adapt to the environment. Adaptive distribution theory suggests you plan for the worst and then adapt to the environment, and the vital signs are key to the adaptation process (Sandidge 2016).

**RETIREE GOALS: THE FOUR M’s**

I call the four goals that retirees have regarding retirement income the four M’s. The four goals are the following:

- **M1**—Maximize cash flow in the early years.
- **M2**—Maintain standard of living, which is about cash flow in the later years.
- **M3**—Minimize cash-flow shocks, which is about providing some level of predictability to cash flow.
- **M4**—Minimize principal erosion.

Note that much of the industry research focuses on the probability of spending all your principal but misses an important nuance, which is that retirees do not want to spend any principal. So advisors need to be able to articulate a goal for how much principal erosion investors might reasonably expect each year, which is precisely what the annualized erosion rate speaks to.

Also note that much of the financial services industry tends to focus on the predictability of income (M3). Perhaps they overestimate the demand for predictability, but more likely they find that predictability is the easiest piece to solve for given the investment products available.

To create a brand as a retirement-income thought leader, advisors must be able to speak to maximizing any of the goals. The key to solutions that are personalized and comprehensive is for the advisor to determine how important each goal is to a particular investor and have strategies for all goals.

The day you put your plan into action you must be prepared to adapt to changes in the environment, and as discussed, retirees face an infinite number of possible paths and outcomes. As Gleick (1987) noted, trying to solve a nonlinear problem such as the Navier–Stokes equations of fluid dynamics is “like walking through a maze whose walls rearrange themselves with each step you take.” This puts a premium on active management.

To balance the four M’s across an almost infinite number of possible paths, retirees must be able to adapt, and they must accept that the assumptions and strategies they used for

---

**Table 4**

<table>
<thead>
<tr>
<th>Years</th>
<th>1–5</th>
<th>6–10</th>
<th>11–15</th>
<th>16–20</th>
<th>21–25</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Worst-Case Losses</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2. Number of Negative Years</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Semi-Deviation</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4. Annualized Erosion Rate</td>
<td>−4%</td>
<td>−3.5%</td>
<td>−3%</td>
<td>−2.5%</td>
<td>−2%</td>
</tr>
<tr>
<td>5. Falling Account Values in Positive Return Years</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>6. Changes in Account Values</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>7. Distribution Rate</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>8. Overdraw Years</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>9. Number of Warnings</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Did the portfolio have back-to-back losses?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Did the portfolio experience a low return followed by a loss or vice-versa?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Did the portfolio decline in value?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Is the semi-deviation accelerating?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Is the annualized erosion rate accelerating?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Is the account value declining at an accelerating rate?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Is the distribution rate accelerating?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
accumulating wealth do not apply post-retirement. Furthermore, Kahneman and Tversky (1979) showed losses have twice the emotional impact as gains for most people; however, Johnson (2010) showed losses may have 10 times the impact of gains for retirees, meaning retirees may be hypersensitive to losses when withdrawals exacerbate losses. These are the reasons retirement income is more complex than accumulating wealth and why professional advice and active management are critical for most retirees.

The plan should begin by preparing for the worst, then adapting. Historically, portfolios with early losses—especially large ones—have had a higher probability of running out of money and risk causing retirees to panic and abandon their strategy. Recall that portfolios with no losses of 5 percent or more in the first five years had a 30-percent failure rate, and those with one such loss had a 72-percent failure rate. That puts a premium on using a risk allocation that minimizes losses, especially large ones, in the early years.

Table 5 shows the 12 years in which a 50/50 risk allocation lost 5 percent or more, something that happened 12 times in the 109 years (11 percent) 1900-2008. Note the more conservative 20/80 allocation only had two such losses (1.8 percent) during that time, thereby minimizing the potential for the type of loss that might cause investors to panic and/or lead to accelerated principal erosion.

Figure 22 illustrates the importance of minimizing large losses early. It compares two retirement–income portfolios, one 100-percent stocks, and one 100-percent fixed income. The red line finished the 17th year with 42 percent of the original investment available compared with the bars, which ran out of money despite the fact the line was less volatile, had a lower average annual return (4.8 percent versus 6.1 percent) and cost more (1.5–percent annual fee versus no fee), illustrating that fees are important but getting the risk allocation right is paramount.

Looking at the yearly returns of the stock portfolio (bars) in figure 22 it is easy to see why it ran out of money. It lost 9.1 percent, 11.9 percent, and 22.1 percent its first three years and 37 percent in the ninth year. But the bond portfolio had positive returns in each of its first nine years. Netting out the 1.5–percent annual fee, the bond portfolio effectively earned 3.3 percent per year versus 6.1 percent for the stock portfolio, illustrating that annualized returns are not predictors of success for retirement income. That is because averages mask nonlinearities (Sandidge 2019; 2020).

The dilemma for investors is that the bond–heavy portfolio was optimal in this environment but there have been many others where such a portfolio ran out of money and a more stock–heavy portfolio was optimal. The answer is to prepare for the worst with an overallocation to bonds in the early years to minimize the risk of losses, then gradually allocate more to stocks. For this paper, bond allocations are equally weighted between Treasury bills and long Treasuries, and the potential for rising rates should factor into the type of bonds used in the current environment.

THE IMPORTANCE OF BEING VIGILANT

Figure 23 returns to my hypothetical scenario in figure 1 and shows the impact of adjusting cash flow before the need to is apparent. Each of the lines began with $1 million and withdrew 5 percent the first year. Reading the lines from the lowest (red) up, the lowest systematically increased cash flow 3 percent...
annually and ran out of money in the 26th year. By employing the same systematic approach, Monte Carlo analysis overstates the risk of running out of money.

The gray line reacted to negative returns in years 4, 7, 10, and 13 by skipping cash-flow increases in those years and finished with $293,079. Simply skipping increases in four negative years increased the ending value from zero to $293,079. The black line also skipped increases four times but did so preemptively in years 2–5 and finished with $410,510, illustrating the impact of earlier adjustments. The yellow line combined the preemptive and reactive approaches by skipping increases years 2, 3, 4, 7, 10, and 13 and finished with $522,437. The blue line decreased cash flow by 3 percent in the four negative years and finished with $610,481. Finally, the purple line withdrew $50,000 each year and finished with $1,162,545.

After the fourth loss (year 10), the lines in figure 23 are still tightly clustered and the long-term impact of early adjustments is not evident. It is only after the fifth loss (year 13) that the lines start to diverge noticeably. This shows the importance of recognizing the early signs of approaching turbulence and adjusting cash flow before that need is evident.

As noted, distributing wealth is nonlinear and therefore governed by the laws of chaos theory. The most well-known aspect of chaos theory is the butterfly effect, which says that even seemingly insignificant changes early in a process can have a significant effect on long-term outcomes. However, that long-term impact is not clear in the short term.

THE GOAL DETERMINES THE STRATEGY

Which strategy in figure 23 is optimal depends on your goals. For example, the top line was best for minimizing principal erosion, ending with $869,466 more principal than the gray line, but it never increased cash flow and paid out $459,201 less in income. Thus, the gray line would be optimal for someone desiring to grow and/or maximize total income, but the top line would appeal more to someone with a higher legacy goal.

Table A2 in the appendix shows what the vital signs for the hypothetical scenario described in table A1 look like if you skip cash-flow increases in years 2, 3, 4, 7, 10, and 13, which is what the gold line in figure 23 represents.

Figure 24 shows how often 30 different strategies that incorporate cash-flow decision rules built around the four M’s and vital signs left you with at least 50 percent of principal for portfolios beginning 1940–2001, so it illustrates the myriad of ways to creatively structure cash flow. For example, the first bar shows that when I took a 4-percent initial withdrawal and increased that dollar amount 3 percent annually (indicated by the notation “4/3”), I finished with at least 50 percent of principal 97 percent of the time. Note the next two bars took larger initial withdrawals but smaller increases (4.5/2 and 5/1) and finished with more than 50 percent of principal as often as the first bar. In fact, most of the portfolios in figure 24 finished with at least 50 percent of principal 90 percent of the time despite taking very different approaches to cash flow.

For each portfolio, the first number is the initial withdrawal and includes portfolios taking as much as 10 percent the first year. When you factor in the 1.5-percent annual fee I included, each of those initial withdrawals was 1.5 percent higher than shown.

Portfolios that include a fixed cash flow have labels that include the letter “F.” For example, “5F” withdrew 5 percent initially and the same dollar amount every year for 25 years. If there is a number after the F, it indicates cash flow is fixed only for that many years. So, F followed by 10 means the cash flow was fixed for 10 years then managed with the “VS” or vital-sign decision rules discussed below.

The letters “SD” indicate systematic decreases in cash flow. The SD portfolio paid a fixed cash flow for 10 years, then reduced that dollar amount 4 percent per year for the next five years and 2 percent per year for all the remaining years. For example, 6SD withdrew 6 percent the first year (plus the fee), paid that same amount the first 10 years, then began reducing that amount in year 11. This might be a strategy for someone who expects to be active in the early years of retirement and then slow down with age.

The letter “V,” for variable, by itself indicates a strategy in which I increased cash flow 1 percent annually but skipped two increases when I incurred a market loss less than 5 percent and reduced cash flow by the same percentage as the market loss in years the portfolio lost 5 percent or more. Recall, a 50/50 portfolio only had losses of 5 percent or more four times after 1941.
Finally, portfolios that include the letters “VS” applied a robust set of decision rules attached to the vital signs. Those rules are captured in table 6, which corresponds to a 5-percent initial withdrawal. The 50-percent recommended reductions attached to R, AER, DR, and CAV in step 2 increase by 10 points per five-year block of time. For example, they are 60-percent reductions in years 6-10, 70 percent in years 11-15, and so forth. I also increased reductions by 10 percentage points for each 1-percent increase in the initial withdrawal and for each five years the cash flow was fixed.

Even with decision rules, managing cash flow is as much art as science. These rules are focused on maximizing early cash flow (M1), and they are conservative for a retiree taking 5 percent or less in initial withdrawals unless the retiree also has a high leg-acy goal (M4). I also only included reductions resulting from exceeding target thresholds, and advisors could skip increases preemptively based on trends before exceeding thresholds.

Finally, reductions were triggered by exceeding one vital-sign threshold, but recall that figure 19 shows that successful portfolios often were able to carry multiple warnings in later years.

Einstein once said, “I have little patience with scientists who take a board of wood, look for its thinnest part, and drill a great number of holes where the drilling is easy” (Calaprice 2005). Given the investment products available, creating predictable retirement cash flow (M3) is the easiest goal to solve for. Advisors who want to establish a brand as someone creating retirement-income plans that are innovative, personalized, and comprehensive must be able to speak to all the goals discussed, with maximizing early cash flow likely the hardest piece to solve.

Figure 25 shows that these decision rules were focused on maximizing early cash flow. It shows year-by-year cash flow for the VS portfolios with no fixed cash flow versus a portfolio paying a fixed cash flow equal to 5 percent of the initial portfolio (red line). At the extreme, the 10VS portfolio paid $388,000 the first five years compared with the 5Fxd paying $250,000, and the 10VS paid more each of the first eight years. It took 17 years for the cumulative cash flow of the fixed portfolio to equal that of the 10VS. Note that the cash flows in figure 25 occurred in a worst-case environment (retiring in 2000), and applying the same analysis to someone retiring in 1975 showed that none of the VS lines ever dipped below the fixed line.

Ultimately, the optimal portfolios in figure 25 depends on the investor’s goals. Table 7 shows the total cash flow for years 1-5 (CF 1-5), the total cash flow for 21 years (Total CF), and

<table>
<thead>
<tr>
<th>TOTAL GOALS (THOUSANDS)</th>
<th>5Fxd</th>
<th>5VS</th>
<th>6VS</th>
<th>7VS</th>
<th>8VS</th>
<th>9VS</th>
<th>10VS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF 1–5</td>
<td>$250</td>
<td>$231</td>
<td>$271</td>
<td>$308</td>
<td>$343</td>
<td>$375</td>
<td>$388</td>
</tr>
<tr>
<td>Total CF</td>
<td>$1,050</td>
<td>$708</td>
<td>$801</td>
<td>$874</td>
<td>$928</td>
<td>$961</td>
<td>$947</td>
</tr>
<tr>
<td>EV</td>
<td>$683</td>
<td>$1,161</td>
<td>$945</td>
<td>$769</td>
<td>$632</td>
<td>$534</td>
<td>$546</td>
</tr>
</tbody>
</table>
the ending values (EV) for the portfolios in figure 25. Table 7 shows that if the goal is to maximize early cash flow, 10VS may be the solution. Meanwhile, if total cash flow is the goal, 5Fxd may be the solution. And if portfolio ending value is the goal, 5VS may be the solution. Challenging assumptions is the genesis of creative insight, and challenging the assumption that every retiree must have cash flow that increases 3 percent annually allows your imagination infinite possibilities about how to meet investors’ total goals.

Recall, however, that figure 24 shows 30 different cash-flow strategies but assumes they all use a 50/50 risk allocation. The myriad of ways to structure risk and cash-flow allocation are key to delivering personalized solutions but also entail considerably more uncertainty and complexity than wealth accumulation.

It gets worse when you add the fact that assumptions and strategies that worked for accumulating wealth do not work the same for distributing it, and that without the security of a pay-check retirees are likely to be more loss averse at a time when distributions will exacerbate market losses.

Research has shown that simple models with a limited number of inputs can be as effective as more-complex regression models that include many more variables. In one example of the power of checklists and simple rules, researchers studying the problem of predicting judicial recidivism found a model using two variables as effective as one using 137 to predict a defendant’s risk of becoming a repeat offender (Kahneman et al. 2021).

Collectively, the high level of uncertainty and complexity of retirement-income planning can leave retirees feeling like a stranger in a strange land. Simplification is the answer to the routine management of extreme complexity, and the vital signs and checklist are key to simplification.

CONCLUSIONS
To be a great problem-solver or a great communicator, you must manage complexity and make things simpler by understanding what to pay attention to and what to ignore. This requires being a master of exclusion. Albert Einstein looked for the most comprehensive yet simplifying axioms stating, “In physics, however, I soon learned to scent out that which was able to lead to fundamentals and to turn aside from everything else, from the multitude of things that clutter up the mind and divert it from the essential” (Gardner 2011).

Simon (1971) noted that attention is a limited resource and stated: “What information consumes is rather obvious: it consumes the attention of its recipients. Therefore, a wealth of information creates a poverty of attention.” Excluding distracting information is the key to problem-solving and communication, for with subtraction comes clarity. Noise is the enemy of creativity and communication, and failing to strip out noise risks leaving investors drowning in information and starving for imagination.

The vital signs and checklist can be used to implement more imaginative, personalized, and comprehensive retirement-income plans that balance the four M’s of retiree goals, adapt to the infinite number of environments, and differentiate the advisor as a creative problem-solver and master communicator. Advisors can facilitate more efficient retirement-income conversations by providing structure focused on the essence of the problem, thereby minimizing mental dazzle and maximizing enlightenment. Finally, it has been said that intellectuals solve problems and geniuses prevent them. The vital signs and checklist can be used to address the need for cash-flow adjustments before the need is obvious, potentially preventing larger adjustments later.

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REFERENCES
In years 11–15, the CAV is dropping in positive years, accelerating and exceeding the threshold of -10 percent. The DR is accelerating and eventually exceeds the double-digit threshold in the 14th year. The number of negative years exceeds the target of three for that block of time.

In years 16–20 the AER exceeds the -2.5-percent target. The CAV accelerates and exceeds double digits. The DR is in double digits and accelerating. The number of negative years exceeds the target of four, and the number of warnings exceeds the threshold of two.


**APPENDIX**

Table A1, which reflects the hypothetical scenario with five losses of 2 percent each (from figure 1), provides an example of how the warning signs might appear with no adjustments. The loss in year one matches the target NN in the first five, which is a caution sign (yellow), and the second loss in the first five years then exceeds that target, becoming a warning sign (orange).

In the second block of time, the four losses through 10 years exceed the NN target of two and the CAV drops 10 percent for two years, giving you two warnings in the seventh and 10th years when the goal is no warnings in the first 10 years. In my historical portfolios, those with no warnings by the 10th year had a 14-percent failure rate, but those with two warnings had an 83-percent failure rate.

<table>
<thead>
<tr>
<th>Year</th>
<th>AV</th>
<th>R</th>
<th>WCL</th>
<th>NN</th>
<th>S−D</th>
<th>AER</th>
<th>CAV</th>
<th>DR</th>
<th>Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$915,000</td>
<td>-2.0%</td>
<td>0</td>
<td>1</td>
<td>2.0%</td>
<td>-8.5%</td>
<td>-8.5%</td>
<td>5.0%</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>$941,275</td>
<td>10.0%</td>
<td>0</td>
<td>1</td>
<td>1.4%</td>
<td>-2.9%</td>
<td>2.9%</td>
<td>5.6%</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
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<td>0</td>
<td>1</td>
<td>1.2%</td>
<td>-1.1%</td>
<td>2.9%</td>
<td>5.6%</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>$879,714</td>
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<td>0</td>
<td>2</td>
<td>1.4%</td>
<td>-3.0%</td>
<td>-9.1%</td>
<td>5.6%</td>
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</tr>
<tr>
<td>5</td>
<td>$898,214</td>
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<td>2</td>
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<td>-2.0%</td>
<td>2.1%</td>
<td>6.4%</td>
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<tr>
<td>6</td>
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<td>2</td>
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<td>-1.4%</td>
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<tr>
<td>7</td>
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<td>0</td>
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<td>-2.5%</td>
<td>-10.0%</td>
<td>6.5%</td>
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<tr>
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<tr>
<td>10</td>
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<td>-2.5%</td>
<td>-11.3%</td>
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<tr>
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</tbody>
</table>

![Caution](https://via.placeholder.com/15) ![Warning](https://via.placeholder.com/15)
NN is driven by the returns and adjusting cash flow does not change the returns, so the NN column of table A2 looks the same as table A1. Other than that, you see considerably less yellow and orange in table A2. Note, the DR column is flashing a warning, but the portfolio was able to sustain a double-digit DR for the last eight years because the AER is within target years 16–26, and the DR is the only warning in the last five years. In my historical research, I found portfolios that similarly had front-loaded negative returns but were able to maintain double-digit DRs in the later years when actively managed. Most importantly, the portfolio finished the 25th year with more than half of its original principal compared with 5 percent in table A1.

Finally, in years 21–26 the AER, DR, and CAV, which has turned turbulent, all exceed target levels, and the five negative years is at the target level.

Table A2 shows what the vital signs of table A1 look like if you skip cash-flow increases in years 2, 3, 4, 7, 10, and 13, which is what the gold line in figure 23 represents. Note that beginning with the second year the AER column is within the threshold values every year compared with table A1, but the unmanaged systematic approach left you over the target in each of the last 10 years. Furthermore, the CAV maintains an orderly decline in the later years, although the extended string of declining CAV years may argue for further cash-flow adjustments depending on client goals.