Making Money Last

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FPA San Francisco, November 7, 2006

Introduction. I have been struggling with this morning's topic on both a personal and professional level for a dozen years. Thank you for the stimulus to review the recent literature.

I began the analysis of the adequacy of my own retirement savings using a spreadsheet. I found that spending and cash flow would be in balance if my investment portfolio earned 5% real[1]. Since U.S. stocks have returned 7% real over the past two hundred years[2], I concluded that my financial future was secure.

As a planning professional, you will immediately recognize that my spreadsheet contained a fundamental error: I had not considered the variations in market return.

Example. You were estimating the sustainable cash flow from an investment portfolio back in 1951. An annuity calculation says that a million dollar portfolio will sustain an inflation-adjusted $80,000 withdrawal for 25 years if the investment return is 7% real.

The annualized return over the twenty five years after 1951 was 7% real and the customer died in the twenty-fifth year. The portfolio grew large, because of above average returns in the early years, and it easily weathered the 1970s bear market.

The annualized return over the twenty-five years beginning in 1972 was also close to 7% real. But the portfolio was halved shortly after retirement by the 1970s bear market and it was depleted within ten years.

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[1] That is, 5% net of inflation. By expressing the investment return net of inflation, the analysis is simplified and the values of future worth are expressed in current rather than inflated dollars.

- The cash flow in a simple annuity calculation is automatically inflation-adjusted when the investment return is net of inflation.
- Under current law, Social Security benefits are inflation-adjusted. To the extent that the only other cash flows are from Social Security, the use of real investment returns avoids the need to escalate investment cash flows.
- Expenses are commonly assumed to increase with inflation.
- Federal and California income tax brackets are inflation-adjusted under current law. Consequently, the real tax liability on a real cash flow can be determined without the hassle of escalating the tax brackets.
- Real returns, real cash flows, real expenses and real tax liabilities produce a future worth in real dollars.

[2] Stocks for the Long Run by Jeremy J. Siegel, McGraw-Hill, 1998, 2nd Ed., Chapter 1.

This example illustrates that variations in market returns and inflation introduce a risk of exhausting a portfolio prematurely, especially when the market declines and/or inflation is high in the early years. Deterministic spreadsheets should not be used to forecast portfolio life[3].

Historical Simulations. A better approach to forecasting portfolio life was developed independently by Larry Bierwirth and William Bengen[4]. Their idea is a variation on the example just described. They reasoned that they could determine the historical probability of exhausting a portfolio within a given time horizon by investigating all possible

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[3] Real security values fell by half in the 1930s, in the 1970s and in the 2000s. (Inflation was a major contributor to the 1970s bear market.) It is prudent therefore to include a serious near term decline in deterministic forecasts. If the portfolio can survive a 50% loss early on, the customer is probably not at high risk of running out of money before death.

John D. Kingston advocates an analogous approach to deterministic forecasting in his "Monte Carlo Simulation: Challenging the Sacred Cow," *Journal of Financial Planning*, November 2001.

[4] Investing for Retirement: Using the Past to Model the Future by Larry Bierwirth, *Journal of Financial Planning*, January 1994.

Determining Withdrawal Rates Using Historical Data by William P. Bengen, *Journal of Financial Planning* , October 1994. See also his most recent contribution Baking a Withdrawal Plan 'Layer Cake for Your Retirement Clients, *Journal of Financial Planning*, August 2006.

Subsequent references to Bengen's work are to his book *Conserving Client Portfolios During Retirement*, FPA Press, 2006,

The "Trinity Study" references an article published by Phillip L. Cooley, Carl M. Hubbard and Daniel T. Waltz of Trinity University in the February 1998 *AAII Journal*. The authors do not cite the prior work by Bierwirth and Bengen and their article broke no new ground.

retirement dates[5] beginning in 1926. (1926 is the first year of the Ibbotson database[6].)

Historical simulations produce estimates, similar to those shown in Table 1, of the risk of exhausting a portfolio within a given time horizon, as a function of the initial cash flow.

For example, there is a 47% risk of exhausting a portfolio within 35 years for an initial cash flow of 5% and the other conditions of Table 1. Or, adopting the nomenclature of Guyton and Klinger, a 5% initial cash flow provides a 53% probability of success.

Table 1. Historical Risk of Exhausting a Portfolio.

Cash flow is inflation-adjusted annually and is after-tax. This portfolio is a Roth IRA, meaning that there is no tax on current earnings or on withdrawals.

0.3% expenses, 60% large capitalization stocks and 40% intermediate bonds, 600 monthly realizations beginning 1929 – 1975.

Initial After-tax Cash Flow	**4.0%**	**4.5%**	**5.0%**
Time Horizon, 20 yr.			8%
25 yr.		10%	24%
30 yr.	6%	21%	35%
35 yr.	10%	27%	47%

[5] Bierwirth examined forty-two rolling 26-year intervals beginning each January from 1926 through 1967.

Bengen examined fifty 40-year rolling intervals beginning each January from 1926 through 1975 and 200 40-year rolling intervals beginning January 1926; April 1926; July 1926, et cetera. He extended the Ibbotson data set through 2015 using the averages of the historical data.

I generally used 600 35-year rolling intervals beginning monthly from January 1926 through December 1975 and I extended the data beyond December 2005 using average monthly returns. Extending the data with randomized monthly returns, even for realizations beginning as late as December 2000, produces a negligible difference.

The "safe" 30-year withdrawal rates for portfolios with 60% large capitalization U.S. stocks and 40% intermediate term government bonds, no taxes, no expenses and annual withdrawals escalated by the prior year's inflation are compared below as a function of sampling frequency.

	Lingane	Bengen
50 periods beginning in January	4.03%	4.15%
200 periods beginning quarterly	4.02%	4.15%
600 periods beginning monthly	3.91%	

Fro the effect of the sampling frequency at other stock allocations, see Bengen's Figure 2D.

I have been unable to identify the cause of the discrepancy between Bengen's safe withdrawal rates and my own but the practical implications are very small.

[6] *Stocks, Bonds, Bills and Inflation*, Ibbotson Associates, annually since 1983.

It is important to read table headings carefully since the risk of exhausting a portfolio depends on whether the cash flow is before or after-tax, how the cash flow is escalated, the magnitude of investment expenses, the portfolio composition and the historical interval.

The time horizon is commonly thirty-five or forty years. The problem, of course, is choosing the appropriate time horizon since the risk of exhausting a portfolio increases as the time horizon increases.

We are asking the wrong question when we focus on the time horizon. We should be focusing on the risk that a portfolio will be exhausted before death.

The risk of exhausting a portfolio in a given year death is the risk of exhausting the portfolio in a that year the risk of living beyond that year.

Example. For a 5% initial cash flow and the other conditions of Table 1, there are no failures in the first 17 years of any of the realizations. There are 3 failures (for the realizations beginning in January, November and December 1968) in the eighteenth year. This determines that the historical risk of exhausting a portfolio in year 18 has been 3 out of six hundred.

The risk of a 65-year-old white female living beyond 18 years is a ratio. The numerator is the number of white women surviving to age 84 (that is, 18 years past age 65 plus 1 year) divided by the number of white women surviving to age 65[7]. The "longevity risk" is 55% in the eighteenth year.

*The joint risk of exhausting a portfolio in year 18 and of also surviving beyond year 18 is therefore (3 / 600) * 0.55 = 0.0028 or 0.28%.*

The risk of exhausting a portfolio before death is the sum of the risks determined for the individual years. The risk of exhausting a portfolio before death is 12% for this example.

The decision as to the initial withdrawal rate belongs to the customer. For initial cash flows of 4, 4.5 and 5%, the risks of exhausting a portfolio within 35 years have been 10, 27 and 47%. The risks of exhausting a portfolio before the death of a 65 year old white female have been 1, 5 and 12% respectively.

All of these risks are historically accurate. But the risk perceived by the customer is appreciable smaller – and more realistic – when longevity information is incorporated into the analysis.

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[7] Arias E. United States life tables, 2003. National vital statistics reports; vol 54 no 14. Hyattsville, MD: National Center for Health Statistics. 2006. Available in Excel format from the CDC website.

CDC publishes data for the entire population and data for the subpopulations of white and black men and women.

Mortality data reflect the past and are imperfect predictors of the future. This is readily apparent by comparing the life tables of a decade ago.

For present purposes, let's agree that the "sustainable cash flow" is associated with a five percent risk, or thereabouts, of exhausting the portfolio before death. For a Roth IRA and the other conditions of Table 1, the sustainable cash flow is therefore 4.5%.

Table 2 illustrates that the sustainable cash flow is smaller for tax-deferred traditional IRAs and taxable portfolios than it is for tax-free Roth IRAs. The sustainable cash flow is to 3.5% for a traditional IRA if the distributions are taxed at 25%[8]. The sustainable after-tax cash flow is about 4% for a taxable portfolio if the current earnings and gains are taxed at 15%[9].

Table 2. Effect of Taxes on Historical Risk of Exhausting a Portfolio Before Death. 0.3% expenses, 60% large cap stocks, aged 65 white female.

Initial After-tax Cash Flow	3.0%	3.5%	4.0%	4.5%	5.0%
No Tax			1%	5%	12%
25% Deferred Tax	1%	7%	17%	27%	36%
15% Current Tax		1%	5%	12%	19%

Table 2 demonstrates that a Roth IRA can sustain a larger after-tax cash flow than a taxable portfolio and that a taxable stock portfolio can sustain a larger after-tax cash flow than a traditional IRA. These conclusions are simply restatements of what you already knew: a million dollar Roth IRA is more valuable than a million dollar taxable portfolio which is in turn more valuable than a million dollar traditional IRA.

[8] The sustainable after-tax cash flow rate from a traditional IRA or pension is (1-IRT) times the sustainable rate from a Roth IRA. IRT is the incremental tax rate paid on the cash flow from the IRA or pension. If IRT is 25% and the sustainable cash flow from a Roth IRA is 4.5%, the sustainable cash flow from a traditional IRA would be 3.4%.

IRT is determined by subtracting the tax liability determined without the cash flow from the IRA or pension from the tax liability determined with this cash flow and dividing by the amount of the cash flow. 25% is about the incremental tax rate paid by a married couple aged 65 who withdraw $50,000 - $100,000 from a traditional IRA or pension assuming $40,000 in Social Security and other income, the standard deduction and 2006 federal and 2005 California tax rules.

25% is also about the incremental tax rate paid by a married couple on a million dollar IRA distributed according to the RMD rules; see the reference in footnote 35.

The incremental tax rate should be personalized to reflect the customer's situation.

[9] This is the preferential rate which currently applies to long term capital gains and qualified dividends. The partial deferral of federal tax, which occurs because gains are not fully realized each year, is assumed to be balanced by the state tax liability.

This estimate should be personalized to reflect the customer's other income and portfolio management practices.

Optimizing the Portfolio Composition. A portfolio is exhausted prematurely when the downside risk is large early in retirement. Downside risk is reduced by changes in portfolio composition which increase expected return and/or reduce volatility. The goal is therefore a portfolio composition which provides a high enough return and a low enough volatility.

Bengen has shown, and others have confirmed, that the lowest historical risks of running out of money within a given time horizon are associated with portfolio compositions containing between about 50% and 75% stocks. Table 3 illustrates a similar result for the risk of exhausting the portfolio before death.

Table 3 also illustrates that the sustainable cash flow increases with age.

Table 3. Effects of Stock Allocation and Retirement Age on the Risk of Exhausting a Portfolio Before Death. 0.3% expenses, no taxes.

Age	CF	30%	40%	50%	60%	70%	80%	90%	100%
65WF	**4.5%**	13%	9%	6%	5%	5%	5%	6%	7%
75WF	**5.5%**	8%	7%	5%	5%	5%	5%	6%	7%
85WF	**8.0%**	6%	5%	4.8%	4.55	4.4%	4.5%	4.8%	5%

Increasing the stock allocation tends to increase portfolio returns but the increased volatility at high stock allocations is apparently the more important determinant of portfolio risk.

Decreasing stock allocations tends to decrease portfolio volatilities but the lower return at the low stock allocations is apparently the more important determinant of risk.

Higher stock allocations are associated with higher values for the final portfolio even if they do not reduce the risk of exhausting the portfolio before death. Thus a customer who is motivated to make his or her heirs rich and who is willing to accept more portfolio volatility might be advised choose a stock allocation towards the higher end of the 50 – 75% range.

Bengen, and others, have investigated the addition of small capitalization and international stocks and REITs to the portfolio. Bengen's preference is for a portfolio containing 60% intermediate government bonds (or 45% intermediate bonds and 15% T-bills), 42% large capitalization stocks and 18% small capitalization stocks.

Studies of the effects of equity composition are limited since there is limited information on international stocks and REITs and other important equity classes before about 1972. Guyton and Klinger report

little difference in the longevity of a multi-equity portfolio and a portfolio of large capital stocks[10].

A commonly quoted rule of thumb is that bond allocations should increase with age[11]. To test this rule in historical simulations, bond allocations were increased by 1% annually. If the initial allocation were 50% for a white female aged sixty-five, the bond allocation would have been increased to 85% bonds at age one hundred.

Table 4. Effects of Changing Bond Allocations during Retirement.
0.3% expenses, no tax, 4.5% initial cash flow, 65 year-old white female.

Initially	60%	50%	40%	30%	20%	10%	none
Constant	8.5%	6.1%	5.3%	5.1%	5.3%	6.1%	7.2%
Up 1%	13%	8.9%	6.9%	6.2%	6.3%	6.7%	7.6%
Down 4.5%	4.4%	4.3%	4.4%	4.6%	5.4%	6.6%	

As shown in Table 4, gradually increasing the bond allocation during retirement increases the risk of exhausting a portfolio before death, although the effects are relatively modest.

It has been suggested that increasing bond allocations during retirement is the wrong strategy and that bonds should instead be preferentially liquidated[12]. This suggestion was tested in historical simulations by decreasing the bond allocation by 4.5% annually until the bonds were

[10] Decision Rules and Maximum Initial Withdrawals Rates by Jonathan T. Guyton and William J. Klinger, *Journal of Financial Planning*, March 2006.

Compare the cash flows sustainable at a 95% confidence standard for a portfolio with 65% equities. Sustainable cash flows are marginally higher with a single equity class: 5.7 vs. 5.5% in Table 6 (40 years) and 5.9 vs. 5.7 in Table 7 (30 years).

Guyton and Klinger draw a different conclusion from their data.

[11] Kathleen Prender writes in the *San Francisco Chronicle* of October 29, 2006 that Jack Bogle suggested to her that bonds should equal age minus 10 during his recent visit to San Francisco.

[12] Extending Retirement Payouts by Optimizing the Sequence of Withdrawals by Jon J. Spitzer and Sandeep Singh, *Journal of Financial Planning*, April 2006.

1. Spend bonds before stocks if the tax rates are the same or favor stocks.
2. The order of withdrawal from traditional and Roth IRAs is largely immaterial but it can be tax-efficient to withdraw from both portfolios simultaneously.
3. Cash flows should come first from the IRA or taxable portfolio with the smaller after-tax return.

These recommendations are based on expected returns and neglect increases in return as a result of rebalancing. These recommendations are based on deterministic forecasts and neglect volatility. These recommendations neglect the other differences between traditional and Roth IRAs which generally sway the decision towards consuming the traditional IRA first.

fully liquidated. Decreasing the bond allocation by 4.5% annually is comparable to taking the entire cash flow from the bond portfolio.

As shown in Table 4, liquidating the bonds first has only a small effect on the risk of exhausting a portfolio before death. Liquidating bonds first generally reduces risk, especially when the initial bond allocation exceeds 50%, that is when the initial bond allocation is above the optimum range.

Bengen reports that long term government or corporate bonds have been inferior to intermediate government bonds as the fixed income component but that the effect on the "safe" cash flow rate is very modest, 4.2 versus 4.4% in his Figure 3D. I substituted Treasury Inflation Protection Securities (TIPS) for intermediate government bonds and observed a positive but equally modest effect[13].

Investment Expense has a strong impact on sustainable cash flow. As shown previously[14], investment expense of one hundred basis points reduce sustainable cash flow from about 4.5 to 4.0%.

Table 5. Effect of Expense on the Historical Risk of Exhausting Portfolio Before Death. 60% large cap stocks, no tax, white female aged 65.

Initial After-tax Cash Flow	3.0%	3.5%	4.0%	4.5%	5.0%
30 bp Expense			1%	5%	12%
130 bp Expense		1%	5%	12%	20%
230 bp Expense	0.6%	5%	12	20%	28%

When a customer has surplus resources, expenses are paid from reduced tax revenues and by the heirs. Investment expenses do not diminish the customer's lifestyle.

The calculus is different for customers with limited resources. Expenses force a reduction in investment cash flow and customer pay these expenses by reducing lifestyle. We have an professional obligation to steer such customers towards lower expense arrangements[15].

[13] The maximum "safe" 30-year cash flow for a portfolio with 60% large cap stocks and no taxes or expenses increases from 3.9 to 4.2% on substituting 3% TIPS for the intermediate government bonds. 12-month returns were simulated as the coupon rate plus the 12-month inflation rate.

The current TIPS coupon is about 2.5%.

[14] Adjusting Withdrawal Rates for Taxes and Expenses by Gordon B. Pye, *Journal of Financial Planning*, April 2001. Pye concludes that the reduction in sustainable cash flow equals the ratio of annual expenses (as a percentage of the value of the portfolio) to the expected mean return.

[15] "There should be no equivocation in ethical parlance on this key point: a certificant should always act in the best interest of the client." Daniel B. Moisand, President, FPA, in comments re

Investment expense can be as low as 20 - 40 basis points annually based on low cost stock index funds and ETFs, bonds purchased at auction and limited advisory services.

Limitations of Historical Simulations. Historical forecasts underesample the early and late years. It is demoralizing to observe that the risk of exhausting a portfolio before death is not affected by the 2000-2 bear market.

To understand the magnitude of the undersampling bias, I extended the data set using average monthly returns. For example, a simulation beginning in December 1999, which is the final simulation in the 1926-2000 interval shown in Table 6, uses historical data for the first five years and average data thereafter.

Table 6. Effects of Increased Sampling of the Recent Historical Data.

60% large cap stocks, no tax, white female aged 65, 4.5% initial cash flow.

The "sustainable rate" is the initial cash flow which produces a 5.3% risk of exhausting the portfolio before death.

	Risk within 35 years	Risk before Death	Sustainable Rate
1926-1970	25%	5.2%	4.50%
1926-1975	27%	5.3%	4.50%
1926-1980	25%	4.8%	4.55%
1926-1985	23%	4.4%	4.60%
1926-1990	21%	4.1%	4.65%
1926-1995	20%	3.8%	4.70%
1926-2000	22%	4.0%	4.65%

The results summarized in Table 6 provide no evidence that the undersampling of recent data materially biases the sustainable cash flows derived from historical simulations.

A concern is that the financial environments over the next eighty years will be different from those that influenced the Ibbotson data set. To use historical simulations, the planner must make a leap of faith that the sustainable withdrawal rates determined from the data of the past eighty years will apply in the future.

Suppose that we had a mathematical model of market performance and that we determined sustainable withdrawal rates for all possible variations in model parameters. This would broaden our understanding of the future. This is the promise of Monte Carlo simulation.

Monte Carlo Lite. Some simulators randomly draw returns for stocks, bonds and inflation from the historical data set[16]. This guarantees uniform oversampling.

Tables 7 compares the risks of exhausting a portfolio prematurely using different historical and randomized data sets.

For a 4.5% initial cash flow, historical simulations using the 1926-2005 data set indicate that the risk of failure within 35 years is 27% and that the risk of exhausting the portfolio before death is 5%. These results were seen earlier in Tables 1 and 2.

If the 12-month returns are randomized, the risk of failure within 35 years is 23% and the risk of exhausting the portfolio before death is 6%. (The decreased risk within 35 years and the increased risk before death imply that the failures occur at earlier times with randomized data.)

If monthly data are randomized; the risks are 22% and 5% respectively.

Table 7a. Effect of Randomizing, 1926-2005.

The risks shown are for exhausting a portfolio within 35 years, or before death. 40% bonds, 0.3% expense, no tax, aged 65 white female.

Initial Cash Flow	4.0%	4.5%	5.0%	5.5%	6.0%
Historical [17]	10, 1	27, 5	47, 12	58, 19	69, 27
Randomized 12-monthly[18]	14, 3	23, 6	32, 9	44, 14	53, 19
Monthly[19]	10, 2	22, 5	33, 9	42, 14	55, 19

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[16] For example, Making Retirement Income Last a Lifetime by John Ameriks, Robert Veres and Mark J. Warshawsky, *Journal of Financial Planning*, December 2001; DIESEL: A system for Generating Cash Flow During Retirement, Stephan Quinn Cassaday, *Journal of Financial Planning*, September 2006; and the Monte Carlo Retirement Calculator, pivotpointadvisors.com.

[17] 12-month rolling returns were calculated for large capitalization stocks, intermediate government bonds and inflation beginning each month from January 1926. The rolling averages were based on the Ibbotson data through December 2005 and on average monthly returns thereafter. 600 realizations were initiated from January 1926 though December 1975.

[18] 12-month rolling returns were calculated from the Ibbotson data for large capitalization stocks, intermediate government bonds and inflation beginning with each month from January 1926 through January 2005. Two hundred series of 1080 sets of 12-month returns were generated by drawing randomly, with replacement, from these returns. Six hundred realizations were calculated for each of these series.

[19] Two hundred series of 1080 sets of monthly returns for large capitalization stocks, intermediate bonds and inflation was generated by drawing randomly, with replacement, from the Ibbotson

Table 7b. Effect of Randomizing, 1946-1999.

The risks shown are for exhausting a portfolio within 35 years, or before death. 40% bonds, 0.3% expense, no tax, aged 65 white female.

Initial Cash Flow	4.0%	4.5%	5.0%	5.5%	6.0%
Historical[20]	21, 2	41, 9	58, 17	66, 24	68, 29
Randomized 12-monthly[21]	7, 1	14, 3	23, 6	34, 9	45, 14
Randomized monthly[22]	5, 1	13, 2	22, 5	34, 8	45, 12

Table 7c. Effect of Randomizing, 1972-2005.

The risks shown are for exhausting a portfolio within 35 years, or before death. 40% bonds, 0.3% expense, no tax, aged 65 white female.

Initial Cash Flow	4.0%	4.5%	5.0%	5.5%	6.0%
Historical[23]	0, 0	38, 6	52, 18	60, 28	69, 36
Randomized 12-monthly[24]	15, 3	26, 6	36, 10	50, 15	60, 21
Randomized monthly[25]	15, 3	25, 6	38, 10	49, 15	60, 20

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data for January 1926 through December 2005. Twelve-month rolling averages were calculated for each of these series and 600 realizations were initiated for each series.

[20] 12-month rolling returns were calculated for large capitalization stocks, intermediate government bonds and inflation beginning each month from January 1946. The rolling averages were based on the Ibbotson data through December 2005 and on average monthly data thereafter. 288 realizations were initiated from January 1946 though December 1969.

[21] 12-month rolling returns were calculated from the Ibbotson data for large capitalization stocks, intermediate government bonds and inflation beginning with each month from January 1946 through January 1999. Two hundred series of 1080 sets of 12-month returns were generated by drawing randomly, with replacement, from these returns. Six hundred realizations were initiated for each of these series.

[22] Two hundred series of 1080 sets of monthly returns for large cap stocks, intermediate government bonds and inflation was generated by drawing randomly, with replacement, from the Ibbotson data for January 1946 through December 1999. Twelve-month rolling averages were calculated for each of these series and 600 realizations were initiated for each series. This is the general approach used by Ameriks, *et al., op. cit.*.

[23] 12-month rolling returns were calculated for large cap stocks, intermediate government bonds and inflation beginning with each month from January 1972. The rolling averages were based on the Ibbotson data through December 2005 and on average monthly data thereafter. 48 realizations were initiated from January 1972 though December 1975.

[24] 12-month rolling returns were calculated from the Ibbotson data for large cap stocks, intermediate government bonds and inflation beginning with each month from January 1972 through August 2004. Two hundred series of 1080 sets of 12-month returns were generated by drawing randomly, with replacement, from these returns. Six hundred realizations were initiated for each of these series. This is the general approach used by Cassaday*, op. cit.*.

[25] Two hundred series of 1080 sets of monthly returns for large cap stocks, intermediate bonds and inflation was generated by drawing randomly, with replacement, from the Ibbotson data for January 1972 through July 2005. Twelve-month rolling averages were calculated for each of these series and 600 realizations were initiated for each series.

The first conclusion is that the risks of exhausting a portfolio were somewhat higher in the 1946-99 and 1972-2005 historical intervals.

The second conclusion is that randomizing increases risk at low initial cash flows and decreases risk at higher cash flows. The crossover cash flow at which randomization does not change the risk of exhausting the portfolio before death is about 4.5% for the 1926-1975 data set and a bit higher for the other data sets.

The third conclusion is that randomizing the monthly data has about the same effect as randomizing the 12-monthly data.

The results in Table 6 are consistent with Bengen's observations[26]: higher risks of exhausting the portfolio for low cash flows and lower risks for high cash flows.

A bear market is commonly defined as a market decline of 20% or more. But a sharp decline followed by a rapid recovery – think 1987 - is not necessarily a portfolio killer. The danger is a large decline followed by another large decline and a drawn out recovery. Bengen reported that negative returns cluster into bear markets less frequently in randomized simulations. In other words, randomization destroys serial correlations.

The lower risks observed upon randomizing the data probably stem from the loss of serial (time) correlations. Planners should be leery of relatively high sustainable cash flows if based on randomized data sets.

Monte Carlo Simulation[27]. The analysis depends on a mathematical model of inflation and asset returns. The challenge is developing a model which adequately describes market interactions[28].

Pye made an historic effort[29]. He assumed that inflation depends on four variables: a constant, the inflation rates in the prior and second prior years and an amount of unanticipated inflation. Because inflation in the current year depends on inflation in prior years, Pye's model honors the serial correlation in the inflation data.

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[26] Bengen, Appendix A. His approach is equivalent to randomizing the data, albeit in a sophisticated manner, because correlations were neglected. Bengen reported the crossover cash flow was 5.25%.

[27] Monte Carlo Methods in Financial Engineering by Paul Glasserman, Springer-Verlag, 2004. Not for the faint of heart.

[28] The Problems with Monte Carlo Simulation by David Nawrocki, *Journal of Financial Planning*, November 2001. Nawrocki' discusses the complexity of the financial markets, with numerous references to the work of others, and provides an example of how neglecting covariance can lead to the wrong investment decision.

[29] Sustainable Real Spending from Pensions and Investments by Gordon B. Pye, *Journal of Financial Planning*, June 1999.

Pye chose the value of the constant term in the inflation model to reflect his view of future inflation annualized over long periods[30]. He modeled the amount of unanticipated inflation as being normally distributed with zero mean and 2% standard deviation. The influences of other variables were characterized from the historical data.

Market returns are largely random in nature. Pye modeled a negative correlation between return and inflation[31] by modeling the mean of the return distribution as a constant plus 4.5 times the amount of unanticipated inflation. Both the constant and the 4.5 factor were estimated from historical data.

Pye included a feedback loop which limited the cash flow in some circumstances. This makes impossible direct comparisons between his results and those of historical simulations.

Guyton and Klinger[32] developed a model which addresses some of Nawrocki's criticisms. The results at low cash flows suggest a higher failure rate than is observed in historical simulations[33]. But it is worth noting that serial correlations were not included in their model, meaning that the model may be doing little more than randomizing the data. Their qualitative result, that risks are understated by historical simulations at low initial cash flows, is consistent with randomization.

The magnitude of the modeling challenge was recently illustrated by San Francisco's William Coaker[34]. He analyzed fifteen assets classes over the past 35 years and concluded the "correlation among asset classes appears to be inherently unstable." That's a polite way of saying that the

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[30] The trustees of the Social Security Administration forecast long term inflation rates in their annual reports which are available at www.ssa.gov. Their "intermediate" inflation forecasts have gradually declined over the past ten years.

1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
3.5%	3.5%	3.3%	3.3%	3.3%	3.0%	3.0%	2.8%	2.8%	2.8%	N/A

Some authors use the difference in the yields of conventional Treasury bonds and of TIPS to estimate long term inflation rates. This difference is currently about 2.3%.

[31] There is a very small negative correlation for the returns of large capitalization stocks and inflation. See Ibbotson, *op. cit*., Chapter 6.

[32] Decision Rules and Maximum Initial Withdrawals Rates by Jonathan T. Guyton and William J. Klinger, *Journal of Financial Planning*, March 2006. Asset returns and inflation were assumed to be lognormally distributed with means and standard deviations calculated from the historical data. Correlations were factored into the model by constructing a covariance matrix based on the historical returns. Serial correlations were not addressed.

[33] Guyton and Klinger report in their Table 2 that a 3.1% initial cash flow was not sustainable 5% of the time over forty years whereas Bengen reports in his Table 4.1 that a 4% initial cash flow is always sustained over forty years.

[34] The Volatility of Correlation by William J. Coaker II, *Journal of Financial Planning*, February 2006.

modeling of the interactions between asset classes by a correlation matrix is fundamentally wrong, that Monte Carlo simulations based on stable correlation coefficients are fundamentally wrong and that forecasts based on such simulations may be erroneous.

The Planner's Contribution. There is no simulation technique that planners can use with complete confidence to address the question how long a retirement portfolio will last. But there are things that we can do to decrease the risk of portfolios being exhausted prematurely.

- Understand the customer. The portfolio design and cash flow strategy is influenced by the customer's spending and income, assets, health, insurance, risk aversion, financial sophistication, family dynamics and doubtless other factors.

  Many customers will not benefit from estimates of the risks we have been discussing. Someone with a $10 million portfolio and a hundred thousand dollar life style is financially secure with the real interest and dividends from a blended portfolio of stocks and TIPS while the customer with a million dollar portfolio and a hundred thousand dollar life style is not financially secure unless spending is reduced.

- Analyze how spending and income escalate and how required cash flow must escalate in order to balance spending and other income. As we shall see, the rate of escalation of the required cash flow affects the sustainable cash flow.

- Build a diversified, low cost portfolio. As we have seen, appropriate equity allocations and low expenses reduce the risk of exhausting a portfolio prematurely.

- Manage for tax efficiency. The general recommendation is to own the investments which produce the most taxable income in pension and IRA accounts[35].

  Accelerate distributions from traditional pensions and IRAs when appropriate. A married couple who plan on taking only the minimum required distributions from their million dollar traditional IRAs might save $40,000 in federal taxes by accelerating distributions[36].

- Insure strategy compliance by recommending appropriate adjustments to cash flow in response to market conditions and

[35] For example, Integrating Investments & the Tax Code by William Reichenstein and William Jennings, John Wiley 2003.

[36] New From Your Employer: The Roth 401k by Peter James Lingane, AAII *Journal*, January 2006.

customer input. Insuring compliance could also mean distributing cash flow and other services[37].

Escalating Required Cash Flow. I have been assuming that the required cash flow escalates in lock step with inflation. Yet the evidence is that retirement spending tends to increase more slowly than inflation[38]. We become less active, less likely to travel and less likely to make major purchases as we grow older[39].

I approach retirement spending by asking my customer to monitor their current spending. After adding the spending that the customer has forgotten about and eliminating the spending which will disappear in retirement, the customer and I escalate each spending category.

Example. Health care expenses might increase at twice the rate of inflation; real estate taxes might increase by 1% annually; food, clothing, utilities, automobile and miscellaneous expense might increase at one half the rate of inflation; and discretionary spending might remain constant. The open circles in Figure 1 illustrate how the growth in spending might escalate over time for a particular customer.

I generally forecast the tax liability year by year. A constant tax rate applied to income may a workable simplification but I'm put off by the need to validate this simplification for each situation.

The solid circles Figure 1 are the difference between spending and the Social Security benefit; this customer has no other income.

The solid line assumes that the required cash flow escalates as inflation. Inflation overstates the required rate of increase for this customer.

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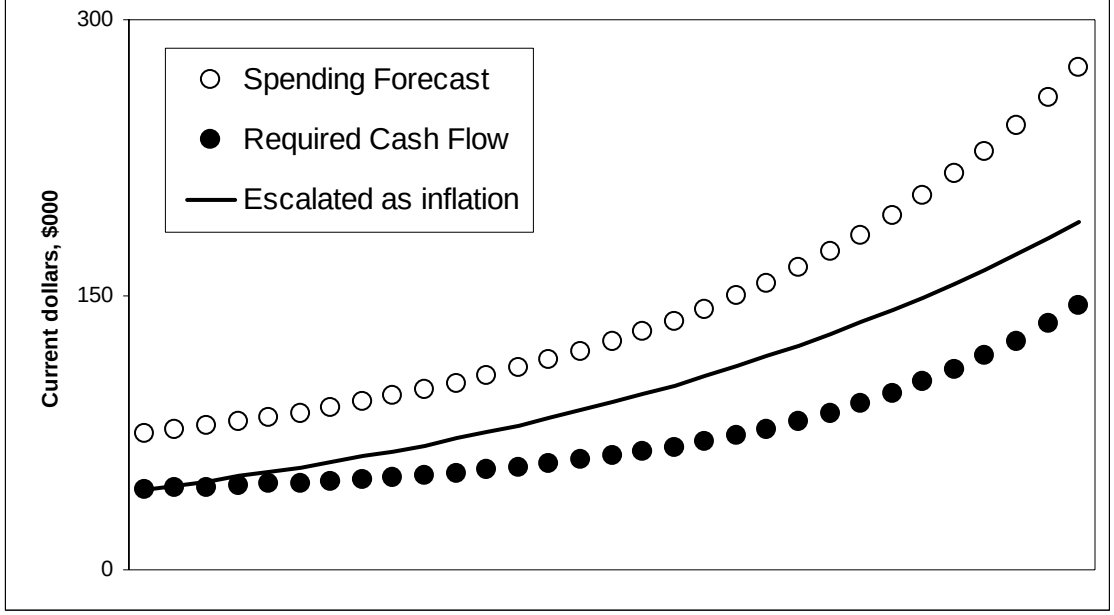
[37] Cassaday, *op. cit.*

- Consolidate accounts at a single institution both for simplicity, which becomes increasingly important as retirees age and lose interest in their finances, and to provide a full picture of money flows each month.
- Maintain three to five months of living expenses in the customer's checking account.
- Review and rebalance quarterly with attention to tax loss harvesting. Withdraw quarterly from each asset class after rebalancing.
- Withhold income taxes. The federal EFTPS system allows electronic payments to be scheduled a year in advance (e.g., quarterly estimated tax payments) and the California Franchise Tax Board offers a similar service called "Web Pay." Both services are free.

[38] See Guyton and Klinger, *op. cit*. "But real-life client experiences, coupled with dramatically rising health care costs and uncertainty about possible reductions in Social Security benefits, make us unwilling to consider the possibility of such natural reductions in a retiree's income needs."

[39] Do Accumulation Models Over-state What's Needed to Retire? By Kenn Tacchino and Cynthia Saltzman, *Journal of Financial Planning*, February 1999.

Figure 1. Spending and Required Cash Flow vs. Time Constant 5% Inflation. expense forecast.xls.



Bernicke, assuming a 3% inflationary environment, suggested modeling required cash flow as decreasing about 1% annually between retirement and age 75 and increasing at about the rate of inflation thereafter[40].

Required cash flow increases more rapidly in Figure 1 than in Bernicke's model. But the same mathematical structure – constant escalation for ten years, escalation as inflation thereafter – provides an approximate fit.

To gauge the impact of the required cash flow illustrated in Figure 1, the historical model was modified with the results shown in Table 8.

Table 8. Effect of Rate of Escalation of Withdrawals on the Historical Risk of Exhausting Portfolio Before Death.

40% bonds, 0.3% expenses, no tax, white female aged 65.

Initial After-tax Cash Flow	4.0%	4.5%	5.0%	5.3%	5.5%
Escalate as Inflation	1.0%	5.3%	12%	17%	19%
1% for 10 years and as inflation thereafter	0.7%	1.6%	3.2%	5.5%	7.5%

[40] Table 5, Reality Retirement Planning: A New Paradigm for an Old Science by Ty Bernicke, *Journal of Financial Planning*, June 2005.

Sustainable cash flow is 4.5% if cash flow is escalated as inflation and 5.3% if the escalation is based on this customer-specific forecast. This result confirms Bernicke's observation that the sustainable cash flow is increased substantially if cash flow escalates less rapidly than inflation.

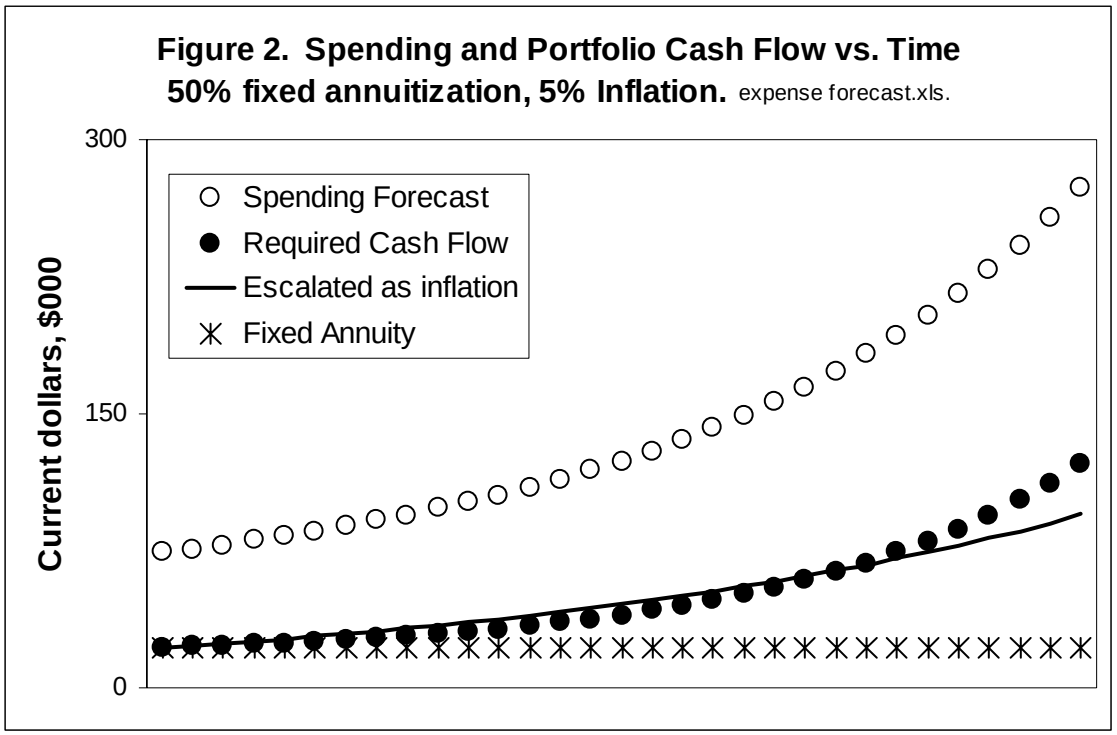
Cassaday, *op. cit.*, reported the sustainable cash flow as 7%. This result is optimistic because he escalated cash flow at constant 3% rather than using the (higher) inflation rates during the study period[41].

The rate of escalation of required cash flow will increase if part of the portfolio is used to purchase a fixed annuity. Figure 2 illustrates that the required cash flow from the remaining portfolio must escalate about as fast as inflation, for this customer, after annuitizing one half of the portfolio. The remaining portfolio will not able to sustain the same rate of cash flow after annuitization due to the increased rate of escalation.

Annuitization makes sense if the payout is high enough[42]. "High enough" depends on the circumstances, which include a recognition of the decrease in the sustainable cash flow from the remaining portfolio.

[41] The sustainable cash flow is 5.7% if cash flow is escalated at 3% and expenses are eliminated and if the 12-monthly returns for 1972-2005 are randomized. This is not as high as the sustainable cash flow reported by Cassaday but it is considerably higher than the sustainable cash flow of 4.5% or thereabouts in Table 7c where cash flow is escalated by the actual inflation.

[42] Ameriks *et al.*, *op. cit.*, and others, have suggested the purchase of 9% immediate fixed annuities as a way to reduce the impact of failure of a self-managed portfolio.



Progress Monitoring. Customers tend to be apprehensive about their portfolios in extended down markets and to ask about increasing cash flow after a sustained market rise. How does a planner determine whether a midcourse correction is in order?

Researchers have been trying for a decade to establish rules which limit the cash flow increase in periods of high inflation or poor returns and which increase the cash flow following periods of strong returns[43].

The recent "decision rules" of Guyton and Klinger have the potential to allow a significant increase in initial cash flow with only modest decreases in real cash flow and cumulative real cash flow[44].

[43] Monitoring Retirement Portfolio Sufficiency by Patrick J. Collins, Kristor J. Lawson and Jon C. Chambers, *Journal of Financial Planning*, February 1997; Implementing a Portfolio Sufficiency Monitoring Program by Patrick J. Collins, Kristor J. Lawson and Jon C. Chambers, *Journal of Financial Planning*, April 1997.

Gorgon B. Pye, 1999, *op. cit*. The cash flow in any given year is limited to the smaller of the initial cash flow escalated by the cumulative inflation or the amount of a fixed annuity over the remaining simulation interval assuming the current portfolio value and the expected real investment return (that is, the annualized real return over long periods).

Decision Rules and Maximum Initial Withdrawal Rates by Jonathan Guyton and William Klinger, *Journal of Financial Planning*, March 2006.

The work of Guyton and Klinger is potentially the most significant contribution to making money last since the seminal work of Bierwirth and of Bengen. But it is premature to recommend 6% cash flows for customers with no spending reserves for the following reasons.

First, the impact of the Guyton and Klinger rules is likely to be smaller if cash flow is escalated at less than the rate of inflation since one effect of these rules is to decrease cumulative cash flow. Specifically, don't take Guyton and Klinger's initial cash flows and add another hundred basis points for a realist forecast of the rate of escalation of cash flow.

Second, Guyton and Klinger have focused on low failure rates, 10% or less, at long times. If I'm right about how life expectancy data can be incorporated into the analysis, their results represent less than a 1% risk of failure before death.

Their rules need to be tested for 5% probabilities of failure before death, which roughly correspond to a 25% failure rate or a 75% probability of success. Rules which work well at low failure rates might be different from the rules that work well at low rates of failure before death.

Third, Guyton and Klinger's portfolio management rules differ from the normal practice of rebalancing periodically and withdrawing cash flow uniformly from the rebalanced portfolio. It would be useful to know the effect of the normal practice in combination with Guyton and Klinger's withdrawal, capital reservation and prosperity rules before recommending a changed rebalancing practice to customers.

Fourth, the Guyton and Klinger model does not include serial correlations and therefore might be no more than a sophisticated

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[44] **Portfolio Management Rule #1**. Following years where an asset class has a positive return that produced a weighting exceeding its target allocation, the excess allocation is sold and the proceeds invested in cash to meet future withdrawal requirements.

Portfolio Management Rule #2. Portfolio withdrawals are funded in the following order: overweighting in equity classes from the prior year-end; overweighting in fixed income from the prior year-end; cash; withdrawals from remaining fixed-income assets; and withdrawals from remaining equity assets in order of the prior year's performance.

Portfolio Management Rule #3. No withdrawals are taken from any equity following a year with a negative return if cash or fixed-income assets are sufficient to fund the required withdrawal.

The **Withdrawal Rule** determines when portfolio withdrawals are frozen from one year to the next. Cash flow is escalated according to inflation except there is no increase in cash flow following a year where the portfolio's total return is negative **and** when the current rate of cash flow would be greater than the initial cash flow.

The **Capital Preservation Rule** reduces the current cash flow by 10% whenever the current cash flow rate rises to more than 120% of the initial rate; the Capital Preservation Rule is not applied in the last 15 years of the planning horizon.

The **Prosperity Rule** increases cash flow by 10% beyond inflation whenever the current cash flow rate falls below 80% of the initial rate.

randomization program. If the model is merely randomizing the data, Table 6 suggests that the model is overestimating the risk at 3% cash flows and underestimating the risk at 5-6% cash flows.

Fifth, the Guyton and Klinger analysis does not include expenses or taxes. As shown in Table 5, expenses can easily shave 50 basis points from the sustainable cash flow.

Finally, these (and likely all) decision rules represent "a bumpy path that not all clients may be willing, or capable, of sustaining[45]." This is especially true for customers without discretionary spending or without the luxury of a financial reserve. If a planner is going to recommend decision rules, they should put in the effort to understand the rules and they should be prepared for the necessary customer support.

Future portfolio values can be benchmarked against the ratio of the current cash flow divided by the age adjusted sustainable rate. If the actual cash flow at age 75 divided by the sustainable cash flow at age seventy-five is about equal to the portfolio value at age 75, there is little risk of exhausting the portfolio before death.

Example. Assume a $45,000 initial cash flow at age 65 and a current $60,000 cash flow at age 75. The sustainable cash flow at age 75 is about 5.5% for a white female. The benchmark portfolio value at age 75 is therefore $60,000 divided by 0.055 = $1,090,000.

If the value of the portfolio at age 75 were appreciably lower than this benchmark, it would be prudent to review economic forecasts, the customer's health and the need for cash flow and to then decide whether an adjustment is appropriate.

Perhaps the customer at age 75 is happy with the current cash flow but is interested in spending or gifting some of the principle. Assuming no major change to the customer's health and to the economic environment, it would be appropriate to spend principle so long as the current cash flow does not exceed the age-adjusted sustainable rate times the reduced value of the portfolio.

Bengen discusses the planner's response to the question about whether the initial cash flow amount should be based on the portfolio value on the planning date or on the retirement date in his Chapter 11. The customer, in Bengen's example, planned to withdraw $44,200 from a million dollar portfolio but the portfolio is worth only $800,000 when the customer retires.

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[45] Voice: A Caution to Fellow Planners by Michael E. Kitces, Thomas Davison, Tom Orecchio, Chris Cordaro and Gobind Daryanani, *Journal of Financial Planning*, July 2006.

Bengen examined retirement in 1933 vs. 1929, 1938 vs. 1936 and 1975 vs. 1973. He concludes that no adjustment is necessary to the real cash flows if retirement is within two years of the planning date.

Financial Reserve. There needs to be a reserve fund to smooth out the variations in cash flow when decision rules are in force. The ultimate financial reserve is a personal residence. I prefer to forecast required cash flow without considering the residence but I'm comfortable with a somewhat higher risk of running out of money when there is a residence in reserve.

The planning horizon for two individuals is determined by their joint life expectancy and required cash flow is adjusted at the first death. I'm less likely to adjust cash flow at the first death when there is a residence since the value of the residence is in reserve should the decrease in spending not fully compensate for the loss of Social Security and other income and for any increase in tax.

Home ownership is also an important option for financing long term care. I am unconvinced that purchasing insurance is the best option for an older homeowner when finances are tight[46].

Conclusions and Caveats

- Longevity can and should be included in the analysis so as to provide a more accurate estimate of the risk of exhausting a portfolio before death. The perceived risk of exhausting the portfolio is smaller when longevity information is incorporated into the analysis and this lower risk is likely to prompt customers to choose higher initial cash flows.
- All methods for estimating sustainable cash flow have limitations. Historical simulations have the greatest present utility while Monte Carlo methods have the most promise, assuming that the formidable modeling difficulties can be resolved.
- Randomizing the historical data is not a valid technique. Monte Carlo models which do not incorporate serial (time) correlation may be little more than sophisticated randomization models. Planners should be slow to act upon the predictions of randomized models.

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[46] The cash flow implications of long term care in the absence of insurance tend to be overstated, especially for the second to die. If income is $50,000 and custodial care costs $100,000, care can be paid from current income if the million dollar home is sold and the proceeds invested in 5% bonds. In this situation, long term care is a personal disaster because of the diminution in life style but the cash flow implications are modest.

There may be an income tax hit on selling the home, future gains are forfeited and it may be necessary to invade principle. But these risks are borne by the heirs, not the older person. Should not the heirs purchase the insurance to protect themselves from these risks?

- A 50 – 75% equity allocation is optimum. The use of a multi-equity class should increase the sustainable cash flow but the effects are small.
- Investment expense depresses sustainable cash flow; unnecessary expense should be avoided.
- The rate of escalation of cash flow should be derived from an analysis of the customer's spending and other income.
- Portfolio monitoring has the potential to increase cash flow and to assist with gifting decisions later in life. Research is needed to confirm the benefits of the Guyton and Klinger decision rules in historical simulators.
- Immediate fixed annuities can be attractive additions to the portfolio if the annual payout is sufficiently high. The benefit analysis should include the fact that purchasing an annuity generally decreases the sustainable cash flow from the remainder of the portfolio.
- There can be significant tax savings from accelerating distributions from traditional IRAs and pensions.
- This analysis contains inadvertent errors and misinterpretations. Your responsibility to your customers is to confirm my conclusions. Please alert the author to the errors and misinterpretations that you discover.

Revised November 5, 2006