of pursuing a min/min strategy. As long as interested parties have differing risk/reward tolerances, it is doubtful that the closer alignment of interests will drive trust litigators out of business. It is difficult to design and administer a total return investment program where the "utility function" of the trustee has been shaped by fifty years of excess conservatism; the "utility function" of the current beneficiary tilts towards maximization of current consumption opportunities; and the "utility function" of the remainderman reflects the track record of the hottest sector funds in his or her 401(k). Trying to do so without an investment policy statement is folly.

The Total Return Trust Administration Demands a New Technology

Guidelines, as opposed to rules, require trustees to think about the consequences of their asset management decisions. These decisions, however, must be made in the face of uncertainty; and, uncertainty undermines our ability to decide. Attaching probabilities to future events, however, changes the vague notion of uncertainty into identifiable and measurable risk. Not only is risk measurable, it can often be managed in a way that increases the chances of favorable future outcomes.

A probabilistic model should be able to illustrate:

- The likelihood of a bad outcome;
- The magnitude of the damage; and,
- The costs, if any, of reducing the likelihood.

Trivially, we make risk assessments constantly in our daily lives. For example, an evaluation of the consequences of driving a car indicates that there is a small likelihood of a bad accident on any trip. The magnitude of such an outcome could be severe in that the accident might be fatal. The strategy that will minimize the likelihood of an occurrence of this worst-case outcome is the decision never to ride in a car (The Min/Min strategy). The opportunity costs of pursuing such a strategy, however, may be unacceptably high in that the consequence is to remain forever homebound.

Modeling the range of possible outcomes for a trust, however, is not a trivial undertaking.

A mathematical expression for the model takes the form of a stochastic differential equation for which there is no closed form (analytical) solution. This means that we must utilize numerical techniques such as simulation analysis. Fortunately, such tasks are tractable to computer analysis. Since World War Two, scientists have modeled and studied likely outcomes under conditions of uncertainty by means of simulation analysis. Modeling the behavior of a single independent random variable is easy. Simply determine its past behavior: *i.e.*, what is the average past result and, from period-to-period, how far has it deviated from the average. Assuming that you have a representative sample, this information gives valuable insight into the range of possible future behavior. For both pure discretion and total return trusts, however, there are multiple variables to consider. Uncertain variables include life expectancy, investment return, and inflation rates. While the behavior of *each* variable is still of interest, success is determined by the complex interaction of *all* the variables. A successful outcome depends on the interactions between each investment in the portfolio as well as the impact of inflationary environments. Tens of thousands of calculations must be made to get good data upon which to base a decision. If the model either ignores a crucial variable or freezes its value, it generates outcomes that lead to a spurious conclusion.[9]

The following examples illustrate how advanced simulation modeling significantly enhances trustee decision making in the face of future uncertainty. Advanced simulation models are next generation applications that are ideal tools for trustees faced with the decision to exercise discretionary powers. Advanced models place a simulation engine into an asset management frame. The technology offers a significant advance in modern trust administrative capabilities because the models can incorporate the effects of intelligent agent behaviors (*e.g.* discretionary distributions, asset allocation decisions, management elections regarding fees, turnover, etc.). The probable future consequences of trustee decisions can be understood, and communicated prior to their actual implementation. Rather than relying on bright-line standards of asset management (developed under former trust law) which may have little or no relevance to the economic circumstances or needs of any particular trust, the trustee can clearly demonstrate use of care, skill and caution with respect to the formulation and execution of investment strategy suitable to the risk and return objectives of each trust.

TWO EXAMPLES

Discretionary Distributions

Query: can a trust's investment portfolio support the cash-flow objectives to a current beneficiary (male, aged 81 in good health) if the trustee elects to

[9] Many first generation retirement simulation programs, for example, yield results that are highly suspect because they either ignore inflation, require the user to input a fixed value for inflation, or assume a fixed investment risk premium in excess of inflation throughout the planning period.

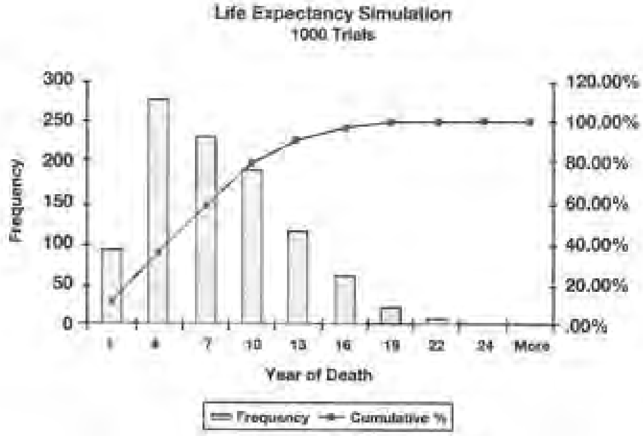
distribute $400,000 for the benefit of his children?

The model tests the sufficiency of the current trust assets ($1,500,000) with respect to:

1. The ability of current economic resources to sustain income objectives for support of the current beneficiary; and,
2. The ability of current trust resources reduced by a gift to next-generation beneficiaries in the amount of $400,000 to sustain cash flow objectives.

The model considers an indexed annuity spending policy defined as a periodic fixed amount distribution ($68,000 per year distributed in monthly amounts of $5,666) adjusted to preserve future purchasing power. Fees and investment expenses are payable from the trust corpus.

The investment objective is to provide inflation-adjusted income throughout the remainder of life. Although no one knows the precise date of future mortality, simulation analysis provides a range of possibilities and depicts the likelihood of the occurrence of any single possibility. The combined data gathered over 1000 trials (or, in this case, 1000 "sample lifetimes") are known as a "distribution of results." The following chart depicts this distribution:



The columns represent the frequency of death (per 1000 initial lives) at various ages beginning at age 81. The superimposed curve represents the cumulative probability of a death over the sum of years. Although the curve becomes steeper as it passes over the tallest of the bars, beyond ten years it flattens dramatically because most of the deaths will have already occurred. Assuming current good health, the cumulative probability curve indicates that there is a 20% chance of survival more than approximately 10 years but only a slight chance of survival for more than 24 years. Average life expectancy over the entire distribution amounts to 6.90 years.

The trustee could make a large discretionary distribution without placing the annuity income objective at risk if the trustee could count on an early death. Conversely, the trustee could refuse any discretionary distribution claiming that it would be imprudent to risk bankruptcy prior to the current beneficiary's death. A third alternative is planning for average life expectancy; but the likelihood of a lifespan equal to exactly 6.9 years is very remote. This is a common situation where the trustee's duty of loyalty and impartiality to various beneficiary classes meets the realities of economics and mortality head on. The extreme degree of uncertainty makes it an ideal fact pattern for simulation analysis.

The simulation model organizes and aggregates the ending (death time) values (dispersion of inflation-adjusted investment results) of 1000 trial lifetimes. Although the following tables contain the complete range of results over all trials, for planning purposes it is best to focus on the results that lie between a lower bound (5th percentile rank), the median (50th percentile rank) and an upper bound (95th percentile rank) for the $5,666 monthly indexed annuity distribution formula. That is:

- the lower bound result is the "worst case" portfolio value that occurs in 5% or less of the trials;
- median value is the most likely portfolio value (50% of results were above median value / 50% of results were below median value); and,
- the upper bound result is the "best case" value that occurs in 5% or less of the trials.

In the aggregate, these bounds provide a 90% confidence interval. The probability of results occurring above or below these bounds is remote.

The following tables summarize results of a 1000 trial simulation of portfolio values.

TABLE 1:

Initial Value $1,500,000. All values expressed in constant dollars.

Rank	End of Trial (at death)		Month 60 (if living)		Month 120 (if living)		Month 180 (if living)	
	Assets	Cash Flow	Assets	Cash Flow	Assets	Cash Flow	Assets	Cash Flow
0%	$104,960	$5,666	$598,199	$5,666	$340,402	$5,666	$425,726	$5,666
5%	$989,990	$5,666	$1,026,896	$5,666	$803,215	$5,666	$554,094	$5,666
10%	$1,182,440	$5,666	$1,186,191	$5,666	$984,587	$5,666	$689,115	$5,666
20%	$1,363,686	$5,666	$1,363,895	$5,666	$1,272,916	$5,666	$1,260,638	$5,666
30%	$1,485,580	$5,666	$1,484,459	$5,666	$1,584,053	$5,666	$1,522,568	$5,666
40%	$1,587,039	$5,666	$1,606,310	$5,666	$1,766,367	$5,666	$1,794,629	$5,666
50%	$1,703,273	$5,666	$1,713,165	$5,666	$1,974,993	$5,666	$2,268,714	$5,666
60%	$1,837,384	$5,666	$1,836,497	$5,666	$2,284,953	$5,666	$2,696,436	$5,666
70%	$2,047,611	$5,666	$1,998,405	$5,666	$2,725,688	$5,666	$3,209,825	$5,666
80%	$2,432,516	$5,666	$2,244,133	$5,666	$3,111,719	$5,666	$3,864,430	$5,666
90%	$3,065,501	$5,666	$2,538,786	$5,666	$3,700,385	$5,666	$4,565,334	$5,666
95%	$3,772,649	$5,666	$2,866,938	$5,666	$4,334,203	$5,666	$5,141,296	$5,666
100%	$9,679,559	$5,666	$4,618,458	$5,666	$6,930,405	$5,666	$6,018,803	$5,666

The table depicts the distribution of inflation-adjusted cash flow and inflation-adjusted portfolio values for all trial results (0th to 100th percentiles). It provides four 'snapshot' views over the applicable planning horizon. The simulation test indicates that across all simulated future economic environments, the current portfolio maintains target cash flow for the duration of life. Additional tests (not shown) reveal that not only does the simulation analysis produce a zero percent bankruptcy rate, but the results across 1000 trial vectors of asset pricing paths also indicate a zero percent likelihood that, at any time, the portfolio drops below a nominal value of $700,000. Likewise the simulation shows a zero percent likelihood of portfolio values ever dropping below five years' projected living expenses.[10]

The next table depicts the economic consequences of a gift in the amount of $400,000.

TABLE 2:

Initial Value $1,100,000. All values expressed in constant dollars.

Rank	End of Trial (at death)		Month 60 (if living)		Month 120 (if living)		Month 180 (if living)	
	Assets	Cash Flow	Assets	Cash Flow	Assets	Cash Flow	Assets	Cash Flow
0%	$0 in Mo. 166	$898	$466,694	$5,666	$185,149	$5,666	$31,675	$5,666
5%	$518,566	$5,666	$681,195	$5,666	$417,265	$5,666	$129,378	$5,666
10%	$695,413	$5,666	$773,815	$5,666	$522,051	$5,666	$416,581	$5,666
20%	$864,052	$5,666	$885,508	$5,666	$687,838	$5,666	$720,766	$5,666
30%	$973,489	$5,666	$988,151	$5,666	$849,021	$5,666	$822,421	$5,666
40%	$1,054,368	$5,666	$1,078,724	$5,666	$973,495	$5,666	$998,722	$5,666
50%	$1,137,342	$5,666	$1,136,627	$5,666	$1,129,938	$5,666	$1,152,510	$5,666
60%	$1,226,849	$5,666	$1,241,628	$5,666	$1,281,361	$5,666	$1,314,477	$5,666
70%	$1,339,687	$5,666	$1,365,529	$5,666	$1,509,268	$5,666	$1,662,424	$5,666
80%	$1,508,168	$5,666	$1,498,511	$5,666	$1,827,826	$5,666	$2,350,801	$5,666
90%	$1,915,829	$5,666	$1,683,318	$5,666	$2,287,338	$5,666	$3,233,521	$5,666
95%	$2,283,374	$5,666	$1,894,534	$5,666	$2,769,706	$5,666	$3,535,897	$5,666
100%	$6,381,320	$5,666	$3,064,657	$5,666	$4,255,224	$5,666	$5,506,529	$5,666

[10] $V_t < 60D_t$ where, V_t equals the value of the portfolio at time t, and D_t equals the targeted monthly distribution amount at time t.

Simulated results as recorded in the table also suggest that, at a 90% confidence level, the portfolio is able to sustain the annuity cash flow objectives in addition to executing a $400,000 gift. Probabilities at the extreme end of likely results change only slightly. The risk of absolute bankruptcy increases to 0.04% (four out of one thousand trials). Worst-case results indicate a bankruptcy in month number 166. In these four "outliers" the average duration of bankruptcy was 18.25 months. Therefore, assets or income entitlements other than those generated from the portfolio would be required to avoid financial ruin. The likelihood of portfolio nominal value ever decreasing below $700,000 is 3.1%; and the likelihood of portfolio values ever decreasing to less than five-year's projected living expenses is 2.1%. These small probabilities suggest that a discretionary distribution of $400,000 is not an imprudent financial decision.

This conclusion is more difficult to sustain if the discretionary distribution occurs at the current beneficiary's age 71. For example, taking $400,000 out of the pot for a 71 year old male increases the bankruptcy risk from 0.03% to 2.9%; and, for a 71 year old female, the risk of bankruptcy increases to 3.9%. Asset management "rules of thumb" turn out to be both age and gender specific! Reliance on average results or bright line standards of practice is insufficient.

Concentrated Allocation in Low Basis Asset

Query: should a trustee avoid payment of capital gains tax by retaining a concentrated position in low basis assets?

One of the most vexing asset management problems for trustees is the decision either to eschew broad-scope diversification by retaining low basis assets in order to avoid capital gains tax or to sell the assets and invest the net proceeds in a more prudent and diversified portfolio.

This problem is beginning to receive greater attention in both the legal and academic press perhaps under the spur of several recent court decisions upholding allegations of fiduciary breach and surcharging trustees who fail to diversify the trust's investment portfolio. Most of the "credible" methodologies for addressing this issue involve direct extraction of parameters from historical results in order to forecast a range of likely future outcomes. The parameters are then fed into analytical engines (or even crude simulation engines) without regard for estimation risk. Estimation risk is a critical empirical problem because the results are very sensitive to changes in the estimates of means and variance. The output, which compares the range of outcomes for asset retention vs. sale and reinvestment, is suspect because of "sample bias."

We adjust for this difficulty by employing a statistical method known as the "bootstrap." This is a computer-intensive sampling procedure that permits a more accurate estimation of true parameter values from selected ranges of historical data. The inputs to the simulation model break with the historical path and better reflect the true but unknown parameter values.

Trustees must have a credible model in order to make (and document) a good decision. The tax-modeling problem for trustees is (at least) two-dimensional:

1) There is the problem of modeling stochastic changes in a portfolio's market value under conditions of uncertain inflation and investment returns. The market value of the low-basis portfolio starts at a higher amount because the embedded capital gains liability has not yet been recognized.

2) There is a second problem of modeling unfolding asset values under conditions of complex cash flows. Distributing a dollar of total return from a low basis portfolio has a greater tax consequence than distribution of the same dollar from a high basis portfolio.

An election to pay capital gains tax decreases the after-tax value of the diversified portfolio relative to the single stock; whereas an election to distribute funds from the higher basis diversified portfolio operates to preserve future value relative to the single stock portfolio. Decision modeling based on simulation platforms can be particularly helpful in providing insight into the complex interactions of these operators.

The following exposition provides a simplified example of this multidimensional problem. The example assumes a twenty-year horizon and, therefore, does not address mortality concerns. The low-basis portfolio has a current market value of $1 million with a $0 tax basis. It is invested in a "single S&P 500 stock." [The application contains an algorithm to determine expected increase in variance (standard deviation) as the number of securities within the asset class decreases. In this example, we increase the variance of the S&P 500 asset class to reflect the fact that only one security is held in the portfolio]. The high-basis portfolio assumes sale of the original $1 million stock position, payment of capital gains tax at an assumed rate of 25% (state and federal) and reinvestment of the net $750,000 of after-tax proceeds into the S&P 500 stock index. The initial basis of the diversified portfolio is the $750,000 fair market value. At the end of twenty years, assets are distributed to the remaindermen in kind (*i.e.* the embedded tax liability remains to be paid).

Dividend and capital gains distributions are reinvested and associated tax liabilities (ordinary income, short or long-term capital gain) are paid from the corpus. For the single security low-basis portfolio initial dividend rate equals 1.5% and assumed turnover rate equals 0%. The case study, therefore, does not reflect the possibility of a taxable event such as a merger or acquisition. For the high-basis diversified portfolio, initial dividend rate equals 1.5% and assumed turnover rate equals 4%.

The first graph shows the average (constant dollar) values of the single stock and the after-tax diversified portfolio at selected years. This example assumes no cash flows into or out of the portfolio during the evaluation period. The systematic dominance of the single stock value through all periods suggests that the election to pay substantial capital gains tax is not a prudent asset management decision. This conclusion, although based on correct data, is fatally flawed because it is based on average or expected value rather than on actual or realized value. It's like thinking that most students receive a "C" grade in a class because the average grade is a "C." Knowledge of the actual distribution of grades [three 60s ("F") and one 100 ("A+")] might cause you to revise this judgment.

Average Portfolio Value: No Cash Flows

A more reasonable reference point is the value that is "most likely." This is the median value, which is the 500th recorded value out of the 1000 trials:

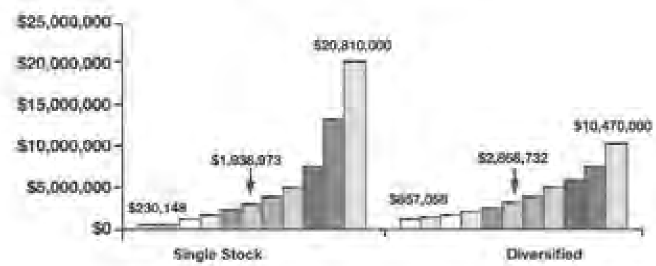
Average Portfolio Value: No Cash Flows

The median (constant dollar) value shows a much different story. At year ten portfolio values are virtually equal. Thereafter, the diversified portfolio dominates the single stock asset. From the reference point of the median result, it appears that the election to trade tax liability for portfolio diversification is prudent if the expected planning horizon is 10 years or longer.

Why is the "most likely" result different from the average result? It is the result of a skew in the distribution of actual results. Looking back to the class grade example, we see that one grade (the "A+") was an outlier at the far end of the upper values. The same is true for owning a single stock-you could have the next Microsoft or General Electric and it would seem pure folly to diversify out of such a winning position. As you add stocks to your portfolio (especially if you have to reduce portfolio value because of tax payments) you reduce the odds of having spectacular but highly unlikely results. After all, what are the odds of having a portfolio of five or ten stocks all of which turn into the equivalent of the next Microsoft? Thus, the average result for the single stock portfolio is skewed because there is a slight possibility that the single stock will produce a spectacular return.

The problem with the analysis thus far is that it reaches tentative conclusions based on sequential presentations based on selected reference points rather than an integrated presentation based on the full set of probable outcomes. Let's compare graphs of the full set of outcomes for year 20 taking results from the 5th percentile (the 50th recorded value out of 1000 trials) through the 95th percentile (the 950th recorded value out of 1000 trials). This range establishes a 90% confidence interval with the 5th percentile acting as the lower bound ("worst case results") and the 95th percentile acting as the upper bound ("best case results"):

Year 20 Distribution of Results
90% Confidence Interval

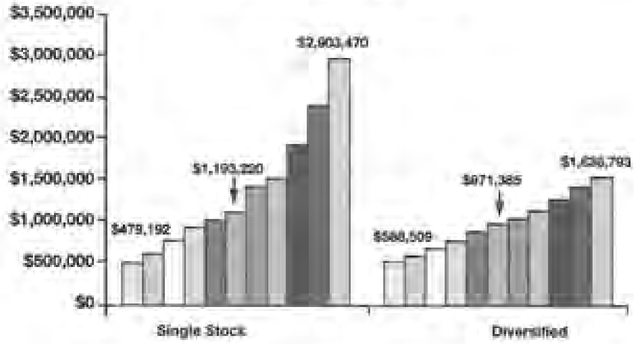


The graph clearly shows the risks of keeping a single stock that, in the trustee's opinion, offers an opportunity for superior future return. Large positive returns are in the far right percentiles of the distribution and, although they undoubtedly may occur, such results are improbable. At the median ("most likely") result, the diversified portfolio dominates. It is not until you arrive at (approximately) the 80th percentile of the distribution that the single stock portfolio begins to evidence clear advantages (although the advantage is mitigated by the fact that the embedded tax liability remains to be paid). Another way of expressing this concept is that there is an 80% probability that actual values generated by a diversified portfolio will equal or exceed values generated by a single S&P 500 stock.

Worst-case results of the diversified portfolio exhibit values approximately 370% greater than worst-case results for the single stock portfolio. All values are inflation-adjusted and, therefore, represent the purchasing power of the portfolio expressed in today's dollars. Expressing results in constant dollars eliminates the potential for "money illusion"—the temptation to think you will be wealthy simply because you own more future dollars. The greater upside potential of the single stock position comes at the cost of greatly increased risk. The trustee must give careful consideration to the risk/reward tradeoffs of tax-driven asset management elections.

The trustee, charged with the task of maximizing the probability for a successful long term outcome as opposed to the task of maximizing short-term return, might well conclude that diversification is a prudent strategy even with shorter time horizons. The next graph depicts the distribution of results after 36 months. Surprisingly, even after payment of $250,000 in taxes, the diversified portfolio evidences higher inflation-adjusted values in over 20% of the trials:

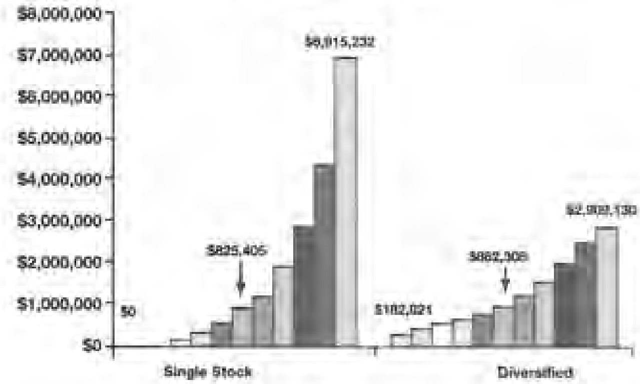
Year 3 Distribution of Results
90% Confidence Interval



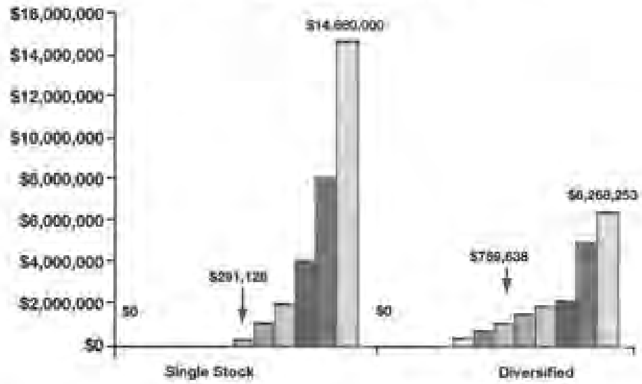
Again, it is worth remembering that the single stock position retains a substantial embedded tax liability that significantly decreases its after-tax liquidation value.

Thus far, the case example has duplicated (albeit with a much richer set of data derived from simulation analysis) a common approach to the "sell; or, retain a concentrated position in low basis asset" analysis that appears in legal and academic publications. The analysis, however, should be taken at least one step further because trustee decisions are often made in the presence of claims for ongoing cash flow by the current beneficiary. The next charts summarize tenth and twentieth-year results for portfolios that operate under the stress of a $4,000 per month distributional demand. Future monthly distributions are indexed to inflation in order to preserve purchasing power.

Year 10 Results: $48,000 indexed annuity
90% Confidence Interval



Year 20 Results: $48,000 indexed annuity
90% Confidence Interval



One striking feature of these graphs is the high bankruptcy rate of the single stock portfolio despite the fact that its initial value is undiminished by payment of capital gains tax liabilities. The bankruptcy rate of the single stock portfolio by year twenty is 41%. This is to say that in 41% of all trials, the portfolio value diminished to zero before the end of the twenty-year period. This is in contrast to the diversified portfolio where the bankruptcy rate is 17.6%. These results suggest that, despite the fact that the single stock portfolio has higher average values, when distributional demands are considered the trustee who remains undiversified runs a significantly greater risk of portfolio failure. Average values are higher only because of the influence of relatively unlikely "outlier" results.

Conclusion

The promise of the total return trust is that, if designed, implemented and administered correctly, it significantly increases the chances of a successful outcome for all interested parties. The pitfall of a total return trust is that, absent adequate information technologies, fiduciaries may unwittingly put the portfolio on a path towards oblivion. This exposition focuses on the benefits of modeling likely future consequences of certain asset management decisions. The real challenge for administration of total return trusts, however, is in the ongoing monitoring and surveillance of the dollar value sufficiency of the portfolios. Given the ongoing need to balance distributions and remainder values across unfolding trajectories of asset returns and inflationary paths, the primary duty of the successful trustee will quickly shift from portfolio "architect" concerned with asset allocation decisions to portfolio "systems engineer" concerned with the probable future consequences of ongoing decisions regarding dollar flows. The total return trust reduces the primacy of portfolio optimization and increases focus on assuring the likelihood that legitimate claims are met. Although it may be too early to throw away the shelves of financial planning and portfolio optimization software, such action may be warranted in the near future.

The prudent trustee of the future will monitor the sufficiency of the capital placed at his or her disposal in terms of its ability to support cash flows without exceeding threshold failure rates. Such rates are defined in terms of probabilities:

- What is the probability that continuation of current distributions will push the remainderman's interest below the threshold value?
- What is the probability that continuation of current distributions will result in future distributions below a threshold value? In absolute bankruptcy? Below 'x' years of living expenses?

Investment efficiency will continue to be measured in terms of MPT statistics such as alphas, Sharpe ratios, and Information ratios; but administrative prudence will be measured in terms of attention to failure rate analysis.

The above observations lead to several suggestions for trustees and estate planning practitioners:

- Net Income Trusts are inherently flawed and, under the new regulatory environment shaped by the Uniform Prudent Investor, Uniform Principal and Income, and Uniform Trust Acts, will be increasingly difficult to justify. When possible, net income trusts should be amended to total return trusts. Drafting of income trusts (unless mandated by tax regulations) should be avoided.
- Total return trusts should have discretionary rather than mandatory distribution formulae. Unitrust and annuity type provisions can be expressed as guidelines that the trustee can follow. However, the guidelines should not be automatically applied without testing the impact of distributional stresses on the likelihood of future portfolio failure rates. This essay suggests that any course of trustee action that has a 90% or greater probability of successfully discharging grantor objectives is generally defensible. However, probabilities change year to year and, therefore, decisions must be recalibrated to actual dollar values lest the risk of failure become unacceptably high.
- Commercial fiduciaries should not provide investment services to total return trusts if they do not possess adequate technology. The total return trust operates without a safety net. The viability of these trusts depends on interactions of multiple variables within an interactively complex system. Decisions of seemingly small significance may, in fact, generate both extreme and unexpected future results as their affects compound over time. In the context of trust administration, the most valuable service within the total return trust structure will be sufficiency-monitoring services. The portfolio architect model is dangerously irrelevant in this context and should be scrapped in favor of the systems engineer model.

Likewise, simulation technology should assist consumers of trust services to make more informed decisions. Commercial trustees offering reasonably priced and rational asset management services should have a great competitive advantage. For example, comparing trustee service packages (a fiendishly difficult task, historically) is now relatively easy. Simply input several defining parameters characterizing the service offering (fees, charges for ancillary services, investment expense ratios, reasonable tax bracket and asset turnover assumptions) and *voila:* likelihood of trustee A accomplishing the grantor's economic objectives vs. likelihood of trustee B accomplishing the objectives.

Appendix: Technical Description of Simulation Model

The examples discussed above represent a small segment of important insights that are available to users of simulation technology. Our simulation application was designed to maximize both the robustness and accuracy of portfolio evolution while providing the flexibility to model a wide range of investment behavior (trustee management elections). Accuracy is critical to any simulation; without confidence that the application has faithfully modeled the underlying system, any analysis of results is futile. Robustness of simulation is equally important and highlights a key difference between Monte Carlo simulation and point estimate techniques. The benefit of a simulation is its ability to allow for a wide range of possible future outcomes; point estimates or highly discrete path forecasts invariably omit from consideration extreme events that could have a monumental impact on the viability of a portfolio. Finally, flexibility in modeling investor behavior is essential in prescribing appropriate behavior to an investor; without knowledge of the effects of different behavior paradigms, it is impossible to provide sound and specific advice to an investor or trustee.

The application forecasts asset price returns using a heteroskedastic CPI driven process. First, CPI is forecast as an auto-correlated, mean reverting random variable. This process produces cyclical behavior of varying duration, comparable to that observed in the sample data. The absolute level and change in CPI is incorporated into the model for forecasting asset class returns. The return model is heteroskedastic and uses a dynamic correlation matrix. Volatility has been shown to be strongly auto-correlated, and is driven by an auto-correlated process with mean reverting behavior. The correlation matrix of assets incorporates random variance predicated on contemporary volatility, reflecting the tendency for assets to exhibit higher correlations in times of greater volatility. The volatility and correlation models produce kurtosis comparable to that observed in sample data.

The application currently forecasts asset classes, and not individual assets. A common fallacy of forecasting engines is to attempt to extract too much information out of historical data; even reasonably efficient markets prevent the simple prediction of future returns from past returns, and therefore it is inappropriate to draw distinctions between expected future returns of individual securities based on past behavior. It limits portfolio distribution to broad asset classes to avoid over-fitting past data. However, to reflect the opportunity for reduced risk through diversification, the application employs a proprietary formula to model the effects of diversifying within an asset class through the use of "significant holdings." Increasing the number of separate investment positions (*i.e.* numbers of stocks) within a given asset class does not alter the period expected return, but it does appropriately reduce the volatility of return.

The application has built in options to enable flexible modeling of user behavior. These options can be broken down into three categories: portfolio and distributions, taxes & fees, and beneficiaries.

1) Portfolio Construction and Distribution Options: Within portfolio options, the user is able to determine the composition of the initial portfolio, the number of significant holdings within each asset class, the dividend rate for each asset class, and if desired, the return and volatility of each class. If desired, the user can also specify that a CAPM model be employed to determine relative returns between asset classes. The S&P 500 is used as the market index for computing CAPM based returns. Finally, the user is able to specify if, and under what conditions, the portfolio should be rebalanced. Rebalancing can occur either at set time intervals or when the ownership of any asset class deviates from the original allocation by a set percentage. Distributions can be specified either by formula or individual entry; formula based additions and subtractions can be specified as either a changing, or constant, percentage of the existing portfolio (unitrust distribution elections) or absolute amount (annuity distribution elections), and can be adjusted to reflect changes in CPI.

2) Taxes and Fees: taxes are determined according to investment behavior and return. Individual bases are kept within each asset class, and the user can express a preference towards either avoiding short-term gains and/or concentrating turnover in high basis assets. Turnover can be specified on a portfolio or asset class basis. Taxes are accrued on a continuous basis, and final simulation numbers are represented on a proprietary adjusted, "post tax" basis. The fee schedule accommodates minimum fees and fee thresholds.

3) Beneficiaries: the portfolio can accommodate up to ten possible beneficiaries, and adjusts mortality calculations according to age, health and gender. All distributions from the portfolio, including specified distributions, taxes and fees can be attributed towards either principal or distribution, with the caveat that the beneficiary of a distribution can never be required to return money to the fund to cover fees or taxes.

Additional information regarding the application utilized in this article is available at www.schultz-collins.com. Select the "Financial Research" button and the "Tools & Techniques" link.