1992 VALUATION ACTUARY
SYMPOSIUM PROCEEDINGS

SESSION 5

Cash-Flow Testing -- The Sensitivity of Key Assumptions

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CASH-FLOW TESTING -- THE SENSITIVITY OF KEY ASSUMPTIONS

MR. PHILIP K. POLKINGHORN: Meredith will be discussing the sensitivity of results to asset assumptions, while in this portion of the session we'll discuss the sensitivity of results to key assumptions regarding policyholder and company behavior.

We have often been told that using the past to predict the future is not a very reliable process. However, in the area of setting assumptions regarding anticipated future mortality experience or withdrawal experience, past history has served as a useful starting point for forming assumptions. This body of historical data is not available with regard to many of these assumptions that must be made in performing cash-flow testing. Many of these assumptions are judgmental. Some examples include:

- Which interest rate scenarios will be important?
- How rapidly will policyholders react to noncompetitive rates of return?
- What will competing products look like in the future?
- How much adverse experience can be passed on to customers in the form of increased cost?

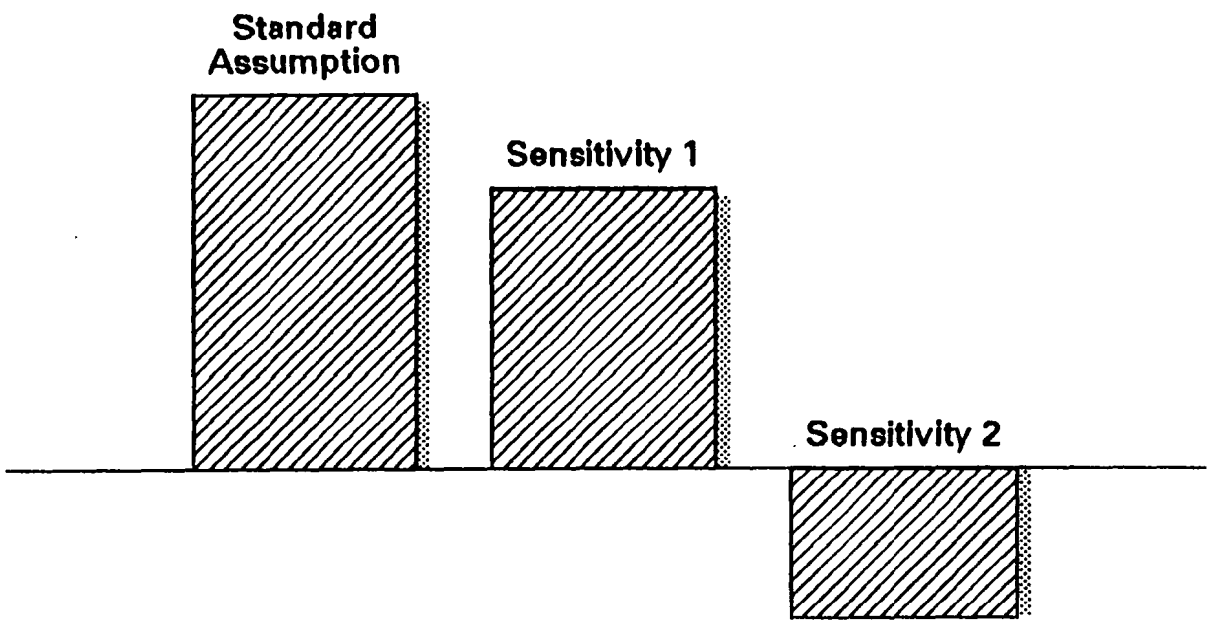
Unfortunately, the results of cash-flow testing can be sensitive to modest changes in some of these assumptions. Part of the responsibility of the valuation actuary is to perform sensitivity analysis. In fact, a report to management would not be considered complete without some sensitivity testing.

Evaluating Results Can be Difficult

Once it is accepted that the valuation actuary must perform sensitivity analysis, we leave ourself open to interesting questions regarding how much weight to give sensitivity test results. Chart 1 presents a hypothetical graph showing the present value of ending surplus using standard assumptions and two sensitivity tests. Analysis of the first sensitivity test presents no significant problem. The results are lower than under standard assumptions, but the present value of

CHART 1

Evaluating Results Can Be Difficult
Present Value of Ending Surplus



ending surplus is still positive. However, under the second sensitivity test result, the valuation actuary might be tempted to call for extra reserves if he gave considerable weight to this set of assumptions.

In our firm's work, we have had an actual situation where extra reserves were required due to results under an interest rate scenario that was outside of the regulatory seven. The company's reserves looked adequate under all of the regulatory seven. However, in an interest scenario where rates dipped down and then almost immediately came back up, results were very unfavorable.

This is an area where some commentators develop concerns with regard to conservatism on the part of valuation actuaries. It is obviously possible to find a set of assumptions under which extra reserves might be required. Adverse results under a sensitivity test should be looked at as an opportunity to examine all of the assumptions for completeness and to look at the company's strategies for possible improvements. As companies venture into cash-flow testing, many of the strategies employed may be stated in relatively simple terms. Sensitivity testing may identify problem areas where a relatively minor refinement in investment or interest-crediting strategy may reduce or eliminate the problem.

Key Assumptions -- Policyholder and Company Behavior

Results of cash-flow testing will be sensitive to certain assumptions regarding policyholder behavior, including but not limited to:

- The rate at which policyholders will surrender their contracts, particularly in times of noncompetitive interest rates.
- The rate at which policyholders will continue to make premium payments on flexible premium products.
- Also important are assumptions regarding policy loan activity and penalty-free withdrawal utilization for policyholders.

Unlike the behavior of the people who issue bonds, there is evidence that policyholder behavior is not always rational. That is, there are times when it would be beneficial for policyholders

to surrender their contracts, yet they refuse to do so. There could be many reasons for this. I heard an anecdote about a policyholder who held a participating policy and was offered an update where his coverage would be increased at no extra cost. The policyholder refused to have his coverage increased at no extra cost, because his divorce decree said that he would provide X amount of insurance and he wasn't going to provide a dollar more.

Assumptions with regard to company strategies that are very important include the following:

- The company's strategy regarding interest-crediting will be very important and should have been developed using cash-flow testing in the pricing of the product.
- The company's reinvestment strategy.
- The product design will influence the results, although by the time the valuation actuary begins cash-flow testing this should be relatively well-established, except with regard to any nonguaranteed elements.
- The company's practices regarding dividends to shareholders or parents will also be important.

We have probably all witnessed situations where company behavior does not seem entirely rational from a purely financial point of view.

Case Study

We have developed a case study in order to examine what might happen to a particular company or product line under a number of different key assumptions. To make things simple, we have selected one product line, the single premium deferred annuity (SPDA) product line. We worked with actual product data, which has been modified and simplified for presentation purposes. A multicell liability model, designed to validate to the company's actual in-force business, was developed. To give you a feel for the size of the block, there were total account values of roughly $650 million. The business had been issued over an eight-year period. Multiple distribution channels were used, resulting in contracts of different average size.

Asset Distribution

Table 1 shows the distribution of existing assets into four major categories. There is a mixture of maturities within each category, but the duration of all the assets in that category has been calculated to give you a feel for the length of the portfolio.

TABLE 1

Asset Distribution

		Duration
GNMA	30%	4.06
A-rated corporate bonds	11	5.26
BAA-rated corporate bonds	47	3.90
Preferred Stock	12	7.70

Note: Reinvesting cash flows in similar fashion

Competitor Rate Definition

It has been assumed that the key competitors for this product are other single premium deferred annuities or comparatively new-money products. The competitor-rate function used follows credited rates for SPDAs historically in a reasonable fashion, and reflects new-money rates fully within six months. This is a very judgmental assumption, and one could argue that it should be subjected to sensitivity testing.

It is important to define competition relative to your own company's distribution methods and policyholder base. Is the competition other companies of similar or higher quality? Does the company typically credit rates in the top half of the market? How the product was sold should be considered. Products sold at a noncompetitive rate might be expected to be less sensitive in the future.

Charts 2, 3 and 4 all illustrate the difference in crediting rates by company quality. Substantial differences in crediting rate have been maintained for the past 18 months. Withdrawal activity has been relatively stable during this period, with the exception of extremely troubled companies. The companies with the highest rating, or the bold line in the graph, are companies

CHART 2

SPDA Average Credited Interest Rates by Rating Group

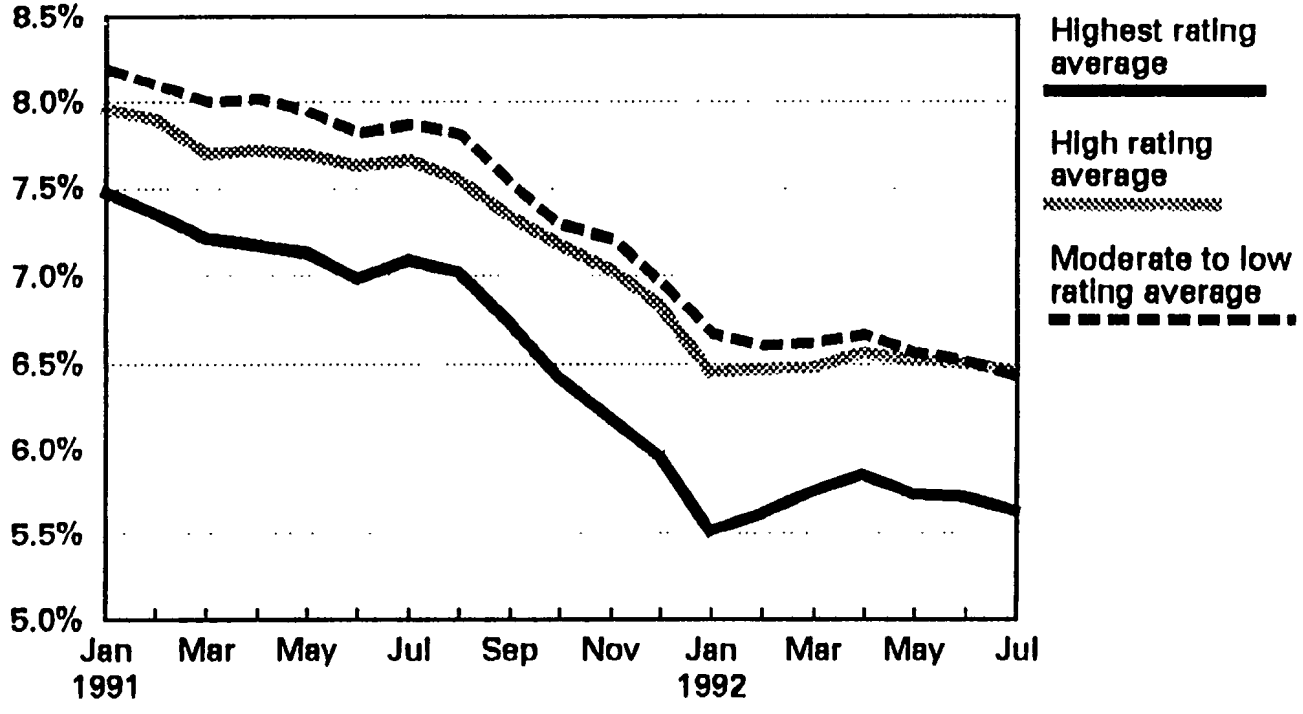


CHART 3

SPDA Average Credited Interest Rates by Rating Group

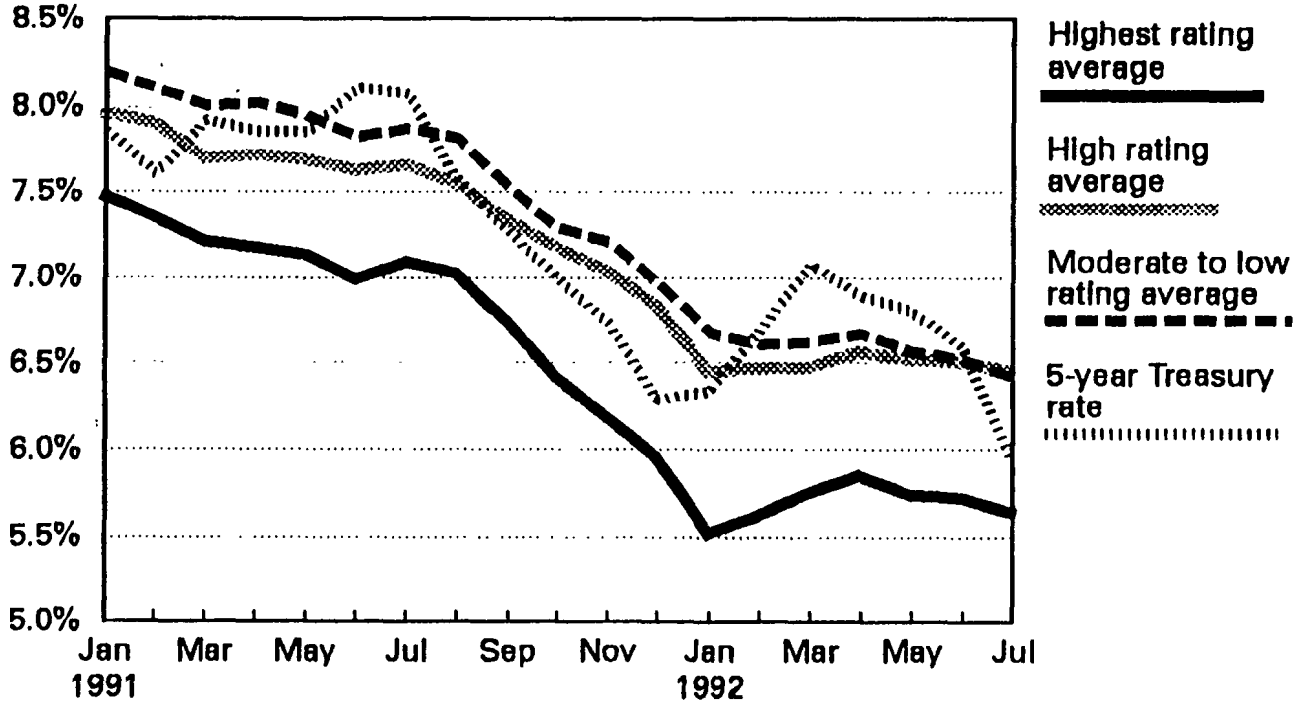
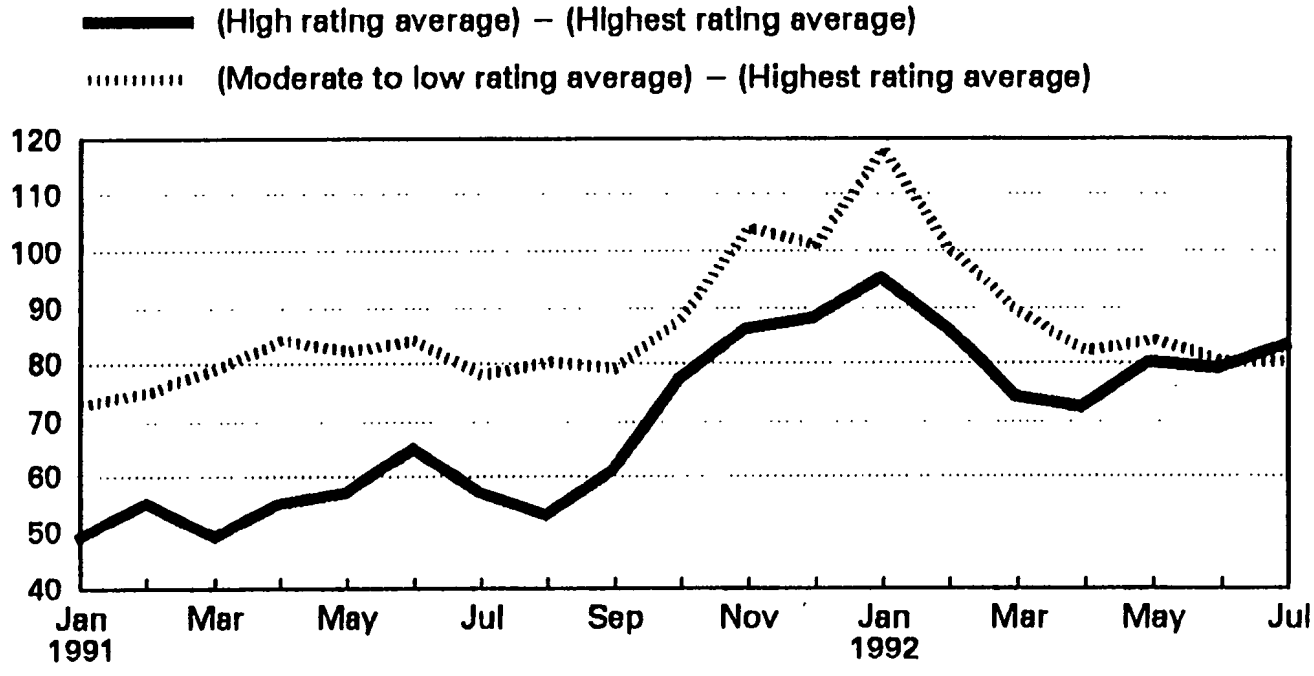


CHART 4

Values of Differences in Basis Points



that are rated AAA by at least one of Standard & Poor's or Moody's. High means companies that are roughly AA or AA+. The moderate to low group is everyone else with the proviso that the company is reasonably active in the SPDA market. Many industry observers have argued that three years ago the crediting rate for these sets of companies would have been much closer. By 1991 the margin for quality was very evident. This margin for quality was generally increasing throughout all of 1991 and peaked in January of 1992. There has been a fairly sharp adjustment between the moderate- to low-rated companies and the other two groups over the past six months.

Crediting Strategy

The company has targeted a 175 basis point investment margin subject to several constraints, including the following:

- The company intends to credit a rate that is no more than 125 basis points below the competition. This will serve to limit policyholder surrender activity.
- The company also intends to credit no more than 50 basis points above the competition. If, for some reason, the company finds itself in a favorable position, it will take excess profits rather than credit a higher yield.
- The last constraint is that the company will limit its losses on investments versus interest credits to 50 basis points. In other words, the company will subsidize to avoid policyholder defections, but only to a point.

Excess Lapse Function

We have developed a formula to model excess lapses that is a function of the difference between the company's credited rate and the competitor rate, as well as the surrender charge. Table 2 summarizes the amount of extra withdrawal activity we would expect at different levels of surrender charges and differentials between the credited rate and competitor rate.

The recent LIMRA study on SPDA withdrawals was inconclusive with regard to the impact of credited interest rate on withdrawal activity. For certain blocks of business there was actually a negative correlation between competitiveness and withdrawal activity.

TABLE 2

Sample Excess Lapse Rates
Competitor Rate Minus Credited Rate

Surrender Charge	1.50%	2.50%	3.50%
4%	6.4%	17.0%	29.9%
2	7.8	18.4	31.3
0	9.2	19.8	32.7

Burnout Effect

A further modification has been made to the excess lapse formula to reflect something that has been termed the "burnout effect." While the past is not necessarily a good predictor of the future, many companies noticed in the early 1980s that, as interest rates rose, there was a wave of disintermediation that then subsided. There are stories of deferred annuity business that may have been as much as 800 basis points out of the competition, yet policyholder withdrawal activity was relatively stable after an initial shock.

In our model we have reduced the otherwise calculated excess lapse rate by a burnout factor. The burnout factor varies by the number of opportunities the policyholder has had to disintermediate. An opportunity is defined as a quarter in which the competitor rate exceeded the credited rate by more than 100 basis points.

Under Factor Set 1, once a policyholder has been exposed to seven or more previous opportunities, the assumed rate of excess lapsation is 50% of normal. Under Factor Set 2, the excess lapses after seven previous opportunities are only 25% as high as normal. Table 3 illustrates the complete set of factors.

TABLE 3

Excess Lapse Modifications
Burnout Effect

To reflect reduced incidence of disintermediation on business that has ignored earlier opportunities

Excess lapses = Excess lapses • Factor

Opportunities	Factor Set 1	Opportunities	Factor Set 2
0-3	100%	0-2	100%
4-6	75	3-4	75
7+	50	5-6	50
		7+	25

where opportunities = previous quarters in which competitor rate exceeded credited rate by more than 1.0%.

Sinking Ship Effect

A common concern in cash-flow testing is how to interpret scenarios where results turn negative, but then pull positive by the end of the projection period. When such results are for substantially the whole company, I feel an additional factor should be built into the policyholder behavior model to reflect increased excess lapses due to poor financial statements. We have termed this the "sinking ship effect." Regardless of the competitiveness of the interest rate, a company should expect higher withdrawals if the company becomes impaired, receives a rating downgrade or poor financial press. As a proxy for this, we have tracked the accumulated surplus for the company relative to statutory reserves. As accumulated losses increase as a percentage of statutory reserves, the company can expect rating downgrades and poor financial press. Table 4 shows the additional excess lapsation expected as the accumulated deficit grows.

Results of Case Study

For our case study we have performed cash-flow testing using the baseline excess lapse assumption and the burnout assumptions under the prescribed seven scenarios as well as under 100 randomly generated scenarios.

TABLE 4

Excess Lapse Modifications
Sinking Ship Effect

To reflect increased excess lapses due to poor financial statements

Accumulated Deficit ÷ Statutory Reserves	Excess Lapses
1-2%	2%
2-3	6
3-4	15
5+	50

Results Under Prescribed Scenarios

Table 5 shows the ending market value surplus, the lowest, maximum and average ending market value of surplus from the prescribed seven scenarios. In all seven scenarios the company has positive ending market value surplus under the assumptions both with and without burnout impact.

TABLE 5

Results Under Prescribed Scenarios
Ending Market Value of Surplus ($Millions)

	Maximum	Minimum	Average
Baseline excess lapses	212	51	152
Modification 1: Factor Set 1	217	61	165
Modification 2: Factor Set 2	223	68	172

Chart 5 illustrates, as expected, the burnout factors only have an impact in the increase in interest rate scenarios.

Results Under 100 Random Scenarios

When we examine the results under 100 randomly generated interest rate scenarios (Table 6), we see that the ending market value of surplus is positive under all scenarios only for the cash-flow study with burnout Factor Set 2. If the company's goal was to pass in 95% of the scenarios, then a slight additional reserve would be required if the standard assumption was that there would be no burnout effect. The dilemma presented is that the valuation actuary believes that a certain segment of the policyholder population will not be sensitive to interest rate changes. If this assumption is valid, no additional reserves would be required. To the extent that the valuation actuary is less confident in this assumption, you might establish some additional reserves.

TABLE 6

Results Under 100 Random Scenarios
Ending Market Value of Surplus ($Millions)

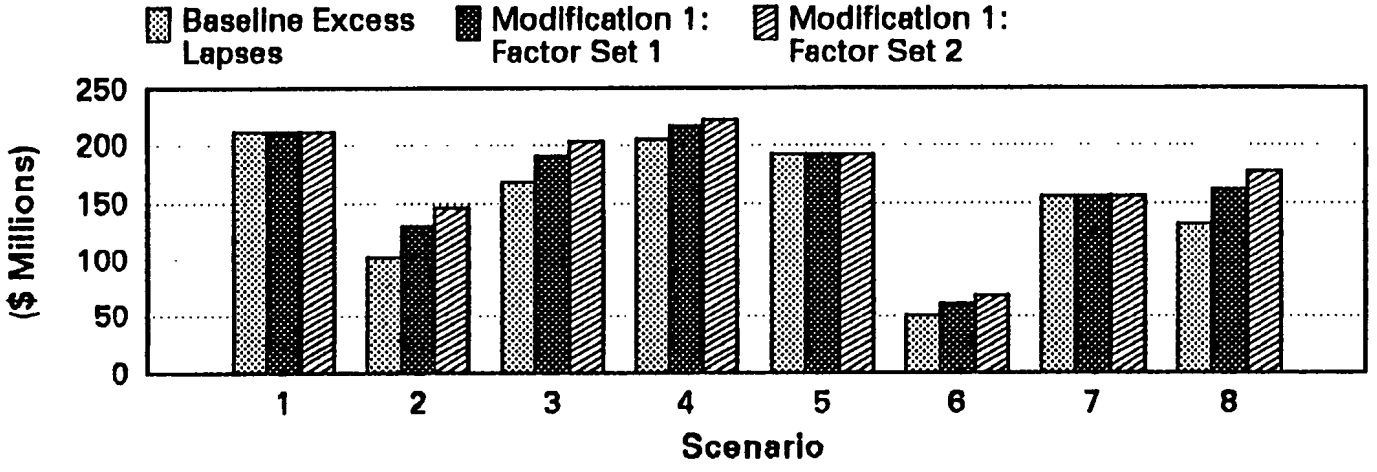
	Maximum	Minimum	Average	Number Negative
Baseline excess lapses	226	(80)	111	6
Modification 1: Factor Set 1	239	(22)	122	2
Modification 2: Factor Set 2	249	35	130	0

Use of Higher Baseline Excess Lapse Assumptions

If the excess lapse function was roughly doubled (subject to a cap of 50%), many of the worst scenarios seem to be the result of the crediting strategy allowing an unprofitable spread. Therefore the results under the higher excess lapse assumption aren't that much worse than the normal excess lapse assumption. In fact, in certain scenarios increases in the lapse rates improved the profitability.

CHART 5

Results Under Prescribed Scenarios
Ending Market Value of Surplus



(1) Level
(2) Slowly increasing
(3) Slowly increasing, then decreasing
(4) Pop up
(5) Slowly decreasing
(6) Slowly decreasing, then increasing
(7) Pop down
(8) Scenario 3 with inversion

Alternate Crediting Strategy

What if the company were to modify its interest-crediting strategy to maintain a 175-basis-point investment margin without any constraints?

Table 7 indicates that the lowest ending surplus under the prescribed scenarios is reduced by $10-20 million using this strategy, although the numbers are all positive. This would seem to indicate that this strategy is not good from an anticipated profitability point of view.

TABLE 7

Alternative Crediting Strategy
Results Under Prescribed Scenarios
Ending Market Value of Surplus ($Millions)

	Maximum	Minimum	Average
Baseline excess lapses	177	31	113
Modification 1: Factor Set 1	184	47	135
Modification 2: Factor Set 2	189	58	146

Results under 100 random scenarios are somewhat worse under this crediting strategy, while some of the losses due to subsidized credited rates are eliminated (Table 8). Excess surrender activity is increased dramatically, often at times at depressed market value of assets.

If we evaluate the two crediting strategies in a risk/reward fashion, the choice of strategy could be influenced by the use of the burnout function (Chart 6). If burnout is valid, then maintaining a spread produces slightly greater ending average surplus over the 100 scenarios with fewer negative scenarios. If burnout is not valid, the original strategy produces significantly greater expected return at a very small level of extra risk.

TABLE 8

Alternative Crediting Strategy
Results Under 100 Random Scenarios
Ending Market Value of Surplus ($Millions)

	Maximum	Minimum	Average	Number Negative
Baseline excess lapses	204	(216)	87	5
	*226	*(80)	*111	*6
Modification 1: Factor Set 1	247	38	128	0
	*239	*(22)	*122	*2

* Original crediting strategy

Shareholder Dividend Sensitivity

Ending market value of surplus will be lower if the company has been paying shareholder dividends to a parent during periods of healthy statutory profits. Under the worst of the 100 random scenarios, we assume that shareholder dividends are equal to 50% of gains and that there are no negative dividends. The ending market value of surplus as a percentage of reserves was analyzed under baseline, burnout and sinking ship assumptions. The results without burnout are disastrous, particularly if the sinking ship factor is considered.

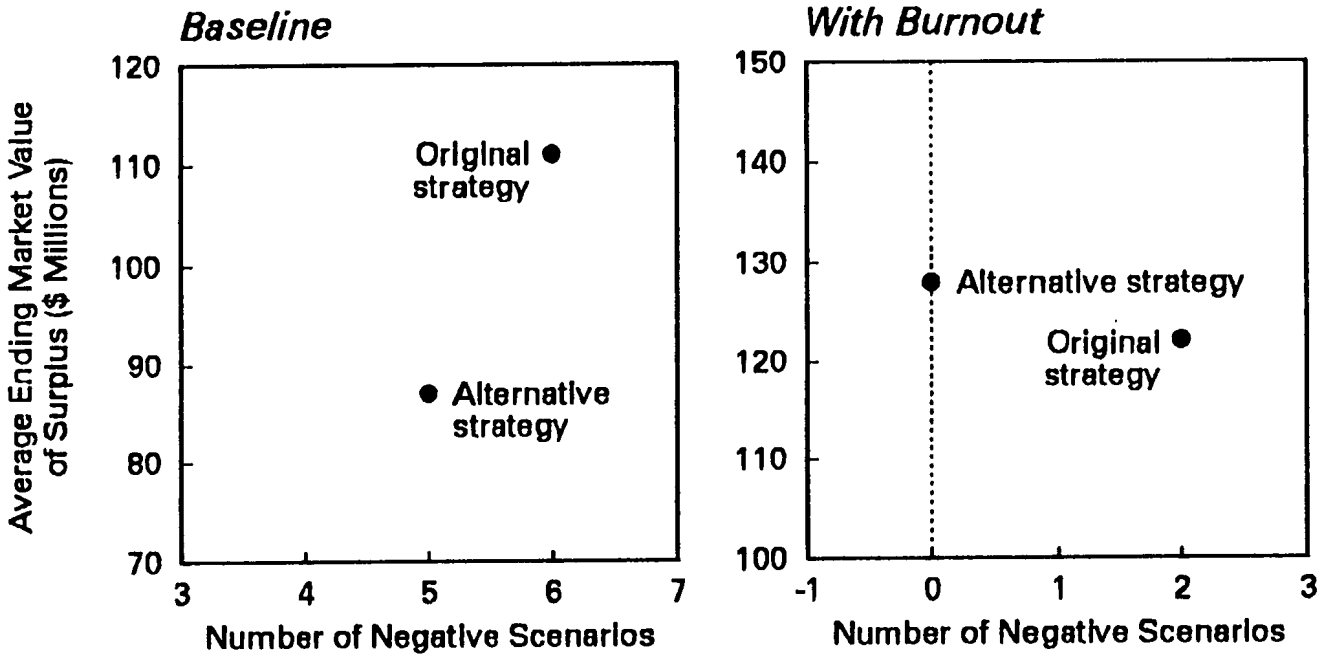
Overall Results

Overall, this company's assets seem to be adequate under a wide variety of assumptions. The only assumption that produced significant negative results was the assumption of paying shareholder dividends equal to 50% of the gain from operations after maintaining target surplus of 5%.

In general, there seems to be no requirement for major reserve strengthening. Further analysis in refining the interest-crediting strategy might be beneficial from both an anticipated profitability point of view and a valuation actuary point of view.

CHART 6

Evaluation of Alternative Crediting Strategy



CASH-FLOW TESTING -- THE SENSITIVITY OF KEY ASSUMPTIONS

MS. MEREDITH A. RATAJCZAK: I have been a consulting actuary with Milliman & Robertson for the last five years. I spent two years in the New York office and two and one half years in the Philadelphia office. For the last six months, I have been spending three quarters of my time on the west coast and one quarter on the east coast serving as project manager for our projection software development project. Over the last five years, I have spent a large proportion of my career working with clients on valuation-related projects and issues.

Many of us are here for the same reason. We feel an additional responsibility placed on us by our standard-setting body and the regulators to stay current on issues that will impact the valuation-related work we do. For year-end 1992 many of you will find yourself with a new title: appointed actuary.

For the first time, you may be called upon to analyze the asset side of the balance sheet in the course of cash-flow testing done to fulfill Actuarial Standards Board (ASB) 14 or to serve as the basis for your opinion about the adequacy of your reserves in light of the assets supporting them. ASB 14 defines cash-flow testing as the process of projecting and comparing as of a given date the timing and amount of asset and obligation cash flows after the valuation date. Projecting implies making assumptions about the future behavior of assets under various economic conditions. As the appointed actuary you must satisfy yourself that the asset models and assumptions used produce "reasonable estimates" of expected cash flows.

We will look at the key assumptions or considerations that impact the "reasonable estimate" of asset cash flows. I will use several case studies and examples that will demonstrate the sensitivity of asset cash flows to changes in assumptions. We will also briefly touch upon the sources of data you have available to assist you with assumption setting.

This session was billed as "Cash-Flow Testing -- The Sensitivity of Results to Changes in Key Assumptions." What constitutes a key assumption for assets? Let's assume for the moment that we have an asset portfolio backing reserves that contains exactly the same proportion of every conceivable asset type. Under this scenario, if you ignore an inherent feature of just one of the asset types, you may seriously distort the expected cash flows for the assets in question.

The portfolios we deal with are not this extreme; consequently, the assumptions considered key will be those that may have a material impact on cash flows.

I have chosen to talk about two categories of key asset assumptions: asset-type specific and general. The list of asset types creeping into insurance company portfolios increases every day. The most common types you may encounter are those classified as fixed-income assets or non-fixed-income or equity-type investments. In the fixed-income category I include corporate bonds, multiple-rate securities, mortgage-backed securities, collateralized mortgage obligations (CMOs), commercial mortgages, residential mortgages, securitized assets, derivative instruments, and preferred stock.

The category nonfixed-income assets includes common stock, real estate, joint ventures, and limited partnerships.

Over the last several years, the valuation actuary symposium has had entire sessions devoted to CMOs. Since I will be discussing many types of assets, I won't be able to go into too much detail on each asset type, but I will try to cover those asset features that are most commonly considered key assumptions or features for cash-flow testing.

For corporate bonds, the options granted to both the investor and the lender will have an impact on future cash flows under varying economic scenarios. The options granted to the investor and lender include call provisions, sinking-fund provisions, put provisions, conversion provisions and exchange provisions.

Of this list, calls and sinking-fund provisions are the most commonly modeled features. The key consideration for modeling the cash-flow behavior for assets with these features is what triggers either the investor or the lender to exercise these options.

Investors or lenders will exercise these rights when they view doing so as to their benefit financially. The protection period as well as the cost to exercise the option are key factors to consider in projecting the future cash flows.

The quality of the bond will certainly impact the likelihood of the bond being called. Noninvestment-grade bonds are not called for the same reasons as investment-grade bonds. Call activity is frequently credit driven and not interest-rate driven. If your bond portfolio consists of below investment-grade bonds, this may necessitate using two separate call algorithms recognizing the different behavior of each class of bond.

Call provisions and sinking-fund provisions are modeled in a variety of ways. For one project, investment-grade bonds were assumed to be called when the call market value exceeded the call price by 4%. For the noninvestment-grade bonds, we assumed that of the bonds that were currently callable, 5% were called each year. For bonds with a sinking-fund provision, a sinking-fund payment was assumed to be made if the current market yield was less than the coupon on the bond.

Floating-rate securities come in various shapes and sizes. The term is used to encompass those securities with a coupon that is adjusted periodically due to changes in a base or benchmark interest rate.

Unfortunately, to the naked eye scanning a schedule D, it is not always clear that a security has a variable-rate coupon, a floating-rate coupon, or some sort of a reset coupon. You will need to ask about the characteristics of this type of asset to determine the timing and basis for coupon redetermination.

The coupons for these securities may be tied to the London Interbank Offered Rated (LIBOR) plus some spread, prime, one-month commercial paper, or some other short-term rate.

As a practical matter, you will not be modeling these indices as part of your cash-flow testing. To project future cash flows, you will need to determine a proxy for the underlying indices in terms of a maturity period and a spread. The redetermined coupon would then be used in the call logic for these assets.

Increasing-rate notes do just that: increase at a particular point in time. The timing of the increase is important as well as the call provisions for the security.

For mortgage-backed securities, cash-flow variability will be a function of prepayment activity. The mortgage pool's weighted-average coupon in comparison to current mortgage rates, the mobility of the homeowner, and the age or seasoning of the underlying mortgage pool are key determinants of prepayment behavior.

The fact that the determinants of prepayment activity are both quantitative and qualitative complicate modeling mortgage-backed-security, cash-flow behavior.

Most of you will use the Public Securities Association or PSA standard prepayment model as the basis for your prepayment assumptions with different multiples being used to reflect the quantitative and/or qualitative differences between the issues in your portfolio.

CMOs have received much attention due to their increased popularity as an insurance company investment. They have certainly received a lot of air time at the valuation actuary symposium in the past. Unlike a mortgage-backed security where each investor receives a pro-rata distribution of any principal and interest payments, the CMO substitutes a principal paydown priority schedule among tranches. The result is a hodgepodge of deals each with its own complexity.

The types of tranches found in a CMO deal may include:

- Sequential
- Z
- Planned amortization class (PAC)
- Target amortization class (TAC)
- Support
- Liquidity
- Accretion directed
- Interest only (IO)
- Principal only (PO)
- Floaters
- Inverse floaters
- Residuals
- PAC Z
- Support Z
- Sticky jump
- Sticky jump Z

Asset portfolios comprised of PAC CMOs may have more cash-flow certainty than those with some of the other tranches listed above.

The priority of the tranches you own will greatly influence the cash flows. Since these are collections of mortgages, prepayments present the most significant cash-flow risk. The list of factors that may impact the prepayment speed is long:

- sale of home
- interest-rate changes
- economic conditions
- refinancing
- accelerated payments

- seasoning
- geography

Reflecting all these factors in a prepayment model is virtually impossible.

From here on out we are moving into uncharted territory. Due to the complexity, instability and cash-flow uncertainty of assets such as securitized assets and real estate, we have not in practice allocated these assets to the modeled business we have been testing up to this point in time.

Commercial and residential mortgages have the same list of assumption considerations. These include prepayments including both timing and penalties, the amortization schedule and the refinancing provisions. These assets are not mortgage pools; consequently, there is more room for erratic cash-flow behavior given an individual borrower's behavior. The prepayment terms and amortization schedules for a commercial mortgage may be different for every single asset included in the portfolio.

Banks are offering residential customers graduated payment structures to accommodate the borrower's expected income stream.

A commercial or residential borrower may or may not be faced with penalties for early prepayment. Geographic concentration, the age of the mortgage, and the refinancing provisions will impact future total cash flows. All of these factors must be considered when determining the projected cash flows.

The cash-flow variability for commercial and residential mortgages may be captured by differing multiples of the PSA assumption or some mathematical model that reproduces the company's actual prepayment experience.

Over the last several years I have found more of my clients purchasing asset-backed instruments for their portfolios. In this category I would include pools of automobile loans or credit-card receivables. The cash-flow characteristics of the loans and the contracts underlying the asset-backed securities determine the cash-flow characteristics of the securities themselves.

Because of their relatively short maturity period and small outstanding balances, these assets tend to have lower prepayment rates than mortgages. Prepayments are virtually unaffected by interest-rate changes. The credit enhancements offered with these instruments offer the investor protection against cash-flow changes resulting from defaults.

Derivative instruments include futures, options and other customized interest-rate risk agreements. To date, I have worked with very few companies that are actually modeling the financial impact of these agreements. These instruments are purchased to reduce the risks associated with other investments. The inclusion of their financial impact will involve quantifying the risk/return trade-off as interest rates change.

Virtually all issuers of preferred stock make provisions for periodic redemption by a sinking fund, redemption of stock in whole or part by call, or conversion into common stock. If these assets are included in a cash-flow analysis, a key consideration is what triggers the issuer to exercise these options. Like bonds, the issuer will exercise these options only when it is perceived as being in the issuer's financial best interest to do so. The trick is quantifying the trigger in terms of cash-flow behavior.

Projecting the future cash flow for nonfixed-income securities may be closer to an art than a science. In the case of joint ventures or partnerships, one needs to look at each arrangement separately to get a clear picture of expected cash flows. For this category of asset, the key determinants of cash flow are capital appreciation and expected future income. Any expected capital infusions must also be reflected in the projection of future cash flow. Past experience or some external index could be used as the basis for the capital appreciation or income-growth assumption.

Up to this point I have addressed asset-type-specific modeling assumptions. There are several general considerations that are critical in appropriately projecting future results in the course of cash-flow testing. Defaults, reinvestment strategy, and asset allocation are important modeling assumptions.

For those of you with a segmented portfolio, asset allocation will not be an issue. Little guidance is provided in the Opinion and Memorandum Regulation other than an asset cannot support several groups of specified reserves unless it is prorated. If there is inconsistency in the allocation method from year to year, it must be noted in the memorandum. Once again, the appointed actuary will be called upon to use his or her judgment to determine which assets support what business. It goes without saying that your cash-flow-testing results will be sensitive to the types of assets deemed to back specified reserves.

Reflecting default costs in cash-flow testing has become more important in the wake of recent default activity in the bond and mortgage areas. A company's exposure to defaults will be dependent on the types of assets that are in the portfolio. If a portfolio contains below investment-grade securities, the provision for default costs will be important. The factors potentially impacting defaults are the size and quality of the types of assets in your portfolio and the number of issuers represented. There is risk if all your eggs are concentrated in one basket. For assets such as real estate and mortgages, excessive geographic concentration may also indicate an additional risk that must be provided for.

I know from the sensitivity testing I have done that asset cash flows and cash-flow testing results are very sensitive to changes in the reinvestment strategy. Reinvestment strategy encompasses handling both positive and negative cash flows. To develop a reinvestment strategy, the questions that must be answered are:

- If selling is indicated to meet required cash flows, what criteria is used to determine which assets are sold?
- Is borrowing more appropriate than selling assets?

- If positive cash flows exist, what are the underlying characteristics of the new asset purchases in terms of asset types, maturity period, quality and spread to Treasury?
- What liquidity position is appropriate for the business included in the analysis?

I have very quickly tried to touch upon the asset characteristics and considerations one may be faced with when modeling the cash-flow behavior of an asset portfolio. The appointed actuary must be comfortable that the assumptions used in the cash-flow testing appropriately reflect the expected behavior of the investors and lenders in varying economic environments.

I have gathered several practical examples that reflect the sensitivity of asset cash flows and results to changes in key assumptions. The first example is for mortgage pass-through bonds. As I indicated earlier, prepayments pose the most significant risk to the investor. In Chart 1, we have assumed no prepayments. The cash flows are stable and unchanged for the entire 30-year maturity period. In Chart 2, we introduce 6% annual prepayments into the projection of future cash flows. By doing so, we have not only shortened our cash-flow stream, but also severely front-ended the cash flows we received for this investment. In a down-interest environment, if we had completely ignored any prepayments, we would have shown better results by not reflecting the additional investment of prepayment cash flows into lower yielding assets.

Chart 3 uses two sequential CMOs with a Z tranche that are identical in structure. The first CMO has a weighted-average coupon of 7.5%. The prepayment formula used would indicate prepayment speeds of 175% of PSA in our current interest-rate environment. Chart 3 shows the projected cash flows for this CMO.

Compare these cash flows with the projected cash flows for the second CMO depicted in Chart 4. The second CMO has a weighted average coupon of 10%. The prepayment formulas used would indicate prepayment speeds of 400% of PSA.

To illustrate the sensitivity of results to changes in the reinvestment strategy, I have chosen two case studies. In each instance cash-flow testing was performed on a block of future issues. Cash-flow testing done at year-end will ignore new business. Future issues are used here to better isolate the impact of changes in reinvestment strategy.

The first case study involves a $100 million block of single premium deferred annuity (SPDA) business. The average policy size is $25,000. The policy has a bailout provision with the rate equal to the initial credited interest rate less 2%. The credited interest rate is the lesser of the seven-year Treasury rate and the credited interest rate for the previous year. Commissions equal 5.5% of premium. Surrender charges equal 7% reducing to zero linearly over seven years. The lapses reflected in the projection include a 15% base component, a market-rate, credited-rate component and a reduction for the surrender charge. The reinvestment strategies tested were (1) buy seven-year bonds callable in four years or (2) buy 20-year bonds callable in seven years. Results were projected under 50 randomly generated interest scenarios. Chart 5 shows the results based on buying seven-year bonds. Chart 6 shows the results based on buying 20-year bonds. Comparing the results in the two tables shows the increased variability caused by investing in 20-year bonds.

The second case study involves universal life future issues with $50 million of premium per year. The credited interest rate is the seven-year Treasury rate subject to a 4% guarantee. Commissions equal 100% of target premium in year one, 15% in year two and 5% of excess and all premiums in years three and thereafter. Surrender charges equal 100% of target premium grading to zero in year 16. The lapses reflected in the projection include a 15% base component, a market-rate, credited-rate component, and a reduction for the surrender charge. The reinvestment strategies tested were (1) buy seven-year noncallable bonds; (2) buy seven-year bonds callable in four years; or (3) buy 20-year bonds callable in seven years. Results were projected under 50 randomly generated interest scenarios. The results for these three reinvestment strategies are shown in Charts 7 through 9, respectively. As expected, there is much more variability moving from the seven-year noncallable strategy to the 20-year callable strategy.

CHART 1

Mortgage Pass-Through Bonds
Cash Flows Assuming Zero Prepayments

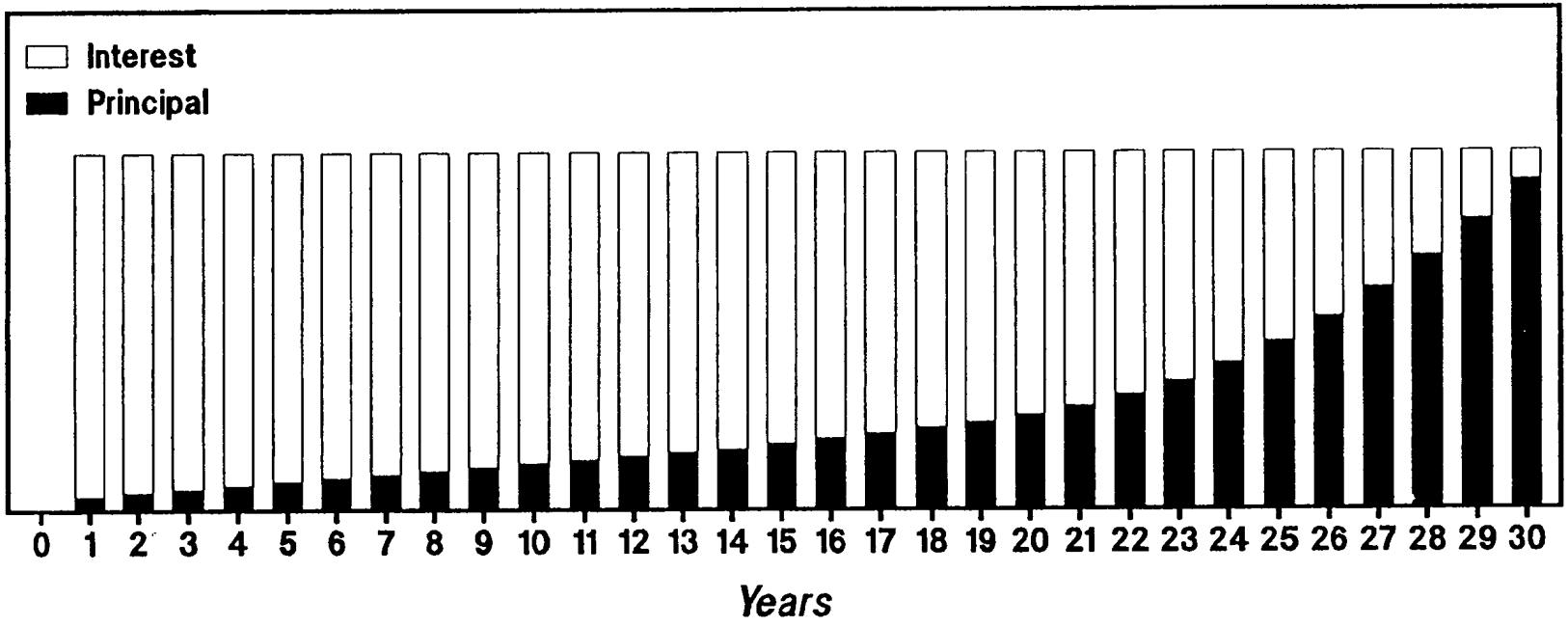


CHART 2

Mortgage Pass-Through Bonds
Cash Flow Assuming 6% Annual Prepayments

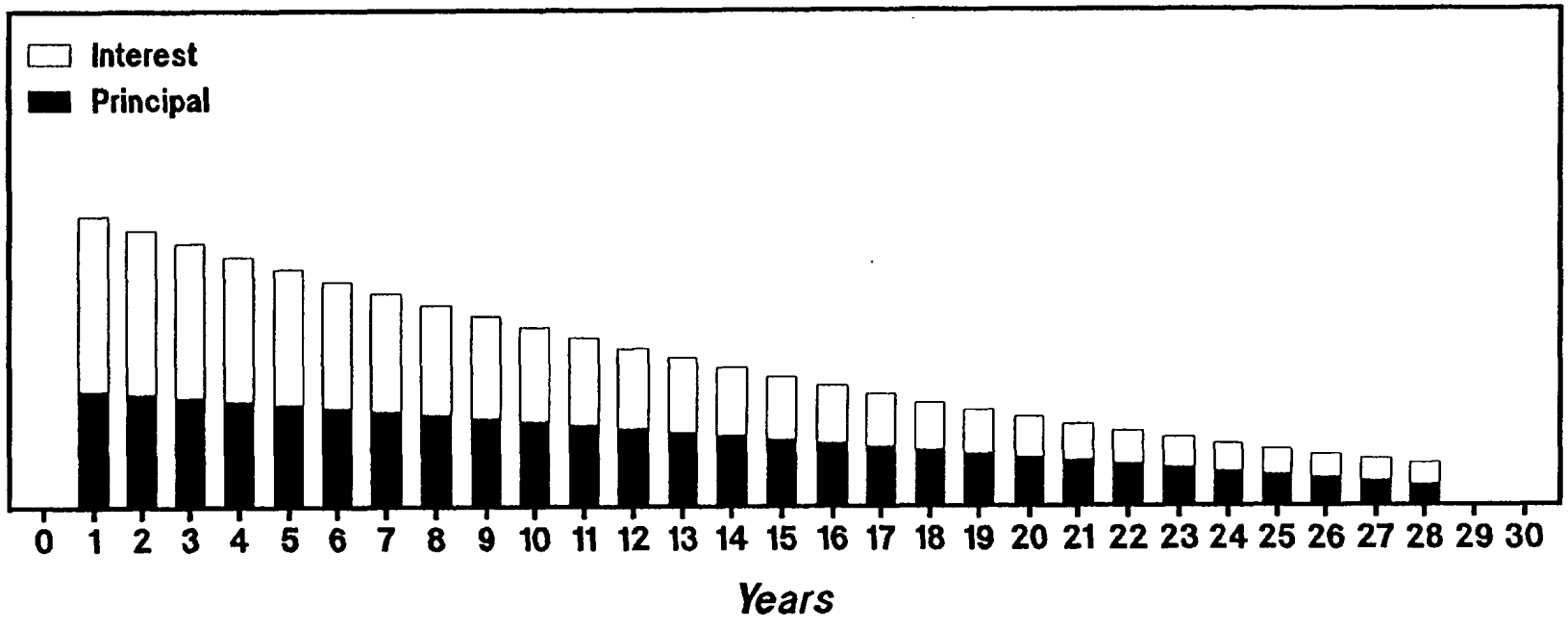


CHART 3

Sequential CMO with Z Tranche
Sample Total Cash Flows -- 175% PSA

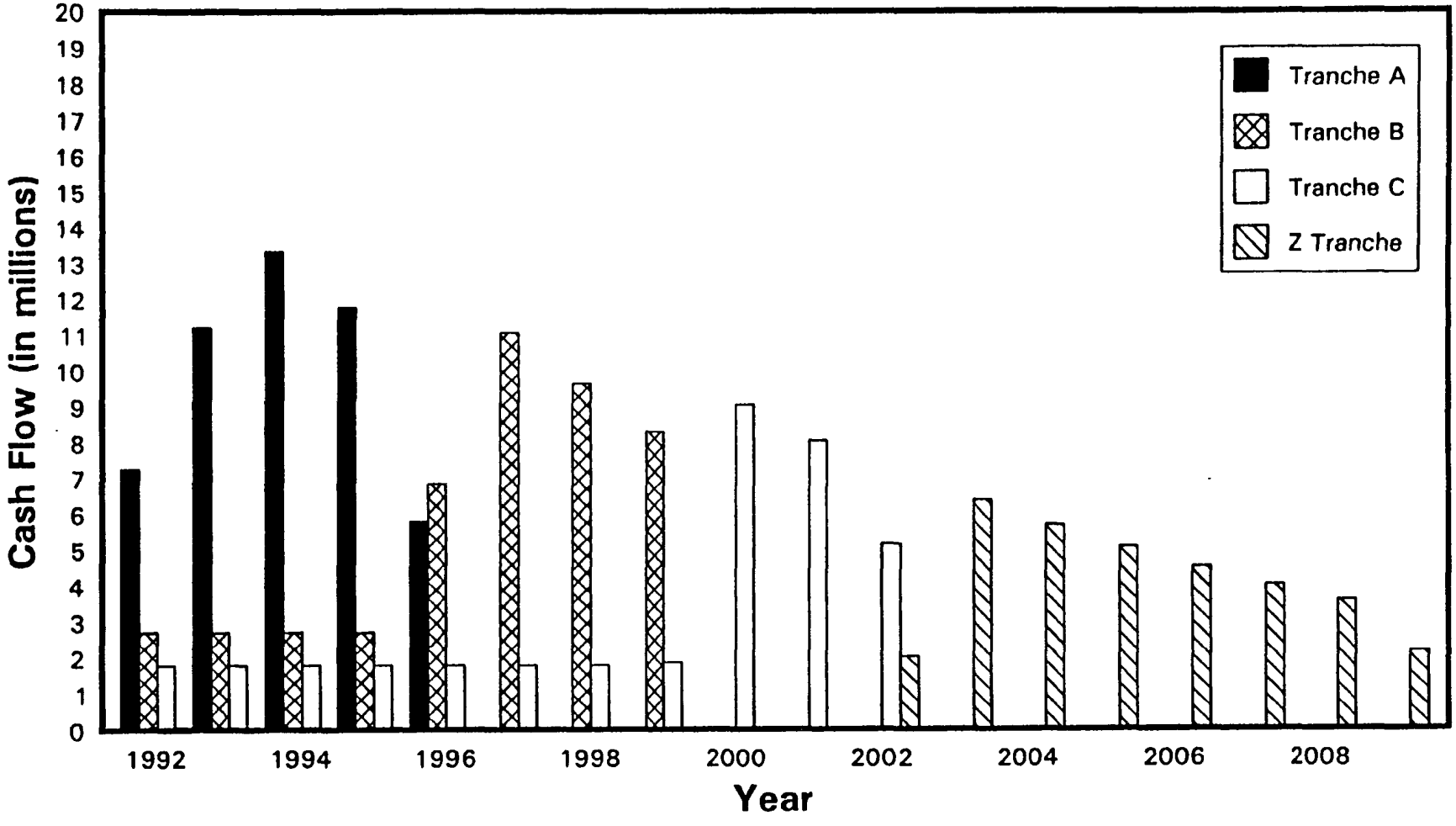


CHART 4

Sequential CMO with Z Tranche
Sample Total Cash Flows -- 400% PSA

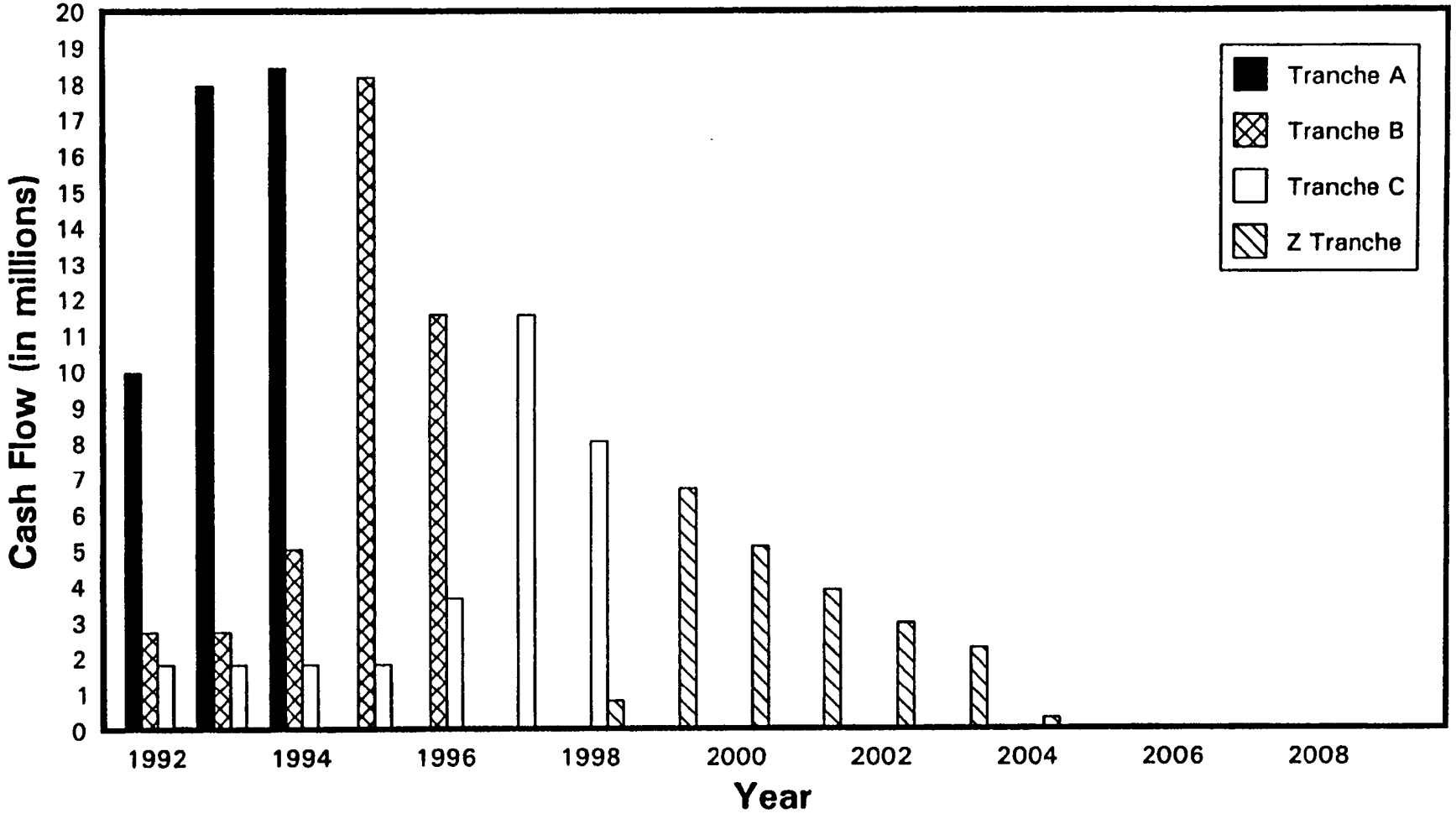


CHART 5

Sample Life
SPDA
7-Year Bonds

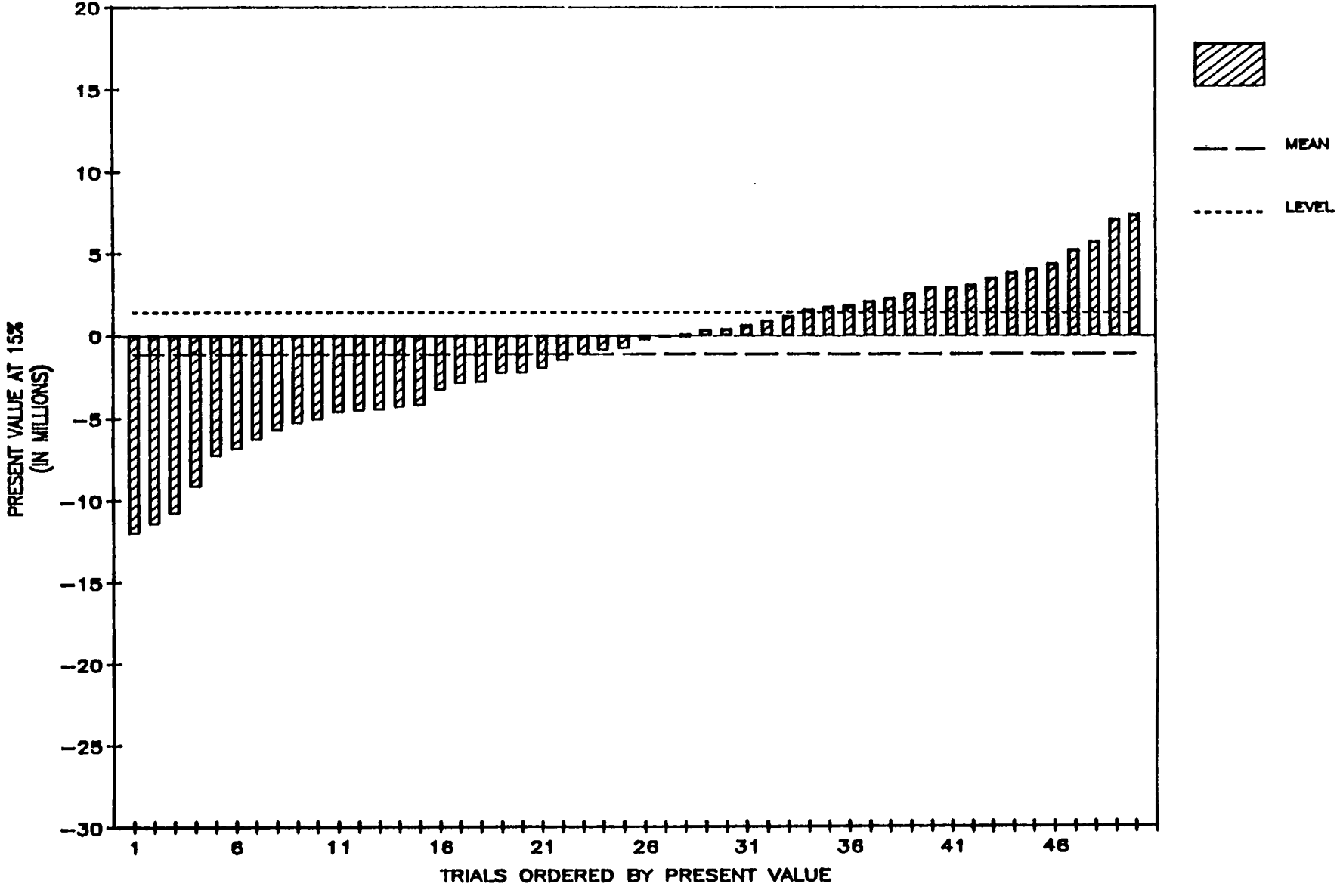


CHART 6

Sample Life
SPDA
20-Year Bonds

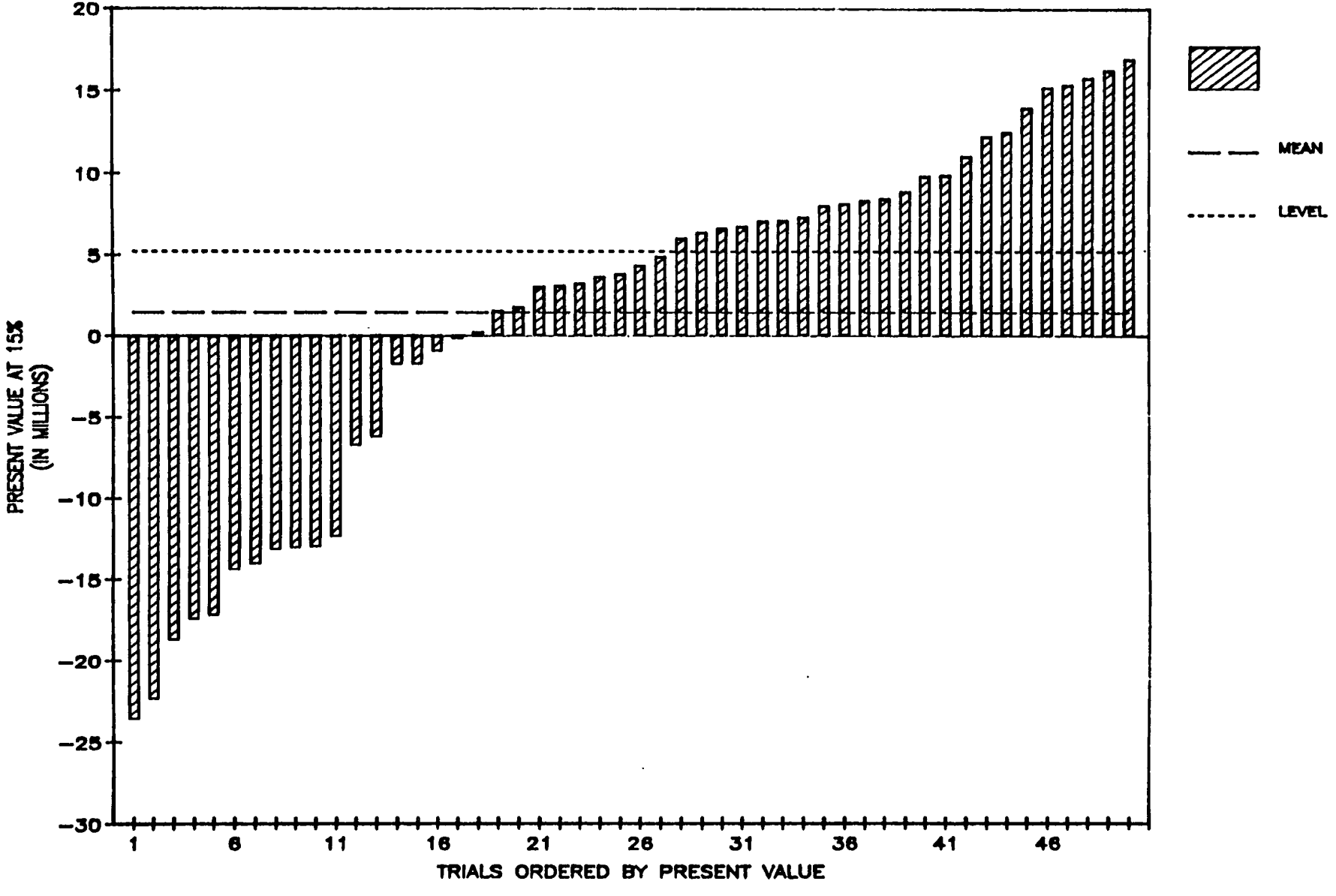


CHART 7

Sample Life
Universal Life Future Issues
7-Year Bonds (Noncallable)

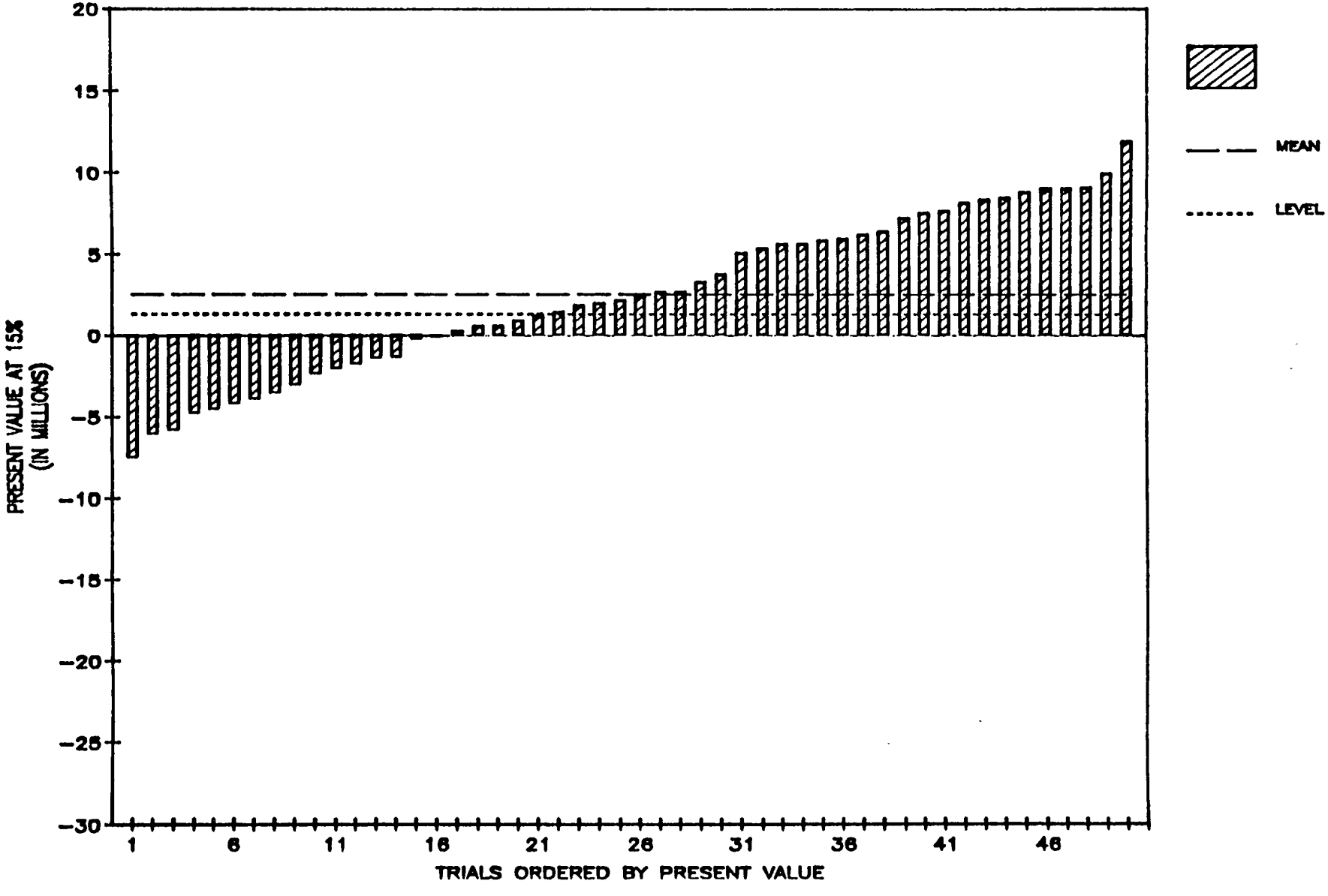


CHART 8

Sample Life
Universal Life Future Issues
7-Year Bonds

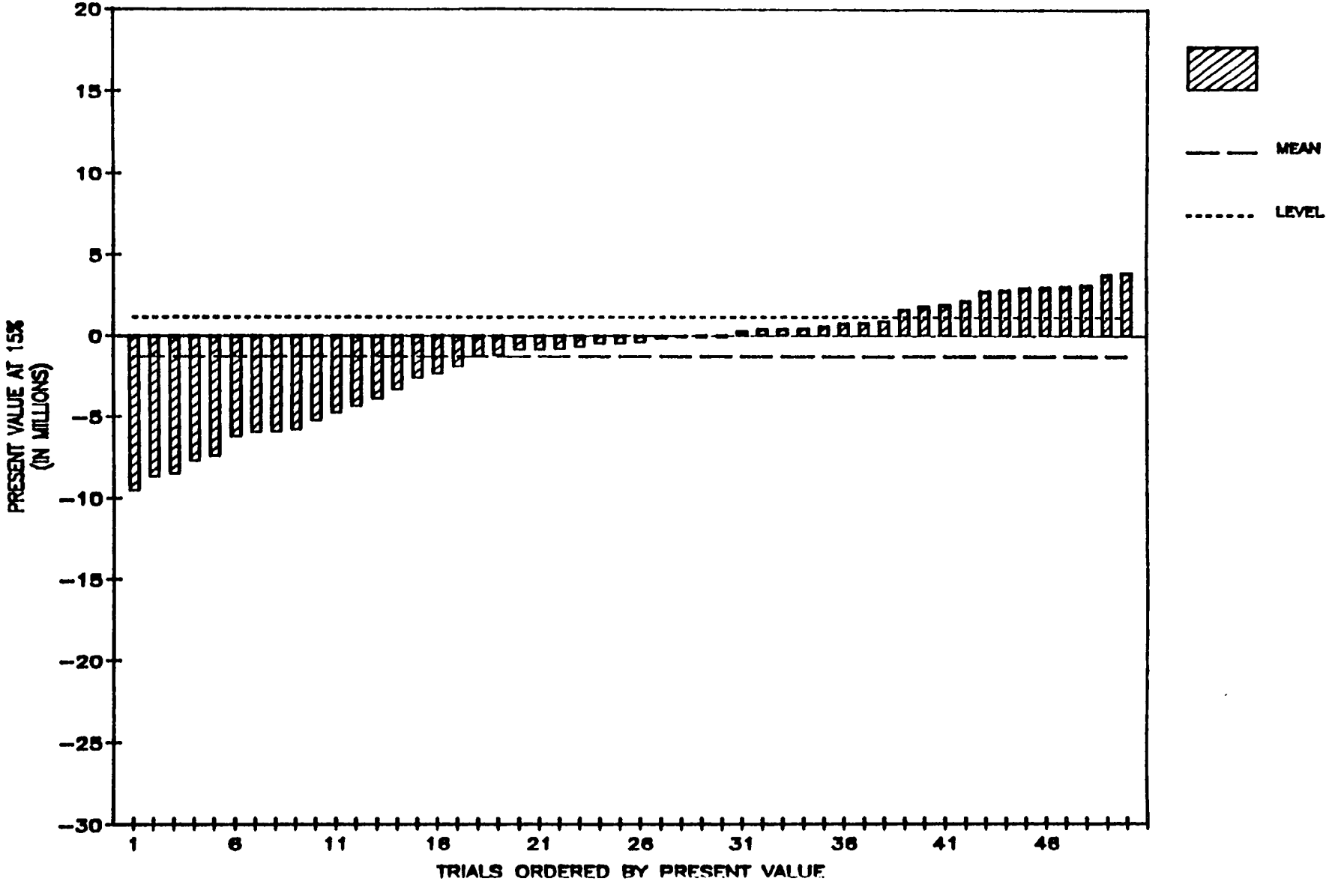
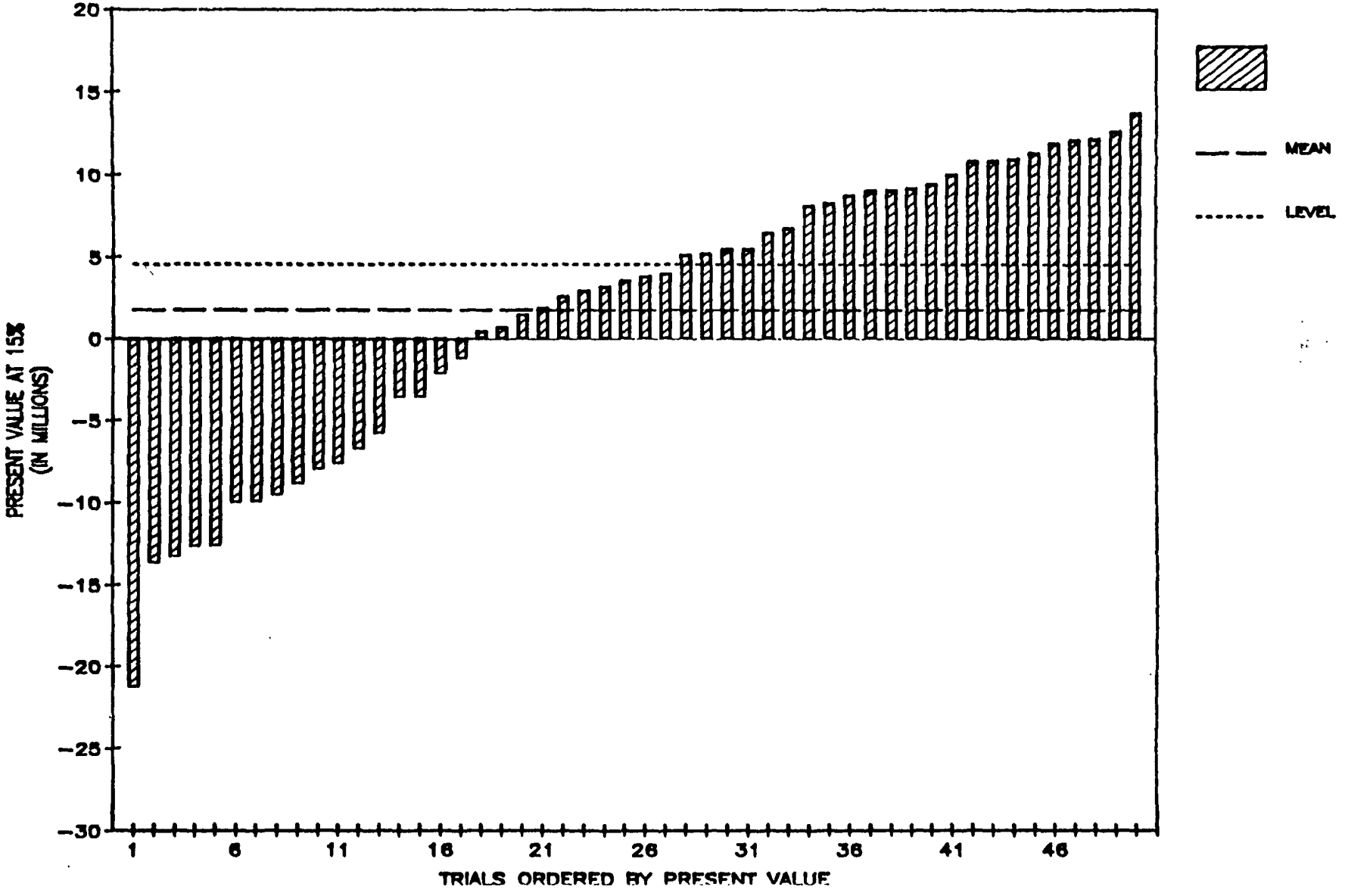


CHART 9

Sample Life
Universal Life Future Issues
20-Year Bonds



What have I illustrated through these examples? The asset-related assumptions made in the course of cash-flow testing can materially impact the outcome of a cash-flow-testing analysis.

There will be much work to be done building the asset model that will produce "reasonable estimates" of expected cash flows. Unfortunately, one will most likely find that it will take as much or maybe more time gathering the asset data needed to develop projection assumptions than actually developing the assumptions themselves.

The process of assumptions development is judgmental. It will be up to each individual doing cash-flow testing to do the sensitivity testing necessary to develop confidence that the asset models do produce reasonable estimates of expected cash flows.