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Session 4TS
Asset Modeling Concepts

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Summary: You are the appointed actuary relying on asset models provided by others. Instructors explain how to scrutinize model results and make wider use of them to make strategic decisions in your company. Specific topics covered include: asset model validation techniques, embedded option derivatives, portfolio management uses and insurance product pricing uses. At the conclusion, participants understand the uses of asset models, as well as the methods used to validate them.

MR. DAVID WALCZAK: The session faculty is made up of Hank McMillan from Pacific Life in Newport Beach, California. Hank's title is senior vice president for institutional products. Being on the Deloitte & Touche Pacific Life audit team, I know that Hank is on several of the risk management and finance committees for the company and is a CFO type as well as being an asset modeling or asset concept person.

We also have Chip Jamison from Allianz Life/Life USA in Minneapolis (I can still say that because I'm an alumnus from that company). Chip's title is associate actuary. He's an investment actuary, but along with his actuarial credentials, he's a CFA and a CPA, but I'm told that it's only valid to say that in Colorado. Minnesota is up for grabs, and we certainly don't know what the state government of California would say about his credentials. We'll say CPA in Colorado to be safe. Chip has a lot of practical issues to talk about, too, as far as the modeling, especially for cash-flow testing models.

My name is Dave Walczak. I'm from Deloitte & Touche in Minneapolis. I have some insurance background in the investment modeling area and have recently been

supporting GAAP audits, working on issues like the implementation of the long-duration standard of practice (SOP) for variable guarantees and modified coinsurance (modco) as embedded derivatives and so forth. I'm also working on some of the proprietary asset models and interest scenario generators. Let's talk about our approach to the session.

We want to talk about asset model validation techniques. How do you know that your model is ready for primetime? We'll also talk about applying the results of your cash-flow testing model to other uses. Many people spend so much time with these models, and we think companies are trying to lever off of them, but maybe there are some other ideas that we can offer. Finally, this proliferation of embedded option derivatives, both on the asset and liability side of the balance sheet, is becoming a hot topic, both for pricing and for valuation, and we want to dig into that.

Before we get into Chip's presentation, we want to ask you what your specific concerns are so that as we're going through our presentations, we can circle back and see how we did. Are there any specific concerns or hot topics at your company or practice?

FROM THE FLOOR: Embedded options and liabilities.

FROM THE FLOOR: Mortgage prepayment rates when rates are low.

FROM THE FLOOR: Hedge assets.

MR. WALCZAK: The modco derivative issue? It looks like we're coming up with enough material for five or six sessions. Let's take one more so that we're off the hook for not having to check off too many.

FROM THE FLOOR: Liability duration analysis and Universal Life (UL) in particular.

MR. WALCZAK: Okay. We're not going to necessarily use this as a report card, but you want to get at least an idea of whether what we're talking about is what you want to hear, so thanks for this input.

MR. HARRY (CHIP) JAMISON: I'll get started on what I'm going to talk about this morning. First, I'm going to give some perspective and background on where I'm coming from and a little bit of a review of the Actuarial Standards of Practice (ASOPs). Second, asset models are driven by a variety of sub-models or inputs. I'll talk about how I look at those sub-models. Third, I'll make a few comments on sensitivity. Fourth, I'll look at ways to review the asset model for one asset, and then multiple assets.

My approach is the same way that you look at liability models: Look at the input, test the single sale-cell and then look at multiple sale-cells. At Allianz, our only

modeling software is TAS from Tillinghast Actuarial Software™. It's not important, but I mention that because my presentation follows the task TAS structure. We also use CMS Bond Edge and Bloomberg for asset models validation.

I begin with the premise that you are the valuation actuary, and somebody else gives you the asset model. I'm going to focus on cash-flow testing; Hank will take that another step and talk about asset/liability management (ALM), and then Dave will delve deeper into some of these areas. But when you look at these charts, think cash-flow testing. Just like you, I have to get comfortable with models. This morning I'll go over some of the ways I get comfortable with asset models.

Just as a warning, some of these charts at the bottom were contrived to illustrate a point. Assumptions may be dated or may not be suitable for your models. Remember the purpose of your model. It's the purpose that defines materiality, time horizon, market calibration and model sophistication.

ASOPs

ASOP 7 is analysis of insurer cash flows. Its guidance includes asset cash flows. Recommended practices say (and I am paraphrasing):

- 3.2 Determining the Level of Analysis of Cash Flows—Look at the asset type, risks, and deviations from expected experience. Understand the drivers for these risks and deviations.
- 3.4.1 Asset Characteristics—How sensitive is this asset to economic factors? How might defaults affect cash flows? How easy is it to convert the asset into cash? Consider the historical experience of similar assets.
- 3.4.2 Investment Strategy—Consider disinvestment and derivative strategies. Can the company realistically execute those strategies?
- 3.10.1 Scenarios—The type and number of scenarios have to be consistent with the purpose and the variability of results. The key is understanding what drives the variability of results.
- 3.10.2 Sensitivity Testing—Based on the intended purpose and use, how well do I understand the model and potential deviations?
- 3.10.3 Internal Consistency—Interdependencies. What is related and how is it related? Is there something else that I am not considering?

ASOP 23 is data quality and gives guidance reviewing data for appropriateness, reasonableness, and completeness.

- 5.2 Use of Imperfect Data—Consider whether this imperfect data may produce material biases. I look for these biases in trying to understand my model. I get comfortable with the models by actively looking for these biases.
- 5.3 Reliance on Data Supplied by Others—The accuracy of data supplied by others is their responsibility. Still, look at the data for reasonableness and consistency. We do not need test just to find questionable data. But be careful as this may be changing. The Academy's Actuarial Update in August said that appointed actuaries may be getting more involved

auditing data, or at least making sure significant data is audited. I did not read that this extends to cash-flow testing, but watch for developments.

It boils down to judgment—your judgment, my judgment—and they are probably different. Judgment is not a cookbook. What I really try to focus on is discovering model biases. I want to make sure I understand where I can exploit or misuse the model, then try to make sure I don't misuse it through model errors or inefficiencies.

Front-End Assumptions

In drivers of asset values, I want to consider how values affect cash flows. Market values impact cash flows when buying and selling. Book values impact investment income, free surplus and perhaps crediting strategy.

In terms of fixed income, interest rates and uncertainty drive market value. There is a lot that goes into interest rate theory, but in these models interest rates tend to be the starting point. Be aware of supply and demand. Back in the days of government surpluses, there was a lighter supply of Treasuries (that is our benchmark), and that influenced other rates and spreads. The other items have to do with uncertainty.

Credit—How certain am I that they will pay me back and on time?
Optionality—Do I know when I will get the cash?
Liquidity—Can I easily convert it to cash if I want to?

In terms of equity, generally we model an index or a market rather than a specific stock. So what drives the equity markets? Long term, market returns pretty much boil down to expectations about profitability, growth and interest rates. These are the primary inputs to the Dividend Discount Model, and it applies to markets as well as individual stocks. Depending on your fundamental or technical view, supply and demand is influenced by macroeconomic variables, business cycles, interest rates, trends and perceived risk.

Next I've listed index options, but want to include other derivatives. Equity derivatives (e.g., calls or puts) are triggered from an equity index. Interest derivatives (e.g., caps or floors) key off an interest rate index. There are many combinations and variants. For cash-flow testing, you see market changes due to:

Intrinsic value—what it's worth now—in the money or out of the money. This defines the cash flow of an option.
Time value—mostly volatility, a little interest. Literally, time value is everything else, but for cash-flow-testing purposes, mostly volatility. This is zero at the end of the option term.

Sometimes we need to break an asset into its pieces to understand it, and real estate is a good example. Real estate can be thought of as lease value and reversionary value. Lease value might be treated as similar to fixed income. It is

affected by uncertainties similar to fixed-income investments—certainty of payments, timing of cash flows and ability to liquidate. Reversionary value is what I'm going to get out of it at the end. It may be a warehouse that's all used up, or it might be apartments that can be sold as condominiums. A couple of other drivers of real estate are demographics and environmental concerns. They are similar to the economic variables affecting other investments.

With alternative assets, can I break them into pieces I can model? Perhaps I can do a decent job modeling one piece and use broader estimates on the other piece. On the piece I can't model very well, is it material to the purpose of the model? It may not be.

Policy loans are listed because they tend to be forgotten. They are still assets that need to be considered.

Hank and Dave will go into a little more detail on scenarios and scenario generators, so I'll save that for them. Besides, in getting comfortable with an asset model, I focus on the deterministic scenarios.

TAS allows several scenario-related inputs, and we don't use all of them. For instance, we define inflation by the interest rate, not the scenario. If I did tie it to the scenario, I would need to make sure it was reasonably correlated with interest and equity rates. Recall that correlations are part of ASOP 7's recommended practice on internal consistency.

I am not an expert in stochastic scenario generators, but I still try to make sure the statistics are reasonable and consistent with the purpose of my model. I like to get a feel for average returns, volatility, correlations, and how they compare to historical averages. I try to be careful about putting too much confidence in historical averages and missing paradigm shifts.

I particularly want to be aware of volatility biases. If I want to test the use of interest rate floors, I need to understand my volatility assumption. I discovered that if I use too low a volatility, floors may never be a good idea. If I use too high a volatility, I may get the opposite answer. This goes back to trying to understand my model biases.

In defining asset classes, TAS uses a linear relationship to define spreads over the base scenario rates. This gives longer assets slightly higher spreads than shorter assets. Defaults, or credit risk, are very closely tied to spreads, and I want to make sure the relationship between the two makes sense.

The most important thing I can say about expenses is they have to be tied to the purpose of the model. In real life, expenses vary by asset class. It costs more to invest in commercial mortgages or real estate than public bonds. If you are maintaining a fairly consistent asset base, the allocation of expenses among classes

doesn't make much difference. Expenses may be important if you are comparing investment strategies between different asset classes.

I already mentioned volatility. I also watch the equity volatility assumption for our equity-indexed annuities (EIAs), particularly with indexes other than the S&P 500.

Chart 1 is similar to a tool I use to evaluate spreads. The top boxes are interest rate input. The left middle box calculates model rates. The right middle box converts it to a spread from Treasuries. Then I subtract default rates and analyze net spreads after defaults.

Look at what the net spreads tell me about model biases. Look how net spreads consistently increase as quality decreases. If I adopt a slightly riskier investment strategy, all the way to BA, I will improve my results. After that, I start slipping. Compared to C-range bonds, I am usually better off investing in anything else, or not allocating them to the line. Also, this tool helps me understand internal consistency problems.

If I know how to exploit my model, I understand its weaknesses. If I understand its weaknesses, I have some ideas on what I want to sensitivity test.

I'm sorry it's not noted on the face of these graphs, but these prepayment rates are from BondEdge. These graphs highlight that coming up with a simple prepayment model is difficult. Collateral, seasoning and ease of refinancing all make a difference. They also highlight that prepayments go from 10 percent to 60 percent with a relatively small change in interest rates. Many of you contributed to this relationship, probably refinancing your mortgage at least twice over the last three or four years.

I won't spend time on data sources for initial assets, but will highlight a couple of points. First, keep in mind the different systems that the data comes from. Most of the problems that I see in the output occur in the first projection period—the transition when the different source data begins getting used in a projection model. Second, and it's kind of obvious, set up a control sheet to keep track of the values and yields going into the model so you can compare them coming out.

There are some items that I call special considerations. Our primary input data comes from our investment accounting system. Many of the data elements needed for a projection are not usually maintained or complete. So we compare that data to BondEdge and Bloomberg and do a little data scrubbing. Some of the items we look for include:

S&P and Moody's ratings—including impaired securities or fallen angels.
Sectors—sometimes to help better identify our asset classes.
Special coupons—zero, step, variable, or Treasury Inflation Protected (TIP).
Principal repayment schedules—calls and sinking funds, perhaps Commercial

Mortgage-Backed Securities (CMBS).

Review how you modeled these special considerations. Sometimes, what was done may not be material to cash-flow testing, but it may be useful for understanding model biases—especially if you want to use the model for purposes other than cash-flow testing.

Earlier, I talked about spreads off of Treasuries. Chart 2 is a TAS report that starts with the model spread and calculates the additional spread it needs to match market values (the last column). I use this report to get a feel for how consistent the model spreads are with the market. If they are consistent, I should get a range of positive and negative additional spreads. However, all positive spreads doesn't mean that I want to change the model. Last year credit spreads were fairly wide, and I did see a lot more positives than negatives.

This is when I need to balance long-term assumptions with current market conditions. Do I calibrate the model to market, or do I stick to long-term assumptions? Since the purpose of this model is long-term cash-flow testing, I lean toward long-term assumptions rather than current market calibration. Sensitivity testing comes in to evaluate what happens when I choose one over the other.

I also use the additional spread to look for outliers, or bonds with a very large positive spread. This helps me identify fallen angels or potential fallen angels. Often, the market price of a bond will reflect a downgrade before rating agency action. That might suggest that I should adjust the rating to reflect market rating (as in recognizing a subsequent event). Or, it might suggest that the book value has been written down, but the par has not been adjusted, and I might be getting unrealistic yields to maturity.

This leads into reinvestment assumptions. Market values and market spreads are important when you buy and sell assets. Over a 20- or 30-year projection, reinvestment is significant in the final result. Too high of a spread and you may get an unrealistic profitability picture. Too low of a spread and you may have difficulty proving reserve sufficiency.

Sensitivity

Think about the data that goes in and how it might affect what comes out. The more I understand what goes in, the better I can choose and evaluate my sensitivity tests.

Last year, New York was concerned about some cash-flow-testing issues. I don't have any inside knowledge of their concerns, but I do want to discuss them in light of this presentation—understanding the biases in the model.

In the case of spreads and defaults, my take is they noticed a bias by using high market spreads with low long-term default rates. They wanted to see what would

happen if you limited the net spread after default charges. We saw something related earlier when we could almost guarantee improving our results by moving to a slightly riskier asset class.

In the case of prepayments, they withdrew their safe harbors. As we saw with the prepayment curve, it's getting so easy to refinance that what was once considered conservative is no longer conservative.

Chart 3 illustrates that materiality goes hand-in-hand with sensitivity. Looking at assumptions side-by-side is useful, and I prefer translating rates to dollars. Based on this example, it looks like investment grade default rates don't have a lot of impact on total default charges. I have about 6 percent of my bonds rated B and lower. Not material? Yes—these two categories generate 60 percent to 90 percent of my total default charges.

By the way, most of my default analysis comes from an annual Moody's study called "Default and Recovery Rates of Corporate Bond Issuers." It usually comes out in February.

While defaults were high over the last couple of years, spreads were also high. In fact, the spreads shown in Chart 4 are a leading indicator as to future defaults. One reason that I included this chart was to talk about hidden margins. If I am using spreads consistent with the 1994–1998 period, what happens when we enter a period of high spreads? I might be penalizing myself because I am buying assets at lower yields than what is actually happening in the market. One of the purposes of sensitivity testing is to help discover or confirm our hidden margins. That is, determine whether it really is a hidden margin.

I have another comment on hidden margins. Besides the input assumptions we discussed, there may be some global assumptions creating hidden margins. In TAS, some of these are found in the calculation parameters rather than the input files. For instance, what do you do with the additional spread we saw in Chart 2? Do you hold it level or do you grade it to zero over the life of the asset? If you are using a selling strategy, grading it may improve your results. (This is just a small example. I bring it up because many people don't think of looking at how global—or system default assumptions—influence results.)

Single Asset Analysis

In terms of single asset testing, I try to select samples from each asset class and from each source system. For the other assumptions, I use no reinvestment, no liabilities, no defaults and no expenses. I focus on level deterministic scenarios with parallel yield curve shifts for fixed income assets, and constant growth models for equities. The reasons I do this is they are easier to understand and the output is comparable to what might be generated on investment analytic systems.

What do I look at? I look hardest at the first projected period. The first period is

where all the different accounting and investment systems come together in a projection model and where modeling errors tend to show up. I like to compare the principal run off with another system, such as BondEdge, Bloomberg or even the portfolio manager. I usually use level, pop-up and pop-down scenarios (maybe 100 or 200 basis point shifts), and look at cash flows, market values, and average lives.

Aggregate Asset Analysis

The process is exactly the same when I look at an aggregate asset model. I still use no reinvestment, no liabilities, no defaults and no expenses. I still use the same deterministic scenarios.

Just as an aside, try including your liabilities in your asset model without reinvestment. You might gain some insights to your risk profile, and how much of your results are due to reinvestment assumptions.

I continue to keep the asset classes separate. I separate the runs by originating system and portfolio manager.

I like to keep a picture demonstrating where all the assets are going, and Chart 5 is a simplified example. I want to know how much cash and investment income is allocated to each business unit. I want to make sure that I don't forget Schedule BA assets, accrued investment income and policy loans. I want to know which lines I am relying on common stocks and real estate to support. I should do it before the fact and not while putting together the memorandum.

I didn't mention this when talking about ASOP 7, but paragraph 3.3.1 says (with some paraphrasing) that the same assets should not be improperly used to support different blocks. Paragraph 3.4.1 requires you to consider limitations on the ability to use asset flows such as those supporting another block of business.

Chart 6 emphasizes testing the first projection period. For example, we use BondEdge to project cash flows for our mortgage-backed securities. One time we plugged the BondEdge projection into TAS and found that our first period change in book value did not match reported growth, principal paid, and book yields. When we miscoded a couple of bonds, BondEdge used starting book and market values, but dropped them from the projection right after that. This example was a little tough for me to reproduce for this presentation, so Chart 6 is an example with S&P 500 call options. For options, book and market values are equal. Notice in the top run the inconsistency between the initial market value and the first period projected value. It's a little obvious there is an inconsistency. The second example still has a little inconsistency, but it is smaller. These inconsistencies also appear in the growth column.

In this case, there is no difference between input files. Both are projected with 0 percent equity growth. Here the difference is in one of TAS's global parameters that I talked about when I discussed hidden margins. Recent historical volatility has

ranged from 15 percent to about 40 percent. In the top example, the equity volatility assumption was 30 percent; in the second case, 20 percent. Which is right? I need to decide if I want to use the current market volatility or a long-term assumption. I need to understand that using a long-term volatility assumption may cause a discontinuity in the first period.

Wrap-up

My goal is to be able to understand the biases in my model. If I understand these biases, I can take measures to make sure that the model is appropriate for its purpose. If I understand these biases, I can take steps, such as sensitivity testing, to develop some comfort with the limitations and results. If I understand these biases, I am meeting many of the recommended practices in the ASOPs.

I'll turn the presentation over to Hank McMillan to take us out of cash-flow testing and into the realm of ALM.

MR. HENRY MCMILLAN: My job here today as part of this teaching session is to talk about how you would take cash-flow testing results—or the asset modeling concepts that you've applied there—and go to a portfolio manager and try to get them to do something with it.

I'm going to be using "ALM" interchangeably with "portfolio management" in this session. I will not deal with the credit issues on your investment side.

We know a lot about interest rate risk, so one of the things we want to do here is try to communicate with the investment side about our current risk exposure and what we might be able to do about it

As Dave mentioned, at Pacific Life I have a job that has moved me out of pure ALM and into more general risk and financial management. I'm going to be offering some ideas that are more along the lines of an asset manager, focusing more on the economic side of portfolio management as opposed to the pure actuarial or modeling side.

Let's begin with the basic issues and objectives for portfolio management. Roughly, portfolio managers are interested in getting the economics right. That's what they're trained in. The issues that you're going to be facing are what securities to buy, whether you ought to somehow hedge or not hedge those securities and what that means because they're coming to you after the cash is in hand. The kinds of risks that they're going to be worried about frequently are going to be the kinds of risks that you built into your product, so in some sense you need to think about what they're doing as you put the product together.

This issue of communication between the asset house and the liability house is essential. What I can say with this session is that I'm trying to get you to think about how odd the concepts of asset-adequacy analysis are to a portfolio manager

so that you can think about how you might want to rephrase, reorganize or reorient those results so they become handy to a portfolio manager.

Let's think about what kind of information you need to have if you're going to be able to make portfolio decisions. First of all, portfolio managers deal in a market world, so it's useful to have market-based information. Second, it has to be time-sensitive. It can be difficult to get things with a short enough preparation lag that it isn't old news. You have to be able to figure out a way to get information to portfolio managers frequently and in near-real time because that's the kind of world that they live in.

The other main issue is to identify your control variables and your objective variables. The present value of ending surplus is probably not an objective variable of most portfolio managers. It's probably not how they get paid. It's probably not how you get paid. Think about what the objective variables are going to be for these people and try to reorganize the cash-flow-testing output so portfolio managers can understand how changes to the variables that they can control affect their objective variables, and of course, affect the present value of ending surplus that you're going to have to deal with through a part of your cash-flow-testing exercises.

For example, they might look for the present value of after-tax cash flows rather than the present value of ending surplus. They might like to use the London Interbank-Offered Rate (LIBOR) swap curve as opposed to using a Treasury curve. I noted that somebody asked about the issue of how you model hedging and derivative activity. If you're going to be using a lot of swaps, starting off with the LIBOR swap curve is a good way to go because you can immediately eliminate the Treasury-to-LIBOR swap spread and the basis risk associated with that.

You're going to be looking for a handful for scenarios that are comfortable and sensible to the people that you deal with. Again, using forward curves off of your current environment, as opposed to those static yield curves that are part of the old New York Seven, probably is going to get you a little bit further toward getting good market-based information.

When you've run all of your models and decided that you've modeled your assets correctly, you need to think about how you end up using that information for people.

You can estimate durations of both assets and liabilities. Also note that people are going to have some cash to invest. What kind of investments should they be buying? What kind of maturity should they be looking for? What kinds of things should they be trying to avoid? It's one thing to say that we're going to have money at the end of the world if we do things right, but we have to decide whether we're going to have more money this month or next month and how we're going to be able to finance extra activities right now.

Again, I'm emphasizing that if you look at the asset-adequacy analysis, its traditional purpose is different. You're looking at doing a simulation of: What if we did this? Would we be okay under that scenario? With portfolio management, you're somewhat looking for: What if we do something else? The "what-ifs" are probably going to be different from what you do with asset-adequacy analysis, and the scenarios that their people are going to be looking at might also be different. That leaves you then to decide what you need to do to convert your basic ALM or asset-adequacy information into things that are likely going to be used for portfolio management. In communicating these things, it's good to have simple scenarios. Parallel shifts work well in that respect.

You have to ask yourself what the key control variable is going to be. Will it be your rate crediting? Are you really going to be crediting as a simple difference from your portfolio yield, or are you going to be looking at some external market index? For the purposes of doing portfolio management, it is nice to be able to focus on an external index that can be easily communicated to people, something like the moving average of the five-year swap rate plus 50 basis points, for example.

As far as reinvestment in borrowing goes, as Chip pointed out, what reinvestment assumption are you using? A good one for communication purposes is cash. People get their hands on that one fast. That way, you can show your cash balances, and people can see that. It's a tangible thing that people understand and identify with well.

It's good to separate the cash flows on your existing assets from cash flows on new assets that you're going to acquire. When you do this cash reinvestment, that's done for you automatically. Don't look at just the present value of ending surplus. You have to get a present value of assets. You're going to need to get a present value of liabilities. You're going to need to segment the cash flows between assets and liabilities and show them to people separately.

When you're doing this, depending upon whatever organization you're in and where the responsibility for taxes falls, you're either going to want to do this before or after taxes and deal with taxes in a way that will be organizationally friendly.

I think that the issue of using effective duration as opposed to Macaulay duration is probably well-schooled with everyone. You need to look at the price elasticity of asset values with respect to interest rates, which is in the effective duration, as opposed to just looking at the time-weighted cash-flow concept, which is really what Macaulay is.

One thing that you also need to do is recognize that you should be getting a good sensitivity in your liabilities, especially if you have UL products. If you're modeling appropriately, the duration of your UL portfolio will not be something that is approximately equal to its weighted average life. It's going to be reflective of

present values that come out of it. You may find that the net duration of the UL portfolio seems to be unusual, and that's largely because you typically look at net cash flows—benefits less premiums—and the premiums almost end up being treated as if they're fixed and interest rate insensitive. You end up getting a certain kind of leverage built into the net present value of your liabilities, and you want to take that into account when you're talking with people.

That gets into the basic questions. As Chip was saying, you look at judgment. Do the cash flows make sense? Do the durations of these assets and liabilities make sense?

I think the next question is interesting. Does the credit rating strategy reflect what we would do in that interest rate environment if we ever got there? We always sit down and do our rate crediting strategy. We do it on our own, go out and present the numbers to people and frequently don't describe what that rate crediting strategy is. That's important. You need to get to the people and ask, "Would we really do what I assume we're going to do when we get to that spot?" If not, what behavior are you missing? Get back and ask that question. You may have a beautiful model and think that behavior is sensible, but it might not be the behavior that you're going to get.

Finally, is this thing good enough for primetime? If you're talking about making decisions based upon this information, you have to be willing to do it yourself. How can somebody else be willing to do it if you're not?

In general, when we end up doing these things, we end up making recommendations to our investment people about physical trades about where we'd like to see assets being acquired and what kinds of maturity and what characteristics we'd like to have. We also have recommendations for portfolio design and for funding and about what kinds of liabilities we would like to acquire.

For derivative trades, you need to look at sensitivities to determine whether your derivatives are going to be consistent with what you have in the model. The key is that your investment people are probably going to be able to go out and measure their own sensitivities for futures contracts and swap contracts, but they're probably not going to be calibrated exactly with what you have in your model.

Because the volume or magnitude of the trade could be large and could be done quickly, you also want to try to work with them to coordinate, so that you understand that there might be some subtle difference that could change, for example, the number of futures contracts that you'd like to put on by approximately 30 percent. They may differ from your recommendations quite a bit in that way. You need to calibrate their market-based information with your model sensitivity at that same derivatives contract.

Although not asset portfolio management, you should also think about the liability side. Are there things that we can do instead of changing the assets to change the nature of our liability so that it will more closely conform to the kinds of assets that we already have? That's probably not going to happen at the drop of a hat, but you need to think about trying to work with your marketing and product development people to try to create a concept about rate crediting that is consistent with what kinds of assets you can acquire.

We also look at issues about hedges among product lines and portfolios and the other kinds of risks that are going to be there. One of the issues right now is what other risks might offset interest rate risk. The world that we live in is interesting. We're just coming through an environment where stock markets have gone down, and interest rates have gone down. In the '70s and early '80s, stock markets went down, and interest rates went up. As we roll forward, you need to ask yourself if there are going to be circumstances where the lapsed behavior or the profitability of a fixed-rate product is going to depend upon the performance of equity markets.

If there's a situation where you can find an easier way to hedge your net position in an interest rate market than in an equity market, and you believe that the correlation in the movement of interest rates and equities is going to be large and strong, you might want to take the advantage of doing that—essentially overhedging the interest rate risk to offset some of the equity market risk.

Here are a couple of points about stochastic scenarios because they need to be used in many ways. I should say that I'm not a big fan of stochastic scenarios for much portfolio management. I find that they frequently obfuscate issues rather than clarify them. I think partly it's the way in which a lot of these things are created and the results are communicated that causes the problem.

If you're going to be doing this, you should be using a model generator that is in some way influential. Suppose that you plan to use mean/covariance matrix for equity market indices developed from regressions run using the past 10 to 15 years of monthly observations. Will those parameters and model be influential to somebody who is in your trading area or to an economist who thinks about the nature of business cycles?

That economist may not think that the first decade of the 21st century is going to resemble the last decade of the 20th century and that there are good reasons to think that the historical statistics that you're getting out of your sample period aren't all that sensible and meaningful to use for portfolio management going forward. If you're trying to generate stochastic scenarios based upon limited historical samples, recognize that people aren't necessarily going to buy into it.

You need to think about what other kinds of views could be built into that. Is this a decade where we're going to have a lower average growth rate in stocks than we

have had in the previous 50 years? If that's what your primary institutional view is, you probably ought to use a stochastic generator that reflects that.

Chip did a good job of dealing with the issues of those biases, so I'm not going to go on with that any further.

I want to remind you to look at who your audience is when you're looking at this. Sometimes it's people beyond the people who are skilled in a lot of these statistical nuances that actuaries know. You need to be able to communicate where we are clearly. I like the idea of showing the distribution of equity market returns using something like a histogram so that people get an idea about what kind of returns are generating the results that you're going to be presenting. If you're doing this for interest rate scenarios, can you tell me where my level scenario would have fallen in this group of 100 or 1,000 scenarios that you ran? Would it be the median? You'd be surprised how many people think that the level scenario should be your 50^{th} percentile run. It's not always going to be.

The other thing to think about is: If you take a look at the top or bottom decile of your runs, do they share something in common? Graph them out and see what happens. A typical situation with variable annuities (VAs) might be that any scenario that has a quick drop in the equity market is going to be in the bottom decile, and anything that has a quick rise is going to be in the top decile, and the stable things are going to fall in the middle. It doesn't matter what the average return is over 30 years. What goes on in the first few years might be driving your results. You can see that if you graph the actual returns that are generating these numbers.

You have to ask yourself what kinds of economic environments give rise to these scenarios. Is it an economic scenario that we're likely to experience?

As I said, if you can't rerun everything, do the best you can by trying to explain that if we look like we don't do well in down scenarios, we need to buy longer assets and put some kind of swaps or floors on.

If you can, think about how you might want to adjust the credit rate. One other thing that you can do is try to change the variables that you're presenting to people to move them out of the pure economics of market values and present values and try to get into the emergence of earnings and how these things affect them.

You can create a more general risk review where you basically compare present values and the emergence of earnings over a business plan as it is affected by various kinds of risks. You can look at an interest rate risk and how various divisions might be affected by an interest rate event, both in terms of its present values and fair values and in terms of emergence of GAAP earnings.

You can look at the magnitude of the relative risks that are facing your company, and perhaps instead of spending all your time trying to worry about dealing with a particular interest rate risk—that is in fact quite unlikely—spend more of your time worrying about a persistency issue or liquidity issue that you find may have a bigger effect on the company.

Finally, one of the other things you always want to do when you do these is to think about the qualitative effects. The models are giving you numbers, and let's not confuse precision with accuracy. Let's think about the general tone of where we are, and whether we are missing things. Are we including things or the numbers in the approximate right order of magnitude?

This is a wrap-up. When you're looking at M in ALM, don't confuse it with measurement. Remember that you're going to be using it for management as well. When you present these kinds of information, you need to think again of the people and the backgrounds of the people who are going to using them. That's why you need to think about changing the information around so that instead of asset-adequacy analysis, it becomes portfolio management information.

MR. WALCZAK: I'm going to revisit the easel quickly to see how we're doing on topics. That was a lot of information to have thrown at you in the morning.

I want to talk about embedded options and product pricing issues. Let's start by talking about some of the driving forces. This should be fairly familiar, so we won't spend too much time on it, but certainly the EIA market has taken off in recent years. We'll touch on a few points about why that is and why it's interesting.

VA guarantees need no introduction. Coming from an accounting firm, the accounting drivers are interesting, and they're ever-present in audits and in audit review meetings. The work of the required capital group on C-3 risk is starting to interface with these embedded derivatives and interest scenario generator topics. Finally, the low-interest-rate environment in itself is interesting because it's causing people to think more about derivatives.

Let's talk about the EIA market. Certainly, it's a product that provides a new point on the Markowitz risk return frontier for policyholders because it's a fixed and VA hybrid. It invariably requires hedging by the company, and the crediting structure of the product or benefit structure is going to define the asset purchases needed and the hedging that's going to take place. Trying to keep things asset-model-focused, when you buy assets to back an EIA, you have to start with a crediting or benefit structure of the product. FAS 133 is a topic that's aging a little bit, but it dictates the GAAP accounting treatment on a product like this.

A company can give itself some latitude on the backend to get out of some of the embedded option terms that it's locked itself into by redeclaration of participation rates and other possible flexible parameters.

When you model assets behind an EIA, you're going to take your pot of assets and partition into a group of base assets that are supposed to mature into the roll-up of the guaranteed values and also a pot of assets that are intended to hedge or back the equity participation factor.

Determining this hedge reinvestment strategy in an asset/liability model for EIAs is a challenge, and you shouldn't necessarily trust the results. You should go over them again with your portfolio manager and ask whether it makes sense. Are my values valid? It's something that's going to take on a look of authenticity quickly because of its complexity, but the level of trust is something that you should continually question.

Valuing that hedge asset in the future, in your model in itself, is a "how do you do it, what if" question, and many of the projection models have the simpler assets or even a Black-Scholes formula embedded in them. Often you're going to have to use externally projected assets or some sort of approximation techniques. I talked to an actuary a few weeks ago who takes Black-Scholes functions such as an AX + B function of a Black-Scholes formula as the X and tries to parameterize the future based on a fit. It's too complicated to use Black-Scholes, but if you use a function of Black-Scholes, maybe you'll get close and maybe your model will run in one night instead of three weeks.

Finally, there is the stochastic on stochastic topic. You go out with 100 scenarios and at each no in the future, you branch 100 more times. You can overrun hardware that's going to be invented 30 years from now with that kind of a model, and it's impractical but desirable for a product like this.

The growth in VA guarantees is interesting, because it is something that the actuaries didn't demand, and the consumers probably didn't demand. It's something that companies use to distinguish themselves and think might be a bell and whistle, so let's add it. Companies have been vulnerable to losses because of those guarantees that were somewhat arbitrarily slapped onto VA contract chassis. Guaranteed minimum death benefits (GMDBs) have been around the longest, but some of the perturbations of the new features that are coming out and some of the new riders are continually challenging actuaries and asset managers as to how to deal with it.

The cost of writing, valuing and reinsuring these has had people scratching their heads for the past few years. We're going to talk about some specific valuation techniques and why some are right and some are wrong.

We've been using this nomenclature VA GM*B to describe these benefits at Deloitte lately, and I think somebody at a client company originally suggested the phraseology, so I'm going to continue with it. The underlying and payout structure on the liabilities is complex. They are typically not tradable assets that are available

to provide a perfect static hedge. Inherent in the value of the liability-embedded option are policyholder behavior assumptions that have not been validated yet, so the accurate value of the liability is guesswork to the degree that the assumption has not been validated.

Reinsurance, custom options (getting a Wall Street house or somebody like that to write a custom option) and coming up with a dynamic hedging strategy are certainly there to mitigate risk. The reinsurance market is thin right now, arguably one or one and a half writers out there for this kind of coverage.

The S&P 500 VIX is something you can track with your stock quote lookup system on any of your Web sites, and it's the implied volatility in the S&P 500. It's a great graph to look at historically because between 1993 and 2003, it's gone from low and mid-teens to well over 30 at times. It has used 30 as a local mean lately, but the Black-Scholes formula shows you that the option cost is directly proportionate to that volatility term. You can read into it that the cost of hedging or insuring has effectively doubled in the past 10 years and should have doubled. The model that is used today should not be the same one that was used in 1993 when the company rolled out its GMDB unless it's been reparameterized.

Creating a model to cost these features and project cash flows and earnings is going to be based on stochastic scenario generation. It has to be because there's no closed-form solution to value the options in an option-valuation premise context.

Choose your generator carefully. I submit that the risk-neutral cost of the option is the best metric since the counterparty on the asset side is going to be using risk-neutral valuation to put together a synthetic hedge or reinsurance market. Pricing a basic option is going to use a risk-neutral paradigm.

For an asset model for a VA, you have separate account assets, hedge assets and general account standard assets to back general account surplus that's accumulating. You have a dynamic activity occurring in the middle, and the result of your model is going to be distribution of earnings, be they GAAP or distributable earnings on a GAAP stat basis. You have determination of your reserves for the embedded options and validation of your future hedge strategies and other investment strategies.

Let's start getting some practical examples. The way that I value a guarantee on any of the field work that I'm doing starts with a risk-neutral valuation model. We have a number of them that we use at Deloitte that are maybe no better than other risk-neutral models, but the one is powered by a model called the Smith Model, or TSM, and there is nothing in the parameters for Mu or Sigma for equity growth, implied volatility or equity volatility. It's baked in, and it's a parameterized, risk-neutral model that has a daily calibration that has that stuff baked into it. Our parameters are around the liabilities, and this is going to calculate values for GMDB and guaranteed minimum income benefits (GMIBs).

We're going to say that the cohort has 15 years to retirement. We're going to use 2,000 scenarios, a random seed of one and a fund value of 1,000 with no accrued guarantees. We can do this for an in-force block by saying there are accrued guarantees of 15 percent of the fund, a simplistic or unrealistic rollup rate of 2 percent, a guaranteed annuitization basis for GMIB of 4 percent, 10 years for payout and a unified decrement rate of 10 percent lapses and deaths baked into one.

Chart 7 shows the at-issue case. The blue-hockey-stick-looking line is the distribution of cost across the 2,000 scenarios. The green line is the mean of that hockey-stick distribution. For lack of a better term, how about actuarial present value when you get 2,000 scenarios, and you average the cost that you got out of it? Actuaries have typically gone with a mean of a big distribution as a first value.

The Wall Street answer or risk-neutral valuation answer is going to be higher than that in a high-volatility environment. In this diagram, the green line is out about 15 basis points of fund value on an annual cost basis, and the red lines are closer to 30 or maybe 27 basis points. Again, this is at issue.

When equity is dropped by 17 percent one year out, the contemplated future cost on an actuarial present-value basis is going to be about 60 basis points per year of fund value, and the Wall Street or risk-neutral answer is going to be about 90 basis points. If you started out by trying to value these when your company came out with them, and you were taking the mean of the stochastic distribution and getting the green line answer and then going to the reinsurer, to Merrill Lynch or to a Wall Street counterparty and saying, "Take the other side of this for a price close to that green line," they would shake their heads and walk away or offer you the 90 value with a profit loading or risk loading. There was that disconnect and the period where the hedge market and reinsurance market for these benefits started, insurance companies thought that the Wall Street people didn't understand it or were trying to gouge them. They weren't using a risk-neutral paradigm to try to link the two together, and that's probably the more realistic reason why there was a disconnect when the products first came out.

Chart 8 shows two years out with a 35 percent equity drop. Again, I want to throw in the disclaimer that this is an arbitrary model. The calibration of the risk neutrality is accurate and robust, but the product features again are used for this demonstration. You have a 200-basis-point contemplated cost for the actuarial answer, and maybe a 270-basis-point cost for the Wall Street answer.

We can observe one thing that's happening. As the options get more in the money, the difference between the two answers starts to compress, and the reason for that is there is more intrinsic value versus time value, and it's the time value piece that is more the unknown with more moving parts.

When you look at option valuation on a GMDB and look at a single issue year and the cost and how it grades off, you see this decay that's typical of time value, intrinsic value and paradigm of an option value in that you're paying for a lot of time value early, and it disappears and grades off. Underlying the GMDB is the assumption that equity market will catch up and reduce your ultimate cost so that the approach is zero as T approaches infinity or the expire date or limit on your product.

Chart 9 is an implied volatility surface that underlies the model we just used. You can see that this dimension is percentage of equities. I believe we used 80 and 20 or 60 and 40—something heavily weighted toward equities—and this is the term of the projection and this is implied volatility on the Z axis. The surface is the resulting graph, and it shows you that at 100 percent equities were pretty much in this model using a low 20 percent volatility surface with all equities for this particular case. As you weigh more toward bonds and cash, that implied volatility is going to drop, and that's something that you should be thinking about in valuing these as an implied volatility model or surface.

We won't spend a lot of time on it, but Chart 10 shows a GMIB example, and in our case, it's much more of a hockey-stick shape with less slope to it, and it's because we have a longer weighting period and no dynamic utilization of the benefit. There are only a few scenarios out on the tail where the cost is going to spike up.

Let's talk about some conclusions on asset modeling for VA guarantees. The counterparty or reinsurer price of hedge—let's continue to use the phrase "Wall Street answer"—will seem too high to you if you use an actuarial present value or mean event scenarios approach.

Using the right approach for scenario generation and capturing the option of cost distribution tail and the asset price are going to provide you with a higher-quality work product. At least it will provide you with more understanding or more ability to explain and link the portfolio managers or people who trade options with your company management.

Asset valuation methodology is less sensitive as your options get in the money. It matters less what you use to evaluate if equity markets are completely in the tank or have gone up 30 percent a year for the past five years. It's the middle case that is sensitive.

The C-3 group on required capital for VA guarantees has been putting out some interesting updates, and they're available on the Academy Web site. They're interesting, and I recommend reading what they're saying. The work that the members is doing is gathering a lot of these concepts together and asking what we should be using in the next few years for required capital for interest scenario generation. Some of the questions that they're raising and answering are going to be best-practice scenario generation clues for any kind of a use of a scenario

generator. Getting into the debates that they're having and attending their meetings is recommended.

They want to calculate capital using the conditional tail expectation (CTE) approach. It's an average of the tail of a distribution of all the worse scenarios for a certain percentage. View that as total capital and then subtract the reserve from the stat reserve methods or various methods used for these guarantees. The excess is going to be considered the required capital piece, at least in the most recent June and March reports that they put out.

They're giving you calibration standards based on these wealth ratio metrics. They're saying this scenario should roll off at the 75th percentile, with factors of 1, 1.2, 1.4. They're basically time-dependent accumulation factors that can be used to calibrate an equity model generator. There are some different model metrics out there. There's a regime-switching normal model metric; there's an individual regime metric; a single regime and the tables that they're putting out there are good and can be used for gut check on any equity generator.

They're pointing out, too, that both the left and the right tail of the equity distribution is important for pricing and valuing these benefits because the drops on one end of the table are going to drive in ratcheting. A policy that ratchets up that has high or overly high returns could set these water marks too high, and the drops could cause a bigger chasm if a high mark was starting too high. You want to worry about the high and the low marks on these ratchet products, and the work that this group is doing is contemplating that as well.

Finally, the state of New York believes that the mean equity return implied in the AAA calibration might be too high. In other words, it might not be conservative enough or realistic enough on an actual asset pricing basis, and they've submitted a comment on that.

We'll talk for a minute about the low-interest-rate environment. Despite the recent pop-up of the yield curve, we're still in a historically low interest-rate environment. As Hank pointed out, companies are mitigating that risk with the use of floors and swaps and other interest rate derivatives. It's harder for an interest rate hedge or a group of products that you're hedging with these swaps and floors to show effective hedging or hedge strategy to your management going forward than it is on something like an EIA where your asset has an explicit movement with the liability, and you can demonstrate effective hedging in an easier manner.

The current environment has certainly caused callable bonds and mortgages to be called away by the lender. The lender has the right to do so by the prepayment model or by callability. As a result, the turnover of fixed-income portfolios has resulted in lower yields and shorter durations. Dealing with that is a constant challenge to the investment actuary, portfolio manager or asset/liability actuary.

Asset models for insurance companies are going to become more robust regarding prepayment models and callable models because we've just gone through a period of that precipitous interest rate drop, which is new. Never before have insurance companies held so many mortgage-backed securities or mortgages in a declining environment, and validating these prepayment models—be it the Andrew Davidson model, constant percentage model or the Public Securities Association (PSA) model—is what people should be doing right now. They should go back and say, "Three years ago, what did my cash-flow testing model say we were going to get for prepays? What did we get? Why were we wrong? Let's go back to the quant types and revisit the parameters in the model."

For explicit valuation of embedded derivatives, much of the subject matter is on the exam syllabus for the asset parts of the exams, so we won't talk about it too much. We'll enumerate the fact that there are models out there, some of which are practical and some of which aren't: Black-Scholes, lattice methods, accrued Monte Carlo method and sophisticated method and some of these proprietary vendor calibrated models.

Black-Scholes is parameterized, and it is good for call and put options and combinations of such. Software packages such as MoSes, ALFA, FinCAD and Prophet have embedded Black-Scholes functions in them, but again there are five arguments, and you have to have a derivative that fits that five-argument chassis or function of that chassis, or you're not going to be able to use that functionality for your derivative.

The lattice method tries to use a discreet lattice structure to value. When you try to program that, you're going to run into run-time difficulties. You're also going to run into the limit of the partition getting smaller and smaller, being good for interest rates and not good for equity generation. There are some good papers out there; all you have to do is use general Web search engines to find them. Tom Ho wrote a paper a number of years ago also on sampling a 10,000-path lattice for efficient subsets that reproduce the value—the whole lattice.

Here's a brief look at a lattice valuation from the actuary versus Wall Street method again. Maybe this should have come first, but I want to use it to cement in the concept because I know a lot of you have seen this before. Let's look at a paradigm where we have a bond growing from 100 to 105 in value over a year with probability of 100 percent. Let's say it's a strict U.S. Treasury, and then let's say we have an equity that could grow to 125 or drop to 95, and the actuary in actuarial present value manner assigns a 50/50 probability with a limit of 1,000 scenarios (1/1000 per scenario). The call option value pops out as a 50 percent weighting of the ultimate price less the strike price, and you get 25/ 2 * 1/(1+ i), with the big question of what i to use.

Here's the Wall Street approach or answer. The bond grows to 105 with 100 percent probability and certainty. There's no risk there. Your risk-neutrality

paradigm has been defined. Your equity is the 125 and 95, but the one-third and the two-thirds fall out of equating the equity value to the bond value. You're solving that equation so that there is no equity risk premium, and that's how the Wall Street model or the actual options market is working to try to value the embedded derivatives that you used to hedge.

The Monte Carlo (crude) method, and I know this from the old days of trying to crudely price a GMDB, is that you might take a mu/sigma, one regime random walk and try to validate it without any help from an investment professional and maybe do some crude mappings of fund types and allocation. Your output looks and feels robust when you start to exhibit it, so maybe you gain some false confidence in it.

Method two is sophisticated Monte Carlo, and that's when you know something about generators. You know what your ultimate goal is going to be, and you match the two together while maybe you segregated your fund types in a robust manner, and you use a seriatim treatment and dynamic linkage.

The homegrown tips so far are when all else fails, or if you have no other reason not to use a risk-neutral option valuation method for embedded derivatives, test a large number of scenarios if you can and scale down the size until the values start deviating and get a test for how many scenarios to run that way.

Go outside of just actuarial publications to finance publications for broader treatment of derivative modeling. Don't trust your vendor's software for projecting future option values. Take the values to people who do this, who trade options, and ask whether it meets their test, because often the vendor has dealt with it, but not in a robust enough manner to satisfy the people that you're going to have to satisfy when you present this model result.

Finally, follow this NAIC risk-based capital working group. They're doing great work. I'm going to close with a survey of some of the scenario generators that are out there without any kind of a bias toward one or the other. I'll give you information on how to find out more and encourage you if you're using scenarios to research these on the Web sites, to find out more about the risk-neutrality paradigm and to answer some of the questions for yourself.

Vendors are selling two model types called statistical versus economic. A statistical model uses historical time series analysis, and economic uses asset pricing theory. Statistical model projection forecasts are based on past data patterns, and economic models use market price calibrations on the date of valuation. Interpreting model output is done by statistical models by thinking about extra assumptions for horizon and risk tolerance. One example might be five drops of more than 20 percent for the S&P 500 per X number of years as a validation statistic or a minimum or maximum or a 95^{th} and 5^{th} percentile to capture the tail.

In a proprietary versus published grid of some of the ones that are out there that I found, on the published statistical side, or this past data fit side, you have Wilkie, Teeger-Yakoubov (TY) and Whitten-Thomas models, and a Hardy Regime-Switch model that Canadian actuaries have been using. On the proprietary side, CAP:Link and the model Swiss Re are both used in the statistical category. They're good models.

On the economic published side are some types of random walk models, jump, equilibrium models, Cairns models, Barrie & Hibbert_models and the Timbuk1 model, which our U.K. capital markets group at Deloitte publishes free on its Web site.

The Smith model I talked about is a proprietary economic model that has asset calibration and market calibration, and that's all I'll say.

Here are the Web sites:

- Wilkie: http://www.inqa.com/WilkieModel.htm
- TSM: http://www.deflators.com
- CAP:Link: https://www.towers.com/globalcaplink
- Timbuk1: http://www.timbuk1.co.uk
- TY: http://www.sias.org.uk/papers/model.pdf
- Barrie & Hibbert: http://www.actuaries.org.uk/library/proceedings/fin_inv/2001/hibbert.pdf

Let's talk about the Hardy model. It's this two-regime model where you switched from a bad state to a good state, there are like-minded paths down and one outlier. That's typical of a Hardy regime-switching model.

Finally, here are some of the properties we talked about that are in the vendor-calibrated models. Arbitrage-free means you can do what-if investment scenario testing or strategy testing, and you won't get scenarios that won't work in real life. It's foolproof for not getting, "Let's go into all callable bonds because the model says so."

We've discussed risk neutrality. Equilibrium or market calibration is the property that says this will reproduce asset values that equal what's traded in the market today, and some models have it and some don't.

Jump discontinuities include a large number of small jumps and a small number of large jumps to all asset classes, including interest rates, currencies and equities. If you're a dynamic hedger or if you've studied it or you've heard any of the shops come through with presentations on dynamic hedging, a model with this feature is going to find the weaknesses in the dynamic hedging strategies with some of these large-jump discontinuities. You may hear levy process, too, which some of the newer models include to make sure that those things happen.

Finally, what we use in TSM and Timbuk1 to value cash flows is a deflator, which is a stayed price discounted value that replicates market prices as of today. PWC has experimented with the deflator models in Europe as Deloitte has, and it hasn't quite caught on in the United States to the degree that it has in Europe so far.

If we don't have any questions, we want to take a quick look at the topics you brought up and make sure that whoever asked the questions has a chance to ask follow-up questions if the original questions weren't answered. Hopefully we've talked about embedded options in liabilities to the degree that EIAs and VAs have them and gave some of the techniques that you can use to value and think about them.

We didn't get into specific mortgage prepayment rate models or validation of models. That might be a topic for a session of its own: Here are the five models most commonly used. Here is what they would have predicted three years ago and here's an actual versus expected analysis. Are there other observations or questions on mortgage prepayments from the panel or the audience?

We discussed hedge assets for some of the embedded options we were talking about, using some of these custom assets that the Wall Street houses are producing or dynamic hedging. This is just going to be done with a portfolio of equities, equity derivatives, cash short and long, all to try to match the Greeks, so to speak—the first and higher moments of the distributions of the change in these assets.

Concerning the modco derivative issue, suffice it to say that if someone else is holding assets, and you're relying on investment income based on the experience of that asset portfolio, which happens in the modco reserve transfer, there's a credit risk issue or a nonpayment issue, and that's the tough part. How do you estimate that? How do you quantify that? The emerging practice on that is not in. It has yet to be determined. You're going to be hearing a lot more about that in the next year.

In regard to liability duration analysis with respect to UL, Hank might want to throw out a comment on that. Can you tell us anything about a UL product and trying to match duration or convexity?

MR. MCMILLAN: The one thing I mentioned when I was speaking earlier was the issue of how you deal with the renewal premiums and how you want to structure your crediting strategy as a marketing device. That's essentially what you need to work that out. It was my experience when I was doing that several years ago that the models that we were working with typically had a fairly insensitive premium structure in them. Based upon that, you would think that you should have your existing asset portfolio extremely short. That didn't seem intuitive to me. I don't know how many other people feel that.

Just now I was putting some numbers down. Suppose the reserve value or the account value is $100, and that consists of $150 at present value benefits less $50 of the present value of future premiums that you have, so you have an asset with $100. It turns out that the duration of your premiums is eight years. What should be the duration of your assets to get you an exact duration match on that?

If you have duration of 150 at three years, that's 450 duration units. You have minus 50 million of premiums, which is a duration of eight, which is 400 duration units. That's 450 minus 400, which means 50, and you divide that by 100. That means the duration of your assets ought to be one-half year. That says either that you don't want to do it that way or you do want to do it that way if you're that confident that your premiums are going to be coming in regardless of what happens to the interest rates. That's the quandary that you have to get through in your model to make sure that it makes sense.

MR. WILLIAM A. ZEHNER: I had a question on assets and the issue of pledged assets. I know there are no clear references to exactly how to handle pledged assets in cash-flow testing where you have pledged assets and may not even have borrowed yet on it, but they're pledged as collateral. That's one issue. Another issue is where you're overcollateralized. I'm wondering whether anybody has any guidance on this.

MR. JAMISON: Unofficially, what I do is I make sure that I allocate assets to those that are pledged first. For instance, we do some dollar rule strategies. Usually we have a lot of cash to help mitigate our position, so we're using something in the area of additional cash, and I make sure that that gets allocated first to match off of it. In other cases where assets are specifically pledged for something, we treat them as not available for the regular lines of business.

Chart 1

Front-End Assumptions

Spreads and Defaults

	3 Month	1 Yr	3 Yr	5 Yr	7 Yr	10 Yr	20 Yr	3 Month	1 Yr	3 Yr	5 Yr	7 Yr	10 Yr	20 Yr
	Treasury Curve (Bond Equivalent Yield)													
	1.57%	1.53%	2.02%	2.63%	3.25%	3.63%	4.75%							
	Bond Model Spread Constants							Bond Model Multipliers						
Treasuries	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
AAA Bonds	0.20%	0.25%	0.30%	0.35%	0.37%	0.40%	0.45%	1.0060	1.0070	1.0090	1.0110	1.0126	1.0150	1.0210
AA Bonds	0.30%	0.35%	0.40%	0.45%	0.47%	0.50%	0.55%	1.0130	1.0160	1.0180	1.0210	1.0242	1.0290	1.0350
A Bonds	0.50%	0.55%	0.60%	0.65%	0.69%	0.75%	0.85%	1.0190	1.0220	1.0260	1.0300	1.0336	1.0390	1.0460
BAA Bonds	0.85%	0.95%	1.05%	1.15%	1.19%	1.25%	1.35%	1.0300	1.0360	1.0410	1.0430	1.0486	1.0570	1.0670
BA Bonds	2.05%	2.20%	2.35%	2.50%	2.56%	2.65%	2.80%	1.0350	1.0400	1.0450	1.0500	1.0540	1.0600	1.0700
B Bonds	2.40%	2.60%	2.80%	3.00%	3.08%	3.20%	3.40%	1.1050	1.1200	1.1350	1.1500	1.1620	1.1800	1.2100
C-CAA Bonds	4.25%	4.50%	4.75%	5.00%	5.10%	5.25%	5.50%	1.1400	1.1600	1.1800	1.2000	1.2160	1.2400	1.2800
	Model Rates--Treasuries Plus						0.00%	Treasury Spread						
Treasuries	1.57%	1.53%	2.02%	2.63%	3.25%	3.63%	4.75%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
AAA Bonds	1.78%	1.79%	2.34%	3.01%	3.66%	4.08%	5.30%	0.21%	0.26%	0.32%	0.38%	0.41%	0.45%	0.55%
AA Bonds	1.89%	1.90%	2.46%	3.14%	3.80%	4.24%	5.47%	0.32%	0.37%	0.44%	0.51%	0.55%	0.61%	0.72%
A Bonds	2.10%	2.11%	2.67%	3.36%	4.05%	4.52%	5.82%	0.53%	0.58%	0.65%	0.73%	0.80%	0.89%	1.07%
BAA Bonds	2.47%	2.54%	3.15%	3.89%	4.60%	5.09%	6.42%	0.90%	1.01%	1.13%	1.26%	1.35%	1.46%	1.67%
BA Bonds	3.67%	3.79%	4.46%	5.26%	5.99%	6.50%	7.88%	2.10%	2.26%	2.44%	2.63%	2.74%	2.87%	3.13%
B Bonds	4.13%	4.31%	5.09%	6.02%	6.86%	7.48%	9.15%	2.56%	2.78%	3.07%	3.39%	3.61%	3.85%	4.40%
C-CAA Bonds	6.04%	6.27%	7.13%	8.16%	9.05%	9.75%	11.58%	4.47%	4.74%	5.11%	5.53%	5.80%	6.12%	6.83%
				Default Rates				Treasury Spreads net of Default						
Treasuries				0.00%				0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
AAA Bonds				0.02%				0.19%	0.24%	0.30%	0.36%	0.39%	0.43%	0.53%
AA Bonds				0.04%				0.28%	0.33%	0.40%	0.47%	0.51%	0.57%	0.68%
A Bonds				0.08%				0.45%	0.50%	0.57%	0.65%	0.72%	0.81%	0.99%
BAA Bonds				0.26%				0.64%	0.75%	0.87%	1.00%	1.09%	1.20%	1.41%
BA Bonds				1.50%				0.60%	0.76%	0.94%	1.13%	1.24%	1.37%	1.63%
B Bonds				2.40%				0.16%	0.38%	0.67%	0.99%	1.21%	1.45%	2.00%
C-CAA Bonds				6.00%				-1.53%	-1.26%	-0.89%	-0.47%	-0.20%	0.12%	0.83%

Chart 2

Front-End Assumptions

Additional Spread Analysis for Bonds

							Basis Points			
		Accrued	Book	Par	Market		Total	Category	Option	Add'l
Qual	Coupon	Interest	Value	Value	Value	WAL	Spread	Spread	Spread	Spread
TREAS	5.75%	5	760	760	773	0.37	3	0	0	3
AAA	7.12%	79	8989	9000	9902	1.87	21	29	0	-8
AAA	7.12%	9	1000	1000	1100	1.87	21	29	0	-8
BAA	6.25%	47	2002	2000	2002	0.13	437	88	0	349
BAA	6.13%	51	2004	2000	2053	0.59	41	93	0	-52
BAA	6.38%	33	2489	2500	2589	0.79	69	96	0	-27
BAA	6.38%	52	5024	5000	4950	0.84	645	97	0	548
BAA	6.55%	52	10035	10000	10403	0.92	92	98	0	-6
BAA	7.63%	37	3056	3000	3210	1.34	99	101	0	-2
BAA	6.38%	7	974	950	1001	1.37	109	102	0	7
BAA	7.40%	30	10178	10000	10733	1.46	94	102	0	-8
BAA	6.50%	27	10078	10000	10640	1.46	71	102	0	-32
BAA	8.63%	320	9354	9000	9656	1.59	247	103	0	144
BAA	7.38%	12	1019	1000	1091	1.84	83	105	0	-22
BAA	8.50%	10	1035	1000	1108	1.87	111	105	0	6
BAA	6.30%	23	9225	9000	9600	1.96	128	106	0	22
BAA	5.50%	7	3126	3000	3158	1.96	122	106	0	16
BAA	7.88%	392	10395	10000	11025	2	106	106	0	0

Chart 3

Sensitivity

Default Rates

		FACTOR						
Category		AVR Accum	Moodys 1 Yr Ave	Moodys 5 Yr Ave	Moodys 10 Yr Ave	Moody's 20 Yr Ave	Current	Proposed
Treasuries		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AAA Bonds		0.0005	0.0000	0.0001	0.0003	0.0004	0.0002	0.0002
AA Bonds		0.0005	0.0001	0.0002	0.0003	0.0006	0.0004	0.0004
A Bonds		0.0005	0.0001	0.0004	0.0006	0.0010	0.0008	0.0008
BAA Bonds		0.0020	0.0009	0.0015	0.0019	0.0023	0.0026	0.0026
BA Bonds		0.0105	0.0075	0.0129	0.0115	0.0096	0.0150	0.0150
B Bonds		0.0270	0.0393	0.0327	0.0234	0.0135	0.0240	0.0240
Lower Bonds		0.0670	0.1298	0.0556	0.0348	0.0177	0.0600	0.0600
		ACCUMULATION (000s)						
Category	Assets (000s)	AVR Accum	Moodys 1 Yr Ave	Moodys 5 Yr Ave	Moodys 10 Yr Ave	Moody's 20 Yr Ave	Current	Proposed
Treasuries	887,000	0	0	0	0	0	0	0
AAA Bonds	312,000	156	0	31	94	125	62	62
AA Bonds	1,005,000	503	101	201	302	603	402	402
A Bonds	2,357,000	1,179	236	943	1,414	2,357	1,886	1,886
BAA Bonds	2,026,000	4,052	1,823	3,039	3,849	4,660	5,268	5,268
BA Bonds	191,000	2,006	1,433	2,464	2,197	1,834	2,865	2,865
B Bonds	317,000	8,559	12,458	10,366	7,418	4,280	7,608	7,608
Lower Bonds	149,000	9,983	19,340	8,284	5,185	N/A	8,940	8,940
Total	7,244,000	26,437	35,390	25,328	20,458	13,858	27,031	27,031
Wt Average		0.0036	0.0049	0.0035	0.0028		0.0037	0.0037

Chart 4

Sensitivity

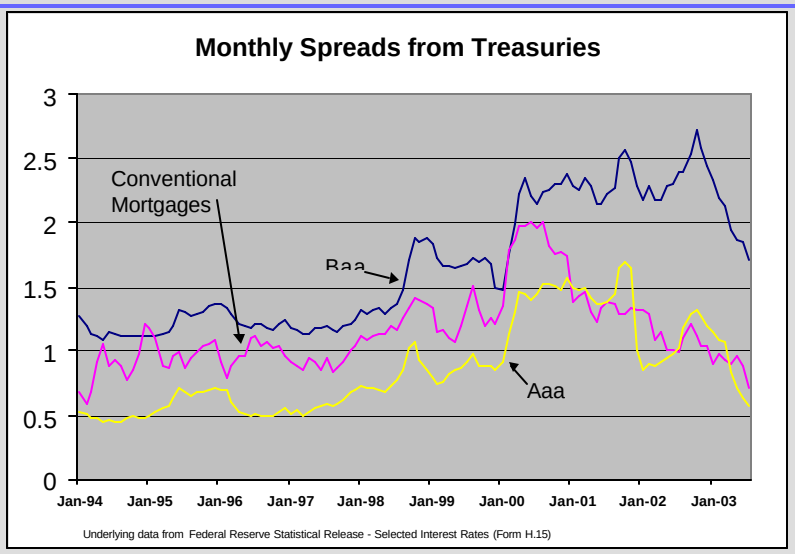

Chart 5

Aggregate Asset Analysis

Asset Summary	Statement Total	Opined Total	LOB 1 CFT	LOB 1 Non-CFT	LOB 2 CFT	LOB 2 Non-CFT	LOB 3 CFT	LOB 3 Non-CFT
Liabilities - Fixed Acct								
Reserves		12,750,545	7,338,982	417,109	539,026	30,490	4,424,932	6
IMR		108,126	108,126	0			0	0
AVR		14,504	14,504	0			0	0
Totals		12,873,175	7,461,612	417,109	539,026	30,490	4,424,932	6
Assets - Fixed Acct								
Bonds - Port 1	7,246,151	6,917,932	4,338,130	62,378	0	16,784	2,500,636	4
Bonds - Port 2	Included	294,999	33,614	0	261,385	0	0	0
Bonds - Port 3	3,251,358	3,251,338	2,038,865	29,317	0	7,888	1,175,266	2
Bonds - Port 4	109,773	109,022	0	109,022	0	0	0	0
Bonds - Port 5	663,790	0	0	0	0	0	0	0
Bonds - Subtotal	11,271,072	10,573,291	6,410,609	200,717	261,385	24,672	3,675,902	6
Stock - Preferred	6,603	0		0				
Stock - Common	516,981	95,089		95,089				
Commercial Mortgages	730,398	730,398	458,021	6,586		1,773	264,018	0
Real Estate	304,526	100,000		100,000				
Sch BA Assets	210,998	114,948	72,082	1,036		280	41,550	0
Index Options	169,536	169,503					169,503	
Cash & Short Term	1,600,157	902,949	391,928	9,636	273,949	1,516	225,920	0
Accrued Inv Income	139,927	139,927	83,829	4,045	3,692	322	48,039	0
Policy Loans	47,070	47,070	45,143	0		1,927		
Grand Total	14,997,268	12,873,175	7,461,612	417,109	539,026	30,490	4,424,932	6

Chart 6

Aggregate Asset Analysis

Asset Model (000s) Start Date: July 2003

Model Name: asbx3 6/30/2002 5-Yr Asian Index Options

6/30/2003 - Actual Level & 0% Equity Growth

Year	Mth	Book Value	Market Value	Accrued Interest	Net Interest	Principal Payments	Growth	Sales	BV Roll Forward
Initial		4,233	4,233	0					
2003	7	10,882	10,882	0	(1)	0	6,649	0	0.000
2003	8	10,581	10,581	0	(1)	0	(301)	0	0.000
2003	9	10,285	10,285	0	(1)	0	(296)	0	0.000
2003	10	9,993	9,993	0	(1)	0	(292)	0	0.000
2003	11	9,704	9,704	0	(1)	0	(288)	0	0.000
2003	12	9.419	9.419	0	(1)	0	(285)	0	0.000

Model Name: asbx2 6/30/2002 5-Yr Asian Index Options

6/30/2003 - Actual Level & 0% Equity Growth

Year	Mth	Book Value	Market Value	Accrued Interest	Net Interest	Principal Payments	Growth	Sales	BV Roll Forward
Initial		4.233	4.233	0					
2003	7	4.426	4.426	0	(1)	0	193	0	0.000
2003	8	4,303	4,303	0	(1)	0	(123)	0	(0.000)
2003	9	4,182	4,182	0	(1)	0	(121)	0	0.000
2003	10	4,062	4,062	0	(1)	0	(120)	0	0.000
2003	11	3,944	3,944	0	(1)	0	(118)	0	0.000
2003	12	3,827	3,827	0	(0)	0	(117)	0	(0.000)

Chart 7

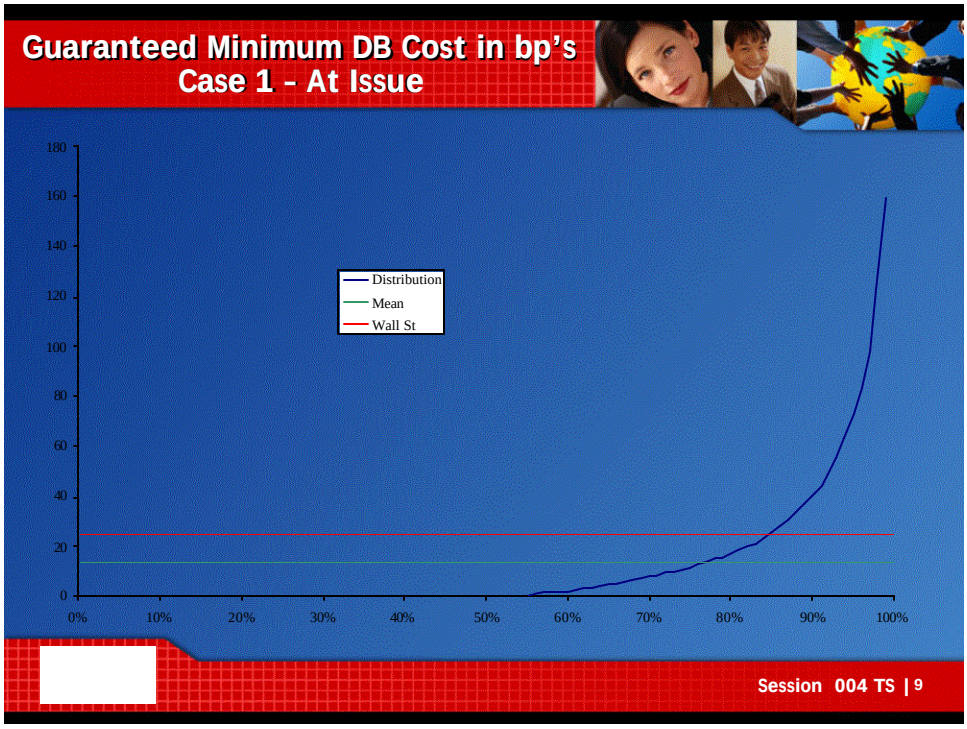

Chart 8

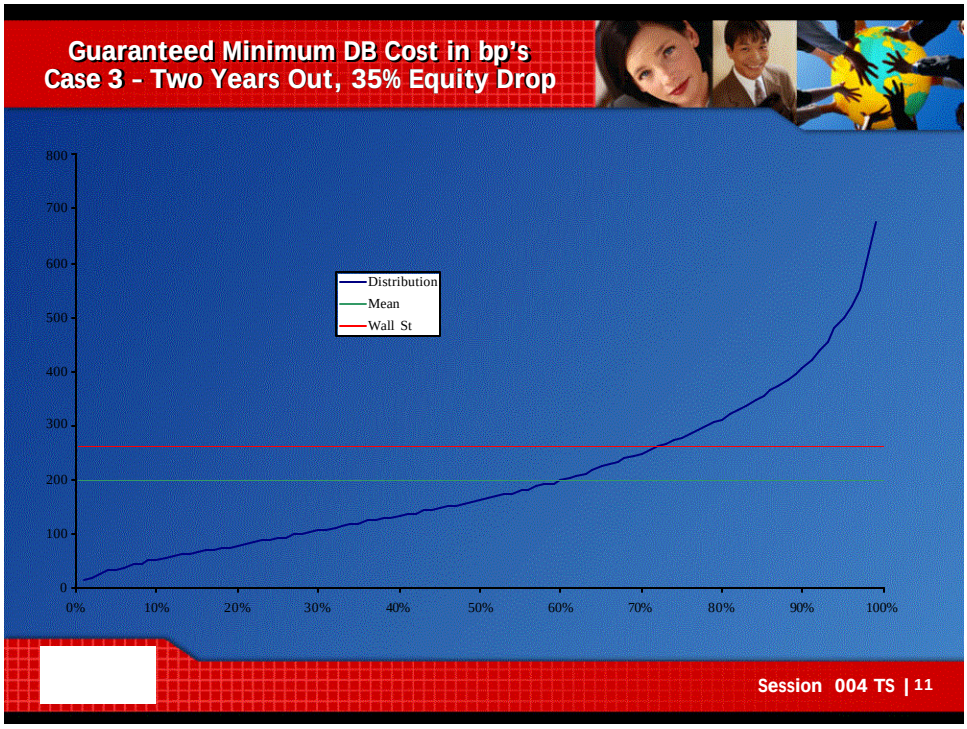

Chart 9

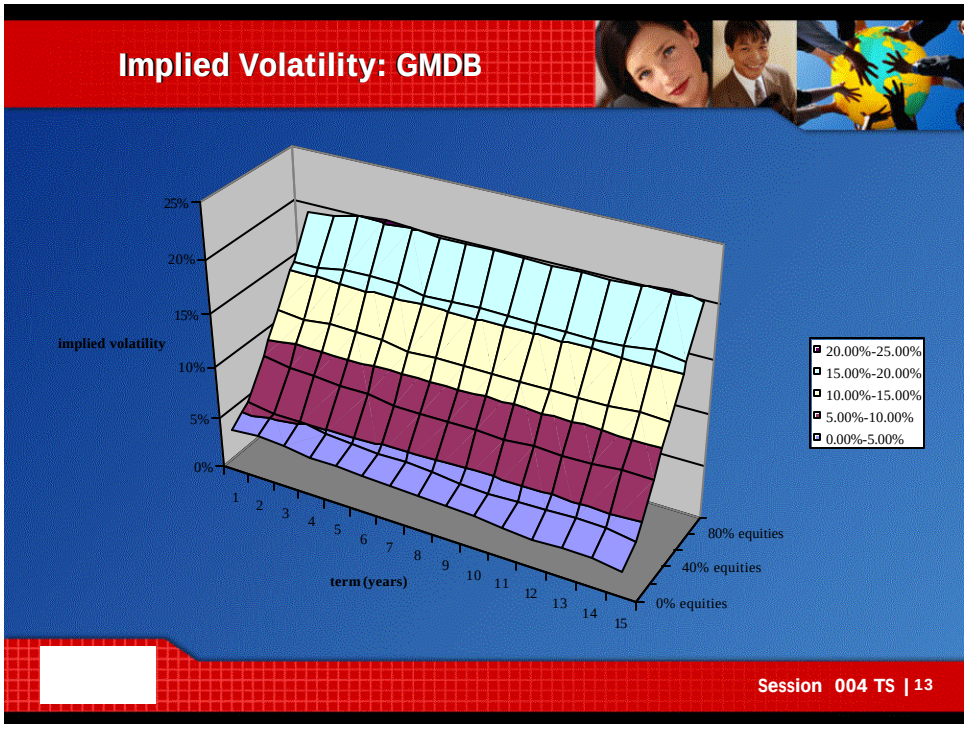

Chart 10