2000 Valuation Actuary Symposium
Washington, D.C.
September 14–15, 2000

Session 45TS
Complex Liability Modeling Issues

Instructor: Douglas L. Robbins

Summary: This teaching session covers realistic liability models for use in asset adequacy analysis, asset/liability management, pricing/repricing, financial reporting, or other purposes. The primary focus is modeling issues for variable product features, such as minimum death benefit guarantees, guaranteed living benefits, and variable immediate annuities.

MR. DOUGLAS L. ROBBINS: I am a consulting actuary by trade. I've worked in the industry for nearly six years now. As a typical consultant, I've done many different things. For a few years, I was concentrating on pricing and product development. Lately I've done a lot of modeling work, helping firms with their cash-flow testing or embedded value (EV) exercises or even a little appraisal work.

Because of the office I work in, I concentrated a lot on variable products and equity-indexed products. People need help with pricing or modeling them in software. That's primarily what I'm going to be talking about today. The syllabus said variable annuity guaranteed benefits and variable immediate annuities (VIAs). With variable immediate annuities, I don't think there's quite as much to talk about. Therefore, I'm going to talk a little bit more about equity-indexed products. I've called my presentation "Formulating a Convincing Evaluation of Risk."

There are five subtopics in my overall topic. There is the introduction. It is kind of a Section A and B with Parts 1 and 2 of Section B. There is modeling the past and then modeling the future, Parts 1 and 2. The final topic is miscellaneous issues and a summary.

I'm going to start off with a story that I thought was really funny when I heard it. It is an absolutely true story.

The story involves the annuity actuary for a major seller of variable products. He was riding in an elevator when a broker that he knows walks in and asks him a question that he loved. He said, "How do you figure out what those guaranteed minimum death benefits (GMDBs) should cost?" The actuary thought, "This is great. A broker that actually cares." He started to talk about stochastic scenario generators, and how you put together the mean return, and the volatility. The actuary said, "We project all this, and if the fund is invested this way and that way, what is it going to get to . . .?" Then the broker stopped him. He said, "No, no, wait. What I meant to ask is, have these things ever really cost anything?" Then my friend understood. He wanted to know why we charge for this. He is the broker, so he wants it to be free. This is the 1990s. Look at what equity markets have done, based on the S&P. So that's view 1. Why do we charge for this? This is the 1990s.

View 2 is, are you sure you're properly reserved for this? Of course, this is the regulator's thinking. He thinks about return of premium. If I invested in a variable annuity in 1928, look at what would have happened for the next ten years. Is anything we're doing sufficient to keep us protected in this situation? View 3 is from the valuation actuary. He thinks, What do I do? How do I handle this?

The regulators are the ones that we have to convince that we're going to remain solvent. Take a simple example—the return of premium and the GMDB on variable annuities. Most annuity sellers have at least dealt with a return of premium. Whatever you pay in is what you'll get back if you die, regardless of what happens in the market. From a stochastic standpoint, we might assume it doesn't cost anything. In practice, most people assume it doesn't cost anything or not very much. We can cover this with our product charges.

We'll assume a Great Depression-type scenario could cause your variable annuity (VA) year 2000 issues an average 50% loss over the next 20 years. The average q's are 2% a year. We lost 50%;

therefore, our net amount at risk is equal to our fund. With a mortality rate of 2%, that means we're losing 2% of the fund every year, just on the GMDB. I want to see a show of hands of people whose product charges will cover 2%? That's what I thought.

We have an actual scenario or something pretty close with the Great Depression. That has really happened in the past, where even a "trivial" GMDB could result in at least your variable annuity block becoming insolvent.

The actuary could turn around and say, "Wait a minute. This scenario has happened once in all the time we've had the stock market around." I sell variable annuities every year. The risk is spread. This would only happen to one block. The sales that occurred in the early 1920s would never have gotten that high, and the ones that occurred afterward would help also. That's true, but of course, ratchet benefits are becoming more and more common. What does a ratchet do? It bunches everybody up every time there's a high point. It doesn't matter. All the sales during the 1920s would have bunched up right there in 1929 with a ratchet, if they had an annual ratchet. That means they would have all suffered the same sorts of losses.

Of course, if you have a roll up, that makes it even worse. That means, instead of having a net amount of risk equal to the fund in my scenario, you have a net amount at risk that gets worse every year. In almost no time, it's twice as much as the fund.

It only gets worse, but a GMDB is not necessarily the worst case! Think about a guaranteed minimum income benefit GMIB or worse yet, a guaranteed minimum accumulation benefit GMAB. We all know what these three benefits are. It is possible for everybody to have GMIBs at once, after a certain policy year, if the product is in the money (or the guarantee is in the money). A GMAB is not a choice. Everybody will have a GMAB when they reach a certain policy year, if their benefit is in the money. It is much more explosive than a GMDB.

Equity-indexed annuities (EIAs) have different issues. They're general account products, so, in a sense, you're not guaranteeing something that you're not prepared to back up with the assets you buy (at least in most scenarios). But they start with a much lower coupon-paying asset base than

a typical general account product. Your coupon paying assets, like mortgages or whatever else we use, back the entire reserve, but now you have a lot of your reserve being backed by options that most people purchase. Most people still back these with options.

On a seven-year guarantee point-to-point product, after a Great Depression-style drop in the equity index, what are people going to do? Your options are going to reduce to having almost no value. But you're still going to have this guaranteed cash value floor on these products. If this were to happen, a lot of people would lapse.

That makes it much more explosive than a typical fixed-deferred annuity. Changes in the yield curve, if they depress your coupon-paying assets, could make the effect much worse.

You might say, I don't have to pass a Great Depression scenario for cash-flow testing. What's your point? You don't have to pass any conceivable scenario in cash-flow testing. You do need to become reasonably certain that you're covering moderately adverse situations. The point is that regulators and everybody else realizes that these kinds of products are potentially dangerous, and most are new. New products attract attention. For all these reasons, they're just likely to get more attention than some of your older and more conservative blocks.

We want to be able to convince the regulators that we're modeling the past and the future reasonably well or they're not going to believe us when we say we're passing five out of seven, or six out of seven, or 90 out of 100 scenarios. If they have all these questions about how your scenarios and how your model is set up, what you are saying is not going to matter to them, because they're not going to believe the results.

Furthermore, other than regulators, there's going to be other people that you're going to want to satisfy, and all your risks were properly analyzed. Some of these people have a higher threshold of a number of scenarios passed than the regulators who are looking at cash-flow testing results. Rating agencies definitely fall into that category. They're going to want to know what your surplus is sufficient to cover. They're probably going to want to know it possibly further into the

future. That's debatable. Corporate management, the board of directors, stockholders, and class-action lawyers are going to want to know. So what are we going to do?

Because we're mostly talking about cash-flow testing, we're mostly talking about in-force business or business already on the books. We're going to talk about modeling the past. The subject that I'm mostly going to want to cover in modeling the past is path dependency, but first let's start by building a case.

What information do we typically have about an in-force liability cell? In other words, how do we do static validation for say, a fixed deferred annuity? Does anybody want to chime in? What kind of things do you look for for a fixed-deferred annuity? With this big a group, the chime in thing isn't going to work.

For a fixed-type annuity or variable annuity, I suppose, we want to have the fund value, the reserve, and the cash value. We want to make sure we're matching all of those with our model. Policy count, the average size of the initial premium, and all these things help us to validate, as of the model start date, when we set up a model. Then we also have other dynamic information, such as commissions, expenses, and surrenders. We want to make sure that our model is doing all these things correctly at the model start date. The things that come out dynamically should compare well to recent and future years.

What extra information might we need to correctly model an in-force GMDB on a variable annuity? Let's talk about that. Let's consider the following annuity with our friend that we've stuck with so far. There is the return-of-premium GMDB. Our fund value is $20,000 at the model start date. The single premium paid two years ago also equals $20,000. We know cash value and reserves but, for this, we don't really need to know them. Do we have enough information to test the GMDB going forward? One person in the audience is saying no. What else would you like to know? The age?

The age is going to have a lot to do with the q's. The average age of your block, assuming this is an average fund value and premium, is also going to be really important. There is the distribution of the ages, and that's a good point. If I wanted to be simplistic, I'd say it is just the one average age. What else might you want to know?

You might want to know the partial withdrawals that have occurred, and that depends on the structure of the guarantee in the contract. With some contracts, if you take a withdrawal, it doesn't reduce the guarantee if you already had accrued interest; for others, any withdrawal might reduce the guarantee. So you might want to know that.

Basically, that might tell you everything you need to know for return of premium. Does the answer change if I add a roll up? It does not change that much. The roll up is 5% per year, up to whatever, but if my single premium was paid two years ago, then probably any maximum you have on the contract won't be hit yet. So you can probably tell, just based on this, what your GMDB should be at the model start date. It might be 1.05^2. If you have partials, and if you know when they occur, then you might still have enough information. What if I say the total of premiums was $20,000, but it's a flexible premium product? What do you need to know if you have a roll up? How many deposits have been made, and what is the timing of those deposits, because your roll up base starts when the premium is received. You can't put in premium at the end of the second year and say, I should get two years of roll up on that. If your contract is written so as to permit that, I advise you to stop selling and rewrite your contract immediately.

What happens if we had an annual ratchet? We really need to be able to consider historical values of the fund. Although prior steps required some knowledge of past events, this is what I usually mean if I use the term path dependency. I'm really talking about historical scenarios and/or historical fund values. If I have an annual ratchet, I need to know that first anniversary fund value in order to know where my GMDB is now.

How do I get that? Somebody in your company must have that information in order to administer the product. My experience of dealing with people, even some major writers of variable products, has shown me that it's not always that simple. If you can get the information,

(if part of your evaluation extract is current GMDB or current high watermark GMDB or something like that), then you're fine. To some extent, you might be able to average that but (and I don't really talk about this in the session), you can average it as long as you do it the right way and as long as you're careful. This is true if you're modeling a whole bunch of cells. What's reasonable in terms of modeling and/or estimation? I have found recently with validating recent death benefits, if the market has always been on an upswing you haven't had to worry about annual ratchets too much, in terms of where the high watermarks were. If your valuation date is at a historical high, for whatever your predominant fund type is (large cap for most people), you probably don't have to worry much about it. Cash and bonds tend to not bother a ratchet too much, and the equity market, if it's at a high, then wherever it was last year or the year before is going to be irrelevant.

Otherwise, someone in your firm might need to do some research based on the fund mix that you have in your variable annuity, and based on historical values of indices that you feel track those fund types. See if you can, at least, estimate what those past high watermarks were. Then, dynamically validate that against the death benefits that you've been having to see if it makes sense.

Everything about dynamic validation won't make sense. That's because these guaranteed benefits are sometimes in the money and sometimes they're not. So you can't just look at last year and assume it should be the same as this year. You can, at least, see if you're close.

There is one thing you want to be careful of while you're modeling, in the sense of grouping a bunch of policies and testing guaranteed death benefits like this, that you probably don't want a group of policies that are in the money with policies that are out of the money. You can distort the average amount in the money by doing that. What you have in your GMDB or your valuation extract is probably going to be equal to fund value for the ones that are out of the money, but it's going to be higher than fund value for the ones that are in the money. So you want to look at the net amount at risk to be correct, on average, for the first. You need to have some way of telling your modeling system what your GMDB is, even though it's way below the current fund value.

Let's discuss the path dependency example of a Canadian Segregated ("Seg") fund, just because I think a variable annuity design that works like this is possible, and I expect it soon. The way Seg funds often work is they combine a return-of-premium death benefit with a ten-year guaranteed maturity value. You basically have a return of premium, guaranteed minimum account balance or accumulation benefit. At the policyholder's option, at any time or at least once a year, both of those can be reset to the current fund value. If you don't already have the information on where that is, what is the problem now? Not only do you need historical fund information, but you also really need to know how to correctly model what each policyholder did. It should be available from your valuation system. You really have to know when the maturity date is, and when the last reset was. If you don't already have that information, it introduces a real problem. I actually haven't thought through what I would do if I were going to model that.

On the EIA side, for in-force modeling, the product is different and possibly more complex. The idea is the same though. We need to figure out what determinations made in the past affect the future. What we need to know depends on what our product type is. For a point-to-point design, if we know the issue date, the participation rate and where the index is at the model start date, relative to where it was when the premium was paid, we're probably okay. For a high watermark, we need to have the same kinds of information that we had for a ratchet GMDB on a variable annuity. For an annual ratchet product, none of that is enough. We need to know where we've ratcheted to as of the previous anniversary. Then we need separate information for what has happened since that last ratchet point.

Annual ratchet for EIA by the way, doesn't mean almost anything like what it means for a variable annuity GMDB. If there's a question about that, I'll cover it during the question and answer period. If any of these EIAs have an Asian averaging component, which any of them could, that introduces the further problem that if a policy is in policy month seven, say, at the model start date, you have to know what happened exactly at each of the first seven months of the year that you're in the middle of at the model start date. Otherwise, your Asian average for the first year that you come to isn't going to be correct.

An Asian average for an equity-indexed annuity refers to a product where either just at the end, or possibly as often as each year, the value you take to get your index increase is not the ending value divided by the beginning. It's an average of say several monthly values divided by the beginning. So if you have a one-year Asian average, it basically means the average of January through December's ending dates, divided by the previous year-end date, if a policy were issued on January 1. That gives you your index credit.

I'll throw this last question out. Why could a regulator have even more concern about accurate modeling of past dependency for an EIA than for a VA guaranteed benefit? I'll give you a hint. It's because of the way companies usually choose to back these on the asset side. It's backed with an option. The bonds for an EIA basically only cover the guarantee. The index increases are backed by options, which might or might not be bought on the same day as you issued the liability. Variable annuity GMDBs, more often than not, as far as I know in the industry, are still run naked. In other words, nothing is bought to try to hedge the risk. So if you get your liability modeling pretty close, and it shows enough losses that the regulator is satisfied that you're not cheating, he'll probably be satisfied with it. But a really big deal for EIAs is timing mismatches. You must make sure that you've got your history and your path-dependent information, correct for both the assets and the liabilities. You have to demonstrate that.

There is one more subpoint to that, for variable annuity GMDB. The risk (at the end of the day) is capped at the total amount that you could lose. So if you paid the premium and you're guarantee is return of premium, even if the market just totally crashed, and everybody died (and you know, that wasn't enough to make you not care about your company), that's the most you can lose. But for an EIA, if you're not properly hedged, you can lose the world, because the stock market theoretically can go up as high as it wants to. It has actually done that in the past ten years.

To summarize historical considerations, there are a lot of complex products out there. To accurately model the future, your computer has got to know exactly where it stands at the model start date. You have to have accurate historical information. As a valuation actuary, you're going to have to be persistent with people getting that information. In the rare instances that you

don't get it, you must be able to use judgment in good measure to put together the pieces of your model and get it ready for the model start date.

Let's discuss modeling the future, part one. What is the breadth of economic scenarios that we consider? How many of you have equity-based products and your regulator has said that it's fine for you to run your New York 7 scenarios and just put 9% in all of them, and call it cash-flow testing? How many have had a regulator at this point ask for something more stringent? Many of you don't deal directly with the regulators. For the modeling people, it's the guy above them (who deals with the regulators). Let's at least hypothesize that they might not buy that. What kinds of things do we need to consider on the equity side? I would maintain that we need to consider expected return. We also need to consider actual volatility. This all goes into economic scenario generators, of which there are many. We need to consider the volatility of the equity, and how much we expect it to swing up and down on average. It is usually thought of as sigma or the standard deviation of the annual return. We need to consider implied volatility, which we will talk about later. We also need to consider the term structure of that. If the volatility is not going to necessarily be constant throughout all durations. It probably has a tendency to narrow a bit, at least based on today's market.

That's what I would consider from a scenario perspective. I think, from my product perspective, I would also want to consider the mix of funds that people are invested in, if it's a variable product. That is not so true for EIAs. I would want to consider the level to which people are diversified, as opposed to each person having chosen one asset class and being 100% invested in that asset class.

When are we likely to be affected by implied rather than actual market volatility? Is it true only when testing equity-indexed products? I think that we probably need to test this, any time we have our own hedging program, and we need to know what options are going to cost in the future. That's when we would most likely want to consider that one item out of my list. If you're testing a VA GMDB or some other benefit like that, and not hedging the risk, implied volatility is probably not an issue at all. Of course, actual volatility in your scenario rates probably is.

How might volatility be modeled? There are many different ways, but most of it has to do with the mix of asset classes that you're talking about. You must build it into the scenario rates that you project. If you're buying options, you might build it into an additional rate called the volatility rate. You want to be able to use that rate within whatever modeling software you're using.

There is an additional question about economic scenarios and this is kind of a short section. Why might modeling of a correlation between market forces matter? All regulators are sharp, but what if you have a particularly incisive one, that devotes a lot of time to your product? Why might they think that correlation is a big deal?

For an equity-indexed annuity, we talked about a seven-year point-to-point product. We could really get hurt, especially because of excess lapses if the market drops 50% or 40%. So far so good. That would be really bad. Because it would induce people to say I've got this guaranteed floor. I can take that now, or I can sit here and hope the market recovers 40% just to get back to ground zero. That's bad. If that happens, and interest rates have also just plummeted to almost 0%, are we really hurting from a cash-flow testing perspective? I see most heads in the audience shaking. That's good. That's right. Even though we started with a pretty low fixed asset outlay, if interest rates plummet, that forces the market values up, or we can borrow money to pay our cash out at almost 0%. Either way, we're probably all right.

What if interest rates have skyrocketed? Then are we hurting? Yes, very badly. If we sold enough equity-indexed annuities, maybe the company is insolvent. Let's assume that interest rates are generated, and equity rates are generated, and they have nothing to do with each other. If we assume that there's a 50/50 chance of good or bad equity and a 50/50 chance of good or bad interest, the chance of having both of them turn out against us, would only be 25%, right? What do we usually assume would happen to interest rates in the U.S. that would cause the market to tank 40–50%? Most of our research in the U.S. is based on the past 20–30 years. The implication is that interest rate hikes just foul up the stock market. If that correlation is built into our scenario generator, the chance of having terrible equity and terrible interest scenarios at the

same time is closer to 50% rather than 25. Obviously, it is something the regulators are going to care about. You want to build into your thinking (into your "economic generation of scenarios" thinking) some correlation to be convincing.

Let's discuss modeling the future, part 2. What kinds of decisions will need to be made, and who will be making these decisions? Let's take a fixed deferred annuity, a credited rate product. What future policyholder decisions are we already used to thinking about on the fixed annuity side? What do our models assume that policyholders will do at certain times? What behavior do they vary? Lapse. That's the key one. If our credited rate is not keeping up with our competitors, lapse rates jump up. If our credited rate is above competitors, lapse rates might bounce down a bit.

What company decisions are we already used to thinking about on the fixed annuity side? The crediting strategy. If interest rates go up, we tend to raise our credited rate. If interest rates go down, we tend to lower our credited rate. The thing about that is, in most of these complex products, the idea is the same. The company makes adjustments to try and help itself stay solvent or profitable, and the policyholder tries to make decisions based on what's best for them. They are just trying to make money on these products.

Let's consider a VA GMDB with no reset options. It can be an annual ratchet, but it's a deterministic annual ratchet. If the fund goes up, it does ratchet. What decisions does either party have to make? It is probable that nothing that's going to alter your model really needs to be done on either side. The company really cannot do anything except maybe control the way they invest. The same applies to the policyholder. They bought the guarantee, and they possibly could be induced to lapse if their guarantee is way out of the money. With an annual ratchet, the risk isn't that big either. It's always going back in the money or at least back at the money.

We think about GMABs to the extent that a company has them a lot, because they could be very costly. But most of them are very deterministic, and there's not a lot of decision-making. If there were reset options, that changes things.

Let's consider a benefit that I think is gaining pretty widely in popularity right now: the GMIB for variable annuities. What are the typical features? I'm only going to discuss a very white bread, very typical, noncomplicated guaranteed minimum income benefit—the type to which the Keel method would apply. You pay a premium. Then, the agent is able to tell you that this is guaranteed to have a fund (other than your actual fund) that grows at 5% a year. Starting on your seventh anniversary, and on any anniversary after that, you can use it to buy an annuity. Even if your fund value has tanked, you can use this shadow fund, if you will, to buy an annuity, using guaranteed rates. That's actually not what the agent is going to tell the policyholder. He's going to tell him, "If you buy this, I'll guarantee you for your $100,000, that at your seventh anniversary, you'll get at least, $20,000 a year for life, even if the market has tanked." He's probably not going to go into the mechanisms about the 5% growth, but that's how it works.

In a stochastic environment, the policyholder decisions we need to consider on the downside are definitely annuitization. If the market tanks, you could have an annuitization function up here, where the policyholder annuitizes much more widely than you thought. On the upside, I would say this might not be true for cash-flow testing, just because we're not all that concerned about how profitable we're going to get in cash-flow testing. We just want to make sure we're not failing. But if you're going to do EV and other modeling uses, you might be interested in your average profitability, and, on the upside of a GMIB, that doesn't reset, if the 5% accumulation has gotten you to $1,500 per $1,000, and the fund value has gotten to $5,000 per $1,000, you might have a lot of people try to lapse and reinstate their GMIB at a higher level. So that's a policyholder decision you might consider on the upside.

There are few company decisions related to investment. You really almost can't buy hedges for this, and we'll see why later, but you can invest in a way to try to do some internal hedging for the company. We're not going to talk about that here. For modeling purposes, you're going to have some assets, and that might modify your investment assumption for reinvestments slightly, but probably not a whole lot.

The big risk, as I said, for cash-flow testing is the downside elective risk. What things can we assume to be true? The more in the money a guarantee is, the more likely a policyholder is to

exercise it. In other words, if our shadow fund is up at 1,500 and the fund value is at 1,000, someone who would exercise then, would also exercise at 600 or 200. In other words, there's a breakpoint for every individual and the lower the fund gets, at some point, it crosses that breakpoint. It is at that point, that he would annuitize. I think that's pretty clear. The second one should also be clear, and that's that presence of a commission on your product, for annuitization under this guarantee, is also going to increase annuitization if it's in the money.

Think about a credited rate product (like a fixed-deferred annuity). Let's think about what happens on the excess lapse. The agent sees that a competitor that he sells for is crediting 8%. Whoever he's going to talk to is out of surrender charge. They're only getting 6%. He might or might not be getting a small trail commission, like 25 basis points on a fixed annuity. But if he can get this guy by showing him the two credited rates to switch, he's in for another 7% or whatever he makes on sale.

Let's say there's no commission on annuitization in a variable annuity. Let's say he's getting the same trail commission or maybe it is higher on a VA. It could be 50 or 100 basis points. What does he think about telling the person to put his money into a single premium immediate annuity (SPIA) purchase based on this guarantee. It doesn't pay a commission at issue and will never pay a commission. He doesn't get that 50 or 100 basis points anymore. Obviously, he has no incentive to remind the policyholder that he is in the money on this thing and really ought to do something. If the policyholder realizes that, then the story will be different.

What are some likely assumptions that might, in fact, not be true? The policyholder has some notion of what kind of SPIA his fund value could buy on a current basis. You might think, I've got a fund of $1,500 and we're crediting 6% on new SPIA purchases, so that means he could get $1,000 a month. He could get $1,200 a month on the GMIB. He's in the money. Does the policyholder have any idea? Does he keep track? Do you show him on his annual statement? Does he have a clue what his fund would buy a month? I think the answer is usually not. Another possibly untrue assumption?

Today, the policyholder has a clue about what his guaranteed SPIA would be one, two, or three years from now. The statement you send him might tell him if he has bought this rider that, right now, if he surrendered under the GMIB, he could get $1,000 a month. Does it occur to him that if he waits, because the fund is going up 5% a year, he'll be getting more money if he waits one, two, or three years?

Finally, did the policyholder realize what he was buying? Did he really know what was going on? Does he ever want to annuitize? Does he ever want a stream of cash flows from this product or did he just do it because, when he was being sold the product, he was convinced that 25 basis points was a good price for some kind of safety net, but didn't really understand what was going on?

The answer on that one might be yes or it might be no. It should be considered. We need to set an assumption, based on all those policyholder considerations, so that we can develop a formula for what his behavior is going to be. So let's do an example. Let's take the downside risk example.

I have a 60-year old who buys a $10,000 single premium variable annuity. It has a GMIB. This person has a deterministic lifespan to precisely age 82, because I want him to. I did this to make my example easier so I don't have to do mortality. The guaranteed shadow fund grows at 5% until age 80. For my example, it only matters through about age 70. The guaranteed purchase rate is 2.5% for a 15-year (certain only) annuity when he's 67, which is the first time he can annuitize under the GMIB because there is a seven-year wait period. Remember, it's a life annuity and his life span is deterministic each year.

Seven years later, the fund has grown by only 10%. So the fund value is at $11,000. On the open market, or with our company, he could get a 5% purchase rate for his 15-year certain payout.

The GMIB shadow fund is at $14,071, and you can punch out on your calculator just 1.05^7 times the $10,000 premium. He hasn't taken any partials. He hasn't taken any loans or anything like that that would affect it.

The fund value is at $11,000. Does the policyholder think he is in the money? Does he care? Does he think he is? He actually is, but if he misguesses and thinks that because a certain cash investment account at his bank is crediting 6%, and doesn't realize that there could be a bigger spread on an SPIA, he might think 6% is the right rate. Even if he bothers to work it out, he is going to misguess and think he is not in the money. He is going to think that the fund value of $11,000 can purchase more than it really can for a life income.

Clearly though, if the fund were at $6,000, he would be more likely to guess correctly. This is what I mean by the more in the money he is, the more likely he is to annuitize. If the fund is at $6,000, and the shadow fund is at $14,000, unless interest rates are sky-high, it doesn't take a rocket scientist to understand it. Your average variable annuity buyer might be sophisticated enough to get that one right.

Let's say the policyholder realizes he's in the money. Will he utilize the benefit rate right away? The answer is, it depends. It's because of the things we talked about earlier. He's now 67. He has a 15-year life span, so he can get $1,136 for life per year, discounting at 2.5%. But if he waited a year, the shadow fund would have gone up another 5%, and his life expectancy will be 14 years, not 15. This means he could now get $1,264 per year. If he doesn't need the life income right away, that might mean that he's not going to annuitize. This is true, even if his fund is down at $6,000. You could build a model that says, if the fund is in the money at all, excess annuitize some people. If the fund is way in the money, excess annuitize almost everybody. You could really be overstating the cost from a cash-flow-testing perspective, because it just might be that not everybody is going to take this right away.

There is actually a lot we don't know about that pertains to what annuitization rates, based on a GMIB, will be like. In today's market conditions, they might not be worth anything. If we're trying to model this thing, we at least ought to consider all these things.

Did the policyholder intend to take a life income? Did he realize what he was buying? Was it just a safety net? The answer to that in your portfolio depends on the percentage of people that are buying this. We know right now that annuitization rates in the industry are down around 1% per year, or something like that. Most people that buy variable annuities, buy them for accumulation, not for a life income. If only 1% or 2% of your people take this rider, there could be some antiselection in the sense that those 1% or 2% all intend to take a life income some day. As soon as they can do it, to their advantage, they will say more like 20–30% of your issues buy this rider. Many people are probably buying it, under the kind of weird squishy safety net concept. They don't really understand it and never want to take a life income if they can help it. They want to get all their money out at once, as soon as it becomes available or whenever. Utilization is just not likely to be as high if that's true.

Will any or all of this affect lapse rates? Maybe so. If a benefit like this is way out of the money, it could mean that people are going to lapse to reinstate it. If it's way in the money, I would forcibly argue that your lapse rates that you model should be reflecting that. If someone knows that in two years, he can get $8,000 a year, he is not going to settle for a lump sum of $8,000 on a lapse. So the more in the money he is, the less lapsation he should display.

You want to have a reasonable formula-based interpretation of policyholder behavior, going forward. You ought to be able to tell the regulator, the stockholder, the board of directors, and a class action lawyer, "We're doing something reasonable here. We are showing that we're stable. We can afford to have this benefit and not become insolvent." Some of those guys actually want to make money, even if things turn slightly downward.

The play in this assumption is what makes this benefit difficult if not impossible to hedge? Since nobody knows when these things are going to be utilized, you just can't buy put options. You would also not know what index to hedge, because on a variable annuity, the fund that the person is in, could switch back and forth quite a bit anyway. That's why the company might be thinking about ways to invest on the side that will minimize the cost. On the investment side, you might want to consider that.

We've mostly talked about accurate histories and then policyholder behaviors. There are a few complex liabilities out there, and an equity-indexed annuity is the primary one. I think it requires extensive input on what the company is going to do. For managing a variable annuity guaranteed benefit, your investment data could reflect some internal hedging, but it's not going to be a big deal. For equity-indexed annuities, we actually go out and buy hedge options, as we said earlier, every time the premium rolls over and becomes a new premium for a new index period. For many products, it's just an annual ratchet that we manage every year. Whenever assets are purchased or whenever we reset the participation rate or spread, we need to consider this. That's the way a typical product works. There's a guaranteed minimum floor that could affect the strike on the hedges we buy, or it could affect our participation rate. There's the indexed fund, which goes up at the end of each index period, based on how the Standard and Poor's (S&P) (or whatever index) has done.

Say we have a nine-year product with sequential one-year terms, and we have an underlying fund of 100% of premium, accumulated at 3% a year, with a surrender charge. There is a participation rate of 50%, but we reset it every year, with a goal of keeping our option budget level. The economic scenario could do a couple of things. We might buy a one-year option that has a strike of 3%, which would also be affected by that 50% participation rate. So that, in essence, would make the strike 6%. That's because if we bought options to hedge a notional of half of our premium, then that would double the strike we want to get to before the option starts to have intrinsic value. That might be too complicated an example for the people who don't deal with EIAs. Suppose, based on the economic scenario, the index fund does really well the first year. Let's say it jumps up to 110% of the premium. In the second year, my guaranteed fund goes up to about 6%, and my index fund is already at 10%. It's not going to go down because that's the way these products work. That means my strike has to be considered to be 1.0, not 1.03 for the purchase I make in year two. That's going to make the option more expensive, which might drive the participation rate down.

The product itself could have varying conditions of whether the guaranteed fund receives that indexed credit. If the indexed fund credit also applies to the guaranteed fund, so that it pops up

to 110%, and now is guaranteed to go up 3% again, for the second year, the strike would be unaffected. Then, there is the 5% option budget. That's what we're saying now at the time of the issue of a product or at the model start date, based on what we can earn on our fixed assets. But if our fixed asset earned rate drops way down, we're not going to be able to afford to credit as much on equity indexing because we're not going to be able to afford as many options. We're going to have to buy more fixed assets to cover our guarantee.

For cash-flow testing of equity-indexed annuities (EIAs), you might not need this level of complexity, because you might only care about going out to the end of the next index term. But many people who are concerned about profitability (not just solvency) are going to want to see future index periods. You might need to be able to do all that. In the example I gave, if you just go out and say I'm starting at a participation rate of 50 and that's what it's always going to be, and just run your model, the fact is, that would be the same as having a credited rate product and saying my credited rate is 5.5% and that's what it's always going to be, no matter what happens to the interest rate. You'll just wind up with some ridiculous returns on investment both on the low end and high side. It's just not managing the product the way the company is actually going to manage it. It makes the whole situation impossible.

Miscellaneous issues and summary. I haven't talked much about dynamic validation. I talked mostly about the static side in the preliminary discussion. On most of these benefits, as I said, things change so much based on whether you're in or out of the money, that it does become difficult to dynamically validate. You want to make sure that you're reasonably related to your past death benefits, maturity benefits, or whatever it is that the guarantee is on. If it's not a direct hedging program, you just want to make sure that your investment data relates to basically how your company is going to handle the benefit. That might only be possible by coordinating with other liabilities that are out there.

I think that to save enough time for questions, I'm not going to directly discuss a couple of other guarantees that are out there. There are income tax rider guarantees and guaranteed floors on variable and immediate annuities. You can crossapply a lot of the topics to a different product. There are high watermarks on the equity-indexed annuities and high watermarks on variable

annuities. The GMDB is one example. You can probably think of others. Feel free to try to apply these concepts to any product that I haven't mentioned.

All these new products pose quite a challenge to the valuation actuary, because they pose quite a risk to the insurance company. Try to get it so that you've already thought about what the people looking over your shoulder are going to ask you. You're going to get some scrutiny, but we want you to impress them so much that they don't even come back to your company. They go on to somebody else who is less prepared.

So we want to have correct historical information, reasonable future decision making, and a reasonable economic interpretation of what the future could be. Individual modeling decisions are just huge, and your company is going to be quite unique. These are going to be up to you.

MR. MICHAEL ANDREW DORSEL: I have a question for you on variable immediate annuities. I guess the benefit would be a possible floor to future payments in the annuity. What sort of methods would you use to value that?

MR. ROBBINS: Do you mean as opposed to cash-flow testing it?

To cost a new issue, if you're going to have a floor that's equal to the premium or 80% of premium, you'd want to do the same kind of economic scenario generation we talked about and then figure out what you think your issue mix is going to be. You'd then run it through those scenarios and figure out what (M&E) gets you back to the same profit that you had without the guarantee. We're not concerned with path dependency on an in-force basis for the ones that I've seen. It's more like 80% of premium. You don't need to be excessively worried about partial withdrawals, although some products with a certain period have them. You want to make sure that your in-force mix is right and that you've correctly modeled what you do have as a guarantee at the model start date. I feel like my answer there is simpler than what you're looking for. If you have a benefit that ratchets, when the fund grows, then you have the path dependency to worry about again.

MR. DORSEL: I was thinking about it at the beginning when considering the issue, but I guess the same considerations apply?

MR. ROBBINS: I think I would cost it the same way that I did a variable GMDB, except that I'm not even sure about what the guidance on reserves is yet in the industry. I'm a modeling guy, and I try to stay current on what all the reserve requirements are. I'm quite experienced at building them into software, but if I was afraid I was going to underprice it, the reserve impact would be my biggest concern.

MS. KATHARINE BRANDT YOUNG: How much more complex would your modeling need to be to do an embedded value modeling on equity-indexed products?

MR. ROBBINS: I'm not sure I understand fully what you mean by "how much more complex?"

FROM THE FLOOR: We kept talking about how you might not need to do it for cash-flow testing.

MR. ROBBINS: I didn't say you wouldn't need to do it. What I said is, future company decisions (and I've heard different views on this), might not have any significant guarantee at all after this index period, as far as cash-flow testing equity-indexed annuities are concerned. The regulator might say it's fine to assume a 100% lapse. As long as you don't care about profitability, and as long as you're solvent, you're good to go. It can be immensely more complex if you need to run 100 or 1,000 scenarios and if you have to, for each of those, at the end of the seventh policy year, reassess participation rate, based on option costs, based on the relationship between the index and the guaranteed fund, and based on asset yields at that point. You can get quite a formula and every piece of that formula is pretty necessary to accurately view company behavior. Having it there can get you from a situation where your standard deviation of return on investment (ROI) is higher than your mean. In other words, there can be many negative scenarios. If your ROI has a mean of 12, you might have a standard deviation of 3 or 4. You know it makes you much more economically viable. It could well be that by looking at 100% lapse after one scenario your ROI is 8% or 9%. That's not going to impress any stockholders.

So you're going to need to have those future periods, but they need to be reasonably nonvolatile. Is that helpful?

MS. YOUNG: It just means you really need to do all the scenarios.

MR. ROBBINS: You do for EV or business plans.

MR. KENNETH BONVALLET: I'm interested in the income tax rider you mentioned at the end. If it's what I think it is, it appears to be a benefit that actually goes down in risk when all your other ancillaries are going up in risk.

MR. ROBBINS: I think that's true.

FROM THE FLOOR: Is it really that great? Is it a magic bullet, or is it not as good as it sounds?

MR. ROBBINS: I don't know if it's a magic bullet. The problem is that if you sell a whole bunch of income tax riders and a whole bunch of GMDB, you've sold a straddle. That means you're fine if things stay more or less around where they are or where you expect them to be, but if they shoot much in one direction, like the GMDB, the policyholder doesn't start to pay you if it gets enough out of the money. The benefit is zero from the GMDB level on up. The income tax rider says that if you die with a whole bunch of gains in an annuity, you have to pay not only estate tax, but also income tax and on all the gains. We're going to pay out on a number of basis points per year. Actually, there are ones that work different ways, but for some charge, we're going to pay you 28% or 35% (or more) of your gains when you die, as an additional benefit, to help pay your income taxes. That means that's a benefit that goes into the money the more it makes; however, the GMDB goes into the money the more it loses. But I think they definitely have a lot of negative correlation, and that's good. If you're getting fees from the GMDB, they will help pay for the income tax rider and vice versa. There are still tail risks that, in the income tax rider case, are infinite, because the market can go up infinitely high, whereas for the GMDB, it's capped.