

**1995 VALUATION ACTUARY  
SYMPOSIUM PROCEEDINGS**

**SESSION 16**

**Practitioners' Forum**

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**Michael E. Mateja**

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## PRACTITIONERS' FORUM

**MR. CHARLES D. FRIEDSTAT:** In our initial planning session for this meeting our purpose was to offer something a little bit different. At past meetings and at many of the other sessions of this symposium, the subject matter could be described as predominantly instructional and/or informational. This is a very important function of the Valuation Actuary Symposium, and always will be. The symposium offers a forum where individuals can gain experience and ask questions about the projection of asset cash flows, as well as learn about new NAIC, FASB and tax valuation issues. But over the years the work of the valuation actuary has changed significantly, especially for larger companies, as additional research and experience has been gained in asset/liability modeling. This session is designed for those actuaries who have had significant experience with cash-flow testing, and other basic responsibilities of the valuation actuary, and who take it very seriously. We will attempt to go beyond the basics and deal with the evolving nature of the work of the valuation actuary and what we strive for in the future. We'll deal with some cutting edge work in the area of asset/liability management, some subjective issues on interpretation of results, some ideas on how to improve the quality of cash-flow testing and other financial projections, other uses of cash-flow testing models, and the role and the responsibilities of the valuation actuary in management decisions.

The panelists with me have a great deal of experience and many years of leadership in this area. They have some very strong feelings and a tremendous enthusiasm about the issues that we're going to be discussing. Dave Becker is vice president and chief actuary of Lincoln National Life Insurance Company. He has been instrumental in formalizing the valuation actuary role at Lincoln National and is a thought leader in many areas of asset modeling.

Mike Mateja is currently a consultant with Chalke, Inc., a division of SS&C. He's been extremely active in the area of cash-flow testing and asset/liability management since the early days when this became a very important topic, and when he was corporate actuary at Aetna.

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Steve Sedlak is vice president and corporate actuary of Nationwide Corporation, which is a multicorporate insurance organization writing business in virtually every product line. He's also been extremely active over the years in the broad range of valuation actuary issues.

Mike, I wonder if you could start out by talking about some of the modeling issues and interest rate models, and where we might be going from where we're at now.

**MR. MICHAEL E. MATEJA:** Let's begin with the notion that risk analysis is really at the heart of the cash-flow testing that we're doing as part of preparation for rendering an opinion about reserve adequacy. Anyone who has worked in this area understands that all of the assumptions that are implicit in that the projections represent a way to quantify some of the risks that we're dealing with. Probably the risk that hasn't been addressed head on is the whole idea of the interest rate model. There is an interest rate model implicit in the cash-flow testing. We're all familiar with the seven scenario test that, in effect, defines the hurdle for an opinion that statutory reserves are adequate.

At Chalke we have always supplemented the statutory test and its simple interest rate model with a one-factor interest rate model, which supports some option pricing analysis because it provides another dimension on the issue of reserve adequacy. Quite recently, we've completed a very sophisticated two-factor interest rate model that is clearly indicating that even the one-factor model that we've been using is inadequate to assess the risk. So I would like to present as an issue that we need to consider the need to be sensitive about the risk of the interest rate model that we're using. That risk very simply is that, while we might fulfill statutory responsibilities in rendering our opinion about reserve adequacy, we may not truly understand, in fact, the underlying risk associated with the reserves and supporting assets because of an inadequate interest rate model.

**MR. FRIEDSTAT:** Dave, could you give a basic description of what the one-factor model versus two-factor model involves? I think that would be helpful for the participants.

**MR. DAVID N. BECKER:** In the area of option pricing all the early work was based off of an interest rate model that had one random variable. This random variable inevitably drove the short rate

of the yield curve. Because of only having the short rate of the curve being driven by that one factor, the volatility assumption, which is generally higher for short rates than it is for long rates, tended to drive the motion of the curve at the longer end. So if you were running high volatility, depending on the nature of your model, that high volatility may essentially percolate out to the other end of the curve, and you can get some fairly dramatic behavior on your interest rate curves as you go out in time.

Now some patches have been put on that. One modification is the concept of mean reversion. Another one is to introduce what is known as a term structure of volatilities. In that modification you specify ahead of time the volatility of various forward rates out in time, and you allow those volatilities to decline, so they match history and what is basically observed over time.

You can do either one of those methods and they do help provide you with a situation in which scenarios don't get quite as wild as you move forward over time. However, both of those models tend to impose some limitations in the movement of the yield curve. And you may not be capturing the type of movements in rates that are observed historically. Generally, one of the best solutions of this problem is to go to a two-factor model, and in fact, in the literature there are even three and more factors. But by going to two factors you can get a little more; you can get better behaved or more realistic types of curves and get more shapes of the curve and behavior of interest rates that corresponds to what you have seen if you look at the history say from the 1950s through the 1990s.

**MR. FRIEDSTAT:** So Dave, a lot of the people, when they do their cash-flow testing now with the one-factor model, would assume parallel shifts in the yield curve. But under the two-factor model, that isn't necessarily the assumption.

**MR. BECKER:** Right. Well, some one-factor models, when they don't introduce mean inversion or term structure of volatilities, tended to cause parallel shifts. So if you have high volatility in the short rate, you are going to get high volatility in the long rate as well. Because the short drives the long in a proportionate manner.

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**MR. MATEJA:** I think the point we're making is that the test of statutory adequacy is premised on an interest rate model that is defined by seven paths. I don't know whether seven paths qualify as an interest rate model, but you can call it an interest rate model. I don't know whether seven paths are adequate. Do you know?

**MR. BECKER:** Well, obviously the intent in the core of this question is based upon whether or not you are doing stochastic testing, or whether you are essentially doing deterministic testing based on the legally required seven scenarios, or as many people do as an alternative, the legally required seven plus a modest number of additional scenarios to test inversions and certain other behavior. But even if you're adding additional scenarios, you're looking at essentially a deterministic test. But we're looking at stochastic tests. Just for reference, it might be useful to know that, several years ago, there was a paper by Merlin Jetton, in the *Transactions*, and just a couple of years ago, there was a paper by Sarah Christensen, comparing a number of interest rate generators.

The generators with one factor that we're talking about here, and many that are available in commercial software, are more a type of generator considered in the Tilley model, which appeared in the *Transactions* a couple of years ago. All these are designed around the concept of testing on a stochastic basis.

**MR. STEPHEN A.J. SEDLAK:** This comes back to the fact that all too often you hear about the famous New York seven. But if you've ever done a number of tests, just picking alternative scenarios, or doing something stochastic, you will find much worse results much of the time than you'll ever see on those seven scenarios. Because valuation actuaries are really interested in the tail of the distribution of results, we can't say with any confidence that these seven tests show reserve adequacy. I think what we have to do is get some picture to the best extent we can, of that distribution of results, and then be able to make statements as to how safe we feel with our reserve adequacy.

**MR. FRIEDSTAT:** Let's move on to some of the other assumptions. I know in our discussions we were talking about the reflection of certain assumptions. For example, the reflection of tax credits

assumes availability of future gains in later years, so that you will be able to take credit for that. Mike, do you have some comments on the reflection of tax on some of these financial projections?

**MR. MATEJA:** It's a common assumption in modeling to assume that, if you have gains then there's going to be a cash tax. If you have losses, there's an effective cash credit associated with it. When you have a situation where there are apparent losses -- recently we've seen more of that -- you need to be very mindful of how that tax credit is operating. The credit may be affecting your judgment about the size of the problem that you have. This is something that deserves careful attention. We've run some tests where we just assumed no tax to get a handle on what the accumulative tax credit means.

**MR. SEDLAK:** An interesting thing about taxes, given the current law, is that there's a lot of effect on cash-flow-testing deductibility. In other words, your reserves for taxes are lower than your statutory reserves and this reduces future taxable income. So from a standpoint of reserve adequacy, recognizing the taxes appears to, most of the time, at least in our company, be advantageous. Now when you get into dynamic solvency testing, that's a whole different ballgame. Then you're starting to get acceleration of taxable income effects into your results, and they will hurt you.

**MR. FRIEDSTAT:** We had a lively discussion in terms of the manner in which the C-1 default risk and the C-4 management risk, or the all-other risk category were reflected in cash-flow testing. Maybe we could discuss how you see those issues. Mike, do you want to start off?

**MR. MATEJA:** Well, I think you can generalize the discussion to include all of the assumptions. Prior symposia have addressed the breadth and scope of all of the assumptions that we can use. If you start laying out all of the various assumptions and the variations that are possible, you're almost looking at an infinite set of results. A clever actuary by choice of assumption can probably dictate a result. We've all managed results by manipulating a few assumptions. This leads me to the idea of quality associated with our work. Quality is something that has never really been discussed much about cash-flow-testing results. But I submit that what we need is very high quality in this area. It's possible to select an assumption set, which I would say is a low-quality assumption set, as opposed

to something that is a high-quality set. Our assumption set and its quality ultimately influences management judgment. The tension between our results and the quality associated with them, and the management judgments that are made is something that we need to be very mindful of.

**MR. SEDLAK:** As long as C-1 was mentioned, I think there are several different market risks that, at least at my company, we can certainly do a better job on. The first of these is the classical C-1, the defaults. I'm sure that it's fairly obvious that assuming 17.4 basis points per year on all assets is not anything like the effect that you get with more reasonable assumptions as to your mortgage defaults, or something based on your actual distribution of quality in your planned portfolio.

Another related thing has to do with variable contracts. It's easy to say to yourself, "Well, the policyholder has all the risks here. We don't have any real problem, and maybe we don't have to test this at all." Unfortunately, the scenarios for your interest rates may have nothing to do with the market value performance in the future. I don't even know what that relationship is, but I do know that, if I have a market value depreciation, I'm going to have a potential problem with guaranteed minimum death benefits. What we're writing here are essentially strings of put options. They're not American options; they're not Asian options; they're mortician options. We have exercisability on death.

The other area that you'll conceivably have problems with is a depreciation will run down your variable market values; associated with that, your variable funds will go down. Associated with that you generally have something like 125 or 150 or whatever basis points of an actuarial risk fee. That will now shrink proportionately. Meanwhile your expenses are going to stay more or less constant. Suddenly the big margins that you're generating prospectively on your products shrink or even disappear. If you are using these margins to help support your opinion on adequacy, you can have a real problem. If you don't have variable business, I guess you don't have any problem at all.

**MR. BECKER:** In the area of the risks, C-1 asset default was mentioned. C-2 is obligation risk. In most of our work, the only thing that's being tested stochastically are the interest rate paths in the future. Asset defaults are deterministic, mortality is deterministic, and so on. In the absence of

having models that are yet more sophisticated and have more random variables in them, which will require running far more scenarios to get convergence of any kind of output distribution, we sensitivity test those assumptions that we believe are critical, but are not stochastic in the underlying model. So we will test for sensitivity to mortality, asset default, expense morbidity, and others.

With regard to the variable account, one approach that handles the decline in market values is to run simulations where you show the decline -- whether it's a slow decline or an abrupt fall followed by a slow decline. You can specifically look under those scenarios and find out whether or not the mortality and expense guarantee charge and the asset management fee will cover your expenses and any runoff of surrender charges that you have.

A somewhat more difficult issue that Steve brings up is the fact that historically guaranteed minimum death benefits have been basically limited to your principal payments. What's happening now is we're seeing a greater creativity, a greater benefit to the policyholder, and a corresponding greater risk to the company, where these minimum guaranteed death benefits are reset at various periods. If you wanted to be real exciting about it, you could design a product that would have a guaranteed minimum death benefit to be the highest of the past values in your separate account. By the way, on Wall Street, this is called a look-back option. And it's expensive, which is not too surprising.

The performance of the variable side is not stochastically motivated now. That's something that in a sense you test in a separate model perhaps using a deterministic approach, or perhaps a Monte Carlo type simulation.

**MR. FRIEDSTAT:** But to what extent do we see some of the models taking into account the current economic environment, and how would policyholder behavior be impacted by that? Certainly in the case of separate account business, the fact as to whether the market is relatively high or relatively low compared to past history might have an impact on that. We've seen some efforts to take into account the economic situations, some cash-flow testing in relation to health insurance and certain disability policies. Do you see efforts in terms of bringing in these other variables and environmental factors into the financial projections?

**MR. BECKER:** In the work we do, we try to decide what are the key modeling assumptions that we think are sufficiently dangerous. We think of them as the behavioral functions. What will policyholders do? We have embedded options in our liabilities. Some of them are fixed guarantees which have reinvestment risks. We do have an array of policyholder options, and how will they exercise these options? The sad part of it is, there's not a large body of credible data with regard to how people will behave.

Similarly what about borrower behavior? Now that's basically the prepayment risk. Unlike callable bonds, the prepayment risk on pass-through and mortgage-backed securities has both the contract (prepayment) or extension risk depending on how interest rates move. Despite all the massive research done by Wall Street, prepayment models have undergone a tremendous shock. No one anticipated what happened in the 1992-93 time frame, when interest rates really fell. The highest prepayment speed you might get before that was 500. And it turned out that it was more like 1,000 - 2,000% of the Public Securities Association (PSA). The borrower behavior assumption is difficult.

A third behavioral risk is the company behavior. If the company has a strategy for managing its business, whether it is a crediting strategy, investment strategy, or disinvestment strategy, will in fact, the company follow its plan? Now with all these risks, especially having a lack of very good credible data, we feel you have to address this by sensitivity testing. Looking at each one of these items to see how sensitive the results are to your assumptions. For each assumption, if the assumptions appear reasonable, then test the output for the sensitivity to changes in the assumption. If your output is unusually sensitive to those changes, you need to go back and do more work. If your output is not unduly sensitive, then accept that assumption as a working position, and continue to reevaluate it as you go into the future, gather more information, and retest.

**MR. FRIEDSTAT:** What about how policyholders would exercise embedded options in the contract and how options are treated in the models? Don't most of the models we have basically treat options as being exercised simultaneously, when in actual practice, they're not going to be exercised all at the same time?

**MR. BECKER:** That's an interesting feature partly because of the way models are built, and partly because of lack of information. Some of the options are, for example, if interest rates go down, people might put in more premium and take advantage of essentially an implicit call option, because you have a contract with a minimum interest rate guarantee in your contract.

On the other hand, if interest rates are rising, the policyholders may choose to reduce or suspend premium payments. They may take partial withdrawals, or in fact, they may lapse the policy. You have to be careful when you're making those assumptions, because not everybody is going to simultaneously engage in all of that behavior. So you have to be careful that, if you're trying to incorporate all that behavior simultaneously, you don't unduly penalize and overwhelm yourself with massive antiselection because of the way policyholders are all going to operate concurrently as opposed to the way that people will actually exercise those options.

**MR. SEDLAK:** I agree with that. That's about the only thing you can do, given this current state of knowledge. Even if you did have some historical knowledge, there's no real guarantee that psychological behaviors will replicate history. In the future maybe someone can figure this out, but I don't think it's going to be me.

Another item that I would like to mention just to present it is again related to variable contracts. Here you have a third kind of put or call option, when there are transfers available between the fixed and the variable funds. Depending on the circumstances, and the contractual barriers to transfer, you could sustain some fairly massive inflows or outflows from the general account.

It's kind of scary what can happen when you model some of these things under certain conditions.

**MR. FRIEDSTAT:** I find the comments about separate accounts very interesting. I realize that the regulators are paying more attention to this. It's very true that up until recently, less attention was being paid to separate accounts in cash-flow testing. It wasn't uncommon to spend your time working with the general account cash-flow testing, and putting in a statement that, as long as the contractual charges that you were taking out of the contracts exceeded the actual expenses involved

with administering the contract, that this would just add and create a more positive position. I think what we're hearing here is that greater attention should be paid to separate account operations in relation to your modeling. I think that is an effort that the regulators also feel strongly about.

**UNKNOWN PANELIST:** One other item on that is that with the liberalization that you see in contract provisions, where they're fixed in variable accounts, many of the companies -- in fact life insurance selling just had a review of variable products -- have limitations on the ability to transfer money out of fixed into variable. I think some of the other companies that didn't say anything about it also did. But I do know that there is somewhat of a move now to try to remove those limitations on moving back and forth between fixed and separate accounts. For marketing reasons and competitive product design, the policyholders want those sorts of barriers that are in there by contract provisions either weakened or removed. It becomes more incumbent upon us to be able to come to grips with those sorts of things, because we have to price for this.

By the way, sometimes people think that there's no risk in transferring from variable to fixed. But if the economy were in a situation where interest rates fell very low and the market performance was poor, people might have a desire to move into the fixed account, if the fixed account has an attractive floor interest rate guarantee. This is just something to think about.

**MR. MATEJA:** A one-word description of the problem here is *guarantees*. The separate accounts have become associated with what I would call supplemental types of guarantees. I think originally they were put in as an afterthought, something to talk about, or an inducement to sales, without really focusing on how much the guarantee was worth. It's the sort of thing that you can say isn't worth much most of the time. But there are times when it can be extremely valuable. It's those kinds of circumstances that I think you need to start focusing some attention on in your cash-flow analysis.

I think this example really points out the inadequacy of some of our risk analysis, as we were discussing earlier in this session. We started cash-flow analysis years ago with the simple seven scenario test. I think the discussion to this point has fairly established that this is a far more robust

problem. You also need to consider all of these supplemental guarantee risks that may not be captured by a simple, seven-scenario-interest-rate test.

**MR. SEDLAK:** This brings up a very good thing that we also need to do. Because what Mike and Dave are pointing out is, we have a tendency sometimes to make the innocuous into the inimical. For example, we liberalize the ability to make transfers, or we liberalize what used to be a low-risk minimum death benefit, and on and on. You need to maintain some kind of relationships with your product people to be able to find out about these things and appreciate their effects before you produce a bunch of them. Otherwise, you're into a damage control process, as opposed to being made a part of the process. I don't know really how you do this but it's probably a necessary part of a well-run company.

**MR. BARRY L. SHEMIN:** On the variable contract guaranteed minimum death benefits, we did some stochastic testing of a look-back provision in our current variable annuity contract. We found results that would not prove to be typical. The expected cost is quite low, and the 50th percentile is even lower. But there are some very high costs out on the tail. That led us to a couple of conclusions. One was to define the target surplus at a certain percentile. And it turns out that the cost to fund target surplus far outweighs the expected cost of the benefits for this kind of provision. The other conclusion is that a reserve is probably not the right way to deal with it. Unless you're in a situation where the market is already deteriorated, you're dealing with a rare event. It's like stop-loss insurance. So I'd be interested in any comments that you might have on that.

**MR. MATEJA:** I think you have the assessment pretty well in hand. The fundamental issue is to understand risk. The purpose of cash-flow testing is to put dimension somehow on the risks that we're assuming, and it's most useful for mismatch risk. Even a simple seven scenario test tells you something about the stress limits that you have associated with reserves and the associated assets. I think I've reached the point, as I explained earlier, that I'm questioning whether a seven scenario test is sufficient today; moreover, is it sufficient to sustain us going forward? When I think about all of the opinions in the new appointed actuary framework, I get a little concerned about what a court may find about the diligence with which we're doing our work. A statistician from some other firm may

come up and say, "You mean to tell me you're relying on these seven tests to make your opinion? Isn't it time that you do something more consistent with the state of the art?" State of the art, I think, is considerably beyond the seven scenarios. And it's one thing to fulfill statutory responsibilities, and I know that's our first and foremost responsibility. But then you have a responsibility to management, stockholders, and policyholders, and I think that requires something more. If I were to leave you with one message I think that's it. And I think that opinion is shared by this panel.

**MR. BECKER:** The only change I would make is that, for various reasons, the legally required opinion and memorandum and the long arm that can reach back to the appointed actuary is, of course, the most obvious point that we see. But in actuality my associates and I at Lincoln see that the primary purpose of our work is to provide the best information about the risk/reward posture to the management of our company, because ultimately the goal is to run the company the best way possible. Everything we do is really focused toward providing that service to management, and as a result, the required reports are just an automatic by-product of what we do. But if our focus is to provide the best information about where we are as a firm, and what our strategies for operating the firm are doing, the rest of this will fall out. As you know, we're thinking where people should go, and we have to raise the level of science in what we do in order for us to be credible with management.

**MR. SHEMIN:** The other area I'd like to ask you about is second-to-die insurance. This has been a rapidly growing area for many companies, and has a number of interesting risk characteristics that I think are important to companies and actuaries. Among these are very large amounts of insurance and retention limits, which are typically higher than single life insurance, and the common use of fraserized products, which often means that you don't even know whether one of the two lives has already died.

In addition there are correlation issues where the insureds are husband and wife. I wonder if any of you have any comments at least on evaluating both the expected level and what might be out there at the tails, for purposes of thinking about how much risk the company might want to assume there.

**MR. MATEJA:** I have no extensive experience in evaluating second-to-die risks. But I would just observe that this again is another example where we boldly stepped in to offer some new product services. We were purely fulfilling a need for the marketing approach and quickly jumped on it. But it's very simple to write up these contracts. It's very difficult to comprehend the full measure of the risk, and I think that's really what you're posing as a problem. I can't address the issue of how to deal with them even in the cash-flow testing other than it's obviously another dimension higher than the normal risk evaluation that we're doing in cash-flow testing.

**MR. SEDLAK:** One of the challenges with the last-to-die product is that you don't really know what your experience is for a very long time. In essence, it's like writing a product which assumes a squared mortality curve because this joint life span acts that way. However, because you're not being informed of any of the change in the joint status you could find out 20 years from now that you have a totally different experience than what you assumed.

Other than doing some social security number audits like you do for annuities to see if these people are still alive, I don't know how you would avoid this.

**MR. BECKER:** As an interesting aside, I think the comment raised is extremely pertinent with regard to that particular product design to show you how people's biases can yield somewhat different opinions, recall that the IRS tends to feel that second-to-die policies are nothing more than annuities with the life insurance wrapper for tax purposes. That's one of the reasons why there are no safe harbors for guideline premiums on survivor-life policies. And yet, we all know that ultimately, whether you use a single-status fraserized method or a multistatus jumping method, the people are going to die, and even if they don't think so, it's going to turn into a life insurance policy. I suggest this is a good opportunity to consult a good reinsurer.

**MR. WILLIS B. HOWARD, JR.:** In a number of the discussions at this and other recent meetings I have inferred that some of the experts say that the seven required interest scenarios are not sufficient. I wonder if that's because they're not stressful enough (which is what I view the purpose of cash-flow testing is), or not refined enough for advising management on what ought to be done.

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**MR. MATEJA:** I'll take a crack at that. I think that's the substance of what we were saying about the adequacy of the interest rate model risk. You have a model defined by seven tests, and you fulfill the model. What do you conclude? I don't know. You survive seven tests. I think you need to put it into some kind of a problematic framework. You can attach some objective level, be it that the conclusion is defined by the interest rate model. So if that's your ultimate purpose, then you want to associate your tests with probably the best interest rate model that science can provide. I think we're saying that ultimately we're going to have to be moving toward two-factor models. They seem to provide the best science right now for interest rate movements and the evaluation of the kinds of results that we're asked to look at.

**MR. FRIEDSTAT:** This is a natural tie in to interpretation of results. Really that's what we're asking: To what extent do the models that we're using effect how we're interpreting the results?

**MR. SEDLAK:** In regard to the seven scenarios question, I think one of the problems with seven is it's too sparse. There are so many things that can happen. I'd be amazed if you've really seen much of that universe when you just look at seven scenarios. We're suppose to look at the distributions of the more adverse results. If we don't have a good look at that distribution of results, we have a hard time fulfilling our role I think.

**MR. BECKER:** The difficulty with using the legally required seven, is what meaning do you assign to the results? Now certainly a big pop up or a big pop down in interest rates ought to cause a certain amount of stress. And it will tell you if that happens. But how often do rates pop up 300% and then stay there? If you look back at historic runs up and down in interest rates, you'll find that some of those pop ups are of exceedingly low probability.

However, what might happen to the block or the firm as things move into the future on a stochastic basis? Let me give you some research that was done. Mike Smith and Mike Zurcher of our company built an interest rate model, and they basically generated about a thousand scenarios. Now nobody really wants to run a thousand scenarios, especially when you're doing reserve and asset adequacy testing at year-end. So they developed a statistical algorithm for taking two scenarios and deciding

whether or not the two scenarios are "sufficiently" identical. And by doing that they took the thousand and condensed them. Think of it as condensing them into equivalence classes, where each class has a representative scenario. Then that scenario is given a probability equal to the number of scenarios within its equivalence class divided by the total number of scenarios generated. In doing that, we try to make the legally required scenarios class representatives, because that way they're automatically included in our study. In one year-end, we found that essentially the probability attached to four out of the seven New York scenarios was zero. They didn't come up. They couldn't serve as a representative of any class with nonzero probability. In another year, three out of the seven came up with a probability of zero.

Well, that's interesting. How good is it? One of the tests that Mike Smith and Mike Zurcher did was to take all of the scenarios generated and create the probability distribution of the outcomes, i.e., the cumulative distribution function. They picked one of our big blocks and just ran the whole thing. Then we graphed next to the block the distribution function based upon the compressed representative scenarios. The two distribution functions were very close over the entire range of the curve, which was an empirical validation of the methodology.

**MR. JAMES G. BRIDGEMAN:** I think this question connects right back to some of the modeling questions you talked about earlier. For understanding risk and pricing for it, the most sophisticated models seem to be required depending on the amounts of money involved and how critical the pricing decision is. For a valuation question, however, it's a yes or no. Is the reserve going to be adequate or isn't it?

In that respect, and in my experience, one of the most useful aspects of stochastic testing is the exploratory one. You think you understand your product. You do a hundred scenarios, a thousand, or whatever. It's hard to connect a meaning from all of the statistical assumptions that drive the model back to your output distributions. It's very hard to say in the end. You can do something about where you have picked your reserve level? Is it at the 60th percentile? The 70th? That's all very interesting. But show me a bunch of scenarios that came very near to the threshold result. Then

show me some specific scenarios drawn out of the random sample that are outside what you provided for.

There is a point at which I can make some intelligent judgment. Do I want my reserve to cover this particular weird scenario or not? More likely what I'll find is some scenario that doesn't look weird at all. Something that I hadn't realized was risky pops out. Now I've learned something about my risks, and the judgments that I have to make when I set the reserve. And as far as the New York seven, in some respects that's how they got there. I go back long enough to know when some of us were stupid enough to look at some products, in terms of what happens if interest rates go up or down? And the first time we did stochastic models up/down or down/up, it killed us. I think that's how those assumptions got into the New York seven. But the point is, you can use these tools. There's something in between being deterministic and trying to make sense out of the entire stochastic universe. You can use the stochastic process to learn deterministic things.

**MR. FRIEDSTAT:** I think that's a very interesting point. And I'm Vice Chairperson of the Committee on Papers for the financial reporting area. And there is a paper that is in the process, or will be in the last of the formal issues of the *Transactions* that deals with just that subject area.

In other words, let's look at the situations where we fail. Let's look at the ruin situations. Let's see what we can learn from those situations. I think that is a very appropriate observation, and I think the people in the audience will find this paper particularly interesting.

**MR. JOSEPH M. RAFSON:** I have a comment on the stochastic generation versus the New York seven. When you begin to talk about stochastic generation, I think we have to be careful not to put too much emphasis on the accuracy of the underlying models. These are pretty crude models to begin with, excluding new business, and excluding many factors. This is a test of the things that can happen to a company versus looking at the New York seven (which I think is really a sensitivity test), which can indicate a mismatch in duration. Perhaps by running a thousand scenarios we're giving ourselves a false sense of security. Maybe the New York seven is indicating a weakness, even though it's a crude test to begin with. I just wanted to make that comment.

At another session a comment was made that, when modeling asset adequacy analysis, you're selling securities from a held-to-maturity portfolio, you have a potential to taint that held-to-maturity portfolio. I want to know, does anyone think that that's a realistic possibility?

**MR. BECKER:** I'm not sure I understand the question. Let me see if I can articulate. For companies that report on GAAP (which is going to be most of them in the not-too-distant future because of *FAS 115*), you have to divide your asset portfolio into three classes: held to maturity, available for sale, and the trading account. If you earmark assets as being in the held-to-maturity account, you're allowed to report them on your balance sheet at book value. And the change in the market value of securities is neither closed directly to surplus, as it would be for the available-for-sale account, nor does the change in market value go through the income statement as they would be if the assets were in the trading account.

If a company has placed assets in the held-to-maturity account, and if you then actually trade those securities and don't qualify for the few exceptions, the Securities and Exchange Commission (SEC) may gently tell you that basically the one bad apple has spoiled the entire bunch, and you have to mark the entire held-to-maturity account to market.

When you're cash-flow testing, you might not have the ability to earmark assets to be sold first, or sold second, or not sell at all. If you're handling negative cash flow by liquidation, what happens if at some point you make a misstep and you actually start selling securities that are actually in your held-to-maturity account?

Well, on the one hand, from a reserve and asset adequacy point of view, I don't know if that's all that big a deal. The question is, if it really were to happen in the future, there would be another party for whom it would be a big deal. I think the simplest way to deal with that is to modify your software, so that you can tag assets as held-to-maturity, so that they will not be traded as you project into the future.

**FROM THE FLOOR:** Well, *FAS 115* says, ability and intent to hold those securities. And I believe the question raised was, if you sell securities in your cash-flow testing, does that draw into question your intent to hold these securities? Do you think this is a realistic possibility that someone is going to spot this in a cash-flow test?

**MR. SEDLAK:** I suppose it might be. When this process started, I remembered thinking that perhaps the cash-flow testing would actually be a vehicle by which you would demonstrate your ability to hold to maturity. Also if you subsequently did have to sell one of these assets, for some reason you would not taint some or all of your hold-to-maturity class using another. That doesn't seem to be the way it's going though, we have some kind of an absolutism, where anything you do that ever assumes that you might sell a security may actually taint the hold-to-maturity class in general.

**MR. MATEJA:** I would submit that this is a clear other risk. We could sit here and speculate all day, and probably not reach any consensus as to what would happen. But this looks like the model application can serve a very useful management purpose. I don't think this issue is at all related to the statutory responsibilities of valuation actuaries. The service of funds is not going to make one bit of difference on your opinion. But when your management finds out that the valuation actuary has been doing this test, and has been "selling it from this held-to-maturity" account, that can be useful. Any advance warning about the potential impact on GAAP results will help in the long run.

**UNKNOWN PANELIST:** I also think it's a little ridiculous if a test is not allowed to have the asset supporting surplus and not allowed new business. I mean, we're in a runoff situation. How can that question your intent or ability? I mean it's not a realistic test to begin with. And yet people mention that in a meeting like this.

**MR. BECKER:** For some reason I want to say this sounds like one of those neat theoretical questions that somebody can ask. Frankly given what we're trying to do has a very low relevancy, in all fairness, if somebody really believes it's an issue, well, modify your software. We did something even simpler. We simply don't have any assets in our held-to-maturity account.

**MR. FRIEDSTAT:** This brings up another topic, in terms of understanding the limitations of a model and the uses of the model. Does management really understand just how sophisticated or unsophisticated the model is? In terms of interpreting results there are different uses for these financial projection models. Could you tie in the use of the model with the interpretation of the results and the communication of this to senior management?

**UNKNOWN PANELIST:** I think that's really one of the main issues that we've been trying to address here. When you start out with the New York seven, and you try to explain to management what they mean, management's interested in whether you can give a clear opinion. I think there's the opportunity here to really serve a useful management purpose, if the testing is supplemented by other results that will help management by helping to understand how to best manage the business. That's really the challenge that we present to valuation actuaries. Become a central part of the management process. I firmly believe that there's that opportunity.

**MR. SEDLAK:** I agree with that. There are a number of things that you can do with this technology that will help you to run the company better, from tinkering with your investment strategies, your interest crediting and strategies, to looking at things like New York seven, and other certain scenarios. You can do an autopsy on these things, in effect, to find out what hits you. You can then find out why you had a failure, whatever that's defined to be. And using that information, you can analyze your products and operations. Here again, I hope you do something about it before it gets to be a big problem.

**MR. BECKER:** To address the issue of management understanding and individuals taking action, we have created the cumulative distribution function of the outcomes of what occurs in our reserve and asset adequacy analysis.

Within that framework we create this cumulative distribution function. We have worked with senior management in the company, the asset/liability committee, the very top people in Lincoln National Corporation, to help them understand. We have had to learn to think in terms of distributions and understand the probabilities of certain things are greater than a certain result or better will happen a

certain percent of the time. We have had to learn how to make decisions based upon the analysis. This leads into other ways of analysis besides the cumulative distribution functions, e.g., focusing on percentile levels or utility theories and other approaches, which is in some way really equivalent, it's just different machinery.

We have done that, and management understands and perceives what our risk posture is, and how adequate we are. But in addition, we've actually used that to modify the way we manage various lines of business. So these results have not only satisfied the regulatory requirement of demonstrating adequacy to the insurance departments, but also the very same tool has been used to make business decisions and to enable us to change our risk posture so it looks more favorable.

Also, these models serve as a springboard to other ways of analyzing the information that provide even sharper tools for deciding on the superiority of one strategy versus the other. It really means using the same underlying model, but using a slightly different objective function with which to evaluate the performance of a given, say, Strategy A versus Strategy B.

**MR. FRIEDSTAT:** Mike, you touched on the quality of the cash-flow testing and other projections a little bit earlier. I know in our discussions, when we were preparing for this, we talked about ways that we could improve the quality. We talked about the possibility of peer review, even whether there might be a requirement for the need to have an independent review of this, that is sort of an external comfort review in order to have a sort of second opinion on this. Maybe you could comment on these efforts. I know in the early days, a lot of the initial reports involving cash-flow testing were really pretty poor. I think we've made great strides since then. I think there's still a wide spectrum in terms of from the fairly poor efforts to some of the really very excellent attempts. Maybe you could comment on that.

**MR. MATEJA:** Well, my opinions on that are founded in my personal experience. I never thought that I would need to consult with others regarding cash-flow-testing results, until such time as I was looking at results that were troublesome. When I asked myself, do I really believe the results that I'm looking at, the quality issue came into focus. And I suspect within the last five- or ten-year time

frame there has been more than one valuation actuary put in that circumstance. One of the thoughts that occurred to me to respond to the quality concern was to take the position that I've seen with some of my coprofessionals. For instance, I've seen some very tough legal issues presented to the management of the company. The law department did tons of work, wrote all kinds of briefs, and then management said, we're still not sure. Management said, we need to go to this reputable outside law firm and get an outside opinion. The outside opinion was rendered basically confirming the internal opinion. Then everybody said, well, we've done everything we can. I started thinking it may be prudent for me to get an outside opinion as well. I never really did that. But I'm certain that there are going to be many actuaries tested in this regard. Someday, we may need outside opinions to confirm the quality of our work.

**MR. FRIEDSTAT:** Anybody else have any feelings on that?

**UNKNOWN PANELIST:** Each year, our outside auditor, Ernst & Young, requests a copy of the memorandum and reviews it. If it's fine, there's no problem. If the auditors have some discomfort with it, they'll let us know, and suggest we change it. If their discomfort level is higher, it will become a management letter issue. And if their discomfort level is sufficiently high, they would qualify their opinion of the firm.

**MR. FRIEDSTAT:** I think the same situation exists at most firms. My understanding is that, to some extent, all the accounting firms will review the cash-flow testing. Some will go into more detail. Some will look to give some valued added ideas for enhancement. I am aware of situations, as Dave mentioned, where the accounting firms have basically rendered a qualified opinion, based on the results of the cash-flow testing done by the company. Now that may have to do with the quality of the job or the financial condition of the company. And there could be a number of other factors. But that's one way. As far as an independent review, that is what's going on currently.

I'd like to finish off with a brief discussion of the role of the valuation actuary. We've touched upon this topic briefly in some of the earlier discussion, in terms of the panelists giving some of their individual philosophies, but maybe we can get into that a little bit more. What is the role of the

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valuation actuary with the normal work that is done with these financial project models? How can that be expanded? What can the role of valuation actuary be in terms of influencing management decision making?

**UNKNOWN PANELIST:** I'd like to just establish a premise that if you felt you built a good financial simulation model, which is representative of the performance of both your assets and liabilities, you have, at your command, the future earnings frame of the company. I would submit that chief financial officers (CFOs) would kill for that kind of information. If you had the credibility that they could rely on, your model could be used in formulating business plans. Your model has the potential to provide some of the most useful financial data that companies have, because that data is founded on what I would call good science. The models that we have -- even as a deterministic tool -- can be more useful if they get expanded into a probabilistic framework. They can help to put dimensions on things that can go wrong. So I see the challenge we face is finding a way to get an appreciation of that within our companies, and then fulfilling it.

**MR. FRIEDSTAT:** I think that's especially true when we talk about other uses of these models. If you have one model that is really well-defined, you can either make it more refined or less refined depending on the purpose, whether they are GAAP uses, financial projection uses, dynamic solvency testing, or other uses for the financial projection. The importance of doing a quality job in building your model is all important.

**MR. BECKER:** The primary purpose of our models is to identify and quantify the risk/reward posture of the firm. And having done that, to identify strategies and changes in how we operate and improve that risk/reward posture. That literally is the driving force behind the models we have, and when you do that, the specific application to reserve an asset adequacy is a natural by-product of the effort. That's what management sees as the primary tool.

**MR. FRIEDSTAT:** Two panelists work for large companies. Although you have some smaller subsidiaries, Steve and Mike, you work with a variety of companies. But what's the trade-off here? I think a lot of the smaller or medium-sized companies that are looking at testing are trying to look

at the cost involved with the potential rewards and benefits from managing it. Do you have any observations on that? I think we talked about some thing. The larger company has all these resources, but what about the smaller and medium-sized companies?

**UNKNOWN PANELIST:** I don't think you can generalize, because it's so much dependent upon the key people in that organization, and their appreciation about what the value is from this. I think you mentioned in most smaller companies this is all used as a cost. And if all of you recall some of the original debate about introducing this, it was all viewed as kind of a layer of expense that was being saddled upon companies, and I don't know what the cost was, but whatever it was at, that cost went up  $x$ . There was no perceived benefit. I'm suggesting that there are benefits associated with this. There probably is a stronger benefit than in a lot of other things that are going on within the actuarial library, especially in terms of how testing can help management appreciate what's going on within the company. A realization or an appreciation of that benefit is probably your foremost objective, to just elevate the stature of the actuarial work that's under our collective direction.

**MR. SEDLAK:** This is technology. This is like a computer. If you have a small company, would you try and run it without a computer? Sooner or later you can't afford not to do that. From a competitive standpoint, from a risk control standpoint and from an ability to just control your own destiny, the smaller companies have got to get into this technology one way or another.

**MR. MATEJA:** I have one view of what might be ahead. I've only been in the consulting business three-and-a-half years, but I've observed a lot of changes in that period of time. What am I going to be looking at in five years or ten years? The hardware is going to be so fast in a few years, it will be hard to imagine. The software supporting financial models will continue to improve. I think that financial simulation models, and their integration into the fabric of the management process, is around the corner. It's going to take another five years or so, and everybody will have their own model, and it's going to be a strategic tool. People are going to use it to understand the financial dynamics associated with decision making. I believe the models are going to be sophisticated enough to provide objective feedback on any management decision. They won't completely replace the gut feeling that business people have been making all along, which is the way the business was run when

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I started out. Today the margins are smaller, and I think the position of the marketplace will make them even smaller in the future. I think we're going to have surgical precision in terms of interpreting the results of management actions. And all of that is going to be doable with the financial models created by actuaries.

**MR. BECKER:** Our environment has far more volatile margins than there have ever been before. Someone will say, well, why I should spend this money to do this? If you're a regional company, and you have a great reputation, maybe you'll survive.