MODELS, METHODS AND TECHNIQUES

MR. ROGER W. SMITH: I want to review some general issues. There has been a lot of discussion about different modeling techniques. These discussions have focused on microscopic defaults. I just wanted to step back and focus on the basic principles that we might overlook. Bob LaLonde is going to spend a bit more time on the details of some aspects of modeling.

In preparing for this, I wanted to figure out just what exactly is a model in the general sense. I went to my *Funk & Wagnalls* and looked it up to see what it said. There are many definitions for a model. It can be a noun, a verb or an adjective. I'm sure we all know some of them. Cheryl Tiegs, for example, is a model, but that's not what we're going to be talking about today.

I think boiling it down to what is a model for our purposes and probably for many other purposes is that a model is something that represents some larger object. In our case it's the financial performance, if you will, or the financial operation of an insurance company. It has to represent a larger object. It needs to imitate that larger object, when we subject it to certain stresses and forces, the model should respond in the same way that the larger

object will respond. Aircraft designers have models that they use to simulate the performance of aircraft, and of course, they hope that the actual aircraft will respond that way.

Another feature, again from my studies of *Funk & Wagnalls*, is that the model should be less expensive than the larger object. Many professionals use models. Weather forecasters make use of models, at least I have been told they do. However, coming from Chicago, I am not sure. Economic forecasters use models.

Why should you use them? What are you trying to do? The ideal is the model will be able to answer a question that you want an answer to. It seems pretty simple. If you don't have a question, you probably don't want to use a model. You should be able to save some time by using a model. For example, instead of trying to study what might happen to our surplus in twenty years, we could just wait, but then we wouldn't have any time to do anything about it. It should save resources. An important result of a model is that it can trigger discovery. This has not happened enough yet, but should be more important in the years to come. The human eye and the human mind are the best pattern recognition devices, devised so far. Probably not even the Japanese will be able to come up with something better, and I think that as we use models more and more, we're going to be learning things that we had not seen before.

How do you build a model? Step one is you have to have a clear description of the problem. It seems pretty obvious, but sometimes it is overlooked. I would suggest that the all-purpose model might not exist. You may need multiple models.

The next step is determine how to express a starting position. Again, I think it's a very basic premise that a model starts with some position of what you're studying, and then you are going to subject that to future activities or future forces. You need to think about how you will express it. An example, again, is perhaps a weather forecaster. Weather forecasters will have different reporting stations, and they deal in terms of temperature and barometric pressure, wind speed, and wind direction from a lot of different locations and attempt to come up with forecasts.

I think the final step in getting a model going is describing the assumptions and relationships. You can think of those as formulas perhaps that you will subject the model to.

Let me hit some of the things in liability modeling. I just listed briefly the kinds of items that we typically consider when we're looking at liability modeling. We want cash-flow events, balance sheet reserves and accruals. The problem that we want to study will greatly affect the level of detail that we want to put into the different items.

For example, you can purchase a copy of the task force on AIDS report, for $15.00. It discusses the needs for creating a model to assess the AIDS risk. It focuses primarily though on the extra death benefits and the death cost due to AIDS, at least for life insurance operations. Premium income is not a real key ingredient to that use of modeling. Another use of a model is cash-flow testing for a Reg. 126 study. We obviously need all of these items somewhere in the process.

How do we express a starting position for liability modeling? Some of the key aspects are premium level, fund level, death benefit, income payment patterns for structured settlements or immediate annuities. Also part of the expression will be the number of cells that we might want to use -- a few or perhaps thousands. I think in setting up the starting position for modeling, what I try to think about is that we're trying to be able to express what the policyholders' current situations are and be able to relate that to what their actions may be in the future and try to anticipate what choices they might make. Of course, we have to bring in the contractual provisions that they have available to them, and then also the external forces that will be acting upon them.

Although assets are different, I think of them in very similar terms. We project cash-flow items and balance sheet adjustments that need to be made. The asset model starting

position, for debt instruments includes the current principle and market values. The cells reflect ways to categorize similar assets subject to equal future prepayment propensities.

For example, people who invest in mortgage-backed bonds or collateralized mortgage obligations (CMOs) find far different experience based on where the mortgage pool happens to be located. Houston, Texas pools have been far different than say Chicago, Illinois based pools in recent years. Then general kinds of asset modeling relationships are the kinds of forces and assumptions that we will subject our assets to as we roll them out into the future. Again, we have to consider the same kinds of things that the liability policyholders have available to them. The debt issuer typically has a variety of contractual options we need to consider. There are definitely the external forces driving decisions.

What I've tried to do here was set just a few general remarks about models and mention some of the issues that need to be addressed and typically are frequently overlooked. Now it's time for Bob to continue.

MR. ROBERT J. LALONDE: Key assumptions is the next subject on the agenda and you're probably saying, "Now, this is going to be easy." When it comes to key assumptions, all I have to do is to come to some meeting like this. They're going to talk about key assumptions. I will be able to write them down on a paper and have them when it comes

time for me to do any kind of work. We have to make assumptions about factors that are going to affect our projection or our model and where do we go to get assumptions?

How do we decide whether they're key assumptions? Well, if everybody else thinks that they're a key assumption, they will be talking about them, but that's not always the case. Some assumptions that are key are not always as obvious as a snake on a table.

We will talk a little bit about the process of trying to decide what is a key assumption, and whether we even need to make any provision for a fluctuation. I serve on the Committee for Life Insurance Financial Reporting, and we have exposed and adopted into practice a standard on how to do cash-flow testing. We're currently working on a standard which would describe when to do cash-flow testing, and we're also working on one to do some kind of a standard for AIDS.

I thought it would be particularly worthwhile to spend a few minutes to look at what is in our standard of practice regarding cash-flow testing. In addition to describing the assumptions utilized in performing cash-flow testing, the actuary should include the basis used for choosing and the source of each assumption in the actuarial report that he or she will be providing. To highlight those, what is it that's being emphasized? Describe the assumption. Tell why you selected that assumption.

That is not as easy as it might seem. Where do we go to look for assumptions? We go to our actuarial study notes. We go to materials that have been handed out at meetings that we've attended. In some areas, like in the area of trying to determine for AIDS, assumptions about infection rates are very foreign to us. The information is about distributions that we probably have never worked with, and we have to rely on the judgment of other people who have studied it much more closely than we have. But nevertheless, we have to be able to describe or tell another person why you selected this assumption, and you have to give the source of the assumption.

Those are the three fundamental things that you will need to be addressing in any kind of an actuarial report or recommendation. Some of these assumptions are very hard to evaluate because you're trying to evaluate people's responses to changes in economic climates. In some cases, that's not too hard. When it comes to a corporate bond, you are perhaps trying to guess what the Chief Financial Officer (CFO) might do in a situation where interest rates have dropped considerably. When would that CFO want to refinance his particular debt issue under the call provisions? In another case though, you might want to be trying to guess what would happen to people's need to refinance their mortgages under a mortgage instrument. It's not always very obvious, and there aren't always references to data. We look for data studies, like the Public Securities Association (PSA) might have some data on prepayment rates. However, prepayment rates always fluctuate,

and you never know for sure whether that same kind of reaction that occurred and was measured in past history will be the same kind of reaction that this group of people may have in the future under a slightly different set of economic conditions.

As we go through any kind of a model and we have to get involved in cash-flow testing, there are two cash flows that we have to concentrate on. One cash flow streams from the investments, and the other cash flow streams from the insurance product itself.

When we're getting into making assumptions about cash flows, we look to the investment cash flows and what things dictate what is going to be a key assumption. We have to look at the contractual terms of the asset and figure out all of the things which will happen due to changes in economic conditions. We have to look at the characteristic of the assets and its dependence on economic conditions with respect to the issuer, the insurance company's buy and sell practices, and responses to changes in market places.

Some of the specific things we're going to look at for investment contractual considerations would be the call provisions on a bond and the premiums that might be paid upon it exercising the call provision by the particular company. Default probability levels are the subject of much speculation. Just think about all the material that you've read and all that you've heard about junk bonds. Some junk bonds are experiencing defaults like everybody

thought they would, and other classes of junk bonds seem to be surviving despite what's happening to the economy.

Some contracts might have coupons or interest amounts that are dependent upon some kind of an external index. Any time you want to build a model, you have to provide somehow for that kind of a scenario. Prepayment speed refers to how fast people prepay a mortgage. We'll get into that a little bit on a CMO.

We also must consider the conversion of equity into debt. Right now we see a great change in the way companies are structured from equity to debt. Leveraged buy-outs (LBOs) are all over the place. We don't see it so much in the insurance industry, but it is occurring elsewhere. Look at the potential United Airlines deal. There are examples of companies where LBOs are being exercised as an option for moving forward.

The other side of the coin are the insurance cash flows. We're probably more familiar with insurance cash flows. All of us at some time or another have done product development work where we have definitely projected the insurance cash flows. We need assumptions for deaths and lapses. We need to look at the contractual terms of the liability and how it might be linked to changes in economic conditions.

What is it that we have to look at specifically when we are building our key assumptions? The credited interest on an annuity or universal life is going to be directly affected by changes in what we and other insurance companies are earning on our assets and our marketing strategy. Certainly surrender charges would be a contractual item that would be driven by people's responses to the changes in economic conditions. Policy loan provisions that have a direct reflection of interest in the borrowing would be different from those that are not directly linked. Persistency incentives, a new universal life feature, have large bonuses that are payable some time in the future. Whether or not the policyholder will stay to receive them is highly uncertain. There's certainly hope that the policyholders will continue to keep paying premiums so that they can receive this large amount of money, but there's always a chance that they might not.

Personal taxes change people's actions. It's hard to build an assumption about what kind of changes might occur in tax provisions. Section 7702 is changing. We see more activity towards potentially taxing the inside build-up in some way. The cash-flow standard said that, in addition to investment cash flows and insurance cash flows, there might be some other cash flows. As you're building your actuarial report or recommendation, you also would need to think of reinsurance arrangements and how they would affect results. They might mitigate or they might worsen the flows of cash emanating from your insurance contract. Federal income tax is a difficult item to always pin down. Provision must be

made for shareholder dividends, administrative expenses. Those affect cash flows on both sides of the ledger, any new business assumptions you may wish to bring into your projection are important.

Remember it's just not sufficient to make an assumption, but one has to give thought to why we're making an assumption, why we're selecting a 20 percent lapse rate, and also to be able to justify it.

I thought it might be worthwhile to take something that perhaps we've heard about a lot, but would like to learn some more about and that would be CMOs. A CMO is a new instrument released within this last decade that has come out for purposes of getting a little bit better rate of return, a little bit better sense of security or to protect against call provisions. The way a CMO works is the following. A mortgage obligation is put together. This might be Federal National Mortgage Association (FNMA) mortgages or conventional mortgages, and there are various tranches, sometimes up to eight tranches.

For example, there's a $185 million grouping of individual mortgages put together; people like you and me have used mortgages and they've packaged them all together. The first tranche is $100 million, and what happens is that all the principal payments received and all of the prepayments received are prioritized according to the tranches, and they go to the

first tranche. Everything that is received in the form of principal and prepayments goes to the first tranche, and then that is completed when $100 million is paid off. Then principal payments received from that point on, and prepayments, go into the second tranche, and so on. The final tranche might be the mortgage principal payments received in the twenty-eighth through the thirtieth years of this lifetime of mortgages.

As you might guess, there are significantly different pricing considerations and significantly different assumptions that affect each of these tranches. The money received in the first tranche is less subject to economic fluctuation. Money that could potentially be received in the fourth tranche is significantly affected by fluctuations. Typically with each tranche they pay, like in a regular Government National Mortgage Association (GNMA), you get flow-through principal and flow-through interest every month. In a CMO, the payments will be made to you quarterly, and the servicer then gets the float between the monthly payments received by all the individual mortgagees and then it makes a quarterly payment. Sometimes the interest rate floats. It floats to some kind of index, such as LIBOR, the London Inter-Bank Offering Rate, and those can be either inversely or directly related.

A CMO passport deal is a Merrill Lynch trust CMO offering of $100 million. Its period is quarterly, which means they're paying quarterly payments, and this is a CMO that was issued and priced in 1986. There are A, B, C, and D tranches. The coupon rate for each

tranche is expressed separately. This particular offering has different coupon rates. This particular $100 million of CMOs is backed by Federal Home Loan Mortgage Corporation mortgages, which have a net interest rate of 9.5 percent. The individual mortgages, have an average coupon of 10.15, so there's a 65 basis point servicing charge taken off the top by the servicer. You notice that here's a 7.95 coupon rate, but all of the mortgages are 9.5. Well, that difference goes to the organizer in one way, shape or form to the trust. What you then have is tranche A, tranche B, tranche C or D. The weighted average length (WAL) of the tranche is much shorter. The factor tells us how much remains to be paid as of the date of this report. Pricing spreads are related to Treasury. This rate, 9.16, is 190 basis points above the 7-year Treasury rate. Now, the reason why CMOs are really interesting assets to buy is because they give you a high rating. They're an alternative to a junk bond because they give you a high yield without the adverse rating. So insurance companies are very interested in this particular kind of asset.

Already we're starting to see some things. If we were responsible for building an asset liability system and we wanted to analyze these assets, we would have to start looking at this kind of asset and think about how we wanted to enter this into the system. Let me share some more assumptions you will need.

Another assumption about mortgage backed securities is the speed. What is the speed? The speed is how fast people are making their mortgage payments and paying down because they're moving to another spot so they have to sell their house or there's a default, which is considered a prepayment. Speeds are frequently computed as a multiple of PSA which built a chart of prepayment rates based on time since the mortgage was made. Prepayment rates initially are not very high and then rise to a level of about an annual rate of 6 percent at month 30, and then they stay level at 6 percent. You can imagine what kinds of economic conditions might cause people to change the way that they are prepaying mortgages. Wall Street firms keep track of prepayments by mortgage pool.

We're understanding this CMO, and we're thinking we have to build some assumptions about a projection that we want to do involving a CMO. What is the source of our assumption? What should that assumption be?

When we were looking at that CMO, certain things we kept talking about. We talked about a weighted average maturity (WAM), we talked about a weighted average coupon (WAC), and there's a type. If you're going to build a system, you'd want to provide for that. The WAC would want to be provided for. The type may be a fixed coupon, a floating coupon or a zero coupon. So we'd have to vary our model so that it could accommodate that. What is a key assumption? It is any event that materially affects the cash flow of an asset

or of an insurance product. That's what you have to figure out. You're not going to be able to learn it for any particular asset from me, but it is something that you have to sit down with. You have to take the responsibility on your own; to be convinced that if you were going to be reviewed by another professional, you'd be able to substantiate it. With the CMO, what might the key assumptions be? Prepayment rates, how fast the mortgages are going to be paying off, is one assumption. What is the source? There are some data available but they are contained in different sources. The format and organization may be key to us. We don't know why we have some assumptions. What could we do that would somehow dramatically link the speed to economic conditions? What economic conditions are occurring that cause those people to change the rate that they're paying off their mortgages? For principal guaranteed mortgages, defaults are usually included with the prepayment rates. Default rates aren't nearly as bad as they might be for other debts.

There are circumstances which would cause mortgages to continue paying much too high a coupon rate and keep spreads down. There is a story that I like to tell about a fellow in Houston who still has a 15 percent mortgage, and I being from Chicago, said, "Hey, why do you have a 15 percent mortgage? Why don't you refinance it? You can get 9.5 percent." He said, "Well, if I did that, I'd have to come up with $50,000 in cash because when I refinance my house, the value that they're going to put on my house is going to be about two-thirds what I paid for it just before 1980, and so I'm paying on a mortgage

balance that right now is about $50,000 in excess of the value of my house. So I just pay my 15 percent mortgage." Well, he is a rare guy. Everybody else in Houston seems to just leave. They take the risk of bankruptcy filings.

This story tells me that you've got to look beyond basic parameters for assumptions. The experience on speed is going to be different if the CMOs are backed by mortgages issued in Michigan or in the east coast compared to CMOs backed by mortgages issued in Texas or in the west coast where things really fly fast. Those kind of things are taken into account in the pricing. You're going to have to make some initial assumptions about pricing. So what might you do? You might have a PSA multiplier that ranges anywhere from maybe 1.4 to 2.37, for example, depending upon what underlies, what's the collateral, where it is located. Then you might have another one which links the speed to the difference between the coupon rate and the current market rates. As outside rates go down compared to the coupon rate, the speed is likely to go up.

As I said, default rates are dependent upon location of mortgages. If you want to find some interesting reading, the American Council of Life Insurance (ACLI) periodically puts out an investment bulletin which analyzes the insurance company's portfolio of mortgage assets. You'd be surprised as to how the default rate varies by geographical area. You probably can guess where the highest default rate exists currently. With respect to key assumptions

then, we'd need to have a system that would input the contractual provisions of the asset. We probably would do that asset by asset.

We'd need to input the contractual provisions of the liabilities, and there we would probably not do that liability by liability, but we would use some form of compression. We would try to describe economic scenarios some way. We would need to put our investment strategy into this system if we were preparing a report that talked about cash-flow testing, it would have to address these kinds of things.

New York Regulation 126 has some requirements about where it wants you to test seven different economic scenarios, but it doesn't put any restrictions on the investment strategy that you might have. You're free to use whatever you want. You would need to input your crediting rate for a universal life or annuity product. For a participating policy you set a dividend strategy. You would probably want to try and link that to changes in economic conditions. Then you'd need to put in all the linkages. That's the hard part. We can look back at history and see what happened in history, but it's very hard to reflect what actually happens, how people change their responses to changes in economic conditions.

Under the category of economic scenarios, we might try to describe a flat positive yield curve. We might try to describe a flat negative yield curve; a flat meaning that as time

marches on, the yield curve stays constant. That's a scenario. Everything stays status quo.

We could have a presidential cycle. What's a presidential cycle? Well, that might be useful for mortgages. Did you ever notice, and this apparently is an observed phenomenon, that as the presidential elections come up, interest rates somehow tend to fall and as the president is elected, then they begin to rise?

There are other things that you could want to put in. There are up/down, and down/up cycles. You just have to be able to justify that.

You have a lot of options for your investment strategy. How do you want to sell or buy your assets? How do you want to sell your current assets? Use some kind of a passive approach to keep a certain percentage of your assets in a representative portfolio of assets. You want to do a direct, active approach, identify asset A to be sold first, asset B to be sold second, asset C to be sold third? There was a tie for first. The buying of assets is subject to the same kind of thing. Those things have to be loaded into any kind of a system that you are designing or seeking to use. It should be able to accommodate that. You have to address the borrowing. What happens when cash flows become negative?

You have to provide for the type, quality, amount, and duration of an asset and all of those things are assumptions that you've got to make into the future. You know what you have in your basket today, but you don't know what you're going to have in the basket in the future. You can have new kinds of assets, like CMOs. CMO was an asset that was just started in 1982, I believe. If you did this kind of work in 1975, you would not even know about this asset. It wouldn't even be an option for you.

Another thing to consider, of course, is money markets, how much money you're going to keep in current cash until you move out to a bond. Are you going to keep up to a million dollars in current and then you move out to an investment? Those are some assumptions that you have to make, provide for and put into your report.

You want to tie crediting strategy to a market rate. That's one option that you can use. What is the market rate? You might want to pick a spot on a yield curve and say overall that is what the market will be flowing against, like a 5-year Treasury plus 200 basis points or a 10-year Treasury plus 200 basis points. And so as you go through your cycles of your projection, that defines what the market is. And you're going to tie your crediting to that particular market rate. You're going to be 200 basis points under that market rate. You could have it refer to a rolling average. You try to smooth out things. You could have it

lagging three months, six months behind your market rate to test that. See, you will be testing many different kinds of variables.

Earlier on, Roger was analogizing to weather forecasting. Suppose you were able to put a probe every square foot around the globe of the earth that would test the temperature, and these probes were one foot apart up to the top of the atmosphere, and you were able to have a computer access those probes to give a reading as to temperature, humidity, wind direction and so on. If you tried to project what the weather was going to be in New York City one month from now, you would not be able to do it accurately because one second after you made a measurement there would have been a little bit of deviation in the way things have happened that would not have been picked up by your sensors and then within an hour these changes would have made a little bit more dramatic effect. In many ways, that's the kind of problem we're faced with when we're trying to do cash-flow projecting. Everything looks pretty good at the start, but we just are making a lot of assumptions. We've got a lot of points out there, and yet it means that we have to be pretty careful with the results that we get. We cannot look at the results as being accurate. That is the problem with assumptions. If your experience follows assumptions actually, then this is what will happen. But our problem is we can do that, we just don't know whether our assumptions are really going to be that valid that far into the future. Things like structured

settlement annuities need to be projected for fifty years, but in fifty years we have lots of options that we can take to be able to handle changes in conditions.

We might tie in our withdrawal rates to market value rates via linkages in our formulas. One formula is A times new-money rate minus current rate raised to a power. There may be an underlying lapse rate like 5 percent. This seems to be a popular formula.

Premium payments vary a lot and are linked to differences between new-money rates and the current rate. Policy loan, speed, default, and mortality linkages are needed. Mortality may be static, but you have to worry about if excess lapsation deteriorates underlying mortality. Who stays on board? Is it the people who are going to be healthy, or is it the people who are not going to be healthy?

Refer now back to the Actuarial Standards Board on how to do cash-flow testing, Section 5.1. The actuarial report should describe the set of economic scenarios used and the methodology used to develop the scenarios. An actuarial report customarily should describe or identify the data, assumptions, and methods used with sufficient clarity that another actuary practicing in the same field could make an objective appraisal of the reasonableness and validity of the report. Those are the guidelines that you would need to consider in any kind of projection methodology. Projection methodology is affected by large number of

assumptions. It's just like forecasting weather. The more assumptions we make, the more we've got to do sensitivity analysis. Our analysis will be affected by what we put in for beginning assets and liabilities and our willingness to make simplifying assumptions. Simplifying assumptions work the other way. We don't want to oversimplify.

Our methodology is affected by the level of detail desired and by the speed of the computer. We also have to consider quality control features. We need to reconcile to our beginning balances. When we do this model, it ought to match up well with the assets that we actually hold and any kind of model that we have used to represent our liabilities needs to match up well with the underlying features of the liability. And we also have to be sure that any model we produce has the ability to be tested for accuracy. That's an important fact.

We can build Lotus spread sheets, but there is so much opportunity for undetected error that it's scary. One must exercise great control, great effort in making sure that those things are accurate. How long do we want to project, forty years, fifty years? Should we do calculations daily, monthly, quarterly, annually? It takes too long to run 500 scenarios with monthly projections, so we give up detail accuracy for something that we think is more accurate in the way of 500 scenarios. The accounting basis is important. Even though

we're doing cash-flow testing, we've got to look at statutory, we've got to look at the tax effect. We may need to look at GAAP.

Regarding grouping techniques, assets usually go in one at a time because they're big guys and we can code them up. We can take care of $10 to $20 million at a time. Liabilities are a little bit different. We use compression to handle that most often. Compression means that you are asking one policy to represent the characteristics of a whole bunch of policies. When we build a model and we might use ages 27, 32, 37, 42, 47, and dump everything between ages 25 to 30 into age 27, we're saying that all those policies in that issue age group go into that projection cell, and when we do our calculation, we project for that one cell. That sounds all right for traditional policies, but for universal life policies that gets to be more difficult because in that cell you can have groups of people who are going to pay premiums and groups who are not going to pay premiums. Their termination is going to be affected differently by the amount of money that they have. So any kind of model that you design has to take that into consideration. Sometimes companies want to do simultaneous projections. That's an important difference. Sometimes we can project our assets and then come back and do liabilities. Other times we want to try and get them closer together.

Companies use two approaches, deterministic or stochastic. Deterministic means that you look at one particular economic condition at a time, and then you run your projection. Stochastic means that you look at a lot of different random economic scenarios, usually, and then you look at the results from that.

What are the advantages and disadvantages of a deterministic method? Well, it's easy to understand. You can control the environment. You can re-run that same scenario and look at a different strategy, an investment strategy. On the other hand, you may wonder whether or not you've defined all possible economic scenarios, and that means you have to do a lot of runs. Under the stochastic method, there are two: MARKOV chain and log normal. MARKOV chain basically takes a number of yield curves that are pre-defined, and you take random walks through those to select your yield curve from period to period, and so one is assigned to each period. What you use then is a probability density function which is used to pick out the yield curve at any time, and then you pick a random number that produces the yield curve at that particular month or accounting period that you're working with. The other alternative is log normal. This apparently is based on twenty years of research, and it says that interest rates, short and long, are connected by a log normal function, and so you're able to use this log normal function to produce your various yield curves---one for short, one for long. Then note the volatility is higher for short term and that your distributions are 70% correlated, but you still really don't have any accurate

model for projecting these things. I personally like to look at one scenario at a time because I can deal with that.

Since it takes a long time to run scenarios, many times approximations and simplifications are made to speed things up in which case you may lose the benefit of doing all the modeling. And I don't know that the conclusions are any stronger than what you get out of just doing deterministic.

Last year when we were at this conference, an actuary made a statement, after giving a very informative report, on stochastic methods; that gosh, he's looked at all these data and there are no correct answers. There's just a lot of answers. See, that's a problem that we have to deal with. We can't be satisfied with that. Otherwise, why do all this work? I suggest we have to work towards results when we can draw conclusions, because we're going to have to as a part of our responsibility as being an actuary in the reports and the recommendations that we prepare. Roger has some additional thoughts.

MR. SMITH: I want to wrap up on just a couple of topics: why models might fail and then some future trends.

Why might models fail? I guess maybe we should define what a failure might be. I think one definition of a failure would be if the model yielded some incorrect conclusion. An example would be, if by using a model we decided on a course of action that should lead us to the road of prosperity, it, in fact, led to a state of collapse. Were the actual events close enough to the expected? I think we would rate that a failure. Some other failures might get back to some of the key criteria that we used. We should be able to save some time, and we should be able to save some resources and get some answers. I see occasionally models failing or being less than satisfactory sometimes because they start off bad with that statement of purpose or defining what sort of questions they want to answer. I would label that as the confused expectations.

Excessive detail is another reason models fail. I've seen models created and established where one particular aspect is unnecessarily excessive in the amount of detail or that detail is not balanced on some other side of the balance sheet or some other aspect of the modeling process. Insufficient detail can give erroneous conclusions. An example is taking a very large company attempting to use only five model projection cells for the liabilities. That might not work out very well.

Inconsistent relationships are another reason for failure. A lot of what we're hearing at this conference and in prior years are the relationships between market levels of interest,

crediting rates and lapse rates and all the dependencies that work on each other. We can definitely have some inconsistencies there. Sometimes we can't do anything about it. I think we need to look for those inconsistencies where we can do something about it. I did see one model that was a very good looking report in a nice binder, and despite it being a very attractive report, the news was fairly bad. All the charts for earnings and surplus position were dropping far into the negative, and all the nice slides and graphs in the report illustrated all the key trends. This was for a mutual life company and terrible dividends to policyholders were spiking up off the charts at the same time that surplus was approaching national debt levels. That's something that would be pretty obvious to spot. Those things won't happen at the same time and obviously we're not going to pay out money to policyholders when, in fact, we don't actually have it.

Bad starting positions are another reason models fail. We've seen a couple of examples where we've not quite captured the starting position. It's probably easier to do on assets. One aspect of a model that needs to be demonstrated or needs to be studied is what is the effect, of being just a little bit off in the starting position. Let me throw out probably an unlikely model. I couldn't imagine that too many people had never had a chocolate chip cookie. Well, I don't know how many of you have perhaps made chocolate chip cookies, but at some point in the process you open a bag of chocolate chips, and you pour them into the batter. Now, let's imagine that we decide to create a model where we want to

determine, based on the order at which the chips fall out of the bag and into the batter, which cookie the chip actually ends up falling into. We might be able to do that. As a matter of fact, we all might have somebody in mind who'd be the perfect person for the job. Suppose we were off by one in the starting position. Perhaps instead of being the seventy-fifth chocolate chip out of the bag, it was the seventy-sixth chocolate chip. Could we make an assumption that, even though we were off a little bit in that position, the two would still likely end up in the same cookie? I guess my intuitive reaction would be that if it's a different chip coming out, even though they're very close together, it's probably unlikely that the two chips will end up close together. We probably cannot predict their ending place just because they were close at the start.

I want to talk a little bit, perhaps, about future trends and what I would expect. Most of what I see and what I would expect to happen is that we will be working with greater levels of detail in the months and years ahead. That will translate to more cells.

I think that we'll probably come to the point where we'll be looking more at demographics. Bob pointed out some of the differences that we can expect in asset portfolios based on demographics. I don't know that anybody has done a lot of work yet on the liability side, for example, to differ policyholder actions based on where they might live. For example, I think if we were projecting universal life activities from a group of residents of Houston, Texas, to continue Bob's example, that the premium pattern flows might be far different

than a group of policyholders in Atlanta, Georgia. I think that typically we will be going to just greater levels of detail. The models will most likely be used more frequently than we're using them today. Finally, I'd like to mention there is a growing book of knowledge on the science of chaos. I'm just a novice there, but it has some interesting possibilities. Weather is one. In weather you can study the relationships down to a very fine level, and sooner or later you reach a point where it seems that things are unpredictable and you have a tendency to kind of throw up your hands and say, "Well, it's unpredictable, it's unstable, and there's obviously nothing we can do." Oftentimes, in some further studies and with probably a lot of computer simulations, patterns emerge so that you can go from the situation where, at a very detailed, cell-by-cell level, there almost seem to be too many variables and too many forces to really get an accurate picture, and somehow when everything gets wrapped together, patterns emerge and you might be able to make some conclusions based on those patterns. That concludes my comments here.

FROM THE FLOOR: I like your thesis that deterministic methods are equally valid with stochastic methods. Believing as I do, you're dead wrong. Defend it.

MR. LALONDE: Nothing like a good piece of controversy to get things going. You're asking me to defend why I believe deterministic methods are more valid than stochastic methods. I just have a preference to it, and I imagine that other people have a preference

to stochastic. I never can understand what direct action you can take as a result of a stochastic run.

I think maybe it's just a personal, and it's a professional thing. Perhaps you would like to expound some more on the benefits of the stochastic method. Would you like for me to publicly announce that answer?

FROM THE FLOOR: No. You made the statement in your hand-out that you were not convinced that there was any value to be gained from stochastic. I don't think I'm omniscient enough. You may be, but I'm not omniscient enough to know what, for example, investment yield curves may look like in the future.

MR. LALONDE: Well, that's it. You run it through 200 scenarios, but what kind of scenarios are they? You see, they are scenarios over which you have no control. You can't sit back and say, "What protective action can I take to protect against a particular scenario?" Explain how you use your stochastic method to identify those scenarios that will cause you to want to change your investment strategy.

FROM THE FLOOR: Well, it's where the world falls apart obviously. It's pretty clear which ones you want to change. I was more curious as to yours, without getting into it, but it's obviously when the world falls apart. In 25 out of 100 cases the company is going

broke, you begin to have some qualms about what you're doing, so you may change your assumption. Now, I don't agree with one assumption you made, and that is that you can't repeat the same set of assumptions. You can use stochastically derived investment curves, but use that curve over and over and over and over again. See, you have the same starting point when you use the curve. Just because you've determined your yield curves by a random process doesn't mean you can only use it once. You can use it 100 times. So you can change your variables. I've always had a deep fear that the results are not randomly distributed. I think some day someone ought to tell us whether they are or not. That doesn't mean that I'm not satisfied that 99 times out of 100 I feel better about it than if it was only 75 times out of 100 that we succeeded.

MR. LALONDE: Well, I just sort of feel like what do you walk away with after you do all the stochastic, running through 200, 500 scenarios? What do you walk away with that you feel pretty good about and pretty certain about? I know what you can do if you do deterministic, because you can look at specific yield curves or you can see what happens to your specific investment strategy and therefore know what potentially could happen. Even though I said that, with respect to assumptions going into the future, those are still speculative. I think you can learn a lot. I don't know that it's just a good idea to go ahead with stochastic on the belief that it gives you something that's more valid or provides you with more information which makes you feel more confident about the strategy or about

your opinion or about your report. We're mechanically capable of doing it. We can do that, but I'm not convinced that it gives you that much more information. I'm sure that there are other people who feel the opposite.

FROM THE FLOOR: In other words, your feeling might be that if we run the seven scenarios specified by New York Reg. 126 and then play with different interest crediting strategies and re-run them or play with different investment asset strategies and re-run them, we might get as much or more value as if we started with the yield curve and random numbers say 250 times.

MR. LALONDE: I don't know that we have to work with those seven. We can invent some others.

FROM THE FLOOR: Something along that idea though for ups and then downs in the interest.

MR. LALONDE: Yes, I would propose that mainly because I wouldn't say that all the random stimulation is going to be better. You'd have things that are going on. You've defined an environment, and just what is your gut going to feel like after you look at this stochastic thing? Don't you have some reservations about the randomness in it? Are you

sure that the randomness actually even is representative of what people will do? I'm not sure it is, and so therefore what I'm saying is that the randomness should not be used to make you feel like, oh yeah, well, I've done this random study so therefore that makes my conclusions more valid. I don't think you can assert that.

FROM THE FLOOR: I disagree entirely when you say you can't study what's happening. If your model is properly conducted, you know why the model falls apart. You know what's happened to the investment yield to make things go to hell in a hand basket and it's clear. So you've got just as much knowledge as you have with a deterministic model.

MR. LALONDE: Well, my alternatives to stochastic would be to decrease the frequency of your analysis. Instead of doing it annually, you need to continually reevaluate your investment positions. You would be just like an investment manager working with a portfolio. Some companies always have a buy and sell position. Other companies have a hold position. But you need to continually look at that on maybe a quarterly basis and then you start over again. You say, "Here are some economic assumptions that we think are going to occur in the future. Well, let's look at what happens." As time goes by, your thinking about future economic assumptions changes. It's like the 74 different kind of economic reports that you can read about in *Businessweek Magazine*. Every year those change. Now, you can run a stochastic model and simulate all those, but you're not going

to hold your assets for all these years, which is what stochastic modeling can do. The people who manage companies are continually reevaluating the positions, and I think the way to deal with that is to stay abreast of their evaluations, to touch base with them, to re-run your models frequently. You change your assumptions frequently. You work with a few strategies that you can understand. You make changes to strategies. You make changes to investment scenarios, and you migrate along to a successful path that way.