SESSION 6B

MODELING TECHNIQUES FOR USE IN TESTING THE SCENARIOS BEING DEVELOPED BY THE CIA SOLVENCY STANDARDS COMMITTEE

(TEACHING SESSION)

INTRODUCTION

MR. GARY C. MOONEY: You are the Valuation Actuary for a progressive, right-thinking company whose management recognizes the need for forward planning and financial control. Management has asked you to develop a capability for scenario testing to meet the soon-to-be-introduced requirements by the CIA.

You are now sitting at your desk with a pad of paper, two sharpened pencils and a large eraser. What do you do next? That's what we are here to answer.

David J. Congram, Helmut Engels and I are all members of the Committee on Solvency Standards, which was formed more than two years ago. The three of us and Allan Brender have been working as a subcommittee on modeling for about a year. Our goal has been to develop a generic approach to modeling that might be used by any company in doing scenario testing.

We have imagined ourselves working for a large company in the office of the Valuation Actuary. We are the coordinating group and have

delegated much of the technical work to the operating segments. Our approach to modeling is designed to fit this environment. I hasten to add that this approach will work in a small company as well in that the Valuation Actuary simply delegates the work to himself.

At the last meeting of the Committee, the modeling subcommittee was expanded to more than a dozen members (using a sub-subcommittee structure) to enable us to extend our research and developments activities.

SCENARIO TESTING UNDER CIA STANDARDS

We are going to restrict ourselves to dealing with anticipated requirements for scenario testing under standards for solvency reporting prescribed by the CIA. These standards will be implemented in three phases. The focus of the first phase will be on the projection of surplus under a variety of prescribed and selected scenarios and the comparison of the results with the amount of surplus required by the Canadian Life and Health Insurance Association (CLHIA) formula. The third phase will likely include some type of opinion on solvency by the Valuation Actuary. The second phase is a transitional one that will reflect evolving financial reporting laws and rules.

Some of you have received a package prepared by the Committee on Solvency Standards that includes the Committee's Statement of Direction as approved by the Council earlier this year.

We will restrict ourselves today to the first phase requirements -- namely, scenario testing under standards prescribed by the CIA.

Technique

Our goal is to be able to project the surplus of the whole company on a going concern basis, including both existing and future business, under various scenarios. These scenarios should cover all of the major risk elements: mortality, morbidity, lapse and expense, as well as interest rate risks.

We want to develop techniques that will be: generally applicable to all lines of business, understandable by the Valuation Actuary, and achievable with current technology. By current technology we mean personal computers (PCs) using the 80286 or 80836 chip and disk operating system, or DOS, together with software products such as APL, Lotus 123 and dBASE. Let's define understandable by the Valuation Actuary. What can we expect about his knowledge of modeling techniques?

Typical Valuation Actuary

Knowledge Good -- Almost all Valuation Actuaries are comfortable with asset share concepts, involving the projection of a single block of new policies. Most are also familiar with concepts of liability cash flow

modeling, whereby multiple years of issue are included and projections are done on a calendar year basis. All actuaries have a good intuitive understanding of the various risk elements involved.

Knowledge Fair -- Some actuaries have some knowledge of asset cash flow modeling, which used techniques similar to those used for liability modeling. Some have experimented with scenario definition concepts.

Knowledge Poor -- Most of today's Valuation Actuaries have had little or no exposure to the use of stochastic methods to evaluate or project future financial results.

Our view is that we must walk before we run, and the walk should not be a random one. So we are proposing a methodology that initially will focus on techniques most readily understood by today's Valuation Actuary.

Presentation

A good teacher knows three rules for getting good results in teaching: Tell them what you are going to tell them. Then tell them. Then tell them what you told them. We'll apply the first two rules today, and you can review what we told you when you receive the proceedings of this Symposium.

I will turn the podium over to Mr. Congram.

ELEMENTS OF SURPLUS PROJECTION

MR. DAVID J. CONGRAM: Thank you Mr. Mooney. Your description of the Valuation Actuary suits me just fine. I believe our associates in the United States are a few years ahead of us in their stochastic scenario testing. Mostly, at the behest of the New York State Department, the last 5 years of highly fluctuating interest rates have accentuated the problems of the non-forfeiture laws, particularly in the universal life and flexible premium annuity lines. While facing a different environment we, as professionals in Canada, are being challenged to gain a better understanding of the capital needs of operations.

While Mr. Mooney and Mr. Engels assembled the initial models we are discussing, my principle interest has been in building-on the cash flow projections particularly as they have related to valuation interest rates. I ask all those embarking on this task to recall a remark by Plato: "The beginning is the most important part of the work." We have heard an excellent expose during this Symposium on the U.S. APPA.

The main objective is to model your total company operation in order to develop a projection of surplus over 5 years. That is a significant undertaking. From the work we have done to date, we recommend the following.

-- Start small

-- Build on what you have

-- Prototype

-- Don't try and do everything at first

-- Cycle through once

-- Keep it simple.

Your emphasis is to be on qualifying the fundamental risks and fluctuations you can expect for your operations.

Kenneth T. Clark, President of the Canadian Institute, says, "Go for some small success." As you embark upon testing to determine the capital needs of your operation, go for some small success.

As I began to use the model, I became interested in trying alternate investment strategies; as I did this and saw the results I went in and modified the model and builtin a model for the reserve for the mismatch between assets and liabilities. After looking at various scenarios, I became convinced that we should consider changing our strategy while achieving the primary objective to test surplus. Don't be surprised if you get a number of additional side benefits.

It is also important for you to know that cycling through the first time is tough. When you have done that once, building on the approach and improving the structure will tend to come easily since you have a clearer understanding of what you want to achieve.

We recommend that you begin by choosing a specific product line as your prototype. The approaches that we found most useful were to choose a product line in which we already had an asset share structure, or to look at a new product that we are developing. It is probably best to choose a product line in which you have a personal interest or a particular concern. Maybe you have been discussing changing the investment strategy to get an edge on the market for your flexible premium annuity product. Maybe you are uncomfortable as to just what exposure your Term to 100 product can have on your operations. Now that Bill 56 is law (the indications are clear that the superintendent will endorse the CLHIA guaranteed minimum formula) just how much capital is needed in excess of the CLHIA formula to withstand the fluctuations from that product that you are uncomfortable with will become much more significant.

Another suggestion is to set a deadline. This may seem strange, but let me remind you that this is a prototype. You are not trying to build a perfect answer. You do want to be realistic, but you want to understand the approach. You want results so you can get your mind around the real problem and issues which you are going to have to face. Set the deadline short and in that way ensure that the design of the model will be simple and operate as a prototype the first time around. This approach will clearly reinforce to anyone who is helping your objective.

Having decided on the product line, spec out the cash flows you are

expecting. These were reviewed during this Symposium in Session 4A, Case Study Using Cash Flow Analysis. You need cash flows to know which asset purchases to make and to build the appropriate reserve liability, the revenue statement and the balance sheet. So, it is best to start specing them out. Clearly, we are all on familiar ground as far as this is concerned.

Now decide on which assets are going to be appropriate to the product you have chosen. Don't get fancy. You will have a lot of time to build the bells and whistles afterward.

You need to handle cash. You can probably do that through using a short-term instrument. You probably need some medium or long-term assets to fit your particular product, such as bonds with perhaps some call provisions and some mortgages.

One consideration you should make at this point is how to handle negative cash flows. Our recommendation would be to borrow short initially since it's easier to do it for the first step. Later, add divestitures as an improvement on the model when you are ready to build in a more complex investment policy.

As you choose the assets you are going to use, spend some time with your investment department. Ensure the assets you model are real and currently available on the market.

As for specing out your model assets cash flows, we are not on such familiar ground, but most of us have had an investment income allocation method to deal with or certainly have had to put together some cash flow projections to determine what is an appropriate valuation interest rate. The types of cash flow you need to model are:

-- Purchase amounts
-- Coupon interest
-- Scheduled principal repayments
-- Elected principal repayments under the terms of the asset
-- Investment expenses.

Notice the similarities with the liability cash flows. When you look at those elected principal repayments (call provision), what you are really dealing with is a probability distribution. Once the principal repayment takes place, then the asset is removed.

Having laid the foundation, now you have to come to grips with the way to structure the liabilities, the assets, the surplus and the interrelationships that drive them. Let me now turn the podium over to Mr. Engels.

CREATING A SCENARIO TESTING CAPABILITY FOR A SINGLE PRODUCT

MR. J. HELMUT ENGELS: I am supposed to describe, in a simple,

conceptual way, an example of one way to developing a model for Canadian solvency testing.

As Mr. Congram just mentioned, both Mr. Mooney and I developed simple models that we used for our own understanding of the concepts, and the possible problems, of this solvency testing proposed by the committee. We both wanted to see what was involved, in a hands-on way.

Mr. Mooney developed a model for a Term to 100 plan, using APL on an IBM AT microcomputer. I wanted to have an even simpler model, and so I did one for a Single Premium Deferred Annuity (SPDA), on a PC, using Lotus 123.

We picked real plans, since we were also looking at the amount of effort it took to develop a reasonable model from scratch. I think we showed that, even with two different product lines, it is possible to develop a model from scratch that will help you understand what is happening, and do it fairly quickly and simply. Mr. Congram was able to take my SPDA model, play with it, and upgrade it so as to better understand why things were happening.

Before I continue, I want to apologize to those people in the audience who have done far more sophisticated modeling than what I am supposed to talk about here. The purpose of this session is to give guidance on how to begin the process. So, imagine yourself as an

actuary sitting at your desk with a blank piece of paper, a couple of sharpened pencils, and hopefully a PC in front of you.

As Mr. Congram already mentioned, the projected cash flows are both for the liabilities and for the assets. The prime purpose of a model for solvency cash flows is to help you see how these cash flows interact in various scenarios. (See Slide 1)

We are proposing that you use a model to do the work involved in solvency testing. We are not asking you to do any seriatim runs, similar to valuation runs. Now, there probably are companies with systems which are capable of doing seriatim runs, and not just modeling. However, for most companies, I think that this approach would be simply too complicated and far too costly. Unless such systems are already in place, I don't think the expense of developing them is justified for this solvency testing.

We are specifying that the model test scenarios, and not be a model that does stochastic testing for solvency. In previous seminars, you heard about doing stochastic type models. We advocate a simpler approach, especially since we assume that, realistically, most actuaries are probably not that comfortable with statistical techniques. Also, company management, to whom you will have to explain results, is not comfortable with stochastic models and statistics. They can relate better to prescribed scenarios.

AN EXAMPLE FOR DEVELOPING A MODEL FOR CANADIAN SOLVENCY TESTING

- Project cash flows
  - assets
  - liabilities
- Model results, not seriatim
- Scenarios, not stochastic probabilities
- Project statement values

I think that scenarios are easier to explain to non-actuaries. For example, in one scenario that we are prescribing you test the effect of interest rates going up by 300 basis points over 5 years and what happens to your surplus as a result. That's very simple to understand. It's similar to the requirements of New York's Regulation 126, with which those of you who do business in New York already have to comply.

Another advantage of using scenarios, in fact prescribed scenarios, as a base is that this will tend to lead to more consistency among different companies' results. Consistency was one of our committee's prime concerns when we began this project. We were told that we had to take an approach that would ensure consistency among companies' results.

Finally, the model has to project statutory financial statement values. The purpose of this solvency testing is to show that you have enough surplus to meet the new CLHIA minimum capital and surplus formula, at the end of 5 years. Therefore, you are projecting your published financial statements. Again, actual statements are easy for non-actuarial management to understand.

Before I go into the type of model that Mr. Mooney and I used, let me just say that the method I will describe is certainly not the only way to do it. The committee is not prescribing a single mandatory method for modeling, as shown in Slide 2.

NO MANDATORY METHOD PRESCRIBED

Different Types of Models Are Possible

- Seriatim projections
- Trending
- Spread models
- Cells

Some companies are capable of using seriatim projections. Some particular lines may be very small, or very stable, or may not be material to your company. You still have to include them in the total, but you may use a trended result to do so. Some people use what I call spread models, in which they know a particular product line is only sensitive to a certain indicator, such as the spread between actual and credited interest rates. Mr. Mooney and I used a cellular approach. And that's what I'm going to restrict myself to describing here.

How do you begin this process? Again, I am assuming you are the proverbial actuary sitting there with a blank piece of paper and a couple of sharpened pencils. First, you are not beginning this process totally unequipped. (See Slide 3) As Mr. Mooney mentioned earlier, we are assuming that most actuaries are familiar with asset shares used in pricing new products and the assumptions used in the pricing. There is a good chance that these assumptions will be the expected basis you can use for the base scenario.

Next, you have to add some assets. To do an asset share, you probably just use an assumed interest rate. Well, the modeling gets slightly more complicated, since you have to decide which types of assets you have backing the liabilities, and what their characteristics are. In other words, you have to model assets, and not just take an interest rate from somewhere.

HOW TO START

- Asset shares – new products
  – expected basis
- Add assets
- Add surplus
- Add in-force business
  – assets & liabilities
- Prototype first
- Do an easy line first

Then you have to decide on the way you want to handle surplus in the model. The CLHIA formula will dictate a minimum surplus level, and this is one of the key numbers you have to project. How you actually incorporate surplus in the model can vary by company.

You can assign a certain amount of initial surplus to each line, or you can have surplus managed as a corporate line of business. How you handle the issue of surplus can depend on the way your company is actually organized, such as into separate divisions. Or, it could depend on the way you do internal profitability measurement and reporting to management. Mr. Congram will get into this topic in more detail.

Next you have to have some idea of what your in force business is and its characteristics for both assets and liabilities. For some product lines that have been around for several years, this is not as simple as it sounds. Because of that, we advocate that you do prototypes first. It also helps if you start with an easy line of business.

Don't try to develop the perfect model on your first try, one which provides for every detail you can dream up. It will be a very complicated task to do everything all at once. Start very simply.

So, getting back to the models Mr. Mooney and I worked on, I picked the SPDA product, which is quite simple. Mr. Mooney picked a Term

to 100 product. I think we learned a lot from these simple products. We learned the interactions that could happen -- namely, your investment philosophy versus what you are selling versus the valuation method. When you're comfortable with how the simple model works, you can progress to doing more complicated lines of business.

If possible, do it on a microcomputer in a language you understand. You learn faster in the beginning by trying things yourself, instead of just assigning the work to a junior student. In fact, to begin the process correctly, I suggest that the valuation actuary be personally involved.

Now, where do you begin? Let's look at Slide 4. There was some discussion in our committee about whether you should do only new business first, or whether you should model your in force business first and then add new business later.

Traditionally, I think most actuaries tend to try to model their inforce business first, because it's there. It's real and it exists, and you've done valuations of it every year. Interestingly enough, both Mr. Mooney and I ended up taking a different approach.

We did new business first, because it's simpler. You could invent it. You have the assumptions from your pricing asset shares. Also, it's easier to prototype new business.

WHERE TO START:

New Business or In-Force Business

1) New Business:
   - easier to prototype
   - asset shares exist
   - expected basis known
2) Simulate existing business
3) Model actual in-force

We were able to get the methodology working and understood. We were able to make sure that the programs worked correctly using only new business. Before you go too far into developing a model, it is very reassuring to be confident that the computer programs are at least working the way you think they should.

The second thing we did, as an intermediate step, was to simulate the existing in force business. In other words, if you have a model for new business that starts with 1987 as a base year, just take that same model and start back in 1980 and project to the present. That will give you a sort of in force block. The advantage to doing this is that you know all the information about that in force block. With this it is much easier to understand the mechanics of your model, the mechanics that result from the methodology you designed into the model.

Only after you are comfortable with the way your model works, based on data that you know should you then model the actual in force.

If you try modeling the actual in force at the same time you try to experiment with your methodology, it takes a lot longer to figure out what's happening and why strange results are coming out of the model. I can give an actual example of this. A couple of years ago my company decided that we should develop a model. It was in APL on the mainframe. What I am telling you now has the advantage of perfect 20-20 hindsight.

Our first mistake was that we picked the most complicated product line, ordinary insurance. We were anxious to have a model of this because it was our biggest line, and we didn't understand what was happening to it. However, I have to stress that ordinary insurance was also the most complicated line we had, and that's one of the reasons we didn't understand it. Also, we started with the most complicated part of it, our U.S. division.

We didn't do a prototype since we were in a hurry. We thought APL would give us the flexibility we needed if we made a mistake in our approach. It didn't. We wanted to design the perfect system right from the start. During the development we continued to make the design more exact and sophisticated. All this was before we had any results from the model.

Then when we finally produced a result, it was very different from our actual experience. It was unbelievably different. It took a long time to figure out why. Why? Was it the data? Was the methodology wrong? Or was there some bug in the programming? I think it turned out to be all three to some degree. In the end, all the errors were ironed out, but it had taken so long, and the model was so complicated, that it had lost all credibility and the whole project was dropped.

My point is that it was very difficult to find problems when <u>everything</u> is untested at the same time -- namely, the methodology, the data and the programming. That's why we recommend that you do it step by

step, and always keep it simple at the beginning. You can get more complicated later, if you really think that you need to. But for the first try at a model, keep it simple, so that you can stay in control of what you are doing.

If you could now look at Slide 5, I would like to talk about the information you need. First, you need the expected basis to do your base scenario, and this is presumably the same as pricing. You need to know what your valuation basis is -- that is, your current valuation basis. You have to know what your investment policy is. You are going to get cash flows in this model, and you have to know the investment mix you will have.

Subsequently, depending on how active you are in your investment policy, you have to know whether you are going to trade and the effects that has on your mix of assets, but I suggest that you keep trading as a second phase. In the first phase, just figure out where you're going to put the money from your cash flows.

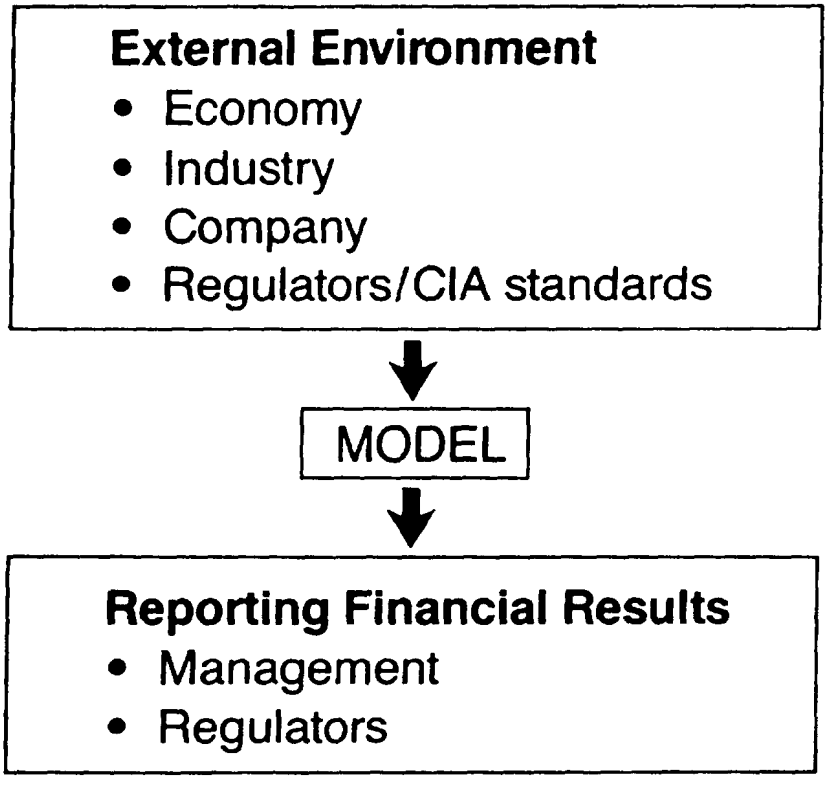
You also need to know a sales plan, because you are being asked to project statement results for 5 years.

Slide 6 gives an overview of where the model stands. You have the external environment, where you've got:

1. the economy,

INFORMATION NEEDED

- Expected basis
- Valuation basis
- Investment policy
- Sales plan


External Environment
• Economy
• Industry
• Company
• Regulators/CIA standards
MODEL
Reporting Financial Results
• Management
• Regulators

2. the particular industry that we're in, and

3. the characteristics of your own company.

They all influence the input to the model, which means the assumptions you are going to use.

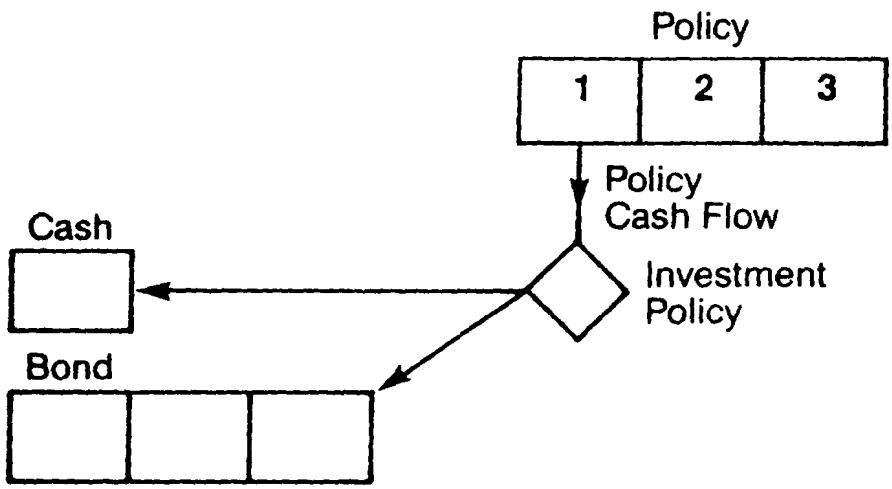
And then you have the expectations or standards of both the regulators and the CIA. The reserves you use have to comply with the CIA standards. The regulators determine what accounting you have to use, and thus what the statements look like.

Your model is like a black box in the middle that you are going to manipulate. Your financial results come out of it. Mr. Congram and Mr. Mooney will talk later about how you actually present them to management.

Now for some specific examples of a model. Slide 7, and again it's very simplistic, shows what Mr. Mooney and I ended up doing in our models.

First, you presume you have sold a group of new policies that year. You set up a cell for that year's business, and it will be tracked for the next 5 years. Premiums will come in during these several years, and you can have withdrawal and renewal expense assumptions for each of the years. The policy cell generates a net policy cash flow.

MODEL – YEAR 1



You have to make an investment policy decision about what assets the cash flow goes to. And again, I kept it very simple for this illustration. I've shown that some of it just goes into cash and the rest goes to bonds. In our models, Mr. Mooney and I had four asset types, and that seemed to be enough to give you some dynamics as the scenarios changed.

All right, Slide 8 uses numbers. In the first year, you have your net policy cash flow. I've assumed it's a simple annuity product, where there are premiums paid each year, and there is an up-front expense load. So your policy cash flow here is premiums less expenses. In this example I've assumed that the product line has an initial amount of surplus assigned to it. For its investment policy, for simplicity, say $50,000 goes into cash and the rest goes into bonds. Now, based on this, you have to generate financial statements. Using these numbers, you can show the year's revenue, which is made up of the policy cash flows, plus investment income and the increase in reserves. (See Slide 9)

You can also generate the balance sheet, and the surplus statement. Within surplus, there is an amount of required surplus, as defined by the CLHIA formula, and the rest is free surplus.

In the second year, as shown in Slide 10, we still have the policies from the first year, and we have sold another group of policies. So you've got some net policy cash flow, from the two years of policies.

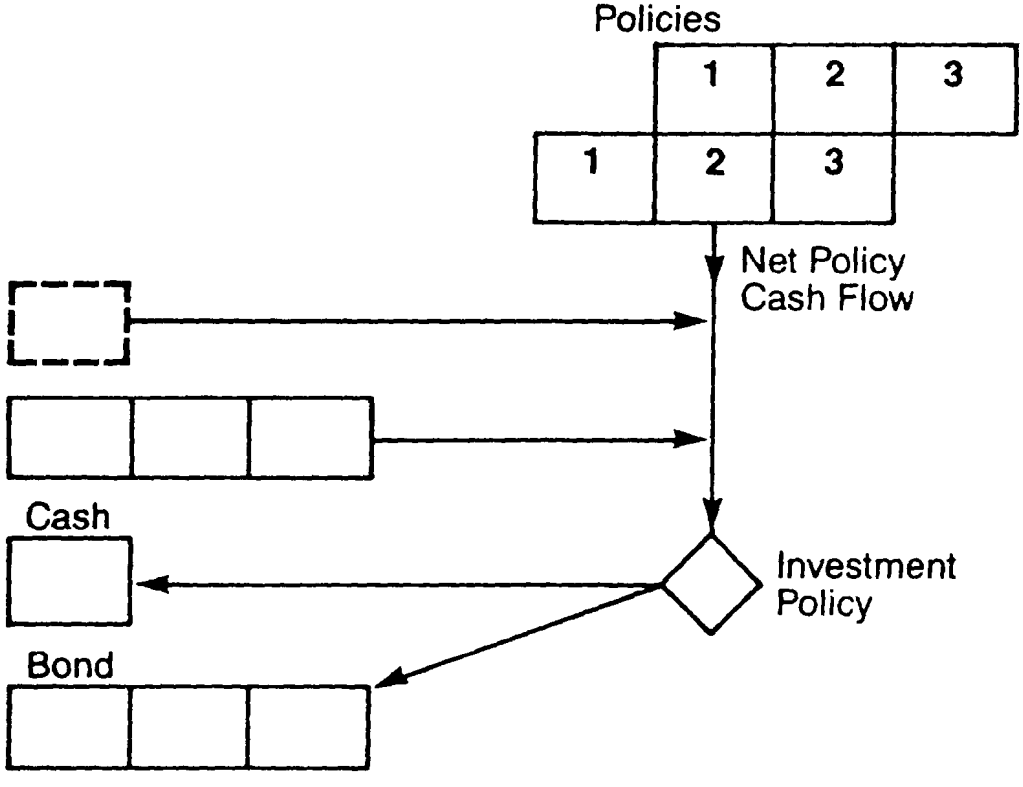
MODEL – YEAR 1

Net Policy Cash Flow	
Premiums	1,000,000
Payments	0
Expenses	(60,000)
	940,000
Initial Surplus	100,000
Investment Policy	
Cash	50,000
Bonds	990,000

MODEL – YEAR 1

Revenue Account	
Premiums	1,000,000
Inv. Income	104,000
Payments	0
Expenses	(60,000)
Incr. in Res.	(1,029,300)
	14,700
Balance Sheet	
Assets: Cash	50,000
	104,000
Bonds	990,000
Liabilities	1,029,300
Surplus: Required	30,486
Free	84,214

MODEL – YEAR 2


Policies
1
2
3
1
2
3
Net Policy
Cash Flow
Cash
Investment
Policy
Bond

Also, from the amount from that you invested in the first year, you have investment income.

All these cash flows, from the policies, from the investment income, and from the cash rolling over, all flow together and get distributed to different asset types using the second year's investment policy. (See Slide 11) All of this can be done with a fairly simple model. You just have to keep track of your buckets of money from year to year.

Again, we can generate the financial statements. You have the net policy cash flows, this time assuming there are some surrenders in the second year.

You also have investment cash flow. This comes from the investment income from the cash and bonds, two separate sets of bonds, those purchased in the first year and those purchased in the second year. You can also consider the rollover of the cash as an investment cash flow, the same way as a bond maturity in the future will be a source of cash.

So the combination of your policy cash flows, and your investment cash flows, is again distributed by your investment policy in the second year. Additionally, your investment policy can change. This time there is $200,000 left in cash, $990,000 that represents the bonds still there from the first year's purchases, and new bond purchases in the second year of $1,026,000. Using the numbers in Slide 12, you

MODEL – YEAR 2

Net Policy Cash Flow	
Premiums	1,300,000
Payments	(150,000)
Expenses	(78,000)
	1,072,000
Investment Cash Flow	
Inv. Inc.: Cash	5,000
Bonds	99,000
Cash Maturity	50,000
	154,000
Investment Policy	
Cash	200,000
Bonds: Yr. 1	990,000
Yr. 2	1,026,000

MODEL – YEAR 2

Revenue Account	
Premiums	1,300,000
Inv. Income	246,120
Payments	(150,000)
Expenses	(78,000)
Incr. in Res.	(1,296,064)
	22,057
Balance Sheet	
Assets: Cash	200,000
	246,120
Bonds	990,000
	1,026,000
Liabilities	2,325,364
Surplus: Required	66,667
Free	70,089

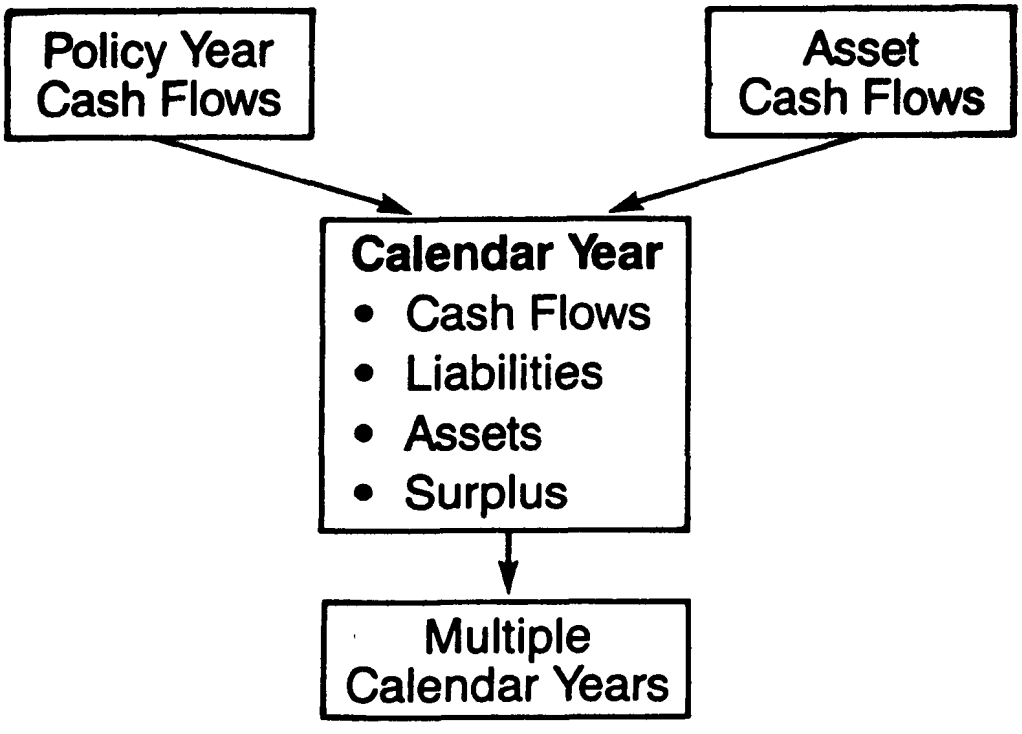
can generate the financial statements for the second year. You have a revenue account a balance sheet and a surplus statement.

Let me summarize. What you have in this type of a simple model are policy cash flows, and asset cash flows. These are related, since the size of the policy cash flows determines the size of the assets. However, they can be modeled as separate parts of the same model.

Going back to the models that Mr. Mooney and I did, we used different methods to project the policy cash flows, but our asset cash flow methods were deliberately kept consistent. (See Slide 13) Then the combination of this policy and asset information will give you a calendar year's data, with which to generate a revenue account and a balance sheet for that year.

Then, the model can project future years' results, which are just a combination of several policy year results. The key is to keep track of the buckets, or cells, of policy cash flows, and the buckets of assets. Each of these in force cells, both for liabilities and for assets, will then generate future projected cash flows. These projections of the in force data can then be combined with the new sales projections, and their associated future asset purchases.

Now that I have talked about the basic model structure, I also want to talk about other capabilities that the model has to have. (See Slide 14)


Policy Year Cash Flows
Asset Cash Flows
Calendar Year
• Cash Flows
• Liabilities
• Assets
• Surplus
Multiple Calendar Years

DYNAMIC MODEL CAPABILITIES

- Expected basis
  - re-pricing
  - dividend scale
- Valuation basis
  - change assumptions
- Investment policy
  - dynamic allocation policy
- Sales plan
- Management action

It has to have the capacity to do more than just one projection using one set of assumptions. There are several prescribed scenarios, and then, depending on your own company's characteristics, you might have to do additional scenarios for particular sensitivities.

Therefore, the model has to take account of changes from the expected basis. For instance, as you incorporate either deteriorating mortality, or changes in interest rates into the scenarios, the model has to be capable of reacting the way the company would.

If changes like this really were to happen, the company might be able to reprice the premiums for some plans, such as YRT or Group Health. Or, it could change the level of dividends, either policyholder dividends or shareholder dividends.

Somehow you've got to be able to get that flexibility into the model. You can either have the model be sophisticated enough that it has the logic programmed in so it automatically does this, or it could be a bit more interactive; in other words, you actually get into the model and manually change the assumptions in the future for the various scenarios.

You've got to be able to change your valuation basis assumptions. Remember that the model will have to project results for 5 years, and at that point you will have to do a valuation based on the expected experience at that time. So you've got to be able to change valuation assumptions, at least at the end of 5 years, and maybe sooner.

Your investment policy should be dynamic. As the environment changes, and as interest rates change, would your company change its investment mix? If the answer is yes, then that should be what the model does as well. The model should allow you to play around with the investment policy so that you can see how sensitive you are to changes in that policy. This is an example where the model, in addition to just letting you do what is necessary for solvency testing, can also provide some very interesting management information.

The model has to have a sales plan. Presumably, that sales plan could change, depending on the results of the scenarios produced by the model.

Finally, the action management could take as scenarios develop in the future overlaps all of the above. You have to assume that management will not knowingly drive a company to bankruptcy. If they actually do, then it is a C-4 risk, and those don't have to be modeled.

For example, suppose there is a particular sales plan, or a particular investment policy, that generates several adverse scenarios. If these scenarios start to develop, then presumably senior management is not going to just sit back and do nothing. There are several managerial actions that can be taken in time to avoid the full consequences of an adverse scenario.

So somehow, after you do your runs, you've got to be able to incorporate what your management would do to avoid insolvency. For example, if

the sales plan is so aggressive that the company is going to run out of surplus within a couple of years, then presumably management will change the sales plan.

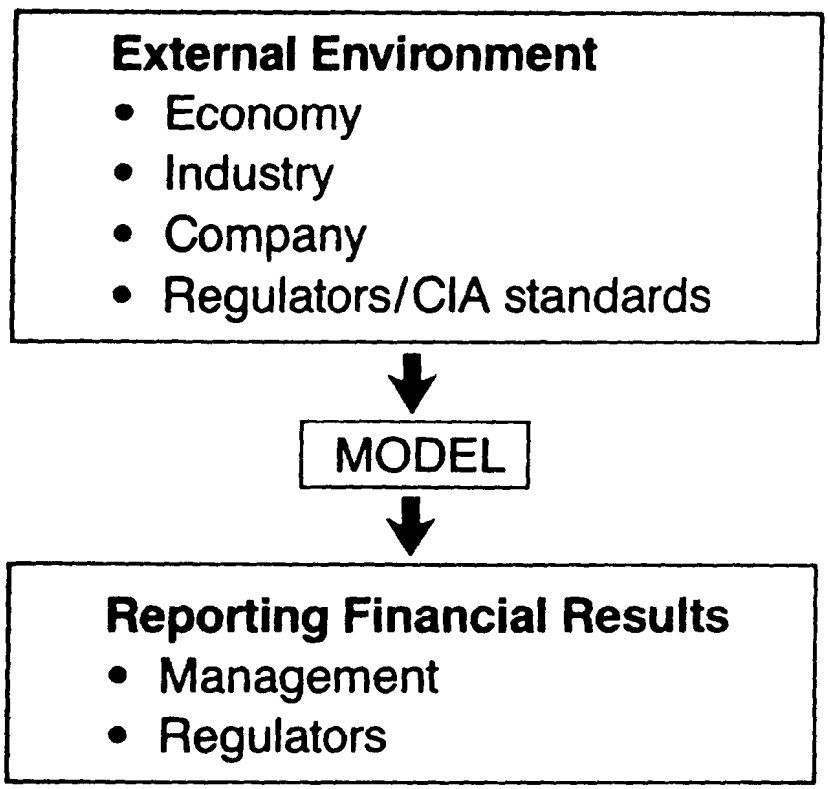
That's the end of my presentation. I've tried to describe the design of a very simplistic type of model, and some of the considerations you have to keep in mind when you are trying to build a model from scratch.

Now let me give you Mr. Congram, who is going to talk about how you take this model for one particular product line and expand it to an entire company.

CONSIDERATIONS OF MODEL CAPACITY

MR. DAVID L. CONGRAM: So far, we have kept to a discussion of the single product and built a projection capability. Mr. Engels has raised a number of issues that need to be addressed within the model. Clearly, few companies provide only a single product. How multiple products would be combined and company structures handled is another consideration you need to address as you see your prototype fit into the total organization. Let us spend some time considering this.

First, if we return to Mr. Engel's Slide 15, he shows the model within an external environment. Let us now look at the model as being a


External Environment
• Economy
• Industry
• Company
• Regulators/CIA standards
MODEL
Reporting Financial Results
• Management
• Regulators

group of product submodels, instead of being a single product. I think this is helpful in conceptualizing. You need to view the model as a hierarchy. A company operates within an industry that is itself influenced and operates within an economic environment. The product lines are subunits of the company and may also be divided into segments. We must determine which constraints apply and which assumptions are best dealt with at the various hierarchies; we must build within the total model.

The economic parameters that must be applied consistently throughout the model include interest rate assumptions, unemployment rates, and economic cycles.

Economic cycle would allow you to build in the change in the expectation of the price of oil from $100 to $10 and subsequent impact on the economy and real estate values. Inflation rates would be another parameter you may wish to include, remembering its consequent effects on interest rate and expenses. There are the demographic influences of say, mortality and morbidity which apply particularly to our industry but you might also want to include regulatory constraints or perhaps competitive issues.

Clearly these items should influence all product models consistently and therefore need to be covered as parameters at this level in the overall model. The next hierarchy that needs to be considered are the issues that arise at the company level. Capital infusions would be made at

the company level and therefore need to be allowed for at this level.

SURPLUS INVESTMENT STRATEGY

The treatment of surplus needs is to be considered at this and all lower levels. At the company level, however, a specific investment strategy is often needed that relates to the nonstandard assets that are held by the company and are usually considered investments of surplus. This may also relate, however, to an investment strategy that perhaps is different at a total corporate level from the individual investment strategies for each product line.

By nonstandard assets we mean assets such as real estate, stocks, and investments in subsidiaries if this is your prototype you may wish to defer on some of these. These particular assets, if they are normally considered investments of surplus, would be brought in at this level. This means that you may need to add modules to your model at this level which would be needed to support such assets.

Tax policy needs to be reviewed to reflect the approach the company takes toward allocation of taxes. You will likely need to model policyholder dividends of a mutual company or the shareholder dividends of a stock company in terms of the approach the management choose to take to distribute earnings. Clearly at this level, it would be necessary to assemble financial statements.

Moving down one step further in the hierarchy, a number of companies are required to maintain separate assets for certain products, so there arises a necessity of grouping within the natural grouping at the company level. Some of the circumstances under which assembling segments would be appropriate include a stock company having a participating and nonparticipating fund. Similarly, where a company is operating in more than one country, the minimum surplus requirements may vary by country. Assets, such as a health fund or the company, may be segmented, and you may have to do some segmentation of the assets so as to more appropriately allocate investment income. Alternatively, there may be some implicit segmentation that you want to take into account in your approach to setting valuation interest rates. There may be subdivisions of accountability or responsibility for blocks of business within the company, and last but not least, you may wish to combine certain products because of the similarity of the risks which they combine.

While these issues may not be of immediate importance in the prototype you are designing, the concept of a hierarchy is important to the way you structure the model and fit the various parameters.

The issues that arise at the segment level are the following.

Investment Policy -- If your assets are segmented at this particular level, you likely have different investment policies applying. Therefore, the capability to have alternate investment policy at a

segment level must be established. Here you have to deal with the cash flows in aggregate and come to grips with how to handle negative cash flows offsetting positives and structure asset purchases consistently.

If surplus is allocated at this level, and clearly depending on the reasons for segmentation, this may not be a consideration. Then, this raises the issue of assets to support surplus, and the need for an investment policy with regard to it. In addition, one needs an approach to define the point at which surplus will be moved in and out of the segment. If ownership issues are the reason for the segment, there may be some constraints.

The issue of taxes again arises depending on the approach to the allocation of taxes.

For a stock company, the earnings of a participating fund will drive the policyholder dividend considerations. So it is at this level that the policy built into the model to reflect adjustments to policyholder dividends must be included. Financial statements must again be developed at this level. This is probably the most appropriate level at which you would buildin a stochastic method of analysis to reflect fluctuations in experience or catastrophic losses. What I'm thinking with regard to catastrophic losses in this particular instance are things like the sudden change in the price of oil and its impact on real estate in Alberta.

Mr. Engels introduced the need for some dynamic model capabilities. He mentioned that it is necessary to build into your model the ability to change the valuation assumptions at the end of a 5-year period. However, this implies that you will be making a judgment on what assumptions are appropriate to the block of business in 5 years' time given the experience of a specific scenario. To properly assess the impact of differing scenarios, and the influence this would have on one's assessment of future expectations, a real need for consistency is required. How do you achieve it?

Introducing the Mechanical Actuary -- If you plan to run a number of scenarios, the ability to predetermine your response in terms of valuation assumptions can be instructive even if only a limited number of factors can be taken into account. If you can program this into the model you will achieve some consistency as you view the results of the various scenarios. Such an approach provides some insight to the manner in which you would apply your judgment given the limited number of parameters in the model.

As I mentioned, the work I have done on a flexible premium annuity product where I was introducing different (in my mind rather wild) investment policies placed a real test on the approach to establish a reserve for mismatch risk.

Some of the investment policies chosen were quite far out such as investing all new cash flows in 20-year assets to cover 5-year

liabilities. Clearly, this was creating a mismatch and called for an appropriate actuarial reserve. A mismatch position does not affect the amount of minimum surplus required under the CLHIA formula, quite correctly. What needed to happen is the valuation assumptions had to change to reflect the degree of mismatch. So the link between investment policy and valuation is essential.

For your model to be of real assistance in testing the way changes in scenarios will impact your future capital needs; it must respond in the various scenarios with a change in your valuation assumptions. It is in this way that you capitalize the effect of future trends. This is a key difference relative to the scenario testing I see being done in Canada compared to the U.S.

Another issue that I think is important to consider is the approach you are going to take in the modeling to reflect management's corrective actions. Given that you may have to share these results externally, one cannot assume management will sit idly by and watch control move from their hands in unfavorable circumstances.

One of the critical assumptions that has to be builtin is the spec with which management would respond to external or internal changes as well as the degree. The flexibility that management can exercise includes the ability to redirect sales into different product lines or into different segments given changing circumstances. The issue of timing is important, changing sales plans can be achieved fairly

quickly. Changing a policyholder dividend may involve significant time lags.

Clearly, the issues we have illustrated reflect the type of concerns that we had in the model building we have done. Your model should reflect the issues and concerns you have since you are clearly the most knowledgeable individual as to the specific risks to which your company is exposed.

Now, I will give you Mr. Mooney.

TECHNICAL ISSUES SURROUNDING SCENARIO TESTING

MR. GARY C. MOONEY: I'll make a few comments on some of the technical issues relating to scenario testing and effective reporting of the results. Then I'll finish up by redirecting the focus of this activity from the theoretical to the real world.

SCENARIO TESTING

Prescribed by the CIA

The CIA's prescribed scenarios will be defined in terms of variations from each company's most likely business plan and will be applied on a segment-by-segment basis. These scenarios will be quite simple but will cover all major risk elements, one at a time. They are intended to

ensure the identification of sensitivities in each company and to provide management and regulators with an intercompany reference.

It will be necessary to generate reserves at the beginning of the projection period on the current basis, cash flows for both assets and liabilities on an expected basis during the projection period, and reserves at the end of the projection period on a revised basis. This revised basis will reflect the adverse deviation defined by the scenario being tested.

Selected by Valuation Actuary

The Valuation Actuary will define additional scenarios that explore the sensitivities identified by the prescribed scenarios. He will also define scenarios that consider pairs of adverse deviations, such as interest rates and lapse rates for some segments. He will also consider various patterns of future business that may be realized.

REPORTING RESULTS

Financial Statement Format

Good communication with management and regulators will be an important part of the process. We suggest that the best way to ensure good communication is through a common language: the language of financial statements. This is the only language common to

all interested parties. In other words, the results of scenario testing should be presented in the format of financial statements. We have been using income statement, balance sheet and sources and application of funds statement for this purpose.

Full Set for Base Scenario

When we produced our first results, we found that we wanted to look at a lot of detail to satisfy ourselves that we understood the process and that the numbers were correct. In particular, we wanted to follow the statements through each projection year. Based on our experience, we suggest that a full set of financial statements be prepared for the base scenario for each projection year and that additional supporting detail be provided as well.

Summary for Others

When we produced results for the various scenarios, we found that we looked at only a few numbers on each statement, and typically only at the end of the projection period. It is easy to generate a mountain of output from multiple scenario projections. It is difficult to generate a manageable amount. Here, we suggest that summary information would be appropriate.

Reporting Levels

If you are projecting surplus for the whole company, you will want to

produce financial statements for the whole company. However, readers will have questions and concerns about major segments of the company. As a minimum, you will need to produce results separately for life par, life non-par and accident and sickness. You will also need to produce results for problem segments, as defined by the scenarios run or by management concerns.

SOME TECHNICAL ISSUES

We are suggesting that you begin with a theoretical model and expand it in an evolutionary manner. As you do, there are a number of technical issues that you will have to deal with, some of which may give you significant amount of trouble. I'll mention some here, but without too much detail.

Liabilities

Multiple-scenario modeling involves considerable number crunching and requires considerable flexibility in changing assumptions. The ability to group plans and ages at issue will be important. Conversely, the ability to define products in a realistic manner is necessary.

Assets

The segment concept requires assets as well as liabilities to be subdivided. There may be both philosophical and technical problems

associated with the initial allocation of assets to segments and with the maintenance of this subdivision over time.

Surplus Allocation

Like assets, surplus will have to be allocated to the various segments. Again, corporate philosophy may be important. Current surplus could be allocated in proportion to the surplus required by the CLHIA formula for Minimum Continuing Capital and Surplus, or on the basis of anticipated need, or otherwise.

Business Plan Reconciliation

If the company already produces a business plan involving projection of future results, it will likely be necessary to reconcile with those results. Reconciliation between systems is always difficult.

Data Linkages

Data will have to be obtained from a variety of systems, including: valuation, policy administration, investment, projection or business plan. Development and maintenance of these links may be difficult.

SOME MANAGEMENT ISSUES

Development of a capability to model the whole company's surplus as a

going concern basis under a variety of scenarios is as much a management problem as a technical one.

Timeframe

This is a project that will extend over several years and one that will compete for attention with other priorities. However, it won't get done if it doesn't get started. We suggest now is the time to start.

Scope

This will be a big project and will eventually require significant resources. We suggest that it is best early on to work toward a small success.

Resources Required

It is clear that the Valuation Actuary's function is becoming more expensive. It is also clear that many companies see this function only as a cost center requiring close control. The communication job to be done is to convince management to devote the proper resources to meet new needs and requirements.

Project Management

Given the timeframe and scope, the development of a scenario testing

system will require competent project management. Continuity and cost containment will be major considerations.

Communications

The end result of the project is not numbers on a page but effective communication of their significance. It is necessary to develop effective communication between the Valuation Actuary and management regulators.

RELATIONS WITH TOP MANAGEMENT

A misunderstanding can easily develop regarding the Valuation Actuary's involvement in surplus projections. Surplus is the responsibility of management, not of the Valuation Actuary. Nevertheless, management needs the work and experience of the Valuation Actuary to carry out its responsibilities. He will have to develop credibility as an advisor without creating the impression that he is attempting to take over management's role.