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MODELING -- WHAT CONSTITUTES A GOOD PREDICTOR

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Recorder: DOUGLAS MENKES

- Size of model
- Lines of business
- Purpose
- Kinds of models
  - Seriatim
  - Cell-based versus momentum
- Accuracy of model versus assumptions
- Presentation of results/how to get credibility

MR. DOUGLAS MENKES: We're going to follow the topics listed above, but not necessarily in that order. Abe Gootzeit is with Tillinghast, and Paul Strong is with Chalke. We should have ample time for questions and, hopefully, answers and any discussion that results.

I've often, from time to time, thought of the process of modeling and how you go about it in terms of some of the things that you have to do when you're painting a house. When you're painting a house, you can use the very best paint in the world, but if you haven't done a good job with the surface preparation -- scraping the paint, sanding it down and making sure it's ready -- your paint job won't last very long. Modeling is a little bit like that, although I'd like to think that good actuaries make more than good house painters. You could be using 20/20 hindsight actuarial assumptions, but if you don't have a good model, you're not going to get good results. It may look good for a month, or for a year, but in the long run, the model probably won't do what it was intended to do.

I've been asked a number of times, "Well, how do you know how many cells to put in a model? What constitutes a good model?" And I usually start with an answer that may sound a little cute, but when you think about it, I think it makes a lot of sense. What I tell people is that the model itself should not be an issue in the discussion of whether or not its results are reasonable. And depending on what you're doing with the model, this could lead you to many different courses of action. Listed below are some of the more common types of assignments that I assume you have used modeling for over the years:

1. Actuarial appraisals. I think they're one of the most well-known.
2. Actuarial equity shares in conjunction with a demutualization.
3. Routine generally accepted accounting principles (GAAP) valuations.
4. Cash-flow testing.
5. Management consulting.

And just to give you an example of how the applications can result in emphasizing different aspects of your model, think of GAAP for a minute. It's very common in building a model to exclude a number of the older plans of insurance. Either there

aren't that many of them around, or you might think that the statutory and GAAP accounting, with respect to a very old block, would be close enough so that if you really have constraints on resources or time, you would not do anything with your older policies. On the other hand, when we calculate actuarial equity shares in conjunction with the demutualizations, we want to pay special attention to some of the older policies because those are the ones that may have contributed more value to the company than any other policies. So, depending on what you're doing, and who the audience is, you're going to have different amounts of effort and different techniques that you use in trying to develop a reasonable model.

Let's discuss some of the transformations that we've seen over the last 10-15 years in working with models. Could I have a show of hands of anybody who was involved in developing models prior to 1980? A few hands. Good. You probably remember that the way in which we went about doing this was once we got the model, we would then develop a projection by calculating a present value factor and multiplying it by the number of units in force. We had what many critics would call a "black box approach" where you basically gave them an answer. It was very easy to do it this way. We didn't have the types of computers we have now. It was simple. It was efficient. In some respects, it was inefficient because it was difficult to explain why the results were reasonable to a nonactuarial audience. In fact, we got involved not too long ago in an expert witness case that involved a valuation that was done about 12 years ago, and it was done using the factor approach. And the other side just wouldn't buy it. They actually tried to recreate it using the type of technology we have.

After we got away from the factor approach, we got into projecting insurance cash flows. This was a little more complicated because, first, we had to calculate a profit study for each model plan. Then we had to make a projection from all of the profit studies. But it was much easier to review this type of projection for reasonableness.

Regarding calendar-year adjustments, if we wanted to vary our lapse rates or inflation rates or interest earnings rates by calendar year, we could do this in a projection. We could see the premiums. We could see the benefits. It actually made a lot of sense. It was much easier to explain it to people. It took a little longer to do and it kind of whet the appetite for some of the insurance company executives who realized that this was a better way to do it. We weren't modeling the whole company. We may have looked at the major plans of insurance. We would not have worried about supplemental benefits, minor plans, riders, and what not.

More recently, we have found a much bigger demand for what I would call the ultimate way to do it, which is not only using a projection approach, but projecting all the cash flows for all the insurance liabilities. And this is the easiest to review for reasonableness. It's certainly the most suitable for outside presentations because we're basically saying, here's the company. We project supplementary benefits and supplemental contracts. We may also be looking at variations in nonforfeiture options as opposed to just assuming that everybody cashes out upon lapse. The problem with this method is it's time consuming and it's expensive. It's not clear to me that the additional time and money spent doing this results in additional accuracy. But it's certainly a lot easier to explain.

Now, Paul is going to concentrate on his experience and some practical applications as they relate to traditional insurance. Abe is going to focus on interest-sensitive insurance. I suspect there will be a little bit of overlap.

MR. PAUL J. STRONG: As Doug just said, I'm going to be concentrating on the traditional aspects of model building. I'll start off with some general comments and then move into more specific comments on traditional aspects.

I'm sure that you're all familiar with one of Ruskin's quote that has been adopted by the Society of Actuaries. In fact, I believe this quote was one of the nominations for the official motto of the Society. Of course, the quote is: "The work of science is to substitute facts for appearances and demonstrations for impressions." Some substitute facts for appearances and demonstrations for impressions. You'll notice it is in there backwards. Just to see if you're paying attention. And it's in there backwards kind of in recognition of corporate modeling. Because it seems to me that corporate modeling does quite the opposite of what Ruskin said science does. We kind of begin by recognizing all the facts that are practical in order to deliver appearances or impressions of what our organizations might look like in the future. From this, one might conclude that corporate modeling is not exactly a work of science, if Ruskin's model is correct. And those of you with any experience in corporate modeling would probably agree with this wholeheartedly. In fact, corporate modeling is far more an art than it is a science. So, like any other art, there's a considerable amount of personal preference in modeling approaches. Models are quite subjective in their construction. Our opinions are going to vary when evaluating the quality of the model. When you throw in the variety of purposes that a model is used for, with the varying requirements for precision, I think we truly have art in the science of corporate modeling.

You might wonder. I certainly do. Most of us got into the actuarial field because of our technical scientific inclinations and strengths -- certainly not because we're artists. If you're like me, you never thought you had an artistic bone in your body. But I think it will serve all of you well to nurture whatever artistic capabilities that you might have, as small as they may be, when you embark upon corporate modeling.

Doug referred a little bit to the evolution of modeling practices over time. I'm sure that actuaries have always recognized the value an accurate projection model can bring to a firm. However, until recent years, the tools simply did not exist to simulate the reality of insurance operations. These tools, modeling software packages, have enabled a quantum leap over previous methods (factor approaches that Doug has referred to). So, while firms providing these modeling tools are rightfully proud of the products that are out there, they're quite detailed. They're quite intricate. I think we all recognize that these tools are nevertheless still very much in their infancy. We can expect more quantum leaps, I believe, in modeling software capabilities over the next decade as companies expand their use of models, as they inevitably will. And software providers respond to accelerated activity in corporate modeling.

So, company managements now recognize the need for effective models and those of you who have been involved with this know that significant resources need to be expended for building and maintaining a modeling capability. And these substantial expenditures give rise to lofty expectations for model accuracy. The fact that we're

in the early phases of modeling software development, whether they be commercial systems or some internal systems that you may use, presents real challenges in credibility for the actuary. Because even with these sophisticated systems, it's a formidable task to reflect all the experience realities in a modeling system. If you're required to reflect all of these due to the nature of the model objectives, time and cost associated with model building may increase dramatically. As you would expect, the real correlation is between the man and the resources expended.

So, the most common situation is that in which you reflect more detailed characteristics gradually over time as your model develops, with a lenient position toward model accuracy at the outset. By accuracy, I mean the ability to reproduce full company financial statements.

I'd like to briefly discuss the speed versus accuracy trade-off, and it truly is a trade-off. In modeling, we desperately hope that the computer run time will be less than real elapsed time. That's the challenge we face. And at this stage in our technological environment, it's a material concern. Unfortunately, seriatim models are simply unworkable. That's why we model. It's rigorous enough running through our model cells let alone running through policy-by-policy in making projections. And as a result, we must pay careful attention to the size of the model that's used. So, the questions always arise: how many cells do you use to represent your liabilities? How many asset cells represent your assets? How many scenarios will you run? How many interest rate paths are there? What are the interest crediting strategies? What is the projection period? These and other issues are some of the determinants of your run time, and that run time is, as I said, very critical in effecting a model that's useful to you.

Understanding the purpose of your model is most important. And when you start out considering models, who among you wouldn't say that you want your model to do many things for you? Supporting a monthly budgeting process to periodically calculate, for example, an option-adjusted value of your firm is perhaps a real range of applications you'll want your model to address. And the fineness, a term that we use is granularity, required of the model is quite different depending on what application you're addressing. So, at those two extremes, if you're looking for an accurate predictor of the monthly budgeting process, you're going to have to look to a very, very fine or very granular model. If it's something for more general value of the firm, referencing an option-adjusted value where you're going to run many interest rate paths, then the need for granularity is not as high.

So, it may seem attractive to begin by building a very detailed or granular model and one that will validate exceptionally well. From this very detailed model, you can then condense many of your model cells creating a very coarse version of your model. Another term we'll use is coarse – a more coarse version of your model. We'll use this coarser model for applications that are real run-time sensitive and when less precise results are acceptable.

I'd like to share with you a little exercise and an example. We began with a liability model that consisted of a very substantial number of cells, a very detailed number of cells and we went through a condensing process that came up with about 10% of the original cells. Table 1 compares what we call a coarse model with a fine model.

And we're looking at certain years over the projection period. Coarse relative to the fine model. In the projection death benefits were about 1% or 1.5% off. Cash values had a little variation, but straddle 100%. On a statutory reserves and premiums we're able to get a very close representation of a fine model. You can see the net cash flows that came out of this in Table 2. As you can see, early on the results produced by the coarse and fine models are a little closer than they are in the 10th and 15th years. All in all, for many applications, this coarser model will suffice. And quicker turnaround by using that coarser model can be expected in any of the applications that you're using.

TABLE 1
Condensing Sample
Comparison of "Coarse" and "Fine" Models

Death Benefits				Cash Value			
Year	Fine	Coarse	Coarse/ Fine	Year	Fine	Coarse	Coarse/ Fine
1	326.251	329.333	100.9%	1	3	0	0%
2	292.265	295.872	101.2	2	195	194	99.5
5	211.164	213.856	101.3	5	3,151	3,046	96.7
10	121.643	123.309	101.4	10	9,363	9,421	100.6
15	68.772	69.791	101.5	15	10,696	10,832	101.3
20	42.865	43.503	101.5	20	9,339	9,524	102.0
Statutory Reserves				Premium			
Year	Fine	Coarse	Coarse/ Fine	Year	Fine	Coarse	Coarse/ Fine
1	6	0	0%	1	4,075	4,029	98.9%
2	2,426	2,397	98.8	2	3,653	3,614	98.9
5	7,028	7,025	100.0	5	2,612	2,589	99.1
10	10,170	10,241	100.7	10	1,457	1,457	99.7
15	10,682	10,833	101.4	15	781	783	100.3
20	9,339	9,524	102.0	20	398	402	101.0

TABLE 2
Condensing Sample
Comparison of "Coarse" and "Fine" Models
Net Liability Cash Flow

Year	Fine	Coarse	Coarse-Fine	Coarse/Fine
1	(664)	(673)	(9)	101.4%
2	2.766	2.765	(1)	100.0
5	1.311	1.353	42	103.2
10	(440)	(401)	39	91.1
15	(1.224)	(1.205)	19	98.4
20	(1.291)	(1.293)	(2)	100.2

This exercise that I've gone through is definitely the exception in my experience. In practice, generally coarse models are built and evolve into finer, more detailed models over time. One of the problems with trying to build a very granular model is that this

defers the time in which projections are actually produced. And few people in your organization are going to be willing to wait the time that's required to put a real detailed model together. This is because the impetus for model building generally comes from a specific need. For example, you've got to hustle to get some cash-flow testing work done and build a model. So, the deadline dictated by the need generally governs the granularity of the model and only rarely is sufficient time really allowed to build a detailed model and to meet the deadline. So, we've found it most common for companies to build the most detailed model possible given the time constraints for the project at hand. This usually results in a coarse model. From this original coarse model, more detailed models will then emerge. While often sufficient for the task at hand, a coarse model presents additional difficulties for the actuary, in the areas of validation and your own credibility. And this is a major issue with model building.

When building a model, the question always arises, how many plans need to be modeled in order for the model to be sufficiently representative of your business? And maybe that's one of the questions that some of you want to have answered. I hope Abe can answer that because I can't.

This is definitely important. The labor of building and maintaining the model, as well as the computer run time to project, are obviously affected by the number of model plans that you use. And I don't believe that there's a rule of thumb to go by to answer this question. So, the art that I referred to in the beginning of the presentation appears almost immediately when you're thinking about a model.

The volume of in-force business is not really a significant factor. It doesn't matter at all if you're a large versus a smaller company. What is significant is the homogeneity of the plans within your company. That's the critical factor. In other words, a small company that has a varied portfolio, that is, a number of plans that are structurally dissimilar, could very well require far more model plans than a large company with a portfolio with little structural variability. So, in the modeling process, the actuary starts off by reviewing in-force statistics and plan characteristics in order to make model plan decisions. And in this process, a number of plans will be chosen to provide detailed parameters to represent the in-force business. Other plans, then, that are not the model plans are mapped into the model plans, which simply means that the volume associated with a map plan will be adopted by the model plan and projected as that model plan.

So, when making these model plan decisions, it's necessary for the modeler to evaluate the structure or product parameters. Experience assumptions, volume and financial impact, and similarity to other clear model plans are some factors to consider when deciding whether or not to create a model plan or map the plan under consideration into another plan. Now, the structure of product parameters accounts for several things. The primary ones are the reserve method and basis. You're going to look at the cash value method and basis, the dividend formula which applies, the dividend era, and how you segment dividends within your dividend practices. The benefit pattern and the premium pattern of the policy also matter. These are the primary components that you're going to look at in making model plan decisions. As far as experience assumptions, you've got the obvious ones such as mortality, lapse, and expenses. But there are also some other important ones on the traditional side.

You've got to give some very serious thought to the dividend option utilization in your company and its applicability to your portfolio.

Loan utilization is a very critical component in making this decision. What is the premium paying mechanism? Does your company get its premiums in cash? Do you have vanished plans? Have you been marketing and administering vanished plans, super vanished plans? These are all important model-plan considerations.

So, to the extent that your plan is dissimilar to any of these items, your model accuracy is going to be affected. And I think you will see right away the run time implications. If you explode your model to recognize all of these factors, both the plan parameters and experience assumptions, you can have an enormous number of model cells to deal with leading to run time in excess of real time. The modeler must decide whether or not a particular form warrants modeling given materiality considerations. In this regard, for example, it's often sufficient to model many term products as one model plan even though they may have very different premium patterns when you evaluate these materiality considerations.

But all in all, I think you can see that an excessive amount of art is required in this decision-making process. You could probably sit down two times independently and come up with different model plan structures.

And there's always a nucleus of plans that are clear model plans. And there's a group of plans that are on the bubble, if you want to use that phrase. And the modeler will balance what plans are modeled, what plans are mapped and the model plan into which they are mapped. There are generally plans that are quite immaterial like the types of plans you just don't know what to do with. They don't appear to map cleanly into any of the plans you selected as your model plan, and they're not material enough to create a model plan for. The modeler may then choose to gross up the entire model (a phrase that I hope most of you are familiar with). So, kind of gross up your model to reflect these other plans. And when you're doing that, you should keep in mind that this practice, in effect, maps these plans to this aggregated model plan, the amalgamation of your entire model. That's what you're really doing. And it's really kind of a "throw-up-your-hands" kind of decision. You really shouldn't be doing this unless there's nothing really remotely close to this plan to map it to.

But generally we find that there is some model plan, which even though not particularly well-suited to represent that plan, is still preferred to the throw-up-your-hands kind of response that you could make. So, that's generally the path that we take unless there's some reason that you can believe that this aggregated amalgamation is somehow going to be more representative of the plan in question.

There are couple of other things I should mention. Issue-year groupings need to be considered during the mapping process. Generally, we find model validation to be improved significantly when recent issue years are not condensed. That is, you actually model recent issue years year by year. Treat them year by year. There appears to be more tolerance to combining issue years the further you are from the projection date. So, for traditional business for many companies, this implies a good deal of condensing, in effect, since for most companies a significant amount of the

business is not recently issued. For those companies doing exclusively traditional business, obviously, that comment doesn't apply.

I have some other artistic comments. We feel that actual plans work best in the model rather than in aggregated or fictitious or combined plans, average plans. We think maintaining an actual plan model is preferable to taking on the task of rebuilding fictitious plans every time you want to run the model at a new projection date. We use decennial ages (sometimes 35, 45, etc. and sometimes 30, 40, etc.). We fix the model ages and determine the best range of ages to map to those model plan ages. We do that rather than fix the range at 30-39, for example, in calculating a representative age. In that way, our model cells are essentially fixed.

With the other approach, new model cells have to be derived and built as this calculated age changes over time. Now, surely this preference is also linked to the properties of our particular software, but it definitely, in our environment, is the more efficient way to go. Changing the mapping is much more efficient than changing the model plan.

Now, I've been referring to model plans and I should make clear that most riders and dividend options can be considered as plans. The key here is that the rider be separable. That is, it should not interact with the base policy to which it's attached. Accidental death, waiver, and family term riders are examples of these. As long as they're separable and not interactive, they can be modeled as a base policy. Now, a contract is a combination of a base policy and other coverage components that interact with each other – they generally must be considered holistically. A contract composed, for example, of varying proportions of base policy, term and paid-up addition components, is an example where separation is not viable, and an integrated model plan approach must be used.

This is a very sophisticated demand placed upon the model to support the logic required to mimic this arrangement through all the types of scenarios and policyholder behaviors that will be tested. But if a meaningful amount of this type of business is on your books, model accuracy will certainly suffer, perhaps significantly, if you don't reflect these combined, and integrated arrangements directly in your model. These are not really the only interactive approaches that must be considered. Over the past decade, vanishing premium products have been marketed extensively in the industry. The modeler must determine the extent to which vanishing premiums are or will be a part of this company's business. And certainly if a material portion of your business is vanishing premium, cash-flow analysis will not be very close to reality if vanishes are not explicitly reflected in the model. If so, then the paid-up adds must talk to the base policy, and also loans on cash values should be reflected at the so-called super vanish which has been popular in some companies. Furthermore, given what's happened with interest rates over the past decade, reappearing premium logic will also be needed within your projection system. If you've been selling vanishing premium policies over the last 10 or 15 years, you need some reappearing premium logic and experience assumptions in your model.

In summary, the modeler should be aware of the marketing approaches used over the years and which approaches have actually made their way from illustration to practice. You know, we illustrate all kinds of things that, when it comes down to real

life and the real activity on the policy, don't come into play. So, you want to look at, not what's been illustrated, but what actually has made its way into practice. So, in making these determinations, it will be quite helpful if the modeler is tuned in to the administrative practices of his company. You need a real link to your administrative area in order to assess the need for this in the modeling process.

But when you get into modeling, you run into many issues that have not been very material during the course of other technical tasks you've done in the past. And these, while insignificant for your past projects, may become quite significant for modeling. So, for example, in the pricing process, we've been quite content to model lapses and surrenders as pure decrements exiting the analysis at the time of incidence. Now, in reality, a portion of these are not cash payouts, but are retained with the company as extended term insurance or paid-up insurance. The question is, should this be modeled as in the past, leaving the company at the time of incidence as we do in pricing? Or should it remain with the model and go forward? Similarly, in pricing, all death benefits are regarded as paid when they occur, with no thoughts about recognizing settlement options made available to beneficiaries. For many applications of the corporate model, this may be acceptable. But again, the modeler may conclude when considering model usage and materiality that explicit recognition of these options is necessary. So, in either case, you've got to evaluate whether this is a material portion to be recognized in your model. It certainly increases the time and resources in model building. And if you determine that it is material, you need a logic branch in your system that tracks this activity with assumptions as to utilization and the experience that ensues under these options.

You'll need to consider other characteristics in your traditional model. I've already mentioned policy loans in the context of vanishing premium plans. However, for many applications, policyholder loan activity will be very important to model outside of vanishing premium concerns. And this is true whether or not you have direct recognition practices in your dividend scale. The economic environment seems well-suited to low interest and to an upward spiral.

Consider the interest rate spiral. This is not a prediction, but I think it's clear that the spiral doesn't have too much further to fall and there's a long way it can go up as you probably remember. So, the economic environment seems well-suited for that. Many of you will recall the serious problems of the early 1980s like the disintermediation through policy loans. There were very severe problems for many companies. It's certainly not a prediction, but this kind of an analysis will be necessary under many interest rate paths. For many kinds of scenarios you're going to look at, you're going to want to assume increased policy loan activity.

Issue dates are seemingly a minor issue. Certainly for most things actuaries have done in the past, the issue date is something you never gave a single moment of thought to. Often in model building, just one central issue date assumption will work just fine. But often it won't. This assumption, accompanied by a monthly mode assumption will deliver a reasonable distribution of premium income, but also results in all dividends being paid on the same date. And it also results in a smoothness of premium income that may not be characteristic of your company. It's quite common for many companies to have peak production towards the fourth quarter. And to the extent that that's material for your model, it's something that you're going to want

to consider. The issue date assumption, along with premium mode, are levers that you can use to model that appropriately.

And, as I mentioned, having all your dividends paid out on July 1 simply does not work well. So, as a result, a spread of issue date assumptions will often be necessary. And there's a similar repercussion if you have assumptions such as lapses and surrenders all occurring on a policy anniversary. You have a real concentration of cash flows that is not going to occur in practice.

And finally, you want to consider what premium modes to model. What model loads will be included? If advanced premium accounts are material, they'll also need to be reflected. Now, when modeling was confined to the actuarial department and modeling tools were limited, validation was really not a particularly important issue. The actuary simply convinced himself that his process was sound and adequate for the task at hand and then he proceeded to model and project. Nowadays, with the increased visibility of modeling, and the important applications it's used for, and the time and money put into building and maintaining the capability, the model is a very visible work product to management. It's usually not sufficient that the actuary simply report that his instincts tell him that the model is sound. A rigorous validation process is often needed to establish credibility for the model. And this credibility is demanded by a variety of people.

One of the real challenges of validation is the accumulation of actual data for comparison. This data must be delivered in the same segments that are developed in the model. So, you're going to need to match up actual and model data in accordance with how your model is constructed. Assuming that data is available, we usually begin by comparing model starting values with actual starting values. We refer to this as static validation. That is, inventories, your static inventories at the model start date are compared to a variety of items. We'll compare the volume in force, the premiums in force, reserves, both statutory tax, cash values in force, dividends and policy count. So, model-plan-by-model-plan comparisons of these items will provide you with comfort that the model appears representative of the actual business. Or it will indicate where changes are necessary to improve the model fit. The challenge here, as I said, is having the actual data segmented just as your model plans are.

Now, static validation comparison of inventories can be extended for the projected years. That is it should be important to convince yourself that the selected plan doesn't just reproduce inventories; it is representative for the ensuing years also. To ascertain this, you need to project all policies that you have mapped into a model plan without any decrements and capture validation data at each year following the start date. So, you must look at the policy records that you have mapped in the particular model plan. Project them out without dividends and look at the values from the previous slide capturing them. And then the model does the same thing. You project your model without any decrements, again, to provide model values for comparison. This will indicate if the model plan that you've chosen truly is representative of the policies that are mapped into it.

Now, this step adds a very significant beneficial layer of validation to the process. But it is extremely demanding on resources, and it is rarely found in practice.

This will become a more common step in the model validation process even though it is not a very common step.

So, once you're comfortable that your starting values are accurate, it's time to test whether your model can project reality in an acceptable fashion. We refer to this as dynamic validation. A major stumbling block here is the ability to obtain actual data which ties to your model structure. Furthermore, many items that enter the Blue Book are probably not included in your model. You know, this may change as modeling matures and more sophisticated models emerge and modeling gets to be more totally representative of Blue Book activity.

The first step in a rigorous dynamic validation process is to create an adjusted Blue Book income statement. You've completed static validation and you're comfortable that you're starting at the right point. Now, you've got to get to an adjusted Blue Book income statement. To do this, each line from the Blue Book is reviewed, the components itemized and you determine which components are reflected in the model and which are not. Components not reflected in the model are backed out leaving an adjusted income statement composed only of items that you are explicitly modeling. Your model output is then compared to the adjusted statement which is the target that you're shooting for.

Then your model structure is adjusted to better reproduce the statement during the validation process. The best way to proceed in this is to validate your model to the prior completed calendar year. So, in other words, if you're building a modeling capability in 1993, 1992 would be the year of validation. So, you'd map your in-force file as of January 1, 1992 into the model plan. You'd have your new business model for 1992 which is not, at this point, a projection. You know what your new business distribution was for 1992, so you can explicitly model that accurately. And then you project with your modeling software, the one calendar year whose actual experience has arisen. What you want to do ideally here, of course, is use the actual experience as assumptions in the program. You don't want to use your typical lapse and mortality assumptions. You want to use what actually happened during that calendar year as assumptions in order to have a sound validation process.

Let's consider premiums in this dynamic validation. This is just kind of a run-through of what you really need to go through on each line of your Blue Book. On the premium line, you really need to know what's going in, how it's going in there and what's not going in there relative to your model. What premiums are booked on the premium line in this statement? They can be paid in cash. Dividends used to reduce premiums flow through this line. Premiums can be paid by surrender of paid-up additions, by policy loans, and with an advance premium account mechanism. Premiums are also paid through waiver of premium mechanism. I think you can see the different ways premiums can get into your traditional policies. You need to look at these in terms of materiality in your model building.

Also on this premium line, you have premiums for base policies, premiums for riders, substandard extra premiums and reinsurance premiums, both ceded and assumed. They're all included in the Blue Book. Are they in your model, or do you plan to reflect them outside of your model? If outside the model, then Blue Book numbers must be adjusted before beginning your dynamic validation because any items in the

Blue Book, that are not in the model, should be backed out leaving your adjusted Blue Book numbers to be compared to the model. So, each line of your income statement needs to undergo this type of review. If you get the feeling that this is a challenging exercise, you're absolutely correct. And the term challenging may be a significant understatement. But I think there's going to be increasing demands for modeling precision and modeling is going to be an increasingly important tool used in managing your company. And we can expect that the customers of your modeling services will demand the capability that demonstrates the ability to reproduce your financial results.

Finally, a critical component of the modeling process is maintaining the corporate model. On a periodic basis, generally quarterly, you must continue to analyze feedback, discover actual-to-expected discrepancies, and improve model fit. This includes recognizing new business, interest rate and dividend changes, new regulations, company strategic changes and experience fluctuations. A consistent and comprehensive model will serve as a foundation for making critical decisions about your firm that will control risks and improve your long-term economic value. I wish you all good luck in the modeling process.

MR. ABRAHAM S. GOOTZEIT: Paul mentioned a lot of topics on the traditional side of things. I'm going to be looking at interest-sensitive business. There really are three sections in my presentation. The first is that modeling is a core actuarial skill. I think you all know that; we do it all the time for a variety of our activities. The second is I have a universal life (UL) example, and the example is important because you need to understand those characteristics of our business that are important to represent. And I'm not sure if you do have a good sense of this all of the time. So, we need to identify those characteristics and represent those explicitly. And in the third section, we'll have some general comments.

Modeling is a core actuarial skill. The work of the actuary is to project future earnings. We discount them to the valuation date and we use an appropriate risk-adjusted rate of return. And we've been doing this for a long time, even before cash-flow testing. The question is, how do we project the future earnings? What facility do we use in that projection? What tools? What methods? In the past, we used to have people doing seriatim approaches on the mainframe computer. That technique has been discarded and we now use a model. The model is a representation of the business. I'll discuss how we come up with that representation of the business.

So, we have a model. The model projects a number of items about the company: the future earnings, cash flows, and balance sheet items. These things are important to know. And we use those in a variety of applications -- product development and pricing, valuation actuary work, forecasting and budgeting, and strategy evaluation. In fact, virtually everything we do that's quantifiable that is part of our core actuarial skill involves this modeling process. So, I maintain that modeling is a core actuarial skill.

General observations. So, we've just discovered that modeling is a very important thing to do. So, how do we learn how to model? Well, we should go to our education. We should go to Warren Luckner and say, what is the SOA doing for modeling education? It's not a topic on any SOA exam syllabus. Modeling is not a prophet. Mark Davis said this is covered in a valuation actuary symposium, and I checked it out and that's, in fact, true. There are very few published referenced

materials on how to model. So, modeling is really learned through on-the-job training and through trial and error.

We also do assets/liabilities when we do our projections these days. And I have a theory. My theory is that we model assets in general (anything I'm saying, of course, is in general because there are 800 companies and 10,000 actuaries). We actually project the income and balance sheet items of assets more accurately and more representatively than we do for liabilities. There are a variety of reasons. The theory is that on the asset side you have a lot more benchmarks. You have asset analytic firms. Collateralized mortgage obligation (CMOs) are very complicated, but we can benchmark the projections against Bloomberg and we wouldn't stand to have our model projections deviate too much in these benchmarks. We don't have a benchmark on the liability side to project the income statement, the liabilities, and the balance sheet items. We have no clue whether or not the future projections of our liabilities are benchmarked accurately. My comments will be mostly confined, again, to the liability side.

What are some of the characteristics of a good model? It needs to be representative, manageable, verifiable and valid. It must be representative of the underlying contractual obligations. It needs to be appropriately sized. We need to have results for components and subcomponents of the companies that are important. We need to be able to verify that the results are correct, accurate, or representative. And we need to make sure it's valid in a variety of validation techniques, the static validation that Paul was talking about, and some sort of backward dynamic validation as well.

There was some discussion at the San Francisco valuation actuary symposium and it's really the great debate of our time. And after the modeling session with Barbara Snyder, Mark Davis and Jackie Abella, where a number of comments about modeling were made, there was some audience participation. And it kind of evolved or degenerated into a debate and the debate involved accuracy versus run time. And accuracy means the correct model could only be achieved by sacrificing run time. That was one theory that was discussed.

And another one was the desirability of big models versus small models, again, depending upon the requirements. Models that accurate and that large were required in order to capture all the important characteristics of the organization, and small models really couldn't do the job. And there was a considerable amount of emotion that was extended in this discussion. The question is, how do we create a better model?

And since I didn't enter the debate, at that time, I'd like to enter the debate now in coming up with my saying for what creates a better model. And that is that better models are better. And the question is, what creates a better model? What can you do to make sure that you have represented the underlying characteristics of your in-force policies accurately? I'd like to motivate that with an example. It's a UL example, because I was asked to discuss interest sensitive products and UL. Now, this is "real hypothetical" data. I want to differentiate that from just plain old made up data. When my wife and I go out to dinner and there are flowers on the table, I can't tell real flowers from silk flowers. So, I think of silk flowers as being real.

Those are like real fake flowers. But I can tell the plastic flowers right away. So, this is kind of like silk flowers.

I've actually gone through and constructed this hypothetical data to represent the characteristics that I want to illustrate. It's a backlog of a UL insurance block. It was sold from 1988 to 1991. There are interesting characteristics that you may recognize from your own business. It has a five-year minimum premium guarantee. It was marketed in a variety of circumstances, including internal rollovers, fully funded circumstances, dump-ins, and five-year term. And there are four underwriting classes involved in the two common genders and the two common underwriting classifications of smoking and nonsmoking. The male nonsmoker business is 60% of the total. All the data is death benefit option A. So, this is the business and you're required to model it. This is tough stuff to model.

As of December 31, 1992, the number of policies was 10,800. The average size was $100,000. Actually, every policy is $100,000 in this real hypothetical world. I guess it was a big group and they all needed $100,000. The fund value was $47 million, as of that date. The statutory reserve was $26 million. The cash value was $17 million.

We're going to try one plan. We're going to use the male non-smoker plan because it has 60% of the business. We're going to try three ages because Tillinghast people always have triplets. And we're going to have four issue years, one cell for each issue year. That's a total of 12 cells. So, this is the model. We're calling the model The Simple Model, and we go through our static model-to-actual valuation. The two items shown in Chart 1 are reserves and cash values. And you see that we did an outstanding job. The model to actual reserves percentage is 72% and for cash values it's 67%. So, I've done my first job. It has been simple, but this appears to be inadequate in representing the business. So, what should I do? The answer is, we need more stuff. We don't have enough stuff. So, let's have more stuff. Let's now represent all four plans: males, females, smokers, and nonsmokers. We'll have one model plan for each of the actual plans. Let's go crazy and have nine issue ages. The issue years won't be an issue here. We'll keep that at four. So, now we have a 144 cells. That's a lot of cells for 10,000 policies. We've represented all plans and I would maintain we represented all ages.

Now in Chart 2 we do our validation and we've improved our reserve validation from 72% in the simple model to 76% in the second attempt. The cash value has gone up from 66% to 75%. We have a lot of cells in there. We've done all the plans. We've done all the ages. What's happening to it? I think a lot of companies actually stop here. Let's think just for a second. It's time to reflect. What are some of those distinguishing characteristics about this block of business that we really need to consider? One is multiple marketing circumstances. This was sold as term insurance. It was sold as fully funded insurance. Rollovers were dumped into it. So, we capture it in our administrative system as one plan code because an older system may have six plan codes for this kind of stuff. We need to be able to recognize and capture the differences. We have these model UL CRVM reserves. Those things are capped at one, and our factor is capped at one. For the average size policy, we get an average R factor that may not be the same as the average of all the R factors out there. So, that's something to keep in mind. Reserves aren't doing very well, and we have the

surrender charge pattern. We actually have some zero cash values out there because we don't get the full benefit of those surrender charges in the early years. This is a very difficult kind of circumstance to model.

CHART 1
Validation of First Attempt

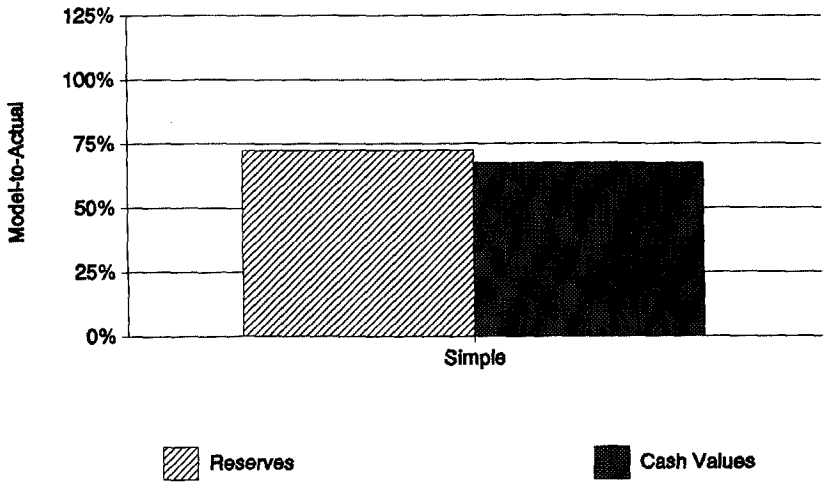
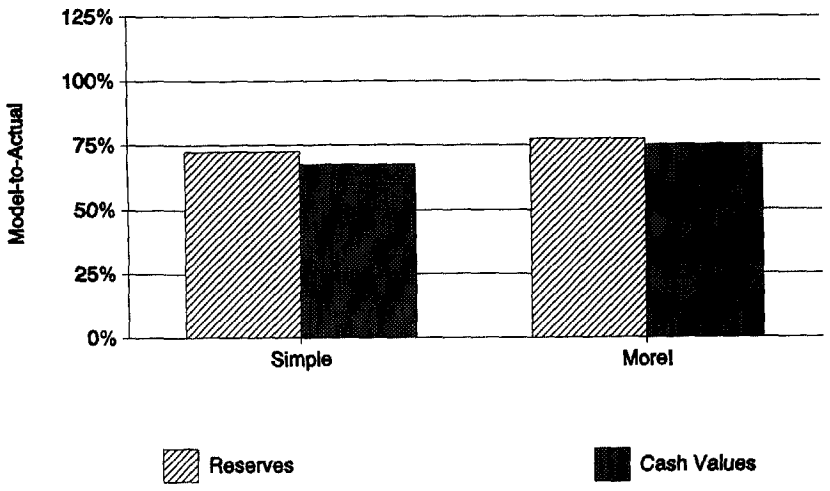


CHART 2
Validation of Second Attempt



So, that's an important thought. This is my only important thought during the presentation. It's critical to segment the business by the funding level, not just the plan, not just the age, and not just issue year. The funding level is critical. If we miss this point, we don't have a valid or a representative model, and that's because of the reserve pattern and the cash value pattern. Those are different, you know, under the model plans for the big and the small funds. With the premium persistency going out, there's likely to be differences. So, the incidence of statutory earnings is not going to be the same under an average pattern over some of the components, and so on.

So, we need to segment it by funding level. The question is, how do we do that? There are a variety of ways that you can do that. I've taken those policies that have positive cash values and those that don't. That's my way. We can go other ways. Now I have fully funded policies. Table 3 shows the way that it breaks down. Another way to segment the business might be with fund values above and below the guaranty maturity fund. It might be those policies that are relatively more funded and those that are relatively lightly funded. So, there are a lot of ways to do it. I've done it by those policies that have positive cash values and those that have zero cash values. And that's important also because when we do our future projections, we're going to have different assumptions in there for those kinds of policies. For the fully funded policies, we'll assume that they have been dumping premiums. The premium pattern will be higher and the premium persistency will be higher than those that have lightly funded characteristics.

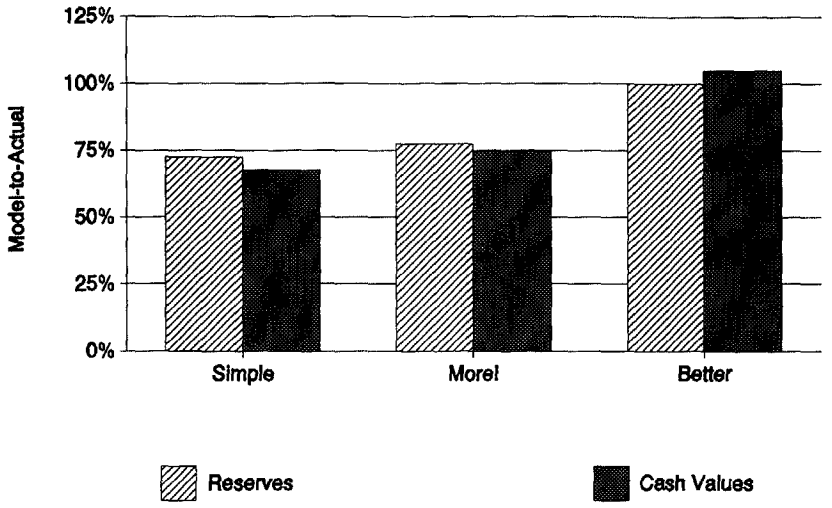
TABLE 3
Segmentation by Funding Level
(Millions)

	Fully Funded	Lightly Funded	Total
Fund value	$36.2	$10.9	$47.1
Statutory reserve	23.7	2.4	26.1
Surrender charge	19.0	17.5	36.5
Cash value	17.2	0.0	17.2

I'm going to try a third attempt at modeling. I've done something that we typically don't do and Paul said that they don't do. I'm going to use one hybrid plan code for this example. The one hybrid plan code is a weighted average of the four cells. The weighing is done by specified amount of insurance and the parameters that we've weighted include things like premiums, cost of insurance (COIs), surrender charges, and reserve mortality.

So, now I'm going to go to the better model. Better models were better. That was how I was going to enter the debate. It is the better model, at least relative to the simple and more models. The better model now is down to one plan code. It has three ages. Triplets are enough to get it at nine ages. We're going to have two funding levels and, again, four issue years. That gives us 24 cells. Now, that's more -- that is a larger number of cells than the simple model, but not as many cells as the more complex models. Let's take a look at Chart 3. It's real hypothetical data. The validation is 101% for reserves and 103% for cash values.

CHART 3
Validation of Third Attempt



Now we think we're partially there. We have a static validation which looks good. Well, static validation is great, but what about the true test? How do we benchmark this thing for future cash flows and income statement balance sheet items against the past? A backward validation is nice with the components in the model, you know, component by component with the recent past.

But I've done something else. Because this is real hypothetical data, I have a lot more at my disposal. This is the real hypothetical stuff and I've made a very refined model of the projected statutory profits, which I'm calling the standard (Chart 4). So, it looks like we're supposed to make some money on this business. It's in-force UL insurance. We've expended our acquisition costs; we're going to make some money. And it will be difficult to make money in the first two years as the surrender charges wear away, but we do make some later on. So, this is the very highly refined standard we're going to compare ourselves against using the three other things we have in there. Chart 5 shows the simple model. It doesn't do very well. Of course, it doesn't do very well early on because we don't have the reserves captured correctly. We have the one off of the reserve increase over time. So, that one looks dreadful.

Then we have the more model in Chart 6. This is the one with the four plans, the nine ages, and the 144 cells. It does slightly better, but it is still inadequate. I'm going to stop it right here. This is the comparison, the benchmark if you like, of our liability projection. And I would maintain that some companies would use this model going forward, but they can't benchmark for the standard. They would never think of using this kind of comparison or this kind of model for a CMO model if they could benchmark it. We can benchmark it because of the asset analytic firms. And we always would tinker with this had this been a comparison of asset cash flows. That

kind of supports my theory that maybe we do a better job of benchmarking in projecting the assets. That was the tangent. Chart 7 is the better model and look just how wonderful it is.

CHART 4
Projected Statutory Profits

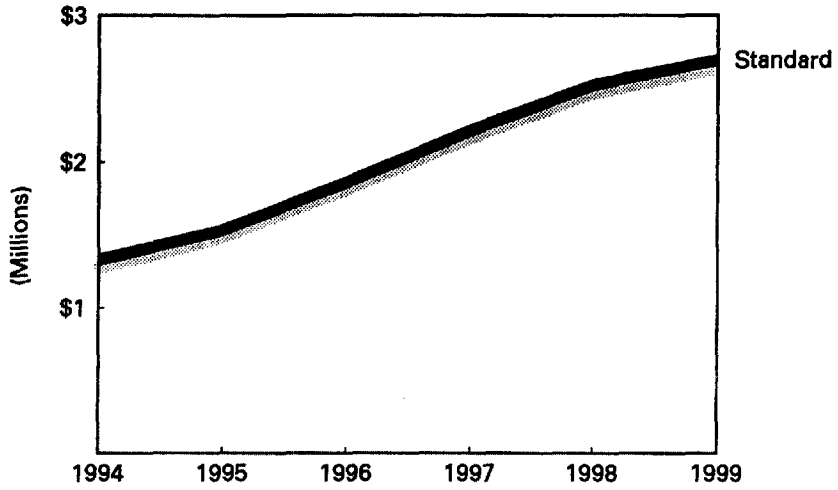


CHART 5
Projected Statutory Profits

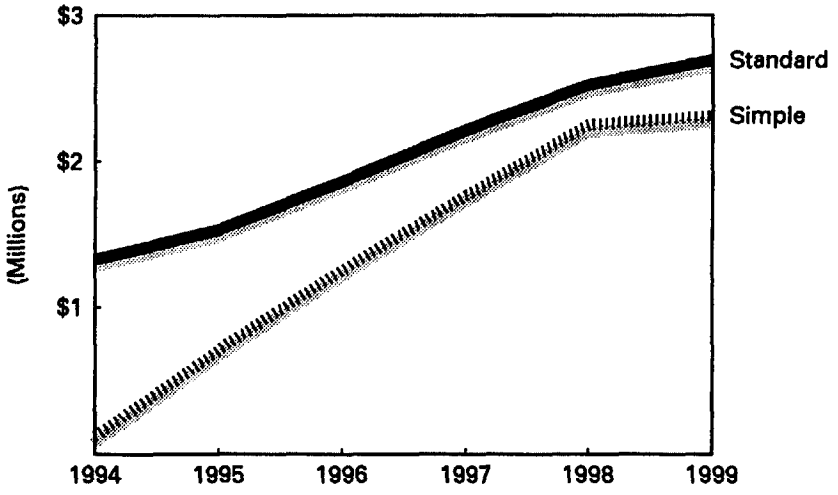


CHART 6
Projected Statutory Profits

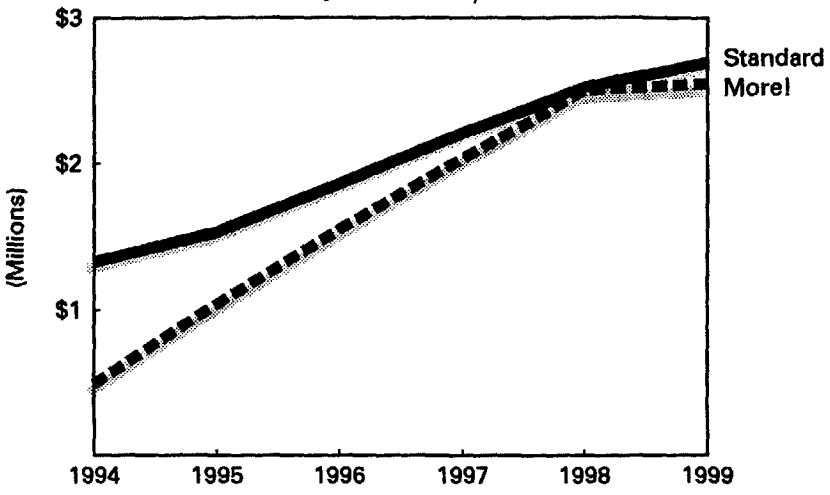
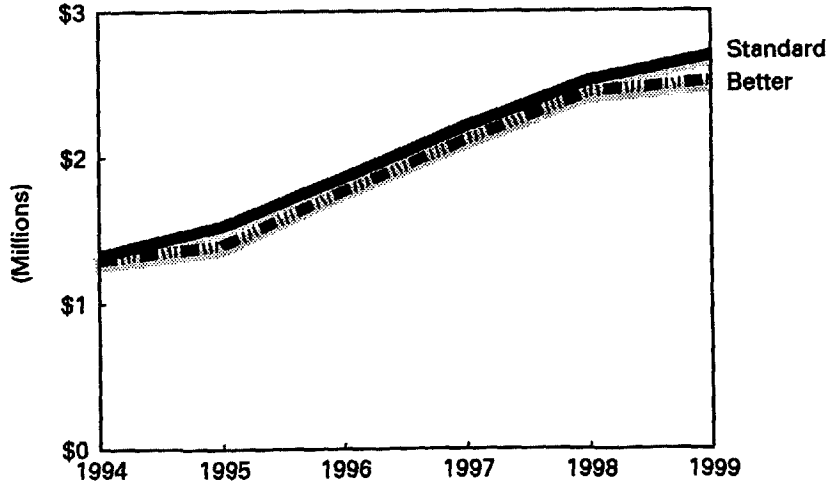


CHART 7
Projected Statutory Profits



Now I have some general comments. We were supposed to talk about different kinds of models. There are five different categories of models: cell-based, momentum, loss-ratio-driven, spreadsheet, and others. I couldn't think of any other kind, so I say "other" because I am sure there are others.

Cell-based models are the kinds where we use a model point to represent business and do the mapping. That's always good. You can't go wrong with the cell-based model except if you overkill in certain circumstances.

A momentum model is when you project the average of components of the income statement and the average of components of the balance sheet based upon the recent past. That actually can work in certain circumstances.

The loss-ratio-driven model is, of course, more health insurance related. It can be used for some circumstances, especially when the elements of cash flow aren't important, but it's just the statutory results that you're interested in. And then there's the good old spreadsheet model and that does have its place for certain circumstances.

Of course, the use of the model is driven by other considerations. What are you going to use it for? You can't select a coarse model or a momentum model for cash-flow testing because you lose a lot of the nuances in it. That's an oversimplification. So, you want to make sure that the model that you select is consistent with the purpose for which it is going to be used. What are the drivers that are going to be the components that you look at? Is it going to be cash flow? Is it going to be statutory earnings? Is it the development of surplus? You may wish to do something that is very, very refined, but you may not have the information sufficiently segmented to support that level of refinement. Maybe we want to go ahead and segment that UL business, but we can't tag the policies. We don't have assumptions that will meaningfully reflect the components that we would like to include. So, these needed parameters are important as are availability of data, resource constraints, and others.

When might certain models be appropriate? I have listed the four kinds of models across the top of Table 4: cell-based, momentum, loss-ratio and spreadsheet. Certain kinds of insurance are listed down the side. For example, you might use a spreadsheet model for financial reinsurance. After you've done your cell-based model, dump the output into a spreadsheet and do your financial reinsurance projections off of that. That might be an acceptable way to do it.

For disability income and long-term care products, if you're going to do cash-flow testing, you probably need a cell-based model because you need the components of cash flow. If you just want the earnings projections, a loss-ratio-driven model may be appropriate.

TABLE 4
When Might Certain Models Be Appropriate

	Cell-Based	Momentum	Loss-Ratio	Spreadsheet
Life insurance	✓			
Deferred annuities	✓			
Immediate annuities	✓	✓		
Group term life				✓
Group health			✓	
Long-term care	✓		✓	
Disability income	✓		✓	
Risk reinsurance	✓			✓
Financial reinsurance				✓

Consider important and easily overlooked characteristics. It is important that we don't overlook the number of issue ages needed. I would maintain that we need to get the right number. What are some things that we should consider? For UL insurance, there is the funding level. I think it is something that you must consider, especially if you have a wide range of different kinds of marketing methods and other ways of selling the policies.

Other characteristics are dump-ins and rollovers. We need to understand the premium persistency even if UL is marketed in some homogeneous way. Premium persistency amongst your policyholders could vary quite dramatically. We usually model premium persistency with some declining amount of premiums coming in each year, but it's really by model. There are some people who pay premiums every year at some fixed level and then there are other people who stop. And if you segment the business into those two components, you get a different earnings pattern a lot of times than if you just assumed the average. There is premium persistency, marketing characteristics, and lapse without value. If you look at the lapses for the UL insurance policy, there are some people who lapse because they ask for full surrender, and there are some people who lapse because they don't have any value in the contract. Again, those are a few things that give you markedly different answers.

Regarding deferred annuities, I was asked to do interest-sensitive insurance and deferred annuities are interest-sensitive. An important and easily overlooked characteristic for deferred annuities is annuitization. You may have a policy with a big surrender charge. On the other hand, the policyholders may have an option to annuitize for a short-term-period certain annuity (maybe one year). They get three years at the favorable rates and they get the full-funded value. That does not require a lot of projection.

Another characteristic is cumulative partial withdrawals. We're being lulled to sleep with these cumulative partial withdrawals. We have a lot of policies with that feature which means we don't have the full surrender charge available to us. If interest rates (and therefore surrenders) spike up, we may only have 40% or 50% of the surrender charge available to us.

There's also the bail-out provision. And finally, the Society experience study showed heavy surrender activity at the end of the surrender charge period. That is something that might repeat itself, especially when interest rates go back up.

I think there is a reason for having consultants leading this session; we have seen a wider range of modeling activities. It was a core business. It still is a core business of ours going back 10-20 years. Yet in the company environment with your basic experience, you may be limited to seeing the experience of one to three companies.

Modeling tips. I think with issue ages, we sometimes do go crazy. Three appear to be enough for life insurance. For deferred annuities and single-premium whole-life, one is usually plenty. The use of hybrid plans should be considered, especially if it's a one-time circumstance. We'll reduce the run time quite a bit. It does make the repetition of that, however, a little more difficult. You might consider combining issue years, as Paul had mentioned, especially for old traditional business. And, of course, when you do your dynamic validation, be wary of discontinuities between your projections in the first year or so and your recent past.

MR. MENKES: There's not much I can add to that, Abe, other than I thought you coined a new oxymoron in "real hypothetical." But then you did use a hypothetical example to produce real world results.

MR. STEPHEN L. KOSSMAN: I'd like to raise two points. First, I certainly agree with Abe's comments of looking at the funding level for UL products. My difficulty is in knowing what the future holds in store for those different funding levels. In your example, you assumed the product that was heavily loaded or had a higher fund value had both dump-ins and that in the future would pay a higher premium than the lower funded product. And I could offer the opposite hypothesis: some policies are sold with a high dump-in in the beginning and have lower levels of premium. So, I understand how you get a high validation at time zero, and I understand how you put the products out. I just don't know what you do with it afterwards.

Just one other quick observation. In the beginning, we were looking at the size of the model and what could control the speed and size of the model. I think that unless you're going to create both the complete detail model and a smaller model to do the comparison, at that point, you've done it already. You might as well use the more refined model. You're going to get a higher level of confidence with a larger model. Two of the things that have not been discussed as far as the time goes is the computer you will be running it on and the software system that you're using. I think that there might be some companies still using 386s and I would certainly recommend both the shift to the 486s, and software that can take advantage of that shift. My understanding is that some software products available are significantly faster than other ones and if you would look at the gain that you can get from a faster software, it may even pay to change systems in the middle.

MR. GOOTZEIT: We could certainly talk about hardware. The panel made a deal before we started that we wouldn't talk about our software.

MR. STRONG: I agree with you, Steve, that it's important to capture all the characteristics of your business, and the characteristics of your business indicate that

your knowledge of the marketing circumstances and experience at certain premium levels are expected on certain blocks of business. Those are the ones that you should use.

The second point of your comment gets back to the great debate. When you do one of the small ones, I think we need the right one. And if you can identify blocks of business that are homogeneous, then you need a very small number of cells to represent that. The difficult time we have is identifying blocks of business that are homogeneous. That's really the trick. If only we knew they were homogeneous and a small number of cells would be adequate . . . .

MR. MENKES: The other way, which tends to chew up so much time, is just to start sooner. We've all decided that's not something that we want to do for many years.

MR. ALLEN BRENDER: We're talking about dynamic solvency testing. Of course, that involves a huge corporate model. To the extent that takes over, and becomes a frequently used in the U.S. as it is now in Canada, I think you're going to see a situation where companies have huge, very detailed corporate models. That's what we're starting.

I agree with everything that you have said. That's why it takes an awful lot of work. I'm very biased towards getting very detailed models. The first time around, it's a lot of work. It's really difficult. But the thing is that if you're going to keep a corporate model going forever, then from period to period, all you end up doing, as long as your products don't change very much, is updating inventory. And that basically becomes some kind of download from whatever administrative system you're running.

And the important thing is to have a model that has significant credibility, particularly when you get into the dynamic solvency testing process. Ultimately the expectation is the actuary is going to go to the board to explain what's good about the company and what the problem is. And if you don't have the credibility in your model, these people who are going to be asking the questions or senior management that might not like what you're going to say, are going to sort of dump on your model. Then you've got a big problem.

We've used this approach that you're talking about in terms of a dynamic verification. I'll throw out a couple of numbers. One large Canadian company projecting a huge block of business, $6 billion in assets started with year-end 1989. It projected for two years. And at the end of the two years, I think it was able to get most of its significant balance sheet and income statement items to agree with the actual within less than 1%. The earned interest investment income rate was within 15 basis points of actual. It took an awful lot of work to do it. But I think that's the magnitude of the numbers you must deal with. And there will be a lot of effort. In verification of the model, you'll go back and make all kinds of adjustments, and it's very much a recursive process. But I think it pays off.

You're going to have to do the asset side on all this. And, of course, in dealing with a lot of interest-sensitive products, you're going to be dealing with the asset side even when you're talking liabilities. People have choices as to what funds they go into.

Their account balances and so on are going to depend upon how you project your assets and your investment performance. So, there's an incredible link. You're going to be talking cash flows. There are important decisions you have to make. For example, in years of negative cash flow, do you sell assets or do you borrow from the bank, or another branch of the company? If you want to get into selling assets, that's a horrendous problem because you must have computer algorithms deciding what assets you sell and when you do it. And I don't think that's very doable. It's hard enough to program investment policy. To program disinvestment policies would be incredible.

Third, you're ultimately going to be running scenarios and whenever anybody builds a model, I think it is extremely important to remember that when you change scenarios, you're changing all kinds of assumptions for projections. You want to build your model in such a way that it's easy to make these changes. You don't want to have to go into a whole bunch of cells and a whole bunch of pieces of your model and make individual changes. Think about how you're building your model so that you can make simple changes in a few places. Somehow they filter through your model as much as possible. That not only helps you with your programming and your keeping track of things, but also with your documentation, which ultimately is something that is extremely important so that you can back up your work.

MR. MENKES: I think that's good advice. I don't know that we need to discuss it any further. We'll give the other people a chance to speak.

MR. WARREN R. LUCKNER: I wanted to mention some of the activities that are going on within the Society of Actuaries that may be of educational value from a modeling standpoint.

I'm not in the education area of the Society of Actuaries, so I'm not directly familiar with what's going on in the basic education. I have been in the research area for the last year and I have been involved in several activities that relate to modeling. One is the recently published statement of principles of actuarial science that are used in the transactions done by the Committee on the Actuarial Principles. It does talk about an actual model. It does talk about actual risks. It defines them and the fact that you can model them in a very general way. It talks in the terms of validation of a model. So, that's sort of a starting point from a general level. One important activity is occurring in the life practice area. There is a research project about modeling. We are trying to figure out a project that would be appropriate to do on modeling that would be of value to the entire actuarial community.

Alan mentioned the Dynamic Solvency Handbook which is going to be discussed at another session.

MR. WILLIAM J. SCHREINER: I don't want my comments to be misunderstood. I believe that modeling is extraordinarily important. I believe it is a core actuarial skill and the universe is better off for all the work that's being done in this area. I think two things are very important in the modeling process. The first is humility and the second is good grammar. We had a former President of the Society of the Actuaries stand up and tell everybody, with respect to an important social program, they had done a good job because they were only off by a factor of three. I think the

important point of that is that the results of all models are wrong, and we should always remember that. We don't know how the future is going to play out and we should never represent our models as doing so.

In that regard, good grammar is important, too, because I don't think it's appropriate to speak of accuracy of models. I think you can talk about precision. And you illustrate the difference between those two words with a suggestion that a value of 6.20 equal pi is quite *precise*, but it is not *accurate*.