**1995 VALUATION ACTUARY
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SESSION 3

General Asset/Asset Specific Modeling

David N. Becker

Peter D. Tilley

GENERAL ASSET/ASSET SPECIFIC MODELING

MR. DAVID N. BECKER: The quality of the financial models that we build is exceedingly important. It's important for two reasons. One that is personally close to many people in this room is that they render an opinion about the reserve and asset adequacy of the company. An equally, if not more, important aspect is that the quality of the information, the knowledge and skill that we bring to bear in building the financial models, directly impacts the analysis of the risk posture and the future performance characteristics of the company. These are exceedingly important to everyone. Although it's often been said at symposiums, it's critical to have good data and good performance because we don't want what we do to be merely a regulatory exercise. We want it to be information that company management can actually use in running the business.

Many of our liabilities are small in size and there's a great number of them, so they are more easily grouped into homogeneous segments. That is basically with the exception of guaranteed investment contracts (GICs) which have large cash outflows. But on the asset side, by comparison, you have many fewer assets. At least two orders of magnitude fewer, possibly three, and those assets are very large. It's difficult to use simplifying techniques because you run the risk of not totally capturing the embedded option behavior in those assets. Therefore, the care in developing asset models used for reserve and asset adequacy asset/liability management (ALM) purposes is extremely important.

The speaker joining us is Peter Tilley, vice president and asset/liability manager for Great-West Life Assurance Company. After graduating from the University of Manitoba, he joined Great-West Life, where he worked on individual annuity product development, group annuity product development, and the forecasting and analysis of earnings. In 1991, he assumed his current position as director of ALM. He is responsible for performing cash-flow testing for Great-West's valuation actuary, identifying optimal investment strategies and consulting with the product lines on investment strategies to fit their liabilities.

MR. PETER D. TILLEY: One of the things that I've observed over the years at these seminars is that when people talk about the kinds of things they're doing at their companies, I always wonder, "Well, what are they doing it with?" I wonder if they have better tools than I have, because they're doing much better things than I am. Or, are they using the same tools that I have, but in a better way? And that's something I'd really want to know, because I'd want to talk to them about that afterwards. So I thought I'd start by running through the kinds of tools that we have at the Great-West Life. These are probably similar to what most of the companies in the room have. The ALM modeling software that we have is the Chalke PTS System. We have the INTEX CMO Model that reverse engineers collateralized mortgage obligations (CMOs) modeling. We also have access, as I'm sure all of your companies do, to Bloomberg Data Services. The bond administration system that we use is the Princeton Asset Management or PAM Bond System. We have a commercial mortgage administrative system that's home grown and was developed years ago. We have a piece of software from Global Advanced Technologies that we have found particularly useful. We have a software package that is used to generate arbitrage-free interest scenarios with probability weights on these scenarios. So rather than generating 1,000 interest scenarios and giving them equal probability weights, perhaps you can get by with the most likely two-thirds of the scenarios. This may cut the number of scenarios down substantially. And on the hardware platform it's pretty simple. We buy lots of Pentium personal computers and when the 686 chip, or whatever they decide to call it, comes out, I will be lobbying hard for buying lots of those, too. The kind of work that we in the industry now do requires faster and faster machines. I think if we could find a way to buy a day that had more than 24 hours, we'd buy a lot of those, too. But to model the kinds of assets that we're talking about here, you really seem to need hundreds, if not thousands, of interest rate paths, and that takes time. The situation is better than it was a couple of years ago. The software keeps getting better and better as well, but time is always the great limiting factor.

I have a couple of topics I'd like to address before I get into the specific types of nontraditional assets. Regarding asset allocation, I will not talk about whether you're better off to be in bonds or stocks today. I have no opinions on that. What I really want to talk about is the segmentation of assets. I think that historically the segmentation of assets has been used as a tool for allocating investment income. People thought that segmentation would be a good idea so that they could understand better

the investment income that's going to their lines of business. But what I really use the asset segmentation for at my company is to help me perform the ALM work in a more efficient manner. Rather than assuming that all of the assets that I've got are available for all of the liabilities that I'm modeling, I prefer to segment the assets into types that are more appropriate to those liabilities. So the assets that I would put against, for example, a single premium deferred annuity (SPDA) or a universal life block would be quite different than the assets I would put against, for example, a long-term single premium immediate annuity (SPIA) or perhaps a structured settlement block. But if you model these assets together and look at the portfolio rate that comes off those assets in your dynamic cash-flow testing and use that information to set an SPDA-credited rate, if the assets that you have don't really represent what you will be using to price the SPDAs, for example, you're using all of your assets instead of just the three- and five-year ones, you'll be kidding yourself on the portfolio rate that you're getting. It may not react as quickly to changing interest rate scenarios. If you kid yourself on the portfolio rate that flows through to the credited rate, which flows through to the policyholder's surrender activity, then you kid yourself on the bottom line results. So what I'm really trying to get across is that if you put all of your assets in one pot rather than segment them, I think that the results that you have are perhaps a little suspect.

The literature gives many approaches to asset segmentation. We could do a one-day seminar just on a good case history of how to segment the portfolio of assets at start-up and on an ongoing basis. But, generally, the asset segmentation should take into account the product mix that you sell, the organization of the company, how the lines of business are set-up, etc. The approach that we use is to break our liabilities into a determinate category and an indeterminate category. The determinate liabilities are things like GICs, certificate annuity products, SPIAs where once you've priced the product that's the liability structure you have, and you're stuck with it whether you like it or not. If interest rates go down and you don't want to be crediting 10% on that GIC anymore, that's just too bad. That is my definition of a determinate liability. The good news is that generally with the determinate liability the policyholder is stuck, too. If he doesn't like what he's got out there, he's still got it; that's too bad for him. On the indeterminate side we have a lot more options as an insurance company to manage them, but, again, the policyholder has a lot more options as well. Those require a different kind of asset.

We take a heavy cash-flow matching approach to the determinate liabilities. We go for the assets that have more predictable asset cash flows. Noncallable bonds would be the best example of that. If we were to go into something like a CMO for that portfolio, it would be one of the more predictable types like a planned amortization class (PAC). But over on the indeterminate side we've got a little more leeway for prepayment risk on those liability categories. We'll take the asset-backed security risk, perhaps, or some of the more volatile categories of CMOs.

We tag the assets to a specific segment when they're purchased. We're a $10 billion company and I think we've got roughly 20 segments. We don't have 500 segments, each of which has two assets in it. On the other hand, we don't have just three segments with large pools of assets. We do try to take a look at each particular asset as it's purchased and based on the liability needs (that we keep track of) and the asset characteristics of what we just bought, we will tag that in our bond administration system or mortgage administration system to a particular segment. So that when it comes time to run the ALM models, we can feed out of the administration systems these assets already on a segmented basis. They'll go, as Shane Chalke likes to say, seamlessly into the ALM model so that we can test each segment independently. We can model the SPDAs separately from the SPIAs. We don't have to worry about this comingling of assets that I referred to earlier.

The next topic I'd like to cover is the importation of externally generated cash flows into your ALM model. Some of the assets that your investment division buys will be in that category that doesn't fit your model. There are CMOs that, perhaps because they were private ones rather than public, or perhaps are so old that no one trades them anymore and the software firms like INTEX or GAT don't want to put that on their system because they only have two clients that still have a piece of it. It may not be available in reverse engineering systems.

There are things that are more recent. One of the asset categories that popped up in our portfolio just last year are callable step-up notes. A good ALM software package can model callable bonds. They can also model bonds with coupons that vary according to some index. But I haven't seen one yet that models a bond with a scheduled increase in the coupons and is callable. So that was one at

my company we did outside of the ALM modeling software and put those cash flows into the ALM software afterwards.

I like to avoid using externally generated cash flows whenever possible, because when you put external cash flows into your model you have to be very careful about the sorts of things that your model is doing after it gets them. If it's trying to use, for example, the market values of those assets, you have to be comfortable that the market values have been calculated properly. On internally generated cash flows, again, any of the good ALM software models out there will do that properly for you. But when you put externally generated cash flows in, you may not get the accuracy on the market value calculations. Also, the external systems may not provide all of the accounting data needed for your analyses. This will limit the scope of your analysis.

If your model has a strategy that says when I need cash to pay surrenders I will sell assets, it has to know what it's going to get when it sells those assets. It has to have a good market value calculation. If it doesn't have a good market value calculation, again, we get that domino theory where that affects your portfolio rate, your credited rate, the results on the bottom line. So be very careful that you're getting the kind of information that the model needs to run properly when you're using externally generated cash flows.

The most common type of externally generated cash flow that we put in is one where we can model it as a sinking fund bond. If you've got a particular scenario and you run the cash flows, for example, off Bloomberg, you can then retrofit those into your ALM model as a sinking fund bond with that same payment structure.

But the results are only as good as the place you got them. Perhaps you're not comfortable with the way the cash flows were originally calculated. For example, suppose you're operating off an outside system that can't take a public securities association (PSA) prepayment model assumption that changes over time and you're doing an interest rate scenario where interest rates go up 50 basis points a year for ten years and then down 50 basis points a year for ten years after that. I think that is one of the scenarios we all have to deal with at least once a year. If you don't have the ability to put in

a changing PSA to track along with that changing interest rate, the set of cash flows that you get out of that data source won't be all that great. And you just have to recognize that and deal with it when you're putting that into your ALM model. Just remember you're only as good as your data source.

You have to have prior knowledge of the interest scenarios. So if you're using externally generated cash flows, you can't put them into an ALM software package that does randomly generated interest scenarios. You have to know what the interest scenario is to know what cash flows are going to come out of it. So if you're doing something like 300 interest scenarios to test a particular product design, you have to have those 300 sets of cash flows generated externally and then put in one at a time into your software package. This presents all sorts of logistical problems and severely limits the number of scenarios in your test to a handful. However, I have been assured by one of the major software vendors that this will not be a problem in the next 12 months or so, that cash flows from outside systems such as Barra, CMS or GAT will be easily imported to a name you would recognize on the software front.

The other concern is that the modeled asset may not really represent all that well the true asset characteristics. If you're modeling a monthly pay CMO and you're trying to put that into a semiannual-pay sinking fund, it depends on what kind of monthly pattern you're getting. If it was a nice, easy, flat, monthly pattern, then maybe it is okay to put it in as two lumps every six months. But if you've got a severely declining monthly pattern of cash flows, say in the first six months of a particular calendar year, to put that in as one lump sum in June can distort your results somewhat. So know the limitations of the cash flows that you've got before you depend too much on the results of the model.

I'll now go into some of the nontraditional asset types that I have to deal with. When Dave asked me to talk about nontraditional asset types, I figured that these days, that pretty much includes everything but noncallable corporate bonds. But I've narrowed it down to a handful of types that are of particular interest to me and I hope to you as well.

Commercial mortgages. You have various interest and principal patterns. You may have a situation where it's fully amortizing over five years. Now that's pretty rare, but it may be what remains on a longer mortgage, 20 or 30 years, that's a fully amortizing pattern. What is more likely is that you've got some sort of a principal and interest pattern such as a five-year mortgage with a 30-year amortization and a bullet at the end of the fifth year. It may be interest only. You may even have a mortgage out there that isn't paying you any interest at all and promises to give it to you on some sort of an accrued basis when the bullet comes up. And I think you have to model those particularly carefully when we start talking about defaults. But know the interest and principal patterns on your mortgages and I guess that's one of the themes I've got running through all of these asset types.

Dave mentioned or alluded to it earlier, that you can't really get to know your policyholders one by one. But even though you can't know your policyholders one by one, it is actually possible to get to know your assets almost on a one-on-one basis and that's important because they're all different. Unless you're talking about something like noncallable corporate bonds, there really isn't much in the way of homogeneity. Every commercial mortgage we have has its own quirks and characteristics and we have trained professionals in the investment division that recognize each particular one by name and can tell you what the quirks are. Each asset-backed security has its own particular characteristics. You can't take asset-backed securities as one pot of assets and model it in some sort of pool. So get to know these assets personally if you can, or pay someone very well to do it for you.

Another point on commercial mortgages is that you think they have well-defined cash flows. You have a particular structure, but it is subject to renegotiation. You may think that you have a 9% mortgage, but next year this may become a 7% mortgage even though its rate reset wasn't until the year 2000. So, again, if you know these things or if you're talking to the people who know these assets personally, they can predict these sorts of things for you. Before I model our commercial mortgage portfolio every quarter, I get an update on these asset by asset. We have about 600 commercial mortgages still in our portfolio. So look at each mortgage with its unique circumstances.

On the default side you have a couple of choices in the modeling. You can model it as a reduction to the coupon, so if you have a 10% mortgage and you want to take 200 basis points for defaults, you

can model it as an 8% coupon instead. Or you can model it as a combination of the probability of default and the salvage value. I prefer the lower interest rate because our company tends to look at the mortgage defaults over a horizon of time as a number of basis points, and I can smooth that across the portfolio. We make particular adjustments for some mortgages that may be, for example, on our watch list.

The prepayment risk, again, should also be looked at on a seriatim basis. We look at mortgages, for example, with long maturity dates, perhaps 10 years or more from now, that have high coupons and are on our watch list. We may decide that we'll shorten those up for our modeling purposes. We don't tell the borrower this. We still like him to pay according to the original schedule. But for our own internal purposes we make adjustments when we think the principal might come back on these. If it's closer to its rate renewal date or maturity date we give it an even closer look. We talk to the mortgage correspondents in our internal mortgage department about each particular one and say this one's coming up for rate renewal in six months, what do you think it's going to do? Do you think it's going to renew? Do you think we'll extend it at its current interest rate? Do you think it will default? What's your call?

Make-whole provisions are common on these kinds of assets, so that it's kind of a market-value adjustment calculation. There's a tendency not to worry about the prepayment risk on these. But you have to look at your own company practices. Are you enforcing the make-whole provisions? If you're not enforcing them, I think they're more appropriately modeled as callable assets. Some mortgages, for example, purchase money mortgages, may have open prepayment windows. You sell the piece of real estate. You take a mortgage instead of cash. My experts back in Denver tell me that perhaps half of these kinds of mortgages have some sort of an open prepayment window. And it may be the situation where if the person who buys the property from you puts a lot of improvements into it, he or she may be quite prepared to refinance if it's in his financial interest to do so. The person takes the equity out of some of the improvements that he's put in. So, again, I stress the importance of getting to know each one of these assets personally. Each one has its own individual situation.

The maturity date versus rate reset date is an interesting question and one that I've had certainly a number of conversations with our own personal regulator on. When you look at a commercial mortgage with 20 years left to run, but its next rate reset date is in five years, do you model this as if all the cash were coming up in five years, or do you model it as if it's an adjustable rate mortgage that's going to reset to an index? And before you make the decision on how you're going to do that, get to know your company experience on these. What is your so-called persistency on rate resets? Just because it's coming up for a rate reset instead of a maturity doesn't mean that they're going to stay with you. It may be that perhaps only 30% or 40% of these mortgages when they hit their rate reset date will actually stay with you. To model them as going forward with the nice, attractive spread as a renewing mortgage may turn out to be a nonconservative assumption.

Now what assets are you modeling for your reinvestment strategy? Let's say you've got mortgages that are modeled at a net after expense and default of Treasuries plus 150 basis points (bps), and I throw that number out not as what Great-West Life does, but just as a "for instance." If you're modeling this at Treasuries plus 150 bps and your reinvestment strategy is to put them into a very conservative noncallable corporate bond, just a generic purchase in your asset/liability model software of let's say a five-year bond at Treasury plus 50 bps, then I think you're making a conservative assumption and one that's supportable when dealing with the kinds of people that like to look over my shoulders. But if you're modeling mortgages at Treasuries plus 90 bps after expenses and defaults, and you've got your reinvestment strategy going into some sort of a noncallable bond with a spread of Treasuries plus 110 bps, then I think you have to be very careful. Because what may happen is that your model is giving you better investment income than you'll really end up with. I like to think that my model is giving me a slightly conservative investment income compared to where I will be on my commercial mortgage portfolio over the next five to ten years.

Asset-backed securities. This is a topic that if we'd had this session five years ago, we could have covered it in about two minutes. Now it's another one of these topics we could spend all day discussing. We've got a wide variety of asset types out there that have been collateralized and securitized. Some of them are bullet structure. For example, credit card receivables and trade

receivables. It's a situation where a company is just borrowing against its most liquid asset, its receivables. And some are sinking fund structures, home equity loans and auto loans, for example.

The bullet structure, at least the ones that I'm familiar with, have very little prepayment risk. They're either noncallable or they have some sort of a make-whole or keep-whole provision that acts as a market-value adjustment. And those can be modeled as a noncallable corporate bond. You may have on these what's called in the asset world a "soft bullet"; so if the bullet maturity was March 1998, what may happen is that you get some of the money in March, April, and May as the receivables pay down underneath the structure. But it's typically a fairly narrow window and I feel comfortable modeling these as a hard bullet. There's usually also some sort of legal maximum in these deal structures, so that if they haven't paid the full bullet back within a 12-month period they're required to make up the difference.

The sinking fund structure is a lot more interesting. There's more prepayment risk on these where you've got the end borrower refinancing. They're not home mortgages. They're things like home equity loans, home improvement loans, auto loans, leases, manufactured housing, or, as we call them in Denver, double-wides, the trailers that you see in Florida on the news every time a hurricane goes by. Those are all loan structures where you've got principal and interest schedules and amortization schedules. Some of them are fairly short. Auto loans, of course, would be short. Something like home equity loans may go as long as 30 years and manufactured housing 20 to 25 years. The refinancing risk, though, is reduced by the borrower profile. What sort of end borrower are we associating ourselves with here? Someone who buys a manufactured house perhaps has a $20,000 loan. The credit rating of this person isn't necessarily very good. The home improvement loans may be something like a third lien on the house. Again, not a particularly good credit rating. These are people who don't have a whole lot of refinance options and, don't necessarily subscribe to the *Wall Street Journal* either.

Now that I've scared you on the credit aspect of these by playing down the prepayment risk, let me talk about the credit for a minute. The credit at the end borrower level really isn't very good and we recognize that. But the credit on the asset-backed security can be enhanced up to AA+, AA-, A+;

it depends on the deal by either over collateralization or some sort of insurance that's wrapped around the deal. We actually prefer the people with the lower credit ratings, because they are the ones who are less sensitive to refinance and have less refinance options. So the kinds of deals that I see when I'm modeling these are ones where it's a fairly high credit, but a fairly low sensitivity as a result of some heavy duty over collateralization. You can model these kinds of assets as a sinking fund bond, through some sort of information that gives you a set of cash flows, perhaps from Bloomberg's system. You can turn that set of cash flows into a sinking fund bond or an externally generated and imported set of cash flows. Or you can model these as perhaps a type of Federal National Mortgage Association (Fannie Mae) mortgage-backed security pool, but not with the same kind of sensitivities that a Fannie Mae pool has.

One thing to be careful about on some of these, for example, the home equity loans and home improvement loans, is that where on the mortgage-backed pools you're very comfortable if it says that it's a Government National Mortgage Association (Ginnie Mae) 9%, paid off in the year 2019, that all the mortgages that are in that pool are pretty similar. In fact, they may be identical. On the asset-backed security structures you're a lot less likely to see that sort of thing. In a home equity loan pool you may see a variety of coupon rates. You may see a variety of amortization terms and final maturity dates. So it's not quite as simple as we'd like it to be and we're trying to do some internal research on how we can perhaps break these into a combination of pools that together would model effectively the overall pool. Finally, some asset-backed securities are tranched. The only ones that I've seen are sequentials. I don't know if there are any asset-backed securities out there that have been tranched into inverse floaters and interest only (IOs) and principal only (POs). I sure hope that we won't be seeing those any time soon. But depending on the market, if the spread is good enough perhaps in a couple of years we will.

Next I'd like to touch on modeling of dollar rolls. What are dollar rolls? They're a by-product of the CMO market. Because CMOs are a tranched version of a pool, what you have when CMO sales are hot is a desire for pools that can be split up. The Wall Street firms may have a piece of a pool that they're looking for that they don't happen to own. They need this particular kind of pool so that they can break it into pieces and make a profit. And what they want to do is borrow your mortgage-

backed security. So a dollar roll essentially is an agreement to lend one of your securities and repurchase it at a future date. You're usually looking at a very short time frame here, something like 30 days. And the repurchase security won't be exactly what you gave them, because they've used that now. It's CMOs and CMO by-products. But what you'll get back is substantially the same. And I caution you a little on substantially the same, because there are some guidelines on these where what they have to give back to you is within a certain dollar amount range or within a certain coupon range. So maybe you won't quite get back Ginnie Mae 8% of a particular maturity date. Maybe you'll get back something that's six months earlier or six months later. Maybe you won't get back quite 8% securities. Maybe you'll get back 7⅞%. You can count on them giving back to you what is in their best interest to give to you. So there's a little bit of antiselection that goes on there.

You can model these as if the dollar roll never existed and that's my method of choice. In other words, you still own the original security. You never lent it out. This ignores the profits on the roll. I feel it's an element of conservatism. I hate to give the liability pricers something that they can't count on happening forever and the dollar roll market is certainly something I'm not sure will be around forever. No matter how you're modeling these rolls, make sure you have a matched book. By matched book I mean, for example, if you're rolling these assets over a 30-day period, I would hope that you've taken the proceeds and invested them in something similar to a 30-day time frame. If you've taken a 30-day roll contract and invested it in five-year assets, I don't think you ought to use this model as if the rule never existed, because there are certain situations where you can get yourself in a world of hurt. If you're modeling it as a continuous roll instead of as if the roll never existed, in other words, every 30 days you just roll this asset again and you build in the financing profits, I strongly advise testing the impact of the roll market drying up. What if you had to take delivery of these assets back? How would you feel about that? What does the model show happens there? And what would happen if the CMO market dried up? I don't think that's an unreasonable question given what's happened since 1993. And what would happen if the market for your particular coupon level dried up? If interest rates change dramatically and quickly, maybe nobody wants to borrow your particular security anymore if you haven't been quick enough trading to current coupon in the bond room.

My final point on dollar rolls is a somewhat obvious one: Don't model your assets twice. It is important on these dollar rolls not to double count the assets. If you're grabbing assets off the balance sheet to use in your cash-flow testing, and you're trying to get the easiest assets you can find to model because you don't have them segmented, don't model the Ginnie Mae 8% mortgaged-backed security and also model the cash you got from rolling that Ginnie Mae 8% as another asset in another segment. You can't have it both ways, so pick one or the other. I certainly advise picking the Ginnie Mae 8%. I think the other thing that helps me with this choice is I struggle to think about how I would model, inside a commercially available software package, a continuous dollar roll without somehow managing to make all my machines blow up.

I want to give you a brief overview of mortgage-backed securities and CMOs. Mortgage-backed securities come in various types. The most common ones that I think everyone's heard of are the government agency-backed ones: GNMA, FNMA, FHLMC. There are also nonagency mortgage backs and I think, again, those are fairly common. They're nonconforming loans usually because of the size. Right now the maximum size that's available for a federal housing administration (FHA) loan is just a little over $203,000. That sounds like a lot of money to some people, but in New York and California, I assure you that is not enough to get a nice three-bedroom house. So nonconforming loans tend to be located in the geographic regions where housing prices are high as well. But that large size, the reason that they're usually nonconforming, is something we have to be cautious about because that's what makes them more prone to refinancing. Someone with a 200,000-, or 300,000- or a million-dollar mortgage is paying a lot more attention to what the cost of refinancing is and what the potential gains are of even a quarter of a point or a half a point drop in interest rates than someone who's down at the $100,000-mortgage level. There are certain fixed costs associated with refinancing that just aren't as significant when you're talking about several hundred thousand dollars of mortgage.

There are also project loans. This is something that we have at our company that may or may not be on a lot of balance sheets, but not all government agency-backed mortgages are on residential mortgage situations. For example, Ginnie Mae 223s are project loans, multifamily housing, low-income subsidized housing developments. They've got particular characteristics and you have to understand what those characteristics are to model them properly. I'll get to that in just a second.

We also have adjustable rate mortgage (ARM) pools that are Ginnie- or Fannie-backed. For some reason that no one can properly explain to me in Denver, the Ginnie Mae pools are usually indexed to constant maturity Treasuries and the Fannie pools are usually indexed to the 11th district cost-of-funds index (COFI). I'm not sure why that is, but understand what your index is and how it will move along with changes in the Treasury curve. COFI tends to lag both up and down. It's more of a rolling average kind of an index where constant maturity treasury (CMT) changes as we speak.

Watch out for the annual and lifetime caps. Don't just model these as purely floating up and down. The caps may come into effect in some interest scenarios, although perhaps not the ones that we are required to consider under Regulation 126 where the maximum increase might be something like 500 basis points over today's levels. But if you're doing stochastically generated scenarios and you have interest rates that are hitting the 15% - 17% levels, make sure you've got those lifetime caps and annual caps built in properly in your model.

Prepayments on these can be modeled as a function of coupons versus new money. So look at the coupon on the mortgage pool on the collateral versus what a refinancing choice would be. What are the new money rates available in the particular interest scenario that you're looking at? You can use either a difference in coupon method or a ratio method. The difference in coupon method just says that if interest rates are 2% lower on the refinance option, then the propensity to refinance will be x%. The ratio method takes a look more at the market value of what you've got and what you could get and actually takes into account things like how many years are left to go on your mortgage. The ratio method really requires that you've got a good handle on the market values and, also, seems to imply somehow that the refinance decision is based on the remaining term-to-maturity of the mortgage rather than the full-term of the mortgage. I think there's a variety of reasons that people refinance and a variety of ways they do it. If someone has five years left to go on their mortgage and I understand that the mortgage pools right now are not that mature, but when you're doing a 20- or 30-year model they'll get mature. When someone's got five years left to go on their home mortgage and the refinancing decision now makes sense either under the difference in coupon method or the ratio method, are they going to refinance into a five-year mortgage, or are they going to refinance into another 30-year mortgage, or are they going to refinance into a 5/25 balloon structure? What are

these people really looking at as their choices? I don't think there's one right answer to that question. I would suggest that the ones that are widely published that people would be looking at when they're deciding whether to refinance are probably more out in the 15- and 30-year term no matter how long they have left on their mortgage. The other thing, though, is that as someone gets fairly close to the end of the mortgage, it just may not make that much sense for them to refinance at all even if interest rates have gone down.

Ginnie Maes are less sensitive than Fannie Maes. Ginnie Maes are assumable mortgages, lower quality, less sophisticated borrowers. They are less prone to refinance under a particular interest rate situation than Fannies and Freddies. But the nonconforming are a lot more sensitive than the Fannies and Freddies, particularly when you're in a range that's fairly close to the current coupon levels in the market. When you start to get more than a 100 basis points off the current coupon, we don't see quite the extra sensitivity. There may be a seasoning element. For example, if someone has a current coupon that's much higher than a refinance opportunity why hasn't he already refinanced it? Perhaps it's because he can't. Perhaps it's because he just doesn't know any better. But why would he know any better tomorrow if he didn't know any better yesterday? So the ones where we see the particular sensitivity are fairly close to the current coupon level.

Project loans are a different animal entirely. The ones that I have seen have some degree of call protection and that needs to be factored into the model. They may be noncallable for a period of five years and have a call premium that grades down over the next five years and be fully callable at par after that. So, again, get to know your assets personally, understand the characteristics of each particular one, because these Ginnie Mae 223s are quite different than a Ginnie Mae residential mortgage pool.

And the last point I want to make on this is that ARMs are particularly interesting to model, because you may actually get into a situation where people will refinance into a higher rate. Back in 1993, it still may have been a lower rate for people to keep their ARM rather than to refinance into a 6.25%, 30-year mortgage. But the attraction of locking in that kind of long-term rate was what made people refinance out of the ARMs. We had a lot more people refinance out of the ARMs in the low-interest

rate environment than we expected and I caution everyone to think about that in their own ARM portfolios.

Finally, CMOs are another one of those topics that could go on for days and I won't let it. I highly recommend Randy Boushek's and Dave Hall's presentation from the 1991 Valuation Actuary Symposium. They did a wonderful job describing the CMO marketplace and all of the different structures and features. Keep in mind you need very good reverse engineering software. Reverse engineering is the software that takes a particular CMO tranche and through a large database relates it to all of the other tranches in that particular collateral pool. It shows for a particular PSA or prepayment assumption what will happen to your tranche, based on what's also happening with the other tranches that you don't own. Typically, if you own one tranche in a deal, you don't own all the other tranches: you might as well just buy the pool if you're going to do that. So you won't really have much of an idea as to what's going on with the rest of the pool, but it can have a dramatic impact on what's happening with your particular tranche. So get a good reverse engineering software package to understand what the cash flows are going to do under a variety of situations.

And when you're looking at software packages, if you haven't already got one, check the percentage coverage on your portfolio. What I mean by that is if you've got a billion dollars of CMOs in your portfolio, how many of them are covered by the software package? You can tell by looking at the CUSIP number, the particular asset identifier number on each asset and see that the CUSIP is on this particular software's coverage. When you're dealing with the software vendors they'll be quite happy to tell you which ones of your portfolio they've got covered. If you've got a low percentage, why is that? Is it because the software package isn't all that good or is it because your bond investors are really wild and crazy, exciting guys? I've got a gentleman in my department who's a big fan of Einstein and he's got a picture of Einstein in his cubicle with a quote under it that says, "Imagination is more important than knowledge." I've asked him to please take that down anytime the bond traders walk by, because I really want to know what these assets are. I don't want to just have to use my imagination as to what these assets might be. If you've got a low coverage on your portfolio and you've got a particular block of assets that don't seem to be modeled on linked reverse engineering packages, or unlinked ones like Bloomberg, then you might be interested in selling some of these

assets. And if your bond traders says, well, now really isn't a very good time to sell, then you can worry even more about why it is you can't model these assets. So go back and ask some questions.

I strongly recommend a dynamic link from your CMOs to your ALM software. That makes it so much easier to do multiscenario testing with stochastically generated scenarios. For the reasons I gave when I was talking about the difficulties of externally generated cash flows, it's just a beautiful piece of software to have. Sometimes the cost of these things can seem a little high. But start to think about what can happen to your surplus if you don't understand all the ramifications of interest rate changes. It's true that we don't necessarily have the budget sometimes for purchasing these kinds of things. But I think we just have to argue harder that they're worth more than their weight in gold.

As you use these software packages to generate the cash flows, do some double-checking for reasonability, particularly on the yields. If your ALM software package is one that puts out a portfolio yield on these assets that are being modeled, look for the ones that are 20% and 2% and find out why. Perhaps there's some problems with the data entry and perhaps these really are 20% yield assets; but it's good to understand and know that the next time the person you work for asks that question.

The collateral prepayment assumption is what drives the cash flows on either mortgaged-backed pools or CMOs. It's an extremely important assumption. There's a feeling perhaps that Wall Street lied to us back in 1993 and I disagree with that. In my view, the structure of these deals is very well defined, but the prepayment behavior is not. There were some people who get paid a lot more than I do at my company who came to me in 1993 and said Wall Street lied to us. They told us that if interest rates went down 200 basis points, here's what the cash flows would be. They were a lot higher than that. And I said, no, actually that's not what they told us. They told us that if the PSAs went to 500 here's what the cash flows would be. What they didn't tell us was that if interest rates went down 200, here's what the PSA would be. Actually, because of more increased consumer understanding, the PSAs went to 1,200. And the reason we got a lot more cash flows is because we didn't understand the borrower, not because we didn't understand the tranche or understand the particular hierarchy of this deal.

There is no universally accepted prepayment model. Gunnar will give you all sorts of proof of that. Most of these prepayment models, in fact, I suspect all of them, are proprietary. The people on Wall Street put a lot of effort into determining whether they've got the prices right on the mortgage-backed securities and the CMOs. So do sensitivity testing and don't do it just at one end of the spectrum. If you've got a base range on a particular collateral pool of PSA from 110 to 350, test it going both directions. So take the 110 down to as low as 75. Take the 350 as high as 1,100. Change both ends of the curve. The extension risk is just as important to test as the prepayment or shortening risk. And be able to answer the question: "Is the prepayment assumption a main driver of your results?" If you don't have that big of a portfolio, or if your liabilities are defined in such a way that you feel you can pass along most, if not all, of the prepayment experience directly to the customer and he won't notice or mind, maybe your results are not all that influenced by what happens with the prepayment assumption. But understand what the drivers are of your results.

[Gunnar Klinkhammer, who spoke at this session, did not submit his presentation for publication.]

MR. TILLEY: I don't think that surplus really needs to behave the same way as the assets that are backing the liabilities. There are two schools of thought in my own company on this. One school says that if you've got an investment policy that's five-year for a particular segment, then the benchmark surplus fits against that segment, risk-based capital, if you will. It could also be in five-year and to the extent that your surplus exceeds your benchmark surplus total for all segments, then that unallocated surplus can be invested however you please.

But we don't look for a zero duration on surplus in my organization. We don't say that we want the market value of surplus to remain the same if interest rates rise or fall. I think we'd be invested in cash or cash equivalents, if we were taking that approach. And the surplus by its nature should allow you to be a little more flexible in your investment policy. If you choose to go into equities or investment real estate, (the kind of real estate that you want to buy, not the stuff that you're left holding in certain circumstances), within certain parameters that ought to be manageable in the organization. And as the result of cash-flow testing, you ought to be able to determine what the

likelihood is of surplus being needed in certain situations and make sure that your investment policy on surplus in those situations will support your needs.

But you don't have to go lock step with surplus investment, going against the lines of business with exactly the same kinds of investments. So we don't necessarily have our surplus invested in option-free assets over on the determinate side, and assets with options over on the indeterminate liability side. There is no particular allocation of investment policy on the surplus for those lines of business.

FROM THE FLOOR: Peter, have you had any experience in modeling real estate mortgage investment conduits (REMICs) where they are now sort of making CMOs but the collateral is not this nice smooth homogeneous pool, but maybe a tranche from that CMO?

MR. TILLEY: To the best of my knowledge we have stayed away from those. If they're hiding one back there it's probably in surplus.

MR. SCOTT MCGUANE: Peter, we've been talking about assets that you currently own. You also briefly went over your reinvestment strategy, and what you might use as a conservative estimate. But you also talked about trying to automate this process as much as possible. To my knowledge there's not a current vendor that provides CMOs for reinvestment strategy. I may be wrong on that. But the vendor that we currently have does not allow you to repurchase CMOs unless you take the time to sit there and put in all of your assumptions about building a CMO. Would you happen to know of a vendor that might have that service available?

MR. TILLEY: Well, in my own platform I have certainly modeled liability portfolios where the investment strategy moving through time was a predetermined combination of pass-throughs and PACs and noncallable bonds. Now the noncallable part is easy enough. The modeling of pass-throughs and PACs, I suppose, was simplified by my choice of using whatever the current coupon was at the time for purchasing.

I think if you wanted the model to purchase at a discount or premium I throw my hands up and refer you to Donna Claire. She is eminently able to answer all of these kinds of questions. Even if the answer is no, Donna knows it very quickly.

I would say that what we've done in the PTS software package is to build a generic pass-through, or a generic CMO structure, and actually I think the generic CMO structure was one that Donna helped me with. Moving forward it would dynamically calculate what the purchase price for these would be, and it would purchase the number of appropriate units based on what the interest scenario was telling it for the market price at the time.

So I'm fairly comfortable that it was doing a good job at that. We ran that with about 300 scenarios. It showed some sensitivities to the liability folks that they weren't necessarily too crazy about. But at least they were quite explainable and understandable. So I have a pretty good degree of confidence with what came out using that dynamic investment strategy for the option assets.