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Unified Valuation System Project

Track: Financial Reporting

Moderator: DOUGLAS A. ECKLEY
Panelists: MARK TENNEY
THOMAS M. GRONDIN

Summary: This session covers principles developed during the Unified Valuation System (UVS) project of the American Academy of Actuaries with support from the Society of Actuaries and the Financial Reporting Section of the SOA. As part of that project, a modeling platform for a fictitious, multi-line company was developed to demonstrate an actuarial framework for assessing total company capital adequacy in relation to the risk being undertaken by the company and to illustrate a fair-value valuation of the company.

MR. DOUGLAS A. ECKLEY: Welcome. Speaking today is Mark Tenney, who has served on various task forces for the actuarial profession. That includes the Unified Valuation System (UVS) and Equity Index Annuities task forces and, currently, a C3-risk task force. He's president of a software company that specializes in stochastic modeling of interest rate variables and things like that. He has worked with a Swiss bank to implement UVS-type methods.

Then we have Tom Grondin, who is a director of risk management for Aegon. He served on the UVS committee's task force and was very helpful to me in some of the things I was trying to do for that same task force.

Note: The chart(s) referred to in the text can be found at the end of the manuscript.

What Is UVS?

Our topic is UVS and the coming transformations in insurance accounting and risk management. I thought we should start by trying to define what UVS is. The first stumbling block for me was to decide what "U" stands for. I've seen it as universal valuation system, unified valuation system, and, I think, also, as uniform valuation system. So take your pick.

Anyway, it's a new approach to reserving. Essentially, it tries to move us from a one-number reserve to an analysis of variance. Then in the end, you might pick one number that you like, but that pick would be based on a certain confidence that you want to have.

Once you've got a display of possible results and variances, then you can pick a number for risk-based capital, which presumably would be a little more conservative. You also can use the same ideas for appraisal value calculations.

I think a good way to interpret the idea here is to look at what we call an S-curve (Chart 1). This is a curve that shows what market value of assets would correspond to what probability of paying off the associated liabilities.

The S-curves generally come out something like this: if you run 1,000 scenarios, you'll see this general pattern. At the very beginning, on the left of the S-curve, you have to build up your assets to some extent just to get anywhere. I mean, very seldom would you see that zero assets actually would pay off some insurance liabilities. Then you build, and around the middle, the increase in assets doesn't have to be that great to cover more of your scenarios. Then at the end, you have the other tail effect. The question is, "Where do you pick your reserve to be?"

A Simple Case Study

We might think about a very simple case study. The simplest one I could come up with was one-year term insurance.

What should the reserve be? Well, current practice would set the reserve equal to V times Q. V and Q assumptions pretty much would be driven by statutory authorities.

An appraisal approach probably would use what's called a "risk discount rate" and put a significant margin into that V. Statutory reserving with the conservative assumptions would have margins in both V and Q. Then cash flow testing adds an assets efficiency test.

UVS tries to take this a step further. To illustrate that again, let V be deterministic for a minute so we're talking only about assessing Q, the mortality. Once you pick a Q, you've weighted the two possible scenarios. Those two scenarios are, of course, that the person lives and that the person dies.

One term that comes into this is best estimate mortality. Most of us would agree that it would not give quite the right price if you're talking about fair value in some way, because the best estimate mortality would not give you any profit margins or any allowance for the risk involved in the liability.

Risk-neutral mortality would be designed to give you that price, if you can observe that price. Now that's another problem.

Another term that we've used is "arbitrage free". If you assumed a zero mortality, that would not be arbitrage free, because it would be possible to buy or sell that liability and not have a chance of loss.

So what we're trying to get is a statement of the form that these assets will support the liability with "X" percent confidence. The task force that we had actually did some of this work. The general idea is to pick some assets, set a lot of assumptions, run a lot of scenarios, and then plot an S-curve and basically read off the answers.

One more issue can occur. What if your assumptions are wrong? That's a type of risk that I call assumption risk. I don't think very much has been done with it to date.

Even if you're running scenarios, you're assuming that whatever is driving those scenarios is a proper reflection of what may or may not happen, and you could be wrong. It's a difficult issue, and we did try to do something with it on the task force. Basically, there's no rigorous treatment known for assessing this. There might be room for further research.

MR. THOMAS M. GRONDIN: First of all, some people just might be confused because you might be wondering at this point, "What is UVS?" Rather than trying to focus on it being a reserve methodology, which I think is how it started, it moved to a required capital methodology—what Level F capital you define, assuming a formulated reserve approach.

Getting past that, I think UVS can be a number of things. You can think of it as a way to set reserves or a way to set capital. You also can use it as a risk management tool or a business management tool that allows you to make educated decisions and gives you a lot of insight.

Stochastic Pricing

Yesterday I attended a session on stochastic pricing, and I remember that a speaker mentioned the impractical nature of doing stochastic modeling on an in-force block or a portfolio of business. That's exactly what we're doing in this project.

Let me explain what that might mean in terms of numbers. Think about calculating market values quarterly for 30 years on 1,000 scenarios. That's 120,000 calculations in the model itself, let alone everything else that's going on in the models, which generally would be calculated monthly. Then on top of that, the scenarios ran over and over and over again. So in the end I think I ended up with something close to 55,000 files and 75 gigabytes of data.

It's all deleted now, because the local area network (LAN) people were very upset with me. So a lot of my presentation here today will be taken from memory, because I don't have my output anymore. But I do have the actual cash flows still sitting with the Society in a database.

One thing I just wanted to caution before we get started here is not to get caught up in the underlying assumptions, because that isn't really what this is all about.

UVS and what we're trying to talk about today are really about an approach and a methodology to setting reserves or capital or doing risk management. So this is a fictitious company, the numbers are made up. If they don't necessarily make sense all the time, don't worry about it. I'll also try to spend a little bit of time on GAAP versus fair value.

Using a Trusted Model

This is a deferred annuity model, and what we've assumed is we're currently at year-end 1989. We actually put a lot of thought into what the starting point of this modeling should be. We decided to go back in time to year-end '89, which was a very interesting yield curve environment that I think Mark Tenney actually suggested using.

By using that model, we actually re-created what was going to be happening to these blocks of businesses that we were responsible for modeling over the next six-year period, using actual movements in the yield curve.

The book of business that I developed for this company was a deferred-annuity block that started in 1983. The company has been quite successful, generating over $2 billion in fund value by year-end '89. But recently, withdrawals have been running quite high. It seems that there's been more and more competition in the industry, and withdrawals have been running at about 150% of expected levels. However, management thought that this was perhaps more temporary in nature, and they thought they could fix the problem. We projected all of the business as of year-end 1989, all of the business as of year-end 1992, and then all of the business as of the year-end 1995—three individual projection points each of 1,000 scenarios each.

In '92, the company basically tweaked the product. They reduced the spread margin from a 200-basis-points spread assumption and would manage to a 165-basis-points spread trying to improve persistency. Then, to help pay for the

reduced spread margin, they negotiated a lower commission scale and utilized a broker sales force as well as their agent force.

Now, unfortunately, management's efforts were not sufficient to stop the withdrawals. As you can guess, with brokers being utilized and the reduced commission scale, withdrawals still continued at a fairly high level. So as a result, in year-end '95, the company went ahead with a withdrawal assumption change. This is what this is all about—recognizing that your assumptions are not appropriate, making a change going forward in terms of the way they would value the business, and increasing the withdrawal assumptions 150%.

Here is a simple statutory balance sheet for the three time points—the relevant points that we're talking about (Table 1). The growth you can see there is attributable to new business that the company is still writing, and this is reflected in the models.

Table 1

Results: Balance Sheet

	1989	1992	1995
Statutory Assets			
Invested Assets	2,130,227	3,326,015	4,853,076
Total Statutory Assets	**2,130,227**	**3,326,015**	**4,853,076**
Statuory Liabilities			
Statutory Reserves	2,037,755	3,202,744	4,626,370
Total Liabilities	**2,037,755**	**3,202,744**	**4,626,370**
Total Surplus	**92,473**	**123,271**	**226,706**

These intervals—from '89 to '92 and again from'92 to '95—are laid out in terms of the income statement, just a simplified version (Table 2). This is measured over the two three-year periods, so it's three years of income combined. You can see the income from '93 to '95 is substantially higher than from '90 to '92, and that's just a result of the growth in the business.

Table 2

Results: Income Statement

		1990-1992	1993-1995
Statuory Revenues			
	Premiums	1,500,000	1,950,000
	Investment Income	633,459	931,727
Total Statutory Revenues		**2,133,459**	**2,881,727**
Statuory Costs			
	Death Benefits	16,273	27,139
	Annuity Benefits	0	0
	Surrender Benefits	772,243	1,122,409
Total Benefits		**788,516**	**1,149,548**
Increase In Reserves		**1,164,989**	**1,423,627**
	Commission	105,000	117,000
	Premium Tax	0	0
	Claim Expenses	0	0
	Other Expenses	15,463	20,950
Total Expenses		**120,463**	**137,950**
Total Statutory Costs		**2,073,968**	**2,711,125**
STAT Pre-Tax Income		**59,491**	**170,602**
FIT		**28,692**	**67,168**
STAT Net Income		**30,798**	**103,434**

You can see the aging of the business and the release of that strain that's being caused by the young age of the business in the earlier years.

Now look at variance of results (Table 3). This is calculated by taking the present value of the market value of ending surplus (I believe it was at the portfolio-earned rate over the model projection years in each of the '89, '92, and '95 model projections). What I've just gathered here is the maximum and minimum values along with the average and standard deviation.

Table 3

Variance of Results

($ millions)	Base Case			Withdrawal Sensitivity		
PV of MV of Ending Surplus	1989	1992	1995	1989	1992	1995
Maximum	427	625	684	350	536	630
Median	293	474	525	231	388	479
Minimum	(129)	(130)	(37)	(129)	(110)	(6)
Average	276	453	511	217	368	467
Std Deviation	83	104	87	72	87	78

So you can see that this block of business—in ’89, for example, at the best performing scenario—had a present value-ending surplus of $427 million. In ’92 the surplus jumped to $625 million, because, again, the company wasn’t realizing the increased lapsation.

When I went to reproduce the ’92 projection, I actually started in ’89. The first three years of scenarios were the same because they were the realized scenarios that actually occurred in those three years. Then lapses actually were factored up to experience. Then everything was dropped back down and turned into the projection for assumptions going forward.

In ’95 there wasn’t such an increase, because after finally reflecting the permanent withdrawal increase, future expectations then matched actual experience. We did not receive the increase in value that we did from ’89 to ’92.

Now this is the base case scenario, which just included expected assumptions going forward. Then we introduced a withdrawal sensitivity (Table 3). For this block of business, for ’89 to ’92, this meant 150% of the expected assumption. For ’95, because of the realized increase in expected withdrawals, the company decided to use withdrawal sensitivity of 125% going forward.

It's interesting how the withdrawal sensitivities actually squeeze the results closer to the median. It's bringing the maximums down; it's bringing the minimums up. I believe that's because the worst scenarios are being hit. They're losing the business faster. So then they're not having as many losses because the business is going away faster. Subsequently, on the high side, when you're making a lot of money, the business is going faster, and then it's compressing results again.

Plotting the present value (PV) of ending surplus over the 1,000 scenarios produces an S-curve (Chart 2). The thicker line is the base assumption and the thinner line is the withdrawal sensitivity. These are percentile ranked or order ranked on PV surplus. The worst scenarios show the base and withrawal sensitivity runs on top of each other. This is because there is a maximum withdrawal assumption of 50% in each year. Realistically, do you expect 100% of a retail business to leave in one year? The answer is no.

Interestingly, partial withdrawals were also modeled stochastically, as were excess baseline withdrawals. So the level of free partial withdrawals—the utilization—was increasing when it was advantageous. So I assumed a fairly sophisticated client base or policyholder base.

Risk-based Capital

Moving on to risk-based capital versus the conditional tail expectation: just reproduce C1 and C4 (Table 4).

Table 4

RBC vs CTE

	1989	1992	1995
Risk Based Capital			
C1	12,355	19,291	28,148
C2	0	0	0
C3	30,566	48,041	69,396
C4	7,875	11,000	14,000
RBC	50,797	78,332	111,543
200% RBC	101,593	156,664	223,087
RBC Ratio	182%	157%	203%

C1 is just taken from the risk-based capital (RBC) requirements; C4 and C3 are as well. In producing these RBC requirements, assuming the company would manage itself at 200% RBC, I just developed these RBC ratios, not as a function of 200% RBC, but of the base case.

Now going to a conditional tail expectation approach, we find the 90th percentile. Taking the average of the lowest 10 percentile results, we define the amount of assets needed for C3 risk (Table 5).

Table 5

RBC vs CTE

Cumulative Tail Expectation (Tail defined as 90th percentile)			
	1989	**1992**	**1995**
CTE	**1,427**	**-79,855**	**-88,916**
Withdrawal Sensitivity	**33,531**	**-40,098**	**-64,397**
Mortality Sensitivity	**35,208**	**-38,188**	**-61,330**
Expense Sensitivity	**35,912**	**-37,440**	**-60,128**
Plus: C1 & C4	20,230	30,291	42,148
Total Capital	**56,142**	**-7,149**	**-17,980**

This is saying that we need an additional $1.5 million in assets at the start of the projection over and above the reserve amount to get a slight positive surplus number at the end. At the end of the day, we might normally think of reserves being at the 80th percentile or something like that in the distribution of results. But when you're using a formula reserve methodology such as the commissioner's annuity reserve valuation method (CARVM), the base case statutory reserve is actually quite sufficient to support the block.

As you'll see, not much capital is required. Again, this is a made-up example. I didn't work the numbers to get to these results. Because of the sheer number of scenarios that are needed, it would just be way too much work to try to get something to make everyone happy.

So then we add in the withdrawal sensitivity. What does the withdrawal sensitivity do to the amount of capital I need? Here I need another $33 million. These aren't incremental; these are the new capital requirements.

Now I need $33 million at the start of the projection. You can still see the '92 and '95 scenarios; as the business is growing and the embedded value of it is increasing with discounting at the portfolio rate, the actual reserves are more than sufficient to support the business.

Then we move along to a mortality sensitivity where we increase mortality by 10%. Obviously this is much more relevant for other products, such as term or universal life (UL), UL being the one that Doug Eckley worked on.

The expense sensitivity is not incredibly sensitive. Looking back I probably could have done a more sophisticated job at modeling expenses. I think we could have all done a more coordinated effort, in terms of having a base-case kind of overhead cost. But these are all unit expenses. We assume that the overhead expenses were modeled from a surplus portfolio that none of us relied on.

Then I'd go ahead and add in the C1 and C4 from RBC, and this is the total capital that's required. So under the base case '89 scenario, this tells me that I only need $56 million over and above statutory reserves and that '92 and '95 base-case statutory reserves are sufficient, and no capital is needed.

What if we were to use an economic approach? I am Canadian, so I have a bit of a Canadian mentality when it comes to setting reserves. You'll see this provision for adverse deviation approach.

I thought, "What if I define my best estimate reserve to be the 50th percentile of the distribution of results?" Then I wanted to go ahead and say, "Define my provision for adverse deviations (PADS) to be the 80th percentile." (Table 6)

Table 6

RBC vs CTE

Alternative Definition of Capital			
Naive Alternative Defined as Best Estimate Gross Premium Reserve (50th Percentile) + Provision for Adverse Deviation ("PADs") (80th Percentile)			
	1989	**1992**	**1995**
C1	12,355	19,291	28,148
C2 & C3	129,606	157,095	111,363
C4	7,875	11,000	14,000
Total Capital	**149,836**	**187,386**	**153,511**
Statutory Reserve	2,037,755	3,202,744	4,626,370
Best Estimate Reserve	1,823,159	2,880,861	4,343,918
Best Estimate + PADs	1,886,719	2,958,995	4,414,722

Then I would go ahead and define my capital base as the amount of assets necessary to get me from the 80th percentile to the 95th percentile. In doing so, I take the C1 and C4 from RBC again, only because those items were not modeled stochastically. So I have to assume that the RBC is right in this case.

Then, C2 being zero—or depending on what you define to be C2—if you call it pricing risk, legitimately you can consider withdrawal sensitivity, mortality sensitivity, and expense sensitivity as part of C2.

Then you have the C3 risk. Basically the 80th percentile was chosen as the amount of assets needed at the start of the projection to support the business. Then I get a zero surplus at the end of the projection. I should have included this on the slide, but the total assets—if you add the total capital number to the best estimate, plus PADs—are $2.36 billion under '89. Under '92, it is $3.146 billion, and in '95, the total is $4.568 billion.

Basically, what this is saying is that the C3 part, which is actually a plug to the C2 and C3 lines, is a plug when I add in the mortality, withdrawal, and expense sensitivity. It also acts as a plug number to get me to the 95th percentile of the base case results—that defines what the 95th percentile is for capital.

So with that said, I'm going to go quickly back to variance of results (Table 3), because there's a couple of other things that I want to mention. When I started this presentation, the question was, "What do we want to get out of this?" Well, is this going to be a new reserve methodology? I don't know the answer to that. Is it going to be a new capital methodology? I don't know.

I've heard some people joke before (and I don't know how serious they are) about modeling and they criticized, to some extent, the whole modeling process. Because there's so much uncertainty, there are many assumptions you have to make.

I say, "If you can't do a reasonable job of modeling it accurately, first of all, if it's a liability, how do you know that you sold it at the right price?" If you bought an asset, how do you know you got a fair price for it when you bought it?

I remember in a previous life, I was doing performance measurement and working in asset/liability management (ALM). If you can't model it, then you shouldn't have sold it, or you shouldn't have bought it. I'm exaggerating there slightly, but try to keep that in mind.

So in terms of looking at the S-curve you can ask yourself the question, "Am I taking enough risk?" Are you effectively employing the capital that you are being told you need to have behind this business? If not, then you either should wrap things up or take on additional risk. If only 10% of your capital is truly at risk because your business is obviously different from the generic approaches used to develop the reserves and capital requirements, then you should ask yourself,

"Should I take some more risk that would not be captured in the capital formulas?"

So what did we learn? You might laugh at this first one, but the process is manageable, I think, with changes to some of the standard software systems out there. They're obviously not expecting you to produce 1,000 scenarios over and over again.

If you can extract the output from the software easily, you can end up with what we had to convert it to—one database each for the '89, '92, and '95 runs, with all the numbers and the relevant variables throughout.

So I think, with some slight modifications, the process is manageable. It will take some run time, it will take some sophisticated modeling, and it will definitely take some streamlined models. You'll have to calibrate, in my view, a streamlined, high-octane model that closely resembles the behavior of your overall business. So you might do 50 scenarios or something, or a 100 scenarios and try to calibrate to your fast-and-dirty model versus the full-blown, embedded-value model that you might have on your business.

The other risk elements that cause significant volatility should be monitored stochastically. This is just so you can consider sensitivities on pricing variables to be part of C2 or perhaps—as it is in the current framework—largely captured in C4.

I think formula reserves are just as they sound. Obviously, they're not a perfect provision for future obligations, because CARVM for one company's product could translate to the 40th percentile and to the 95th percentile for a second company's product. I think the changes made recently in the C3 calculation, with the stochastic work being done there for RBC, is just fantastic, and I applaud everyone who was involved. I think it's definitely a step in the right direction.

Suggested Improvements

Here are some suggested improvements. In terms of making the modeling more realistic, I should have started with a higher withdrawal assumption in the first place because the deferred annuity liabilities are fairly long in my model.

We'd like to make the default assumptions stochastic, as well, and I think we've talked about an approach in which we would have 1,000 scenarios. But each of those 1,000 will have a basket of variables—stochastic variables. So you'd have 1,000 stochastically generated variables of default and interest rates and maybe withdrawals.

The defaults and the withdrawals, or mortality, could be just a factor, for example, on an underlying base case assumption. Then you can just pool those together in one stochastic set. You should be able to get a pretty good picture and still keep it to only 1,000 scenarios.

Fair Value and GAAP

Now to just talk a little bit about fair value (Table 7). This whole methodology in the process is a platform to do a number of things. If you have a well-built model, you can use it for so many different purposes.

Unfortunately, someone said, "Hey, lets see what this would look like in a fair value context." So here is the result. To be able to start from a relative position, we had to move to a GAAP basis. So we have some adjustments to move from a statutory balance sheet and income statement to a GAAP-based arrangement.

Table 7

GAAP vs Fair Value

	1989	1992	1995
Statutory Surplus	**92,473**	**123,271**	**226,706**
GAAP/STAT Adjustments			
GAAP DAC	200,000	291,732	321,676
Reserve Adjustment	(73,369)	(118,900)	(158,734)
Deferred Tax	(44,321)	(52,620)	(41,702)
GAAP Surplus	**174,783**	**243,483**	**347,946**
		1990-92	1993-95
Statutory Income		**30,798**	**103,434**
GAAP/STAT Adjustments			
GAAP DAC		91,732	29,944
Reserve Adjustment		(45,531)	(39,833)
Tax Adjustment		(8,300)	10,918
GAAP Income		**68,700**	**104,463**

On the balance sheet itself, the assets that you'd expect to stay the same are doing so. Under fair value context, the market value is the market value, and it's supposed to be easy to get market values for all your assets (Table 8).

Table 8

GAAP vs Fair Value

FAIR VALUE BALANCE SHEET	1989	1992	1995		1989	1992	1995
	Realistic - No Margin				Risk Neutral - No Margin		
Invested Assets	2,029,219	3,544,957	5,008,371		2,029,219	3,544,957	5,008,371
Liabilities	2,366,624	3,898,292	5,306,493		1,950,440	3,239,874	4,717,815
Deferred Tax Liability	-150,457	-166,715	-183,227		-4,793	63,731	22,811
Equity	**-186,947**	**-186,620**	**-114,895**		**83,572**	**241,352**	**267,746**
	Risk Neutral + Spread - No Margin				Risk Neutral + Spread + Margin		
Invested Assets	2,029,219	3,544,957	5,008,371		2,029,219	3,544,957	5,008,371
Liabilities	1,842,916	3,058,194	4,567,617		1,889,641	3,135,463	4,605,683
Deferred Tax Liability	32,841	127,319	75,380		16,487	100,275	62,057
Equity	**153,463**	**359,444**	**365,374**		**123,091**	**309,219**	**340,631**

Let's assume it is easy. But then, of course, what's the discount rate to use on the liability side? We tried some different approaches. The previous projections I was showing you on the risk management side used a realistic assumption for the generation of the interest rate scenarios. Then we move into a risk-neutral approach with no margin, and then we have the risk-neutral with a spread, which really just means spread relevant to corporate—a curve or something like that.

Then, you add an additional margin if you want to have a margin in calculating the PVs that would increase the size of the liability. The interesting numbers would be on the income statement, because it is the change in value that is relevant from period to period.

The balance sheet values will continue to be the primary focus for debate. For example, in the risk-neutral category with no margin, the invested asset fair value has increased by $319 million. That tells us that interest rates have dropped for where the assets are on the curve. The liabilities went up (it's a negative number) for the income statement by $170 million, so again interest rates have dropped where the liabilities are on the curve. Both values of the asset and liability going up are somewhat offsetting but producing a significant gain.

Now under the ’93 to ’95 approach, you can see that the assets went down, meaning that interest rates went up for the assets. But for the liability, somehow the value of the liabilities went up again. This means there must be a drop in interest rates for the liabilities.

The assets are basically around the five-year point. You see when you go from the heavy line in ’89 to the longer dash line of ’92, there is a drop in rates—a significant drop (Chart 3). But then going from ’92 to ’95, the interest rates went up. So that’s how the assets increase in the first period and then drop in the second period.

Then moving to the liabilities, they’re actually—believe it or not—around an eight-, nine-, ten-year point, just because of how long they were in the projection. So you can see the interest rates dropped, but by a smaller amount than they did for the assets correspondingly. That’s why there was such a massive gain in ’89 to ’92. Going from ’92 to ’95, they dropped again. That’s why they were moving in the opposite direction in that second period of ’92 to ’95.

One observation that we have on fair value is that the scenarios must be risk-neutral. The realistic numbers, if you look back at them, were giving wild results. So in terms of actually trying to determine value, they needed to be risk-neutral.

The asset-liability mismatch is reflected in the balance sheet and the income statement. So everything is transparent. It’s right there for everyone to see, so it is a nice business management tool.

I’m not going to sit here and be a huge proponent of fair value here today; that’s obviously a discussion that has consumed years of time. But it is nice to be able to see it. It does capitalize the impact of the assumption changes quite well.

More accurately, it reflects the strength of the insurance company. So as soon as we had to realize and change our withdrawal assumption in ’95, the change of that is capitalized today. The health of the insurance company is reflected. You could argue that in ’92, it wasn’t reflective. But it certainly wouldn’t be reflected under a formulaic reserve and capital approach either.

MR. MARK TENNEY: I’ll try to keep my remarks reasonably brief, and then we’ll have time for Doug and for some questions.

As Doug was discussing all the possible meanings of the unified valuation system, I was thinking about an additional list of meanings for U, some of which are positive and some negative. Some of these different meanings of U: untitled, uniform, unified, universal, united, union, unique, undivided, under, unfair, unexamined, unexpected, unsolicited, unwanted, unlikely, and unending.

As we look at this list of variables in the next couple of pages, you see that we have variables that can extend beyond just insurance companies. The assets are true of banks or other financial institutions.

One of our goals, or one of the Society's stated goals, is to try to become more of a big tent and to look outward to the other professions. Also, we're in a situation where we're seeing the convergence of banking and insurance and possibly brokerage and so forth. So if we want a system for analyzing risk, we'd like a system that extends beyond just insurance that can be used uniformly or universally across different financial institutions and for united financial institutions such as a Citigroup or others of the like.

If we look at the C3 formula for life, which represents our current approach to risk in the U.S. (risk-based capital for life), we have a similar formula for property and casualty (P&C). We notice these two formulas are very close, but nonetheless, they're different, and therefore our current approach to risk is not unique. Presumably, if there is one right answer, it is a unique answer.

Simulation work does have the advantage that it can be used across all different financial institutions; it could even be used for corporations. There are folks out there, possibly some in the audience or those who come to some of these meetings, who apply these methods to general corporate risk type analysis.

So if we want to come up with a risk formula that can apply across banking, insurance, and other financial services—and perhaps even other corporations—we need something that looks at the fundamentals. Hopefully we can get to something that uniquely looks at the risk as opposed to somewhat made up formulas.

Life Insurance Variables

We have this list of variables as we go starting with life, and then P&C, disability insurance, and health. Then if we were looking at banks or some other financial institutions, these variables or ones synonymous to them would suffice.

Now if we look back at the risk-based capital formulas, we see that they have a certain sense to them (Formula 1). For example, insurance risk C2 is unrelated to the C3 or C3A risk, which is a reasonably good assumption. That mortality, for example, is unrelated to interest rates.

Formula 1

Asset Risk - Affiliated Amounts (C-0)

Asset Risk - All Other (C-1)

Insurance Risk (C-2)

Interest Rate Risk (C-3a)

Health Credit Risk (C-3b)

Business Risk (C-4)

Total Risk Based Capital After Covariance [*]

$$C\text{-}0 + C\text{-}4a + \text{Square Root of}\left[(C\text{-}1 + C\text{-}3a)^2 + (C\text{-}2)^2 + (C\text{-}3b)^2 + (C\text{-}4b)^2\right]$$

Effectively this formula assumes that insurance risk is uncorrelated to the asset risks both which are uncorrelated to the business risks.

[*] The symbols and the typesetting of this formula are exactly as they appear in the NAIC LifeRBC Forecasting book.

But nonetheless, this formula represents the adding together of risks. Suppose, though, that there is a problem with mortality in year one of looking into the future. That's going to affect the magnitude of the interest rate risk.

If we're measuring interest rate risk as even standard deviation of some sort of measure, then the fact that we lost money in year one for mortality means we're going to have a different number for the standard deviation of interest rate. This is because the total scale we're applying later in the simulation has changed as a consequence of the C2 event. All of these numbers interact, and they interact through time, as well.

Perhaps looking back at these formulas raises the question, "Are we under valuing now, or are we over valuing now?" We really can't tell from this formula. It doesn't answer that question. It does allow us to calculate a number, it can appear on the annual statement, it has a square root and some squares in there. It vaguely looks like the covariance formula between some uncorrelated assets and correlated assets that we might see in our statistic book.

But if we evaluate that formula, what does it really tell us? How do we use this number? How does this tell a regulator or a rating agency or a customer very much about the company? Well, it's very unintuitive.

Now, with a great number of years of experience, we built up some understanding of this formula and how it works out in practice, which gives us some benefit in

using it. But nonetheless, it doesn't really relate specifically to the answer to any question the way the probability of default or the expected policyholder devastate or conditional tail expectation does.

Developing a Stochastic Model

So for dynamic financial analysis, we need to construct a stochastic model of the company, a line of business, or other subunit to simulate the financial, economic, and insurance variables—relevant company variables.

Then, within the simulation, we have things going on, just like in a real company: we make and collect payments, customers exercise their options, events happen, and the company exercises its options (or control features)—including investment strategy and amount credited.

As we look at this, and we think about actually applying this to a company, it's a rather difficult exercise. We had the advantage for our group of making up our data, so we didn't have to go to the systems people and ask them to produce that. That undoubtedly would have taken much longer for our project.

But also, if this was to be applied in a company, the criticism is that it would be an unending task to put this together to do this work. However, with computer systems being what they are, there's going to be a setup cost, an initial cost, and a period where it's phased in. Once that's done, moving forward on an ongoing basis will be possible with some reasonable efficiency.

This also gets to one of the meanings of unfair. It is an unfair burden to ask companies to do all this work. One might think so given the cost and expense, but if you're looking at it from the point of view of a regulator, a rating agency, or a customer, a customer expects to get a certain bundle of benefits by buying insurance. One of these is that the company will be solvent.

From their point of view, it's unfair to sell insurance if you haven't determined the risk and haven't managed your company so that the risks are handled. We often talk about customers having reasonable expectations, not being informed, or having certain ideas in their mind. Customers definitely believe that actuaries are looking at the risks of the company and have those in control. They don't know whether we're using percentiles, conditional tail expectation, or a square root formula, but they believe that there are folks in place who know what they're doing, who are managing the risk properly, and who are being supervised.

The Question of Fair Risk

That, in fact, is the benefit that customers believe that are buying. Ultimately the question of fair risk comes down to the customer.

This task force has been trying to work on examining this. We've done quite a bit of work and have gotten some very good results. But also, there's been quite a bit of

work done here in Canada, as well, which we've had a chance to hear over the last couple of days.

This also gets us to another one of the U's—unlikely. One might say it was unlikely, but we've actually seen it happen last year in Canada, and so we see that it is, in fact, likely here. A step also has been made here to apply it. You will very shortly be allowed to use this methodology to set your reserve for any product that you wish in Canada, which is a big step forward. Perhaps this is a way for us to evolve the U.S., as well.

Unending? Well, it did end here, and we got to some results. So I think we can handle those U's, as well—unexpected, unsolicited, unwanted.

The customers do expect it. They believe that they're being solicited to buy insurance on the basis that it's already been done and done properly. Unwanted? The customers definitely want it. Okay, so back to some of the nuts and bolts of my talk. Let me just mention a couple of points of overall clarity.

Starting Assets and Failure

We're finding the amount of starting assets, such that you're going to be solvent some percentage of the time—like 95 percent. We vary that starting amount of assets until we get to that result.

Failure could be defined in terms of an ending date or an intermediate date. If it is defined over intermediate dates, you need to define a measure of failure for those dates. Conventional or existing reserve formulas can be used for that. But if we replace those, we need some definition of what it means to fail.

Double Mean Reverting Process™

Let me talk now about the simulation. The Double Mean Reverting Process™ was used for the interest rates (Formula 2). This is an arbitrage-free model, but in the way that classical academics like Black-Scholes might think of it, as well as in the ability to calibrate to an initial yield curve.

Formula 2

r = instantaneous force of interest

$$u = \ln(r)$$

$$du = k_1(q - u)dt + s\,dz_1$$

$$dq = k_2(q_2 - q)dt + s_2 dz_2$$

The model works by taking the logarithm of the instantaneous rate, which is r. We then assume this follows this first equation, which basically tells us that it's mean-reverting and that the target rate itself is mean-reverting. For those who have been

following the work of the CIA task force and SEC funds and Mary Hardy, you'll see there's a certain similarity to the regime-switching model being used for volatility that works.

We can add additional variables like inflation. A simple model like we used in this group was to simply take, I think, a spread below the three-month treasury. So it was negative.

One can have a more complex inflation model—for example, increasing with the levels of the three-month yield and also increasing with the inversion of the yield curve, plus some sort of residual.

As we look at broader issues than just life, we have to look at more types of inflation, and even within life expense inflation.

We also modeled unemployment, which relates to disability as well as possibly some other things (Formula 3).

Formula 3

Unemployment Modeling

Unemployment Rate: U_t

$$v_t = \ln(U_t)$$

$$dv_t = k_v(q_v - v_t)dt + s_v dz_v$$

Stock returns were modeled using a lognormal process and then a dividend yield, where the dividend yield is mean-reverting (Formula 4). One thing that we should bear in mind is that as we did these studies, we looked a lot at volatility, and the Canadians have looked a lot at volatility. But the mean of the stock return is a big issue.

Formula 4

Stock Return Model

S_t stock index value

D_t is the dividend yield

$$s_t = \ln S_t$$

$$x_t = \ln D_t$$

$$ds = m_s dt + s_s dz_s$$

$$dx = k_x(q_x - x)dt + s_x dz_x$$

There was a paper by Arnott and Ryan in the Spring 2001 issue, of the *Journal Portfolio Management* Volume 27, Number 3. Their comment was that asset returns

over the next 10 or 15 years are not going to be as good as they were over the last 10 or 15 years. We've had returns of 8, 9, 10, and 12%, however you wish to measure it. If you project those growth rates indefinitely, you very quickly reach a point where the financial sector exceeds the real economy.

The real economy is growing only at about 2% or something like that. So it's hard to see how you can perpetually have 8% asset growth. This implies, then, that if you knocked that down to, say, 4%, 5%, or 6%, then looked over a 10-year period; your tail could be lower from such an adjustment than from simply looking back over the past 50 years and asking what was the worst volatility base sort of drop. This is because the past 50 years builds in a higher mean.

If that variable is changed, that can then fundamentally shift the distribution adversely. So much of what we do depends on favorable asset returns that we have to be very careful about that number in particular, not only for stocks but also for interest rates.

Mortality Issues

Mortality probably is unrelated to interest rates or other economic variables but possibly has some relation. And one could imagine how they might become correlated in some unique events in the future.

There is a need for more empirical work as to the relationship of all these different variables that we had earlier in the presentation. The more anyone can do to contribute to that will greatly push forward the profession.

Convergence

I'm going to speak about convergence problems a little bit.

As we look at the tails of the distribution, how many scenarios do we need to get an accurate answer? Well, you need more. The farther out you look in the tail, the more you need, which follows simple math.

If you want to look at the 98th percentile and you have 100 scenarios; that's two scenarios, which isn't a whole lot to get the convergence. If you want to look at the 99^{th} percentile, that's one scenario in 100. So if you want to look at those percentiles, you really have to start talking about 1,000, 5,000, 10,000, and maybe even more; depending on the product, the investment strategy, the crediting strategy and, the customers' behavior

Now in our approach, the number of scenarios we use typically has been governed by computation time in the past, just as a practical matter. Now computers are becoming more powerful—maybe we're getting clever at programming, or maybe we're becoming sloppier.

But we do need to solve the convergence problem. We do need to know if these are the numbers we produce and provide in the annual report. They have to be accurate. It can't be that we pick another 500 or 1,000 scenarios, and we get a different annual report or a different regulator's report. That's simply not going to work.

To answer the question of convergence means that you to have to run out to mind-boggling numbers of scenarios to a point where you know the answer is correct. Then look at how you've done in smaller sets. You can't just look at 1,000 and a second 1,000 and find they're the same and say, "OK, we've converged," because it quite often happens you have not.

Monte Carlo

One method of improving convergence is having low discrepancy sequences—also known as quasi-random Monte Carlo. A great deal of research has been done on this at Columbia University and at University of Waterloo.

It is based on a mathematical theory. There is a convergence theorem. You can't prove when you converge, but you can prove that there is a convergence in an asymptotic relationship. As we move to adopting these sorts of methodologies or have adopted them, there are a number of plausible methodologies that suggest themselves which don't have a mathematical base.

We have to be very careful about adopting those methodologies in which there is not, in fact, a theorem and proof structure from formal mathematics that underlines those approaches. Low discovery sequences do have such a theorem and proof basis.

So if we look at an example—this is a single-premium deferred annuity (SPDA) problem—it has a seven-year guarantee of 4% return per year. Then at the end, we have four to the seventh power as the obligation, and we invest the assets in this in a very unrealistic way (to illustrate the point) in five-year or coupon bonds and roll them over each quarter.

So then if we contribute 0% capital by the company, this is the bankruptcy frequency, at the end of that seven years, from the Monte Carlo, it takes about 2,500 scenarios to converge in this case. With low discrepancy, you can argue around 250. Of course, it depends a great deal on what sort of validity you want. Now if we look at the very low capital, we have essentially about one-half, roughly 0.4%. So in other words, out of 1,000 scenarios, you'd have 40. So if you have 100, that's less than 1%. So when you're down to a hundred, you have a real problem getting less then one scenario. LDS manages to get to something reasonable around 500, with Monte Carlo sort of zigzagging around. Again, in order to get conclusions about convergence, 10,000 is quite a few; but to really get these questions locked down, we need to do 10,000, 50,000, 100,000 using Monte Carlo,

LDS, and various other methodologies.

In terms of the absolute number without low discrepancy, below 1,000 is indicated as not being sufficient. In some of the other cases, you might want more then 1,000, depending on your accuracy. A thousand does seem to do reasonably well.

As we carry this over from SEC funds or variable annuities—which are easier to run 1,000—life policies, we're going to have the same problem in that we're going to need numbers in the thousands range. So that's something for us to think about.

Why UVS?
Why UVS? Doesn't current statutory reserving work?

I think we approached that. You get certain numbers, but they're hard to interpret. We really need to say, "What are the questions?"

It's our job to ask that and then define the answers. The questions are things like "What's the probability of default? How bad would the default be if it happened?"

Back to the U's
So let me just go back then to that list of U's and see how we've done.

Untitled: Well, we are trying to get an idea of exactly what we're doing, but I think we're close.

Uniform, unified, universal, united— all those issues are of a broad methodology that can apply to all insurance products beyond just life, as well as other financial services.

Trying to come to a unique answer, we've seen another meaning of unique, in terms of convergent results. But we definitely have a unique answer as to once we know the right question, then we can construct the machinery to answer that question. That question seems to be, "What's the probability of default?" or "How severe could the default be?"

Then, whether that's unfair, I think we've answered that it is fair to the ultimate beneficiaries—the policyholders. Whether we're over or under valuing now depends on the product line, the company, and many other variables.

As for the issue of comparability across companies, we also get a little illustration from the square root formulas. I mean, do two companies that have the same square root number have the same risk? The answer is no.

So we might have a rigid formula basis that allows us to compute answers, but the fact that those two numbers come out to be the same number doesn't mean that it

relates to the same financial reality. This means that it's not a proper indicator variable. So again, it's not answering the question.

Therefore, the fact that because you get the same number from two different companies the formula is mechanically applied in the same way doesn't mean the companies have the same financial situation. This actually is a major criticism of the current methodology.

Unexpected, unsolicited, unwanted—I think the profession has been building to this for many years out of a realization of this consideration and other similar ones.

Unlikely. In fact, I think it's becoming quite likely now because we realize that we have to answer to a broader audience. We now talk to the Federal Reserve in the U.S. OSFI in Canada is a much more united organization in terms of financial services. We do need to be able to explain what we do to other professions and other groups we're responsible for. If our answer is, "We have this square root formula" or "We have this made up reserve formula," that's not going to be very meaningful or convincing.

Finally, that brings us to unending. There are still some serious issues to be resolved. But I think we are getting closer to doing that. The work in Canada shows in fact, it has ended and come to a working methodology for some of these products.

MR. ECKLEY: To wrap it up, I thought I would spend a few minutes talking about where we've been and were we might go with UVS. I guess you have to ask, "What's wrong with what we've got? What's wrong with current reserving?"

Though perhaps we're being somewhat evil, let's consider the General American problems in 1999. What you had there was a ratings downgrade that triggered a run on the bank by these mutual fund money managers. The thing that UVS would miss, I believe, is the human element there. It's very hard to model human behavior and that would include things like policyholder lapsation.

I don't know that we can realistically expect to get very far along those lines. I think UVS might have helped a little bit by shedding some light on the fact that there was risk present in the first place, and that things like rating downgrades might not be out of the question. Another thing I think UVS type approaches can do is to add more information to appraisal values.

Another problem that sort of caught my attention can be framed like this: Consider 1,000 universal life policies, and let's make them Type A. To make things simple, the cost of insurance is deducted in arrears.

Consider two groups of policyholders—one that keeps a very large fund, or account value, and the other group that keeps a very small account value. The small-

account-value group's statutory reserves and GAAP reserves are going to be pretty close to zero. For the other group, obviously reserves will be much higher, because the account value drives the reserving.

Which group do you think is going to be healthier, based just on their behavior? It seems to me that people who expect to live a long time will be more investment-oriented, and will be the people with the larger account values. My point is I think you will see a dichotomy there, and the reserves are not really reflecting the risk. So there is something that's being missed here.

UVS might be able to lessen the controversy around asset valuation, because to me the question that's being asked is, "How much of the asset portfolio is needed to support the liabilities?"

Consider two identical companies—except one holds assets at book and the other holds assets at market. One interpretation of UVS is that you run through your scenarios, you come up with a point on the S-curve that you like, and then you can answer the question by saying, "We need this percentage of the assets. It doesn't really matter whether we value them at book or at market; here are the assets we need to have a 50% or 95% chance of funding liabilities."

UVS can provide new information, and by that I mean it's more then one number. If you look at the things we have now, risk-based capital comes up with one number. A statutory reserve is one number, and even an appraisal value is just one number.

With UVS you try to add a dimension and see what confidence you have if you were to change this one number. I'm visualizing the S-curve as I say that. Here is a futuristic balance sheet once UVS is implemented. And you might argue that it won't ever be implemented—if you're a cynic. But it could look quite a bit different.

Here's one idea—a listing of the assets with their values in some sense (I don't want to get into the debate of whether that should be book value or market value). But then corresponding to those, you can supply a cumulative S-curve reading. For example, if you take just the first asset of 100,000, then 15% of the time, that will support the liabilities of the company. Then when you add in the second asset, you get up to 36%. This is really just an S-curve in table form. Finally there's going to be a small percentage of ruin out at the tail. Here that chance of ruin is 3%.

So now, a progress update. We've done a lot of illustrative modeling. We've investigated some techniques; obviously we've made a lot of use of the S-curve, risk neutral scenarios, and one-standard-deviation-off assumption setting. That last one is my terminology, and was an attempt we made to get at this thing that I call assumption risk.

Consider a starting point of a set of withdrawal rates. That allows us to define certain scenarios. You can flip a coin for each policyholder and, based on the

assumed lapse rate, decide whether in this scenario that person lapses or continues. But that lapse assumption could have been wrong. That's a very difficult problem to get at.

Now we're in a communication phase that includes the Chicago presentation last fall. The Bowles Symposium earlier this year did a lot of UVS communication and there have been some articles in various journals.

But what's yet to come? Well, to echo what Mark was saying we need some techniques to reduce the crunch time. It really was a burden for us on the committee. Eventually we might get to some sort of unification of statutory reserving, GAAP reserving, risk-based capital, etc. If you're a believer in UVS, that's what you hope for. Perhaps there will be interest in researching assumption risk.

I believe we could generate a debate over the importance of using free cash flow and doing appraisal values. With your indulgence, I'll talk about that and then we'll be just about done with this part of the presentation.

Let's say that A holds higher statutory reserves then B. Currently appraisal practice is going to give B a higher appraisal value because of the risk discount rates that are used.

The discount rates are higher then the earned rates, and so the more statutory reserves you have, the later you get your cash and so on. But UVS would say that there's no difference in the percentage of assets required to support the liabilities at the same confidence level. That brings up the question of whether free cash flow is the right approach.

I floated that idea about 10 years ago. Everyone in the room may disagree with me, but one point to make here is that the Standard & Poor's (S&P) 500dividend yield is only about 1.3%. Somebody out there believes that sucking the cash out of the acquired target is not the way to go, they believe that leaving the cash in the business makes some sense and can provide a higher return.

If you do appraisals based on getting cash out as quickly as you can, I think you may be missing the point. To some extent, if we had fully efficient and evolved markets, we could replace UVS with a market price number. That's a theoretical discussion that I'm not sure we want to get into. You would observe a price, but would still need analysis to estimate the distribution of the price over future periods.

MR. ALAN BRENDER: I'm from OSFI. I have a couple of remarks.

One is, you talk about withdrawals and sensitivity of withdrawals, and we know very little about withdrawals. Withdrawals have been used in Canadian valuation for

quite a few years now, and I think we've learned that we're sensitive to withdrawals in ways we never understood.

We probably don't really understand how to get the assumption right in the first place. You have variation by company, by distribution method, by the kind of products, from company to company, and obviously there's an effect of the economy and so on.

One suggestion that might be promising is a brand new field called behavioral finance. Finally the finance people or some small number of them are beginning to combine finance with psychology in trying to figure out what people really do. Perhaps we will learn something that might let us improve models and dependencies of things within models. So that's one item I wanted to mention.

The second item is about UVS and fair value. If we can get the accountants away from this idea that liabilities and assets aren't linked, then effectively the whole idea of this approach is that the value of a liability is nothing more then whatever the carrying value is of the assets that back that liability. If you want to call it market value—if you want to use market value of assets—you get market value of liabilities. Bingo!

Forget about all kinds of contorted ways of defining market value of liabilities. We have to get them away from the notion that there's no link. Now the fact that there's no link seems to be, in accounting terminology, axiom No. 1. I think the thing that they don't realize—and the argument that you can make—is that every time there's a transaction involving a sale of an insurance business, or a block of business, a good part of the discussion is about what assets we are getting to go with it.

You never almost never have a sale of a block of business for cash. There's usually a well-invested block of assets sitting there, and people want that. Very often the purchaser comes in and cherry-picks the assets that they want to get a reasonable match on in the first place.

So argue on a market value transaction kind of basis, the market determines the value of the liability. The market determines the value of the package and the assets are definitely linked. So I think that the financial people, the accountants, have it all wrong, okay. That's item number two.

Item number three is that with this convergence, it's occurred to me that we're trying to get is a cumulative distribution. So maybe what we should be doing is what the casualty people do, which is fitting a distribution to simulated results.

There's a whole notion of loss distributions that is a well-developed theory and is part of the Canadian actuarial syllabus. So the idea is that you assimilate, I don't

know, maybe 1,000 scenarios, maybe using well discrepancy sequences, and then try and fit some well-known family of curves to the thing and see what you get.

Maybe if we try and see what happens as we fit the curves to more and more results of increasing number of scenarios, we can find out that there's some kind of stability to get reasonable fits. Then you don't have to go out to 10,000 scenarios. But I think there is promise here, especially in modeling the tail as something is known and understandable.

MR. GRONDIN: I'll just mention something on policyholder behavior, and I think that adds a good comment.

In terms of how we model lapses and excess partial withdrawals from a base line assumption, these are what I call the policyholder behavior assumptions. So from that standpoint, at least actuaries for quite some time (ever since I've been involved in modeling) have been trying to model the behavior of policyholders and take into account the varying levels of sophistication. And hopefully, with enough business to model, the law of large numbers work with you, and you'll be able to get fairly accurate results.

But still the methodology is being refined all the time, and certainly many companies have been—and are still—waking up to surprises today. They're just not realizing just how quickly their business could leave them and move to a competitor product within their own company, or just to another company altogether.

MR. TENNEY: I guess one or two thoughts occur to me. I agree that fair value of liabilities is a very difficult topic. I mean, how exactly you go about doing it is something I don't think we've really answered yet. So I agree with you there.

I do agree it is linked to the assets. So I think one of the interesting challenges for our profession is to answer that question of how you go about getting a value to the liabilities. It's sort of like if we drew up a list of 10 problems for actuarial science or finance—I think you've mentioned at least two or three in that list. One is liability; one is behavioral finance or how people really behave; and convergence, or how we understand better these probability distributions.

MR. ECKLEY: I appreciate the comment about accounting and not linking the assets and liability. I wouldn't want to say that it is only the accountants who are that way. But even if we never adopt UVS in any formal sense for reserving, if we open up some questions and some new thinking, then I think we've won a pretty good part of the battle.

MR. JACK TAYLOR: I'm with Prudential Operations in the Philippines. When I hear us going downstream to 5% likelihood of ruin and statements like that, then I wonder: What was the percentage of companies that went bankrupt under the current procedure? It seems to me it's less then that.

So I see two things here—one, an excellent tool that we're trying to refine for analyzing the business and risk of subsets of the business and helping in risk management. But then when you go to valuation, which has to be done on a routine (monthly, quarterly, whatever) basis, it seems like reality sort of leaves us a little bit. So my question is, "Are we trying to go too far on the formal valuation capital determination requirement?"

When we're talking numbers like 5% comp limits and maybe 1% or 2% of the companies have gone bankrupt, it seems to be questionable whether we will gain acceptance.

MR. TENNEY: It has seemed to me over the years that the insurance profession has had a very good understanding of its business and has used that understanding to try to leverage a lot out of these formulas.

The reserve formula, the capital formula, and others are constantly in need of adjustments. A new product or new market conditions come along, equity index annuities come along, and we develop CARVM-UVM and the other variations. We look at seg funds (Canadian name for variable annuities, abbreviated to seg funds), and variable annuity death benefits, and the existing formulas aren't working and don't cover it.

Then we try to either adapt the old formulas or go to something new. Then as we go through that process, I think, with segregated funds, we find that we really do need to move to percentiles or something inherently stochastic. You just can't look at these sorts of stock market downturns, and possibly severe stock market downturns, without looking at the probabilities, without it being probability-based.

It seems to me that as you look more at equity markets, you need more sophisticated methodologies. However, there are problems that could come with interest rate markets as well. Interest rates in Japan are close to zero and have been for 10 years. Rates in Switzerland are low. We've seen in these countries that it is even possible for companies to continue to sell products with guarantees higher than interest rates currently are in the market.

If we include the whole world of insurance companies, we have much higher rates of insolvency. We have Japan and we have Equitable in the U.K.

Equitable's problem was annuity guarantee options where they basically said, "OK, once your policy matures or your investment matures, you get a bonus, and then you can annuitize at a high rate, and then they didn't have the money to do that."

So they said, "OK, you can't get your bonus if you want to annuitize." The House of Lords said, "No, it doesn't work that way." There's so much that can go wrong that we constantly have to be very smart to know how to tune these formulas to keep them going. It's getting more complicated. The business world and the financial

world today is just more difficult than it was 10, 20, or 30 years ago. It seems to be getting more so.

So we're much more international now. We have companies across borders. Regulators and rating agencies have to look at big multinational holding groups and try to figure out what it means when they talk about the legal entities that are within their jurisdictions.

In the U.S. and Canada, you have a tremendous professional commitment in the actuarial profession. To some extent, that's true in the U.K. as well. But if you look in other countries, they don't have the same tradition. Some of those countries have holding groups that own substantial portions of our financial firms. These holding groups have interactions between their legal entities onshore and offshore.

So there are questions about what the interior state of that holding group is. It's very hard, to be sure, that you can look at the legal entity offshore and know that you know everything that they're doing. They may have internal reinsurance or derivative deals or all sorts of things going on that have to be tracked. So you really need a comprehensive methodology that you can use in every country.

That can be adopted worldwide so that we can really have a handle on these holding groups. And there are reports produced on them at the home office and the home countrythat then can be looked at by professionals in other countries and who can also agree on what the numbers mean, what the definitions of the terms are, what's being answered.

So it's very much what you say—looking backwards the bankruptcy rates have been much lower. But looking forward we're looking at regulating and managing companies that are part of international conglomerates where there are many barriers of language and understanding and comprehension about what all these things mean when we talk to each other.

MR. GRONDIN: Maybe just a couple of quick follow-ups.

I think the fact that there haven't been many insolvencies in the U.S. and Canada is great. I think there's a lot of conservatism currently in the formula-based reserve and capital requirements. Moving to an approach like this would not necessarily increase insolvencies. It could perhaps reduce them and allow us to be more competitive in the financial markets with other institutions. Although there have not been a lot of insolvencies, if we're not effectively using our capital and deploying our capital or investing in our business, we're at a competitive disadvantage.

One last comment: The thoughts of Doug regarding appraisal value and the equity in free cash flows are his alone—not necessarily reflective of the views of this panel or the Society of Actuaries!

Chart 1

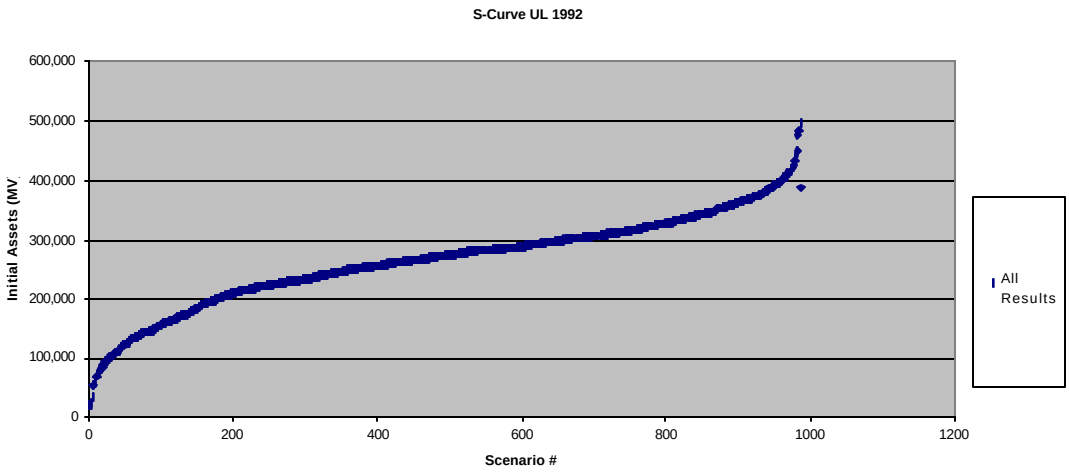


Chart 2

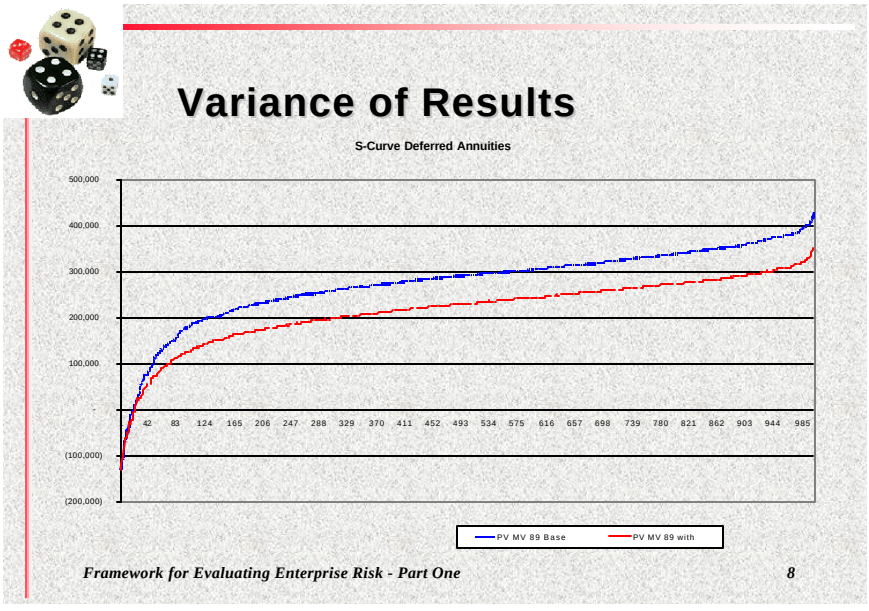
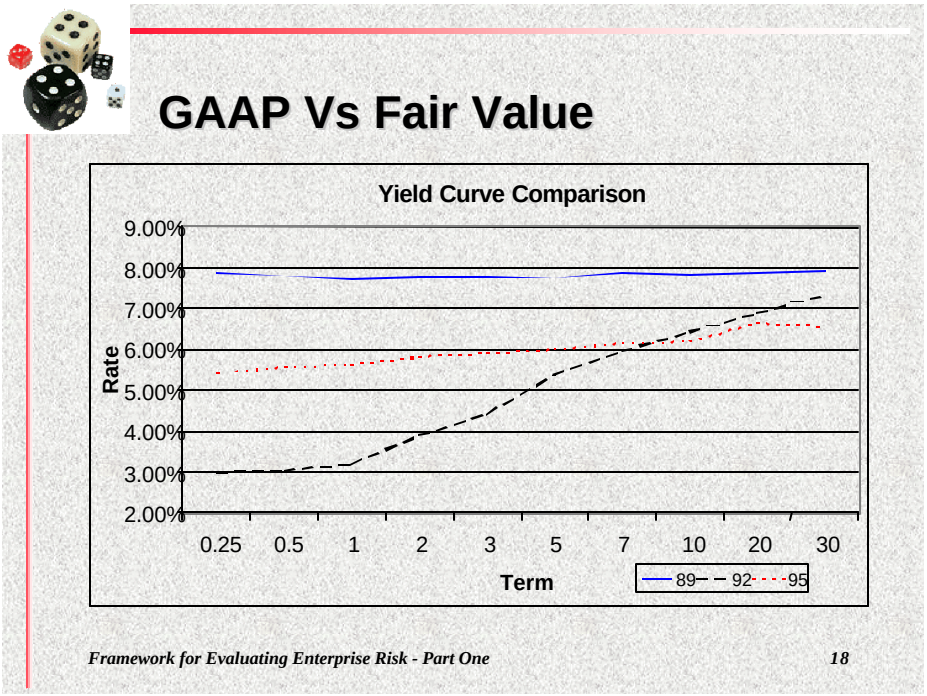


Chart 3


GAAP Vs Fair Value
Yield Curve Comparison
9.00%
8.00%
7.00%
6.00%
5.00%
4.00%
3.00%
2.00%
Rate
0.25
0.5
1
2
3
5
7
10
20
30
Term
89
92
95
Framework for Evaluating Enterprise Risk - Part One
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