RECORD OF SOCIETY OF ACTUARIES
1988 VOL. 14 NO. 2

PRICING METHODOLOGIES

Moderator: PHILIP K. POLKINGHORN
Panelists: SHANE A. CHALKE
DOUGLAS C. DOLL
Recorder: LARRY N. STERN

- What pricing techniques are used?
- How are profits measured?
- To what extent is scenario testing employed in product pricing?
- Is it the function of the pricing actuary to perform sufficient testing to ensure compliance with solvency standards?
- Discussion of Claude Y. Paquin's paper, "Cash Flow Analysis by the Prudent Banker's Method, or Discounting Turned on its Head." See September 1987 Preprint, *Transactions*, Volume 39.

MR. PHILIP K. POLKINGHORN: I'm going to begin with a discussion of Claude Paquin's paper, "Cash Flow Analysis by the Prudent Banker's Method, or Discounting Turned on its Head." For those of you who haven't had a chance to read this paper, it's a presentation that deals with considerations in calculating the ROI profit measure for unbehaved profit streams. The paper will appear in *Transactions*, Volume 39.

In this paper, Claude states that the prudent banker will charge more on loans than he pays on deposits. Most of us can grasp this concept fairly easily. If a product design has a loss followed by a stream of positives, followed by another stream of losses, this paper would say that some of these losses might be viewed as return of previous deposits. Because these deposits are held by the insurer using conservative investments, it should credit a rate of interest less than its ROI rate.

Consider a simple three-year product with the following profit stream: a loss of a $100 in the first year, a gain of $220 in the second year, and a loss of $120 in the third year. This stream can be broken into two substreams. The first substream has a loss of $100 in the first year followed by a $120 gain. The second substream has a $100 gain followed by a $120 loss. Obviously, 20% is an ROI for this profit stream.

However, interestingly, there are actually two solutions, 0% and 20%. So, one of our problems is, when you have multiple solutions to the ROI question, how do you get a single solution, and, furthermore, what is the single solution that will help you make your decision regarding a project? These sorts of multiple ROI solutions are fairly common in a lot of today's universal life products where the minimum reserves aren't sufficient to offset renewal losses or where you have persistency bonuses. Another key situation, which Mr. Doll will be talking about later, is scenario testing. By its very nature, since you're testing under a lot of different scenarios, the profits aren't always well behaved.

The following view can be taken of the previous example:

PRUDENT BANKER ROI
Earned Rate = 7%

Year			Deposit		Loan
1	(100)	=	0	+	(100)
2	220	=	112	+	108
3	(120)	=	(120)	+	0
ROI					8%

The loss in year three can be viewed as the return of a prior year's deposit. Let us assume that the company is willing to credit to the deposit only the after-tax investment rate, which is assumed for this example to be 7%. In order to refund that deposit in the third year, it has to hold back $112 from the $220, and the remaining portion is $108. According to this concept, the ROI is only 8%, where previously we had to choose between 20% and 0%.

According to Claude's paper, one cannot compute a rate of return without first knowing or deciding what rate of interest to pay on these deposits. We've chosen the after-tax earned rate and using this rate the ROI comes out to be 8%. In this paper, there is a fairly key assumption that we will get to later -- What rate will you pay on these deposits?

There is another paper that has just been accepted for publication in the *Transactions*, written by David Becker, titled a "Generalized Profits Released Method for ROI." This paper takes the concept described in Claude's paper and expands upon it.

In the paper, Dave first makes an argument for the rate paid on deposit to be the after-tax insurance company investment yield rate. This is done so that the accumulated value of surplus from the deposit equals the later withdrawal. Dave then discusses the precise algorithm for calculating the ROI. What he does is take the profit stream and break it in two components. One is called "profits retained," and the other is called "profits released." In the example that we had before, if our after-tax earned rate is 7%, these are the same two substreams that we had previously.

PROFITS RELEASED ROI
After-Tax i = 7%

Year			Profits Retained		Profits Released
1	(100)	=	0	+	(100)
2	220	=	112	+	108
3	(120)	=	(120)	+	0
ROI					8%

The algorithm that Dave describes incorporates the following premises. The losses in a product must be covered either by (1) future gains discounted at the ROI, or (2) past gains accumulated at an after-tax interest rate.

Dave's algorithm will produce a unique ROI for the profit released substream, and the paper generates a proof that this is so.

The following three graphs will show how this method will work. In Graph 1 we have a profit stream with a first-year loss, gains in years two and four, and losses in years three and five. Although the numbers aren't on the graph, if you want to go back later and check my math, I'll give you the numbers so you can jot them down. They are as follows: -15, 17.5, -5, 15.95 and -10. The ROI on this stream of profits is 24%; there may be additional ROIs but we did not find any between the rates of 0% and 100%. The Becker algorithm would split these profits into profits released and profits retained substreams.

In Graph 2 you would start at year five. This is a loss so it goes into the profits retained substream. The losses are then discounted back at the after-tax earned rate until they are wiped out by the previous year's gain. You can see that we use up over half but not all of the fourth year's gain. The remaining gain is discounted back at the ROI rate until we reach the beginning of the policy. In this example, the remaining gain in year four discounted back at the ROI rate is sufficient to offset the loss in year three.

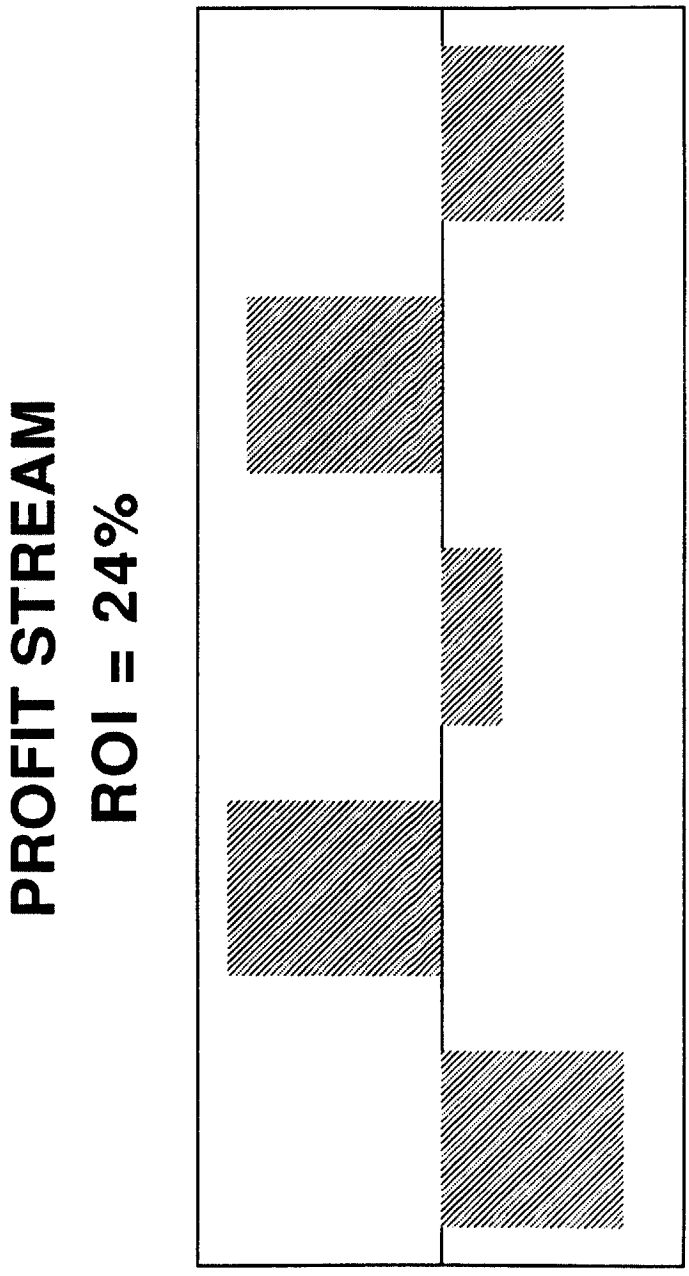
In other words, if we discount back the profit stream and come up with a negative discounting subtotal, we're in the profits retained substream, and we discount back at the after-tax earned rate. However, when the numbers are positive, we're in the profits released substream, and we discount back at the ROI rate. Note that as a result of this, you'll get an ROI of 20% versus the 24% shown earlier. Also note that in this method, future losses are permitted as long as they are offset by future gains at the ROI rate.

Finally, I would like to discuss another method. This one is referred to as the prudent actuary method. This method is different from Dave Becker's but may be consistent with Claude Paquin's. What the prudent actuary method says is "If you project or anticipate future losses on a block of business, what you really should do is set up stronger reserves until these future losses are eliminated." In this case, the reserves would be increased such that we would reserve out those losses. The years where we had the heavy gain we would reserve out a piece of those gains. In our example, this method would reduce the ROI to 17.5%. In practice, the prudent actuary might set up more conservative reserves which would eliminate the negatives and make them positive rather than zero (Graph 3).

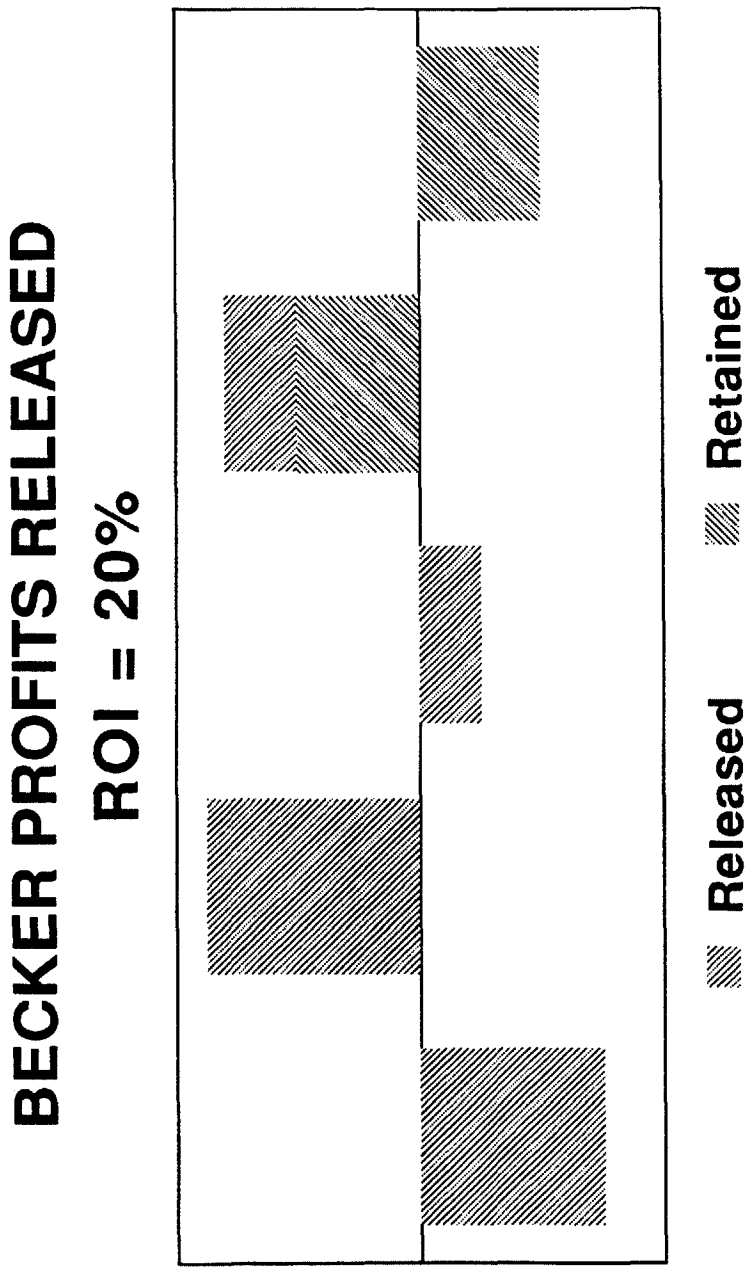
I would like to make a couple of concluding remarks. The preceding discussion may seem a bit theoretical, but we have run into this problem several times for projects other than pricing, for example, appraisals where the discounted value of future profits is very important and you are projecting a stream of negatives. In this case, it might be incorrect to discount those negatives at high-risk discount rates and thus diminish their importance.

Also, it is possible that there may be situations where a dual ROI solution is desirable. Specifically, I am thinking of a mutual company that might have the twin objectives of returning all profits to policyholders by the end of the asset share period which would imply an ROI equal to the earned rate and would also want to be able to support a growth rate, say, 15% per year which would imply at least a 15% ROI. There may be situations where dual objectives are desirable.

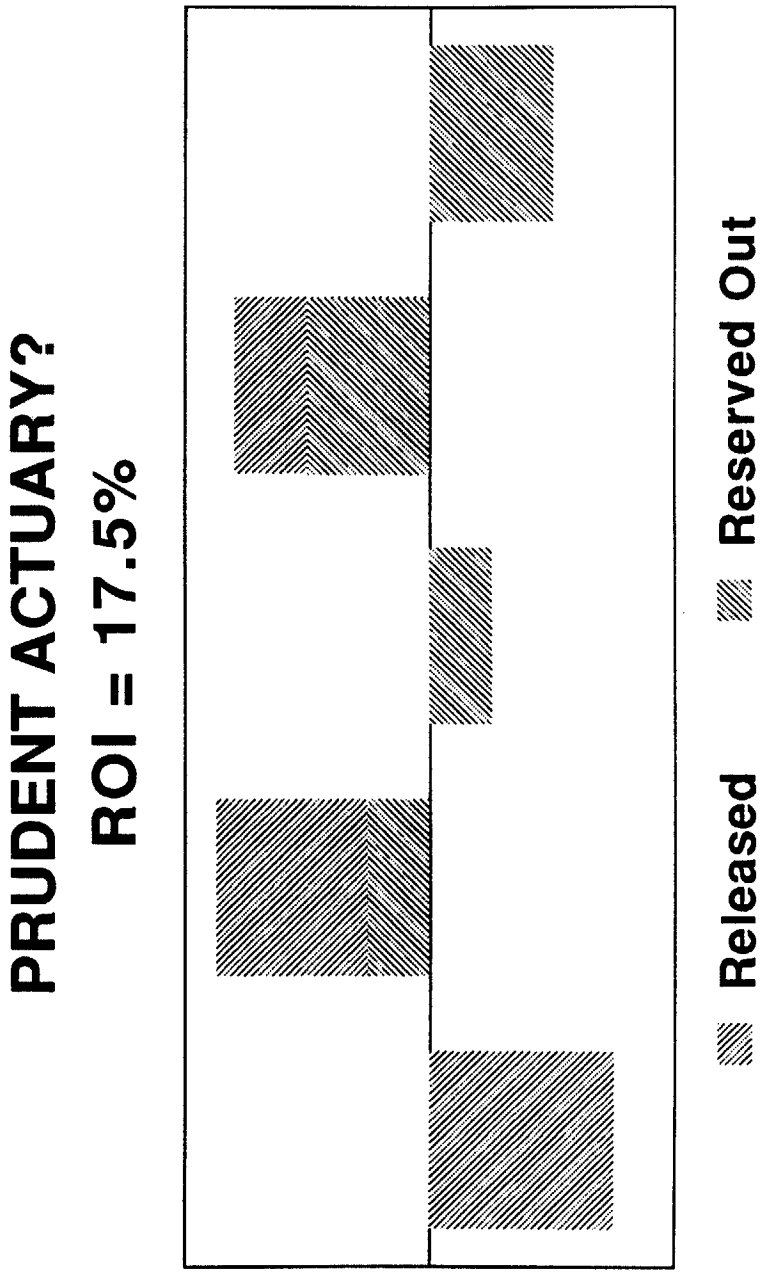
GRAPH 1



GRAPH 2



GRAPH 3



Also, there are some alternative opinions as to the rate at which deposits should be accumulated. There are some who feel that early gains aren't necessarily going to be invested in bonds which would earn some relatively modest rate of interest, but rather, some of these gains will be invested in the writing of new business and if new business achieves at least your hurdle rate, then there is a supportable view that these deposits ought to be accumulated at your hurdle rate rather than the after-tax earned rate. That can have a substantial impact on the answer.

MR. SHANE A. CHALKE: I think most pricing actuaries over the past several years anyway and maybe longer have felt that traditional actuarial techniques have really failed us when we are faced with a competitive environment. Over the past five years or so we have been using a technique for pricing that has gone through many stages of evolution, and what I would like to present is the current state of what it is that we try to accomplish in the present process. I'm going to start by a real quick and dirty, mostly dirty, analysis of the traditional pricing technique or what it is that most actuaries do today while they are in the pricing process.

Product pricing today can be characterized by three basic principles or at least methodologies. First, most product pricing is done on a unit basis -- meaning that the unit of analysis tends to be either a per thousand face amount or per policy or per some segment of business. The second principle is that the pricing algorithm is one that economists would call cost-plus. We don't usually think of it that way but the technique that we actually use to arrive at a price that we want to go to market with, what is the retail cost structure or even the wholesale cost structure, is the cost-plus algorithm. The third characteristic of pricing as it is traditionally done is that expense assumptions tend to be artificial. And what I mean by artificial is that expense assumptions are used which are not directly correlated with the activity at hand. In other words, some artificial allocation of expenses occurs typically in order to arrive at the assumptions actually used in the pricing process.

Now, a cost-plus pricing algorithm is usually set in terms as follows: you look at what it costs to sell a product, the cost of goods sold, you add to that what your profit requirement is and you end up with the cost to the consumer. Now, insurance is quite a bit more complex because it is important we control the wholesale and retail level of price, but this is our basic algorithm. Actuaries tend to turn this around and bury the first two items together and add them explicitly to the asset share profits. This is basically the cost-plus algorithm used by actuaries today.

There are a couple of problems with the cost-plus algorithm. The first is that it doesn't work. And what I mean by it doesn't work is that a cost-plus algorithm does not lead you to a decision in the competitive environment. The very nature of a competitive environment is that, to state it very simply, you can't pick how much money you make. You can't say, "Well, we're going to make 5% of premium" and then price it to make 5% of premium. That is a fictitious world that only exists in a monopolistic situation. Since we are only a semi-monopoly, we're not faced with that kind of pleasurable environment.

In a competitive environment you make as much money as you can, but you certainly can't pick how much you are going to make. Now where this comes from, I think, is really from the very roots of insurance. I'm not real knowledgeable in this area but I think that insurance may have begun as a

cost-plus philosophy. An idea of cost-plus naturally arises from a co-op philosophy or a mutual philosophy or a group of people getting together to do something for themselves. However, even though there are many companies that are mutual in form and still would like to operate under a cost-plus philosophy, even a co-op cannot use cost-plus pricing for the sake of the competitive environment because if the price is wrong the co-op falls apart.

Now what I would like to do is replace these three characteristics of pricing that I mentioned previously with three brand new ones and see where that leads us. The first thing I would like to do is rather than have unit-based analysis or units as the basis of the type of numbers I'm going to generate, I'd like to look at the entire project. In other words, rather than look at my asset share type analysis, I don't want to divide it up into shares, I want to look at the whole thing.

Second, if I have to come to grips with the fact that pricing is an optimization process, I can't pick how much money I make, so I make as much as I can. That's said in very simple terms; the process is not quite that easy, but we're a lot better off if we recognize the fact that it is an optimization process. We're choosing among alternatives and maybe even the best alternative isn't one that we like but we choose the best out of the ones that are available.

The third one, for some reason, tends to be controversial. I don't know why, but it is clear to me that you never want to use anything in your analysis other than purely marginal expenses because of the fact that marginal expenses are the only form of expenses that can give you a clear picture of the profitability of a particular venture. In other words, we would only include those expenses that are a direct result of the type of action we might take. In some of the seminars that we do, we end up spending a half a day on that topic.

Now one of the things is called project base analysis, or in our shop we have been calling it macro pricing for several years; we've also called it other things. We've called it separate venture pricing or project-based analysis or what have you. One of the things it allows us to do is bring into play the economic principle that the less you charge the more you sell. The more you charge, the less you sell.

Now if that principle of the price of insurance tends to be a little bit more confusing, it's because we again control both the wholesale and retail price. However, by fixing one of those two prices and wiggling the other one, we definitely are subject to the economic rule that the less we charge the more we sell. Now, in order to do the macro pricing concept, it would be very easy to just go ahead and mathematically solve what the optimal price would be if we knew the demand curve for our products. I'm going to simplify this, and I'm not going to talk about the three-dimensional demand surface which is really what the insurance company faces. I'm going to limit it to two dimensions. If we knew what the demand curve was, in other words, if we knew how much more we would sell by charging $1 less, then it is just a mathematical exercise to figure out how much to charge to make the most money. But in fact, we don't really know how much more we are going to sell, so we have developed techniques in order to try to reverse the process and back out what we have had as implied assumptions in the past.

What we would really like to have happen is that we would like to walk into the marketing department and ask them "What is the demand curve for this new

single premium universal life that we are going to develop?" and have them say, "We'll work on it and have the graph on your desk Monday morning." Then we would apply our analysis and we would figure how much to charge. Unfortunately, life doesn't work that way. There is not a single entity within the life insurance corporation that will provide that information or stick its neck out and make a stab at that kind of information. What we have to do is come to grips with the fact that we do have a lack of demand curve information. We know the direction of the relationship because it is economic law. However, we don't know the degree of the relationship or the sensitivity of the relationship.

We have to deal with the lack of demand curve information. We are going to integrate all of our marginal expenses and analyze what the marginal expenses are in relation to the project at hand and also, very importantly, in relation to the question we are being asked. In other words, if we are asked the question, "Should we sell the product or not?" then more things will become marginal than if we say, "We are going to sell it, you design it." That's a different scenario, different expense assumptions. But we try to integrate marginal expenses that are often left out or only explicitly brought into the pricing process, such as if you add a fancy feature to universal life that costs $165,000 in system modifications, we want to bring that into play in the analysis directly because that would be a marginal cost of making that particular decision.

This macro pricing process, as we call it, is most successful if we quote profits that are based on what our ultimate corporate goal is or our highest level corporate goal. Many times in a stock company, the highest corporate goal is to raise the stock prices as high as they can go. Maybe a good proxy for that is to make as much total profit as you can.

What I'm going to do is go through a couple of examples of a macro pricing analysis to show the kind of things that we look at and the kind of things that we do. And I'm going to start with a few basic assumptions that are going to look a little different from what you normally might see. First, I'm going to assume that the question I'm being asked is, "Do we sell this product, or not?" Now pricing actuaries are often asked different questions and often they are not told what the question is. When actuaries start out on a pricing project or product development project, oftentimes they don't know whether the task is to price the product because management is going to sell it or whether the question is one of feasibility, whether to sell it or not. Oftentimes, I think, management may make those sorts of decisions as to what is up for grabs in midstream. In other words, management could feel that yes we are definitely going to sell this product; however, once they see the extreme negative results, they may change their minds. Apprising the actuary that that question is up for grabs up front is necessary in order to figure out what is marginal.

These are the kinds of expenses that we normally would consider marginal on a project basis. What it might cost for system modifications, for advertising, for a proposal system, for actuarial expenses, etc. -- we want to bring these kinds of expenses into play directly. Never break them up on a unit type basis; we want to leave them whole and intact. In that way when we test different production scenarios, our analysis remains valid. Now in addition to this, we're also going to use unit marginal expenses; in other words, when we sell a particular policy, what does it really cost us to sell that policy? What is our actual cost of goods sold once we get it up and we are actually issuing contracts? And also, the analysis I'm going to do happens to be a single premium universal life

contract. I'm going to quote profits in terms of present value of the total GAAP profit.

Now what we do in the process is to look at the particular plan and analyze the broad range of production scenarios and perhaps arrange a product life. In other words, is this product going to lapse in two years, three years, one year, six months, maybe, four years, what have you? Couple that with the series of production scenarios and actually run model office projections. Look at what the statutory profits are compared to the GAAP profits or the book profits or whatever is important to you and characterize this entire book of business; characterize its value in a single number.

In other words, what we're really doing is an appraisal on business yet to be sold. If we look at just one particular product, we can graph what the GAAP profit looks like across different production scenarios (Graph 4). Now this is just the one particular product. When looking at this particular kind of graph, we can answer certain questions; for instance, if premium production is going to be $50,000,000 we know that we can expect around $4,000,000 present value GAAP profit. In other words, if we sell this product, and if we do this level of production, this is what it is worth to the company on a value added type of basis.

Now, we have not done any pricing yet because we haven't done anything with price. I have chosen a certain pricing structure, produced the graph and presented it as such but we haven't yet begun the pricing process. We just did one pretty picture and that hasn't done anything for us as of yet. But there are several advantages already before we even do the pricing process. First of all these numbers are a lot less mysterious to others in the company than the typical quotations of profit that we will actually provide.

When you are having a meeting with marketing, management, and product committees and you say that a product has a 13% internal rate of return or a 2% premium margin or something like that, these are not numbers that are easily grasped by nonactuaries who are not used to dealing in these terms. Yet if I present the product and say, "OK, if you sell $50 million it is worth $4 million to the company," that's a readily discernible number and one that others can grasp. You'll find that other people in the company will place more of an interest in what the actuary does during the pricing process.

The second advantage is that just showing the macro numbers facilitates cost-benefit analysis. In other words, we'll spend a lot less time and resources on a project where no matter how good things look, it might only be worth $75,000 to the company. There are lots of projects like that that are just not really worth it, but you never find out that information when you are looking at unit profit. To the extent that we can show real numbers for loss and gain in each year, they help to bring everyone up on an even keel; everyone can relate to the magnitude of numbers, what the product will really mean to the company (Exhibit 1).

I think now we will go ahead and price the product or look at what happens during the pricing process. Basically we are going to just accomplish two steps. In order to determine what the optimal price is or the optimal pricing structure, we have to look at a range of prices. We have to move the price around and see what the results are for each price. Now, again, if we knew what the demand curve looked like, what the elasticity of the demand was, it would be a

GRAPH 4

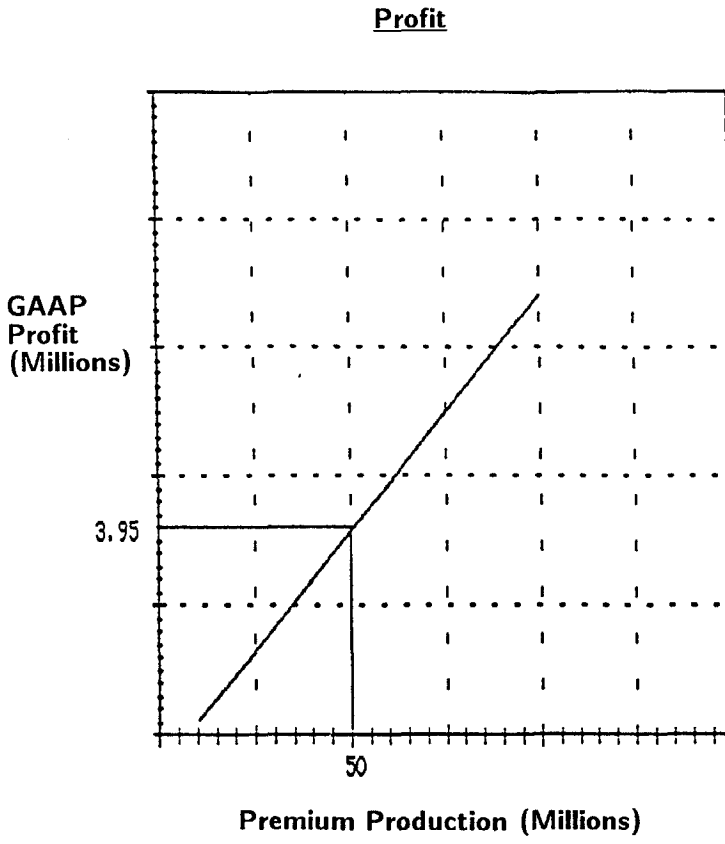
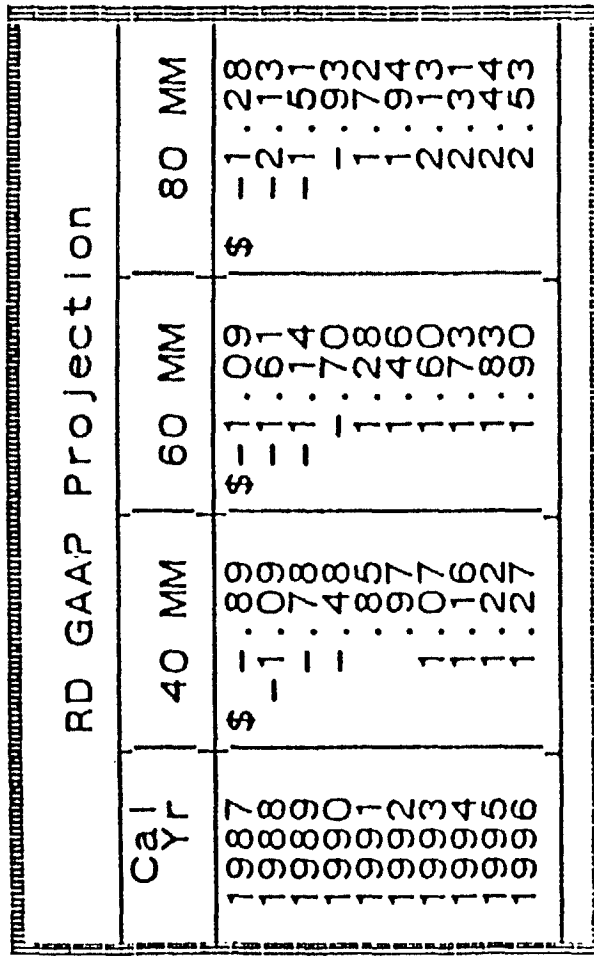

Profit
GAAP
Profit
(Millions)
3.95
50
Premium Production (Millions)

EXHIBIT 1



very simple exercise to just crank through the numbers to find the optimal price; however, we don't know the demand curve elasticity.

I'll go through a couple of examples as to how we do this. We're going to turn the process around and extract information that in the past has been implicitly buried in the pricing process. For our single premium product, I'm just going to change one component of the price. As you know, insurance is quite complex. There are lots of things that can be characterized as price to an insurance product; at the wholesale level we can certainly alter commission, we can change what we spend on our service to our agents and so forth, we can change other forms of compensation, better or worse conventions, things like this. These are all components of what I call the wholesale pricing structure.

At the retail level we can of course change premium, cash values, death benefits, cost of insurance (COI) rates, interest rates. There is almost an infinite array of possibilities for varying retail price in modern insurance products: whether we want to have interest bonus or reversionary interest credits or give back charges, reverse mortality, different methods of COI rates and interest banding, different loading structures. There are lots of different things that we can play with and it can become a little bit overwhelming.

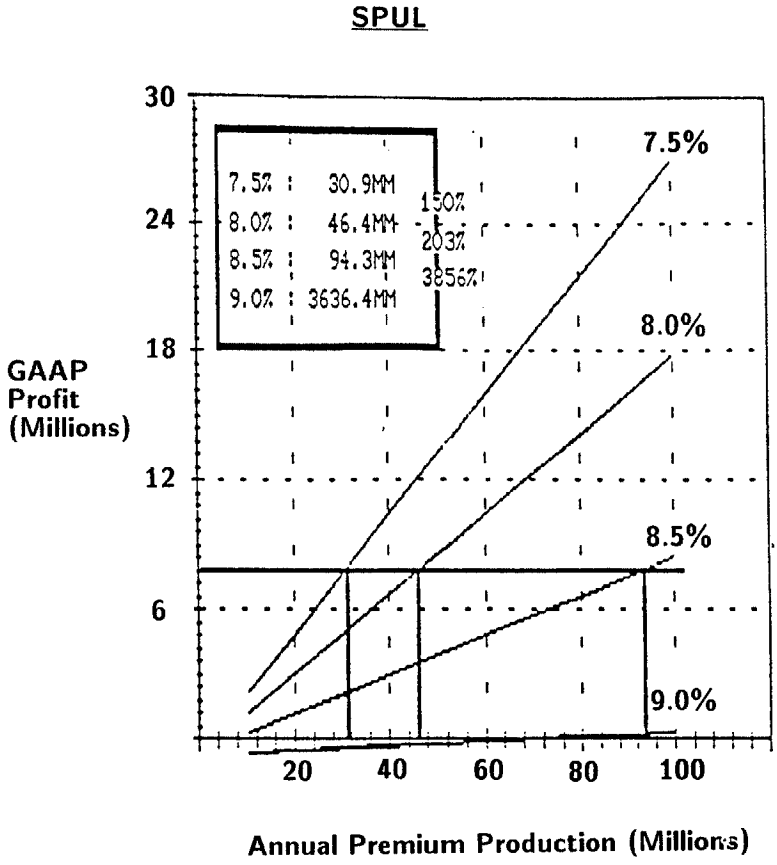
Today I'm just going to deal with the interest rate to make things very simple. But in fact, during the pricing process, you would, of course, try out more than just one parameter. The other thing that I'm going to do is make it simple so that I can price a product quickly; I'm going to assume that I'm not going to wiggle the wholesale price. I'm going to leave the commission rate at 5.0 or 5.5%. That way I can put it on two dimension graphs as well.

Graph 5 is for one price. This happens to be at the time I did this analysis, the "price" of crediting an 8.5% interest rate on a single premium product. This is what happens, this is what it looks like for the company. Now, what we want to do is try a range of prices. This one happens to be 8.5%. We can look at what happens when we credit 9%, 8%, and maybe 7.5%. Of course, this is very crude. You normally wouldn't look at such extremes in price but I wanted to make the graph spread out so it could illustrate the point a little better.

The first thing that we can do and this would be the technique that we would use if we were in an uncooperative situation. I term an uncooperative situation as one where the marketing people involved will not tell us what it is worth to them to have a little bit better pricing structure. So what we do is, we'll tell them what it will cost them to have a little better pricing structure and we'll just draw a horizontal line across the graph and where it intersects the profit curves we can just drop vertical lines. And now we have instantly developed a relationship between production and pricing structure that we can now turn around to find out if it is worth it to go to a more competitive pricing structure.

We know that at a credited rate of 7.5%, we have to do something over $30 million of annual production. Crediting 8% requires $46 million in production. Now, could you make any decisions based on that? Probably not. What's going to happen is, if you ask the marketing people, "If we give you 8% instead of 7.5% will you do another 50% of production?" They'll say, "I don't know" or they might say, "Yes." You're lucky if they say yes. Some of the decisions get a little more clear though. At 8.5% we have to do $94.3 million of annual production. And at 9% we have to do $3.6 billion of annual production.

GRAPH 5


SPUL
30
24
18
12
6
GAAP
Profit
(Millions)
7.5% : 30.9MM
8.0% : 46.4MM
8.5% : 94.3MM
9.0% : 3636.4MM
150%
203%
3856%
7.5%
8.0%
8.5%
9.0%
20
40
60
80
100
Annual Premium Production (Millions)

Now, what we have already shown and the real value of this type of analysis is that we cannot necessarily reach a very clear decision but we can certainly kick out the decisions that make no sense. Looking at things on a unit price, asset share type basis, it's not that infrequent that decisions to go to 9% are made because of the fact that no one ever shows what the multipliers are. Here the multipliers show that to go from 7.5% to 8% requires a 50% increase in production. Maybe you can't. To go up to 8.5%, you have to justify a 200% increase in production. Maybe you can't. Single premium is a very sensitive market. It's like single premium deferred annuities (SPDAs), you either get the business or you don't. But certainly if you go to 9%, can you get something like a 3,800% increase in production? Some of the decisions are clearer than others.

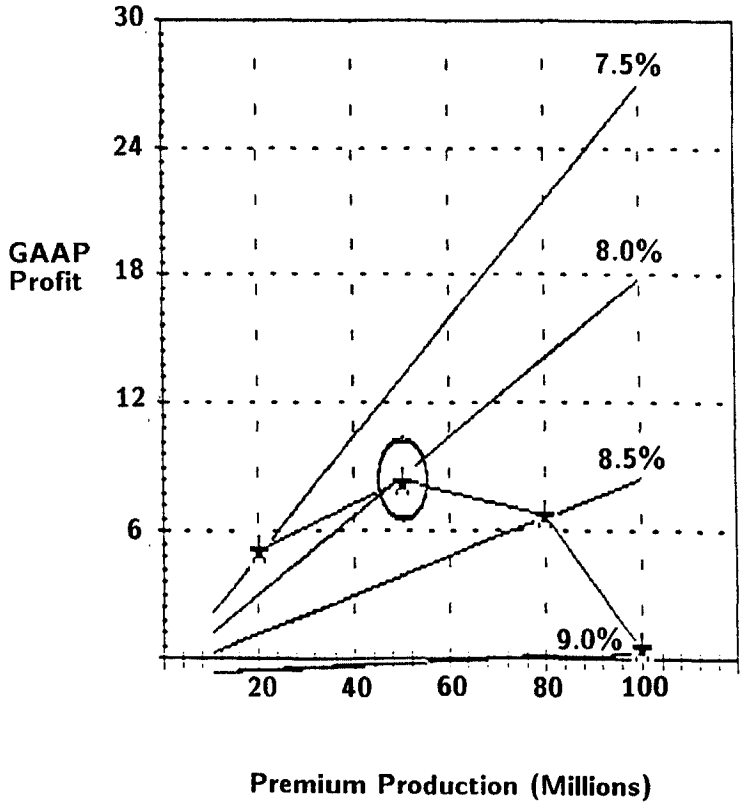
So generally the process that we'll go through is to turn this around and be able to provide this information; the responsibility for the increased production will rely, not on the actuary's shoulder, but in the marketing department where it belongs. One of the problems I think with unit-based pricing is that actuaries wrap in the marketing plan with the financial analysis and really take responsibility for both sides of the fence and have these inherent inner conflicts that cause all kinds of stress. If we had cooperative participants, in companies that have been through this a couple of times, they become more versed in how the communication can occur between actuarial and marketing. It is a little bit easier technique.

Here is the same graph of profit curves (Graph 6). What we can do is get actuarial, marketing, corporate, management, whoever together. We start by picking a point on one of the profit curves, say crediting 7.5% and say, "Well, if we give you 8% instead of 7.5%, how much more do you sell?" Maybe we draw another dot and, "If we give you 8.5% instead of 8%, how much will you sell?" Maybe we plot another dot and, "If we credit 9%, how much will you sell?" Maybe we plot another one. We can connect the dots and it becomes a fairly academic decision to choose the one with the highest total profit. Now it seems as if we're making a lot of subjective assumptions here and admittedly we are. The key point is that we're not making any more subjective decisions than are made in any pricing process. All we're doing is taking those same subjective judgments and making them explicit with the aim of improving the quality of the subjective judgments.

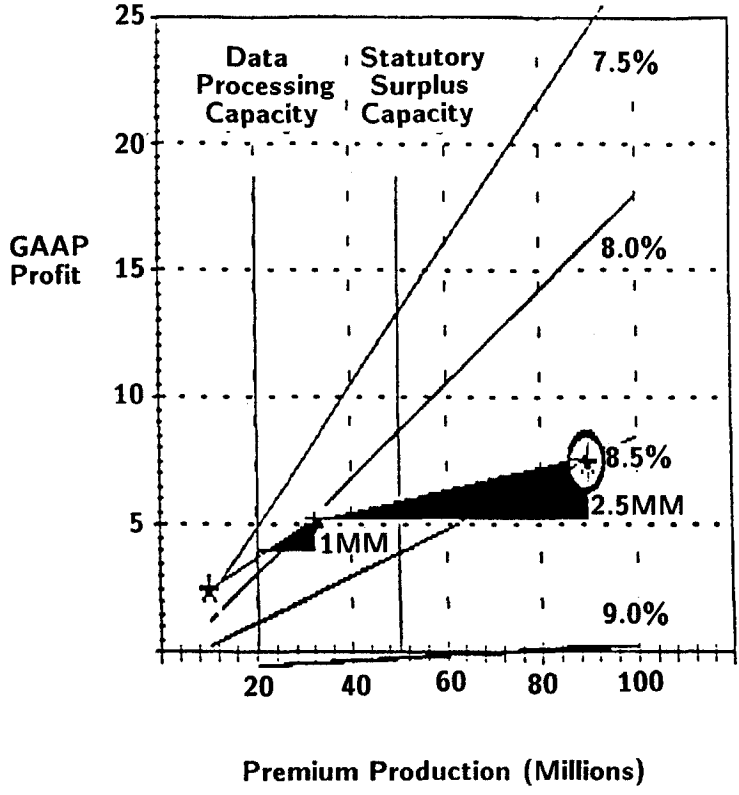
If you're on a unit basis and marketing says, "If you give us 9%, we'll sell a lot more," so the actuary says, "OK, I'll lower my profit goal". The actuary goes back and reprices for 9% and marketing is happy and actuarial is happy but no one ever knows what they put themselves on the hook for. They have to do 38 times the production that they would otherwise do. It's a subjective decision that's made but the quantity of sales required is not known.

Now there are a couple of other real advantages to showing the macro numbers and I'll just go through a couple of quick ones. Here's our same profit graph (Graph 7). Let's just suppose we get together with the marketing folks and we connect the dots and we end up with maybe this kind of a structure. Now what that would lead us to is to go ahead and credit the 8.5% because that's the maximum total profit. However, insurance companies are not an unlimited resource. We can't sell business forever. We're constrained by various physical constraints, various capacities to produce. We want to take these into account and I'll throw up just a couple. Maybe we'll assume that we run out of data processing capacity at about $20,000,000 of production. Maybe we're processing

GRAPH 6


30
24
18
12
6
GAAP Profit
7.5%
8.0%
8.5%
9.0%
20
40
60
80
100
Premium Production (Millions)

GRAPH 7


25
20
15
10
5
GAAP Profit
Data Processing Capacity
Statutory Surplus Capacity
7.5%
8.0%
8.5%
2.5MM
1MM
9.0%
20
40
60
80
100
Premium Production (Millions)

on a personal computer or something. Once we hit $20 million of production our daily cycle takes 24.5 hours or something. Let's also assume that we run out of statutory surplus at $50 million of production. We want to take these things into account. This analysis allows us to take them into account explicitly.

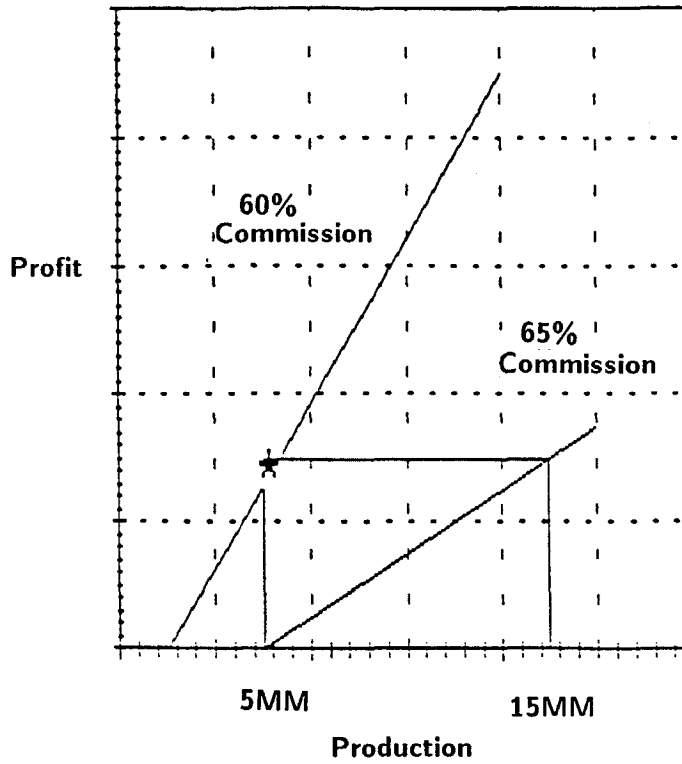
What we can do is say, well we would otherwise limit ourselves to $20 million of production and optimize profit on that basis by crediting somewhere between 7.5-8% but what we can do is analyze what the cost is to us of foregoing the profit lost by not crediting 8% for instance. What we can do is look at what that little wedge of profit is. We know that in this case it is $1,000,000. We ask ourselves, can we move off the PC administration onto a mainframe for $1,000,000? Well, the answer probably is that the cost is far more than the potential profit. But at least in the analysis we can decide whether that is a prudent decision or not. Similarly what does it cost us to buy statutory surplus? I think you can say that in Louisville, OK. Compare that with the forgone profits of not buying the statutory surplus. In this case we would make an extra $2.5 million if we could move out to the 8.5% credited rate. Do we do it? Well it depends on what it costs us to buy the surplus, to buy the capital, or rent the capital or do a surplus relief deal or what have you.

Now this all looks a little bit complicated. The best thing is to get some really wonderful graphs but there are some very simple techniques that you can apply immediately in this type of analysis that really shed some light on some really fundamental questions. One that is very prominent that comes up is what commission rate to pay on a product. Oftentimes we'll see graphs like this where maybe you analyze 60% commission and you get a profit curve of this form and if you pay another 5% you get a profit curve like this (Graph 8). Well there is an enormous amount of information here that can hopefully lead us toward a better decision. We can certainly draw our horizontal line and look and see if we have something like a 3 to 1 ratio. Just ask ourselves if we go to the 65% commission, is it reasonable to think that we will do 3 times the production? If the answer is no, then perhaps we shouldn't do it. On this type of analysis we've seen multiples as high as 7 or 8 to 1, even on things like renewal commissions where it tends to be a very easy decision where you might say our field force probably doesn't know what the renewal commissions are. Never mind what their level is. Maybe you decide it's not worth it to raise renewal commissions or maybe you even decide through this type of analysis to lower them.

Just as a little bit of a summary, I think there are several advantages to a macro approach. And it is, I think, quite a bit different from what actuaries' are used to, but it is common in other industries. I think we are one of the very few areas in the economy where we look at things on a unit basis, cost-plus type of paragon. The first advantage is that you look at real numbers. I think that it is a real advantage. It brings more of a sense of reality to the whole process. We can show numbers that are more correlated to expected financial results or what we want to occur as far as financial results. We can find out about what the big picture is. I think it is unarguable that you do have the best chance of optimizing price. Right now most algorithms don't go through an optimization procedure at all. They go through a sort of infinite human capital look between actuarial and marketing until everyone is tired and then they decide on the plan. I think it is your best bet of a useful decision tool.

As just a final point, what I'd like to do is take a look at what happens inside the company when you institute a macro pricing type process. I'm going to

GRAPH 8



start with the product development algorithm that I feel is commonly in place today and it looks something like this. First you try to figure out what it is you're trying to accomplish with the plan in terms of what kind of a plan are people looking for. Then you try to determine what you want the plan to do as far as performance. Then the actuaries go to work and run lots of asset shares and things that balance all the little cells, make sure they're happy with the spread of profits and the levels in different areas. Then run a bunch of illustrations and perhaps meet with the marketing people at that time and several things happen. The marketing people say, "Wow, that plan is hot, that's too competitive. Back off a little actuaries." Or what might happen is they'll say, "Boy that plan's perfect, just right" or somewhat more common, "This stinks."

So what do you do? You've already gone through your algorithm with them, you've done everything you're supposed to do. You've figured out what policy, you've done your expense analysis, you've run the asset shares, you're done. This is frustrating because you think you're done. So what you do is go back to the drawing board into what I commonly call strategy. What it really is more like, well, I won't say. You know what I mean. If you get through that loop which really is a loop, maybe a 4 or 5 or 6 times loop and maybe a dozen times loop, then you're off to doing some of the final detail work so you integrate all yourselves, figure out the competitive composure again and if you're unlucky you're back into the soup again, marketing doesn't like it any more because you changed that female smoker substandard age 8 rate. You're back to the strategy session. Another infinite loop, potentially infinite loop and once you're out of all the loops, I think for reasons that everyone is more tired than anything else, you have your final plan done and no one particularly likes it.

Macro pricing algorithm is unique in that it eliminates the looping. We start out very similar, we figure out what our design constraints are, try to determine what our competitive goals are just to have some broad brush starting point. We'll still go through the balancing process coming up with some initial what I call plan mock ups. Then we do our macro analysis. After we do our macro analysis, we're ready. We're ready to meet with marketing and management and provide our findings. And really we're ready now, we have the whole picture on the table. Everything's there to make a decision. And our loop becomes not one of go back and do another product, it becomes one of, gee whiz, do we want to do this whole project or not. Maybe we do, maybe we don't. Of course, if it is a no go, we're back to strategy again but it truly is strategy this time. We're talking about strategy of what product line do we want to be in. Do we want to be in this type of business and so forth.

But really you only have the one loop and it is a very large loop that brings into play the true strategy considerations rather than bumping heads. If its a go, you go ahead and optimize the competitive profile based on the profit curves that you have developed. Integrate your cells and pick out the product detail. It seems there is more to do but there is actually a much shorter or tighter time circuit involved in the product development.

I'm going to stop right there. Obviously, this subject could warrant many, many days of discussion. But I just wanted to provide you with sort of a general overview of really what it is all about. I think it is rather exciting and maybe a little bit of a new turn for product development actuaries.

MR. DOUGLAS C. DOLL: We recently performed a survey of pricing methodologies that was sent to product development actuaries. We found in the survey

that not many pricing actuaries are doing interest scenario testing even on interest-sensitive products. There are probably a number of reasons for this. First of all, it requires a lot of work. Second, the company may not even have the system to be able to do such analysis. There is a perception still that scenario pricing is useful only for things such as setting the investment strategy. Many pricing actuaries still may feel that it is not their responsibility to get involved with that. There may be a subconscious fear among some pricing actuaries that if they do such analysis, the only thing that this will do is make the product less competitive, and they are not sure that they want to find out about that.

All of those excuses are somewhat valid, but are breaking down. The pricing actuary is getting more involved in setting the strategies for crediting interest rates and investments, and he is becoming more responsible for the profitability for in-force business. We have the new actuarial opinion in the annual statement that requires an opinion as to whether illustrations are supportable. All of this is putting more and more pressure on the pricing actuary to do scenario analysis.

When you start doing scenario analysis, you run into three basic problems. First, what assumptions do you use for scenario pricing? The problem here is if your assumptions are worthless, then the results are going to be worthless. The second problem is what scenarios do you test? How do you decide which interest scenarios to use? The third problem is, once you get all of the results, which could be massive amounts of data, what do you do with them?

There are several important dynamic assumptions to make when doing scenario testing. On the liability side, you have the credited interest rate, the competitor interest rate and the excess lapse function that gets involved when the credited interest rate is different from the competition interest rate. Inflation of expenses is a secondary issue. On the asset side, you have the reinvestment strategy, how to handle negative cash flows, and what to do about defaults and call prepayments. Actually, two of these "assumptions," the credited interest rate and the investment interest rate, are more in the nature of strategy rather than assumptions.

It is true that there are not really good assumptions for such things as what the competitor interest rate will be in all interest environments and what the lapse interest rate will be in extreme interest environments. At the Valuation Actuary Symposium last fall, I spoke on the topic of functional relationships, which included these assumptions, and I partially tongue-in-cheek spoke about the progression of choosing actuarial assumptions. The first stage is the "dart board," where you just try different assumptions and see what kind of assumptions gives reasonable results. The second stage is the Xerox, or copying approach. This stage might involve copying the assumptions that someone else used, say, in a presentation at a SOA meeting. It progresses until you eventually come up with stage three -- actuarial rules of thumb -- which are the result of lots of people getting up and making presentations like this. Pretty soon everyone is using the same assumptions, and they start to gain validity.

There are some data available. We do have some experience on what happened to SPDAs in the early 1980s when interest rates went way up, so there is some analogy that can be made there. We also have some experience as to how universal life credited interest rates have reacted as interest rates have fallen the last few years. We are still are waiting to see what will happen when interest

rates go up on those credited rates. As I mentioned, you can do some sensitivity testing on the assumptions, which is what this whole game is about anyway. Do the sensitivity testing and find out how sensitive your product is to the asset/liability mismatching risk.

Regarding the scenarios problem, there are two issues. The first issue is how do you generate the scenarios? Do you do them stochastically or hand-picked? The problem with hand-picked scenarios is that they are quite judgmental. They lead to a lot of bickering. In appraisals, we have found that one of the keypoints of contention between a potential buyer and a seller is what scenarios we should be testing when blocks of interest-sensitive business are involved. The problems with stochastic scenarios are: How do you generate them? How many scenarios do you need? What do you do with all of the results?

With regard to generating the scenarios, Tillinghast is using a system that uses the so-called log-normal interest scenario model. There is research that says that this is a good model. In the last *Product Development Section Newsletter*, Joe Buff had an article in which he documents some of that research so you can go back and look at that. There are other models in use, too.

With regard to how many scenarios are enough, during the last few years it seems to be fairly typical for persons (such as myself) to show results using forty or fifty scenarios. I would like to say that the number 40 or 50 was scientifically chosen, but, in reality, the reason we have been testing 40 or 50 scenarios is because, if you show the results one line per page, that is the number of results you can get on one page of output.

If you are just looking for the mean result on the profits, 40 or 50 is probably a good number. If your results are normally distributed, you could come up with a confidence range assuming that the standard deviation of the mean is equal to the standard deviation of the sample, divided by the square root of the sample size. For example, if you have a 100 sample size, take your standard deviation of the sample and divide that by ten, and you have a standard deviation to calculate confidence ranges on the mean. When you start looking at the tails of the profitability distribution, you run into problems. There are two reasons for this. First, it would be nice if the distribution of results were normally distributed, but, in fact, we have found out that the distribution is not normal. That is intuitively obvious. If you consider the interest sensitivity of, say, a block of SPDA business, on the loss side you have a significant tail. There will be several scenarios where the SPDA business shows very poor profitability, but there are not very many scenarios where you show excessive profits. The bad things that can happen to you are a lot worse than the good things that can happen to you. The profit distribution curve is skewed. It is not a normal distribution curve; therefore, some of the typical statistical analysis you might apply will not work.

The second reason is the number of scenarios. Forty or fifty is really not enough to get a statistical analysis of the tail of the distribution. We have been doing some analyses. We ran 4,000 scenarios on a block of universal life business and have been analyzing the tail of the distribution to see what kind of confidence we can get. We tried to fit a curve to the data to find out what sort of profitability distribution we could find. We found out that there was no curve we could find that was simple enough to actually work with. We have done enough analyses to be able to make statements such as the following:

Let's say that you want to be 95% confident that the product will lose money no more than 10% of the time. According to our calculations, if you have a sample size of 40, then the only way you can have such confidence is if none of the scenarios show a loss. That is not very good. If you generate 100 scenarios then you can have up to four scenarios that lose money and still be 95% confident that the universe is no more than 10%. If you go up to 200 scenarios, then up to 6% of your actual scenarios can fail and you can have such confidence. So, you can see that 40 appears to be a low number. One hundred, two hundred, you wonder where to draw the line, but it seems that if you are going to be looking at the bottom 10% or bottom 5% of the range, you are going to have to be looking at a few hundred scenarios to be credible.

Now, of course, once you have run a few hundred scenarios the question is how do you show the results? There are three options.

1. List all of the results.
2. Use graphs to show results.
3. Use utility functions to calculate a single number.

We have found good use in showing results to management with graphs (Graph 9). What we like to do is show a dark middle bar that shows, say, the middle 80% of results. The outer bars would show the worst and the best results. Regardless of sample size, you cannot put a whole lot of credibility in your best and worst results, so it is probably best to be looking at the 80% middle results.

Regarding utility functions or risk-adjusted value, there have been a couple of articles on that in the last two *Product Development Section Newsletters*. This is a formula for how you can use an exponential utility and calculate a risk-adjusted value.

$$\text{Risk-Adjusted Value} = \frac{-1}{r} \ln \left(p_1 \cdot e^{-rx_1} + p_2 \cdot e^{-rx_2}\right)$$

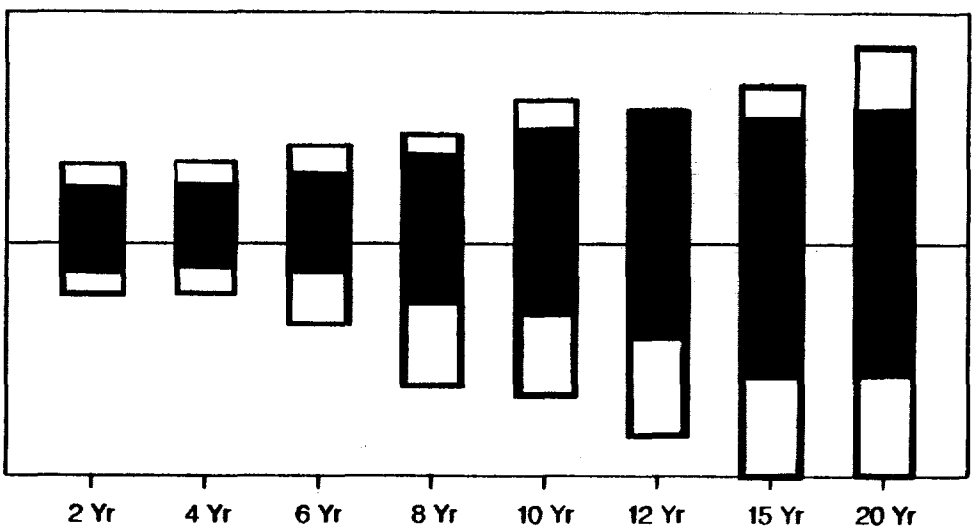
Exponential utility functions applied to insurance products are not new. I was able to go all the way back to a 1971 *Transactions* article by Hans Gerber. He discusses the use of utility functions and particularly the exponential utility function. The new *Actuarial Mathematics* textbook, published by the SOA, talks about utility functions. So, it is not a brand new concept, but it is not being put to very much use, at least in life insurance. Casualty insurance may be using it somewhat more.

The essence of using utility functions is that people and institutions (life insurance companies) have an increasing aversion to a loss as the size of the loss goes up. The exponential function is just one of several functions that has been used to represent this increasing aversion to risk. The value "r" in the formula is the measure of the risk. It is called the risk aversion factor. It usually has to be determined empirically by getting sample values from a person or company, saying "How much would you charge to cover this loss?" or "How much would you be willing to pay for a situation where you could have a certain chance of gain and another chance for a loss?"

The major criticism of utility functions is that the value r is subjective. It is hard to pin down. Company managements may not understand just what the

GRAPH 9

Universal Life
Investment Strategy Variations
Present Value of Profits



meaning of the risk aversion factor is. It may be hard to explain, and they may not be comfortable with it. When you boil down the results, you may get to a "black box."

To give you an idea of what the value of r is, and what effect it can have on results, here is an example (Graph 10). Let "risk capacity" be defined as the reciprocal of r. Consider a loss in a sample with 100 scenarios and a risk capacity of $1 million. If the value of the loss becomes large, relative to the value of risk capacity, the risk-adjusted value assigns a greater value to the loss. If the loss is very small relative to the risk capacity, then the value of the loss is about the same (e.g., the value of a loss of $100 is minus $100). But, if one of your scenarios shows a loss of $3 million (a multiple of three), the utility function risk-adjusted value will assign a value to that loss of about minus $18 million. So, if your scenario testing shows any losses that are larger than your risk capacity, it is going to drag down the risk-adjusted value quite significantly.

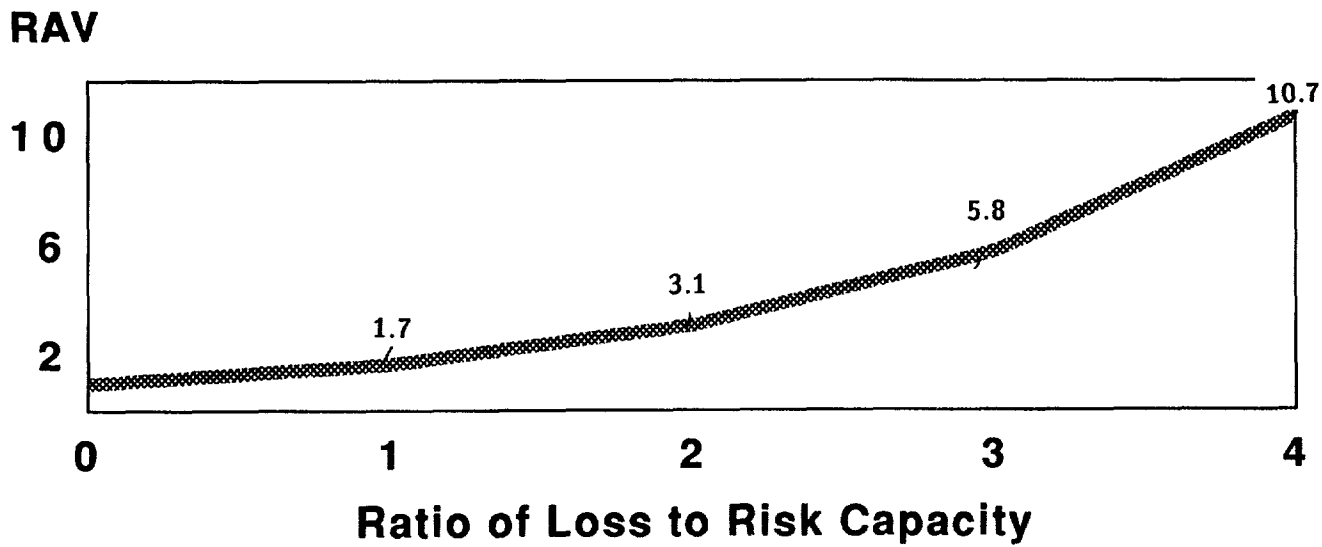
One other point on risk-adjusted values. If the utility function is backing out the risk of the product, then an argument could be made that the discount rate for profit ought to also back out that element of risk. If this were the only risk involved in the product, then you should be using a risk-free rate of return to discount the profit. Obviously, when you are in the life insurance business, the asset/liability risk is not the only risk involved. If that were so, then it would be appropriate to sell variable life products discounted back at a risk free rate of return. It is another consideration to take into account if you are going to apply this approach.

GAAP RETURN ON EQUITY

This is a topic about which there have been quite a few articles written recently. Brad Smith has an article that will appear in the next *Transactions* on pricing in a "Return on Equity Environment." Don Sondergeld had a *Transactions* article a few years ago that addressed this. It seems to be something that companies are looking at more and more. Let me define what I mean by GAAP return on equity. It is GAAP profits divided by GAAP equity where GAAP equity takes into account statutory accounting. By statutory accounting, I mean the fact that you are required to hold statutory reserves, and you are required to hold a certain amount of bench-mark statutory surplus. So the required equity would take all of this into account and basically would be equal to the amount of statutory bench-mark surplus plus the GAAP balance sheet adjustment switching from statutory to GAAP. The GAAP earnings would include, of course, the investment income on the GAAP equity.

Although it is possible to do GAAP such that the GAAP rate of return on equity on all years would exactly equal the statutory internal rate of return, in the real world it doesn't work out that way. In fact, it absolutely does not work out that way. You might have a statutory internal rate of return equal to 15%, but you have a GAAP return on equity that varies year by year. The most obvious example of why this might happen is the fact that under GAAP you generally do not defer all of your acquisition costs so that first-year profits are less than renewal profits. It is not atypical to have a very low GAAP return on equity in the first policy year. The FASB 97 GAAP for Universal Life policies has brought a lot more attention to the fact that there can be a pattern of earnings under GAAP that is very much different than the statutory internal rate of return.

RISK ADJUSTED VALUE OF LOSS
As Multiple of Expected Value
(100 Scenarios)



GRAPH 10

If you are going to be pricing on a GAAP return on equity basis, you are going to be looking at year-by-year numbers that are going to vary. We thought it would be interesting to try to calculate a single number GAAP index that would take the return on equity into account. These formulas were presented by Tricia Guinn at last year's Colorado Springs meeting, but since it was in a seminar format session, it did not make it into the *Record*. So I am going to present this again.

We decided to see what would happen with two different single GAAP indices, as follows:

Level Production:	$ROE = \frac{\text{Sum of Earnings}}{\text{Sum of Equity}}$
Production Increasing x% per Year:	$ROE = \frac{PV\ @\ x\%\ (\text{Earnings})}{PV\ @\ x\%\ (\text{Equity})}$

I think it is intuitively obvious that, if you had level production of the same product all years, ultimately the GAAP return on equity in a company would simply be the sum of the GAAP earnings divided by the sum of the GAAP equity. So if you had the year-by-year GAAP profits, you should add up the GAAP earnings, divide them by the sum of the GAAP equities, and you are going to get what your ultimate GAAP return on equity would be if you sold the same amount of production each year. Less intuitively obvious, perhaps, is the formula for a constantly increasing production each year. If your production increased x% a year then your ultimate GAAP return on equity would be the present value discounted at x% of the year-by-year GAAP profits divided by the present value discounted at x% of the year-by-year GAAP equity.

Now, how does this work in actual practice? We GAAPed an SPDA product. I have simplified the numbers somewhat (Graph 11). Under our "standard GAAP assumption," which was to defer all acquisition costs and to amortize the acquisition costs over all years of the product, we essentially got a 12% GAAP return on equity in all years of the product. Since our GAAP return on equity is 12% all years, then both of our indices, either assuming level production or increasing 15% per year, also are 12%. Next, we decided not to defer some of the acquisition costs, which lowered our first-year return on equity to 9.4% and increased the renewal year to 12.6%. Surprisingly, this really did not have much effect on our indices. The level index went to 12.3% and the increasing index did not change at all. It stayed at 12.0%.

We decided to try a more extreme example. We amortized the deferred acquisitions cost (DAC) over 10 years instead of 30 years and now we got in year one, 8.4% in years 2-10, 11.6% and in years 11-30, 22.6%. Our level index went up to 15.3% and the increasing index went down a little bit to 11.8%. We have three GAAP ROE streams here for the same product. The one that has the lowest numbers in the early years gave us the highest level index. This sort of invalidates that index as a worthwhile index to look at. The fact that the increasing index only went from 12% to 11.8% in the extreme example makes me wonder whether it is going to be worthwhile to try to substitute this as a single GAAP index without looking at the year-by-year GAAP indices.

IN SEARCH OF A SINGLE GAAP INDEX

GRAPH 11

YEAR	STANDARD	NONDEFERRED ACQUISITION COST	10-YEAR DAC AMORTIZATION
1	12.0%	9.4%	8.4%
2	12.0	12.6	11.6
11-30	12.0	12.6	22.6
AVERAGE			
Level Production	12.0%	12.3%	15.3%
Production Increase @ 15%	12.0	12.0	11.8

We want to try one more index that may be supplemental to all of these other indices that you are looking at. This is something we labeled the Management Horizon Index.

$$\sum_{t=1}^{n} \frac{\text{Distributable Earnings}_t}{(1+i)^t} + \frac{\text{GAAP Net Worth}_n}{(1+i)^n}, \text{ where } i = \text{hurdle rate}$$

Consider that your management is only concerned about GAAP performance during a certain period of time, say, to the end of its incentive compensation agreement or to retirement.

In that case, if management has a hurdle rate of I that it wants to achieve, then what management should be looking for is to maximize GAAP profits discounted at that hurdle rate during that period of time. So, the formula we have shown here is a summation over the management horizon of distributable earnings, discounted back at the hurdle rate, plus the GAAP book value at the end of that time, again discounted back at the hurdle rate. This would be an interesting index for management to look at and, if you discuss this with management, it might be something it would want to see. The implication of an index like this, of course, is that it dumps on future management. You may have two GAAP products, one with the higher early duration GAAP earnings and one with greater GAAP earnings in later years. This index will choose the one with the higher early year GAAP earnings. Still, in real world situations, this may be something you want to look at.

PRICING METHODOLOGY SURVEY

We sent a survey out to all Product Development Section members that were not employed by reinsurers or consultants. What we were looking for was direct life insurance company pricing methodology on recently developed products. We asked the companies to identify themselves as stock versus mutual, and then by size of company by assets.

PROFIT MEASURES FOR UNIVERSAL LIFE

There were not too many surprises in the profit measures looked at. Let me break this down between stock and mutual companies. We have about 80 stock companies' replies. The heavy favorites were profit margin and internal rate of return. Profit margin still seems to slightly outrank internal rate of return in popularity. There was no pattern by size of company. The smallest companies and the largest companies seemed to show roughly the same proportions. There were a lot of dual goals; a lot of companies said that their primary goal was internal rate of return with the secondary goal profit margin or vice versa. A lot of companies looked at break-even year five to ten years on reserve. Looking for break-even on cash value in five years also seemed to be popular.

The profit margin goals did vary considerably. If I had to pick a median profit margin goal, I would say about 6% pre-tax, but it did vary quite a bit. Regarding an internal rate of return, that was very interesting. It indicated that 15% was used by about 2/3 of the respondents on internal rate of return. About 1/3 of the companies who say they use internal rate of return say they use it

with target surplus added in. There was no pattern there, either, except that I noticed the very largest stock companies seemed to use target surplus a lot more than the smaller companies. The interesting thing about this is when you look at the absolute value of the goals, the average internal rate of return without target surplus was actually smaller than the average goal with target surplus. Since adding target surplus lowers the internal rate of return, I found that to be a fascinating result.

One of the measures I asked companies to mark down was whether they use GAAP ROE as a profit measure. I did get half a dozen responses from companies that use ROE. I am not sure what it means when you say you price for a 15% return on equity, given that it is going to vary year by year, so that was a poorly phrased question.

Another thing that was interesting is that I asked for the pricing horizon -- how many years companies look at to calculate these profit measures. The vast majority of companies are saying they look over a 20-year period for universal life. One out of every four or five companies said that they are measured out to 30 years or to maturity of the product.

Some people wrote in comments. The most amusing one I received on the profit measure was that they put in a primary measure but for the secondary goal, they wrote in "whatever is necessary to be competitive even if money is lost."

For mutual companies, the biggest mutual companies were not represented, but, from about 20 responses I found, interestingly, profit margin was a pretty popular goal. There was also quite a significant representation of accumulated surplus and internal rate of return. The profit measures overall for a mutual company were a little bit lower than for a stock, but not as much lower as I might have anticipated.

TARGET SURPLUS

We asked companies what level of target surplus they used. We got no pattern by size of company there either. Rather than categorizing the company by just its size, we perhaps also should have asked whether the company was a subsidiary of a larger company, because I had one stock company less than $250 million that had a pretty elaborate target surplus formula, then I had another stock company greater than $5 billion of assets, and it had the same elaborate target surplus formula. So I looked them up in *Best's* and found that, sure enough, one was a subsidiary of the other.

It seems to be pretty common for universal life to use, say, 3% to 4% of reserves and some amount per $1,000 and that amount per $1,000 can go all the way from $0 or $1 to $6 per $1,000. A handful of companies use 25% of expected mortality, instead of a per $1000 amount. I expect that might be based upon the Lincoln National paper that came out a few years ago where that was suggested as an appropriate measure.

FEDERAL INCOME TAX

It was surprising to me how few companies said that they included federal income tax in their profit measures. I would have thought that in calculating things such as internal rate of return the fact that tax reserves are different from statutory reserves in many cases would have prompted companies to include tax, but fewer than half of the companies said that they use tax. That is for stocks. For mutual companies, it was more than half. There were a few

companies that use tax for calculating internal rate of return, but do not use it for profit margin. That is appropriate because you can get some anomalous results if you calculate a profit margin with tax and if you have tax reserves that are different from statutory reserves. It depends upon what this profit margin measure means to you. You have to get a clear picture of what it means to you, and then you have to decide whether or not the after-tax number has meaning.

For mutual companies, we asked the question about how the surplus tax was incorporated into the pricing. The majority of the companies based that extra tax upon accumulated surplus generated by the policy. A few of the larger mutuals (larger among the ones that responded) did say they used target surplus as a means of allocating the surplus tax. One company said that it did it simply by decreasing the base profit objective and did not include it specifically. We asked the mutual companies what number they assumed for the differential earnings rate. I got numbers ranging from 7.5% to 9.3%. I can understand 7.8% because that is what the tax bill said was the initial rate, and I can understand 8% because that is 7.8% rounded up, but how companies came up with 7.6% and 9.3% is a mystery.

SCENARIO TESTING

Only about 12 companies out of the 100 responses said that they use stochastic interest rates to test the profitability of universal life. There was no pattern by type of company. If I had to speculate why the representation among smaller companies was just as large as for larger companies, I would probably say that it is because some of these smaller companies have a much larger proportion of interest-sensitive business and they have to do this kind of analysis to make sure that they are going to be around in five years. Maybe in larger companies it hasn't yet reached that stage. We also asked if any other stochastic analysis was done and one company said that it does stochastic analysis of mortality. It did not elaborate as to how it does that.

EXPENSES

We asked companies if they use fully allocated expenses, in-between full and marginal pricing, marginal expense assumptions, or other. It was almost 50/50 between the full and in-between, and there were only three companies that said they use marginal pricing. We did get some interesting comments. A lot of people wrote in saying that they use full allocated expenses but at sometime off in the future (say, five years from now) with projected sales. There were a number of comments like that. One company said it uses full allocation of "optimistic expense levels." Another company said it uses "full allocation of target expense levels." Another company just checked "other" and wrote down "wishful thinking."

PROJECTIONS

We asked the question: "Do you do simply per unit pricing, do you project the product results, do you project all new business results, or do you also project results with in-force business?" About 1/4 of the companies said that they projected out all new business along with in-force business in order to project the year-by-year profitability. Interestingly, it was more heavily weighted toward the smaller companies than the larger companies on this. Again, I suppose for the smaller companies it is a matter of survival and surplus requirements over the next few years. They have to project everything out to make sure that they are still going to be in business three years from now, whereas a large company perhaps can rely a little more upon projection of trends to realize

that no matter what happens to new business, overall, things are going to change kind of slowly. There was one company that said on its single premium life that it modeled production versus competitiveness on the product. There may be others. We didn't ask that question directly. There were a couple of companies that said they compared their expense allowances with the sales forecast. About half of the companies only do per unit pricing. About a quarter of the responses were in between. Again, this questionnaire was directed at pricing actuaries. The corporate actuary may be doing additional modeling.

MR. WALTER N. MILLER: The general comment is just to repeat something that I've said before at sessions on similar subjects which is to wonder whether many of us who say that we are product development actuaries or pricing actuaries, are we really developing and pricing products or are we merely constructing illustrations?

I have a question for Shane. As I understood your description of the macro method, it's largely based on analyzing or projecting bulk dollars of profit or present value of profits. If that's true and having heard Doug's summary which indicates that it seems a lot of companies have financial pricing goals that are capped in terms of various sorts of percentages, be they margins or internal rate of return (IRR) or ROE or whatever, how would you adapt your method in a company that has some sort of percentage animal as one of its primary financial goals?

MR. CHALKE: I think the basic answer is that you can't. In attempting to do any kind of macro analysis the basic intent is an optimization procedure; you can't always get what the goal is so you get the most that you can. However, you can use some sort of a percentage goal as a minimum hurdle. In other words, you can make a management decision that says if we don't get a 3% of premiums we're just not going to do with it at all. Then you optimize and see if your optimal price structure gives you 2% of premium and then you abandon the project. But I think the entire idea of macro pricing completely abandons the idea of a profit goal because of the fact that in today's environment, or, I say, in any competitive environment, you really just can't choose how much money you are going to make. It's just not that easy.

MR. POLKINGHORN: Before you start off, I've got a question I'd like you to expand on. In your analysis, do you do anything about the pattern? Do you come up with an optimal present value of profit based upon a price and your projection of the demand? Do you then tool around with how that profit may average in the early years versus later years? Things that would influence an ROI.

MR. CHALKE: Actually, you have opened a real can of worms. What we actually do as part of our pricing process is we'll do the analysis of the various interest crediting and investment strategies. We have been using exponential utility functions for many years to condense these numbers down into a single risk-adjusted value to the company or risk-adjusted value added to the company. I guess the way you characterize it best is to combine exponential utility function and option pricing theory to discount the cash flow. I think ROI is a significant measure. However, I would apply it quite a bit differently. I think insurance companies do two things and they can be divisible. Insurance companies sell insurance and they are also investment companies. The typical ROI that actuaries will calculate (and there is usually one on book profit which is sort of a fictitious entity) is really statutory profit adjusted for the flaws of

statutory accounting. To calculate ROI and say book profit or statutory profit, what you are really doing is intermingling with two ventures of the company.

We tend to look more, if we are going to look at ROI, on pure cash flow rather than try to mix in the investment component. I think that avoids some of the problems that Claude Paquin noticed in his paper. If we separate the two entities a lot of our problems as to what this ROI really means tend to dissolve and go away.

MR. LYNN C. MILLER: I think the obvious question that a lot of people would ask is in the macro pricing approach; somewhere along the line some recognition of overhead expenses has to be taken into account or at least looked at. It's my impression that in many companies, the fixed expenses are a significant portion of the total. Just one other comment. If we were starting a brand new company today and using this pricing methodology, would there be a point where the thing that caused the fixed expenses to start weaving would be considered marginal in pricing certain products?

MR. CHALKE: That's a good question. I'll answer the second part first. If you had a brand new company, what's marginal and what's not really depends on what the question is. If you're doing analysis and the question that's asked is should we start this company or not and you haven't spent these start-up expenses yet, I would analyze them all as marginal because our decision set includes to go with the company or not go with the company. If I'm faced with the analysis task of how much to charge for products and it's predetermined that we're going to start the company, then those expenses are sunk -- the start-up expenses. There is nothing I can do about them. The first part covering overhead, it's important to realize that macro pricing is really much more than just doing projections of product. The key component is the fact that you consider it an optimization process -- if you optimize profits which are marginal to any course of action. In other words, you maximize those profits by taking a particular choice from a decision set and you haven't covered overhead within the context of the decision that you are asked to decide on is nothing.

Let's expand the decision set and perhaps open up the question to not doing the project. Or not being an insurance company. Let's grow corn or let's be a bank or what have you. Within the context of any decision set you look at what's marginal. Now an interesting point is if you expand the decision set to include should we be an insurance company or not, everything is marginal. The point or the base line is that what's marginal and what's not can't be determined outside of the context of the particular question or a particular decision. So the idea of doing expense analysis and dividing things up, overhead and marginal, is really a misnomer. You have to know what the question is before you can decide that.

MR. POLKINGHORN: Would you then say, when you get to that point when it's impossible to cover overhead, "We just can't do it." What happens in your experience? Surely the company doesn't say let's go grow corn. Don't you look at some of these assumptions? It looks as if the results are very sensitive to what is assumed on production versus price, and wouldn't you rather say, "Okay, we recognize there is some imprecision here. Perhaps our best goal is to try, albeit at a risk, to charge a price that's outside the graph that we drew but higher and see if we can't achieve a sales level that will help us cover overhead."

MR. CHALKE: I guess I would have two comments on that. First, some companies do decide to grow corn. If you determine to the best of your ability that you can't make money in a certain venture, I think the best thing to do is not do it. We have seen many of our clients abandon projects based on this type of analysis. One of the advantages, I think, of a macro approach is that it really breaks companies out of this infinite loop of every product is better than the last product. Everything gets squeezed a little more each time.

Doug characterized the marginal pricing as run like a deer, and the overhead price was the cow. What we find in moving toward this marginal optimization approach, the most common result is that companies will back off a little bit from this extreme pushed competitiveness and actually come out with products that are a little higher priced based on this type of analysis, so it is a little bit opposite of what you guess.

MR. POLKINGHORN: I guess the thing that I was trying to get at was it looked like the sensitivity of the results to those assumptions made are as great as or greater than the sensitivity to the asset/liability risk. For example, do you do any sort of sensitivity test off of the demand curves that you create?

MR. CHALKE: I'd say that something close to half the time you'll get sidetracked in that fashion by looking at perhaps different assumptions about demand. Most of the time we're involved in what I call the "uncooperative situation." We're looking at things that are as objective as possible and trying to back out implicit assumptions about demand curve. Now I have seen situations where you might have a very high multiple, in other words, management says we really need this price, this competitive profile, and the analysis shows that we need to do 17 times the production that we are doing now. I have seen decisions made where the result will be, well we are just going to have to try to do 17 times the production. At least you know what it is you are assuming and what your goals are.

I think although there are many subjective sensitive assumptions, the important thing for me, I suppose, is that all of the assumptions are already being made within your companies. You just don't know what they are. This methodology is no more subjective than any other and in fact the bottom line is you can't get out of making subjective decisions because all economic decisions are subjective. You can try very hard to objectivize things, but you can't. Here I think we have the best chance of making a reasonable subjective assumption.

MR. GARY CORBETT: I have a question for Shane. Over what period of time do you generally look for the expenses to be variable, to be marginal? To classify them as such, are you looking to a 2- or 3- or 5-year period or just a 1-year period?

MR. CHALKE: I'm not sure what you mean by time period in expense.

MR. CORBETT: Well, so many expenses are not marginal in the short term but are marginal over a longer period of time. You don't cut underwriting staff as soon as production goes down and so on.

MR. CHALKE: That's right. I think rather than look at time frame we'll look more in terms of the ultimate results of each path in our decision set. For instance, if one of the paths in our decision set is to charge a high price and sell a small volume, we might start asking questions. When the volume decreases

are you going to lay off underwriters? If the answer is, "No," then you say, "Well, are there other very valuable tasks that these underwriters could be doing that they're not doing now?" Or, if production stays at a small level indefinitely, will you eventually decrease your underwriting staff? The answer is probably, "Yes" through attrition, that sort of thing. We'll try to find out what the most likely actual expenditures will be given that we go down a particular path in the decision set. The way we characterize marginal expenses is we just look at total company expenses by taking an action and subtract from that total company expenses from not taking the action and just look at the difference. That's really the most rigorous definition. I think it is more decision related rather than time frame related.

MR. PHILIP J. T. CERNANEC: Shane, about your model -- where you have a lot of fixed expenses on the front end and you come up with an answer that says 17 times production is required, one way to approach that might be to look at another way of structuring the project so that your front end expenses can be moved into a variable range, such as systems development, where you might move into a partnership or venture operation that can take that huge front end expense and divvy it up into something that might be more digestible and you can look at a production level. It might change a little bit of the slope of the curve later on but you might find your break even and threshold for the success of the project is much shorter than 17 times production.

MR. CHALKE: I agree with that completely. I did way oversimplify, but, in fact, we will end up with a different set of marginal expenses for the different production levels as well. You might very well say at a very low production level we might buy a PC system for $40,000 or something and at a high production level maybe it costs us a great deal more or conversely at a lower level of production maybe you do third party administration or something like that.

Again, the goal, and it's good to always keep this in the front of your mind, the goal is reality. So you want to try to characterize in the modeling process as much as possible what is really likely to happen, given that you go down a particular path, and rarely will you end up with a situation that's as simple as OK, it's going to cost $285,000 for systems work because even that cost will vary as the production levels vary.

MS. REGINA MCDERMOTT ROHNER: Shane, I have a question for you concerning how this method would be adapted to something using direct response methods where, as you increase the production and response rates fall with larger volumes, your marginal costs increase.

MR. CHALKE: I guess I would turn that around and say I think macro pricing is what you people already do, when you do direct response analysis because you tend naturally to look at the big picture, looking at what your mailing costs are, what your large fixed costs are , once you decide to do the mailing and looking at various response rates and so forth. I think it is a more natural approach and for some reason people find it a lot less controversial when you apply macro pricing techniques to mass marketing type situations. In my experience, many companies that are involved in mass marketing really already use these sorts of techniques.

MR. JEFFREY G. STEVENSON: I'd like to comment on Shane Chalke's presentation with a thought I think will add a different perspective and perhaps simplify his remarks. It is an analogy to Henry Ford. Was Ford an actuary or

marketer? When we think of Henry Ford, we think that he invented the assembly line which lowered production costs, then lowered prices and as a result sold millions of $500 automobiles. This is the classic view of Henry Ford as an actuary. Let's look at our costs, add our profit and go to the market. In fact, Henry Ford was a marketer. His thought was that if he could set the price of cars at $500, he could sell millions of them. He then had to figure out how to sell cars for $500. The assembly line was the result, not the cause of cars costing $500. Henry Ford repeatedly emphasized this point although most of us (actuaries at heart) refuse to let this sink in. They would first determine the price at which they felt the most sales would result, then figure out how to meet that price and thus optimize their profits. Of course, we're not in the same type of manufacturing environment, but the parallels are remarkable. We see it happening all the time. Price competition is forcing us to dig for profits and squeeze expenses. The key point is to set the price where expected sales levels will optimize profits. Don't start with the current cost factors and then determine the price.