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## Session 44PD

### The Role of Futurism in Creating Actuarial Models

**Track:** Futurism

**Moderator:** ROBERT G. UTTER

**Panelists:** PETER C. BISHOP<sup>†</sup>  
STUART KLUGMAN  
MARK C. ROWLEY

**Recorder:** ROBERT G. UTTER

*Summary: This session identifies meaningful, evolving dramatic insights arising from the studies and techniques of futurism. It shows how such insights are measured and affected by each other and existing dynamics through the use of actuarial models and related tools.*

**Mr. Robert G. Utter:** I am the Chairperson of the Futurism Section. One of the challenges that the Futurism Section has faced from its beginning is being able to demonstrate how applied futurism can help actuaries in their daily work. The first big step was taken several years ago with the writing of the Applied Futurism Study Note. I don't know if many of you have seen that. It is available from the Society of Actuaries. One of our presenters, Dr. Peter Bishop, was a co-author of that study note, along with a member of the Council, Alan Mills.

The next step coincided with the restructure of the exams when the study note was added to the Course 7 materials. Now, we're taking the next big step, which is to present a new case study that, hopefully, will become part of the Course 7 core curriculum. Our panelists are the three people who have developed this case study. On behalf of the section, I would like to thank them for their time and effort in producing this case study for Course 7.

Dr. Peter Bishop is an associate professor of human sciences and chair of the Graduate Program in Studies of the Future at the University of Houston, in Clear Lake, TX. One of a few places in the United States where you can actually take courses and obtain a Master's degree in Studies of the Future.

He specializes in techniques for long-term forecasting and planning. He delivers keynote addresses and conducts seminars on the future for business, government, and not-for-profit organizations. He also facilitates groups in developing scenarios, visions, and strategic plans for the future. He received his Doctorate degree in

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sociology from Michigan State University and received his Bachelor's Degree from St. Louis University where he also studied mathematics and physics. Some of his clients include IBM, HealthTrust, Toyota, Shell, and the Defense Intelligence Agency.

**Dr. Peter C. Bishop:** I have worked with the Futurism section for about five years now. We're still at square one. Today, I hope, we're going to move to square two.

I want to commend the Society of Actuaries. Your Society is the only professional association that I know of that actually has an explicit section for looking at the future the way we do in future studies. Your colleagues in accounting, law, and whatever, don't seem to believe the long-term future exists. They simply ignore that part of their life.

The subtitle of this talk is that Futurism meets Actuarial Science. This meeting, however, is like PT 109 meeting the Queen Mary. Futurism is not exactly on a par with the Society and actuarial science in general, but we are still trying to figure out what it is that we futurists can offer you from our views and our perspectives.

My presentation will consist of a case of how applied futurism fits into your job and the job of actuarial science. I can tell you up-front that futurism is not going to take over actuarial science. In fact, it will always be a small part of the actuary's job. But as you will see, and I hope you are convinced by this case, it will be a vital part. Much as the seasoning is sometimes the most important part of the meal, so your look into the long-term future the way we do in future studies at the University of Houston—Clear Lake is something that we definitely want to share.

I will outline the case. Unless we get your ideas and your reactions, we don't know where we stand. So this is to some extent a challenge. Is this something that you and other actuaries could use?

Let me talk about our objectives then, which is basically to make this case, and then Stuart and Mark will be talking about introducing materials based upon these ideas into the modeling course which they both teach.

Let me just start by reviewing things that we know well going from the known to the unknown. Modeling, of course, is the representation of some system in a valid and useful manner. There is nothing strange there. Models in my estimation have three basic components. They have the form, which in a mathematical model would be the equation itself. They have parameters, which are the estimated coefficients and various other numbers that are required by the model in order for it to be specified. Then there are the boundary conditions or the initial conditions which set-up the model. There is nothing strange there either.

If you are going to make a forecast using that model, then you must also assume that nothing major is going to change between now and the time horizon of the forecast. Well, of course, we always assume that, but therein lies the problem. If you can make that assumption validly and strongly, then you don't need future studies, because the model is as good as it's going to get. But if you can't make

that assumption or in long-term forecasts where you make that assumption at your own peril, then we futurists come in.

Future studies basically takes over when the assumption of continuity in models is a weak assumption or in which there is some reason to believe that one might not be able to use the same model throughout the whole forecasting period. That's our charge and that's our purpose.

I believe it's a serious one, because one can't simply go blithely along saying, "Well, we'll just assume that the world will stay the same, particularly over the next 15 or 20 years." With the pace of change the way it is today, that assumption has not been true over the last 20 years, and it probably won't be true in the next 20 either. So the question is, "If it's not true, then what do you do?"

Well, we make a distinction, and this distinction to some extent divides our two professions. The distinction is between prediction and forecasting. When I give talks as a futurist, I say futurists don't predict, because predictions are almost always wrong. Actuaries, on the other hand, do predict. That is your business, and you have to be as right as possible, because the people making the financial decisions that use your models need to have as clear and precise a prediction as possible.

We've learned how to make predictions, I believe, in the more well-studied areas of science: physics, and chemistry, even biology, and the other areas in which mathematics does a lot of good. The problem is that we walk that over to domains where we are not so sure. But it's the only model we have or, more precisely, the only model we have learned. So if we can predict the phases of the moon, why can't we predict the Gross National Product? Why can't we predict the outcome of an election? Why can't we predict the outcome of a new technology—when it will appear and what its consequences will be?

Unfortunately, we're dealing with two realities here and, again, we go back to the nature of assumptions. In a physical system or in a system of large numbers or in actuarial systems, the assumption of uncertainty is fairly weak. You are quite certain about the history and the theory that you're using.

On the one hand, in some systems and in some areas even in your own case, that assumption is not. Therefore, we make forecasts, statements about the future, even though the assumption of continuity and the assumption of negligible uncertainty are not well supported.

There are two ways that we deal with assumptions, and I characterize that as the good news and the bad news. An assumption, basically, is made to resolve an uncertainty. It's to say we really don't know what the outcome or this effect will be, but we assume it to be this way so that we can proceed with the model. If the uncertainty is small, that's a great thing to do. That's exactly what needs to be done. If the uncertainty is large, however, then that's where the risk comes in and

that's where there is danger of making an assumption when, in fact, it ought not be made.

Now, we tend to make it anyway, because we don't know what else to do. I mean we're not going to sit there with the model sitting right in front of us and say, well, I can't assume continuity, so I'll just throw it away and go to lunch. We have to make that assumption anyway. In future studies we don't make that assumption. We don't allow ourselves to make that assumption. Rather we deal with the uncertainty directly.

The uncertainty comes about in two ways. There are uncertainties that are tractable. They're uncertainties that we can manage and handle with enough time, with enough money, with enough research, and with enough data. We can get more information. With enough analysis, we can get a better theory and a better model. But they're also uncertainties that are not tractable. One form of these are the uncertainties that arise from the newer mathematical techniques of chaos.

Chaotic systems, systems in chaotic states, aside from all the Madison Avenue hype about the name, are, of course, a very interesting set of systems. They are a new class of system states that break the relationship between determinism and predictability. A chaotic system is deterministic, future values are based upon previous data points, but it is unpredictable in the medium term, nevertheless.

Prior to the discovery of chaotic systems in the 1960s, it was assumed that if a system was deterministic, it was also predictable. The other type of system, known for over 100 years, is the random and stochastic system.

Now we have a third type of a system that is deterministic. Every single step is mathematically a function of the previous step. But since it is sensitive to initial conditions, it is unpredictable in the medium term. That is a new kind of a system. There's no amount of research, there's no amount of study, there's no amount of data, that are going to solve that problem. So we have degrees of uncertainty that are not open to traditional and classic ways of reducing uncertainty down to any little epsilon that you'd like to see.

Another type of uncertainty originated in the Santa Fe Institute. They are known as complex adaptive systems or emergent systems. These represent a whole new way of looking at a system. These systems are not parameterized models, but they are modeled as the actions of independent agents. Without going too deeply into it, these systems produce emergent phenomena, phenomena of a higher level that are unpredictable given the rules of the agents.

Some of you may have heard of Edward Conway's Game of Life, a very simple, little two-dimensional set of pixels that turn each other on and off, given the local conditions that each one has. There are structures that emerge in there that I'd defy anyone to predict given the rules of the game.

Sugarscape is a complex adaptive system recently created by the Santa Fe Institute to model world conditions. The metaphor is little ants working on little sugar piles. Out of that one gets global structures, trends, and arrangements that are quite remarkable—emergent properties, unpredictable, sometimes called self-organizing properties. Again, no amount of research will lead to that.

Then, of course, we come to a philosophical class of problems: Are we free or not? Now, in the mass, human freedom tends to cancel out, and the degree of uncertainty can be quite small. But the actions of a few influential people could be also considered unpredictable and intractable.

So my point is that it is not always possible to reduce the uncertainty down to whatever level you need to through continued research. There are intractable sources of uncertainty that must be dealt with in a different way. Not a way that does away with actuarial science, but comes into play when it needs to. Those are what I call the different ways of forecasting.

Predictive forecasting you're very familiar with. This is actuarial science. Futures forecasting is what we do: there are many domains, it's very complicated, very fuzzy, and there are no real clear solutions. But, most importantly, we do not come up with a single inaccurate forecast. Rather we project a range, a plausible forecast and that's the trick. Does one give up in the face of intractable uncertainty? No. One looks to where that uncertainty is going to appear and how to handle it.

Now, it's not a 100% solution. What does one do with a decision in the face of multiple, plausible forecasts? Well, that's a decision-making problem, but that's what those folks, I believe, get the big bucks for. I mean it is not up to you, it's not up to me to solve the problem of the future for them if, in fact, they are facing intractable uncertainty and risk. They'll just have to make the decisions on that basis. It's not a situation that we like, but to me it is preferable to simply assuming away the risk and telling people, "well, my model is okay and now you can go ahead and proceed on the basis of what you want."

Bob mentioned that I worked with the Intelligence Agencies on their forecasting and estimation. Frankly, they're in the same position that you are. The decision makers would prefer to make the decision because the computer told them so, rather than having to make the decision in the face of all known risks and uncertainties. In the professional capacity it is necessary not to maximize risk, but certainly not to minimize it either by assuming it away. Therefore, how do we include the risk in the forecast?

The risks involved have to do with assumptions. Where are the big problems in forecasting? Forecasting accuracy is not usually a function of the data. The data are excellent. The big problem is not with the model either. The models are pretty good. It's the assumptions that people make surrounding the model that turns out to be inaccurate. So futurists use forecasts to reflect back on people's

assumptions. What assumptions are you making and, therefore, what alternative assumptions could you make and how might the future turn out differently? So, basically, there are three types of forecasts or three types of models that we'll be looking at. The point forecast is what you're all familiar with. It is the ideal. It's the scientific model applied to human behavior and actuarial science. You know it is a function of the data, and the model, and the initial conditions. No problem there. That's your science. You know it a lot better than I do.

Sensitivity analysis is a different type of forecast. We do sensitivity analysis when we have weak assumptions about the parameters. The parameters might be higher or lower than the best estimate. When that's true, one needs to create a range of forecasts using the typical kind of high, medium, low type of analysis. Again, I'm sure you're quite familiar with that.

There's a third type of forecast though that I'll bet you're not as familiar with and that's not where the uncertainty is in the parameters, but where the uncertainty is in the form, in the very basic equations that go to make up the model.

Do forms of models ever change? Does the world change once in a while to the point where models become useless and inaccurate? Absolutely. If that point, if that cusp, if that discontinuity lies within the forecasting time horizon, then the form is going to be good up to that discontinuity, but it is going to be wrong after it. Therefore, the scenario, which is the third type of forecast, is a function not just of data and forms, but it is also a function of the discontinuities that might arise.

Let's consider the sensitivity analysis. There are no discontinuities in sensitivity analysis. It is basically a continuous change from the present, although we are not sure about various rates. Identify the drivers, posit different conditions and values for those drivers, choose a parameter for each separate condition and then each condition becomes a scenario.

The sensitivity analysis is the type of model that Mark has in the Course 7 case that he will be talking about. It's an excellent example of a type of scenario that's a sensitivity analysis under conditions of uncertainty. Interest rates, mortality tables, loss rates—as you know—all of these are subject to great deals of uncertainty. I'm sure you do sensitivity analysis quite a bit. It is used when there are plausibly different values for critical parameters in the model. Again, this is nothing particularly different from what you already know.

Let's turn then to the third of those types in scenario development. Scenario development rests on a theory of change that is not continuous. The theory is called punctuated equilibrium, meaning that there are periods, long periods, of relative stability in the system where the forms and the models stay relatively the same. But those periods are punctuated with discontinuities.

The concept comes from biological evolution. Darwinism, you know, is a form of gradualism. Darwin thought every little generation, every little mutation, sooner or later resulted in speciation. For some cases I'm sure that's true, but most of the

fossil records show a different story. When you pull up the coral from the bottom of the ocean, you find long periods of almost no change and sudden periods of big change. Those sudden periods, obviously, mark the Paleolithic periods that we study—the Cambrian, the Jurassic, the Triassic, and so on.

Well, if that's true for that biological change, might it not work for human affairs as well? We go for relatively long periods of time and, unfortunately, the longer the period, the more we are lulled into believing that's the way the world is. Then sooner or later, Bang! We are subject to a punctuation, a discontinuity. Again, if that is to occur in the time horizon, then the model, obviously, isn't correct.

Take health care liability after managed care as an example. Now, I'm going to make an assumption that managed care changed the actuarial model of healthcare. Other examples are casualty liability after the hurricanes, the natural rate of inflation after e-commerce, and a future on—life expectancy after genome applications. Where does one put that?

Today, the debate in economics is whether we have changed the natural rate of unemployment, the productivity, and the rate numbers to this new kind of technology. Many of the traditionalists say no. Some of the new economy people say yes. Nobody knows for sure. So you have to admit, I hope, that once in a while the models do change.

Where do these discontinuities come from? Well, we're familiar with the super critical systems, systems that are on the verge of substantial change. The ideal type is when you drop little sand particles on a pile of sand, like an hourglass. If you drop them in an ordinary way, the cone forms a natural angle given the viscosity of the material. When it gets greater than that angle, it flows down and maintains the constant angle. If you drop it carefully enough though, you'll actually get an angle that is larger than the natural angle and pretty soon it collapses. That's a type of system. Systems under stress.

In the global atmosphere we may be even close to those kinds of systems. Ocean currents. We don't know where we are there. Complex adaptive systems I've talked about already provide novelty, emergence, and self-organization, and free choice and people can actually create new types of models.

Were there discontinuities? Are they hard to predict? They are probably impossible to predict. Again, that's why people give up. "Well, we don't know what those things are. There's no way of telling." They're right. There is no way of telling. Should we investigate the phenomenon anyway? The futurist's recommendation is "Absolutely!"

But how? What do you do? Pick some plausible discontinuities. They don't even have to be the right ones. As long as there's a sensitivity to the fact that the discontinuity might occur, one is at least alerted to the possibility of significant and long-term change going on.

There are two selection criteria. Impact is one. Pick those discontinuities that will have the greatest impact on the model. The second criterion is the degree of uncertainty. When I talk to other groups, at school or in training programs, the degree of certainty is often confused with the probability. People generally believe that if it's highly likely, then it's certain and if it's highly unlikely, then it's uncertain. Well, of course, that's not true.

The most uncertain is the 50% likelihood, the flip of the coin. We've never investigated that territory. We have always been taught not to say anything if we don't know what to say. At 50% probability you don't know what to say, but that's when futurism takes over.

That's when futurism says, "That's the point we need to talk about, because we have a branching structure. We might go to A, we might go to B. We need to understand the model under those different conditions of uncertainty." High impact, highly uncertain futures are where scenarios come from.

Obviously, if you have different parameters, you'll have a forecast of a range of your outcome variable. If you have different forms, you're actually forecasting what we call a new era—a new set of relationships among variables that require new forms and new understandings. You can't predict when that's going to happen, but you need to prepare for it nevertheless.

Let me conclude then by saying that we don't just assume away uncertainty, we manage it, both through sensitivity analysis and through scenario development. There are times that you can approach a difference in degree and actually create a difference in kind.

My favorite example is the motion picture. Motion pictures, you know, made in the 1900s, 1910s and 1920s were jerky little affairs where everybody looked like little puppets. The problem was technical. Running film at about 15 or 20 frames per second was too slow. The speed of the eye, the speed of the neuron in the optic nerve, is 25 frames a second. If you go from 20 frames a second to 30 frames a second, all of a sudden, everything looks smooth because we can no longer detect the difference between one frame and the other.

There is a difference in degree creating a difference in kind. How much of any of the parameters that you are dealing with once they get past some critical level might actually cascade into a tremendous amount of change? Significant uncertainty and poorly understood systems and, therefore, the scenario approach, whether through sensitivity analysis or through a new form, a new era is what we are recommending. The purpose is not to be right, but rather not to be surprised—not to be taken unaware about possible discontinuous change when it comes along.

Is considering the possibility of discontinuities necessary? I'll leave that question for you. Is it necessary for actuaries to deal with this degree of uncertainty, to face it, and to try and manage it with the best available tools? In this case, since it is

unpredictable, we manage it with the development of alternative scenarios when those are called for, when there are critical, uncertain, discontinuities which could, indeed, not just change the parameter some, more interest rate, less, but actually change the form in the relationship between variables.

**Mr. Utter:** Dr. Stuart Klugman is the principal financial group professor of actuarial science at Drake University. A position he has held since 1987. From 1984 through 1988, he taught actuarial science at the University of Iowa. He has a Ph.D. in Statistics from the University of Minnesota. Stuart has just completed a three-year term on the Society's Board of Governors, is Chairperson of the Committee on Actuarial Principles, and is the Common Core Chairperson for Course 7. He is a co-author of *Loss Models*, a text used on the current third and fourth examinations.

**Dr. Stuart Klugman:** I'm not a futurist. When we started putting Course 7 together we had a representative from the Futurism Section on our task force and we were encouraged to incorporate futures thinking into our Course 7 Seminar in Applied Modeling. We didn't do a very good job of it. Part of what I'm trying to do by working with Mark and Peter is to see if we can go a little bit further to make that happen as we develop Course 7.

For those of you who are not familiar with it, Course 7 is a four-day seminar. It's a required piece of the Society of Actuaries qualification system for Fellowship. We gather about 40 students together and lock them in a room for four days. We do case studies; talk to them; they give presentations; and then we give them a project which they have 24 hours to complete. We encourage them to sleep a bit during that period. They sometimes choose not to. We then grade the projects and if they're successful, they can move onto the next stage of their actuarial education.

What I'd like to talk about is how we're trying to get futurism into Course 7 and then Mark will show us exactly how we're trying to do that with something he and I will propose shortly to be part of the Course 7 curriculum.

When we set up the learning objectives that drive the content of Course 7, there were a number of aspects of it that clearly related to future studies. One is the feedback loop that we wanted to emphasize as best we can. One of the challenges is that in a four-day course it's hard to loop. You can maybe get through about one-half of the curve and you never do get a chance to come back on yourself and get back to the beginning. One of the things Mark and I are trying to work out is a way to get through more than one cycle of the loop in that short period of time on a particular case study project.

We're very interested, of course, in sources of error. Peter talked about that. Unfortunately, most of the things we do concentrate on those traditional sources of error: measurement error and data error. Model error may be measured from the uncertainties related to alternative things that could happen in the future. So we know that error is there. Our challenge has been to try to incorporate that into the course.

The same is done with sensitivity analysis. We're very good at having the students manipulate the parameters and see the effect of that parameter manipulation. We're still struggling with looking for a way to get them to manipulate broader aspects of the problem. Another learning objective is understanding the useful life of the model. That is, when will the future arrive? You have a model that looks pretty good today. How long a horizon can you count on it being useful and how do you know when it's no longer useful?

Now, we also stress communication in Course 7. In the study note that the Futurism Section created there is something called "genius forecasting." In a sense, I appreciated that it was there because in the chat rooms about Course 7, the people studying for it used up lots of bandwidth chuckling about genius forecasting and that kept them from concentrating on more serious issues that we might actually have had to do something about. But the issue of communicating your thoughts about the future is not easy and we're also struggling with ways to get that done.

When we've asked students to think about the future in their report, that was one area they had a hard time writing coherent sentences and working it into their overall document. By the way, the Futurism Study Note is number 7P-26-00—"Applied Futurism, an Introduction for Actuaries" and can be ordered from the Society office.

So, as mentioned, we could do a lot better although we have been sporadically using futurism in Course 7. Mark and I have done two Course 7s together. By together it means I would present the first day-and-a-half and Mark the second day. Mark has a full day to do a single case study. He has the opportunity to do a little more than just talk about the mathematical model, the estimation, and the sort of technical work we want the students to understand. He pretty much insisted that if you were going to do this, we would have to include a futurism component in his case study. I think it actually came off pretty well.

The case study issue was about mortality improvement. In particular, we used a good bit of brainstorming and scenario development and asked the students to perform some of those activities as they did their project.

So what do we hope to happen in the future? What's the future use of futurism? For Course 7 we hope the future is 2001. What Mark and I, mostly Mark, are developing is a common core case study and Mark is going to take you through our prototype, and so you're also a test group. Feedback would be excellent, so that when we do this for our Course 7 students, it will be a lot better than what you're getting today. We will appreciate your thorough interaction and involvement as Mark takes you through this exercise. We really would like comments on it that could make it go better as we develop it.

If this were a real common core case study you would have received something to read that sets up the problem and gives you a basic background. It might take you

through a few little mathematical exercises. When we meet the students, they are geared up and ready to think about it. Mark will take you through that pre-reading very quickly and give you a flavor of what you would have known coming into the room had you been a Course 7 student.

What Mark will do is lead you through an expansion of what was in the pre-reading, set-up the problem and end the first part with the homework assignment. At our Course 7 Seminar that would take place in the evening. In the evening the students break up into groups and we do it as group work. Typically, the groups consist of 3–5 students to work on the assigned task. There are typically multiple tasks and not every group works on the same set of tasks. But some of the groups would be working on the futurism task that Mark would have given them.

The next morning we start our second day of the Course 7 Seminar with the groups presenting their findings. There might be four groups of three working independently the evening before. In the morning they have about an hour to meet as a group of 12 to synthesize what they discovered the night before and create a unified presentation and which, also, then can get some critical feedback, both from the other students and from the instructors. Part of our goal is to make sure that everyone is left with the key points.

The students in the evening have generally been very good at getting 90–95% of the way toward what we would like them to have discovered during their homework period. Mark and I would just have to add a few more comments the next morning to make sure they got out of those assignments what we wanted them to.

Why do we like case studies? It certainly promotes brainstorming. It gives people things to think about. It allows us to give them problems that are large enough so there are multiple correct answers. One of the things we really hope comes out of Course 7 is if they haven't picked it up in their working life, for sure Course 7 candidates understand that there's no answer in the back of the book. There's no unique correct answer.

They can pass our course with a variety of different solutions. What counts is the quality of their support and that they communicate it clearly. That's another advantage then as it gives us communication challenges. It also makes it a little more like real life where things aren't clear. There's a lot of decision making. They have to figure out what's important, what's relevant in their reporting. What do you need to tell someone to explain to them what you've done, convince them you've done it right, and yet not overwhelm them with details to the point where they have lost sight of what you were trying to accomplish.

One of the things Mark and I would really like to get into the seminar is the feedback loop. You can reveal the future in stages when you do a live case study; give them some information; have them go work on something based on that information; and then they can return and go to the next step. If we're really

clever, the next step in the future could even depend on what they've done at the intermediate step.

I've seen statistical-based case studies that look like this. You send some people off to design an experiment and then they design the experiment. After that you give them the data that would come from the experiment they've chosen to conduct. Depending on what experiment they choose to do, they have different sets of numbers to work with to draw ultimate conclusions. They are in control of it a little more than if we had just handed them all the numbers.

Currently, the students are given all the data. They're told that you can't get anymore. There's no place to go. We're in this closed room. We can't go pull policy files. We can't go conduct medical experiments on anyone. Here are your data. The best we can do is to ask them to tell us what data they wish they had. But we'd really like to create an environment in which they could actually go get additional data. We have a box full of data, but they can only get it if they ask for it. So part of their challenge is to figure out what they really need to solve this problem. We're hoping we've anticipated those needs and then can supply it on demand to make it, again, look more like they're cycling through.

As they conduct an experiment and realize that it didn't reveal the answer, they can come back and maybe ask for some different data, conduct another experiment until their problem is solved to their satisfaction. I'm not quite sure how to pull all that off in the short time frame we have, but that's one of the things we hope to incorporate, particularly in our futurism-oriented case study.

To finish off, here's some parting logic. Here are quotes from the SOA Mission Statement. "Provide expert advice and relevant solutions for problems involving uncertain future events." We are the "leading professionals in the modeling and management of financial risk and contingent events. The obvious conclusion is actuaries model the future, therefore, actuaries should know about futurism.

**From the Floor:** Is there a limit to how many folks you move through this course?

**Dr. Klugman:** Because it's required for progression to FSA, we've been offering as many seminars as it takes to meet the demand. We've been averaging 1 every 3 weeks at 40 persons per seminar. We've been getting it done. It's been fairly difficult to manage from an administrative perspective. I think from a candidate's perspective it's gone fairly smoothly. Whether we can keep up that intense pace of offering 40 person seminars, I'm not sure.

We have a couple of Australian colleagues who have ameliorated some of the problem by using distance learning techniques. In their expanded version of this seminar, they don't have to be in the same room with all of their students. It's one of the things I think we're going to be investigating as an alternative way to deliver the Course 7 Seminar. Of course, you've got to find a way to manage the

interactions and the group work. Now, there are certainly Internet-based tools out there that help make that happen.

But our major challenge has not been the intellectual content or helping students learn. It's been site management, registration management, trying to process 600–700 students a year through this course. That's wound up, unfortunately, detracting from some of the time that would have been better spent on content development and helping bring some better learning to the seminar. Whether we're going to be able to stay with the current format and just eventually get good at offering this many seminars a year, that remains to be seen.

**Mr. Utter:** Mark Rowley serves as the education and research actuary at The Principal Financial Group. He has a Bachelor's Degree in Actuarial Science from Drake University. He's worked with long-term care, financial reporting for pension products and, most recently, with Capital Management. In year 2000, he served as a Course 7 Business Faculty Instructor.

**Mr. Mark C. Rowley:** When Peter was talking, I observed that he was talking about how actuaries try to be right. It didn't quite sound right to me. I know I tell my management all the time the one thing you know about this forecast I just gave you is that it's not right. Some of you have probably made similar comments to your management, also. It's certainly true as Stuart said.

Stuart took you through the normal Course 7 process, where there's pre-reading, and then a one-and-a-half hour lecture, and then homework. What you're about to see is quite abbreviated compared to all of that.

The other thing you might have noted in the program is that this session was still listed as a panel discussion. Well, you'll find that when you put on a case study, this isn't going to be anything like a panel discussion. I'm going to have you do some small group work.

The case study that we've been working on for Course 7 I'm calling right now "required returns by country". In most case studies you would need a problem to solve. In this case we're asking the students to think about whether we should invest money in a certain Latin American country. You can think about this in terms of, perhaps, there's a price for everything. So if we can get enough return, no matter what the risks are, maybe we'll go ahead and invest there. Of course, there might be some situations where the risk is just too great whatever the return is, we're not going to bother with that. So that's kind of my premise. We're going to quantify this with capital markets theory.

We talked about modeling in Course 7. This is the model that I've seen used by equity analysts, the kind of people that I work with.

### Capital Markets Required Return

$$R_x = i_{US} + ERP_{US} + SS_x$$

$R_x$ : Required return for country  $x$ , given the risk.

$i_{US}$ : U.S. risk free rate.

$ERP_{US}$ : Extra return U.S. equity investors demand to take equity market risk.

$SS_x$ : Sovereign Spread. Extra return U.S. equity investors demand due to risk in country  $x$ .

A fairly simple thing.  $R_x$  is this required return. So this is the return we have to think we can get to be willing to invest in this country given the risk/reward tradeoff. So you look at  $R_x$  as that and it's made up of three components.

You start with the U.S. risk free rate. Peter mentioned the Treasury Rates before. That's what I'm talking about here. You add to this next the equity risk premium. This is the extra return that a U.S. equity investor would demand if they're investing in the U.S. equity market, investing in the stock market rather than just buying treasuries. They demand this extra return. On top of that is what's called the sovereign spread.

Presuming that this Latin American country is even riskier than the U.S., we're going to demand even a greater return if we're going to invest in a Latin American country. So to cut to the chase here, make some quick assumptions. Say at some particular point in time, the Treasury Rates, the risk free rate was 6.75% and the equity risk premium was 5.5%. This means, in theory, that a U.S. equity investor would be hoping for 12.25%. That's what they've had to expect they would be able to get for them to be willing to take the risk of the U.S. equity market. So the required return for investing in this Latin American country then is 12.25%, plus the sovereign spread.

This is an oversimplification, but when equity analysts look at the sovereign spread, they're basically asking two questions. Will the country's inflation be under control? And, what's that country's credit rating? Basically, can that government pay its bills?

I suppose where futurism kind of comes into this or where I'm suggesting it should come into this is when you're thinking about this sovereign spread. Certainly, in a lot of these countries there are many different plausible futures. So how do we weight all these scenarios? In theory, you should weight all the possible future scenarios. Maybe you'd even consider scenarios constructed by futurists when you do this. Now, I don't know if capital markets are really efficient enough for you to be looking at scenarios constructed by futurists, although, maybe that does go on sometimes. This is kind of this efficient market hypothesis. Do we really have

perfect information out there? Probably not. But this all makes sense to me that it could work this way.

What I'm going to go through with you are several scenarios that were constructed by Allen Hammond and I just found these on the Internet. He works for the World Resources Institute. I want to talk a little bit about how a futurist can construct scenarios by looking at the key drivers of the future.

In this case, since we're interested in getting at that sovereign spread, what we're looking at is what are the key drivers that would impact inflation and impact the country's credit rating. There was a question earlier, how do you start to think in this way, how do you start to brainstorm and construct scenarios? That's not part of the traditional actuarial syllabus. We might not be sure that we could do that, but I'm sure some of you have used brainstorming in your jobs for various purposes.

I had a mortality case study I used with Course 7 in 2000. This was something that was based on a project that was done at my company, where there was just a bunch of actuaries who didn't know how to do this kind of thing. They got together and they figured out quite easily how to do the brainstorming techniques. It was a group activity and we wrote scenarios. So this is something that's not really rocket science, although, I'm sure if you were an everyday futurist you'd get a lot better at it. But I think the general concept is something that we all can do if we just have the discipline to force ourselves to brainstorm.

When I read the scenarios that Mr. Hammond wrote, these were what I thought were the key drivers; disparity in wealth/levels of poverty, social unrest/crime/corruption, environmental change/pollution/disease, governmental economic policies & political structures (democracy versus military rule), information technology, population growth, and materialism versus anti-materialism. These are the things that varied between the three scenarios that we're going to be looking at. If you think about these things, all these things impact inflation and the credit rating sometimes fairly directly, sometimes more indirectly, I suppose, you could say. The way that most scenarios are clear and I presume the way Dr. Hammond created these was by looking at different combinations and permutations of these driving forces. If you did that, you could come up with, I suppose, thousands of different combinations and permutations of these key drivers and write a story around those. But, usually, your management or even yourself, you're not going to be interested in reading thousands of stories. So you try to summarize them into a few key stories and that's what Dr. Hammond did in this situation.

We're going to be looking at three different scenarios that he called the market world, the transformed world, and the fortress world. The first scenarios applied to the world. One of the known things with the market world scenario is that what we see happen is governments around the world set sound economic policies. In the transformed world one of the key things is that you see a massive public attitude change toward anti-materialism and social responsibility. In the fortress world, this is by far the most pessimistic of the three scenarios, I guess. It says

that the economic boom does happen, but it leaves out the poor, so the disparity of wealth even widens from where it is today.

So as I said, we're going to focus on a Latin American country and this is just a generic Latin American country. I'm not telling you which one it is and I don't think you need to know that. Right now we can observe in the market that the sovereign spread is 5.75%. You remember the required return I had before was 12.25%, plus the sovereign spread. So, the required return in this Latin American country right now would be 18%, 12.25% plus 5.75%.

Most of you are probably familiar with this idea of a sovereign rating. A rating agency like Moody's or Standard and Poor's will rate each country. This is getting directly at that idea of the credit rating. So in my example, the sovereign rating for this country is BB, which is a below investment grade kind of rating. We're also interested in inflation. More specifically, we are interested in the ability to control inflation in the future. The inflation between 1995 and 2000 has varied from minus 2%, which would actually be mild deflation, to a positive 3%.

The next three scenarios apply to this Latin American country. In the market world there is an economic miracle by 2010. Things are very different in Latin America than they are now. Another interesting thing in this scenario is there is now an American Free Trade Agreement (AFTA), which was an extension of the North American Free Trade Agreement (NAFTA). So there's free trade between all the countries in North and South America pretty much.

The transformed world sees a rapid decline in wealth disparity. As many of you are probably aware in Latin America now, there's a huge wealth disparity. There are a lot of haves and have nots in that part of the world today. Based on the efforts of some visionary leaders and, also, a very strong base of community and religious groups, this situation has changed. Not that there are no poor people anymore, but there's been a big change in that. There's also a lot of improvement in infrastructure. Schools are constructed, especially in these rural, poor, areas and land is given to the poor, so their economic status could be improved.

In the Fortress World, another scenario which seems plausible to me, is that this doesn't happen for the poor. It's certainly not happening for the poor today in Latin America. So in this world the economic boom doesn't reach to the poor.

We finally are ready for your assignment. As Peter alluded to how futurists deal with ranges of numbers instead of single point estimates, well, I think actuaries do that a lot in their work, too. That's what I'm going to ask you to do. I want you to estimate a fair range for the sovereign spread. I'm going to give a third of you the market world to look at, a third of you the transformed world, and a third of you the fortress world. I want you to assume that you're certain that world's going to happen. I want you to think about what a fair sovereign spread would be for just that world.

Remember, the sovereign spread is 5.75% when you weigh all these scenarios together somehow. All the possibilities, should average 5.75%. I'm going to want you to think about that and recall the drivers of sovereign spread, the government credit rating and whether inflation can be under control.

I know one of the challenges we've had when we've taught Course 7 is when we've asked the students to think, outside of the box. I think it will be important in Course 7 for me to say at this point I'm not expecting you to be highly skilled equity analysts or accomplished futurists when you do this. Instead, I'm just challenging you to think. As I said earlier, there's no right or wrong answers with this exercise. You may very well come up with a better answer than me.

As you do this, you're going to be looking for details in the scenarios that you think would have some correlation or some impact on the government credit rating or inflation or the ability to control inflation.

**From the Floor:** Are you talking about equities or operations that already exist in those countries?

**Mr. Rowley:** Why don't you actually think of it from an individual instead of an insurance company perspective? You're just an individual with a certain risk tolerance and you're trying to decide whether it makes sense to invest in this. You can also think of it as an insurance company. Maybe it has some free surplus to invest and it kind of has some money to play with and it's trying to decide whether the risk/reward tradeoff is good here.

**From the Floor:** I just want to clarify. I'm not thinking of it from the perspective of starting a new business or developing an operation in one of those kinds of countries.

**Mr. Rowley:** No, you're not. You're just buying in equity securities.

**From The Floor:** Okay.

[At this time, the audience is broken up into three study groups for discussion. The Record picks up after the discussion period.]

**Mr. Rowley:** I wish we had more time, but we really need to wrap up. I'm sure you could spend a lot more time discussing this. I should congratulate all of you, because you've now done a futurism exercise. I think one of the things I've always observed about it, I haven't done a lot of futurism work, but when I have done it, I think it's a lot of fun, because, usually, it's a group activity.

Another artificial thing about what we're doing compared to the real Course 7 is that we have a lot more time in the real Course 7. The Course 7 should work better in that sense. First let's hear comments from the group who discussed the market world.

**Mr. James H. Murta:** I'm the spokesperson for the market world group. Through all the changes described in this scenario it would become an absolutely fabulous place to invest money. There are so many dollar-chasing opportunities that you just can't believe it. The sovereign spread we feel would be somewhere in the range of maybe minus one to plus three—fairly small because there is just so much opportunity. The chance to get in as part of this is filling us with enthusiasm. You almost get carried away with it. Why would you want to invest domestically when you have this great opportunity to be part of this expansion?

**From the Floor:** Absolutely. We go with the hype. We're going with the beaches. We're going with everything.

**From the Floor:** Sometimes I think we spend too much time discussing those issues, all of the aspects.

**Mr. Murta:** There was some disagreement over the range.

**Mr. Rowley:** Good. What I came up with wasn't a lot different. The minus one was interesting. It's actually less risky than the U.S. is what minus one would mean.

**From the Floor:** But that's giving credit for being part of the hype, part of the media.

**Mr. Rowley:** Some of the things I pointed to, such as, the economic boom is going to make it easy to control inflation, make it easy for the government to make their debt payment. Some of this stuff about the pollution, corruption, drug cartels is all very positive stuff and should have an impact on the economy.

Can we have a representative from the transformed world?

**From the Floor:** We were pretty optimistic after reading through this; this is a pretty good scenario. I think we focused right away in our scenario that political and social stability are no longer in question. So of the two risks, the credit risk we thought was pretty easy to get at and that's pretty low. So because of that factor we immediately felt that the sovereign risk isn't that high. Inflation was a little bit more difficult to get at. We weren't sure how large the size of the economy. Probably the runaway inflation is not very likely. But whether it would be a real low risk for inflation, that was sort of the uncertainty, so that's maybe where the range would come in.

We kind of settled on a number and didn't really get to a range. We were at first landing on around 3% as the average and then we kind of moved a little more toward 2% as we thought about it some more. So I guess our point estimate would be somewhere around 2% with a range around that and we didn't really nail that down.

**Mr. Rowley:** I came up with something that, again, was not a lot different. I came up with 1–4% for the transformed world. I probably emphasized a little less than you did the political stability or I said it in different words, so that's certainly a key factor. Certainly, one thing that's keeping the sovereign spreads in Latin America as high as they are right now is a question of how stable the situation is there. It might be a little more interesting with the fortress world and what the ratings were there.

**Mr. J. Thomas Liddle, Jr.:** Before we talk about the surcharge, the sovereign spread, we are concerned about the administrative costs. We believe, first of all, we have to charter a plane for all of us to go down there and look at the environment, get to meet some of these people and, et cetera.

We believe there is a very distinct possibility no reasonable investor would, in fact, get involved there. There may be, however, strategic reasons why you would really press yourself to do so. One would be that you're a company that has facilities there and do want to expand them. Another would be that it's a strategic reason, there's oil there, or there's tin, or something like that.

So, consequently, our range is very wide. We think there are circumstances where the range would be infinite. The top end of the range would be infinite. We believe that under these possible driver reasons that it could be as low as 12% surcharge on top of the 5%. In other words, 17% and it's 12% plus 5%. So, realistically speaking, if we were to do the investment, we think the range is 17–100%. Yes, the 100% being a proxy for infinity.

**Mr. Rowley:** So it's 17% to infinity.

**Mr. Liddle:** Yes, or 17–100%, whichever you prefer.

**Mr. Rowley:** I didn't go to infinity, I guess. But I think you're probably more right than I am. There are certainly investments out there that the risk is just so high we're just not going to go there, which is kind of the same thing you're saying, infinity. I like that thought process.

Now, just a lot of instability is what I would see. Economic boom not reaching the poor and so forth. So you didn't try to relate that back to what's going to happen to inflation. Is this government ever going to pay off its debts or are they going to be in a cycle of debts just being forgiven which happens in underdeveloped countries quite often.

Again, I wish we had more time.

**From the Floor:** I want to ask you something about taking an average of all your different scenarios.

**Mr. Rowley:** Well, I know when I was developing this case study and getting comments from Peter, he didn't like all the numbers that were in here. It's kind of actuarial futurism. I guess we need to have some numbers.

I could use all the numbers you came up with and weight that to 5.75%. I'm not sure about the infinity, but let's say it's a 100% instead. I could get to the 5.75% which is kind of what you observed in the market today. There is this element where you want to weight that and try to understand where the 5.75% came from. But we don't want to fool ourselves that this is a lot more accurate than it is. In this kind of exercise you can't really quantify things precisely.

One of the key elements and I was going to get into is how you use this to help make strategic decisions. So if you believe—and that's what I've been suggesting—that each of these scenarios is plausible, so it has some probability. I don't even want to tell you whether that's 5%, or 1%, or what. The question you have to ask yourself is if you believe that each of these scenarios is plausible, are you willing to make this investment? That's the choice that companies have to make with strategic decisions or we, as individuals, have to make. That, if you let me weight them however I want, I can get to 5.75%. That's not really what I did.

Like I said, futures and techniques do have a practical application. We're talking about applied futurism. In the case of the mortality scenarios futurism project at Principal, we wrote different plausible futures. We also considered the strategic implication that was in the project. So there was something that management could lock onto, and look at, and evaluate whether our current strategies are applicable.

I think if you really believe the market world scenario or the transformed world scenario, you would probably make this investment. In fact, there's a chance for arbitrage here, because we're thinking the 5.75% is really more than you need for the risks. If you believed the market or transformed world, you'd put as much money in this as you could.

Now, if you believe the fortress world, obviously, you come to a different conclusion and that's probably the issue here. How much do we believe in the fortress world? If you believe the chance of the fortress world is a lot less than the market is assuming, then you'd make this investment. If you were more on the pessimistic side and you thought the fortress world had a high probability, you're probably going to stay away from this situation.

There's also something in this futurism technique. I've been using the futurism scenarios technique. If you read the futurism study note that's been alluded to, there are lots of different futurism techniques outlined in there. The only one I've ever really done much with is the scenarios technique. In this case, say you made the investment. Now, you're not just going to buy and hold and just let that investment stay. You also want to monitor this and see if things transpire that might have you make a different decision about that. Either you're going to increase your investment, have no change, or maybe you want to get out of that

investment. That's what this leading indicators idea does. You know, identify items to track and monitor. You actually try to determine which scenario is emerging. From a practical standpoint what you'll see is there isn't one of these three scenarios that's emerging precisely. What's probably going to be happening is some combination of the scenarios given. There are some elements of each scenario that are happening.

So let's assume that we did invest. If you're monitoring things and things are transpiring, so you think the fortress world is coming. Things have changed. You're probably going to disinvest. But if the signs are more positive and it looks like the market world or the transformed world is emerging, you're probably going to do something different.

Let's think about this leading indicator's concept, because I think this is a key idea for futurism in using scenarios. We're trying to monitor and track which of these worlds is emerging. After brainstorming quickly as a full group here, what would you want to track? What would you want to keep track of in the world? What elements could you think of?

**From the Floor:** The broad view social program investment with educational levels.

**From the Floor:** Income disparity.

**Mr. Rowley:** You might want to track the social program investment, infrastructure investment in schools and that kind of thing. What else might you want to keep track of as you monitor this investment?

**From the Floor:** Movements to or from democracy.

**Mr. Rowley:** What's the progress toward democracy?

**From the Floor:** Trade agreements.

**Mr. Rowley:** Are they getting more opened or more closed? See this futurism stuff is easy, isn't it?

**From the Floor:** What kind of political activity or war type activity.

**Mr. Rowley:** Are they either formally at war or is there just civil unrest. Have a civil war idea within countries. Good.

**From the Floor:** Probably on the basis of efficient markets look at the change in the sovereign spread.

**Mr. Rowley:** Sure. You track the sovereign spread which is something you can observe in the marketplace. That's one of the more obvious ones I thought we

passed by. Another one that is probably too obvious to say is inflation which you'd probably track.

I think you've hit most of them. Of course, you'd have to figure out how to do this. What reports would you get? So you'd probably have to do some leg work to find what economic and market statistics there are. I can tell you in some of these countries you don't have a source of data that's as reliable as you can get in the U.S. The less developed a country is, the harder it is going to be to get information. You might look at reports on government spending for infrastructure. Try to get a sense for environmental changes, drug cartels, corruption and so forth that exists in a lot of these countries.

Well, Stuart talked about the feedback loop and I don't think we'll have time to do this as a small group activity, but this is the idea. I would announce to you that it's 10 years later and these are the things that have happened. Economic growth has been better. Inflation's actually up. So what was minus 2-3% in that earlier time frame? Sovereign spread is down. Sovereign rating is up. There's some good news in terms of corruption, the drug business, and rural infrastructure.

Now, if we had more time I'd have you break up and think about this question. If sovereign spread is now 4% and I just made all this up, of course, does that seem reasonable given all these things on the list? Or, would you have expected it to go a different direction? Any quick thoughts on that? It's all pretty subjective. It all requires us thinking outside the box, of course.

I'll give you the answer. Yes. The spread seems plausible if it's at least within a range. Another thing I can comment on from my limited experience working with these sovereign spreads, is that sometimes they can include a lot of financial information, like market information. There can be anomalies in these numbers. I think there are some situations in different parts of the world today where the sovereign spread just doesn't make sense. We think it's probably a temporary phenomenon and it will come back in to a more reasonable range at some point. But right now it's just out there and it's a statistical fluctuation maybe even in some cases.

I guess the reasons I gave to say yes is, inflation has been down. It's not to the deflation, but it's still in a pretty reasonable range, especially considering this part of the world. I would also consider all the news about corruption, infrastructure, drug cartels. You have to think a little bit to see what the tie is of those things to the debt rating and the inflation, but there is a tie.

I've talked about some good news on the drug front and some other things. Talked about where inflation was, where the sovereign rating was. Which world does this seem most like? Does it seem like market world, the transformed world, or the fortress world, or some combination?

To me, it seemed like maybe a mild version of the market world. You know, there was euphoria when the market world people came up. This was the greatest place

in the world to invest. In fact, it was better than the U.S. I don't think what I described was quite that good. Perhaps, that is my own version of the market world.

Part of the process and part of how futurism can be helpful here is you do this monitoring. You're tracking leading indicators and, occasionally, you might actually think it's time to update the scenarios. Maybe you stopped for 10 years in the fortress scenario. It no longer seems plausible. So maybe you want some different scenarios and it would be helpful at that point to update all the information.

We've given you some ideas as to how futurism can be useful in modeling and decision making. I think it's useful when you're making an initial decision and, also, as you're monitoring that decision. I think these techniques are, certainly, within the grasp of actuaries. We haven't been trained in them, specifically, but a lot of this comes down to brainstorming. Though, like I said before, you can get real good at it if you spend even more time on it.

So, again, we've used the futurism scenarios technique and part of that is this leading indicator's concept. These techniques, as Peter said, really help us to manage uncertainty and discontinuities. I think these are good examples if you think about what could happen in these countries. They're not on a steady stream where things are not changing.

In many countries around the world you can see in the last 10 or 20 years, there have definitely been some discontinuities in those countries, where things have gotten a lot better or a lot worse. You can't just have the past predict the future.

**From the Floor:** Mark, one thing that you didn't do at the end was evaluate whether you were happy to you have made the investment. When all is said and done the question might be how would this investment work out? Are we satisfied that we made it? I think the answer, clearly, here is yes, but we wouldn't take too much disturbing of the outcome to make it no. I think that this might be something that you might cover at the end.

**Mr. Rowley:** That's a good point. We didn't have an evaluation at the end as to whether we were happy to make the investment. Obviously, we were, because the spread narrowed.

**From the Floor:** Inflation wasn't too bad?

**Mr. Rowley:** It's also true that there's probably still a chance for a black cloud on the horizon that could change that answer very quickly. Yes?

**From the Floor:** Can I offer my congratulations on what I think is a very exciting and educational development? I think this is a component of the education of future actuaries which is likely to help them. I know a four-day seminar must be very crowded. But I think it would be very valuable for the students if at some stage toward the end they were given the opportunity to reflect on the process,

the brainstorming, the working together in groups like this to develop their own appreciation of the possibilities that brainstorming and working together can bring. I think that would be valuable to them. I think it's very exciting.

**Mr. Rowley:** You have a modeling seminar in Australia, also, as part of your syllabus. Is that correct?

**From the Floor:** The controlled cycle subject that in many respects is similar, yes.

**Mr. Rowley:** But have you done anything with futurism?

**From the Floor:** No, not as such.

**Dr. Bishop:** I did teach statistics before coming a futurist, so I'm not afraid of numbers. Sometimes I think they're inappropriate. I did do the averages of the three groups that you worked on. Your low ranges were almost identical with the market sovereign spread of 5.75%. If you average the low ranges, they were about 6%. For Mark's low numbers it was about 5.3%.

But if you take the high ranges, of course, in the first case, it's indeterminate. That raises the other question whether you should even invest at all. The average of Mark's numbers was more like 10%. So that your collective judgement was that the sovereign spread in this case was, perhaps, a little bit low given the possible alternatives. I think that is an interesting outcome. I appreciate it.

**From the Floor:** I think there's one more ultimate question and this is to Professor Klugman. How did the students do? Did they pass Course 7?

**From the Floor:** The students in your audience today?

**Dr. Klugman:** Oh, these students. I'll tell you grading is the worst part of this whole course. These students were probably more enthusiastic in their presentations. They didn't have that nervousness that comes with knowing that they're going to be graded on what they do. So one lesson is the lack of pressure from earning credits from our Society frees us up to probably do a better job than we might have otherwise.

But I appreciate the fact that you were enthusiastic about it without having to be rewarded with exam credits and a salary increase made it fun for us.

What Mark and I would like to do on the real thing is at the end of the first night, the teams could turn in the leading indicators they would want to look at and we would work with theirs instead of working with Mark's. Now, overnight, we would sit and think of how they turned out and then present to them in the morning. We could come back and say, "Here's what your leading indicator said, now what?" We could do it in their term. Or, maybe even make up a few different sets of leading indicators to distribute among the different groups to see what they come up with. So the terms are decided by how they want to attack the problem.

One of the things we fight with is our seminar tends to turn out more like what Mark had to do here. We always have to keep coming back to the way Mark wants to solve the problem, so that we can go the next step, because he's already planned out in advance what's next. So it's hard to get off track when you have to plan so much. If we have a little gap in time where the instructor could change the direction so the students can create the alternative futures themselves of what happens next, that would be beneficial. We're really going to try to find a way to make that happen when we put this into the real thing. I think that will make it more fun for the students and get their enthusiasm level up as well.