RECORD, Volume 23, No. 3*

Washington Annual Meeting
October 26–29, 1997

Session 78PD
Actuarial Modeling

Track: SOA Research
Key words: Research, Society of Actuaries

Moderator: ALLAN BRENDER
Panelists: ROBERT E. HOYT†
EDWIN C. HUSTEAD
Recorder: ZAIN MOHEY-DEEN

Summary: Preliminary results of an SOA-sponsored study of the relationship of an econometrics series to life insurance company operations is presented. The researchers have constructed a database of annual statement fields using National Association of Insurance Commissioners' (NAIC) tapes for the past 12 years with approximately 1,700 companies per year. Using this database, they examined the impact of both firm-specific and economic factors on the performance of individual life insurance companies.

Mr. Allan Brender: I'm a principal in the risk finance and insurance practice at William Mercer in Toronto. Robert Hoyt is from the University of Georgia and Edwin Hustead is from the Hay Group in Washington. Our recorder is Zain Mohey-Deen, a research actuary with the SOA, who is responsible for the insurance and investment practice areas. He has been quite instrumental in running the projects we're going to be talking about.

Actuaries have always used mathematical models in their work. With the arrival of cheap and abundant computing power, the nature of the models that we use, and the uses to which we put these models, is changing and evolving. In particular, we're making increasing use of cash-flow projection models to study and to value pension plans, insurance companies, and large-scale systems such as Social

†Mr. Hoyt, not a member of the sponsoring organizations, is a Professor at the Terry College of Business at the University of Georgia in Athens, GA.

Security. It's not surprising, therefore, that the research activity within the SOA devoted to actuarial modeling has been increasing rapidly recently.

In December 1996, we held the first of what is expected to be a series of seminars on actuarial modeling. This seminar was held at Georgia State University in Atlanta. There were several excellent talks delivered at the seminar, which were published in issue number three of the first volume of the *North American Actuarial Journal*. If you haven't already seen them, I'd really recommend that you pick up that issue and read them because there's some really great information there. We had announced at the time that we intended to make these seminars and this modeling activity a regular event, and we are beginning to plan now for the second such conference, which will be held in either late spring or early fall of 1998. The first seminar was dedicated to the memory of the late Ed Lew, a former President of the SOA, and a prime mover of our development of research in actuarial modeling. Much of the work that we'll be discussing is in fact due to Ed's forceful push to get people working in this area. At a meeting in connection with the 1996 annual meeting of the SOA, the SOA Board of Governors established a prize in memory of Ed Lew that will be given for the best paper on actuarial modeling that is submitted within the competition period. As it happens, the competition period for the first prize closes at the end of December 1997. The prize is in the amount of $10,000. We hope that we would award this first prize at the next modeling seminar.

Besides sponsoring seminars and meeting sessions on modeling, such as this one, the SOA has a number of funded research projects on modeling. Researchers are contracted, for a fee, to carry out research on a specific project. The researchers report to project oversight groups that are composed of volunteer SOA members. We're going to hear about two such projects. Both are concerned with background assumptions that underlie our actuarial models—such as economic assumptions or demographic assumptions. The first of these studies, and particularly the one that was motivated by Ed Lew, is concerned with the relationship between certain econometrics series and life insurance company operations. The goal of this research is to produce life insurer financial performance models that integrate market and economic variables with an insurer's own asset, product mix, and capital structure choices. The researchers for this project are our speaker, Professor Robert Hoyt, and his colleagues, Professor Mark Brown of the University of Wisconsin at Madison and Professor James Carson of Illinois State University at Normal. I am the chairman of the project oversight group. Professor Robert Hoyt is professor of risk management and insurance in the Terry College of Business at the University of Georgia in Athens. He will be speaking on this project.

The second project is in the area of pension modeling. To be precise, the project is a macrodemographic model feasibility study—it will assess the usefulness and

limitations of existing models and data sources for projecting the effect of changes in the environment on the design and cost of retirement benefit plans. We'll hear about the work of this project from Ed Hustead, an FSA, and a subcontractor on this project. He is senior vice president in charge of the benefits division of the Hay Group in Washington, and he has done extensive work in modeling projects for the Department of Labor (DOL) and the Congressional Research Service.

Mr. Robert E. Hoyt: I'll be talking to you about the results of these projects that are reported in two papers. As was briefly described to you, the goal of this research is to investigate the importance of various economic and market factors on life insurer financial performance while controlling some of the firm characteristics that were described just a few moments ago.

I'd like to discuss our motivation for the focus that we took in this research. As was just articulated, some primary motivation was the fact that there's a tremendous and growing interest in doing dynamic financial analysis. The SOA modeling project that we're a part of is certainly one example of that.

The Casualty Actuarial Society (CAS) has also been proactive in supporting some work in this direction, and they actually have a Web site that they've set up to disseminate some of the information. What we see in some of the prior literature, at least the academic literature, was a fairly significant focus on a rather severe measure of financial performance, namely bankruptcy. Much of the focus had been in looking at life insurer insolvency. A number of papers that have come out over the last few years examine issues in modeling bankruptcies in the U.S. and in some other markets. Most of those studies focused solely on firm-specific characteristics.

Some work that we attempted to do in the midst of this project resulted in the first of the two papers that came out of the project. They were to look at what sorts of economic factors might have actually been indicative of bankruptcy levels in companies in the life insurance industry over the last 20 years. I'll touch on some of those results later. What the second paper really ended up producing was an acknowledgment that bankruptcy is off the radar screen. What we're really more concerned about is ongoing concern issues of financial performance. Therefore, what sorts of factors do we see that are significant for over 99% of the insurance market, at least in the U.S., that doesn't encounter bankruptcy? This segment has to worry more about their ongoing financial performance. That is more significant to managers and actuaries that are involved in the modeling process.

As I've alluded to, the study actually has led to two papers. The first one is by Brown, Carson, and Hoyt from September 1997. We look at the insolvency rate in the U.S. over a fairly lengthy period, and we use quarterly data from 1972 to 1994.

We look at economic and market predictors that might have been indicative of higher bankruptcy levels in that period. The methodology ends up being a logistical modeling exercise or a regression model that we utilize in that project. The second paper focuses a little more on the ongoing concern aspects. I'll mention what measures we've used at this stage, but there are ongoing concern measures of financial performance. We incorporate firm-specific characteristics and economic predictors or potential predictors. We end up with annual data for 1,593 life insurers. Again, this is based on U.S. companies. After an 11-year period, 1985–95, we end up with a panel data set-up or cross-sectional time series data. We have data on companies over time and then for a number of companies.

The methodology puts us into the realm of using some of the panel data methods, like one-way, fixed effects, and random effects models. Some of you are moving more in the direction of doing some econometric modeling or financial modeling. The data package that we use is called Lemdep. It's sort of the econometrician's software for a lot of this economic modeling, and it provides a number of these routines for doing the kinds of analysis that we do here. This works fine on just a regular desktop personal computer (PC).

Let me just mention to you, then, which factors are incorporated in the study up to this point. This is certainly not an exhaustive list, but we tried to look at what we thought might be the most relevant economic and market data to incorporate. I'll mention some of the firm-specific information that we capture as well. There is the unemployment rate, disposable personal income per capita, stock market returns, Standard and Poor's (S&P) 500, and change in short-term interest rates. The thinking behind this is that it's relatively well understood that life insurers tend to operate like many financial intermediaries in the context of having longer assets than liabilities. Therefore, when you get a change in interest rates, your re-pricing is different on the left side of your balance sheet than on the right side of your balance sheet. This captures, to some extent, what impact changes in interest rates would have on that re-pricing of assets and liabilities.

Unanticipated inflation is described as the actual inflation rate over a three-year period, less what the three-year Treasury rate was at the beginning of the period. The idea is that the interest rate would embed the market's forecast of inflation over that period, and then we take what inflation actually was. The difference would be the unanticipated inflation rate. For investment profitability, we use a triple-A bond grading here to capture what the impact of a lot of the significant investment component would be. The slope of the yield curve is an interesting variable that we've incorporated. Insurers tend to be financial intermediaries in their structure. In addition, there's some research that shows that the slope of the yield curve has served as a very accurate predictor of recessions. As the yield curve starts to flatten

out, you get a prediction of a downward cycle. The steeper the yield curve, the more robust the forecast. That's the idea. That's what we're hoping this variable in the model will represent. Real estate is much more of a concern over recent periods of time, so we'd have a real estate return variable as well.

The ongoing concern measures that you'll see when we talk about that part of the study is nothing particularly unusual. The ones that we utilize—like the percentage change in capital and surplus, the return on assets, and the return on equity—are all book measures of return, and we're incorporating these in this study.

Allow me to give you just a sense for the firm-specific information that's incorporated in the study. We have solvency ratios, and we incorporate some of the ratios that don't already reflect some of the other factors. This would be affiliated assets, the proportion of affiliated assets, non-admitted assets, the product mix change, and the asset-mix change.

Another grouping that could be thought of would be those that reflect the asset structural mix: real estate, mortgages, asset liquidity measure, proportion in separate accounts, and then some measures of firm size. In the liability structural mix, we have several leverage measures, like premiums to surplus, reserves to capital and surplus, reflecting insurance, and financial leverage. There's also a reinsurance component as well. We have some proportion variables reflecting differences in the product mix; there is ordinary life versus annuity versus accident and health.

Finally, disintermediation like the ordinary life lapse rate, proportion of policy loans the firm is holding, and then an asset/liability mismatch variable reflect the degree to which the insurer's assets and liabilities appear to be mismatched. We're not doing anything perfect here. It's tough for you with your own companies' detail data to figure out exactly what your duration mismatch is for your own company because even just figuring out what the duration is for your liabilities is a big challenge. It's really more of a maturity mismatch. We hope to reflect, as best we can, the extent to which there's a mismatch for the company.

Where do we get some of the information? Again, I won't belabor these points. In the first portion of the study, where we looked at insolvency rates, we're getting insolvency information from A.M. Best. NAIC data tapes was where the wealth of the firm-specific data came from. You may not be all that familiar with these yet. They've had them for awhile, but only a few universities own the NAIC tapes, and it basically provides data for every U.S. insurer, giving financial statement data back to 1984. The 1984 tape is a little rough. That was their first year, so that's why the study has 1985 and subsequent years. We also need preceding year data for some

of the things we're doing. Another source for some of the economic data that I was describing to you earlier is the *Federal Reserve Bulletin*.

I want to describe the results of each of those papers to you as Study One and Study Two. The first one looks at that severe measure of financial performance or the bankruptcy rate. I don't think you'll find this to be a particularly unexpected trend of what bankruptcies have looked like.

Let's discuss the bankruptcy rate per thousand of U.S. insurers, over the period from 1972 to 1994. Many companies failed from 1988 to 1992. Let's take a look at what sorts of economic factors have surfaced as important here. In the case of the model, where we take the bankruptcy rate and model that against various economic series, the bond returns are negative in their relationship to the bankruptcy rate. There's a negative relationship between bond yields and the insolvency rate during this period. The slope of the yield curve was a forecast of impending recession and was positively related to the relationship. If we have an increasing slope, then there is an increase in the rate of insolvency. Unemployment was positive, so the higher the unemployment rate, the higher the bankruptcy rate. Personal income is a little bit counterintuitive. What we find is as disposable personal income goes up, so does the bankruptcy rate.

In the first part of the study we get a reverse in the relationship. One way you might think of this is that we see, as income levels are increasing, people were moving towards alternative investment sources or reallocating amongst insurers. Obviously some insurers were facing financial distress as a result of that. The number of insurers would be a reflection of competitive market conditions, so what we found is as the number of insurers declined, the rate of insolvencies also declined. Remember we're not just talking about the absolute number of bankruptcies here. That's the basic findings in the first portion.

In the second portion, where we then take a look at data for all the companies, and the financial performance is being modeled with a percentage change in surplus, a return on assets, and a return on equity, some of the results are as follows. First we find that by looking at the firm-specific characteristics over this period, larger firms with less separate account business and lower financial and insurance leverage were producing superior returns measured by these particular proxies. There is some evidence that higher proportions in mortgages during this period, and a higher proportion of your business mix in ordinary life, was producing lower returns, which are measured by these particular variables.

In the economic data series, we see that long-term bond yields were significantly positively related to these performance measures. I mentioned earlier this issue of

the personal income flip-flopping. Performance increases in personal income have been positively related over this period to these various return measures. We're looking at return on equity, return on assets, and percentage change in surplus. We're really not capturing anything about the risk related to the strategies of these companies with regard to performance.

We took a look in the second paper, at what would happen if we tried to proxy for risk in the variation in the returns on these different measures. In essence, we look at the relationship between mean returns on those different bases, and the standard deviation of returns over that sample data period. Obviously, it's possible to produce superior returns on these measures, but in many cases, that's going to come with additional risk in terms of variations in those returns. Let's look at what sorts of relationships we see in terms of these risk-adjusted returns and performance. When we adjust for risk in these performance measures, we find larger, less separate accounts and more liquidity. Once we start worrying about the riskiness, then liquidity surfaces. It wasn't an issue previously. Fewer policy loans wasn't an issue when we weren't looking at risk adjustment. The leverage measure, however, is consistent.

There are some other things that are interesting to observe once we make that adjustment for risk. The solvency ratios now become very important in describing risk-adjusted return performance. Mortgages, interestingly, go the other direction. There's an issue with mortgages in terms of performance measures if they aren't adjusted for the risk. Once we controlled for riskiness, the product mix wasn't as important. Obviously, it becomes very critical to think carefully about what measure of performance you're actually focusing in on in this modeling process. The outputs that you want are critical, but we do see some rather significant differences. At this point, there isn't any commentary on the economic variables in the context of the risk adjustment because we did the risk adjustment over that full period. We have variation only in our economic series over time, not across the company, so we do not have any economic variables in that risk-adjusted measure.

One thing of interest to us is, where could we get economic data? As some of you explore doing more modeling activity in this area, that may well become a critical issue to you as well. I mentioned some of the data sources previously, but I want to touch briefly on how much additional information has been available on the worldwide web. In the case of economic data, this has been a really nice development. The Federal Reserve Board statistics site has a whole series of different sources, and selected interest rates are just one of those on that same site. The CAS has a link to a whole series of many free sources. Some have a charge, but it’s really amazing how much of the economic data is readily available and can be downloaded for free. The Federal Reserve Board in St. Louis has a database that has

a wealth of information in it. If you're ever looking for economic kinds of information, the World Wide Web is really a great way to go.

I heard that a lot of people are concerned that their employer sees them spending far too much time fooling around on the Web, and now some creative entrepreneur has come out with a software package that has a hot button. When you hit the hot button, a form to nominate your boss for Boss of the Year flashes up on the screen. The Web is a place where you can waste a lot of hours, but in this context, it is a place where you can just really obtain a wealth of information, almost without any cost, and quite readily. It is already in data-usable form, so you can just transfer it right over.

Both external and firm-specific factors are important in the modeling of financial performance. It is amazing how little people have worked on that in the past. I pointed out to you the issue of risk adjustment. It's critical that when you go through the modeling process, you're alert to what the constraints are on what you're trying to model. Are you going to take into consideration risk considerations as you're doing this modeling? If so, it has, at least in our work, made quite a difference. As I pointed out, the data accessibility issue has made research and further activity by individual companies who model some of these processes much more feasible. You can access computer packages now that'll do most of the statistical routines that you need right on your laptop or on your desktop computer.

Mr. Edwin C. Hustead: I'm going to talk about the macrodemographic model feasibility study, which is not only a mouthful, but also a little erroneous in its phrasing. As most of you know, over the years, there has been this margin where the economist and the actuaries try to come together and understand each other, and this is one of those areas because we can certainly learn a lot from each other. It is called the "macrodemographic" model feasibility study. I'll tell you why I put that in quotes later.

We embarked on the study a couple of years ago. This all started with Bob Berin's presidential speech in 1995, when he expressed a good deal of concern about how the SOA did not have much impact on federal actions. There are a number of examples. There is the Omnibus Budget Reconciliation Act (OBRA) 1987, which is the one that put the current liability limits on the pension plans. It was basically put together in the last two or three days of the calendar year mainly for the purpose of raising tax revenue and helping balance the budget. There was not a lot of thought as to whether it should be 150%, or 150% of what, and how and what it would do. The only modeling that was done was by putting a 150% limit on this, we could save *x* billion dollars in revenue, and 175% could save *y* billion dollars, so that drove the whole issue.

These actions are taken without a good deal of understanding of what the actions will do to pension plan sponsors. We are really at fault. Bob was pointing out that we don't have a model, so no one can come to us and say what's going to happen if we put 150% current liability limit on it. I did take umbrage with one of his statements. He said that in 1994 the actuaries were not well represented in the debate on health care reform. He believed that we should be involved in pension care reform. There were many papers produced by the AAA that were very much part of that debate, so I think we were involved a good deal in health. We clearly haven't been involved in pensions, particularly pension modeling issues. He said that a good model is essential, and that the SOA should be the source of the model. If policymakers have questions about what proposed changes will do to plan sponsors and to plan participants, they should come to us as the source.

The question then was, what model? What should we do? His idea was, let's build a new model. As the SOA committees looked at that issue, they decided that building a new model would be an expensive and time-consuming thing. They wondered if there were some existing models that we could possibly build on or maybe we could work with the sponsors of those models to have the actuarial aspects that would get us what we needed, without starting from scratch. That led to a review of the existing models and a contract by the SOA to look at those. That's mainly what I'm going to talk about.

The contract was given to Capital Research Associates, and Joe Anderson is the researcher. We are working with him to try to help translate the economic principles and actuarial principles, and where they collide and where they are the same. I'll talk to you about the different types of categories of models, and which ones we're particularly looking at. I'll tell about two models in particular that we've look at so far, and how we have evaluated how they might meet the needs of the SOA or how they might not.

There's a Committee on Retirement Systems Practice Advancement, and reporting to them is a Committee on Retirement Systems Research. When a project like this comes up, they appoint a project oversight group (POG). So there's a POG staffed by the members of the SOA committees that were looking at this. In this case, we've also brought in some people from outside, particularly Olivia Mitchell, head of the Wharton School's pension research, to try to keep this moving and make sure it's doing what we want it to do.

I put macrodemographic in quotes. There's a macro, there's microanalytic, there's demographic, there's economic, and there's simulation. You can put these words together in many different ways. It turned out that in asking for an analysis of macrodemographic models, there are no such things, or at least none that are

relevant to us. If a client comes to us and says, we'd like to do a projected unit entry-age normal-cost method, the first thing you do is tell the client politely that there is no such thing, and then tell them what they are really asking for. We were putting these words together incorrectly.

What Joe has done is identify and categorize for us four different types of modeling approaches that these various models are based on. He has shown how they are used.

One is macroeconomic models. *Macro* means you're doing something from the top. You're looking at overall categories like all health care expenditures in the U.S., and checking how that changes over time. *Micro* means you're looking at individuals to see how they change in their relationship to each other. You are adding them up or weighting them to an overall total. I think the terms *macro and micro* are clear. The macroeconomic models are taking these overall total units, like total pension costs, total health benefits costs, and looking at each one of those to see how they change over time as you introduce different factors into the different parts of the economy.

The interindustry approach is—my picture of—anyway, is those old models that used to be in the *Scientific American*, where you take the different industry segments and you say what the impact and the outgo of each of these has on each other, and then see how the industries change, and then add that up for the economy. There's the transition-matrix approach, that really comes fairly close to what we do. We take a matrix of units and apply to them some transition probabilities, like mortality, and then see what that matrix is going to look like after it moves through the mortality factors or the other factors. Finally, the ones that we're really focusing on most are microanalytic simulation models, and there are two, in particular, that we've looked at so far. Those take information on individuals in, say, a pension plan or the economy at large. They look at those individual units, individual people, or families. As the economy changes, or as inflation changes or as the pension plan changes, and these people move across time, what happens to them? We must weight them according to their representative part of the universe.

What economic models do actuaries use? My first response was, we don't use any. Joe said, "You do something to predict how much pension plans are going to pay and how to fund that, don't you?" I said, "Yes." He said, "That's a model." We need to think about how that model equates with these microanalytic simulation models, and macroeconomic models to see how they fit in the structure of each other.

In pension plan modeling, you have a full census of people at the valuation date. You may have a sampling, but you usually have the full census. You take that census of people and you project it through a projection program to figure out when the people are going to leave the group, what their salary contribution is going to be between now and when they leave, and what benefits will be paid after they leave. The thing we do, which most economic models don't do, is to take the present value of those amounts so we can figure out the funding. That's the way a pension valuation system works.

A microsimulation model seems to work in this way. You have a base data set, and that could be a representation of the entire population at some point in the past. To get to the base year, to begin your projection, the first thing you have to do is to take the base data set and project it to today. Let's just say we're starting with 1998, a base year of today, and projecting it forward. Then you take a projection program, and project the annual results year by year in the future. So you're not starting with a full population; you're starting with a representative sample that you can weight. You're probably starting at some point in the past and bringing it up to today, and then you're projecting that into the future to get the projected annual results.

As we all know, when you do projection programs, you have something that might have been theoretically correct, but it gives you answers that are obviously wrong. We will apply our fudge factors or our calibration to those to make them realistic. In doing the base year and projecting the future, these models look at some outside factors and adjust these amounts to what we have projected on a macro basis that will happen in each of these years in the future. For instance, you might start with a 1973 data set, and you might project it to today, which would then have today's population by age. You look at the actual population by age and you have some differences. So before you begin projecting the future, you need to calibrate that model to the actual ages of today, or calibrate it to something exogenous, like total Social Security payments now. If projecting the future, take the Social Security Administration's projections of total Social Security payments in a year, and then adjust all the people in that year so the total comes up to something that you think is going to be the total from other reputable sources.

DYNASIM AND CORSIM are microsimulation models that we have kind of worked through. MDM and SSASIM are really macroeconomic models, which we will be looking at in the future. PRISM is a microsimulation model as is PIMS. We've looked fairly intensively at DYNASIM and CORSIM. DYNASIM is an acronym that comes from dynamic simulation of income model. It has the advantage and the disadvantage of being the first large-scale microanalytic simulation model. It was developed in 1975. As you might suspect, while it was very state-of-the-art in 1975,

when you look at it versus other models, it is not as flexible, and obviously no one imagined that high-speed PCs could deal with a model of this size back in 1975. It was totally mainframe-based at that point. I think most of you probably deal with models in your own companies or your own work, you know that if you build a model and then you keep patching it up to do things over 10 or 15 years, at some point you have to say I'm going to throw this whole thing out and start over again. DYNASIM is still grounded in the way it began. The natural reaction is to call it a dinosaur. But it is there, it is useful, and it is a good model of the universe.

DYNASIM begins with a sample of the U.S. population, a 1973 current population survey. Between the decennial censuses, there is, I believe, an annual current population survey that is done both to keep up, and also to bring in particular aspects of the economy. One might emphasize, for instance, the health care status of individuals. There was a 1973 current population survey, which was the first input to this model. The jobs and benefits model has some retirement information, but the information is strictly on an individual basis, so there is some attempt to determine what the individual has in terms of potential retirement income. It was matched with Social Security records. That's a critical comment, because you couldn't do that anymore because of privacy issues. So it may be the first and last large-scale model of this kind that actually was linked with specific Social Security records. One thing that you looked for in this type of model is what the feedback capability is. You might wonder what's going to happen if interest rates change. You might do that projection, and then say, now let me look at what's going to happen if we put in one of the Social Security reform proposals to try to get them to interact with each other. There's very limited feedback capability with it.

The next one is CORSIM or the Cornell Microsimulation Model. It was first developed in 1986, so it has the advantage of being more recent. A current version, 3.0, that was released in 1995. While people have worked at DYNASIM over the years to add new things to it, it's pretty much left undisturbed. There's a great deal of active work going on at Cornell, and there are new versions with new capabilities that are released periodically. It begins with 1960 census data, which at first says, it's older than DYNASIM, but it might actually be better because it goes back further in the past. By demonstrating that it is able to work through the 1970s, 1980s, and 1990s, in a reasonable fashion, it gives you a lot more confidence in building it in the future. Because you couldn't match Social Security benefits anymore, it has simulated Social Security benefits based on the individual's earnings records. That's probably not much of a limitation. We know enough about individuals and their past Social Security history and future and what that does. We can probably do almost as good a job as actually having a match with Social Security records. It does have much more feedback capability. Two things have been done recently that are similar to what we would like to do. One is that Canada has adopted it as a

basis for analysis of pension policy in Canada, and second, the American Association of Retired Persons (AARP) is now working with Cornell to get a version that will be adopted and be specific to the U.S. pension policy. Those are interesting developments that might be useful.

Now that we know about these models, or will know about these models, how do we decide whether there is a model that will be of use to us, and one that we should invest some time and money in and try to modify for our purposes, rather than to build one from scratch or to give up on the whole thing? That's really what the end point of this particular analysis will be. I think we want to be convinced that the base data set in the model, both in terms of the set and the quality of the data, is as good as you would have with any pension modeling or Social Security modeling. The first thing you look at is whether you have garbage or good data. Second, what do the data elements in the source tell us about age, sex, salary history, pension plan information, and Social Security information. What is the source of these data? Is it a source that we have some reasonable expectations for, as far as the validity?

Another major aspect to look at is the projection methods. How does it get from this base year to today, and how does it project into the future? How flexible and valid are the methods? Are they really good predictors of what will happen? Anyone who works with models knows that another aspect is output. You can have the best data and the best projection in the world, but if you don't have good and readable output from it, it doesn't do you much good. Another point is accessibility. Is this a well-documented system? Is it a system in which we can get access to the creators and the builders and really understand what's happening? Can we download it on PCs? Can we work with it?

Finally, a very critical issue is the prospect for the modifications. My understanding of DYNASIM and CORSIM is that they are developed for specific purposes by universities and places like the Urban Institute. The people who use them do their work and then they walk away from it. If somebody else comes along with a contract or an idea or some money, they pull it out again and work on it some more. It's not like an actuarial firm. You can go to eight different large actuarial firms and get proposals to do actuarial work. I know there are actuaries at these firms that will do the work for me. In the case of DYNASIM or CORSIM, we have to find the people who did it, and see if they're available and willing to work with the SOA to do the modification.

Let's take a look at the strengths and weaknesses of DYNASIM and CORSIM as examples. DYNASIM has a very good base data set, and it's good quality, but it is old. It was done in 1975. It does have extensive data on financial means and

Social Security of individuals, so it is very good from that aspect. What it does not have, which is very critical to us, is anything on pension plans or sponsors. One problem with the microanalytic simulation models, at least the ones I've seen so far, is we're looking at individual units and family units. We aren't really looking at plan sponsors. To some extent, there is an attempt to put in model plan sponsors and model plans, but there is nothing really on looking at the pension plan universe. It has good projection methods, but with little feedback ability. Documentation is very poor, and there is little expert support of the system or the documentation. It's sitting out there. It was developed by Urban Institute. Given enough interest and money, I suppose we could stimulate the Urban Institute to take it back off the boards and begin working with us to try to build something on it. Right now, it would be quite an effort to do that. Because of the time it was developed, it is primarily mainframe-based, so the chances of it getting into the current high-speed PCs is very slim. There has been little interest in modifications over the years. All in all, we're looking at a fairly negative report so far on DYNASIM, particularly as we're beginning to see how some of the other models might be used and how they are being used.

CORSIM has more advantages than DYNASIM, but there are a lot of disadvantages that we need to think about as we're looking at other economic models. The base set is of good quality, and it's recently updated. As I say, it's a 1960 base year, but that doesn't mean it's older than DYNASIM. It just means that there's a lot more information. Social Security is simulated and not actual, but I think simulation probably works out. Currently there's nothing on pension plans or sponsors, so it has the same limitation as DYNASIM. We'll keep an eye on the AARP project, and perhaps what they are doing might lead to us building a model that would be useful for people. Documentation is poor. We write programs and say we are going to come back and document them some day, but we never do it. It is at least more current, and therefore better documented than DYNASIM, but it is still not what you would really like to have. There is expert support to build it, but it is limited, so you'd have to work with the developers to make sure you fit into their academic schedules so they can work on this. It can be run, in some versions, on the high-speed modern PCs, which is very good. They are interested in making modifications. They have worked with Canada and AARP quite recently to put modifications in force.

We'll be looking at the other four or five models, and hopefully come back to the SOA with a report towards the end of the 1997. The question is whether one of those models or some combination of models will lead us to something that we can use to work with the modelers to develop. Hopefully we will have a good policy-driven model so that the next time a full-funding limit or something is considered, Congress can come to us and say, “Evaluate it for us.”

Mr. Brender: One of the things that the material that Rob Hoyt was talking about leads to is a process that is known under various names, but generically called financial condition reporting. In the U.S., there is something called dynamic financial condition analysis, where the actuary would be modeling a company, testing the company under various kinds of stress tests, and reporting to management and the board about the results. The of information and the relationships that Rob and his group have been developing will provide a lot of insight into the kinds of things that we should test and look for. Session 120 at this meeting is given by the people who are doing the *Dynamic Financial Condition Analysis Handbook*. The NAIC has a booth with some brochures. They're selling a database. There is a fee and they must have polished it up because the brochures look really slick.

Ms. Faye Albert: Ed, one of the things you kept mentioning was that the Social Security data was available on the older data set. You said that the comparison had been done, but that it hadn't been done on the newer one. You were confident that you could tell what Social Security benefits would be because of tracking the data itself. It seemed as though a good way to check it might be to use the same algorithm on your old data, and see if it comes up with a similar result.

Mr. Hustead: I think the various models will have salary history, and so I think they should be able to predict pretty well. That's a good idea.

Mr. Irwin T. Vanderhoof: I wasn't aware that the NAIC is offering this database. As far as I know, all of these data comes from One Source, and the data have been made available to academic researchers on a nominal-cost basis, or on a favorable-cost basis. I have not heard that the NAIC has anything different from this One Source data.

Mr. Brender: I don't know, but I was surprised to see them here.

Mr. Vanderhoof: The last I heard was that it was all coming from Best.

Ms. Carol J. Tveite: One Source gets its data from the NAIC. So the NAIC is the source of all that data for One Source. One Source puts it in a form that's easy to use.

Mr. Hoyt: The data tapes that have been available from the NAIC to the academic community are actually the NAIC's. As you guys report your financial statement data on diskette, they're just compiling that and putting it right onto the data tapes. So they're the primary source for all that information, but I'm not exactly sure what they're vending here either. I ran across this at one other university that had been

buying the tapes like we have. The university had some brochures on the information that was available. I don't know if that's in cooperation with the NAIC or not. I wish I was more informed on this as well. At any rate, they are the original source for their data.

Mr. John B. Kleiman: I work with the One Source database quite extensively. I'll caution you that if you take the NAIC straight out, it has not been cleansed. We know that a lot of the financial reporting is just atrocious. I've found many instances where things are not reported in the thousands but in actual dollar amounts, but in other instances they are reported in thousands. When you add them all up, you'd better know what you're dealing with. We've had to go back and even tell One Source, and they will try to cleanse the data.

Mr. Hoyt: When we ordered the annual tapes from the NAIC last time, they asked when I'd like to receive them. I thought, the sooner the better. I said, "When will they be ready?" The women on the phone said, "We have them as early as the summer, but those data are not very reliable." The NAIC continually cleanses and updates. As the auditors come back with reports, they update their information. We don't buy the tapes until the fall, but you're exactly right. Oftentimes, the dropout grade of companies is because of some very strange things like that, and we just really didn't have information to change those numbers either.

Mr. Kleiman: The other thing is that sometimes they're lacking data. I know that when we get our first tape from One Source in March, companies like Prudential and Metropolitan might not be there, so it's very hard to compile.

Mr. Hoyt: I asked the woman at the NAIC, "When are the data fairly reliable?" Obviously we don't want to wait three or four years to get an annual tape, but we do not get our tapes until the fall. She said that the fall is a pretty good time.

Mr. Kleiman: If you go back to the insolvencies, there is no correlation to bonds. Of course, the high-profile insolvencies like Executive Life were basically due to high-yield junk bonds.

Mr. Hoyt: Are you referring to a default?

Mr. Kleiman: Yes.

Mr. Hoyt: Right. We do not have that in there. Actually, that wasn't a widespread cause over that time period. In a model like ours, I don't think it would have surfaced anyway. That's a very good cautionary point. You would not want to infer

from this that there aren't some other factors that could very reasonably have an impact on bankruptcies.

Mr. Kleiman: I read about some of the insolvencies. When we look at just sheer numbers of companies, wouldn't we find that a lot of those accident and health companies?

Mr. Hoyt: Sure. There are periods during that time when that's very true.

Mr. Brender: Can you interpret how personal income is positive one way and negative in another?

Mr. Hoyt: We articulated it a little better in the paper. The interpretation that I would offer at this point is that when you look at the bankruptcy paper, we're really looking at, as I described it to you before, a very severe measure of financial performance. In that case, I think we see two things captured. One, over that period of time, as income levels increase, we see a tendency for them to look for alternative outlets for their investment dollars, such as mutual funds and things of that sort, which puts a lot of pressure on the life insurance industry. Second, there is a reallocation of funds within the industry, away from some of the smaller carriers and toward the larger carriers. That was really a function of what we see going on with the income levels as well. The consolidations over the last several years would be consistent with that. That's the best way I can address that apparent conflict.

Mr. Brender: With the rise in personal income, there has been much more deposit business, and those people who are inclined to be poor investors and do lousy record-keeping have certainly contributed to insolvencies. There has been more opportunity. On the other hand, for people who do it well, there has been better business. You could get this sort of double-edged effect.

Mr. Hoyt: Yes, I think that's consistent as well.

Mr. Brender: I might mention that this project that Rob is reporting on was started a number of years ago. We had a number of false starts and Rob, at one point, was even on the POG, and not the researcher. The person who was really working to get this going is Bob Johansen.

Mr. Robert J. Johansen: I'm chairman of the Life Insurance Research Committee, and this all developed out of some ideas that Ed Lew expressed some years ago. He kept after it until we have arrived at this point. The objective will not be to develop a model because we figured we didn't have enough funds to develop a model that all companies could use; rather we could come up with factors that a company or a

consulting firm that was going to build a model would take into consideration for its own use. The objective would be something like this: the actuary reports to the board of his company and says, "I have good news and bad news. The good news is there's only one chance in a hundred that the company will become insolvent by the end of the year. The bad news is, we will be insolvent by the end of the year." So the objective here is that a company that is considering changing its investment policy from mostly triple-A bonds to 60% real estate investments could test what might happen to the company in the next five or ten years by predicting the way the economy would go. They could develop a what-if analysis of the possible change in company policy. So this will come out of it eventually, but it will take quite a bit of doing. As Allan mentioned, I was chairperson of the POG that originally set up what Rob and his associates worked on, which was part one. Part two was to develop the factors, and my POG, at that time, was dissolved. Allan took over everything, so we now look to Allan to come up with these factors. You can look forward to these factors at some point. It's a long process, but the end results will be well worth waiting for.

Mr. Brender: I didn't know what I was going to do. I'm not sure I do now, either.

From the Floor: I'd like to make one clarification about data. In addition to the 1973 match between the current population survey and Social Security earnings records, there was also a match done in 1978 that's used in the PRISM model, which is a model that we're reviewing right now. Congress passed legislation that prevented the release of future matches to the public for confidentiality reasons. The advantage of the match is not so much that you have Social Security contributions paid, but you have the actual earnings of the actual individuals in the sample, going back to 1937. As we know, those vary quite a bit. It's still an open issue, in my mind and the committee's mind, as to how good we can simulate those, given that the most recent match was done in 1978. There's not any model available that's going to have recent data like that.