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## CORPORATE MODELS AND ASSUMPTIONS

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1. Various approaches to the development of corporate models and the attendant advantages and disadvantages; including in-house development, purchase of a software package, and the role of consultants.
2. Technical problems encountered in modeling, such as:
  - a. grouping of in force business into representative calls;
  - b. modeling of supplemental benefits and minor lines;
  - c. treatment of various practical problems, such as different underwriting bases, male/female variations, modal premiums, calendari- zation, etc.
3. Development of model assumptions, including use of historical data, inclusive of economic and other exogenous variables, and sensitivity analysis.
4. Uses of corporate models and related problems.

MR. ROBERT A. LYLE: Our task today is to consider some of the approaches, techniques, and problems in the development of corporate models and assumptions. For those of you who are involved in model development, we hope that we can provide you with some fresh ideas for dealing with the types of problems that you face. For others amongst you, we hope to give you an understanding of the applications and limitations of corporate models and increased appreciation for the efforts and accomplishments of those who work with such models.

Our panelists will present their views from three diverse backgrounds. Sam Sung will describe MONY's experience in developing an in-house model. Sue Wimmer will explain the adaptation of a software package. Allan Affleck will view the role of the consultant in helping a client choose and use a model.

### DEVELOPMENT OF A CORPORATE MODEL

MR. KIHONG SUNG: In order to develop and implement a model there must be at least two parties involved: (1) the sponsor (usually the user); (2) the builder.

Usually sponsors and users are the same party but there are certain instances where sponsors and users might differ. For instance, top management might sponsor a model to be used by them as a planning and management tool, a segment of which might also be used by the line managers in their work. The model builder is basically a technician who provides mathematical and computer expertise for the model's development.

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Whether models should be developed by in-house staff or purchased from outside firms as a package depends on the expertise of the sponsor and the user, and the in-house technical capabilities. Generally, if the sponsor and user are knowledgeable in the financial aspects of the business enterprise, and have a capable technical staff, it is better to build the model in-house:

1. It usually requires a minimum amount of out-of-pocket expenses;
2. The model would be developed on a tailor-made basis for the company;
3. The model itself could be readily modified due to a better understanding of the mechanism and structure of the model;
4. It is usually easier to train the financial expert to use the model developed by in-house staff.

Some disadvantages of in-house development are:

1. Because of the relatively minor out-of-pocket costs involved, the company may overlook the total cost of developing the model. This would have to include staff time which could be devoted to other projects and the inefficiency sometimes associated with the inertia of in-house employees.
2. Even if the staff is capable, they may lack the experience of software firms having more diverse and in-depth experience in model building. If the company lacks in-house technical expertise, it usually would be advantageous to purchase a software package rather than hire a technical staff to build a model unless the company had top management support and the resources to build and elaborate, permanent and ongoing corporate model.
3. The model may be less efficient in terms of computer use due to a lack of technical expertise. A software firm usually provides updating services, of course with a fee, to use more advanced technology.

The above statements are only generalities, so I would like to explain the situation with Mutual of New York where I am employed.

MONY started to use computer models in 1969. I was an Assistant Actuary in charge of the financial statement, financial analyses, and projections. Working with me was an actuarial student who was very capable on the computer and who also had a good understanding of the company's operations. At the time we installed our first time-sharing terminal using APL, the company was involved with a number of new ventures in terms of additional lines of business and diversification activities. These new ventures required long term financial projections under various sets of assumptions. All that could be accomplished manually was the financial projection of one or two hypothetical operations.

Management usually asked a number of questions before plunging into any significant new venture. We found our model to be a handy, convenient and efficient way to supply the answers. We were quite fortunate in being the

sponsor and builder of the model and in having in-house capability and expertise without expending additional out-of-pocket expenses other than the time-sharing costs.

Mutual of New York's corporate model is essentially an offshoot of our modeling activity for the early ventures. Since we are responsible for the financial projections of the company's operations, we decided to do these projections using the computer rather than actuarial worksheets. Our approach to the corporate model was to develop the financial reports we had presented to management in the past; the numbers could be readily changed if management wished to change the assumptions.

It is crucial that the initial model be reasonably simple and easily understood by management. Of course, it is necessary to feed a basic, simple model with other models involving more sophisticated and theoretical considerations. For instance, for individual life insurance we have a sub-model called a cell generator. This starts with basic sales assumptions and distributions of business each year in terms of age, products, size, etc. It generates all necessary insurance operations items such as premiums, reserves, policy payments, dividends, and expenses. It also provides analysis of gain by source which has been our traditional approach to financial projections and financial analyses. Cash flow generated by this cell model is then fed into the corporate model.

Another example is our common stock simulation model. We have a substantial amount of common stock investment. The financial results of common stock performance in capital gains and MSVR is generated by using Monte Carlo simulations. The results are then fed into our corporate model.

What I would like to stress here is that we have basically a reasonably simple corporate model, but it is supported by various sub-models. It is not necessary to run all these sub-models to run the corporate model. These sub-models are practically independent of each other - except that their output is all fed into the corporate model. This way we can keep our cost of running these models at a reasonable level, while at the same time we retain our ability to run sophisticated and refined programs.

MS. SUE WIMMER: In 1973 United of Omaha made the decision to purchase a software package rather than build a model. The advantages outweighed the disadvantages given our situation and past experiences. It had been decided in 1967 to begin development of a corporate model. As is common with most small or medium size companies, other priority projects had interfered with the model development time and time again. Also, since it was possible to assign only one or two people to this project, the model development experienced severe setbacks whenever one of these people terminated or was reassigned. Thus, when the progress of this model was reviewed in 1973, it appeared that it would be at least 5 years before development of a corporate model could be complete. The five year time span was optimistic and assumed no interference by other priorities or staff changes. This situation heavily influenced the decision to seek information about available software packages. Thus, the first advantage to purchasing a software package in our situation was that the model development would get done.

Another consideration became apparent as a search of available models began. All of the models performed the functions previously designed for our in-house model plus some that had not yet been considered. The software models were complete. They included all operations of the company and all the individual items were tied together in a cohesive and efficient manner. This contrasted with the state of the development of the in-house model which had begun with a projection of in-force business which was not supported by a documented and complete plan of the overall projection process. This situation arose because the proposed uses of the model had changed over the six year period with knowledge gained about how a corporate model could be used in the planning process.

Therefore it appeared that there were three options available: (1) purchase a software model; (2) start over on the in-house model; or (3) continue with the current model adding other needed items at a later date. However, it was acknowledged that previous systems of this magnitude that were developed piecemeal became inefficient, unwieldy, and of questionable accuracy. Thus, the option to continue with the current model was eliminated.

When evaluating the relative advantages or disadvantages of developing a model in-house or purchasing a software package, cost became a consideration. Much had been learned in reviewing the software packages and a package that seemed to fit well with the planning process was available. It was recognized that while an in-house model could be developed along those same lines, the development time and cost would be lower if a software package was purchased.

Another advantage in purchasing the package in 1973 was that the package was in a developmental phase and United would be a sponsor company. Therefore, the opportunity existed to assist in molding the final form of the model. This would alleviate a common disadvantage to purchased models - that the system is generalized to fit all companies and must be radically modified before it fits a specific company. Although the current system does not directly handle all idiosyncracies, input provisions were made for many items so that they could be manually handled. This has prevented many extensive modifications to the system. A corresponding disadvantage to this situation was that because the system was still being developed at the time of purchase, it will not be fully operational at United until late this year. However, this is well within the time frame in which a comparable system could have been developed.

Another disadvantage to purchasing a package is that the software company has many clients all possessing different sized computer equipment. The software package is developed to run on the smallest computer of the client group. Thus, the system does not run efficiently on a large scale computer. With a system as extensive as a corporate model, computer run times are a definite consideration unless the company is in the fortunate situation of being able to obtain large blocks of computer time. However, it is felt that minor changes can be performed to significantly reduce run times of the package that was purchased.

To generalize United's experience, there are several questions that a company should answer before making the decision on whether to purchase a software package:

1. What is the situation in terms of staff available, money commitment, and knowledge of the staff?
2. How well is the desired model conceptualized and how much and in what direction is the future planning process likely to change?
3. Is there a software package available to do what the company desires in a manner that is efficient and timely?
4. What is the cost of doing the model in-house vs. purchasing a package, and what are the respective benefits?

MR. ALLAN D. AFFLECK: My role in this introductory topic is to describe why a company might want to consider retaining a consulting actuary as it approaches the development of a corporate model. I'll also review what the consultant's role might be.

Perhaps the most important reason for involving a consultant in a modeling project is to take advantage of the experience and expertise in the development of corporate models for others. Corporate modeling of insurance companies is not a topic on the actuarial exams, and the only way we know of developing expertise in this area is through experience gained over the years. Most companies starting out to develop a model don't have a great deal of background in this area, and the effective use of an experienced consultant can be helpful. While each company has its own unique problems, most companies face a common core of problems in developing a corporate model, and the insights brought by a consultant who has worked through these problems a number of times in the past can prove to be valuable.

Another reason for using a consultant might be the limited availability of resources within the insurance company to undertake a project of this nature. This may be particularly true if there is a specific timetable to meet. The time needed to develop a corporate model varies substantially depending on the company's size but typically will take from six to twelve months (or more) if there is a full commitment from management to get the job done. In many companies the resources required simply can't be made available, so the only way the model can be developed is to involve a consultant to help with part of the work.

A third reason for working with a consultant is the independence brought to the assignment. This can serve a variety of purposes depending on the situation. For example, the consultant can begin a project not influenced by previous biases that may exist within the company. The resulting model may carry more credibility than would be attached to it if it were developed entirely in-house. If the consultant is responsible for some aspects of the project, it may be easier for senior management to insist on a timetable being met, since the consultant is an outsider. In small companies, the consultant can act as a resource for the staff actuary to bounce ideas off and as someone who can provide reassurance about the suggested modeling approach.

When a company uses a consultant, it is important for the consultant's role to be understood by both parties; it can vary considerably from one situation to another. In our assignments, we frequently find our role is one of working with the company actuary by doing part of the model building, completing experience studies, giving advice when called upon, and providing

direction and suggestions based on our past experiences. In other situations we are called in to complete the entire project when the company can't devote adequate staff resources to it. In this case, it's particularly important for the company staff to work along with the consultant if they are going to be in a position of continuing the model work by themselves in subsequent years.

One of the problems a consultant faces is specific knowledge of the company's operations, unless a close consulting role existed in the past. Related to this is a knowledge of the working relationships within the company that is needed to perform the consulting role in an effective manner. It is also important for the consultant to know the objectives in developing the corporate model, and since different people in the life company may have different ideas of the model's purpose, this may be a difficult task. However, this step is critical if the consultant is going to act as an advisor for the client rather than directly setting forth purposes for the project.

These problems can be overcome with adequate involvement of the consultant in the planning process.

MR. LYLE: I think you'll agree after these opening comments that there are a number of factors to be weighed and considered in deciding on an approach to corporate modeling. This is only the first step on the long road to having a finished working model. Obviously, the individual situation in any company or circumstance needs to be considered independently. There are no easy answers to this question.

#### TECHNICAL PROBLEMS: GROUPING OF IN-FORCE BUSINESS

MR. LYLE: We would now like to move on to some of the technical problems encountered during the model building phase. The basic purpose of any model is to produce an abstraction from reality. The model must retain those factors which are essential to a study of the system being modeled, but which eliminate the complexity of the real world. Modeling then is as much an art as a science.

One of the basic aspects of modeling is the art of including sufficient detail to get a reasonable level of accuracy and sensitivity, while keeping the model simple enough to be both useful and comprehensible. It is to this aspect of modeling we now turn our attention. To begin, I have asked Allan to discuss a specific method that has been employed by M & R for summarizing a company's in-force business into a workable number of cells.

MR. AFFLECK: There are many parts of the life company that must be modeled. My role is to describe how we have approached the problem of modeling in-force business.

Our concept of the in-force business model is a limited number of plan/age cells which can accurately be used to represent the in-force business. Our experience has been that a model can be composed of 2%-5% of the total number of plan/age cells in force and still do an accurate job of representing the in-force business.

The starting point in our modeling process is the company's in-force records containing amount of insurance, gross annual premium, and mean reserve. The first analysis is a Preliminary Distribution by Plan Report, which

simply lists each plan in force in descending order of importance by insurance amount, gross premium, and mean reserve. A separate listing is provided for each of these three parameters, so the actuary can determine what plans are important for each parameter. At this stage, there is enough information to select the plan/age cells which will become the model. We find that in most situations 70%-85% of the business in force from each of the three parameters is represented directly by the model plans. Once the model plans have been selected, all other plans in force are assigned to be represented by one of them. For example, if Life at 65 is one of the model plans, we might assign all other limited pay life plans to be represented by the Life at 65 plan.

Once the initial model has been defined and the other plan assignments tentatively made, we calculate the ratio of the actual insurance amount, gross premium, and mean reserve from the in-force records to that expected from the model plan/age cells. In the example just given, this means we would total the actual amounts of insurance, premiums, and reserves on the limited pay life plans and compare them with those expected if they had all been Life at 65. This validation process is a critical step in the construction of the model, since it verifies that the model does, in fact, represent the business in force. We generally establish tolerances that are very small for the company's entire business but which get larger as we move into blocks of business and finally into individual plans. For example, on all business we might want the actual-to-expected ratios to be within 1/10 of 1%, but for each rate book we might accept a tolerance of 1%-2%, and for each plan, 3%-5%. Our experience has been that once the initial model is created, the actual-to-expected ratios do not change significantly from one year to the next, even though the same plan/age cells are retained in the model.

As you can gather from my description of our approach to modeling, there is a substantial interaction with the actuary at each stage in the creation of the model. The system does not create the model by itself and relies to a significant extent on the experience and judgment of the actuary to obtain a close fit. This modeling technique for in-force business is a very simple one, but we have found that it works successfully in practice for both large and small companies.

MS. WIMMER: United intends to take a similar approach at some point in the future. However, our corporate model produces a variety of reports. The three parameters Allan mentioned of volume, gross premiums, and reserves didn't contribute a lot of accuracy for each of our uses. As we began to add parameters, it became impossible to select plans that would accurately reflect a group of business.

The approach we have taken is to interface with our master file on a serial basis. Early next year we'll be evaluating different approaches to constructing models.

MR. SUNG: Allan's model generator is essentially the same as our cell generator. Our cell generator is a completely flexible program which takes about 10 parameters. Depending on the parameters used, we can fit them into any number of plans we want to. We find it's a very powerful and flexible tool.

MR. LYLE: The method Sue mentioned obviously is the way to get complete accuracy. But certainly in many situations, especially if you're a large company or if you're pressed for computer time, taking a seriatim pass of your whole file is time consuming. However, if you try to reduce the size of your model by grouping into cells then decisions have to be made as to what parameters provide the best fit. These decisions depend on the purpose of your model.

#### PRACTICAL PROBLEMS

MR. LYLE: Once there are cells, however defined, for the initial state of the model, the modeler must then turn attention to the forward projection of those cells. The calculation of parameters such as premiums, benefits, and reserves on a cell-by-cell basis is at least conceptually a fairly straightforward process. However the modeler soon faces a number of practical problems. For example: how are different underwriting bases to be treated in the model; what about variations between male and female in terms of policy values, mortality rates, etc; how are different premium modes to be handled?

MS. WIMMER: The practical problems encountered in United's Corporate model have involved evaluating possible costs against resulting benefits. The costs were normally expressed in terms of computer run times, ease of gathering data, and availability of data. The benefits were normally expressed in terms of the accuracy desired and the amount of accuracy gained in handling the data on an exact basis. Most models literally allow the user to input data on a policy-by-policy basis if so desired. This provides an infinite variety of choices when assumptions are set for the model. In many cases, decisions on the assumptions for the model were made with the recognition that changes may be made at a later date.

Our model has the facility to handle different underwriting bases directly. Gross premiums, net premiums, and reserves are input for each record and these are obtained from an interface to the master file. The same records have fields containing substandard extra gross premiums, net premiums and reserves. These are then used in the projection process.

An alternative to this would have been to input the substandard extras as separate policies but exclude them from any count fields such as number of policies or amount of insurance. With this method, substandard mortality and withdrawal rates could have been used in the projection process. However, this approach would have significantly increased the input and hence run times.

It was decided to handle substandard extras in the manner provided directly by the model and to use aggregate mortality and withdrawal tables in the projection process. With this system, factor files are used for input on the regular portion of the policy and reserves are calculated only for substandard cases. Also, this method most closely matched our present data files and valuation system.

In handling male and female variations, the decision was again made to attempt less rather than more accuracy using basically the same criteria. Mortality and withdrawal rates varying by sex could have been handled by assigning different plan codes to the male and female policies. However, the use of combined records and mortality tables introduces errors only if



the distribution by sex has changed over the years. United's distribution has changed very slowly and has remained relatively stable over the last 5 years. Thus, shorter run times with a slight loss of accuracy was again chosen.

The corporate model will project monthly cash flow for a two year period for use in investment planning. Since this was an important function, accuracy in the collection of premiums was desired. This required accurate modal premiums. Seven modes are defined in the model: annual, semiannual, quarterly, regular monthly, bank plan, payroll deduction, and other. In these cases, the premiums are converted to a monthly basis and the model assumes a monthly payment cycle. The other mode category includes 9-pay, 10-pay and other irregular modes which are common with tax sheltered annuities. The model will eventually be modified to reduce the exposure in the summer months for these plans if the error incurred in the monthly cash flow by not making the reduction becomes significant.

Input for the model is grouped into cells before the projection process begins. The grouping process combines policies with the same issue year, month, age, mode, and plan. The model then projects each cell individually for each month in the projection period, exposing cells for premium payments when actual modal premium due dates occur. Thus, if mortality and withdrawal assumption were a reflection of what actually happened in each month of the projection, the projected monthly cash flow would exactly match actual results.

The in-force data that is gathered reflects a particular calendar date rather than a particular policy anniversary. Since mortality and withdrawal rates are available on a policy year basis, a conversion of these projection factors must take place. This process is called calendarization. Calendarization uses several assumptions and calculates probability factors which are appropriate for projecting a cell from the start date of the projection to each month of the projection period. In this process, the model assumes that deaths are uniformly distributed throughout each month in the policy year and that withdrawals are uniformly distributed at every modal premium due date within each policy year after the first. In the first policy year, skewing factors may be input to change the distribution of withdrawals. For example, on a semiannual mode, the user may input a skewing factor such that 60% of the first year withdrawals would occur at the first 6-month anniversary. In later policy years, the model would assume that 50% of the withdrawals occurred at that time.

There are basically four types of probability factors used in the model for projection purposes which reflect different combinations of mortality and withdrawal rates:

1. The probability of surviving from the projection start date to the end of a given calendar month. This factor is used to calculate reserves and amounts in force for each projection month.
2. The probability of surviving from the start date to a given month and then dying in that month. This factor is used to calculate death benefits incurred in that month.
3. The probability of surviving from the start date to a modal premium due date. This factor is used to calculate premium payments incurred in that month.

4. The probability of surviving from the start date to a modal premium due date and then lapsing or surrendering without paying the premium. These factors are used to calculate the amount of policy proceeds to be distributed among the various nonforfeiture options.

MR. AFFLECK: I would like to underscore what Sue Wimmer has said about the importance of recognizing the distribution of lapses on modal premium anniversaries. Anticipating the proper premium is an important aspect of the financial projection, and our system allows lapses to be allocated to the beginning and end of the policy year. Since lapse, particularly in the initial policy years, is heaped around the early modal premium due dates, we try and examine the company's experience to develop the appropriate withdrawal allocation. In absence of experience, we rely on factors developed by Mr. Buck in his paper which appears in TSA XII.\*

#### MODELING OF SUPPLEMENTARY BENEFITS AND MINOR LINES

MR. LYLE: Another area of technical problems involves the modeling of supplemental benefits, such as accidental death and premium waiver, and the minor lines of business, such as the health lines, group lines, and annuities.

MR. SUNG: Our supplementary benefits such as ADB and waiver of premiums are included in our basic corporate model. They are not associated with the cell generator model because this line is of minor financial importance and its results are usually reasonably predictable - at least on a short term basis such as five years.

On the other hand we found the financial results of other lines of business, especially the group line, to be quite volatile and unpredictable. We tried to build a model for group operations and found the results very discouraging due to the cyclical nature of group health insurance and the generally volatile sales results. I presented a paper at the Management Research Techniques Committee meeting of LOMA as to how a model might be developed for the group line, but I advise you (at least from my own experience) that any attempt in this area might be futile.

As far as the individual health line is concerned, an attempt is being made to produce a cell generator model. The non-can disability income line can have a reasonably good cell generator model.

MR. AFFLECK: Our approach is somewhat different from that described by Sam for the minor lines. While there are situations where the minor lines are insignificant, in a surprising number of companies the financial impact of these lines can be important. In these cases, we have used our Model Generator System to create abbreviated models for the ADB, WP, RPU, and ETI business and then completed separate projections for them. We have also modeled the supplementary contracts on deposit and attempted to determine what portion of the cash values are converted into RPU and ETI and what portion of maturities are left as funds on deposit with the company. All these blocks of business are then projected so that earnings on them can be taken into account in the overall company projection.

\* "First Year Lapse and Default Rates" by Norman F. Buck (TSA XII, 258)

MS. WIMMER: United has taken the same approach as Allan described, especially in consideration with waiver premium and ADB. The only other lines that we're really concerned about are the group lines. We originally envisioned developing a model but we do not have an approach to it yet. We will probably handle that as an input item also.

#### DEVELOPMENT OF MODEL ASSUMPTIONS

MR. LYLE: Once you have worked out a logic for a model, the problems don't stop. There still remains the need to develop the data and the input assumptions to drive the model. This is a vital aspect, both of model development and also of the continuing maintenance and use of the model. Thus it concerns the model user as well as the model builder.

MS. WIMMER: Assumptions for the corporate model come from three basic sources: experience studies, other supporting models, and data provided by operating departments. It is difficult to separate these sources into three areas since each contains input from the others. However, the distinction is helpful to define the primary emphasis for the development of each assumption.

As with any corporate model, mortality and withdrawal assumptions were needed. For projection purposes, persistency was assumed to vary by mode at issue and plan type, that is, permanent, term or annuities. An enhancement will be made to the model so that first year persistency can be improved for each year of new issues. Mortality is not assumed to vary by mode but varies by line of business. Five lines of business are being used: ordinary, disability, accidental death, deferred annuities, and immediate annuities. Experience studies were used to develop both mortality and withdrawal assumptions.

Experience studies were used to develop lag factors. Since the model calculates death benefits, surrenders, and premiums on an incurred basis, lag factors are used to distribute the incurred amounts of money to the months in which the money will be paid or received. Experience studies were also used to develop assumptions of the distribution of money into various settlement options upon surrender or death. All of the experience studies have used the most recent data available. However, it is felt that things such as lag or distribution factors should probably be analyzed as to trends that might affect these factors and take these trends into account in the projection process. Before doing so, however, a sensitivity analysis will be performed on how important such factors are to projected results.

In cases where an experience study did not seem appropriate, a model was sometimes developed. One of the models was a sales and manpower model which will be used for information on projected new business. The model developed can be used one of two ways: new business goals may be input with the model generating needed results for agents hired, agent retention and productivity; or the manpower information may be input and the model will project new business. It was felt that the facility to generate results on either basis was needed for strategic planning by the Marketing Department. With this model, the user can input current manpower figures and see the production results from no change, input production goals and see the manpower improvement needed, and then modify the manpower input in a manner that the projected new business is attainable and consistent with programs under way or

anticipated in the agency area. The model that was developed used the concept of transition matrices with probability elements that vary by duration of the agent. These matrices reflect the probability that an agent has: a decrease in production; an increase in production; production at the same level; or termination with no future production.

The projection is performed by agency type since it is desired to obtain projected results from the corporate model by agency type. United has three agency types: two types of General Agencies, and Branch Offices. All new agencies currently being appointed are Branch Offices. The reasoning behind projecting by agency type is that agent productivity, hiring, retention, expenses, and commissions vary by agency type and the movement to Branch Offices can be expected to affect corporate results. Because of this situation, the sales and manpower model takes into account the probability of death or retirement of the General Agent. Manpower results for each agency type are used to generate expenses and commissions for the corporate model and new business volume results are used in the corporate model directly.

Another model that was developed is a policy loan model. A study was made on many variables that were thought to contribute to policy loans. It was determined that two primary factors could be used to closely reflect the amount of policy loans taken out: the total cash value available for loan and the current AAA Corporate Bond interest rate. Thus, the policy loan model takes the cash value available for loan from the insurance projections and the interest rate assumed for new corporate bonds and projects the investment in policy loans. This amount is then combined with the cash flow coming from insurance operations and the cash flow from previously invested assets. The aggregate cash flow available for investment in other assets is then determined.

In other cases, assumptions are based on data provided by operating departments and projections of the economy and the insurance industry from outside sources. This includes interest rates on newly invested assets for each projected year. These are provided by the Investment Department and vary by type of asset. The Investment Department also provides an investment strategy which will determine how the cash flow available for investment is to be distributed among asset types. Assumptions on reinvestment strategy inherently include interest rate expectations.

Although the Sales and Manpower Model projects total issued volume, input is required for the plan, age, and mode distributions of new business volume as well as the average policy size for each projected year. These assumptions are set through discussion with the Marketing Department using company experience, demographic projections, industry projections, and expectations as to results of future programs.

Other assumptions set by input from user areas are: expected improvements in persistency; and potential IRS rulings regarding our tax situation.

Sensitivity analysis will be very important to the tuning and refinement of the model assumptions. Before needed accuracy levels for each assumption can be determined, the sensitivity of projected results to these assumptions must be determined. United has not yet reached the point where sensitivity analysis has begun.

MR. LYLE: I would like to second the emphasis on the importance of sensitivity analysis. The cost of data collection is not insignificant. It is

important to get a model developed, get it running, experiment with it a little bit, and find out which are the important assumptions, before spending a lot of time and money getting detailed and very precise data together for input assumptions.

#### USES OF CORPORATE MODELS

MR. LYLE: Many applications for corporate models have been proposed. Each of these presents its own considerations and problems for the user. The use and usefulness of the model must be considered along with establishing user confidence in the model.

MR. AFFLECK: In recent years one major use of the corporate model was to compute aggregate GAAP reserves for adjusted earnings purposes. From a management point of view, by far the greatest use of models has been as a starting point for long-term projections. During the last ten years, we have been providing projections of statutory earnings, and more recently GAAP earnings, for life insurance companies. Our experience has taught us that the most difficult part of completing a projection is securing a valid data base to represent the in-force business at the start of the projection period. This seems to apply regardless of whether the company is a large one or a small one. The projections themselves serve a variety of purposes, the most important one being an estimate of future statutory or GAAP earnings based on the company's best judgment of future experience. It is particularly instructive to present management with a series of projections showing the results from different sales levels, lapse rates, and mixes of business. The whole area of tax planning is greatly aided by the availability of after-tax projections. Cash flow is another by-product of the projection process.

Since both statutory and GAAP earnings have limitations as a true measure of a company's performance during the year, several of our clients look to the year's statutory earnings plus the increase in the present value of future profits as the most meaningful measure of total company performance. This represents the "value added" to the company during the year and can be provided as a by-product of the projection calculations.

Perhaps one of the greatest difficulties in using corporate models and projections is establishing the credibility of the model in the early years of its use. One approach we have used successfully is to complete the initial projection by going back one year and making sure that the projected results for a year ago were reasonably consistent with the company's actual earnings during that year. Unless deviations from the projection can be explained reasonably, management will lose confidence in the model. Consequently, great effort should go into the analysis of the initial results from the model or projection before they are communicated to management. It is difficult to regain management's confidence in later results if the early figures turn out to be wrong.

Another major use of the corporate model that we haven't discussed in detail is the agency submodel. By identifying levels of new business expected from agents at various stages of development with the company, reflecting agent turnover rates, and projecting the expected level of new agents hired, a projection of new business can be made. It is always interesting to see how closely this projection matches the agency department's production goals. Long term production goals sometimes seem to be obtained independently from

any close examination of the characteristics of the company's agency force and the anticipated levels of new agent hiring.

Another valuable exercise is to take the company's profit objectives for the next five years, the level of profitability in the current products, and the production expected from the current agency force and then determine how many new agents must be hired in each of the next five years to meet these profit goals. In some situations, we've found a huge gap here, and the exercise has put some startling results before management.

The point of these last two illustrations is that corporate objectives need to be company-wide and consistent from one department or division to another. Using the corporate model or submodels as a tool can open up the lines of communication and become a vehicle for pulling the company in a common direction.

MR. SUNG: At Mutual of New York I am responsible for all financial reporting, accounting, tax planning, and corporate actuarial functions. Therefore, we are basically the users of the model as well as the developer. We use the corporate model essentially to provide financial projections and analyses and to answer questions raised by management. We also use various models to monitor our subsidiaries and several product lines. Some examples are:

1. Determination of Payable Dividend Scale - Each year we present to the Management and Board the estimated change in surplus funds for the current year in conjunction with dividend recommendations for the following year. We use the model to test whether we can reasonably expect to support the dividend scale for a foreseeable future.
2. Tax Planning - In order to minimize Federal income tax the model is extensively used to establish an appropriate reserve valuation basis for all product lines. Furthermore, the model can be used to evaluate on optimum mix of investment for tax planning.
3. Corporate Goals - MONY has a number of corporate goals in connection with a corporate plan. The model evaluates whether we can achieve some of these goals under given assumptions.
4. GAAP Earnings - Our cell generator model is used to compute reserves for GAAP earnings for one of MONY's life subsidiaries.

I would like to emphasize that you should not try to build a model unless such a model is going to be accepted and used. For instance, in our company I would like very much to build a marketing model for manpower recruiting of new field underwriters. We did not try because of our lack of confidence in convincing the marketing area and obtaining cooperation from them. For that reason our sales result is always an assumption rather than being based on our planning for field manpower.

There are several problems with our model. First, sales assumptions are given. Second, there is the effect of outside economic conditions on the life insurance business. We can obtain an economic forecast on such items as gross national product, unemployment rate, and inflation rate from many econometric models. However, they do not provide us with information as to

what it means in terms of life insurance business, such as field underwriter recruiting, quality of recruiting, consumer attitude for life insurance buying, lapse rates, and interest rates.

Third, the volatile nature of other lines of business sometimes undermines the credibility of the model.

Fourth, for model building and maintenance, we use actuarial students on rotational assignment. The language we use is APL. It is difficult to maintain continuity and good documentation of the model. Of course, the advantage of using actuarial students is to provide them a good training ground.

There are two things which must be avoided to successfully develop and implement a model. First, avoid an elaborate and comprehensive model. Not only is this type of model costly in terms of out-of-pocket expenses and required manpower, but it would usually delay the project so long that its credibility would be in jeopardy, too. Even if the project were completed in due time, because of the expense involved management and the sponsor would expect miraculous results from the model. This kind of overexpectation usually results in disappointment and lost enthusiasm on the part of the sponsor and undermines the value and very future existence of the model. Furthermore, we build a model to simplify reality in understandable terms. If the model is too complicated it winds up reproducing the reality which leaves us as confused as before.

The second item to be avoided is overplaying the value of the model. It should be emphasized the model can never predict the future; it simply translates the sponsor's or user's judgment as to the future business and economic environment into readily understandable financial terms. This limitation of the model has to be stressed over and over again so that the sponsor understands the nature of the financial projections.

I would like to conclude with a few general rules which might help in developing a corporate model in-house. Some of them are direct quotes from an article by Kenneth C. Levine in "Management Planning":

1. Find an appropriate sponsor unless you are the person responsible for the financial projections. The model must have a political sponsor in senior management if it is ever to be used for top level policy making.
2. Retain a low profile. Do not hire a staff but use an actuarial student with financial and time-sharing experience to do the programming and documentation of the model.
3. Make it simple. Start with a financial model that reproduces the financial reports of your company. Once the financial model is operational and it is accepted by management then begin to increase the capacity of the model to provide more sophistication and flexibility.
4. Make it credible. Spend a substantial part of your time identifying and analyzing the significant interrelationships between items on your financial report. It is essential that the model not be too naive and that it generate a consistent outlook.

5. Set short run objectives and complete them quickly. Determine in advance the objectives of the initial model and document what it will and will not do. Otherwise the modeling process becomes an open proposition without a logical end.
6. Do not be concerned about data. Historical data is rarely consistent over a period of time. Start your initial model with your best guesses from your sponsors, or with defensible statistics or mathematical relationships requiring minimum analysis. The original input can always be replaced by more sophisticated information at a later date.
7. Do not spend a lot of money. By following the suggested game plan the cost of the model's development can be minimized and the only marginal (and obvious) cost should be the time-sharing cost. This can be kept to a minimum of several thousand dollars during the initial phase of development.

MS. WIMMER: Because of a different situation, United has made a conscious decision to violate almost every one of the general rules put forth by Sam. At United, the primary sponsor of the corporate model is not the Actuarial Department. The primary sponsor has been a committee called the Long Range Planning Committee. This committee reports to the general policy making committee of the company and to the President. The Long Range Planning Committee is comprised of the Chief Actuary, Controller, and Chief Agency Officer. This committee sought and obtained Board approval before a software package was purchased. When approval was obtained to begin the corporate model development, several sessions were held for management personnel to explain the purpose of the project and to seek management's assistance in the developmental work. There were many questions asked by this group of management about how the corporate model might be used in functional areas of the company. From these sessions and questions, several secondary sponsors were identified: the Tax Department for use in tax planning, the Investment Department for monthly cash flow projections, and the Actuarial Department for analysis of products and product lines.

The primary sponsor, the Long-Range Planning Committee, will be using the corporate model as a tool to perform their various functions. Currently, their principal tool uses the present value of future profits concept. However, this concept is difficult to explain and does not present the total picture needed for corporate planning. The corporate model will be one of the tools used by the Long Range Planning Committee to ask a wide variety of "what if" type questions. Under this approach, various scenarios for the future can be developed. Against these, the results of various decisions can be measured and corporate directions can be developed to either maximize the gains or to minimize the losses. This variety of sponsors and users has created the multi-purpose situation previously mentioned and has added to the desire for accuracy and level of details.

Obviously, the development of such a comprehensive and elaborate model has taken a great deal of time and cost a lot of money. The time has not been a problem except that we have already wished many times that the model could be used to aid in making a specific decision. However, these decisions have normally been such that a less elaborate model would have been of limited assistance. In the cost area, we have taken the position that you get what you pay for. Had we chosen a less elaborate route for development, most of



the decision questions we have identified thus far would have required substantial modifications and a corresponding loss of response time. Thus, it appears that the temporary situation of not having a model will be more than compensated for by the ability to respond to a wide variety of decision criteria.

Because of the sponsor situation at United, acceptance of the results of the corporate model has been an identified and planned-for problem. We feel that this acceptance problem can be solved from two directions: education of the sponsors; and the design of reports. In both of these processes, the level of interest in detail of the individual and the kinds of decisions which will be made by these individuals must be taken into account. Although a large amount of detail is available for validation and technical analysis, it is anticipated that the sponsors will generally receive summarized reports.

Looking back at United's decisions and developmental work, we feel that our approach has been a good one. Also, the approach has contributed to a more widespread acceptance of planning principles.

MR. AFFLECK: Each of the panel members has spoken to the issue of simplicity in the model versus the credibility of results, and there are, naturally, important practical trade-offs to be considered. From our experience, I would emphasize the importance of the model being credible and suggest a company beginning a modeling and projection project err on the side of credibility, accuracy and sophistication rather than constructing too simplistic a model. The latter, if it does not gain management acceptance, simply won't be used, and the whole exercise will prove to be futile.

I would also like to allude to a comment that Bob Houser made this morning. He observed that when their projection was first established, they spent all their time explaining why the projected results weren't achieved. Much of this related to problems with the model and the projection rather than to changes in assumptions. In our experience, the projection is more valuable as a tool for evaluating alternative courses of action than as a predictor of actual profit or balance sheet results under a specific course of action.

Again, picking up on a comment of Jim Anderson's, the separate projection of existing and future business allows a company to determine where its profits are arising and to examine profitability from each block of business. This is particularly important for participating business where equity should be maintained in the dividend scale for each block of business.

MR. LYLE: This concludes our portion of the program. The members of the panel will be happy to answer whatever questions you may have.

MR. LEE LAPIOLI: I am Lee Lapioli from Penn Mutual Life Insurance Co. I'd like to support the seriatim approach. The corporate model must be able to provide information at any point in time. The purpose of a model is not only to project but to be an information system as well. The seriatim approach gives the flexibility of using the information for many other applications. For example in sales projections, each general agency must know the source of its income. Also, seriatim processing can develop the amount of overrides and allowances the general agent will receive.

Sorting the information to begin with into cells and project them from that point in time takes time but each policy has to be read anyway. When you

develop cells, you are restricting yourself which makes it difficult to change anytime you like.

MR. LYLE: Thank you. I think you're talking about a very extensive kind of system, at least if you're as large as some companies. Certainly those are very valid approaches to the use of the model.

MR. JOHN WOODY: I am John Woody, North American Re. I don't think that any Society of Actuaries discussion of models would be complete without mentioning the current status of SOFASIM. The documentation has been completed and a copy is being mailed to each contributor to the cost of the mortality and other investigations.

I believe that SOFASIM is relatively unique in that it is a Monte Carlo type of model whereas most of the models are expected value models. The deaths, lapses, and new business are stochastic. The actual values of the deaths, lapses and number of new policies sold in each month are generated by drawing random numbers while the other parameters are based on the user's own expected values. I should mention also that you can turn that off if you don't like it and have a deterministic model.

MR. CLAUDE J. MARTINEAU: Would the panel explain how they treat reinsurance business in their models.

MR. AFFLECK: We have a reinsurance ceded facility in our model and the user can input the percentage of the business reinsured, the average size policy, and the retention limit. In the projection we show the reinsurance premiums and offset death claims by the reinsurance claims and the experience refund, if any, generated from the assumptions.

MS. WIMMER: We have a ceded facility similar to Allan's. Our reinsurance assumed is handled similar to our new business.

MR. SUNG: Our in force created is net of reinsurance ceded.

MR. MICHAEL HUGHES: My name is Michael Hughes. I am a partner in E. S. Knight and Co., consulting actuaries from Melbourne, Australia. I thought you might be interested in some comments on the Australian situation. We have been constructing models for life insurance companies for about eight years. Most of the offices we deal with are substantially smaller than the American offices, and as such, costs are a significant problem. Our general approach at present is to construct a model while we run through the entire valuation file. Business at least two years in force is grouped only by attained age. Business less than two years in force is treated as new business issued at the appropriate duration in the past. This gives us satisfactory results with 99% accuracy on reserves. We have found that we can generate this degree of accuracy with something like 500 model policies on the in-force business and 40 or 50 on new business.

The drawback of using an age attained basis is that you can't have select rates of withdrawal beyond the two year period. However, the experience in Australia in the last few years has been such that the withdrawal rates are much more dependent on economic conditions than on strict policy durations. Under that condition we believe greater accuracy can be obtained with the original concept.