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**SOFTWARE TOOLS FOR
ASSET/LIABILITY MATCHING**

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- o An objective discussion and inventory of what systems are available, what they do and don't do, and the advantages and disadvantages of each.
- o This session is designed to assist the actuary who is trying to decide whether to build his own system, or to buy or "rent" an existing one. This objective will be accomplished, in part, by a survey of the capabilities of a number of existing systems. A comparative survey of these systems will be available as a handout.
 - Investment strategy selection
 - Options pricing models
 - Projections
 - Fixed scenario testing
 - Monte Carlo scenario testing
 - Testing duration match
 - Sophistication of the underlying asset and liability models

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MR. STEVEN A. SMITH: The Section Council of the Financial Reporting Section realized that there are many actuaries who need to do some form of valuation actuary asset and liability matching or cash flow projections. I would expect that there are quite a number who haven't yet decided exactly how they're going to do this. We intend to provide information on available systems which will assist actuaries in the preparation of actuarial opinions and the management of their company's assets and liabilities. It seems to us that there are three or maybe four choices:

1. Build your own system. In this case, the session should assist the actuary by indicating, through both the remarks of the panelists and the questionnaire, the kinds of things that others have been putting in their systems and how it was done.
2. Rent a system on a consulting basis. In this situation, the session should give you an idea of some of the systems that are available.
3. Buy an existing system. This could be done either with the idea that the purchasing company would have the seller maintain the system through a maintenance and upgrade contract, or the idea that the system would be purchased as the basis for a system of its own, assuming that the purchaser is able to get the source code when he buys the system. In the latter case, the system would be modified and maintained by the purchasing company.
4. A combination of 2 followed by 3 above, which is what my company did.

Obviously, this panel doesn't have a representative from every company that has an asset/liability system. However, almost all of the vendors that I currently know about represented.

MR. BRIAN BAMBROUGH: I'm responsible for the Bambrough and Associates Asset/Liability Matching System. The purpose of this system is to take all or part of a company's existing business and project the pre-tax cash flows from it. These cash flows are then used to compute present values and Macaulay durations. The main use to which companies are currently putting this system is to

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satisfy the requirements of the New York Regulation 126. First, I'd like to tell you a little bit about the history of this system.

In 1983, a major East Coast insurance company decided to provide an asset liability matching consulting service to its reinsurance clients. They called in me and my programmer to help write the support programs for this. After successfully completing several analyses, the company decided that the resources employed in this project could be better used elsewhere. So in 1985, they called me in again and asked me if I would like to buy the rights to the system. I said I would. The idea was that I would develop the system into a form that could be sold to insurance companies. The first system was installed in Western Life Insurance Company's home office in St. Paul in late 1985. Since then, nine other companies have become users, and these include Berkshire Life, Capital Holding Corporation, Connecticut General, Farm Family Life of Albany, Knights of Columbus, National Liberty, Phoenix Mutual, Union Labor Life and Unity Mutual. The purpose of telling you this is to demonstrate that the system has several man-years of development behind it and has been used in real-life situations. Most of the companies I just listed are using the system to comply with New York Regulation 126 for year end 1986. Now, I'm going to tell you about *one feature of the system where I could really talk for an hour and a half.* When I was writing the system, I tried to put myself in the place of the actuary using it. My feeling was, as a user, it would be essential for me to be able to prove the system was producing correct results. Now, this isn't easy with an asset and liability matching system, since the system takes the model office set up by the user and runs an enormous amount of computations to end up with just a few pages of reports. The checking method I selected was to allow the user to run any one cell from the model office of the liability or asset. The results of all the detailed computations entailed in this cell are stored, and the user can then print them out.

For example, in an annuity computation, the user can print the basic cell data or the input tables, develop the probabilities from the rates, commutation functions using the payout period, the detailed analysis of payout benefits and expenses, all the dynamic elements of the lapse scenario changes when the interest scenario changes and, finally, the breakdown of the cash flow for the cell. With this as a tool, the actuary can verify whether the whole system works correctly. This is because the result for the company as a whole is

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simply a seriatim summation of the single cells. Last October, at the Society of Actuaries Exposition in Chicago, we handed out a 40-page brochure that describes the system and shows single-cell computations for annuities and bonds, just as two examples. If you would like one, you can call or write me at my address in the Society of Actuaries *Yearbook*.

MR. DENNIS L. CARR: The name of our system is CALMS. CALMS is a microcomputer-based asset/liability modeling system. It can be licensed and installed on a commonly configured microcomputer system. CALMS is specifically designed to handle interest-sensitive products, such as universal life, flexible and single premium deferred annuities, and single premium life, as well as fixed cash flow streams such as immediate annuities. CALMS is a generalized type of model. It can operate in a typical pricing fashion -- that is, issue one hundred policies today and track them forward for twenty to thirty years -- or it can project in-force assets and liabilities, the type of projection you might use to comply with regulations such as Regulation 126 in New York. In addition, the system has the capability of handling future new business in the projections.

The assets and liabilities modeled under the CALMS system are projected quarter by quarter, on an interactive basis. This allows the modeling of interest crediting strategies based on the actual asset portfolio earnings rate, less a given spread. In the model, the earnings rate from the assets is calculated each quarter. The interest rate on the liability is then reset according to the crediting strategy which you define. Cash flows are projected, investments are made, and the process is repeated. This illustrates what we mean by an interactive projection of assets and liabilities.

Included in the software is an interest rate scenario generator, which develops random sets of scenarios. There are many user-defined variables in the scenario generator, including volatility, minimum and maximum rates, and the correlation of short- and long-term rates. This allows modeling over a full range of possible scenarios. The model also allows you to build your own scenarios and use those if you wish. CALMS allows for several dynamic assumptions -- assumptions which change as the interest rate scenario varies. These include the credited interest rate, the investment strategy employed, withdrawal rates, premium payment patterns, expenses and expense inflation, mortgage prepayments, and bond calls.

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I'd like to finish up by describing some of the general ways in which CALMS can be used and how we've used it in several projects. These include definition of interest crediting and investment strategies for new products or for in-force blocks of business. Also, CALMS can be used to evaluate the financial consequences, under various scenarios, of various product design features, including extended interest rate guarantees, no-cost policy loans, bail-out provisions and various surrender charge scales. And, finally, CALMS can be utilized to perform in-force projections for valuation-type studies, such as New York Regulation 126.

MR. PETER B. DEAKINS: I'm actually going to talk about two systems: the Milliman & Robertson system that we call the optimizer or the risk analysis system, depending on what kind of mood we're in, and a system that PALLM has called the PALLM PRO. Essentially, the two systems are the same, which is why I'm going to speak about both of them right now. What happened is that Milliman & Robertson sold the rights to license the system to PALLM, so the companies that want to license the system work through PALLM. Companies that want to use the system on a consulting basis work through us.

The system has evolved over the last four years starting from the work we did for the rehabilitators of Baldwin-United. We have gradually developed a fairly sophisticated and flexible system that handles just about anything on both the asset and the liability sides. I feel like we have as flexible and sophisticated a system as there is around. One of the things that's kind of unique about our system is what we call "optimization." When our system is in optimization, it solves each year for the investment strategy; it maximizes expected profits, while conforming to the management's constraints about how much money management is willing to lose. That capability offers a lot of unique opportunities for strategic analyses of how much risk a company should be taking and for evaluating the risk/reward function. I think the thing that's really exciting about our system and where we've gotten the most use out of the system is in strategic analyses, analyzing what companies should be doing with their investment strategies and what companies should be doing with crediting strategies and how products should be developed -- in other words, what kind of surrender charge schedules produce the best expected return risk relationship. That's really the key to what we're doing. In everything we do, we attempt to balance risk and

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reward and help companies evaluate where they want to be in terms of the risks they take versus the expected rewards they're going to get.

MR. STEVEN SMITH: I think that the Milliman & Robertson system is available on a consulting only basis. If you wanted to purchase it, you can get something that's very, very similar from PALLM, and PALLM has both a main frame system, written in APL, and a PC system which runs on an IBM AT or something comparable. The two systems are quite similar.

MR. SHANE A. CHALKE: My company's primary business is doing product development-type consulting. However, for the past five years we've been marketing a PC system called PTS, which quite a few of you are using now to handle pricing and profit projection decision making for interest-sensitive life and universal life products. Approximately four years ago, we developed a decision theory model to be used in conjunction with structured settlement annuities in order to make decisions about investment strategy and interest crediting strategy. Over the past year, we've integrated the PTS system and the asset system, which is, I think, the natural progression of our PTS system.

I'm going to talk about one aspect of our system which I think is truly unique and that is the decision theory model. We're using an exponential utility function from decision theory which has really been through the wringer on the casualty side, as far as a decision-making tool that's especially appropriate for the way insurance companies would want to act and behave in risky situations. What a decision theory model does is to take a risky environment and translate that into an equivalent fixed dollar amount. So, if you're faced with a range of possible scenarios that could unfold, you can translate these into their risk-adjusted certain dollar equivalents, and maximize on that basis.

Let me go through one example to show you what I'm getting at. Suppose you want to do an extremely simple asset model; by extremely simple, I mean, you might project across ten possible investment environments. You might try three different interest crediting strategies, and three different investment strategies. Well, what are you going to get out of the system? You're going to get 3 x 3 x 10, ninety reams of paper, which are going to have all kinds of numbers on them, some positive, some negative -- numbers all over the place.

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How do you make a decision based on this? Well, what we're doing with the decision-theory model is taking the results across all these ninety possible outcomes, adjusting them by modeling all moments of the probability distribution and translating them to their fixed-dollar equivalent utility and drawing it on a three-dimensional graph and showing you where the maximum point is, so we find the optimum combination of investment strategy, interest crediting strategy, across the various scenarios. How does the decision theory model work? Rather than looking at something like the variance across the different interest crediting scenarios, which gives you partial information, we're modeling the distribution, looking at all moments of the distribution and viewing our translation through a linear transformation that way. It all sounds very complicated. It is very complicated to understand, but it's very easy to use.

So much research has been done on the casualty side as far as applicability of decision-theory models to attitudes toward risk that it can actually be boiled down to a fairly simple procedure, such as if I offer you a choice between picking a coin toss where you get a dollar if comes up heads and you pay me a dollar if it comes up tails or I just take a quarter out of my pocket and hand it to you. Those are two very different events; in one, I give you a quarter, and the quarter is in your pocket and it's certain. In the other event, you have an expected value of 0, but you might win a dollar. Your maximum win is much higher, but your maximum loss is much worse.

How do you choose between those situations? It's entirely 100% subjective as to what choice is appropriate. It depends on your personal risk profile, your attitude toward risk. What we're doing is trying to model certain attitudes toward risk so that you can quantify these types of decisions. Because I do feel that it's pretty close to impossible to look at the types of output you're likely to get from an asset model and make decisions based on that. There are just too many numbers and I don't think it's a real possibility.

MR. SHELDON EPSTEIN: Before I begin, I would like to emphasize that Morgan Stanley's model is not for sale; however, we use it to study assets and liabilities for our insurance clients. The Morgan Stanley model is an option pricing model for life insurance liabilities. Its main value is in allowing the arbitrage free pricing of the stream of interest-sensitive cash flows, such as those generated by insurance products. Our model is best used for asset/liability management of

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the C-3 risk, for actual pricing of insurance products, and for setting baseline indices against which portfolio managers can actually construct an appropriate investment strategy.

Our model has not been used for valuation actuary issues, though it is certainly suited to do so. The Morgan Stanley model does project liability cash flows over multiple interest rate paths. However, our model does not create statutory or GAAP profit and loss statements for each path, since it is not necessary to do so in order to determine a proper hedge for the C-3 risk.

The Morgan Stanley model is a continuous option pricing model, so that interest rates are not constrained to move up or down in volatility steps. The model is arbitrage free, and is thus unique among actuarial asset/liability models. We sampled paths of interest rates from the model using the Monte Carlo approach. The special property of the arbitrage free set of paths is that the average of the present value of the cash flows over all the paths is the fair market value of the cash flow stream.

Thus, we have one unique value as a result. The model generates interest rate paths that are implied by the yield curve on the date of the valuation. Thus, our model generates entirely new paths when the initial yield curve is shocked from its current level. This allows us to determine numerically the derivative of the market value of the liability with respect to changes in interest rates. By dividing this derivative by the market value, we calculate the option adjusted duration of the liabilities, which can then be compared to the option adjusted asset durations. These durations are the true price-sensitivities of the assets and liabilities. We also calculate the convexities, or the second derivatives.

An essential component of the model is the cash-flow generator, which produces path-by-path cash flows that allow every assumption to be interest-sensitive as well as path dependent. Everything that I've said with respect to the liability model applies equally well to the asset models. Morgan Stanley has developed separate models for callable bonds, mortgage-backed securities and individual options and futures. In fact, we regularly value assets for purposes other than insurance asset liability matching, using the same models.

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Our system is modular, so we can quickly devise cash-flow generators for specific assets. Here's a list of interest-sensitive parameters allowed on the liability side: we have interest-sensitive lapses, policy loans, premium dump-in's, expenses, the interest rate recrediting strategy and the competitor's interest rate crediting strategy.

When we perform a study for a client, we calculate the present value of his liabilities and assets. We determine what option-adjusted yield spread above the treasury yield curve is required to support the liabilities with the given assets. We calculate the option-adjusted durations of the liabilities and the assets and suggest specific strategies for achieving any desired state of duration match or mismatch. The yield spread, combined with the duration and convexity characteristics of the liabilities, forms the baseline index against which the portfolio manager can measure asset performance. The portfolio manager can carry out his responsibilities exactly as if he were comparing his performance against a market index like Moody's. Assuming that the market value of assets at valuation time is adequate to cover the market value of the liabilities, the portfolio manager can then hedge against the risk that the asset market value will ever become deficient. He dynamically hedges the C-3 risk by selling those assets whose yield spread above Treasuries becomes narrower than required to support the liabilities, and by keeping the durations in match. The Morgan Stanley model is ideally used on an ongoing basis to determine any rebalancing that is necessary to improve or achieve the desired duration match.

MR. DOUGLAS N. HAWLEY: Since you have the surveys, which Mr. Smith put together, I'm not going to talk that much specifically about my software. I would suggest to you generally that I can see the process of asset liability matching coming in three phases.

The very simplest phase would involve perhaps one person and some worksheets and basically involves getting comfortable with the concept. This would be meeting and talking with your investment manager about investment philosophy, and seeing what sort of data base you currently have for your assets. What detail do you have on mortgages? What do you know besides what's in the annual statement? Obviously, the annual statement is a starting point for your asset block; what else do you know about your assets? What do you know about your current investment philosophy? Calculate the market value of your assets.

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Find out the cash value of your equity policies, be they annuities or life insurance. See if you can calculate some sort of liquidity index. Without any forced sale or redemption, how much cash flow will result from your existing asset block?

So, you've done this, you've met the people, you've found out what information is easily available. The second phase is really the phase that my software represents. This is the point at which you do several scenarios, nothing really sophisticated. You run off probably time horizons of ten to thirty years, ten to forty years, depending on what you feel comfortable with. You would find out your projected cash values at the next ten or twenty durations; you would be calculating your asset values for the next ten to twenty durations; you'd be calculating the projected yield rates, based on whatever your scenarios are. This would be the point that I think would make most companies and most actuaries feel comfortable about satisfying the regulators and satisfying themselves. I think this is something any company should do even without force from the regulator. I think the force for this stage should be internal, rather than being something that you do at the last minute because you have to get a document approved by your state insurance commissioner.

The last stage is the stage that most of the people on this panel represent, and that's when you're getting into the more exotic areas: investment swaps, optimization, and decision theory. At that point, it's most likely that unless you're a very large company, you're probably going to bring in somebody from the outside. I would suggest just a few things about the process. I think that regardless of what the regulators are requiring, the actuaries should get involved in this for their own well-being. You should be pioneers. Try something new. Make some mistakes. Who knows? The Joe Smith method might go down in actuarial literature. You might stumble onto something that nobody else has thought of. Give it a shot. Try some things. Make some mistakes. The other thing I would say about the process is don't do your asset/liability matching outside your other financial projections and reporting and pricing. Don't have pricing over here on this table, asset/liability matching on this table, and no connection between the two. Make sure that all your reporting is on an integrated basis. Not only will it simplify it, I would think it would give you a greatly higher level of confidence.

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I believe Mr. Smith did a great job of putting together this survey, and it tells you a lot of information about my system. If you have further interest, definitely give me a call.

MR. ALAN W. SIBIGTROTH: My system has grown through management consulting engagements. It's a decision support system to view optional business strategies. It features an integrated structure, that is, all modules are tied together. It uses file and terminal control for better system performance and it also features on-line graphics for better communications. All of the modules, once added to a system, are fully integrated across the various components.

As far as applications, we have used the system to develop estimates of statutory or cash investment in new business, to develop financial expectations of business plans, to develop an estimate of investment risk using option prices which can be directly inserted into the financial projection. It has also been used to value business segments or components.

The main options feature the financial projection module, which develops statutory GAAP and cash flow statements for either single block or open block projections. Life insurance plan values develop the plan structure and reserve as well as sales total for comparing products. The consolidation module takes different product segments or plans and ages and brings them together into a single statement. This is linked by a sales matrix which one can change for different scenarios.

As an example, we also have graphs of different policy types. One shows three different annual premium variable life contracts at different interest rates shown on the same plot. We also can show a graph of death benefits, account values and premiums, which I think is a good illustration of the value that one gets in living and death benefits from the contract. We also have a couple of different Universal Life illustrations which can be used as part of a scenario simulation and which we have done at a later time. It's important to understand the relationship between statutory income, GAAP income and cash income. They have very different levels and are important to understanding what the comparative measure is for those different performance measures. One of the interesting things we get into is looking at statutory surplus across different product ages. As an example, we see that for a Universal Life plan at one particular age we

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have a low surplus return. The system looks at the macro-picture first and then helps define where you should zoom in to better understand the problems that you're having with your program. You also adjust to find the data. The charts, by the way, come directly from our system. We have a fair selection of charts and you can introduce new charts. Performance measures are important. We can look at cash from operations, cash underwriting gain and investment income. Cash from operations includes investment income and you can see the various components. You also might note that the cash underwriting gain, which excludes investment income, tends to decrease more quickly than cash flow from operations. We can also show expenses by components and measure the relative importance of different expense items.

The investment menu includes an option composition analysis, which is a way of putting together a collection of options to estimate the insurance risks and shows you how options work in concert. We also use cash and future option pricing models to develop values for options and can estimate density function from past experience. We use what I call a star or explosion chart to estimate the value of different call strategies or option strategies, and we can replicate here a floor or a cap for different investment vehicles. If you happen to prefer pie charts, we have those as well.

Under the consolidation module, we can bring together in this case three different segments, Universal, Single Premium, Variable Life, to develop a projection over ten years bringing in new business, and one of the things we might want to look at is the development of statutory surplus which is broken down into its cash component and paper component. That can be shown as well. We also have a number of helpful aids. We developed commutation and experience mortality tables. For a large job, you can submit them as a batch job rather than as developed under an interactive session. That gives you a little overview of our system.

MR. ROGER W. SMITH: I want to tell about where PolySystems has been and touch on the highlights of our philosophies and how that has shaped our asset/liability development efforts. We've been around since 1970. We've tackled a very wide variety of actuarial software tasks, including product development, statutory, regular GAAP, mutual GAAP, purchase GAAP, valuation kinds of issues, forecasting and experience analysis. Our asset/liability efforts today

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have benefited greatly from the many lessons that we have learned over the years.

The product that we have, we're calling DELPHI. It's a name of a forecasting system for liabilities that we first introduced some eight years ago. The system was enhanced over the years, and the asset side was added in 1986. It looks very little like the original offering. One of the issues that we dealt with very early in the process was that the asset/liability systems represented somewhat of a moving target. I think the industry and the profession as a whole are going to be on a learning curve for some period of time. What our approach involves is the ability to include all the assets and all the liabilities that you might have while at the same time being able to focus on whatever subset of that that you might want to review more intensely. We try to mirror real world effects in the projections, so we do the projections month by month, cash items, income statements, balance sheet items, statutory, and tax. We feel these are all important things to carry along.

There are two qualities that you strive for in putting together software: flexibility and user-friendliness. Many of the ways that you gain flexibility, however, cause you to suffer a little bit on the friendliness issue. And, sometimes on the user-friendly portion you will find yourself missing some of the options or restricting yourself in some way. What we have done is left the primary projection portions, what I would call very flexible, and we've tackled that other issue of writing something that is very sophisticated, an overall mechanism for the system. So from the user standpoint, you really don't have to be all that intimate with it.

The first thing is to specify objectives. Ask yourself: Do I just want to focus on cash flow? Do I want statutory results? Do I want GAAP results? The answers to those questions will affect later steps. With our system it really doesn't matter how many scenarios you want to do. They can be deterministic or stochastic. Next comes the really fun part, it tends to be one time in nature, but it's where you do all the data file set up and so forth. We do support a very step-by-step process, it does take some time, but it doesn't require a great deal of ingenuity to understand the process.

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After you have defined things, then you want to analyze your results and play "what if?" Through our control system, you can change your investment strategies, crediting interest rate strategy, lapse rates, or your FIT assumptions and see what effect that has. Briefly, here's some of the assumptions that we can deal with. There are all types of assets: bonds, stocks, mortgages, real estate and one of my favorites, cash. We can make assumptions about default rates, yield rates, prepayments and dividend levels. With regard to liabilities, again we're contemplating all lines of business.

I think the overall process is going to be a big job. It's going to be time-consuming, it's going to be expensive; therefore, try to get as much out of it as you can. Try to get your managements as excited as you are about asset and liability work. I think it will smooth things along. I believe it's something that you want to update and run quite often to get the maximum use out of it.

MR. DENNIS L. STANLEY: I am a consultant in the Seattle office of Milliman and Robertson, Inc. The system that I have been working with during the past few years is call PCAPS. The system was originally developed to support the pricing of interest-sensitive products. It has evolved to include an asset model for evaluating strategic issues related to interest-sensitive products. Although our focus is on the product development perspective, we are moving towards a projection of the entire company.

PCAPS is an integrated system that addresses issues including product development and pricing, financial reporting, and financial analysis of the company. The heart of the system is not the calculational capabilities -- I feel that most of the systems described today deal with the calculational concepts of dynamic projections. Rather, the strength of PCAPS is the database that controls the interface between the user (who gathers and codes assumptions) and the system. Asset/liability projections require considerable data, and this database concept facilitates those data management issues.

PCAPS was not developed as a product to market, but rather as a tool to support our consulting services. The sales of the system so far have resulted from clients who liked the support provided by the system and then inquired about how to purchase it.

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The types of projects that we have completed with the system include:

- o Product development using static-type assumptions.
- o Company projections using static-type assumptions.
- o Testing of the C-3 component of a target surplus formula (see the paper from the 1986 product development seminar in Boston).
- o New York Regulation 126 filings.
- o Testing of alternative product management strategies -- credited rate and investment mix under alternative scenarios.
- o Development of a coupon-stripping investment strategy for a structured settlement line of business.
- o Establishment of a range of actuarial appraisal values for a block of SPDA policies.

MR. MEL STEIN: Let me point out that not one of the other speakers has mentioned the ability to project inverted bilevel option, variable multiplex bonds with the new dynamic, optimized, trilevel call features. Not one of them has been able to say that. This may be because I just made it up. The point I'm making is that *Instant Forecast* is not meant to be used for daily investment department decisions. It is instead a strategic management decision-making tool. *Instant Forecast* is now operational and it's in use after more than two years of development. It is radically different from anything else available to the insurance industry. It was required to meet the following specifications:

1. user-friendly, to the extent to be usable by non-actuaries,
2. provide users with the best of the main frame computer and the PC,
3. an on-line system which runs immediately,
4. run times in minutes, so that you can get answers to your critical questions in your management meetings,
5. input via screens and menus -- organized to allow you to change your input assumptions in minutes,
6. better than acceptable accuracy,
7. full capabilities to project the various types of assets and liabilities,
8. fully recognizes the many dynamic relationships between the scenarios, assets and liabilities,
9. usable by several people at the same time, each from his own office,
10. accessible via PC or terminal,

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11. ability to quickly run diverse scenarios like a 5-year projection of Universal RE sales only, followed by a 25-year projection of annuities in force for New York state, followed by a 5-year total company projection including traditional life and health products. All this might take a few minutes for each.
12. handle the C-1 as well as the C-3 risk,
13. dynamically incorporate the powerful real life dimension of state of the economy versus econometrics. There is more to scenarios than interest rates, much more. Econometrics are every bit as powerful as interest rate scenarios, if not more so.
14. analytical output conducive to decision-making, understandable by everyone, not just the actuaries. It doesn't do any good to get something if you're not going to make any decisions with it.
15. multidimensional output evaluation criteria; in other words, the present value of book profit is not the only measure of a strategy's performance.
16. an effective tool for dynamic pricing and product management,
17. a system so valuable and desirable to insurance company management that even a company which has a recently purchased a competitive system will feel compelled to have Instant Forecast.

Instant Forecast gives you reliable decision-making information, virtually at your fingertips. It is an incredibly powerful tool. It saves a tremendous amount of people time and elapsed time. Instant Forecast gives you a lot of capability with the ultimate user-friendliness, minimal work, almost immediate answers, and more than acceptable accuracy. If you have it in-house on your computer, you have unlimited use and no extra cost. Otherwise, you have your time-share to Forecast Consultants and you have a very limited cost. There are no middle men; it's usable by everyone. It provides concise, understandable, bottom-line output. It's so user-friendly it only takes a few hours to learn to use Instant Forecast. Everyone in your company can use Instant Forecast: the actuaries, office of the president, executive committee, investment committee, pricing committee, financial management, etc. You can now obtain accurate, reliable answers in minutes without impacting your other work, without hiring expensive new employees and have a lot of capability available throughout your company to be able to coordinate the actions of different departments.

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MR. STEVEN SMITH: The preceding were the systems known to me. There may be one or two others that are included in the survey (see Appendix A). If you have any specific questions about any of these systems, there are names and phone numbers and lots of information in the survey, so it's easy enough to call and find out more. We'll open it up to questions. How necessary do you feel that Monte Carlo testing is, and what benefits can we get out of it? Anyone can field that question.

MR. DEAKINS: I think that Monte Carlo testing is necessary if you want to do strategic analyses, but not necessary if you want to do valuation actuary type work. In other words, either internally or externally to satisfy the kind of things that we're trying to do for Regulation 126, I don't think you need Monte Carlo testing. But when you try to price a product, take into account the value of the imbedded options, or when you try to design an investment strategy to balance risk and reward, or when you test several different alternative crediting strategies, I think that's when it becomes essential to do stochastic analyses using the Monte Carlo method so you can get a distribution of outputs to get a picture of what your expected reward is and also a picture of your risks. Then you can make judgments to balance those two. I really think that the easiest way at least to do that is through Monte Carlo type testing.

MR. STEVEN SMITH: As I recall, one of the highlights of your system is that it will help you decide on the optimal investment strategy, given the constraints, and it does that by looking at 40 or 50 scenarios.

MR. DEAKINS: Yes, based on user-defined probabilities, the optimizer or the PALLM PRO can select an investment strategy that maximizes expected profits within user-defined constraints as to how much the company is willing to lose over the projection period.

MR. STEVEN SMITH: Alan, I think I recall that you've done a fair amount of work with options and things like that. Would you care to elaborate a little bit more about that?

MR. SIBIGTROTH: I have not done a great deal of Monte Carlo type simulation, primarily because I have a somewhat different view of investment risk. If you're looking at a structure of liabilities, my thought is to try to decompose the

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liabilities into a collection of basic investments, and investor options that have been sold by the company to policyholders. The problem with scenario simulation in part is that you are caught picking assumptions for which you do not have very good information, such as equal probability of a variety of different investment scenarios, as well as a concern that the universe of investment possibilities, for example, very high interest rates, may not have been adequately evaluated. The thrust of this approach is to try to identify option vehicles that one can then work to develop investment strategies around to hedge those option vehicles, either with cash investments or perhaps using some third party or option investments to cover that risk, and if it looks like an option and smells like an option, to treat it like an option, rather than a series of disintermediated cash flows.

MR. STEVEN SMITH: Your system will then recognize that there are options in the insurance product and act accordingly?

MR. SIBIGTROTH: Well, for example, if you have a book value surrender feature, it can allow you to portray that as a put vehicle. You can use our graphics component to develop the appropriate relationship for that put vehicle, and then use the option pricing techniques to evaluate the estimated cost for that vehicle and put that in as a composite to your financial projection and see if the company can recover that cost as well. The problem that you find is that many companies can't do that. They're thrown into a loss position if they accurately reflect the cost as it is priced in the secondary markets.

MR. BAMBROUGH: On the Monte Carlo testing, I think it's good to generate a bunch of interest rates interest scenarios and run them, but the real dangers in the future lie in a whole different direction which should be tested, maybe by Monte Carlo techniques. Let me ask you a rhetorical question. You have SPDA products, and you allow the credited interest rate to become 200 basis points below the interest scenario rate. Now, what does that do to your lapse rate? Do you multiply lapse by 1.4 and add 10% to it, or what do you do? How about mortgage foreclosures? What's going to happen when the mortgage rate starts to vary from the interest scenario rate or if you have prepayments or bond calls? The point is, I don't think that we, as a society, know the answers to these questions. I've been proselytizing for people to do studies in their own companies and try to find out some of the answers to these things. I think Morgan

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Stanley has already made a good crack at this on some things, maybe on bond calls, but I think a lot more needs to be done.

MR. CHALKE: You can draw a fairly tight analogy, I think, between modeling the investment side and modeling the mortality side. We accept certain levels of risk on the mortality side through our retention limit. If you look at the broad strategies on the investment side, one strategy is to eliminate the risk. That would be equivalent on the mortality side to setting your retention limit at zero. Another strategy is to figure out what options are inherent in your product, and figure out what the opposite side of that option costs in the secondary market, and attach a price tag to the option that way. That's equivalent to pricing your mortality by saying, what would it cost me to reinsure everything and consider that a cost in your model? The way we've approached it is different than both of those. We were attempting to not price the risk in the secondary market, not eliminate the risk, but to treat your stance toward risk comparable on both sides. Whatever degree of risk you're willing to take on the mortality side, you ought to be willing to adopt a similar risk profile on the investment side, which means not eliminating the risk, not assuming the cost as the same as a secondary market, but developing a consistent risk profile as you approach your business and make your decisions.

MR. STEIN: We're talking about optimization and Monte Carlo and it's a good concept. The problem is you're doing a 2-dimension optimization in a three-dimensional world. Now the optimization, as I understand it, says, let's run a bunch of scenarios, say 50, and we'll let the optimizer pick the strategies that'll get us our best return, probably in terms of present value or profits, without taking a risk of exceeding the maximum amount of loss. Now that's fine, but if you toss in that third dimension, the maximum amount of loss is going to be a lot bigger, maybe 2, 3 or 4 times as big if you recognize the real world. Interest rates alone do not make a scenario.

MR. RICHARD JUNKER: We've worked with a model on a particular product and we've come up with a conclusion as to how long we might safely invest in certain maturities using return on 20th year surplus. Whereas, if you look at it from the point of view of return on investment, it suggests a little different maturity range. So we're kind of at an art at this point and not really science where we can reproduce a result by two different approaches. Perhaps that's not the

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perfect analogy, but we think hard about it when we look at an entire portfolio. Are we safely matched? We have a choice of at least ten companies to choose from. I'm wondering if anybody has ever done New York Regulation 126 using 2 different systems and come up with pretty much the same conclusion?

MR. STEVEN SMITH: It's bad enough to do it once. Any reaction to that question? Apparently, no one has done it twice.

MR. STANLEY: Well, my guess is, given the consistent assumptions that we get the same results on a New York Regulation 126 analysis.

MR. SHRIRAM MULGUND: In discussions which have taken place in the last two days, most of the concentration was on the C-1 and C-3 calculations for bonds. The cash flow is much more predictable than with other assets. The moment you start applying it to common stock or real estate, you have a lot of different variables. Can any of the panelists give an indication as to how their models handle the common stock or real estate? For example, how do they bring in the capital gains? How do they adjust to bring in the effect of the future interest scenarios on the coupons?

MR. BAMBROUGH: In the Bambrough and Associates system, the asset module has 3 kinds of assets: bonds, equities and mortgages. The gentleman asked about the equities. In my model, this is the simplest of the 3 kinds of assets. You can put in your initial cash flow stream and you can dynamically vary that according to the interest scenario. The value or the market value of the bond can also be dynamically varied accordingly to the interest scenario, and then you can sell the mortgage and the equity at any time you want. I don't do the complexities in my system that you're asking about. If you're talking about mortgages and bonds, then it's a lot more complicated.

MR. STEVEN SMITH: Do you do it for mortgages and bonds?

MR. BAMBROUGH: Well, if you want to find out, I'd suggest you send and get my brochure, because, for bonds anyway, I have it very well described in there. Mortgages are pretty complicated. You've got tons of things varying in there; you've got the mortgage interest rate, obviously, you've got prepayments, you've got foreclosures, and then you've got all kinds of things you can

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do with the interest. Money can come in two different ways. You can have an amortized payment of the mortgage where you've got a principal and interest piece coming in, or you can have balloon payments. Another variable is whether there are regular interest payments on the principle or whether interest just accumulates and gets paid at the end. So there are all kinds of variables with mortgages.

MR. HAWLEY: The asset model AM-88 requires the user to state rollover rates, interest rates and profit or loss on sale for the categories of assets other than bonds. Now, this is either more work or extra freedom depending on how you want to look at it. But, you are required to state your estimation of what's going to happen to these three things and these will calculate then the interest that you get out of it and the rate at which these things go away as they roll over. It will also allow you to get a proper loss on sale or redemption. It's simple, but I think it works. It does require you to coordinate that with whatever your other input may be into the insurance side or into the asset side.

MR. ROGER SMITH: It's a little bit tougher to tie stocks to interest rates. We don't have any strong answers on what that relationship should be. For real estate, we rely on the expertise in the company about how to value that asset. I talked to one company that actually had a fairly good-sized parcel of undeveloped real estate that they bought several years ago and they were going to sell it in 18 months. Somebody was going to build a hotel and shopping center on it. In our approach, it could be as simple as importing something off a LOTUS spread sheet. I think there are many assets out there that do not fall into the nice, scientific analysis mold that a lot of bonds and mortgages will.

MR. JOSEPH SIKORA: *I've heard everyone give their presentations and they all stress some kind of financial projections. In any one system, do they analyze any kind of durational analysis?*

MR. EPSTEIN: We actually calculate the duration of the assets and liabilities. I'd like to clarify what option pricing theory does in decomposing a liability into its option component. Option pricing theory is a method to calculate the present value of the market value of an interest-sensitive stream of cash flows. We do everything on a market value basis. We know what the market value of a stock portfolio is on any date. In general, we assign a duration of zero to it. As far

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as liabilities are concerned, we can calculate the duration because we can calculate the market value given an interest rate system at a certain level. Given that we shocked that system so that the interest rates have now moved, we can calculate a new market value, and calculate the numerical derivative and thus have the true duration of the price sensitivity index of those liabilities. That's what the investment manager wants to match against. The beauty of our method is that it gives a practical target for the portfolio manager who's actually got to put all this stuff into practice. It gives him a yield spread over a treasury rate that he has to earn, and it gives a duration target, and he's used to managing against that. Now this gives you a hedge value. I'd like to make one more point using the analogy to a coin. What our model basically does is to tell you whether the coin is equally sided, whether there's a 50/50 probability or a 40/60 probability. You can't tell what your risk position would be, even if you are risk adverse or you're a risk-taker, unless you know whether that coin is equally balanced. We give you the hedged position, and then you can make your risk position decisions based on that position.

MR. BAMBROUGH: My system also uses Macaulay durations. For each module, ordinary life, annuities, assets, and the soon-to-be Universal Life, you put in an interest scenario and you come out with a cash flow stream. Then it's very simple to take the time-weighted value of the cash flow divided by the present value of the cash flow for each of the three modules and then compare the duration of assets versus the duration of the liabilities. I would add parenthetically that I've been hearing that New York will not require Macaulay durations next year.

MR. STEVEN SMITH: As a matter of fact, this probably wasn't required this year. The only place that Macaulay duration calculation comes into effect in Regulation 126 is on the penalty reserves, and the regulation says that you use Formula 1 for penalty reserves anyway, irrespective of Macaulay duration. And, as you indicated, I believe that they are planning to amend out the Macaulay duration requirement next year.

MS. FAYE ALBERT: The creation of many of these systems has been in response to requirements for the New York regulation, although they should be able to be used for a lot of other things. These scenarios are supposed to show that the stream of cash under your assets is going to be sufficient to meet the

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stream of your obligations under the liabilities. You use the various scenarios to test whether that's true, and if it is true then you can value your liabilities using higher interest rates, resulting in lower liabilities. I wonder what kind of information the department has been given to support the valuation of the liabilities at the higher interest rates, and whether anybody has been restricted because of using these systems.

MR. STEVEN SMITH: I'm not sure whether you're going to get to lower your liabilities because they also have minimum reserves. It's clear that if you come short at the end, you may have to put up more reserves, although I believe there's an example in the material along with Regulation 126 where one of the scenarios in essence fails, but yet the starting reserves were viewed as being acceptable. I assume that has to do with probabilities, I'm going to have to look into that.

MS. ALBERT: I assume that you gentlemen have all had a chance to look at a lot of different runs that have shown different kinds of companies and portfolios doing these tests. Have any of the portfolios ever failed, and have any companies found that they really needed to restructure their assets seriously?

MR. STEVEN SMITH: Under Regulation 126, Bob Callahan said that about 60% of the companies chose not to file opinions. They just took and added the penalty reserves. *Of the remaining 40%, 2 have been rejected. Those were rejected because of poor assumptions or omitting certain items (for example, defaults or expenses). I guess the company would have a chance to fix that or to do more work and show that the reserves were acceptable, or else they will have to put up extra reserves. All I know at this point is that 2 have been rejected.*

MS. ALBERT: But was that because the assumptions were bad or because the work was improper?

MR. STEVEN SMITH: I think he said that there was inadequate or inappropriate work, or bad assumptions. That's where I think the whole question of Regulation 126 and the valuation actuary is in a murky area.

MS. ALBERT: In other words, wherever the work has been done thoroughly, we have not been found to be lacking in any case. Is that right?

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MR. STEVEN SMITH: There were 60% that didn't file an opinion and put up extra reserves. Forty percent filed and were found to be acceptable. I don't know whether there were any individual scenarios which failed amongst those which were viewed as being acceptable.

MR. GEORGE SILOS: In our Pension Department, we spend about 20% of our time trying to put together an asset/liability model, and the other 80% trying to put together a data base. I suspect that's because we're trying to value each and every asset. I wonder if the panelists also are trying to value each and every asset in a segment or in the company, or if they're using a cell model approach. Also, about how many assets go into the system, 100, 1,000, or 10?

MR. STEVEN SMITH: I believe there are some questions that address that in the survey, but I know that at least some of the systems here would model all of the existing assets into some number of cells, and then treat those cells on a seriatim basis. Would everybody agree with that?

MR. BAMBROUGH: I could add one thing. I've seen some practical middle-sized insurance companies, and it isn't too bad if you use Schedule D, which is where most of the assets are. You end up with 400-500 assets. So, it really isn't worthwhile to group those bonds into cells unless the bonds are absolutely equivalent. You might as well treat each one separately, and that's what I see being done with my system and its predecessor. I can't say that for every case, but certainly I've seen it happen.

MR. STEVEN SMITH: The offsetting thing is if you have 20,000 bonds or 50,000 bonds, it's a question of how long the system is going to run. It may run a thousand times faster if you only have 100 or 500 asset cells compared with 20,000.

MR. DEAKINS: We find that you have to make a decision whether to model things or keep them separate. We also find that at 500, it's certainly a lot easier to just have every asset separate. At 20,000 I think it's definitely easier to model them, and there's some crossover point. If there's more than about 2,000 or 3,000 assets, I start to think about modeling them. If there's less, I just leave them all separate. I find that if it's on a computer, then in terms of the actual work to get it prepared, there's no more work if there's a thousand

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assets than if there's ten. It's just a matter of writing routines to sort everything.

MR. STEVEN SMITH: It's only if you have to manually enter them that it becomes a real problem. If you have some form of mechanical data transfer, then it shouldn't be a real problem. For our New York subsidiary doing the Regulation 126, we did every individual asset and for the parent company we did modeling and then treated the thing seriatim after it was modeled. We modeled characteristics of call features. With any projection system you have that kind of a trade-off: what do you want to model, what do you want to do on an individual policy basis? You probably have more limits on the number of liability cells than the number of asset cells.

One of the prime uses of these systems is for doing asset/liability matching or pricing on Universal Life, SPDA, interest-sensitive type products, whereby you have 3 things that are very much related; that is, the earned rate of your assets (what they're really earning), what your crediting strategy is, and what the associated lapse rate is that depends on that. For example, you might say that the lapse rate was 5% plus 5 times the excess of the current market rate (what everybody else is paying) over your credited rate. If you start out by investing long, say all in 20-year bonds, when interest rates are 10%, you could have a crediting strategy of always crediting 8%, even if interest rates go to 15% on everybody else's product. Obviously, if you have that kind of a crediting strategy, namely continuing to credit 8%, then these systems will calculate a substantially increased lapsed rate, which becomes larger as the difference is between the current rate of other products and your crediting rate increases. Maybe you'd want to test the current market rate less 200 basis points as the creating strategy. Then the issue is how do you go about figuring out what's the optimal investment strategy? You can either run lots of scenarios to get a feel for the best strategy, or maybe there's a system that will solve some kind of an optimal strategy. But your objective is to do some kind of a risk/reward analysis. That's what these systems do, and allow us to plot how much profit we can make versus how much we can lose under different scenarios on a mean basis. That is the real difference between random scenario testing, where you look at 50 scenarios with interest rate grids and rates going up and down randomly versus the deterministic requirements in Regulation 126. For example, one of the scenarios that you have to test for Regulation 126 is where the interest

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moves upward 500 basis points over 10 years and then stays there forever. They don't come back down. There's another one that goes up and then back down, but you don't have any that go like a sine or a cosine curve up to the top and down to the bottom, and you may get a very different result under those.

MR. MARK GREENE: I was very interested in the analogy between carrying options and futures on assets to carrying 100% reinsurance on insurance policies. I think that's a very good analogy and I think that to the extent you do that, you give up a lot of the profits that you make on the investment side of the house. I'm very interested in matching on price sensitivity parameters, particularly the concepts of duration and convexity, as they relate to price sensitivity, and I am curious as to how far away we are from being able to incorporate these concepts in the cash flow projections that are being required by the regulatory bodies. It seems to me this is the solution to the problem. To the extent that you can take advantage of real-life investment practices which have apparently been proven in the other financial services area and be able to demonstrate the efficiency of those practices via cash flow analysis, I don't think we'll have much of a problem with the regulatory requirements.

MR. SIBIGTROTH: I think that's a point very well taken. When you're looking at development of risk analysis, if you want to draw an analogy, I look at the hedge ratio of price sensitivity of an asset or liability portfolio as an indirect measure of duration. That is, you can draw an analogy between a ten or twenty year bond and if you have a hundred basis point move in the market place, you can calculate how much of a basis point move you would expect in your underlying principal values. This is tantamount to attempting to measure your investment exposure via option type risk. I find that, particularly in trading on my own account, it's very important to know what your book of business is. That can start from the liability side. You drive the analysis from the liability side. You have a portfolio of business; what do you have? What is the investment portion, what is the option type portion, because I don't know how to develop an investment strategy until you've got it in those terms. When I go out to trade, the first thing I ask is: what is my book of business? What do I have? How long am I in certain things, how short am I in others? This is the whole concept behind what I'm trying to do, to try to break that down into its various components so that you as a manager or you as the product or financial person

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can articulate a dialogue with the investment people and, in effect, talk in the same language. A large part of our problem relates to the communication process between the financial area and the investment area, what they are passing back and forth in terms of information and do they really understand what is being said. Somebody says "asset share," another one says "coupon." It's important to be talking the same language.

You need to adopt that approach, and try to get away from the concept of having to work with 50 or 100 deterministic or stochastic scenarios to evaluate the business. The practical matter is the markets are moving quickly and you want to be active in the marketplace, you just don't have time to spend a lot of effort with large systems, you have to find a way to break it down into its fundamentals and say, "What do we really need to look at to make a decision in a timely fashion?"

MR. STEVEN SMITH: You're going to have much smaller models for pricing than you will when you get involved with trying to reprice all of the adjustable products that are in force. You're looking at a much, much bigger model, a bigger block of business when you're doing a total company, like a Regulation 126. I could visualize using these systems to manage profitability year by year on the entire in-force block. You're going to have valuation people using the systems, you're also going to have pricing people using the systems. We hope we can also get our investment department very interested in the results from whichever set of actuaries they come from.

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APPENDIX A

BA	Bambrough & Associates, Inc.
DH	Doug Hawley Insurance Consultant
FC	Forecast Consultants
M1	Milliman and Robertson, Inc., PA
M2	Milliman and Robertson, Inc., WA
MS	Morgan Stanley & Company
PA	PALLM, Inc.
PS	PolySystems, Inc.
SC	Shane A. Chalke, Inc.
SE	Sendero Corporation
SI	Sibigroth & Consultants, Inc.
TP	Tillinghast/TPF&C

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Survey of Intercompanies with Asset/Liability Matching Systems

1. Name, address, telephone of company?

- BA Bambrough & Associates, Inc., 330 Tall Timbers Road, Glastonbury, CT 06033, (203) 633-2727
- DH Hawley Actuarial Software, 13 Council Crest Drive, Corte Madera, CA 94925, (415) 924-4645
- FC Forecast Consultants, Inc., 4345 Sigma Road, Dallas, TX 75234, (214) 233-1192
- M1 Milliman & Robertson, Inc., 259 Radnor-Chester Road, Suite 300, Radnor, PA 19087, (215) 687-5644
- M2 Milliman & Robertson, Inc., 1301 5th Avenue, Suite 3600, Seattle, WA 98101, (206) 624-7940
- MS Morgan Stanley & Co., 1251 Avenue of the Americas, New York, NY 10020, (212) 703-8969
- PA PALLM, Inc., 2601 Fortune Circle, East Drive, Indianapolis, IN 46241, (317) 241-2510
- PS PolySystems, Inc., 55 East Jackson Blvd., #400, Chicago, Illinois 60604, (312) 663-5670
- SC Shane A. Chalke, Inc., Suite 325, 8260 Greensboro Drive, McLean, Virginia, 22102, (703) 821-1555
- SE Sendero Corporation, 6900 E. Camelback Road, Third Floor, Scottsdale, AZ 85251, (602) 941-8112
- SI Sibigtroth & Consultants, 90 South Rd., Port Washington, NY 11050, (516) 883-4360
- TP Tillinghast/TPF&C, 815 S. Main Street, Suite 200, Jacksonville, Florida 32207, (904) 398-5661

2. Name of system(s)?

- BA The Bambrough & Associates, Inc. Asset/Liability Matching System.
- DH HAS is the overall description, but contains many independent modules including AMB7, the asset model.
- FC Instant Forecast
- M1 Optimizer/Risk Analysis System. NOTE: This system is virtually the same as the PALLM-Pro System which can be licensed through PALLM. The M&R version is available on a consulting or timesharing basis.
- M2 PCAPS
- MS Morgan Stanley Insurance Cash Flow Option-Pricing Model.
- PA PALLM-PRO (Profit/Risk Optimizer)
- PS DELPHI
- SC PTS
- SE The Sendero Model for Insurance Companies
- SI SIBCO FIT
- TP CALMS - Comprehensive Asset Liability Matching System

3. Is the system operational?

If not, when is it expected to be?

- BA Yes. Three modules have been complete and in use since 1985. These are the Ordinary Life, Annuity and Asset modules. The Universal Life module has been written and is currently being tested. It will be available for sale in June.

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DH Yes, but being continuously upgraded.
FC Yes.
M1 Yes.
M2 Yes.
MS System is operational.
PA Yes.
PS Not fully. July 15, 1987.
SC Yes.
SE First Product Segment in Beta Test. Additional Products in Beta Test July & August.
SI Yes.
TP Yes, since April, 1986.

4. What hardware is required to run the program?

BA Minimum: IBM PC XT with 640K RAM and a 10M Byte hard disk. More powerful machines can be used to enhance performance e.g., IBM PC AT; COMPAQ 386.
DH IBM PC/XT/AT or Compatible
FC IBM or IBM Compatible Mainframe Computer. As Instant Forecast is an on-line - terminals and most PC's can be used to access Instant Forecast from your desk.
M1 NA.
M2 IBM PC, Preferably an AT.
MS No user hardware is required. Runs on Morgan Stanley mainframe computer.
PA 1) IBM PC-AT, 2) IBM 43XX or 30XX
PS UNISYS A Series.
SC IBM PC/AT or compatible, 512K, graphics, hard disk.
SE 386-Based Super Microcomputer or DEC VAX
SI HP/3000. Timeshare through IBM PC.
TP IBM compatible PC, 640k memory, 10M hard disk, (math co-processor chip [8087] desirable)

5. What additional software is required?

BA STSC APL*PC
DH DOS 2.1 or up
FC TSO and COBOL
M1 NA
M2 STSC APL
MS No additional software is needed.
PA 1) None, 2) IBM APL2 (MVS TSO or CMS)
PS None.
SC STSC APL*PLUS/PC
SE Vendor will supply graphics software and compilers.
SI None.
TP MS-DOS and LOTUS 1-2-3

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6. Is the system aimed specifically at Valuation Actuary issues?

- BA Yes.
- DH No.
- FC Yes. This is one of many applications.
- M1 No. Valuation Actuary issues are a subset of system uses.
- M2 No, but it deals with them effectively.
- MS The system is not aimed specifically at Valuation Actuary issues.
- PA Yes
- PS Yes and no.
- SC The system is designed for product pricing and management. Valuation actuary issues can also be dealt with.
- SE Yes.
- SI No.
- TP Yes, in addition to pricing issues.

7. Is the system suitable for use in more general management information applications?

If so, what kind?

- BA The system is specifically aimed at the asset/liability matching process. It is ideal for use in complying with the new New York regulations. To the extent that a cash flow, present value analysis can be used for other purposes, the system can be used in other applications. For example, one customer has told me that the system can be used in the pricing process.
- DH Yes. Profit testing, inforce & cash flow projections, actuarial values.
- FC Yes. Instant Forecast is a management decision making tool designed to allow you to get your answers in minutes and enable you do do much more while eliminating most of the actuarial time normally spent in the projection process. Additional applications include:
 - Implementing a United Planning Process
 - Corporate Planning
 - Dynamic Pricing
 - Repricing
 - Interest Crediting Strategies
 - Investment Strategies
 - Strategic Decision Making
 - Linking pricing/product development to corporate financial earnings results.
 - Strategic resource allocation decisions
 - Management training and education and much more
- M1 Yes. Pricing, corporate planning, financial projection analysis of crediting and investment strategies.
- M2 Yes. Credited rate strategy, Investment strategy, surplus needs.
- MS Yes. The system is suitable for Pricing, Asset/Liability Management, Setting investment yield, duration and convexity targets (Baseline Indices).

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- PA Yes. Product design, pricing & profit studies, portfolio management, financial projections.
- PS Yes. Forecasts of Financial Statements (STAT, GAAP and TAX), Gross Premium Valuation, Appraisals.
- SC Yes. The PTS is designed for the optimization of interest crediting and investment strategies for the new and inforce business.
- SE Yes. A/L Management, Product Profitability, Risk Control, Corporate Planning and Capital Needs Management.
- SI Yes. What if.
- TP Yes, the system is suitable for analysis of interest sensitive product management decisions (i.e., crediting strategy, investment strategy, etc.)

8. In what language is the system programmed?

- BA APL and BASIC
- DH BASIC
- FC COBOL and TSO CLIST
- M1 APL
- M2 APL
- MS APL
- PA 1) Compiled PASCAL, 2) APL
- PS ALGOL, COBOL, FORTRAN.
- SC APL
- SE Model is written in the user-oriented Sendero-XL financial modeling language. the resulting models are compiled in 'C'.
- SI Pascal
- TP FORTRAN, LOTUS 1-2-3, and some C

9. Can the system be easily modified to accommodate special requests?

- BA The system is designed to be very flexible as delivered. If a user has a special request, then if the capability can be used by several clients it is built into the basic system. For capabilities that are very non-standard, custom coding is done at extra cost.
- DH Probably
- FC Depends on request. Many are easy. Some requests could be difficult.
- M1 Yes.
- M2 Yes.
- MS The system is easily modifiable to accommodate special products.
- PA Yes..
- PS Yes.
- SC Yes.
- SE Yes.
- SI Yes.
- TP Yes.

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10. Can users modify the system?

- BA No.
- DH Yes.
- FC No.
- M1 NA.
- M2 Yes.
- MS The user cannot modify the system.
- PA 1) By request. 2) Yes.
- PS If it is licensed and installed on user's equipment, yes.
- SC Yes. The PTS has been written and documented with user modification in mind.
- SE Yes, the system is designed to allow the user to personally customize, tailor and make modifications to meet individual needs.
- SI Yes.
- TP Yes, if necessary.

11. What level of system documentation exists?

- BA The source code and system documentation is proprietary and not for sale.
- DH Actuarial & program logic in detail.
- FC System delivered with documentation which compares favorably with industry standards.
- M1 Extensive, detailed.
- M2 Complete actuarial formula.
- MS All system documentation is internal.
- PA 1) Formulae & 2) Source code, cross ref. & calling sequences, function def., complete formulae.
- PS
- SC Line by line documentation, flowcharts, Technical Reference Manual.
- SE Conceptual Overview
- SI
- TP Complete original specifications.

12. What level of user documentation exists?

- BA User documentation is complete and is delivered with the system. The user documentation was written with actuaries as the target audience. It includes not only information on how to run the system, but it also includes complete actuarial descriptions, with examples, of every computation that the system does.
- DH All input is explained in detail.
- FC Excellent. Full help screens and written manuals - both of which provide many formulas and definition of terms.
- M1 Extensive.
- M2 Well commented functions, description of each function, flowcharts, examples.
- MS Morgan Stanley has published various research papers describing option-pricing model applications for insurance liabilities.

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- PA 1) user manual, screen & reports manual, 2) data dictionary, user manual, screen manual.
PS User manual.
SC User's Guide.
SE User Guide will be released with the product.
SI User manual & online help.
TP Complete user manual which includes overview, formulas, case study, etc.
13. What is the initial price of the system?
Additional costs?
- BA The cost for the basic system is \$14,000. This includes the Ordinary Life, Annuity and Asset modules. The Universal Life module costs \$6,000. The only additional cost is the need to purchase STSC's APL*PC. Most software retailers charge a little over \$400 for it.
DH Total system \$16,000. Modules from \$325. Asset Model AM87 \$1,250. No additional costs.
FC Annually renewable lease. Introductory price is \$30,000 a year, with price protection. Maintenance and enhancements are included in annual fee.
M1 It is typically used as a consulting tool, rather than licensed.
M2 \$50,000. GAAP reserves module \$10,000. Sources of profit module \$5,000. Traditional Reserves and Values module \$5,000. Training and installation \$5,000-10,000.
MS The system is available to Morgan Stanley institutional clients.
PA 1) \$50,000 2) \$95,000 Additional: 1) \$5,000 2) \$5,000.
PS Varies by size and application.
SC Available on request.
SE A base system is \$110,000, including four products, corporate consolidations and analysis capabilities. Additional: 10% Annual Maintenance Fee.
SI \$95,000. No additional costs.
TP \$40,000. No additional costs.
14. Besides use of the system, are any additional services included as part of the initial price? If so, what are they?
- BA All enhancements to the system for the first year after purchase are included as part of the initial price. Also included is a reasonable amount of telephone support and membership in the users group.
DH Unlimited telephone support.
FC Installation and client education.
M1 NA.
M2 No, however we recommend completing a consulting assignment before acquiring the system.
MS NA.
PA 90 days maintenance & enhancements.

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- PS No.
SC Telephone support, Training classes extra.
SE Customer Support, initial training on the model and Sendero-XL language.
SI No.
TP 1) Training 2) 90-day warranty.
15. Is there a maintenance agreement available for the system?
If so, what is included in the maintenance agreement and what does it cost?
- BA For subsequent years the user can purchase a maintenance agreement. The cost of this is contractually limited in the first renewal year to \$4,000 for the basic system and will probably be less than this. The actual price has not, as yet, been set.
DH Not as such. Changes can be negotiated. Users can change system. Updates are available for the increase in price over earlier versions.
FC Included in annual lease price. Maintenance is to correct deviations from system specs and bugs.
M1 NA.
M2 Not currently.
MS NA (Periodic update analyses are available).
PA Yes. Telephone consultation, extended education, quarterly enhancement program, updated documentation.
PS Yes. Updates, fixes, telephone support; 15% of current license.
SC No formal agreement. Maintenance is contracted on an individual basis.
SE Yes. 800 Hot Line Customer Support, product support and enhancements 10% of the license fee annual maintenance.
SI Yes. \$2,000 per month.
TP Yes, \$5,000 per year. Maintenance agreement includes: 1) telephone support, 2) software corrections, 3) enhancements, 4) documentation updates.
16. What are the best uses of your system?
- BA Asset/liability matching to comply with the NY regs.
DH Pricing, Actuarial Values, Projections.
FC In general as a user friendly management decision making tool to be used by actuarial, financial, investment and corporate management. Asset liability matching is a major use. Other specific applications are listed under question 7 above. Instant Forecast is a tremendous saver of actuarial resources. It enables the actuary to do much more in a fraction of the time.
M1 Product design/pricing, risk analysis/valuation actuary work, analysis of alternative investment and crediting strategies.
M2 Product development and pricing, strategy testing (credited rate/investment).
MS The best uses of the system are: a) Setting Duration, Convexity Targets. b) Pricing. c) Setting investment yield targets for investment managers.

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- PA Product design/pricing, risk analysis/valuation actuary work, analysis of alternative investment and crediting strategies.
- PS Valuation actuary issues and capital/profit management.
- SC Determining interest crediting for investment strategy, pricing and model office work.
- SE A/L Management, Rate Risk, Product Pricing.
- SI Operations review risk management. Product structure design. Segment Profitability.
- TP Interest Sensitive Product analyses including: 1) Investment strategy, Crediting strategy, and product features, 2) Valuation actuary analysis, 3) NY Opinion 126.

17. What is the size of the staff supporting the system?

- BA 2.
- DH 1.
- FC Five members of systems staff, including a systems programmer. Actuarial support varies depending on the current stage and level of development. Average is 'several' at least part time.
- M1 5 FSA's and 8 actuarial students and programmers; more resources are available as needed.
- M2 3 FSA's, 1 ASA, 1 Student and 1 programmer.
- MS NA.
- PA Seven plus specialized support from staff of 250-300.
- PS 10.
- SC 5.
- SE Sendero currently has a staff of 60+ people dedicated to supporting our Asset/Liability Systems.
- SI 3.
- TP Six people participate in continued development and support phase plus Tillinghast consultants in each office.

18. Describe how input data is made available to the system. Specify what form(s) or media can be used.

Asset data

- BA The data can be keyed in by hand. A great deal of effort has been put into making this easy to understand and quick to do. Data can be imported into the system. The user sets up an APL file and the system can directly bring this data into the system. E.g., at least one user down-loaded Schedule D from the mainframe, converted this data into an APL file, and imported it directly into the system.
- DH Diskette files, Keyboard input.
- FC Normally interface investment files (i.e. Stock and Bond, Mortgage). Manual input is used when no system (i.e. Real Estate) is available.

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- M1 Seriatim listing of asset characteristics for each asset. Typically provided on tape.
- M2 Key punch, floppy diskette, tape.
- MS Asset data can be input from listings or tape.
- PA Data is generally keyed in by hand using menu driven screens, but some data may be input from files or tape or transferred from previous studies.
- PS Magnetic Tape, PC diskettes, manual entries.
- SC PTS has specialized routines for managing data. Data can be from any source, but must be downloaded to PC.
- SE Fullscreen data entry of files transferred from the mainframe or other system. Data Entry or file transfer.
- SI Screen entry.
- TP All data can be entered through interactive, menu driven screens. In addition, the following data may enter directly via a text editor or records extracted from the companies own administrative systems. Menu driven screens or records extracted from asset administration system.

Policy records

- BA See comments in 'asset data' above.
- DH Individual policy records not used. Volumes input from Keyboard.
- FC Interface Traditional Life, Annuity, Universal Life.
- M1 Grouped into model cells outside of system. Then either typed in or transferred by computer.
- M2 Key punch, floppy diskette, tape.
- MS Census data can be input from listings.
- PA
- PS Magnetic Tape, PC diskettes, manual entries.
- SC
- SE Data entry or file transfer.
- SI System generated.
- TP Menu driven screens or records extracted from policy administration system.

Policy description parameters

- BA See comments in 'asset data' above.
- DH Keyboard input.
- FC Input manually or receive on tape, depending on client and type of insurance (i.e. Traditional Life, U.L.).
- M1 Entered in response to system prompts prior to the initial run.
- M2 User-friendly menus.
- MS
- PA Screen entry & inter-study transfers
- PS Magnetic Tape, PC diskettes, manual entries.
- SC

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SE Data Entry.
SI System generated.
TP Menu driven screens.

Policy values

BA See comments in 'asset data' above.
DH Files created by system modules.
FC Normally interface files.
M1 Based on the model; this can be transferred by computer or entered through a terminal.
M2 User-friendly menus or keypunch or formula generated.
MS
PA
PS Magnetic Tape, PC diskettes, manual entries.
SC
SE Data Entry or file transfer.
SI System generated.
TP Calculated by the system.

Assumptions

BA See comments in 'asset data' above.
DH Diskette files, Keyboard input.
FC Manually or receive on tape--depending on type of assumption and client capabilities and assistance.
M1 Entered in response to system prompts prior to the initial run.
M2 User-friendly menus.
MS Assumptions are input via a questionnaire.
PA
PS Magnetic Tape, PC diskettes, manual entries.
SC
SE Data Entry and user defined data relationships.
SI Menu Screens.
TP Menu driven screens.

19. Describe how results are reported by the system. Specify what form(s) or media can be received.

BA The system produces printed reports. Also, reports can be sent to a file instead of being printed so that they can be reformatted by the user or imported into a Lotus spreadsheet or whatever.
DH Printouts/Diskette files.
FC Reports are on line via P.C. or terminal screen. Selective print is optional. Computerized Graphics will be forthcoming.
M1 Detailed reports are produced for each scenario. In addition, the user can design additional reports to be added. Reports summarizing a number of scenarios are also produced. Results can be printed to screen, to file, or to hard copy.

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- M2 Extensive storage of results on a data base. Standard reports are available. New reports can be developed by users.
- MS Morgan Stanley provides a written report which details the interest-sensitivity of assets and liabilities, effects of various options on price and interest-sensitivity, and suggests actions to move the portfolio to a hedged position.
- PA Report data is stored in master file. Selections from 34 reports (detailed & summary) printed and viewed on screen. User designed reports can be added on mainframe system only.
- PS Paper, Magnetic tape, PC diskettes.
- SC Hard copy; APL file; ASCII file.
- SE Viewed onscreen, printed reports, graphics.
- SI Illustrations, Ledgers, Terminal, Line listing.
- TP Results are available: 1) Computer video screen, 2) Printed copy, 3) Diskettes, 4) LOTUS 1-2-3.

20. What facilities exist for including data generated outside the system? For example, can the results of a group model be combined with other lines of business at a reporting level?

- BA See question 18 above for the first part of this question. The user can identify subgroups of any or all of the modules. These subgroups can then be run and the results combined.
- DH User built interface or manual input.
- FC Profit centers projected by client can be included in INSTANT FORECAST data base, in some cases, this approach will eliminate a number of dynamic capabilities.
- M1 Yes.
- M2 Yes.
- MS Results from various products can be easily aggregated at a reporting level.
- PA 2. Some data transfer possible.
- PS Yes.
- SC Depends on format.
- SE Yes. Preprocessing software for summarizing & transferring data to the model.
- SI Yes.
- TP Asset and/or Liability cash flows from "outside" the model can be included in the model.

If an asset is so specialized that it does not fit within any defined category in the system, can I bypass the standard projection and supply my own projected results?

- BA Yes, but you lose the dynamism of the input values being affected by the various interest scenarios.
- DH Only as an off-system worksheet addition.
- FC Yes. Currently for existing assets.
- M1 Yes.
- M2 Yes. The system is very modularized, permitting a knowledgeable APL user to handle special situations.

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MS Asset valuation can be custom tailored.
PA Requires modification of base system.
PS Yes.
SC No.
SE Yes.
SI Yes.
TP Yes.

21. Are the asset and liability cash flows dependent upon each other or are they independent?

BA Independent
DH Asset cash flow includes that generated by insurance operations.
Dependent.
FC Dynamically dependent.
M1 Depends on interest rate scenarios.
M2 Dependent.
MS Asset and liability flows are INDEPENDENT.
PA Depends on interest rate scenarios.
PS Dependent.
SC Either, depending on interest crediting strategy.
SE They may be dependent or independent as defined by the user.
SI Dependent.
TP Fully dependent.

22. Can the program project in-force assets and liabilities?

BA Yes.
DH Yes.
FC Yes.
M1 Yes.
M2 Yes.
MS Yes, the system can work in a pricing or valuation mode.
PA Yes.
PS Yes.
SC Yes.
SE Yes.
SI Yes.
TP Yes.

23. Can the program incorporate projection of new business in future years?

BA No.
DH Yes.
FC Yes.
M1 Yes.
M2 Yes.
MS Yes.

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PA Yes.
PS Yes.
SC Yes.
SE Yes.
SI Yes.
TP Yes.

24. What determines a scenario? Is there a limit to the number of scenarios which can be processed other than processing time?

BA User input. Up to 10 interest scenarios can be computed at one time. However, multiple sets of 10 can be processed so there is no limit to the total.
DH No. Asset scenario--insurance cash flow, initial assets, future investment assumptions.
FC Interest curves and levels plus 'state of the economy'. State of the economy is a practical application of econometrics and provides the user with another very dynamic dimension to his scenarios.
M1 Scenarios can either be input by the user of stochastically generated based on user supplied parameters. There is no limit to the number of scenarios.
M2 Scenarios can be randomly generated or user specified. No limit on the number of scenarios.
MS We use an option-pricing interest-rate generation technique. A sample set of scenarios is generated using a Monte Carlo technique based on a stochastic process which is arbitrage-free. The arbitrage-free characteristics allow the results of the various scenarios to be averaged, and as a result a single unbiased price will result.

There are no limits on the number of scenarios processed, though we have found that 100 to 200 scenarios give good results.

PA Scenarios randomly selected or user-specified. 1) Yes (200) 2) No.
PS A scenario is a single track of economic events for each interval of the projection period. No.
SC Short term rate, long term rate, inflation rate, shape of yield curve--all by year. No.
SE Up to 80 quarters of the yield curve (and market rates if desired). No. Scenarios can be user-defined or downloaded from an external source. Forty random/stochastic scenarios can be generated at one time.
SI Assumption Matrix. No.
TP Scenario refers to the dynamic yield curve pattern over a 30-year projection horizon. Up to 40 scenarios in a single computer run.

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25. What assumptions can be made to vary as interest rates change?

		<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
Withdrawals				
BA		<u>x</u>	<u>---</u>	<u>---</u>
DH	Note--the user must set all the assumptions independently. dynamic	<u>x</u>	<u>---</u>	<u>---</u>
FC		<u>x</u>	<u>---</u>	<u>---</u>
M1		<u>x</u>	<u>---</u>	<u>---</u>
M2		<u>x</u>	<u>---</u>	<u>---</u>
MS		<u>x</u>	<u>---</u>	<u>---</u>
PA		<u>x</u>	<u>---</u>	<u>---</u>
PS		<u>x</u>	<u>---</u>	<u>---</u>
SC		<u>x</u>	<u>---</u>	<u>---</u>
SE		<u>x</u>	<u>---</u>	<u>---</u>
SI		<u>---</u>	<u>x</u>	<u>---</u>
TP		<u>x</u>	<u>---</u>	<u>---</u>
Premium payment amount				
BA		<u>x*</u>	<u>---</u>	<u>x**</u>
DH	dynamic	<u>x</u>	<u>---</u>	<u>---</u>
FC		<u>x</u>	<u>---</u>	<u>---</u>
M1		<u>x</u>	<u>---</u>	<u>---</u>
M2		<u>x</u>	<u>---</u>	<u>---</u>
MS		<u>x</u>	<u>---</u>	<u>---</u>
PA		<u>x</u>	<u>---</u>	<u>---</u>
PS		<u>x</u>	<u>---</u>	<u>---</u>
SC		<u>x</u>	<u>---</u>	<u>---</u>
SE		<u>x</u>	<u>---</u>	<u>---</u>
SI		<u>---</u>	<u>x</u>	<u>---</u>
TP		<u>x</u>	<u>---</u>	<u>---</u>
New business sold				
BA		<u>---</u>	<u>x</u>	<u>---</u>
DH	dynamic	<u>x</u>	<u>---</u>	<u>---</u>
FC		<u>x</u>	<u>---</u>	<u>---</u>
M1		<u>---</u>	<u>---</u>	<u>x</u>
M2		<u>x</u>	<u>---</u>	<u>---</u>
MS		<u>x</u>	<u>---</u>	<u>---</u>
PA		<u>---</u>	<u>---</u>	<u>x</u>

* Universal Life

** Ordinary Life, Annuity

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		Yes	No	Currently Planned Future Enhancement
PS		x	---	---
SC		x	---	---
SE		x	---	---
SI		---	x	---
TP		x	---	---
Expense inflation				
BA		---	---	x
DH		x	---	---
FC	dynamic	x	---	---
M1		---	---	x
M2		x	---	---
MS		x	---	---
PA		x	---	---
PS		x	---	---
SC		x	---	---
SE		x	---	---
SI		---	x	---
TP		x	---	---
Reinvestment assumption				
BA		---	---	x
DH		x	---	---
FC		x	---	---
M1		x	---	---
M2	It can be	---	---	---
MS		NA	---	---
PA		x	---	---
PS		x	---	---
SC		x	---	---
SE		x	---	---
SI		---	x	---
TP		x	---	---
Policy loan utilization				
BA		x	---	---
DH		x	---	---
FC	dynamic	x	---	---
M1		x	---	---
M2		x	---	---
MS		x	---	---

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	Yes	No	Currently Planned Future Enhancement
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	---	<u>x</u>	---
SE	<u>x</u>	---	---
SI	---	<u>x</u>	---
TP	<u>x</u>	---	---
Interest rate credited to fund			
BA	<u>x</u>	---	---
DH	<u>x</u>	---	---
FC dynamic	<u>x</u>	---	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	---	<u>x</u>	---
TP	<u>x</u>	---	---
Bond calls			
BA	<u>x</u>	---	---
DH	---	<u>x</u>	<u>x</u>
FC dynamic	<u>x</u>	---	<u>x</u>
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	---	<u>x</u>	---
TP	<u>x</u>	---	---
Mortgage prepayments			
BA	<u>x</u>	---	---
DH	<u>x</u>	---	---
FC dynamic	<u>x</u>	---	---
M1	<u>x</u>	---	---

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	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
M2	<u>X</u>	---	---
MS	<u>X</u>	---	---
PA	<u>X</u>	---	---
PS	<u>X</u>	---	---
SC	<u>X</u>	---	---
SE	<u>X</u>	---	---
SI	---	<u>X</u>	---
TP	<u>X</u>	---	---
Defaults			
PA	<u>X</u>	---	---

26. What assumptions are scenario dependent?

- BA The user can cause many of the values to vary as the interest scenario varies. Examples are: lapses, credited interest, bond calls, mortgage prepayments and foreclosures, universal life premiums.
- DH All of the usual operations assumptions--lapses, mortality, inforce etc. may be varied. Investment assumptions such as future interest, investment choices, profit or loss on sale (for some classes of investments) may be varied.
- FC Every item listed in 25 above plus: Foreclosures (dynamic), Partial Fund Withdrawals (dynamic), Stock and Bond Defaults (dynamic), Investment Strategy, Policy Loan Interest Rate (dynamic), Direct Recognition of Policy Loans (dynamic), Dividends (dynamic), A&H Claim Levels (dynamic), Loadings (dynamic)
- M1 See #25. Also, investment and liquidation strategies.
- M2 Any assumption you wish. For example, the system can be coded to use different interest crediting parameters for each scenario.
- MS All assumptions can be scenario dependent.
- PA See #25. Also, investment and liquidation strategies.
- PS
- SC Same as question 25.
- SE All variables may be related to interest rate scenarios.
- SI None.
- TP Same as question 25.

27. How can interest rate scenarios be defined in the model?

a. picked by user?

BA	<u>X</u>	---	---
DH	<u>X</u>	---	---
FC	<u>X</u>	---	---
M1	<u>X</u>	---	---
M2	<u>X</u>	---	---

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	Yes	No	Currently Planned Future Enhancement
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	<u>x</u>	---	---

b. stochastically generated?

BA	---	<u>x</u>	---
DH	---	<u>x</u>	---
FC	---	---	<u>x</u>
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	---	<u>x</u>	---
SE	<u>x</u>	---	---
SI	---	<u>x</u>	---
TP	<u>x</u>	---	---

c. other, describe?

BA			
DH			
FC			
M1			
M2			
MS	Arbitrage-free Option Pricing Model		
PA			
PS			
SC			
SE	Externally supplied, such as New York Parameter or Data Resources, Inc.		
SI			
TP			

28. What types of investment strategies can be used?

Fixed Investment Percentages

BA			
DH	<u>x</u>	---	---
FC	<u>x</u>	---	---

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		<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
M1		<u>x</u>	<u>---</u>	<u>---</u>
M2		<u>x</u>	<u>---</u>	<u>---</u>
MS		<u>---</u>	<u>---</u>	<u>---</u>
PA		<u>x</u>	<u>---</u>	<u>---</u>
PS		<u>x</u>	<u>---</u>	<u>---</u>
SC		<u>x</u>	<u>---</u>	<u>---</u>
SE		<u>x</u>	<u>---</u>	<u>---</u>
SI		<u>x</u>	<u>---</u>	<u>---</u>
TP		<u>x</u>	<u>---</u>	<u>---</u>
Synthetic Options				
BA		<u>---</u>	<u>---</u>	<u>---</u>
DH		<u>---</u>	<u>x</u>	<u>---</u>
FC		<u>---</u>	<u>x</u>	<u>---</u>
M1		<u>---</u>	<u>x</u>	<u>---</u>
M2		<u>---</u>	<u>---</u>	<u>---</u>
MS		<u>---</u>	<u>---</u>	<u>---</u>
PA		<u>---</u>	<u>---</u>	<u>x</u>
PS		<u>---</u>	<u>---</u>	<u>x</u>
SC		<u>---</u>	<u>x</u>	<u>---</u>
SE		<u>---</u>	<u>---</u>	<u>x</u>
SI		<u>x</u>	<u>---</u>	<u>---</u>
TP		<u>---</u>	<u>x</u>	<u>---</u>
Duration Match (Average, Macaulay, etc. Duration of A = Duration of Liability)				
BA		<u>---</u>	<u>---</u>	<u>---</u>
DH		<u>---</u>	<u>x</u>	<u>---</u>
FC	Indirectly	<u>---</u>	<u>---</u>	<u>---</u>
M1		<u>x</u>	<u>---</u>	<u>---</u>
M2		<u>x</u>	<u>---</u>	<u>---</u>
MS		<u>---</u>	<u>---</u>	<u>---</u>
PA		<u>---</u>	<u>---</u>	<u>x</u>
PS		<u>x</u>	<u>---</u>	<u>---</u>
SC		<u>x</u>	<u>---</u>	<u>---</u>
SE		<u>x</u>	<u>---</u>	<u>---</u>
SI		<u>---</u>	<u>---</u>	<u>---</u>
TP		<u>---</u>	<u>x</u>	<u>---</u>
Profit Maximization				
BA		<u>---</u>	<u>---</u>	<u>---</u>
DH		<u>---</u>	<u>x</u>	<u>---</u>
FC	Indirectly	<u>x</u>	<u>---</u>	<u>---</u>
M1		<u>x</u>	<u>---</u>	<u>---</u>
M2		<u>---</u>	<u>---</u>	<u>---</u>

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	Yes	No	Currently Planned Future Enhancement
MS	---	---	---
PA	x	---	---
PS	---	---	x
SC	x	---	---
SE	---	x	---
SI	---	---	---
TP	---	x	---

Other

BA Each asset has its own set of assumptions associated with it and the asset's cash flow is then generated from these assumptions and the interest scenario.

DH

FC

M1 Optimization.

M2 Describe the strategy and it can likely be programmed.

MS Liabilities valued independently from asset strategy.

PA Optimization.

PS Currently planned future enhancement.

SC Risk adjusted Profit Maximization.

SE Tied to rate scenario.

SI

TP Yes.

29. What types of crediting strategies (for policy values) can be used?

Market Rate

BA	x	---	---
DH	*	x	---
FC	x	---	---
M1	x	---	---
M2	x	---	---
MS	x	---	---
PA	x	---	---
PS	x	---	---
SC	x	---	---
SE	x	---	---
SI	x	---	---
TP	x	---	---

Earned Rate Less Spread

BA	x	---	---
DH	*	x	---
FC	x	---	---

* If the asset part has been run first.

SOFTWARE TOOLS FOR ASSET/LIABILITY MATCHING

	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>NA</u>	---	---
PA	<u>x</u>	---	---
PS	---	---	<u>x</u>
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	<u>x</u>	---	---
Fixed Rate			
BA	<u>x</u>	---	---
DH	<u>x</u>	---	---
Note--fixed rate by duration may be made by user to match external market etc. rate.			
FC	<u>x</u>	---	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	<u>x</u>	---	---
Lag Market			
BA	---	<u>x</u>	---
DH	<u>*</u>	---	---
FC	---	<u>x</u>	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	<u>x</u>	---	---
Other			
BA	---	<u>x</u>	---
DH	---	<u>x</u>	---
FC	<u>x</u>	---	---

* If the asset part has been run first.

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		<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
M1	(user definition, e.g. investment year buckets)	<u>x</u>	---	---
M2		---	---	---
MS		<u>x</u>	---	---
PA		---	---	---
PS		---	<u>x</u>	---
SC	Moving Weighted average with any of above.	---	---	---
SE		<u>x</u>	---	---
SI		---	---	---
TP		---	---	---
Combination of the Above				
BA		<u>x</u>	---	---
DH		---	<u>x</u>	---
FC		<u>x</u>	---	---
M1		<u>x</u>	---	---
M2	(Combinations with greater of etc.)	<u>x</u>	---	---
MS		<u>x</u>	---	---
PA		---	---	---
PS		<u>x</u>	---	---
SC		<u>x</u>	---	---
SE		<u>x</u>	---	---
SI		<u>x</u>	---	---
TP		<u>x</u>	---	---

30. How can the system be best used to determine optimal investment strategy?

- BA By general asset/liability matching techniques with special emphasis on the affect of the interest scenario on things like lapses, credited interest, calls, foreclosures,etc.
- DH Iterated usage.
- FC Test alternative strategies under successive logically related scenarios.
- M1 System logic solves for an optimal strategy given user's definition of optimal.
- M2 By selecting a base set of assumptions and trial and error testing of the variation of results under several scenarios and investment strategies.
- MS The system allows the portfolio manager to actively manage the porfolio while still optimizing the duration match between the assets and liabilities so as to enhance the total return.

SOFTWARE TOOLS FOR ASSET/LIABILITY MATCHING

The results of the liability valuation include the market value, duration and convexity of the liabilities. As well a Baseline index is generated which states the spread required above risk free interest rates (i.e. the Treasury yield curve) in order to support the liabilities. These results can be used to structure a portfolio with the optimal duration and convexity characteristics, and indicates which assets should be bought or sold based on achieving or exceeding the Baseline Index.

The portfolio manager has freedom to select any assets which meet the above constraints, or to intentionally mismatch if that is desired. In pricing mode the portfolio manager can assess whether the above constraints are realistic. Ideally the liability and assets are periodically revalued to indicate whether any rebalancing is needed on account of the aging of the portfolios or on account of duration drift. The revaluation of the assets is useful to determine if any assets in the portfolio are good trade prospects by determining if their market yield spreads are below the Baseline Index.

- PA Optimization process projects "worst" and "expected" future scenarios and determines future necessary portfolio returns. Subject to constraints on losses, portfolio composition, security trading, etc., an optimum new portfolio in each period is found which maximizes return in the next period, while meeting all constraints.
- PS Provides decision support data for investment professionals.
- SC PTS uses exponential utility decision theory model; will iterate for best strategy given certain risk profile.
- SE The Sendero system is designed to test alternative investment strategies thru simulation modeling, taking into account alternative interest rate scenarios and other pertinent relationships.
- SI Option Composition Analysis.
- TP Examine summary results of multi scenario runs using selected investment strategies that you realistically might implement in your company.

		<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
31.	What types of assets can be included:			
	Cash?			
	TP	<u>x</u>	---	---
	Bonds?			
	BA	<u>x</u>	---	---
	DH	<u>x</u>	---	---

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	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
FC	<u>X</u>	---	---
M1	<u>X</u>	---	---
M2	<u>X</u>	---	---
MS	<u>X</u>	---	---
PA	<u>X</u>	---	---
PS	<u>X</u>	---	---
SC	<u>X</u>	---	---
SE	<u>X</u>	---	---
SI	<u>X</u>	---	---
TP	<u>X</u>	---	---
Mortgages?			
BA	<u>X</u>	---	---
DH	<u>X</u>	---	---
FC	<u>X</u>	---	---
M1	<u>X</u>	---	---
M2	<u>X</u>	---	---
MS	<u>X</u>	---	---
PA	<u>X</u>	---	---
PS	<u>X</u>	---	---
SC	<u>X</u>	---	---
SE	<u>X</u>	---	---
SI	<u>X</u>	---	---
TP	<u>X</u>	---	---
Stocks?			
BA	<u>X</u>	---	---
DH	<u>X</u>	---	---
FC	<u>X</u>	---	---
M1	---	<u>X</u>	---
M2	---	<u>X</u>	---
MS	<u>X</u> but not meaningful	<u>X</u>	---
PA	---	<u>X</u>	---
PS	<u>X</u>	---	---
SC	<u>X</u>	---	---
SE	<u>X</u>	---	---
SI	<u>X</u>	---	---
TP	---	<u>X</u>	---
Policy Loans?			
BA	<u>X</u>	---	---
DH	<u>X</u>	---	---
FC	<u>X</u>	---	---

SOFTWARE TOOLS FOR ASSET/LIABILITY MATCHING

		<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
M1		<u>x</u>	<u>---</u>	<u>---</u>
M2		<u>x</u>	<u>---</u>	<u>---</u>
MS		<u>x</u>	<u>---</u>	<u>---</u>
PA		<u>x</u>	<u>---</u>	<u>---</u>
PS		<u>x</u>	<u>---</u>	<u>---</u>
SC		<u>x</u>	<u>---</u>	<u>---</u>
SE		<u>x</u>	<u>---</u>	<u>---</u>
SI		<u>---</u>	<u>---</u>	<u>---</u>
TP		<u>x</u>	<u>---</u>	<u>---</u>
Real Estate?				
BA		<u>x</u>	<u>---</u>	<u>---</u>
DH		<u>x</u>	<u>---</u>	<u>---</u>
FC	*currently in force only	<u>x*</u>	<u>---</u>	<u>x</u>
M1		<u>---</u>	<u>x</u>	<u>---</u>
M2	(Possibly)	<u>---</u>	<u>---</u>	<u>---</u>
MS		<u>x</u> but <u>not</u> meaningful	<u>---</u>	<u>---</u>
PA		<u>x</u>	<u>---</u>	<u>---</u>
PS		<u>x</u>	<u>---</u>	<u>---</u>
SC		<u>x</u>	<u>---</u>	<u>---</u>
SE		<u>x</u>	<u>---</u>	<u>---</u>
SI		<u>---</u>	<u>---</u>	<u>---</u>
TP		<u>---</u>	<u>x</u>	<u>---</u>
Hybrid?				
BA		<u>x</u>	<u>---</u>	<u>---</u>
DH		<u>---</u>	<u>x</u>	<u>---</u>
FC		<u>x</u>	<u>---</u>	<u>---</u>
M1		<u>x</u>	<u>---</u>	<u>---</u>
M2	(Possibly)	<u>---</u>	<u>---</u>	<u>---</u>
MS		<u>x</u>	<u>---</u>	<u>---</u>
PA		<u>---</u>	<u>---</u>	<u>x</u>
PS		<u>---</u>	<u>---</u>	<u>x</u>
SC		<u>x</u>	<u>---</u>	<u>---</u>
SE		<u>x</u>	<u>---</u>	<u>---</u>
SI		<u>---</u>	<u>---</u>	<u>---</u>
TP		<u>x</u>	<u>---</u>	<u>---</u>
Options, Futures?				
BA		<u>---</u>	<u>x</u>	<u>---</u>
DH		<u>---</u>	<u>x</u>	<u>---</u>
FC		<u>---</u>	<u>---</u>	<u>---</u>

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		Yes	No	Currently Planned Future Enhancement
M1		---	---	x
M2	(Possibly)	---	---	---
MS		x	---	---
PA		---	---	x
PS		---	---	x
SC		---	x	---
SE	Options	---	---	x
	Futures	x	---	---
SI		x	---	---
TP		---	x	---
Mortgage Backed Securities				
FC		x	---	---

32. What types of assets can be utilized in the reinvestment assumption for future cash flows?

- BA The main purpose of the system is to get cash flows so that Macaulay durations and present values can be computed. The reinvestment assumption used for cash received is that it is reinvested using an interest scenario and rollover assumption specified by the user.
- DH Bonds of varying maturities.
- FC All of the ones checked in 31 above (real estate is not yet operational for reinvestments as of 4/21/87).
- M1 All of the assets listed in #31.
- M2 Bonds and mortgages at par/discount or premium. Sinking fund bonds, zero coupon bonds, variable rate mortgages.
- MS Instead of assuming the types of assets into which future cash flows are reinvested, the model requires an assumption as to the yield spread above risk free rates that can be consistently earned.
- PA Any supported by the system.
- PS Any asset can be used.
- SC Any asset type.
- SE Any type.
- SI
- TP Same as Question #31.

33. Are future market values computed by the system?

BA	x	---	---
DH	x	---	---
FC	x	---	x
M1	x	---	---
M2	x	---	---
MS	---	x	---

SOFTWARE TOOLS FOR ASSET/LIABILITY MATCHING

	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
PA	<u>X</u>	---	---
PS	<u>X</u>	---	---
SC	<u>X</u>	---	---
SE	<u>X</u>	---	---
SI	---	<u>X</u>	---
TP	<u>X</u>	---	---

If yes, how many options exist for the market value formula?

BA	2, 3--varies by asset type
DH	1
FC	2
M1	2
M2	1--discounted future cash flow.
MS	
PA	3
PS	4 for bonds, 3 for mortality, 1 for others.
SC	Tailored by investment.
SE	User-defined Parameters.
SI	
TP	1, discounted cash flows.

34. Are income statement and balance sheet accruals/amortizations determined?

BA		<u>X</u>	---
DH	approximate methods used	<u>X</u>	---
FC		<u>X</u>	---
M1		<u>X</u>	---
M2		<u>X</u>	---
MS		<u>X</u>	---
PA		<u>X</u>	---
PS		<u>X</u>	---
SC		<u>X</u>	---
SE		<u>X</u>	---
SI		<u>X</u>	---
TP		<u>X</u>	---

35. How is tax treatment reflected?

BA	No.
DH	Calculated in insurance model, deducted from cash flow.
FC	Initially as a percent of gain from operations modified for tax purposes.
M1	User defined tax rates and tax reserves.
M2	1984 Tax Act, including mutual company surplus tax.

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- MS Tax treatment is generally not reflected. Taxes can be built into the pricing and valuation studies to determine profitability.
- PA 1) User defined tax rates and tax reserves. 2) Planned enhancement Summer 1987.
- PS
- SC Explicitly
- SE User-defined Parameters.
- SI Based on tax formula for mutuals or Stocks. Co. Supplies %'s.
- TP Taxes are calculated based on a combination of three items: 1) Gain from Operations, 2) Capital Gains/Losses, 3) Surplus.

36. To what extent does the system reflect asset prepayments?

- BA The user has several ways to reflect market prepayments: 1) The asset can be sold. The sale date and sale price computation method are specified by the user. 2) Bond call and prepayment schedules, and mortgage prepayment and foreclosure schedules, are set up by the user and are influenced by the interest scenario.
- DH Incorporated in rollover assumptions for certain assets.
- FC Fully.
- M1 User defined asset prepayment formulas vary with interest rate movements.
- M2 Prepayments and calls have a fixed durational percentage plus a
- MS All assets with options such as callable bonds or mortgage backed securities are valued using option-pricing models which incorporate specific pre-payment models.
- PA Bond calls and mortgage prepayments vary with interest rate movement.
- PS Bond calls and mortgage prepayments are scenario dependent variable.
- SC Bond calls and mortgage prepayments.
- SE A comprehensive Prepayment processor and user-defined formulas.
- SI
- TP Completely.

37. Does the system project assets seriatim or are the individual characteristics blended before any calculations are performed?

- BA Seriatim.
- DH Blended.
- FC A combination of the two.
- M1 Seriatim.
- M2 Future assets--seriatim. Existing assets--seriatim or blended.
- MS Assets are valued seriatim.
- PA Seriatim.
- PS The system anticipates that assets will be projected seriatim.
- SC Seriatim.
- SE Assets may be combined or consolidated to any degree required.
- SI By segment.
- TP Assets are projected seriatim. If desired, individual asset blending could be done prior to running the model.

SOFTWARE TOOLS FOR ASSET/LIABILITY MATCHING

38. Can the system support dynamic and passive investment strategies?

- BA Each asset has its own investment strategy implicit in the assumption tables associated with it.
- DH User can adapt investment strategy based on previous runs.
- FC Yes. Currently planned future enhancement.
- M1 Yes.
- M2 Passive, although sales can be triggered to cover negative cash flow.
- MS The system is designed to support the development of either dynamic or passive investment strategies.
- PA Yes.
- PS Yes.
- SC Yes.
- SE Yes.
- SI
- TP Yes.

How many distinct asset groups can be specified for sale?

- BA Each asset has its own sales assumptions associated with it.
- DH Rollover rates can be specified for most asset categories. My investment strategy assumptions vary by duration.
- FC No specific limit.
- M1 Limited only by computer time and imagination.
- M2 All.
- MS
- PA Liquidity is specified by user for each asset.
- PS 10.
- SC No system limit.
- SE User-defined in customization process.
- SI
- TP System does not sell assets.

39. What lines of business or products does the system project?

	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
--	------------	-----------	---

Traditional life

BA	<u>x</u>	---	---
DH	<u>x</u>	---	---
FC	<u>x</u>	---	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>x</u>	---	---
PA	<u>x(1)</u>	---	<u>x(2)</u> Summer 87

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	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
PS	<u>X</u>	---	---
SC	<u>X</u>	---	---
SE	<u>X</u>	---	---
SI	<u>X</u>	---	---
TP	---	---	<u>X</u>
Universal Life			
BA Available June 87	---	---	<u>X</u>
DH	<u>X</u>	---	---
FC	<u>X</u>	---	---
M1	<u>X</u>	---	---
M2	<u>X</u>	---	---
MS	<u>X</u>	---	---
PA	<u>X</u>	---	---
PS	<u>X</u>	---	---
SC	<u>X</u>	---	---
SE	<u>X</u>	---	---
SI	<u>X</u>	---	---
TP	<u>X</u>	---	---
Income paying annuities			
BA	<u>X</u>	---	---
DH	<u>X*</u>	---	<u>X**</u>
FC	<u>X#</u>	---	---
M1	<u>X</u>	---	---
M2	<u>X</u>	---	---
MS	<u>X</u>	---	---
PA	<u>##</u>	---	<u>X</u>
PS	<u>X</u>	---	---
SC	---	<u>X</u>	---
SE	<u>X</u>	---	---
SI	<u>X</u>	---	---
TP	<u>X</u>	---	---
Deferred annuities			
BA	<u>X</u>	---	---
DH	<u>X*</u>	---	<u>X**</u>
FC	<u>X</u>	---	---
M1	<u>X</u>	---	---

* New Issues Only

** Inforce & New Issues

Liabilities Static unless projected by F.C.I.

Requires code modification to input external liability projections.

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	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
M2	<u>x</u>	<u>---</u>	<u>---</u>
MS	<u>x</u>	<u>---</u>	<u>---</u>
PA	<u>x</u>	<u>---</u>	<u>---</u>
PS	<u>x</u>	<u>---</u>	<u>---</u>
SC	<u>x</u>	<u>---</u>	<u>---</u>
SE	<u>x</u>	<u>---</u>	<u>---</u>
SI	<u>x</u>	<u>---</u>	<u>---</u>
TP	<u>x</u>	<u>---</u>	<u>---</u>
Health			
BA	<u>---</u>	<u>x</u>	<u>---</u>
DH	<u>x*</u>	<u>---</u>	<u>x**</u>
FC	<u>x</u>	<u>---</u>	<u>---</u>
M1	<u>---</u>	<u>---</u>	<u>---</u>
M2	can input external liability projections Possibly, assuming cash flows can be modelled into a profit study format.		
MS	<u>---</u>	<u>x</u>	<u>---</u>
PA	<u>##</u>	<u>x</u>	<u>---</u>
PS	<u>x</u>	<u>---</u>	<u>---</u>
SC	<u>---</u>	<u>x</u>	<u>---</u>
SE	<u>---</u>	<u>x</u>	<u>---</u>
SI	<u>x</u>	<u>---</u>	<u>---</u>
TP	<u>---</u>	<u>x</u>	<u>---</u>
Group life			
BA	<u>---</u>	<u>x</u>	<u>---</u>
DH	<u>---</u>	<u>---</u>	<u>---</u>
FC	<u>x#</u>	<u>---</u>	<u>---</u>
M1	<u>x</u>	<u>---</u>	<u>---</u>
M2	Possibly, assuming cash flows can be modelled into a profit study format.		
MS	<u>x</u>	<u>---</u>	<u>---</u>
PA	<u>x</u>	<u>---</u>	<u>---</u>
PS	<u>x</u>	<u>---</u>	<u>---</u>
SC	<u>---</u>	<u>x</u>	<u>---</u>
SE	<u>x</u>	<u>---</u>	<u>---</u>
SI	<u>x</u>	<u>---</u>	<u>---</u>
TP	<u>---</u>	<u>x</u>	<u>---</u>

* New Issues Only

** Inforce & New Issues

Liabilities Static unless projected by F.C.I.

Requires code modification to input external liability projections.

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	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
Group health			
BA	---	x	---
DH	---	---	---
FC	x#	---	---
M1	---	---	---
M1	can input external liability projections		
M2	Possibly, assuming cash flows can be modelled into a profit study format.		
MS	---	x	---
PA	##	---	---
PS	x	---	---
SC	---	x	---
SE	---	x	---
SI	x	---	---
TP	---	x	---

Other

BA			
DH	Term, Interest Sensitive Life	x*	---
FC		x	---
M1		---	---
M2	Possibly, assuming cash flows can be modelled into a profit study format.		
MS	(GIC, CLOSEOUTS)	x	---
PA	(GIC)	---	x Summer 1987
PS		x	---
SC	SPUL & ISL	---	---
SE	GICs	x	---
SI	Pension	x	---
TP	(SPWL)	x	---

40. Can the model be used for:

- a. single product, homogeneous product line, multiple products, and multiple product lines?

BA		x	---	---
DH		x	---	---
FC		x	---	---
M1		x	---	---
M2		x	---	---

* New Issues Only

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Liabilities Static unless projected by F.C.I.

Requires code modification to input external liability projections.

SOFTWARE TOOLS FOR ASSET/LIABILITY MATCHING

	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	<u>x</u>	---	---

b. a typical entire company?

BA	<u>x</u>	---	---
DH	<u>x</u>	---	---
FC	<u>x</u>	---	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	---	---	<u>x</u>
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	---	<u>x</u>	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	---	---	<u>x</u>

41. Are liabilities processed seriatim or are they modelled?

BA Seriatim by model office cell.
 DH Seriatim by model office cell.
 FC Neither.
 M1 Modelled. Seriatim by model office cell.
 M2 Modelled.
 MS Liabilities are valued on a cell-by-cell seriatim model.
 PA Seriatim by model office cell.
 PS They can be processed in either manner but modelling is expected.
 SC Seriatim.
 SE Modelled.
 SI
 TP Liability cells are processed seriatim. If desired, liability modeling could be done prior to running the model.

42. How many companies had your system operational at their sites as of April 1, 1987?

BA 10.
 DH 28 Subsets of Total. 4 Essentially complete packages. Note--number of clients doing modelling is unknown.
 FC 1 (thru timesharing via dedicated line).

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- M1 1) 3. 2) 3. More than 20 had used the system on a consulting basis. Plus 6 have liscenced similar system thru PALLM.
- M2 7, although only 2 companies are currently using the asset-liability projection features.
- MS NA.
- PA 1) 3. 2) 3.
- PS 0.
- SC List available on request.
- SE The Sendero Model is operational at more than 500 Banks, S&Ls and other financial institutions worldwide. The initial release of the first operational part of the Insurance model is scheduled for 3rd Quarter 1987.
- SI 0.
- TP 5 companies and 8 Tillinghast consulting offices.
43. How many additional companies had purchased your system as of April 1, 1987?
- BA 0.
- DH 0.
- FC 6.
- M1 3.
- M2 1.
- MS NA.
- PA 1) 0. 2) 2.
- PS 0.
- SC List available on request.
- SE NA.
- SI 0.
- TP None, since installation of the system takes less than a day, purchasers become operational sites immediately.
44. Can the system be used to test for the effect of displacement of in-force business when new products are introduced (in-force assets start to unfund--i.e., what does this do to investment strategy)? If yes, describe how.
- BA Since the system is primarily aimed at the asset/liability matching process, only existing in-force business is analyzed.
- DH Yes. Insurance model reports negative cash flow. Negative cash flow inputs to Asset Model.
- FC In force business run off books thru death, lapse, maturity, etc. New business is sold and builds up reserves, insurance inforce, etc. Existing assets mature, call, default, prepay, etc. New assets are purchased according to investment strategies. Inforce business and new sales can be projected separately.

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- M1 Yes, by changing lapse formulas to reflect the impact of new products.
- M2 It could be used in this manner, although we have not approached this question in a project.
- MS Yes.
- PA Yes, by changing lapse formulas to reflect the impact of new products.
- PS Yes. User sets withdrawal dependencies.
- SC Yes.
- SE Yes. Investment strategy can be set to change automatically when product mix changes.
- SI Yes. Sales matrix indicates mix of new and inforce business, can be changed to reflect displacements.
- TP Yes. When in-force lapses increase causing negative cash flow, you may use a different investment strategy than with a positive cash flow.

45. Test new sales assumptions--and new business cash flows--is each year's new business a "closed block" or is the sum of new business merely an integral part of the total portfolio less volatility in results?

- BA Since the system is primarily aimed at the asset/liability matching process, only existing in-force business is analyzed.
- DH Integral part.
- FC Each year's sales is projected separately.
- M1 A closed block.
- M2 We have completed projects directed at this issue.
- MS Yes.
- PA A closed block.
- PS New business becomes an integral part of the whole.
- SC Each year's sales are independent and either dynamic or predetermined.
- SE In-force and new business may be modeled separately or combined.
- SI New business can be integral part of portfolio.
- TP New business specifications may be predefined or may be dynamic in response to your relative competitive position.

46. Can programs project:

	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
Cash Flow			
BA	x	---	---
DH	<u>x*</u>	---	<u>x**</u>

* for traditional life & UL
 ** for other lines

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	Yes	No	Currently Planned Future Enhancement
FC	<u>x</u>	---	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS	<u>x</u>	---	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	<u>x</u>	---	---
SAP			
BA		x	
DH	<u>x*</u>	---	<u>x**</u>
FC	<u>x</u>	---	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS		x	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC	<u>x</u>	---	---
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP	<u>x</u>	---	---
GAAP			
BA		x	
DH	<u>x*</u>	---	<u>x**</u>
FC	<u>x</u>	---	---
M1	<u>x</u>	---	---
M2	<u>x</u>	---	---
MS		x	---
PA	<u>x</u>	---	---
PS	<u>x</u>	---	---
SC		---	x
SE	<u>x</u>	---	---
SI	<u>x</u>	---	---
TP		x	---
Real Tax Income			
BA		x	
DH	<u>x*</u>	---	<u>x**</u>
FC		---	<u>x</u>

* for traditional life & UL
 ** for other lines

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	Yes	No	Currently Planned Future Enhancement
M1	<u>x</u>	<u>---</u>	<u>---</u>
M2	<u>x</u>	<u>---</u>	<u>---</u>
MS	<u>---</u>	<u>x</u>	<u>---</u>
PA	<u>x(1)</u>	<u>---</u>	<u>x(2) Summer 87</u>
PS	<u>x</u>	<u>---</u>	<u>---</u>
SC	<u>x</u>	<u>---</u>	<u>---</u>
SE	<u>x</u>	<u>---</u>	<u>---</u>
SI	<u>x</u>	<u>---</u>	<u>---</u>
TP	<u>---</u>	<u>x</u>	<u>---</u>

47. Can the program identify "puts and calls" contained within the insurance contract?

BA

I don't understand what this question refers to. If it means "can the system help with analyzing the effects of anti-selection?" then the answer is a definite "yes".

DH

User controls interest earned & credited, surrender charges & loads if any, lapsation, premium amount.

FC

M1

The system values insurance options implicitly through the projection process.

M2

MS

PA

PS

SC

SE

SI

TP

<u>---</u>	<u>x</u>	<u>---</u>
<u>x</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>---</u>	<u>---</u>
<u>x</u>	<u>---</u>	<u>---</u>
<u>x</u>	<u>---</u>	<u>---</u>
<u>x</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>x</u>	<u>---</u>

48. Can the program identify option risks for the asset portfolio as a whole?

BA

DH

FC

M1

The system values options through the projection process.

M2

MS

PA

PS

SC

Ambiguous question

SE

SI

TP

<u>---</u>	<u>x</u>	<u>---</u>
<u>---</u>	<u>x</u>	<u>---</u>
<u>---</u>	<u>x</u>	<u>---</u>
<u>x</u>	<u>---</u>	<u>---</u>
<u>x</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>---</u>	<u>x</u>
<u>x</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>x</u>	<u>---</u>

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49. Does the program include option pricing techniques? (option pricing techniques may be preferred method to simulation)

	<u>Yes</u>	<u>No</u>	<u>Currently Planned Future Enhancement</u>
BA	---	<u>x</u>	---
DH	---	<u>x</u>	---
FC	---	<u>x</u>	---
M1	---	<u>x</u>	---
M2	---	<u>x</u>	---
MS	<u>x</u>	---	---
PA	---	<u>x</u>	---
PS	---	<u>x</u>	---
SC	---	<u>x</u>	---
SE	---	---	<u>x</u>
SI	<u>x</u>	---	---
TP (option pricing techniques may be preferred method to simulation)	---	<u>x</u>	---

50. What are the limits to the size of the asset and liability models?

- BA Each module can have up to 200 plans with 300 cells per plan.
- DH Billions of dollars. # Bonds depends on storage up to a 1000 with diskettes. # Cells in liability--26, but each can be combination of an unlimited number of component plans.
- FC No limits.
- M1 2000 assets, 50-200 liability cells; currently planned enhancements will allow up to 5000 liability cells.
- M2 In a practical sense, existing assets should be modelled to 100-200 cells and liabilities to 50-200 cells.
- MS None.
- PA Limited by available hardware space.
- PS No practical limit.
- SC
- SE Practical limits of processing time and disk capacity.
- SI Unknown.
- TP No theoretical limit on assets. Liabilities are limited to 24 plan/issue age policy description parameters and/or 300 issue date cells (policy records) for any given run of the system.

For questions 51 through 57:

- Given (1) 3,000 distinct assets
- (2) 200,000 policies
- (3) 400 plan codes

51. How many asset cells or groups would be optimal for the system to work with?

- BA As many, or as few, as the user needs.

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DH 500--depends on number of bond vs other assets.
FC Instant Forecast is indifferent to number of cells.
M1 1,000-2,000.
M2 100.
MS 3,000.
PA Probably 500-600.
PS 15-25.
SC Completely user defined; possibly 50 for pricing decisions.
SE Up to six product classes and 15 investment types per product line with no practical limit to the number of product lines. The Sendero Model assumes that assets and liabilities are summarized for modeling purposes.
SI Variable.
TP Up to 200-300, practical limit dependent on hardware.

Are there any limits, given the size of the machine for which the system is designed?

BA Limited by hard disk size only. (See also 50.)
DH Depends on number of bonds.
FC No.
M1 See #50.
M2 Present DOS limits the workspace, a 3,000 cell asset model would require some reprogramming to use the disk.
MS None.
PA See #50.
PS No.
SC No practical limitations.
SE No.
SI
TP No limits other than machine speed.

52. How many liability cells or groups might the system work with?

BA See 50. Given about 40M bytes of hard disk storage, the entire 200 plans and 300 cells for each module could be set up. However, this is far more than any user could ever want.
DH 25 (?) User can control grouping.
FC Instant Forecast is indifferent to number of cells. Instant Forecast does not use the old asset share-model office approach.
M1 100-200.
M2 100.
MS
PA No system limit.
PS 2,000-4,000.
SC Up to 10,000.
SE Reference question 51.
SI 10-20.
TP 50 to 100 from a practical point.

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Are there any limits, given the size of the machine for which the system is designed?

BA
DH May need hard disk.
FC No.
M1 See #50.
M2 Yes, same as the assets, although the program is designed to work with 50 cell groups of liabilities and combine results.
MS No.
PA See #50.
PS No.
SC No.
SE No.
SI
TP Maximum of 300 cells in any one projection.

53. How long will it take to prepare the initial data files?

BA No definitive answer can be given to this question. It depends on the number of cells the user chooses to use in modeling his or her company and whether the data is keyed in or imported. See 18 for tools available. No user so far has requested help, however personnel could be made available to do as much of the work as the user required.
DH Very first run/total company--1 week.
FC Depends on scope of project (i.e.--UL only or total company). Normally several weeks to several months.
M1 4 to 6 weeks.
M2
MS
PA Depending on state of user's files 2-8 weeks.
PS 2 weeks - 3 months.
SC Approximately 2-3 days given immediate access to data.
SE Varies depending on the structure and availability of users system data and assumptions.
SI 2 weeks.
TP Fifteen to twenty hours but as little as 2 hours for a simple model.

What parameters will affect the time required?

BA
DH Number of plans in life model, number of bonds.
FC Scope and difficulty of project, level of assistance from client.
M1 Quality of company records, degree of computerization, responsiveness of company personnel.
M2 Availability of computer tapes and documentation of the formats.
MS
PA Type of records available from modeling done for other purposes.

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- PS Format & completeness of data files.
- SC Specificity of modeling; i.e., # of asset groups, etc.
- SE Availability of the users data and the software tools supplied to interface data to the model.
- SI Complexity.
- TP Number of asset and liability cells.

What software tools are provided to streamline the process?

- BA
- DH Various utility file print, build & correct files.
- FC FCI asset and liability interface software.
- M1 Extensive programs have been developed.
- M2 We suggest commercial data base or report generator systems be used to summarize and model the inforce.
- MS
- PA Support is available from PALLM.
- PS Various conversion tools and model validators.
- SC Automated Data Cell Construction.
- SE Sendero-XL Modeling language and the file interface preprocessor.
- SI
- TP Timesharing model builder system.

To what extent are vendor personnel available to assist this process?

- BA
- DH Telephone support freely given. Anything else is negotiable.
- FC Normally, FCI personnel--working with client actuaries, etc.--do most of the work in producing base projection and creating Instant Forecast data bases to minimize impact on client manpower.
- M1 Generally, we perform this process.
- M2 M&R services has considerable staff available to support modelling. We also have modelling systems which can be employed.
- MS
- PA On contract.
- PS We can manipulate all data files, if necessary.
- SC Complete phone or on-site support.
- SE Routine support and Guidelines for obtaining data are included in the purchase price of The Sendero Model. Additional support, when required, is available on a consulting basis.
- SI As needed under consulting contract.
- TP Tillinghast consultants and staff are available to assist in creating these models.

54. Are there various levels of detail available?

- BA A major feature of the system is the ability to run a single cell and produce reports that show complete detail on all the computation steps involved. Also, the system is set up so that any subset of the data can be run.
- DH Assets--by type & duration (for bonds). Insurance--By plan/age, plan & company.

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FC Yes.
M1 Yes.
M2 Yes.
MS NA.
PA Yes.
PS Yes.
SC Yes, broad range.
SE Yes.
SI Yes.
TP Yes.

To what extent is detail available?

BA
DH
FC Many reports showing different levels of detail as well as types of analysis.
M1 Detail is available for each liability cell as well as for each asset class.
M2 Liability cell components of cash flow on a year by year basis. Same for assets.
MS
PA Period within trial, trial summary, individual cell.
PS Month by month, data item by item, for each grouping of cells.
SC Policy by policy.
SE Complete audit trail to the level of input data.
SI
TP Calculation results are available for quarterly or annual display for the entire projection period for individual scenarios.

55. On what hardware can the system run and what are the minimum amounts of resources that might be needed to process the block described above?

BA The block of business can be run on an IBM PC XT with 640K RAM and a 10M byte hard disk. A more powerful PC compatible computer would be desirable to speed processing.
DH IBM PC/XT/AT--hard disk recommended.
FC IBM or IBM compatible mainframe. System runs in minutes.
M1 Mainframe, mini-computer, or enhanced PC.
M2 Modelling--mainframe to collapse the inforce to perhaps 10,000 records. Submodelling--assets and liabilities on an IBM AT, 40 Meg hard disk and 640K memory.
MS MS Mainframe.
PA 1. IBM AT with 80287 or Compaq 386; 40+ meg hard disk, 4.5+ meg memory.
2. IBM mainframe; 10 MB active region for proposed large model.
PS UNISYS A Series 3-4 hours on an A-3.
SC PC-386 approximately 10,000 data cells/day.
SE 386-based super micro with 4Mb memory 40Mb Hard Disk
DEC VAX - 5Mb memory, 70Mb Hard disk
SI HP/3000, 4M CPU & 100M Storage.
TP The minimum resources are: (1) IBM compatible PC with 640k memory, (2) 20 MB hard disk, (3) Epson compatible printer.

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		<u>Yes</u>	<u>No</u>
56.	Is the system available for license?		
	BA	<u>x</u>	---
	DH	<u>x</u>	---
	FC	<u>x</u>	---
	M1 Through PALLM.	<u>x</u>	---
	M2	<u>x</u>	---
	MS	---	<u>x</u>
	PA	<u>x</u>	---
	PS	<u>x</u>	---
	SC	<u>x</u>	---
	SE	<u>x</u>	---
	SI	<u>x</u>	---
	TP	<u>x</u>	---

If so, would source code be made available?

	BA	---	<u>x</u>
	DH	<u>x</u>	---
	FC	---	<u>x</u>
	M1	<u>x</u>	---
	M2	<u>x</u>	---
	MS	---	<u>x</u>
	PA	<u>2</u>	<u>1</u>
	PS	<u>x</u>	---
	SC	<u>x</u>	---
	SE	<u>x</u>	---
	SI	---	<u>x</u>
	TP	<u>x</u>	---

57. Is the system available on a timesharing or consulting basis?

	BA	---	<u>x</u>
	DH	---	<u>x</u>
	FC	<u>x</u>	---
	M1	<u>x</u>	---
	M2 Consulting	<u>x</u>	---
	MS	---	<u>x</u>
	PA Available from M&R (M1)	---	---
	PS	<u>x</u>	---
	SC Consulting	<u>x</u>	---
	SE	<u>*</u>	---
	SI	<u>x</u>	---
	TP The system is available for trial use as well as on a consulting basis.	<u>x</u>	---

* The Sendero Model for Insurance Companies will be made available through consulting firms as they become trained and certified by Sendero.

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If so, how are fees determined?

BA

DH

FC On individual basis based on scope of project.

M1 Time and expense.

M2 After the project is defined we provide an estimate of the time and expense, which can vary widely depending upon the scope of the project.

MS

PA See M1.

PS Describe and quantify the scope.

SC Consulting fees.

SE Negotiated in each unique case.

SI Per month charge.

TP Consultant and staff hourly rates.

Are flat fees available?

BA

DH

FC Yes.

M1 No.

M2

MS

PA See M1.

PS Yes.

SC Yes.

SE Yes.

SI Yes.

TP Estimates are available from consultants.

Are there any plans to make the system available for license in the future?

BA

DH Note--System can be rented as well as purchased. Actuarial but not investment consulting is available.

FC Yes.

M1 See #56.

M2

MS

PA Currently available.

PS Yes, it will migrate to other hardware (micros and mainframes).

SC Already available.

SE Currently available on a license basis.

SI

TP Already available.

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Other comments:

- M2 It should be noted that PCAPS is intended to be a system used from "start to finish" within a company. For example:
- Initial product development & pricing
 - Testing interest crediting strategy and investment strategy for new products
 - Development of GAAP reserve factors/methodology
 - New business projections--product line
 - Existing business projections--product line
 - Total company projections.

