



THE FINANCIAL REPORTER

NEWSLETTER OF THE LIFE INSURANCE COMPANY FINANCIAL REPORTING SECTION

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From the Editor

by G. Thomas Mitchell

We take a mostly forward look in this issue. Mike Lombardi reviews, with humor and insight, the year-2000 problem from an insurance company perspective. Mike McLaughlin reports on FASB's considerations on extending fair-value accounting to the liability side of the balance sheet. He concisely summarizes a recent presentation by COLIFR to FASB, and I present the favorable results of a test of a new method for selecting Monte Carlo scenarios using low-discrepancy sequences.

On the U.S. regulatory front, Jim Backus develops a visual way of thinking about implementing *Actuarial Guideline 33* for deferred annuity statutory reserves. The long review process on this article was a tribute to the power of his methodology, as hidden issues became clearer under his analysis.

David Rogers penetrates the not obvious, but very important subtleties in *SOP 95-1* for U.S. mutual life company GAAP accounting.

We also welcome ongoing updates by Ted Schlude on the NAIC Life Health Actuarial Task Force developments, and Harold Forbes on COLIFR meetings, both with very broad and active agendas.

Your Section Council continues to be quite active. The next issue will cover successful Asian seminars and an interesting lineup of sessions for the Spring meeting in Hawaii. Other projects in the planning stages are Latin American seminars and input into the financial reporting content of the new Society examination system.

Correction—In Issue 35 (December 1997), Jim Lamson's firm, Actuarial Resources Corporation, was incorrectly shown as Actuarial Research Corporation. I regret the error.

G. Thomas Mitchell, FSA, is president of Aurora Consulting Inc., in St. Louis, Missouri and Editor of The Financial Reporter.

Year 2000 Clock Is Ticking

by Mike Lombardi

Editor's Note: This article originally appeared in the December 1997 issue of Marketing Options and is reprinted with permission.



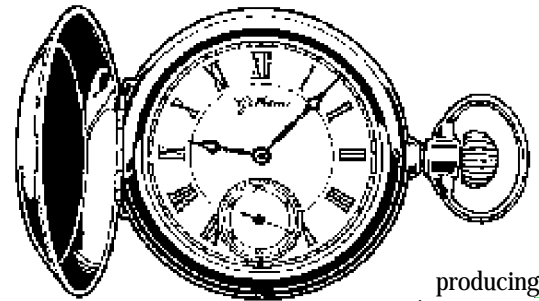
The general year-2000 problem facing governments and the private sector has already been described. Jokes

may be made about planes grounded because they are 99 years overdue for maintenance, long distance phone calls that get charged for millions of minutes, and credit card bills with a century of overdue interest charges. However, it is indeed a serious problem. This article looks at the year-2000 issue (often called the "Y2K" issue in the computer literature) from the perspective of the insurance industry and some special issues faced by insurance companies.

The Problem Is Real

The two biggest obstacles faced by many insurers are awareness and denial. According to a recent study by the Olsten Corp., nearly one in six North

American senior executives surveyed was unaware of the year-2000 problem. Garner Group, Inc. has estimated that approximately 50% of companies with this software problem may not become year-2000 compliant in time and will have all or part of their computer systems shut down (or start



producing incorrect data) on or after

January 1, 2000.

For major companies with heavily customized software systems, however, much of the corrective work will have to be done by the companies themselves. For example, the Prudential Insurance Company of America reportedly expects to correct approximately

continued on page 6, column 2

In This Issue

	page		page
Call for Papers	10	Improving Monte Carlo Modeling with Low Discrepancy Sequences—A Test	
COLIFR Corner		by G. Thomas Mitchell	19
by Harold Forbes	2	Thanks to 1997 Annual Meeting Speakers	25
COLIFR Discusses Fair Value with FASB		Visual CARVM: Multiple-Benefit Streams in Pictures	
by S. Michael McLaughlin	3	by James E. Backus	12
From the Editor		Year 2000 Clock Is Ticking	
by G. Thomas Mitchell	1	by Mike Lombardi	1
The Gap in SOP 95-1			
by David Y. Rogers	9		
Highlights of the NAIC Life and Health Actuarial Task Force Meeting—December 1997			
by Raymond T. (Ted) Schlude	23		

COLIFR Corner

by Harold Forbes

This is the second installment of "COLIFR Corner"; the first installment appeared in the September 1997 issue of *The Financial Reporter*. This issue addresses activities from June through December 1997.

The Committee on Life Insurance Financial Reporting (COLIFR), chaired by James E. Hohmann, is one of a number of committees that exists within the American Academy of Actuaries. The committee monitors financial reporting activities related to life and health insurance, reviews proposals made by various public and private sector organizations affecting accounting and auditing issues related to life and health insurance, and is generally responsible for analysis and recommendations on life and health insurance accounting issues.

"COLIFR Corner" will provide a brief update on financial reporting activities that the committee is involved in and give some limited information on where current issues stand.

NAIC Valuation Task Force

Work continued through the end of 1997. A report to the NAIC Life and Health Actuarial Task Force on a Unified Valuation System was released on December 5, 1997. The report contains sections on:

- **The advantages and disadvantages of the current valuation system.** Advantages centered on standardization and simplicity. Disadvantages included inconsistent requirements that do not adequately address current products, lack of reflection of current experience, and significant risks not being appropriately addressed.
- **An international report on the valuation practices of other countries.** Fourteen countries were selected for study. The work from this section outlines valuation practices and also provides snapshots of the financial markets and insurance industry environments, as well as summaries of the market size, products available,

investments, taxation, regulation, and the role of the actuary.

- **Development of objectives and framework.** The objectives for a valuation system have been articulated and finalized. Each of the objectives has been related to a subset of potential audiences and each audience's needs from a Unified Valuation System.
- **The methodology for the Unified Valuation System.** This section catalogues what "tools" are available to the actuary. The Task Force has concluded that additional valuation mechanisms will be needed to develop a Unified Valuation System.

AAA Nonforfeiture Working Group

This project has been delayed until the current valuation and disclosure issues have been resolved. The project is on hold for at least six months.

NAIC Codification of Statutory Accounting Principles

The work of this committee has entered the final stages. The work product, consisting of nearly 100 issue papers, was released to the task force at the fall meeting. The process now passes to the EX4 subcommittee for approval. Some comments received on the issue papers were incorporated into the final drafts. Many comments were ignored. Some modifications were to remove references to model laws or existing statutory regulations. Specific language was substituted. Concerns that have been expressed, from companies' perspectives, are that the process is moving on without taking time to look at finalized SSAPs. Final SSAPs should be available on the NAIC's web site, www.naic.org.

continued on page 3, column 1

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COLIFR Discusses Fair Value with FASB

by S. Michael McLaughlin

For the last several years, the American Academy of Actuaries has participated in a series of meetings in an ongoing dialogue with the Financial Accounting Standards Board (FASB or the Board) on matters of actuarial interest. In October 1997, representatives of the Academy's Committee on Property/Liability Financial Reporting (COPLFR) met with the Board to discuss fair-value reporting of property/casualty insurance liabilities. On November 24, representatives of the Committee on Life Insurance Financial Reporting (COLIFR) met with the Board for a similar purpose.

The FASB is a nonprofit governing body formed in 1973 for the purpose of establishing accounting standards. It promulgates Statements of Financial Accounting Standards (SFAS) and other documents that, together with pronouncements of other accounting

bodies, define generally accepted accounting principles (GAAP) in the U.S. Board members are appointed from industry, academia, and the accounting profession, and are supported by a full-time staff.

The FASB has been interested in insurance, actuarial, and present value-related issues for many years. This interest can be traced back to *SFAS 60*, issued in 1982, which addressed accounting and reserving for traditional life insurance contracts. In 1988 the board began a major project dealing with broad uses of present value in accounting measurements. In 1990 it issued a discussion memorandum, "Present Value-Based Measurements in Accounting." In 1994 it issued *SFAS 115*, which specified carrying values for most debt and equity securities. Many insurance company assets are required to be carried at fair value, depending on

their classification (that is, "trading" or "available for sale" categories; assets categorized as "held-to-maturity" are carried at book value). Insurance liabilities, specifically policy reserves, were also considered, but the board concluded that there was no consensus on appropriate methods for fair value of these liabilities. Hence insurance liabilities must be carried at values specified in other statements (for example, *SFAS 60, 97, and 120*).

Current U.S. GAAP reserve methods for policy liabilities are often labeled book value methods. Although many insurance contracts are interest-sensitive, their values as liabilities do not change much, if at all, with changing interest rates. Of course, market values of the supporting assets do vary

continued on page 4, column 1

COLIFR Corner

continued from page 2

AAA's State Variations in Valuation Laws Task Force

There has been little activity over the past six months. One remaining issue concerns the responsibility of maintaining and updating the system once it is in place. However, the recommended changes to the Actuarial Opinion and Memorandum Regulation that would allow states to accept an actuarial opinion based on the valuation requirements of an insurer's state of domicile, combined with the NAIC's codification project and Valuation Task Force objective to create new valuation system, may eliminate the need to maintain a central depository system.

Demutualizations

Work has begun on updating the 1987 Garber Report on demutualizations. Much of the original report was theoretical, because there were no actual demutualizations from which to draw. The COLIFR committee intends to produce two items for publication. The first item would be a practice note that discusses in some detail the

demutualizations that have occurred to date. The second would be an extension of the original report which provides clarification based on the demutualizations that have occurred to date, as well as extending the theoretical discussion into new areas, such as mutual holding companies that have developed since the original publication.

GAAP Issues

A survey of management practices that is currently being developed has received 85 responses to a recently issued survey. A practice note will be developed over the next two months.

Some of the current issues of interest include:

- **Harmonization.** This is an issue that would move U.S. accounting standards to be more in line with the rest of the world. The goal is to accomplish this by the year 2000. The SEC would accept registrations on this basis. The premise is based on market value accounting. Many open issues exist.

- **Derivatives.** A standard for the accounting derivatives and hedging is being developed. Derivatives would be accounted for on the balance sheet at fair-market value. Changes in value would go through income. Special rules would apply to hedging situations. Hedges are specified to include existing asset/liability matches, firm future commitments, and foreign currency.

- *FAS 130* on comprehensive income was adopted. There will be no earnings-per-share impact.

- *FAS 131* on segments accounting was adopted. Income streams will follow management's approach when reporting by segment.

Activities in these areas and others will be reported as they develop in future installments.

Harold E. Forbes, FSA, is an actuary at Milliman & Robertson Inc., in Bloomfield, Connecticut.

COLIFR Discusses *continued from page 3*

with changing interest rates. This inconsistency in the balance sheet produces quirky changes in equity when interest rates change rapidly.

The board has continued to pursue improved methods of measuring liabilities. In 1996 the FASB issued a Special Report on present value measurements and in June 1997 issued an Exposure Draft of a proposed concepts statement, "Using Cash-Flow Information in Accounting Measurements." These are not part of the GAAP's authoritative literature but are important discussion documents. By issuing documents at this level, the board signals its thinking in advance and solicits thoughtful commentary.

Clearly, the board is moving toward full-market-value, or fair-value accounting. This includes considering the possibility of determining fair value of insurance contract liabilities. This is consistent with related developments on the international scene. The International Ac-

"In 1996 the FASB issued a Special Report on present value measurements and in June 1997 issued an exposure draft of a proposed concepts statement, 'Using Cash-Flow Information in Accounting Measurements.'"

counting Standards Committee comprises members from several countries, including Canada, the U.K., Australia, and the U.S. The IASC has discussed many of the same concepts and is preparing a paper for exposure. The IASC currently excludes insurance contract liabilities from fair-value measurement.

The Academy offered to participate in discussions with the FASB on the current status of thinking on the fair value of insurance liabilities, and the board welcomed the input from the profession. Arnold Dicke led a delegation of current and former members of COLIFER to the FASB offices in Norwalk, Connecticut. The group included Robert R. Reitano, James P. Greaton, Robert Wilcox, and me.

Wayne Upton, FASB project manager of the fair-value project, introduced the delegation to board members and staff. Arnold Dicke led off the discussions with a description of various types of life insurance and annuity products. He also described key characteristics of

these liabilities, including their contingent behavior compared with typical participants in efficient financial markets. He introduced the discussion on fair value, or market value, by noting that there is a very limited secondary market for most insurance liabilities; thus concepts of fair value could not easily be pegged to market values. This situation contrasts with many assets for which formula-driven values can be pegged to market values.

I discussed my paper, "The Indexed Discount Rate Method for Fair Value of Insurance Liabilities," originally presented at a seminar held in New York at the New York University Sloan School of Business. The seminar, produced by the NYU Salomon Center and the SOA, attracted several papers and international attention. Proceedings of the seminar will be published by NYU.

The indexed-discount-rate (IDR) method is a multiple-scenario method of projecting liability cash flows using realistic assumptions including mortality, morbidity, persistency, expenses, and interest credited. The number of scenarios used must be sufficient to cover the behavior and the range of options that might be exercised by the

contract holder and by the company. Both conservative and liberal assumptions are considered. The range of assumptions should reflect the actuary's judgment as to the sensitivity and riskiness of each assumption. For example, multiple-interest-rate scenarios may not be necessary in valuing term-life insurance; instead, a wide range of mortality scenarios should be considered.

In determining credited rates, models of typical asset portfolios and industry representative experience may be used. The company's actual asset portfolio may be used if it is representative, but unusual or idiosyncratic characteristics are not reflected. This approach ensures that liability fair value is independent of company-specific assets. Investment-earned rates may be converted to credited rates by modeling a crediting strategy appropriate to the characteristics of the liabilities. Thus credited rates are not based solely or primarily on the company-specific portfolio of assets and company-specific crediting strategies. Rather the

intent is to reflect market considerations and the inherent characteristics of the liabilities (for example, dynamic lapse sensitivity).

Projected liability cash flows are discounted at a risk-free interest rate, determined objectively from Treasury spot rates appropriate to the duration of the cash flows. No spread adjustment, either positive or negative, is added to the risk-free rate because it is unnecessary. Instead, the range of scenarios reflects the range of risks considered significant to the cash flows. The fair value is the unweighted mean of the present value of the projected scenarios.

My method meets several desirable criteria. It is independent of the company's specific asset portfolio and many other company-specific characteristics. This is appropriate because a market value reflects a consensus of many market participants and is not dependent solely on a single entity's view of value. The method is relatively objective—actuarial judgment is required in setting the various assumptions but not in setting the discount rate. The method is consistent with asset values and existing methods, uses currently available modeling tools, and will be capable of consistent application at all companies. Finally, the method is sufficiently general that it is applicable to a wide variety of types of contractual liabilities, including property and casualty insurance contracts.

Four main characteristics of the method were discussed. First, the fair value is interest sensitive; thus liability values will be volatile. This is appropriate volatility—it is fully consistent with volatility in the market values of assets. Equity volatility will exist only to the extent that the assets and liabilities are not well-matched. Second, there may be gain or loss at issue. Fair value may not correspond to exact break-even at inception of the contract. Third, profit emergence will not be as "tidy" as present book value methods—instead, profits will depend on

continued on page 5, column 1

COLIFR Discusses*continued from page 4*

initial price, asset and liability duration mismatch, the spread between actual investment income and the risk-free rate, and release from risk. The liability fair value reflects uncertainties in future cash flows. As time passes and experience emerges, future uncertainty is reduced, thus tending to decrease margins in the liability and release in profits each year.

A fourth characteristic of this method is that fair value may fall below contract surrender value. No adjustment is made for this situation. This fair value appropriately reflects the probability of surrender given a large group of contracts under varying economic conditions. Of course, this situation is not different from current GAAP reporting—for many contracts, the net liability (reserves less deferred-acquisition costs) falls below the contract surrender value, causing no conceptual problem.

Board members appeared very interested in the discussion and asked several questions. One question focused on the possibility of manipulation of results due to the subjectivity of the assumption-setting process. In response, I commented that the actuarial profession is well accustomed to using judgment in assumption setting (for example, cash-flow testing and actuarial appraisals) through long practice and the application of existing professional standards. Further, one of the most subjective assumptions, the discount rate, is established with complete objectivity under this method.

Bob Reitano discussed his paper, "Two Paradigms for the Market Value of Liabilities." The paper provides a theoretical background for discussion of the concepts. For example, the law of one price explains how the value of a complex asset with embedded options may be measured by valuing its constituent components. On the other hand, this widely accepted law has theoretical limitations, for example, when applied to securities with default risk. The paper explains the incomplete secondary market for insurance liabilities using the concepts of "long" and "short" markets. The "short" position in an insurance liability is the perspective of the company, the "long" position is that of the insurance contract holder.

In this regard, one of Reitano's key discussion points was that fair value in a secondary market would potentially differ from the initial sale price of an insurance or annuity contract. In other words, a

gain or loss may occur at the inception of the contract. I, also, referred to this issue. Reitano also commented that credit risk could be modeled explicitly, and if it was, there would be no need for a spread in the discount rate. Again, this was consistent with earlier comments relating to my method.

The two paradigms referred to in Reitano's paper are the direct- and indirect-measurement paradigms. These concepts were initially mentioned in COLIFR's presentation to FASB in 1993. At that time, a COLIFR task force compiled a listing of several actuarial methods that were considered applicable to measuring fair value of insurance liabilities. The direct measurement paradigm views the liability as a payment or series of payments to be made subject to certain contingencies. The fair value is defined as the present value of these payments.

The indirect paradigm views liabilities as a lien on assets.

The residual assets, or equity, represent a stream of corporate earnings which may be valued using actuarial appraisal techniques. The fair value of liabilities is then the difference between the fair value of the assets and the value of equity. A conceptual difficulty with the indirect paradigm is that liability fair value is dependent on asset fair value. This dependency is unpalatable to the accounting profession in part because it implies that the derived value does not relate solely to the liabilities. For example, the fair value of a specific asset is determinable without reference to other assets or liabilities. It would appear that fair value of a liability should likewise be determinable without reference to other liabilities or assets.

While these two measurement paradigms are theoretically reconcilable, many adjustments or refinements are necessary. For example, the value of equity may include "franchise" or going-concern value, debt, and the so-called "put option." The owners of the insurance company have the ability to "put" the company to the state guarantee fund if it should become insolvent. This value is offset to the extent that the company is required to make payments into the fund while solvent.

FASB members questioned Reitano on various concepts. Perhaps the most revealing question related to the general acceptability of Reitano's and my concepts in the actuarial profession. While it would be premature to conclude that there is a consensus among actuaries on a single method, the COLIFR group answered affirmatively. The question implied that the accounting profession, and the insurance industry generally, were perhaps not quite ready to embrace present value-based methods. Other interesting concepts covered included the sensitivity of the liability value to company strength and the relationship of cash-surrender value to fair value.

Next, Jim Greaton provided practical examples of application of fair-value methods to equity-indexed products. The account value of an equity-indexed prod-

"The indirect paradigm views liabilities as a lien on assets. The residual assets, or equity, represent a stream of corporate earnings which may be valued using actuarial appraisal techniques. The fair value of liabilities is then the difference between the fair value of the assets and the value of equity."

uct grows at a rate dependent on an external equity index, typically the S&P 500®. Many versions of the product exist, with varying participation terms and different minimum guarantees. These relatively new products exist, with varying participation terms and different minimum guarantees, and have considerable market appeal but are complex to value. The examples illustrated emergence of profit at issue and thereafter under various assumptions of the growth rate in the index and under various interest rates. The examples used a valuation approach similar to that in the current FASB exposure draft on derivatives.

continued on page 6, column 1

COLIFR Discusses *continued from page 5*

Bob Wilcox gave a brief presentation on the activities of the AAA's Valuation Task Force. This Task Force was formed in response to a request from the Life and Health Actuarial Task Force of the National Association of Insurance Commissioners that a new approach to statutory valuation be developed. The Task Force is not to be hindered by the need to reconcile its approaches to current methods and has been referred to as the "clean-sheet-of-paper" committee. The Task Force hopes to develop a unified method of valuation that would be applicable for a wide range of purposes, including statutory and GAAP financial reporting. It will make a presentation to the FASB early in 1998.

Dicke wrapped up by presenting a taxonomy of valuation methods developed by David Babbell and Craig Merrill. The taxonomy classifies current methods according to their use of deterministic or stochastic cash flows and interest rates. Dicke also showed several graphical examples of profit patterns that would arise from different implementations of fair-value methods, based on a presentation to the New York University seminar mentioned previously.

Following the presentation, several board members chatted informally with the presenters. The board appeared to appreciate the dialogue with the actuarial profession and will consider our input in future deliberations. It remains clear that additional deliberations will be necessary. For example, COPLFR's view of fair valuing P/C liabilities is that more research is needed before agreement in concept or on a specific method can be reached. As mentioned above, the accounting profession and insurance industry executives have not reached a consensus on appropriate methodology.

On the other hand, the pace of discussions is accelerating. The issue of fair value of insurance liabilities could come to a critical juncture within several months. The actuarial profession has a unique opportunity, perhaps a duty, to contribute to resolution of this important financial issue.

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Year 2000 Clock Is Ticking *continued from page 1*

125 million lines of code at a cost of approximately \$200 million. Manulife projects it will need a team of 200 people, a third of them on contract. Most major corporations, including larger insurance companies, are expecting to spend around \$50-\$100 million each. Although the costs of corrective action vary from company to company, a common rule of thumb is \$1.50-\$2.00 per line of source code to correct the date field problem. That's a great deal of investment, with zero additional profit, just to stay in business! And these costs exclude considerable additional amounts for project management, communication, routine supervision, analytic support, and training.

A major factor in the complexity of the issue is that we're dealing with many, many systems that have effectively been on autopilot for perhaps decades. How these systems work is largely unknown to the current users because these systems were created many years ago in COBOL, FORTRAN, or ASSEMBLER languages, which few modern programmers understand very well. In general, users may know

what inputs are required and what reports of information are generated but they do not understand the detailed code behind these systems. Also, users may not understand how different systems (administration, commission, financial reporting, reinsurance) interact with each other. Such information may soon be required but will be very difficult to obtain.

Denial isn't limited to retiring chief information officers. Another form of denial is expecting that a third-party contractor or consultant can be hired to fix everything. The reality is that no outsourcing firm can be expected to do it all. Internal staff is needed to understand all the customized approaches used by a sophisticated insurer and to validate all changes during the testing phase. As the year 2000 approaches, the cost of corrections will increase because of the shortage of "experts."

How stable will the project team be when the insurance company down the

street is in the same predicament and offers huge "incentives" to staff to jump ship and help them? Computer consultants' fees will skyrocket as the deadline approaches.

Suppose the accounting or policy issue systems aren't functioning? What are the consequences? The most simple consequence is a company can't accept policies or pay any invoices. No one will come into or leave the insurance company. Management and staff now have an unthinkable dilemma (of course, the company faces an even greater and more immediate one if the payroll system isn't working).

It's not just the core systems. The problem could be something as mundane as input screens for policy issue or renewal need to be looked at, since many are still legacy systems that accept only two-digit years. Even if dates are entered as four-digit years, there is no certainty that the core system will use all four;

many systems accept four digits but strip out all but the last two digits before processing. Outputs using "sort" routines will read

"A major factor in the complexity of the issue is that we're dealing with many, many systems that have effectively been on autopilot for perhaps decades."

"00" issues as very old 1900 data and place these at the bottom of the pile. Back-up systems can be dangerous because they may purge new "00" files or records. If the "last payment received" is January 1, 1900, will policyholders lose coverage because their policies are automatically lapsed? Generations of actuaries or actuarial students have set up what were meant to be "quick and dirty" APL programs for valuation, illustration, quotation, and sometimes even policy administration or accounting purposes. These systems have gone on to become routine production systems, but documentation does not exist and the actuary or programmer may have long left the company.

It is not just software, either. Hardware controls critical environment systems such as elevators, lighting, heating, telephones, voice-mail systems, air conditioning, electricity, and

continued on page 7, column 1

Year 2000 Clock Is Ticking

continued from page 6

security. These need to function as well. Insurance companies will also need to make sure their PCs, operating systems, and peripheral equipment do not have hardware-date overrides that invalidate the software changes.

Even if later generation PCs and local area networks (LANs) are "year-2000 compliant," if these interact with the mainframe system via uploads or downloads, they too are part of the problem and need to be tested.

Even if every system in the company is "year-2000 compliant," this may not be enough. The company still gets vital information and direct input from reinsurers, ceding companies, policyholders, brokers, agents, banks, investment firms, suppliers, contractors, and so on. There is no guarantee these sources will have their own houses in shape. Can the insurer survive if a large number of these sources are going under?

If a company cannot get its system running properly, there is the real risk of a traditional liquidity crisis or "run on the bank," as policyholders get wind of a troubled company and decide to pull money out fast before the regulator steps in.

Solutions

Many companies are now setting up committees or task forces to deal with the issue. The problem cannot be left up to the "techies" to solve; the problem affects everyone in the company. Buy-in from senior management is critical. Management may get too ambitious and demand that other upgrades occur at the same time. Often this is a mistake because many of these are significant projects in their own right. However, unlike these others, the year-2000 problem has a "no excuses," fixed deadline that cannot be moved.

Exactly how to use outside consultants is hotly debated. Much of program analysis is boring grunt work involving combing through archaic code. Some companies feel the expertise needed is too specialized and may never be used again. Why not let staff experts concentrate on issues of greater strategic importance? Retirees would make great consultants on the project because of the nature of the languages. Others very strongly believe that it is a mistake to move the fate of the company into outside hands. In any case, testing and verification must be done in-

house by employees. It cannot be outsourced.

Once the problem areas have been identified and a plan of action put in place, solutions follow three broad approaches: upgrade, repair, or replace.

- **Upgrade.** Vendors should be contacted to determine their policy on upgrades. They may have new tools or special features that minimize the problem. However, converting specialized changes or modifications unique to the company generally goes beyond the scope of vendor assistance.
- **Repair.** This is, by far, the most likely choice for most legacy systems. Fixing these systems will require the utilization of people and resources that would otherwise be available for other projects. Questions that need to be answered early on are who developed the program, what language was it written in, and who is around who understands it.
- **Replace.** It may be better to scrap the whole system and re-engineer the process or redesign the application. However, it normally takes at least two years to bring in any large new system. Some systems are scheduled for obsolescence before the year 2000, but there is no certainty they will be replaced. In such cases, repairing existing systems is not wasted effort, it may instead be the prudent choice.

A large part of the challenge is effective communication. It is very useful to have a documented conversion plan and to understand how it interacts with other business priorities. Impact analysis should identify the most critical issues. PC-based systems, such as sales or illustration spreadsheets with many macros, may give rise to big headaches. An innovative communication approach being used by at least one insurance company is to hire a communication manager or other staff members with specialized skills to periodically communicate progress through the corporate intranet system.

Special Considerations

There are several areas where insurers need to pay particular attention:

- **Acquired Companies.** Ongoing consolidation within the insurance industry is creating conglomerate opera-

tions that formerly represented two, three, or more insurance companies or administration systems. Large segments of these former systems survive and run in parallel to the original company systems. Any solution will have to address not only the company's own systems but those inherited through acquisitions.

- **Future Acquisition Targets.** As to due diligence investigations of target companies, the acquiring company should investigate the target company's year-2000 compliance status. Some companies may decide to sell divisions or subsidiaries before the year 2000 because it would cost more to make the division or subsidiary year-2000 compliant than its net revenues could justify. The acquiring company should make this same analysis and either reserve the right to adjust the purchase price to reflect this year-2000 compliance or reserve the right to "walk" in the event the acquiring company's estimate of the year-2000 compliance cost exceeds a pre-agreed minimum.
- **Reinsurance.** Much business is either ceded or acquired from other insurers. Solutions to the year-2000 problems need to include examination of reinsurance operations, including how policy data are transmitted, received, and processed.
- **Strategic Alliances.** Many types of strategic alliances are in place with insurance companies or other entities for a variety of reasons such as ownership restrictions, market entry, distribution, product development expertise, third-party policy administration, claims adjudication, or investment operations. These strategic alliances may be key elements of the operation and should not be ignored.
- **Group Life and Health.** Group health-claim systems often include annual maximum limitations and will reject payment dates deemed

continued on page 8, column 1

Year 2000 Clock Is Ticking

continued from page 7

more than one year old. Often, health claim information is supplied in electronic form directly from the participating hospital or dentist. Given government cuts in health care, it is unlikely that hospitals have an abundance of funds for any purpose, let alone for the purpose of helping an insurer maintain accurate records. Weekly indemnity or long-term-disability payments have date-sensitive fields, including start dates and expiry dates.

- **“Obsolete” Systems.** The big problem in a comprehensive plan is identifying all the affected systems. More often than not, programs declared obsolete or no longer centrally maintained continue to be used for vital functions.
- **Data Uploads and Downloads.** As to the “obsolete” systems dilemma, many companies have numerous data extracts that are processed or analyzed further on PC systems. It will be little comfort to know that these systems can handle four-digit dates if the only dates it receives are in two-digit format. Also, there are few standards with respect to order of dates. What does a report dated 01/02/03 represent? January 2, 2003; February 1, 2003; February 3, 2001; March 2, 2001; or something else?
- **Projection Programs.** Many corporate planning, valuation, and projection programs determine results for several quarters or even years into the future. In many cases, these projections must include the effects of compound interest. Elements such as investment income, cash values, statutory reserves, and tax calculations may “blow up” or turn negative for no apparent reason. Even if a year-2000 problem is suspected as the problem, it does not tell us where it originated—corporate planning systems are the conglomerate result of many “feeds” from other lines of business. Projections systems may not affect retail transactions, but they are too critical to ignore.
- **Disclosure.** Companies with significant year-2000 problems may be reluctant to talk about the magnitude of their year-2000 corrective work for fear of providing damaging information to future plaintiffs in the event

the year-2000 problems are not corrected in time. However, companies may not be able to safely hide their year-2000 problems because disclosure may be required under various accounting standards, securities laws, and regulatory examination policies. For example, one of the GAAP principles promulgated by both the CICA in Canada and the FASB in the U.S. provides that contingencies that are reasonably possible, whether or not the amount can be calculated or estimated, must be disclosed in a note to the financial statements.

- **Accounting.** The financial impact of the problem is exacerbated by the recommendation of the Emerging Issues Task Force of the Financial Accounting Standards Board. It recommends treating year-2000 expenditures as current-year expenses rather than amortized costs. This hotly argued recommendation will have a direct impact on the bottom line and give rise to additional volatility in company ratings or stock prices.
- **Regulators.** The Office of the Superintendent of Financial Institutions (OSFI), the regulator of federally licensed insurance companies in Canada, has requested effective December 31, 1996 that company actuaries, in their annual Appointed Actuary reports, address the issue of how the actuary’s work is affected by the year-2000 problem. Any problem areas need to be highlighted and a plan of action should be recommended.
- **Audit Issues.** Prior to January 1, 2000, a company’s independent accountants or auditors may feel obliged in their audit of the company’s financial statements to examine the likelihood of the company’s failure to become year-2000 compliant in time. One major accounting firm in Britain has already announced that British companies that do not have a viable year-2000 plan in place may receive a qualified statement. Auditors may wish to document their assessment of the year-2000 disclosures by their clients in order to show compliance with applicable audit standards.
- **Director and Officer Liability.** The possibility of personal liability is usually very effective in moving man-

agement away from any inaction or attitude of serene complacency. Corporate law typically imposes standards of care on the company’s managers and directors which could be breached if they are negligent in dealing with the year-2000 problem, resulting in potential personal liability for the directors. If a company fails to adequately disclose its year-2000 problem in its annual report and subsequently has to shut down its business because of the problem or otherwise experiences substantial operational difficulties, shareholder and policyholder suits are likely to follow. Policyholders may launch class-action suits alleging fraud, breaches of contract, or failure to perform services. In the event of liquidation, other suits will follow from creditors, employees, other investors, reinsurers, or guaranty institutions such as CompCorp. One defense can be reliance on the reports of the company’s officers and third-party experts in the course of making corporate decisions. It would be useful to be able to produce detailed documentation as to the company’s year-2000 corrective plan and the diligence with which it was pursued.

- **Business Interruption Insurance.** Insurance policies which cover “business interruption” claims (such as property/casualty policies) usually require that the business interruption result from a “fortuitous event.” It will be argued that because the year-2000 problem has been well known for years and is totally within the control of the insured to correct, it does not qualify as a “fortuitous” event. Property/casualty insurers issuing business interruption insurance may decide to highlight the year-2000 problem in an insert or letter to their insureds in the next year or two in

continued on page 9, column 1

Year 2000 Clock Is Ticking*continued from page 8*

order to be able to establish conclusively that their insureds are aware of the issue. Alternatively, they may not renew the policy or choose to exclude this as a covered event.

- **Millennium Insurance.** Where some see problems, others only see opportunities. Millennium insurance is available through the Minet group and AIG. AIG policies come with limits of liability up to \$100 million (U.S.). The policy term runs from issue until January 1, 2001. Premiums will be based on a company's circumstances but will range from 60% to 80% of the limit. In some cases there may be a rebate if no claim is made. However, without realistic year-2000 plans in place, companies will be unable to get accepted for this coverage.
- **Other Priorities.** All insurance companies must deal with the issue of limited resources. Management must exercise patience when

ambitious plans for critical projects (growth through acquisitions, fixing "vanishing premium" problems, demutualization, strategic alliances with banks, new insurance products, Internet marketing, or disaster recovery) must be put on hold. While management may initially balk at this, what can be more critical than the survival of the company?

- **International Business.** In South America, Europe, and parts of Asia, the year-2000 problem has not been getting the same level of attention as it has in North America, but the deadline is the same. Insurance companies operating outside North America need to be particularly concerned about their policyholders, suppliers, and reinsurers in other parts of the world.

Conclusion

Here are some suggestions for surviving the first few weeks following January 1, 2000:

- Be careful not to book a flight on planes that are 99 years overdue for maintenance
- Do not make any long distance phone calls after New Year's Eve or you may get charged for millions of minutes
- Be careful with credit card statements that show 100 years of overdue interest charges
- Brokers, take a good look at your come sliod statements

The Gap in SOP 95-1

continued from page 9

them was designed to produce roughly the same effect. More conventionally, the accounting model used for these contracts, and promulgated through FAS 97, is described as the "retrospective-deposit approach." Under this approach, the insurance contract is accounted for as a savings account, with periodic deductions made for services rendered. Profits are recognized as services rendered. That is, margins in the mortality and expense charges are recognized as those charges are deducted from the accumulated policyholder account balance. Additional profits are recognized as the interest credited to the policyholder account balance is less than the interest deemed to be earned through the investment of that balance.

If the profit loadings are somewhat level (that is, mortality charges set to produce a level annual loss ratio, expense charges effectively equal to grossed-up direct expenses, and a level spread between earned and credited interest), the result of the retrospective deposit approach would be nearly the same as the "full-release-from-risk" method described earlier. As we know, the pricing structures of these contracts are clearly much more complex and in only the simple case can a reasonable comparison be made to the FAS 60 accounting model.

Acquisition costs (or at least those which are deferrable) are recognized in proportion to the profits as they emerge. In fact, all nonlevel charges are spread over the life of the contract in proportion to the gross profits (as defined in the standard). Barring significant changes in the expectation of the future, profits will emerge from these contracts as the services are provided, that is, as mortality charges are assessed or interest is credited, for example.

Recently the accounting community took up the challenge of accounting for perhaps the oldest version of the life insurance contract known to the industry—the traditional participating life insurance contract. The evaluation of this type of contract led to the conclusion that it contained elements of both traditional and nontraditional (universal life) life insurance contracts. The result of these deliberations was the accounting model described in SOP 95-1. The accounting model includes elements of the accounting models in use for both traditional and universal life insurance contracts.

The determination of benefit reserves and the amortization of DAC are borrowed from the model used in FAS 97. But because there is not a policyholder account balance, a practical expedient has been developed. In theory, the benefit reserve should have been the amount assumed to be the policyholder's interest in the contract. This would have been the "dividend fund" or, in other words, the amount of assets accumulated under the contract which supports the amount of the dividend which is paid. As a practical expedient, SOP 95-1 uses a net level premium reserve based on assumptions underlying the contract's nonforfeiture values. This amount is both readily calculated and easily audited. Acquisition costs are deferred and amortized against the "gross margins" developed through the operation of the contract.

This is all comparable to the FAS 97 model, although the benefit reserve, as calculated, bears some similarity to the

"I believe the SOP 95-1 approach is not a combination of the FAS 60 and FAS 97 models, but rather a completely new model with new problems, because of the treatment of acquisition costs."

FAS 60 benefit reserve. In both instances, a net level premium method is used in the calculation with the only difference, albeit substantive, being the breadth of the underlying assumptions and their relative conservatism. The principal aspects of the FAS 60 used in the SOP 95-1 model are those related to income statement presentation, where premiums and benefits are fully recorded. Under the FAS 97 model, only the excess (or underage in the case of surrenders) of paid benefits in comparison to the account balance is recognized as an expense (or income). Premiums are simply deposits into a liability account.

I believe the SOP 95-1 approach is not a combination of the FAS 60 and FAS 97 models, but rather a completely new model with new problems, because of the treatment of acquisition costs. Mutual insurance companies develop dividend scales based on the concept of equity, using the contributions principle. (In fact, this is a requirement for the applicability of SOP 95-1 treatment.) Additional considerations, of course, bear on the

final determination. The application of this contributions principle requires consideration of the acquisition costs. Some provision for the recovery of acquisition costs must be made in the dividend scale. This could be done through the use of an asset-share approach to establishing dividend scales. In this case, the acquisition costs would be charged immediately against the dividend funds and perhaps no dividends would be paid until the dividend fund exceeded zero. Alternatively, and perhaps more commonly, acquisition costs are considered to be spread over the early years of the contract in some pattern. In either case, the treatment of acquisition costs has a bearing on the pattern of gross margins the contract develops, as those margins are defined in SOP 95-1.

The dividends payable according to the dividend fund represent margins before acquisitions expenses, less a provision to recover acquisition expenses. The SOP 95-1 gross margins are before deferrable acquisition expenses but after dividends. Therefore, the SOP 95-1 gross margins are after the dividend scale provision to recover acquisition costs. The difference between the provision to recover acquisition expenses that is used in the dividend scale formulation

and the amortization pattern of DAC required by SOP 95-1 creates the issue. Neither FAS 60 nor the FAS 97 accounting model includes acquisition expenses in the amortization basis established. SOP 95-1 does, although perhaps inadvertently.

Figure 1 on page 11 illustrates the effect of this "double counting" of DAC.

To develop the figure, we used a traditional whole life insurance contract, but assumed that everyone died in the twentieth year, to keep it simple. We developed gross margins (as defined by SOP 95-1) before dividends and then

continued on page 11, column 1

The Gap in SOP 95-1

continued from page 10

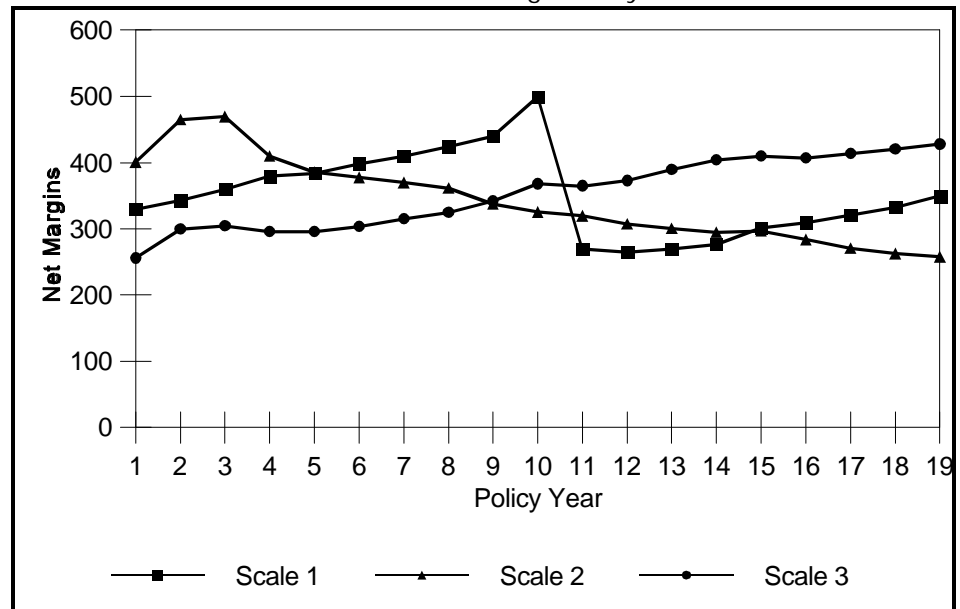
went on to develop representative dividend scales. To develop the dividend scales, we assumed dividends would represent a level portion of cumulative gross margins after unamortized (dividend scale) acquisition costs and an annual permanent contribution to surplus. The three patterns of resulting "net income" are developed by comparing three alternative patterns of recognizing acquisition costs in the dividend scale. The three patterns are:

- *Scale 1:* Acquisition costs are charged to gross margins in straight line over the first 10 contract years.
- *Scale 2:* Acquisition costs are charged over the life of the contracts relative to gross premiums. This is effectively the *FAS 60* method of recognizing acquisition costs.
- *Scale 3:* Acquisition costs are charged over the life of the contracts relative to gross margins before dividends, as defined by *SOP 95-1*.

I am not making any representations about the reasonableness of the dividend scales we developed. However, each treatment of acquisition costs seemed theoretically reasonable. I have not considered the competitive environment or, perhaps more importantly, taxes, among all the other complex inputs into this process. The amounts shown in the figure and labeled "net margins" are simply *SOP 95-1* gross margins after the amortization of acquisition costs (therefore, they are not "net income" in the conventional sense.)

A

FIGURE 1
SOP 95-1 Net Margin Analysis



comparison of the three scales illustrates the issue I have been describing concerning *SOP 95-1*. Scale 3 represents a relatively conventional pattern of "net income." On the other hand, Scale 1, with its downward spike in the tenth year, and Scale 2, with its overall downward trend, are rather unconventional and, in my mind, undesirable. Both are front-ending earnings relative to Scale 3. At the same time, Scales 1 and 2 are based on more conservative methods of recovering acquisition costs.

What is the lesson? I am not sure. I would not recommend that mutual life insurance companies change the way they recover acquisition costs to be consistent with the approach promulgated for their accounting by *SOP 95-1*. It is

also rather late to be taking pot shots at an existing accounting pronouncement. I suppose I hope the outcome will be a chance to consider this issue as the accounting for insurance contracts evolves, as I am sure it will. Further, as the international insurance community discusses the accounting model used in international accounting standards, perhaps it will incorporate some of these thoughts into its deliberations.

David Y. Rogers, FSA, is an actuary and partner at Price Waterhouse LLP, New York, New York. He wishes to thank Charlie Linn, FSA, a manager in the Price Waterhouse Insurance Software Division, for generating the data underlying the figure.

A Call for Papers

Actuaries are invited to submit papers for possible publication in the *Journal of Actuarial Practice*, an international refereed journal. Papers may be on any subject related to actuarial science or insurance; they do not have to contain original ideas. Preference will be given to those papers intended to educate actuaries on the methodologies, techniques, or ideas used (or can be used) in current actuarial practice. The journal also accepts technical papers, commentaries, and book reviews. However, all articles must have some relevance to actuarial practice.

Please send an abstract of the paper by Friday, May 1, 1998 and five (5) copies of the completed paper by Friday, June 19, 1998 to:

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Visual CARVM: Multiple-Benefit Streams in Pictures

by James E. Backus

In the early 1980s, when revisions to the NAIC Valuation Law requiring CARVM for deferred annuities were implemented, the only significant benefits provided by most deferred annuities were surrender values and annuitization, and the policyholder's most important choice was when to surrender. The primary problems that CARVM addressed were the promises of declining surrender charges and crediting rates higher than could be supported by safe investments, unless policies were held to maturity. Even in that simpler environment, complexity was a major stumbling block because of CARVM's requirement to value each possible benefit stream.

Since then, so-called ancillary benefits have become more important. Guaranteed purchase rates that once were cheap have become more expensive as interest rates have fallen and mortality has improved. Death benefits in variable annuities may involve material mortality risk when share prices are depressed. Benefits are now provided for such contingencies as nursing home admission, disability, and financial hardship. Additional elective benefits, such as free partial withdrawals and return-of-premium guarantees, have also been developed. In this new environment, CARVM valuation of multiple-benefit streams has become much more difficult not only to perform, but also to understand.

Pending revisions to *Actuarial Guideline 33*, new *Guideline 34*, and proposed *Guideline ZZZ*, describe how to apply CARVM to newer products. They formalize the distinction between elective and nonelective benefits on which many companies justified their valuation of an-

cially benefits. They state the requirement that the valuation process must consider, if not explicitly determine, the present value of *any benefit stream, including so-called integrated benefit streams*. The guidelines rely on words to get their requirements across, and working papers used in developing the guidelines include tables showing detailed sample calculations.

This article provides a way to visualize the valuation of multiple-benefit streams that appears to be consistent with the intent of CARVM and the guidelines, and which may be easier to understand and communicate. This may not be the only way to apply CARVM to multiple-benefit streams, but it is a useful way to think about CARVM.

In all of the examples that follow, we will assume that:

- Guaranteed interest rates are 7% in year 1, 5% in year 2, and 3% thereafter
- Surrender charges start at 3% and decline 1% per year until zero
- Contract matures at the end of year 4

- Plan Type A valuation rate for death benefits and annuitization is 6.5%
- Plan Type C valuation rate for cash-surrender benefits and the maturity benefit is 5.5%.

Let's first consider a simple annuity design—a single-premium fixed deferred annuity without annuity purchase rate guarantees. For this product, the policyholder has only to choose each year whether to surrender the policy early or hold it for an additional year. The typical CARVM valuation is presented in Table 1. The CARVM reserve is the highest value in the last column, or \$989.22.

This method breaks down when more complicated options are considered. Let's assume that an additional elective benefit is added to the contract, a penalty-free withdrawal (PFW) of

continued on page 13, column 1

TABLE 1

End of Policy Year	Account Value	Surrender Value	PV of Surrender Value
0	\$1,000.00	\$ 970.00	\$970.00
1	1,070.00	1,037.90	983.79
2	1,123.50	1,101.03	989.22
3	1,157.21	1,145.64	975.64
4	1,191.93	1,191.93	962.15

TABLE 2

End of Policy Year	Undecremented Account Value	Undecremented Surrender Value	PV of Surrender Value	Adjusted Account Value	Adjusted Surrender Value	PV of Current PFW and Later Surrender
0	\$1,000.00	\$ 970.00	\$970.00	\$800.00	\$776.00	\$976.00
1	1,070.00	1,037.90	983.79	856.00	830.32	987.03
2	1,123.50	1,101.03	989.22	898.80	880.82	991.38
3	1,157.21	1,145.64	975.64	925.77	916.51	980.51
4	1,191.93	1,191.93	962.15	953.54	953.54	969.72

Visual CARVM

continued from page 12

20% each year. How can we value this? We could try adding additional columns, as in Table 2 on page 12. These new columns reflect the result when the policyholder uses the PFW only once to immediately withdraw \$200, and then elects the "worst case" (or best case, from the policyholder's viewpoint) electc 05 c3ll Tj9 186 0 c 0erstapoldes 0.0471 Twderns reflscyioners probably use tg aing a pPFW,.10 Tc 0(97 Tc4p

account using CARVM as written, but most practitioners probably use this approach.

Figure 1 does not really help to understand the valuation. On the other hand, Figure 2 on page 14, although cumbersome, provides a very clear picture of

tree for this product by noting that at each step, the future reserve potential, following a PFW, will equal 80% of the reserve potential following an otherwise similar node that excludes the PFW [3]. For example, at time 1, the node for valuing a PFW has a value of \$994.21, which is the

Figure 1
Deferred Annuity without PFW, Annuitization, or Death Benefit

This chart not available online. Please contact Susan Martz at smartz@soa.org for a hard copy.

FIGURE 2
Deferred Annuity with PFW

(This chart not available online. Please contact Susan Martz at smartz@soa.org for a hard copy.)

Visual CARVM

continued from page 13

the account value, and that the mortality rate is 0.1% each year. (The 105% is arbitrary and serves to clarify the changes in the example.) The multiple-benefit stream, or integrated-benefit stream approach, may be stated as follows:

The CARVM reserve potential at any node is the sum of (a) the nonelective decrement rate times the nonelective benefit amount, plus (b) (one minus the non-elective decrement rate) times the largest of the elective benefit CARVM reserves at the subsidiary nodes [5].

Figure 4 shows the results of this calculation for our new product. Note that the rates used above are the result of application of the current decrement rate (for example q_{x+t}) and not the cumulative impact $(_{t-1}p_x \times q_{x+t})$. [6]

This approach may be generalized to the following:

The CARVM reserve potential at any node is the sum of (a) the sum over all nonelective benefits of each decrement rate times its corresponding nonelective benefit amount; plus (b) [one minus the sum of all non-elective decrement rates] times the largest of the elective benefit CARVM reserves at the subsidiary nodes [7].

Figure 5 shows this approach if we add an additional elective benefit (annuitization worth 97.98% of the account value [8]), and an additional non-elective benefit (waiver of surrender charge on nursing home admission, which has a probability of 1%).

Part (a) in the formula above is the present value of nonelective benefits at each node. In part (b), the sum over all

nonelective benefits of the decrement rate replaces the single nonelective decrement rate above, and the choice of the largest elective benefit is the typical implementation of CARVM without integrated benefit streams.

It is possible to still further simplify Figure 5. Table 3 shows two sets of intermediate calculations:

- The first line of italicized values shows the total present value of all nonelective benefits (death or nursing home admission) at each node.
- The second line of italicized values shows the present value of the largest available elective benefit (surrender, annuitization, and/or maturity).

These intermediate results permit us to represent the same valuation process

continued on page 18, column 1

TABLE 3
Largest Elective Benefit, Value of Nonelective Benefits, and Reserve Potentials

Policy Duration	0	1	2	3	4
Decrement Rates					
Mortality	0.00%	0.10%	0.10%	0.10%	0.10%
Nursing Home Admission	0.00	1.00	1.00	1.00	1.00
Combined Decrement Rate	0.00	1.10	1.10	1.10	1.10
Survivorship	100.00	98.90	98.90	98.90	98.90
Discount Factors					
Plan Type A Valuation Rate 1-5	1.000000	0.938967	0.881659	0.827849	0.777323
Plan Type C Valuation Rate 1-5	1.000000	0.947867	0.898452	0.851614	0.807217
Undecremented Account Value	1,000.00	1,070.00	1,123.50	1,157.21	1,191.93
Nonelective Benefits					
Expected-Death Benefit		1.1235	1.1797	1.2151	1.2515
Present Value of Death Benefit		1.0549	1.0401	1.0059	0.9728
Expected Nursing Home Benefit		10.7000	11.2350	11.5721	11.9193
Present Value of Nursing Home Benefit		10.0469	9.9054	9.5800	9.2651
Present Value of Nonelective Benefits		11.1019	10.9455	10.5858	10.2380
Elective Benefits					
Annuity Value Factor		0.9798	0.9798	0.9798	0.9798
Current Annuitization Value		1,048.43	1,100.85	1,133.88	1,167.90
Present Value of Annuitization		984.44	970.58	938.69	907.84
Current Surrender Benefit	970.00	1,037.90	1,101.03	1,145.64	1,191.93
Present Value of Surrender Benefit	970.00	983.79	989.22	975.64	962.15
Largest Present Value of Elective Benefits	970.00	984.44	989.22	975.64	962.15
PV of Penalty-Free Withdrawal Available	0.00	202.84	201.88	197.10	192.43
PV of Continuation with Balance		787.55	791.38	780.51	769.72
Largest Present Value if PFW Higher	994.23	994.22	982.39	966.82	942.43
Reserve Calculation	994.39	994.23	982.17	966.42	962.15

Visual CARVM

continued from page 16

in Figure 6, a simplified version that reproduces the reserve development of Figure 5. Figure 6 shows that this structure is, in fact, general enough to handle most currently annuity designs. The valuation framework depicted there does not depend on whether one benefit or many is being considered at each node [9]. This suggests an additional benefit of the visual CARVM approach:

- The calculation of the reserve has been further modularized, so that three steps can be performed more or less independently at each node
 - Valuation of all nonelective benefits in the aggregate
 - Valuation of each elective benefit and determination of the largest
 - Logical combination of the above values in the reserve calculation.

The valuation of each possible benefit will require determination of the dynamic valuation rate using the plan type and guarantee duration appropriate for the benefit types and payment dates any, for each benefit, an appropriate valuation

that is, a development for valuing the reserve process is, we, were cut.6

T is approach brings to mind possession

dynamic rate provision of the SVL, were

valuation hinges in the rate of the formulae the value used at each node

that is, is derived from (age) Tj90 -10.8 TD -0.8972 Tc 0.3483 Tw periods, m (using theme the most similar) TjT*D -01.474 Tc 0.0555 Tw (then that used in operation picmg [10], oh pe from CARVM-style valuations is

taking those additional steps is neither feasible nor desirable

Unfortunately, this is no free lunch, not even a cheap lunch. The techniques described above help to understand and communicate CARVM requirements in a user-friendly way and lend themselves naturally to recursive computer calculations. Unfortunately, for some products, actually diagramming for more than a few years is impractical, because the resulting

company permits complete surrender following partial surrender without re-applying the surrender charge to the partial withdrawal (or equivalently, the company always applies (1-max PFW) times the scheduled surrender charge, the most straightforward way to handle this is by adjusting the calculation of the surrender benefit at each node.

existence of an enhanced nonelective benefit and may, in fact, decrease reserves for some products such as those guaranteeing a high rate of interest for many years relative to a calculation that ignores nonelective decrements and assumes that all policyholders will be around in those later years to collect under the guarantees.

aries may wish to consider the extent to which persons actually admitted to the plan because the corresponding benefit and the effect of subsequent events and is clear that the plan is in conjunction with the benefits available. In practice, this is probably not a realistic

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Visual CARVM*continued from page 18*

surrender, present value of continuation, and the value of [enhanced benefit value plus (1-election rate) times the larger of surrender and continuation] for each type of partial-benefit election.

10. That technique does not generally work with the dynamic valuation spot rates since, for example, the death benefits, annuitization benefits, and surrender benefits available at a subsequent node must potentially each be valued using different valuation rates. An additional problem (although somewhat more manageable) is that forward rates implied in the SVL's dynamic rate provisions are probably often negative. This was done to produce a greater degree of conservatism for benefits payable in the more distant future, but does not integrate well with a normal, positively sloped yield curve.
11. If each possibility progressed to terminate at the maturity date, the number of terminal nodes would be c^y , where c is the number of possibilities and y is the number of years to maturity. In general, the number of nodes will be much lower because many nodes are "dead ends," for example, following death, annuitization, or complete surrender, further projection is unnecessary.

Author's Note: *Coming soon: Visual CARVM Release 2.0: Diagrams for a New Guideline.*

James E. Backus, FSA, is Consulting Actuary with TransAmerica Reinsurance, Charlotte, North Carolina.

Improving Monte Carlo Modeling with Low Discrepancy Sequences—A Test

by G. Thomas Mitchell

Monte Carlo simulation is a powerful, robust tool for evaluation of financial risk problems. In theory, almost any complex model can be evaluated by running many random scenarios and observing the resulting statistics.

The scenarios are typically generated using a standard random number generator. These are, strictly speaking, pseudo-random numbers because they are deterministic.

Is there a better way to choose scenarios?

Intuitively, random numbers are like throwing darts at a board. As one throws more and more darts, some will inevitably land very near a previous toss. Likewise, small patches without any darts will be present at any stage of throwing. As the number of darts increases, there is an increasingly "wasteful" nature to the random process.

A mathematical measure of the uniformity of the darts is termed "discrepancy." Precise definitions vary, but it basically measures the biggest surplus or deficit of actual versus expected "darts" in any neighborhood on the "dart board."

"Low discrepancy series" (LDS) are attempts to construct series of scenarios that minimize discrepancy. Irwin Vanderhoof has expounded on the idea several times in *Contingencies* magazine [1]. The idea is in active use by investment houses in pricing derivatives, CMOs, and other complex financial instruments.

I worked on finding out for myself whether this stuff really works for actuarial problems, starting from scratch with publicly available information (yes, there is some intrigue in this field!). I will work through a real life, only slightly simplified, example and let you judge for yourself.

For LDS work, the Monte Carlo method is usually viewed in a rather formal way:

- We wish to estimate the value of a function (or some statistic of a

function) over a space of possibilities, involving many, say " n " variables.

- This is equivalent to a calculus integration problem.
- We can standardize the problem by normalizing each of the n variables to a uniform distribution over the range 0 to 1.
- This defines the space of possibilities as an n -dimensional unit hyper cube.
- The function is to be integrated over the cube.
- Choosing scenarios is equivalent to choosing points within the cube.
- One hopes for rapid convergence to the answer, if for various size neighborhoods in the cube, the worst deviations of actual numbers of points versus expected based on a uniform distribution are minimized.

Most LDS techniques choose points using number theory, making use of prime numbers, powers of prime numbers, modulo arithmetic, and combinatorial mathematics. Several basic recipes exist, with many variations on each.

Results are deterministic. Typical pseudo-random number generators are also deterministic, but behave mostly as if truly random.

I tested the conventional and LDS approaches on an example complex enough to approach a real life actuarial question, but simple enough that I can document it for you.

Test Problem

Evaluate the present value of profits of a variable annuity death benefit provision, as a percentage of the single premium for the policy. Benefits are death benefits in excess of the account balance. Minimum death-benefits charges are 10 basis points on account balances.

continued on page 20, column 1

Monte Carlo Modeling

continued from page 19

The minimum-death benefit is return of the single premium, reset at the end of every third policy anniversary before age 80 to the greater of the account balance or the previous minimum. Benefit expires at age 85. Because of the reset feature, the benefit is highly path-dependent.

New policy with a \$1.00 single premium, no front load, sold to a 55-year-old male, exhibiting 75–80 male ultimate mortality, and with a 7% lapse rate. Present values at 8%.

The net returns on the account balance are figured at the stock market return less total fees and charges of 1.75%. The stock market model is an annual lognormal model for 30 years, assuming straight-line results within a year, base gross return of 8% and volatility of 16%.

Old Approach

A total of 10,000 pseudo-random sets of 30 numbers were generated using the Excel random number generator.

The running-average profit figure for the first k scenarios, as k moves from 100 to 10,000 by increments of 100, is plotted as the dotted line in Figure 1. The conventional approach converging rather slowly over 10,000 scenarios.

New Approach

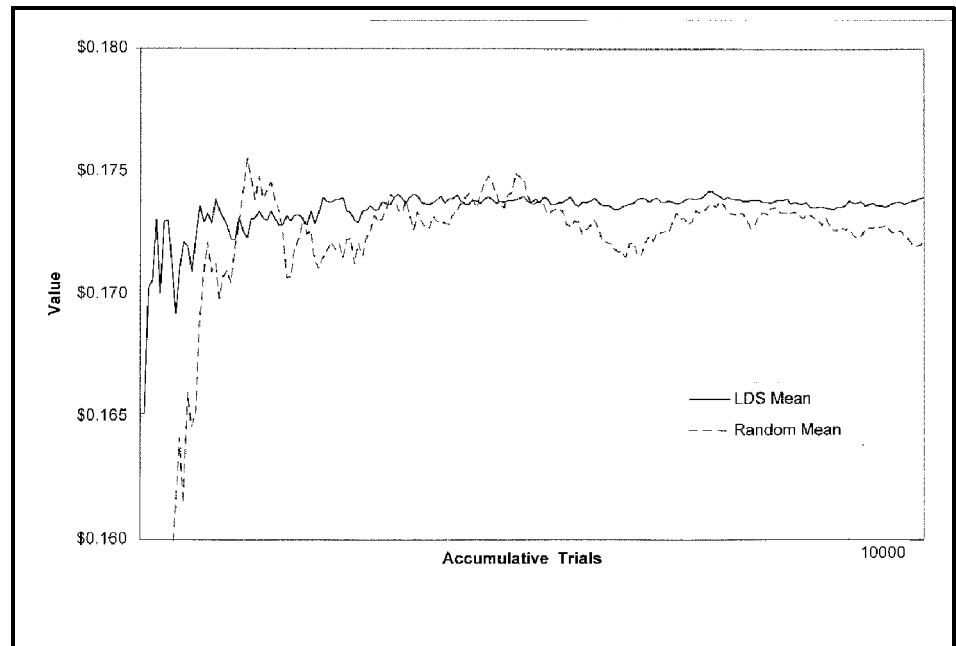
Each scenario requires 30 random numbers. In LDS terms, therefore, the problem is of dimension 30. A sequence of 10,000 sets of 30 numbers were constructed as indicated below.

I devised my own LDS generator. It uses generalized Faure points, along lines laid out by Vanderhoof. In general terms:

1. Choose a prime number p slightly greater than the number of dimensions.
2. Choose a starting "serial" number, incrementing it for each subsequent point.
3. Express the serial number as an "inverted" decimal in base p .
4. Multiply combinational numbers times each digit of the inverted decimal, to get n new inverted decimals.
5. Choose another number $q < n$ wisely.
6. Multiply the digits from step 4 by powers of q modulo p to get n final inverted decimals for the final point.

The recipe, for sufficiently many points, passes various statistical tests for

FIGURE 1
LDS versus Randoms



bias. I also looked at slices of the hyper cube—that is, plotting points on various pairs of the n dimensions. The results show excellent overall distribution over the resulting unit square, but with a regular small-scale lattice of patterns typical of LDSs. See Figure 2, showing both a good cross section, and Figure 3, one still in progress towards being a good one after 400 points.

Comparison

The solid line on Figure 1 shows the running average figures for the new LDS approach. You can quickly see the substantially faster convergence.

To get a more quantitative view, let us analyze the standard deviations of the present value of profits in the two approaches. For the randoms, the standard deviation over 10,000 runs is \$0.00199. Table 1 also shows the standard deviations arrived at by grouping runs and comparing the groups. For example, group into 40 groups of 250 each, and look at the standard deviation over the 40 groups.

Because of the random approach and assuming the underlying distribution of the value of profits is not overly bizarre, we can estimate the standard deviation for any size grouping. In other words, the variations *within* a grouping and *among* groups are "cut out of the same cloth."

For the LDS approach, the standard deviation over 10,000 runs is a similar \$0.00196, as we would hope. Unlike the

random, however, we *cannot* generalize from this to estimate other size groupings or variation within groupings. When we look at the 10 groups of 1,000, the LDS standard deviation among groupings is only \$0.0016, versus \$0.0043 for randoms.

The conventional approach converges in proportion to the square root of the number of scenarios. One extra significant digit in the answer requires 100 times as many scenarios.

With LDSs, the convergence can be much faster. In this case, an LDS run of 93 is equivalent to about 620 randoms, a speed-up of 7. Approximately 930 LDSs are equivalent to about 32,000 randoms—34 times. Table 2 summarizes the speed-up results, and Figure 4 shows them graphically. (For the curious: the LDSs for the test are based heavily on the prime number 31—as a consequence, sequences that are multiples of 31 tend to converge faster than for other measuring multiples).

continued on page 21, column 1

Monte Carlo Modeling

continued from page 20

Benefits

Primarily, speed-ups from LDSs can benefit either by decreasing computation time or by achieving better results in the same time.

There are other benefits. For example, if I want to look at the tail of the distribution, the fluctuations in the sample points for the tail will be less than for randoms. If I run 1,000 points and look at the 1% tail, I hope for 10 points. For randoms, this is plus or minus about six points, with 95% confidence, a 60% potential deviation. For LDSs, it depends on particulars, but the deviation will tend to be far less, and one has better expectations that those points may be "nicely" spaced out.

There are numerous tricks to squeeze more efficiency out of random points—antithetical variables, or stratified sampling, for example. Antithetical variables work nicely for estimating the mean but destroy information about the variance. In general, "tricks" either destroy information or are problem-specific.

Minuses

1. Computational overhead of LDSs.
2. Practitioner's learning curve.
3. LDS techniques are robust, but each application needs to be checked for possible unfortunate correlations in LDSs in relationship to the problem. One can concoct models for which LDS approaches perform poorly. For example, evaluation of a function that is very periodic (as the ocean's surface, for example) could spectacularly fail, if the periodicity of the function resonated with the periodicity of the LDSs.
4. A change in the number of dimensions of a problem forces recomputation of Faure LDSs. This is not the case for other techniques such as Sobol or Halton points.
5. For small number of scenarios, LDSs often perform poorly. Tom Ho's work on path spaces may provide a better tool for smaller runs.

continued on page 22, column 1

FIGURE 2
Cross Section of 403 Points—"Good" Mix

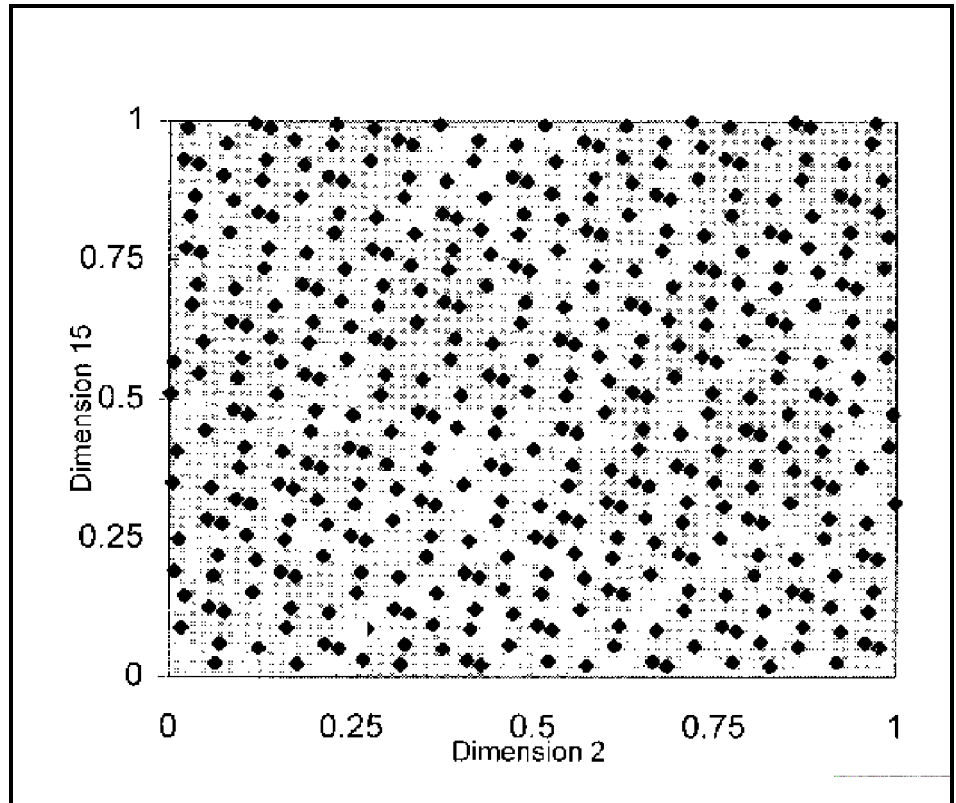
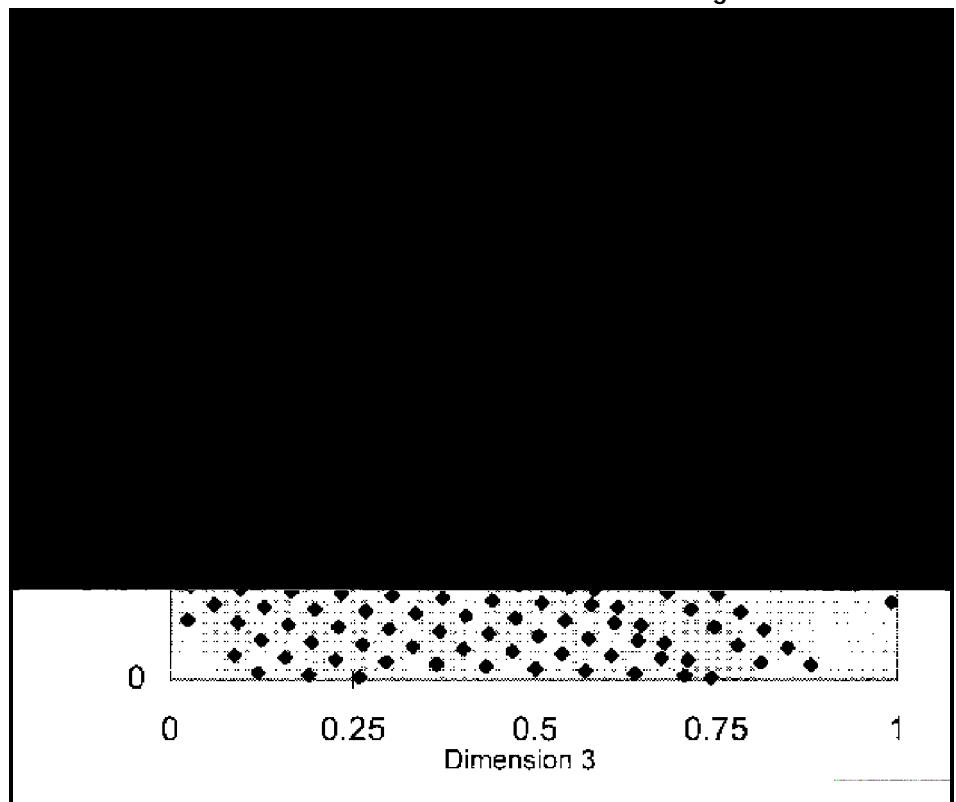


FIGURE 3
Cross Section of 403 Points—Mix Still in Progress



Monte Carlo Modeling
continued from page 21

6. LDSs are well proven through 360 dimensions and tested up to 1,000 dimensions, but uncharted in territory above that.

Conclusion

Our example indicates a speed-up of 7 to 34 times, depending on accuracy desired. The advantage accelerates as accuracy increases.

LDSs are, in general, proving to be unreasonably efficacious and robust for real-life financial problems.

LDSs already have a great impact on state-of-the-art calculation of values of derivatives and collateralized mortgage obligations. In my opinion, the techniques will prove to have a major impact on actuarial applications as well.

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Web sites with information:

- auroraconsulting.com/MonteCarlo by the author, for very general information
- sequences.com for sample sequences
- numerix.com for a multiple techniques approach to the subject
- cs.columbia.edu/~ap for Papageorgiou's work at Columbia University.

A web search shows many papers on the issue, most of them physics-

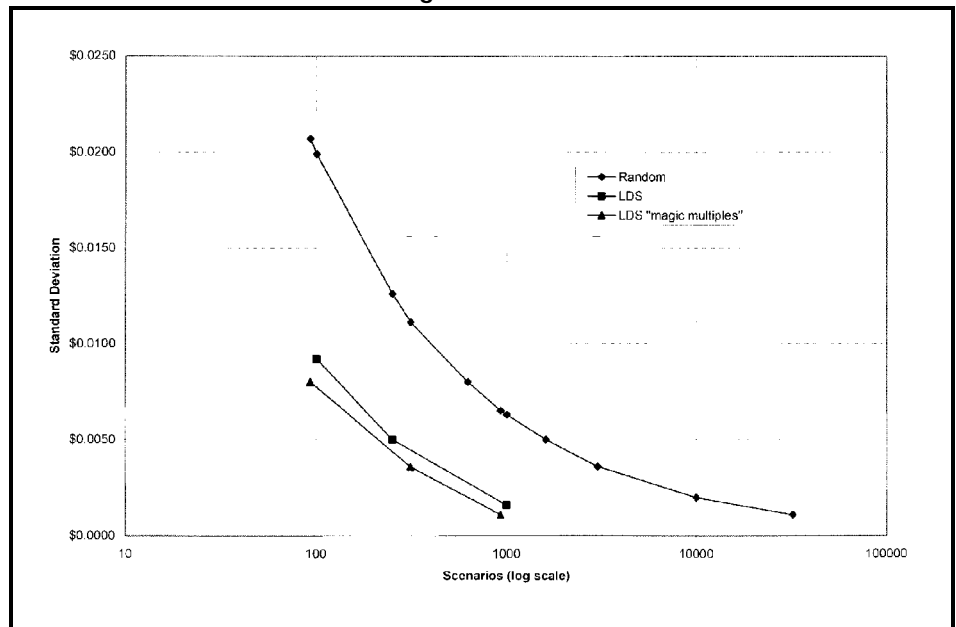
TABLE 1
Standard Deviation of Means

Group Size	Groups	Randoms		LDS
		Actual	Predicted	Actual
1	10,000	\$0.1994	\$0.1994	\$0.1965
93	107	0.0215	0.0207	0.0080
100	100	0.0227	0.0199	0.0092
250	40	0.0106	0.0126	0.0050
310	32	0.0105	0.0113	0.0036
620			0.0080	
930	10	0.0048	0.0065	0.0011
1,000	10	0.0043	0.0063	0.0016
1,600			0.0050	
3,000			0.0036	
10,000			0.0020	
32,000			0.0011	

TABLE 2
Scenarios

Standard Deviation	Randoms	LDS	Ratio
\$0.0080	620	93	7
0.0036	3,000	310	10
0.0011	32,000	930	34

FIGURE 4
Convergence to Answer



related, but many generic or financial oriented.

G. Thomas Mitchell, FSA is President, Aurora Consulting, Inc., St. Louis, Missouri and editor of The Financial Reporter. The author wishes to thank Ken

Seng Tan, ASA, University of Waterloo, Waterloo, ON, and Ken Klinger, FSA, CNA, Chicago, IL for their assistance in reviewing the article, and Faye Albert, FSA, Actuarial Investment Consulting, Miami, FL for earlier assistance in the research.

Highlights of the NAIC Life and Health Actuarial Task Force Meeting

by Raymond T. (Ted) Schlude

The NAIC Life and Health Actuarial Task Force (LHATF) met in December 1997 and discussed the following projects.

Annuity Working Group—Equity-Indexed Products (EIP)

The regulators reviewed the Final Report of the American Academy of Actuaries Equity-Indexed Products Task Force dated December 6, 1997.

Larry Gorski raised several issues regarding language in the reserving chapter, generally concerning ambiguity, which might be interpreted as permitting reserving methods that Larry believed should be explicitly forbidden. The EIP Task Force agreed to tighten up the language, and the revised language was incorporated into the final report. The three remaining acceptable methods are CARVM with Updated Market Values (CARVM-UMV), Market-Value Reserve Method (MVRM), and the Enhanced Discounted Intrinsic Method (EDIM). In order to use the MVRM and EDIM, certain criteria must exist including a policy form design that features a single dominant benefit, which is the most likely benefit to be provided and in the case of EDIM, satisfaction of the "hedged-as-required" criteria as well.

Discussion then shifted to other products that should fall into an EIP-type reserve method. These products were described as separate account products that are invested in equities or a clone-type equity index but contain a floor guarantee. An American Academy of Actuaries memorandum regarding variable products with guaranteed living benefits (either surrender, annuitization, or both) was discussed. There are also guarantee fund issues raised by such products, as one regulator noted.

The Final Report now includes language for equity-indexed life products as well. A presentation was made by the AAA regarding potential methodologies to be used for equity-indexed life products. All EIL products currently being issued have a UL-type chassis which reflects the reserving methods being discussed to date. Testing similar to that performed for annuity-reserving methods is in process.

The life reserve methods are:

- Implied Guaranteed Rate Method, similar to MVRM
- Updated Market Values with CRVM, similar to CARVM with UMV
- Modified CRVM: Reserves would reflect policy guarantees including the guaranteed participation rate for the initial term.

Because of annual premium payments in EIL products, designs introduced to date do not extend participation guarantees beyond one year. One regulator expressed a concern that companies might begin extending the participation guarantees. It was also noted that there are no single-premium EIL products in the market today. A long-term plan to change the life illustration model regulation to accommodate EIL products was also discussed.

Discussion moved to reinsurance, in particular, the equity wrapper reinsurance structure in which the equity portion is reinsured off and the fixed portion is retained by the direct-writing company. The regulators will continue to consider whether the equity-indexed product is a unique product such that the separate risks (fixed versus equity-related) can be carved out and still be consistent with the reinsurance model regulation risk transfer requirements. If regulators allow the equity wrapper structure, one regulator suggested that the reinsurance model regulation should be rewritten to be more explicit regarding (1) two-tier annuities and (2) YRT reinsurance that generates substantial surplus relief.

The AAA will begin to pursue outstanding issues including (1) separate account products to which the EIP reserving methodology should apply and (2) EIL reserving and other issues.

Larry Gorski then reviewed his December 3, 1997 letter to valuation actuaries for companies licensed in Illinois on 1997 year-end valuation requirements. The current draft of *Actuarial Guideline ZZZ* on equity-indexed annuities is attached to his letter. *ZZZ* was modified to restructure the definition of "term" to focus on the concept of a "single dominant benefit" and also has been changed to be applicable to immediate annuities

and separate account products with floor guarantees. The letter continues to require a memorandum Executive Summary, provides a status report on *XXX* (not required effective 1/1/98), and discusses Illinois' expectation that the Annuity 2000 and 1994 GAR tables will be effective 1/1/99.

The annuity working group then discussed its 1998 and 1999 charges, which include:

- Development of an Actuarial Guideline on EIA—June 1998 meeting
- Development of an Actuarial Guideline on EIL—September 1998 meeting
- Exposure drafts by the December 1998 meeting
- Continued development of Actuarial Guidelines and work on nonforfeiture for all EIP—1999.

The group then changed its name to the Innovative Products Working Group, which will consider reserving, disclosure, and nonforfeiture issues for any emerging products identified by the working group.

Life Nonforfeiture Law

A discussion by the Nonforfeiture Law Working Group related to whether the nonforfeiture project should continue given the lack of consensus on the direction of a new law. Ultimately, the task force decided to defer further work on nonforfeiture pending further developments by the AAA Valuation Work Group. The regulators felt that a new nonforfeiture law which would enable more innovative products would not be desirable unless there was a new valuation methodology in place to deal with such new products.

The nonforfeiture working group will no longer work actively on a new nonforfeiture law, but will focus its attention on any valuation, nonforfeiture, and disclosure issues that may arise.

continued on page 24, column 1

Highlights*continued from page 23***Life and General Matters Meeting**

The following topics were discussed at the life and general matters meeting.

AAA Valuation Work Group—Report to NAIC LHATF on a Unified Valuation System

Bob Wilcox, the Task Force Chairperson, presented results of the Report of the AAA Valuation Work Group on a Unified Valuation System.

The Task Force identified one of the desirable characteristics of a unified valuation system as being one in which margins can be explicit rather than implicit. There is also a strong desire for one system rather than tax, statutory, and GAAP.

The report contains various sections prepared by different subgroups of the task force including a summary report, a report on existing NAIC requirements, a report on international practices for 14 different countries, a report on the various valuation methodologies in current use, and a report on regulations, requirements, and standards that would be affected by a Unified Valuation System.

The next steps planned are to evaluate the methods and tools in current use, to draft a model law (by mid-year 1998), and to create a strategy for implementing a new law.

Regulators' comments on the new direction included a desire to establish consensus on the meaning of best estimates and margins for adverse deviation and that safe harbors, which were discussed at the last Valuation Task Force meeting, are in conflict with basic principles and should be avoided. There was also some concern over whether there would ever be a single system that would be workable for SAP, GAAP, and tax purposes (particularly tax).

Revisions to Actuarial Opinion and Memorandum Regulation (AOMR)

Several items were discussed relating to revisions to AOMR. Two unresolved issues were:

- *Basis for Alternative Reserve Benchmark:* In order for a state of domicile reserving basis to be accepted by regulators, a benchmark reserve computation has been discussed. Two benchmark reserve alternatives were identified as (1) rules/regulations specified by LHATF, which would be controversial and a great deal of work, and (2) codification standards, which are only applicable to prospective new issues, thus not being very meaningful initially.
- *Gross Premium Reserve Certification.* The issue on this calculation is what is meant by "best estimate." Regulators view "best estimate" as containing some provision for moderately adverse deviation, while they are concerned that others doing the gross premium valuation could view "best estimate" as a 50/50 likelihood.

A lengthy and wide-ranging discussion took place on how LHATF should proceed with this matter. Leslie Jones of South Carolina will lead a subgroup to develop specific recommendations for changes to AOMR, to be reported at the spring national meeting.

Other items related to AOMR revisions such as the additional asset tests, liability concentration triggers, regulatory asset adequacy issues summary, yield curve normalization, and so on, will continue to be worked on rather than

Most of the discussion revolved around treatment of IMR under modified coinsurance. IMR would be handled consistently with the terms of the reinsurance agreement. If gains are passed through investment income credits, then IMR would explicitly be established by the assuming company. If the investment-credit formula excluded capital gains, then the IMR would be established by the ceding company and credited to the assuming company as IMR is amortized.

Synthetic GICs

GICs was exposed for comment. Two reserving methods have been discussed: (1) a prospective approach where liability cash flows are compared to the market value of assets with certain haircuts, and (2) a retrospective accumulation of risk charges approach. The LHATF accepted the prospective approach and exposed the

discussed the direction being taken on accident and health loss ratios for limited benefit plans which will most likely be applied to other products (long-term care and disability income) in future years. Conceptually, the regulators want a company to disclose its expectations on future rate increases up-front to a policyholder. There would then be penalties imposed on a company that implements rate increases more frequently than disclosed. The type and magnitude of the penalty would depend on the magnitude and number of increases implemented compared to those originally disclosed to the policyholder.

The next meeting of LHATF will be in conjunction with the NAIC spring meeting in March 1998.

Raymond T. (Ted) Schlude, FSA, is a consulting actuary at Milliman & Robertson, Inc., in Chicago, Illinois.

Thanks to 1997 Annual Meeting Speakers

The Life Insurance Company Financial Reporting Section Council would like to thank the following 1997 Annual Meeting speakers for their efforts in Financial Reporting Section sessions. Their efforts and talents were essential in making this a rewarding meeting!

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- **Session 85WS, "Canadian Financial Reporting Update"**
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continued on page 26, column 1

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