SOCIETY OF ACTUARIES

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RISKS AND REWARDS

THE NEWSLETTER OF THE
INVESTMENT SECTION

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BY THE SOCIETY OF ACTUARIES

Chairman's Corner

by Max J. Rudolph

Wow! My three years as a member of the Investment Section Council are almost over. It has been a great experience. In this short period of time I served as Web liaison, Investment Actuary Symposium co-chair, moderator, speaker and continuing education liaison. I got involved with the 2005 E&E initiative and the section/practice debate. I have served on two project oversight groups and a specialty guide update. I helped form the risk management task force, was exposed to the SOA leadership and made a lot of new contacts and friends.

I believe that my company came out ahead on the deal, as I have become aware of many financial initiatives that I might not have seen otherwise. Whether it's your church, your community or your profession, it feels great to get involved and know that you have influenced others in a positive way. In the actuarial profession, I have been blessed to work for and with individuals who have encouraged me to grow both personally and professionally. Exposure to these

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Inside...

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This newsletter is free to section members. A subscription is $15.00 for nonmembers. Current-year issues are available from the communications department. Back issues of section newsletters have been placed in the SOA library and on the SOA Web site: (*www.soa.org*). Photocopies of back issues may be requested for a nominal fee.

Articles Needed for *Risks and Rewards*

Your ideas and contributions are a welcome addition to the content of this newsletter. All articles will include a byline to give you full credit for your effort. For those of you interested in working in further depth on *Risks and Rewards*, several associate editors are needed. For more information, please call Dick Wendt, editor, at (215) 246-6557.

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PREFERRED FORMAT

In order to efficiently handle files, please use the following format when submitting articles:

Please e-mail your articles as attachments in either MS Word (.doc) or Simple Text (.txt) files to the newsletter editor. We are able to convert most PC-compatible software packages. Headlines are typed upper and lower case. Please use a 10-point Times New Roman font for the body text. Carriage returns are put in only at the end of paragraphs. The right-hand margin is not justified. Author photos are accepted in .jpg format (300 dpi) to accompany stories.

If you must submit articles in another manner, please call Joe Adduci, 847-706-3548, at the Society of Actuaries for help.

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Thank you for your help.

actuaries make us all not only better at our jobs, but better people. At Mutual of Omaha, I have been lucky enough to work for both Burt Jay and Cecil Bykerk. Both are like the Energizer bunny. They just keep on serving. Steve Miller now works in our investment department, but I don't know anyone who understands the ins and outs of derivatives and stochastic analysis better than he. He always makes time to share his vast knowledge with co-workers and the industry. My predecessor as investment chair, Peter Tilley, has become a good friend through our SOA dealings. He is a prototype of the future actuary—one who is very good with people as well as being brilliant. I have learned a lot from him. Thanks to these and many other actuaries who continue to mold me, both as an actuary and as a person.

I want to welcome the three incoming council members who won the recent election. Thanks also to those who were willing to run and didn't win. The vote is always very close. Bryan Boudreau from Morgan Stanley, Steve Easson from ERC and Michael O'Connor from Tillinghast are our new members. The Investment Section has been blessed with a very active council over the years, and this is driven by members willing to serve.

In addition to my status as the lame duck chair, Vic Modugno of Internetactuary.com and Dave Ingram of Milliman USA are also completing their terms this year. Both have been active members of the council and will be missed. Vic, in addition to being one of the editors of *Risks & Rewards* and council secretary, suggested and recruited many worthwhile investment/pension sessions at SOA meetings. Vic was instrumental in creating the investment boot camp for pension actuaries. Dave has also been an active member, coordinating the risk management seminars and in serving as the founder of the Risk Management Task Force. This is a very active group that is reporting on its progress via the *soa.org* Web site and various seminars this fall. Check it out!

The Investment Section has three stand-alone seminars remaining in 2002. In addition to the sessions at the annual meeting, the section is co-sponsoring a reception with the Financial Reporting Section on Tuesday night. Stop by and say hi! I'm very excited to see that Peter Bernstein (Against the Gods and The Power of Gold) is the keynote speaker in Boston. The SOA has clearly taken note of Dave Ingram and his group's work on risk management! The joint lunch in San Francisco, working with the Pension Section, was very well received. Many thanks go to Mark Bursinger (spring meetings) and Joe Koltisko (annual meeting) for coordinating these efforts. Reports have been positive on the ALM seminar at Wharton this summer, which included a European delegation. We are working with the Financial Reporting Section to make this material available. There's still time to sign up for the Investment Actuary Symposium to be held in Chicago November 7-8. With a three-track schedule and an exhibit hall, there is something for everyone. Next year the IAS will be co-sponsored by the CIA, and will be held in Toronto November 13-14, 2003. Dave Ingram and Larry Rubin will co-chair two risk management seminars to be held in New York December 4-6. The beginning and advanced sessions will appeal to distinct audiences, and both will be well attended with knowledgeable speakers.

I'd like to especially thank this year's section officers and editors. The section council will be in the good hands of Doug George after the annual meeting. As vice-chair he has been very helpful and I'm sure he has some ideas that will continue the section's progression. Craig Fowler has served ably as treasurer, and Vic Modugno and Charles Gilbert have served the council well as secretary. It takes nine active members for a council to work smoothly, and I was lucky that the Investment Section voted in candidates who were willing to help out and share their opinions. In addition, during this past year, Nino Boezio, Vic Modugno and Dick Wendt have edited *Risks & Rewards*. Great job! I thank you all.

It's been a great three years. I thank you for allowing me to help out, and I thank my wife (and fellow actuary) Karen for encouraging me to be active.

Max J. Rudolph, FSA CFA FLMI RHU MAAA is a vice president and actuary with Mutual of Omaha, focusing on financial risk management. He can be reached at max.rudolph@mutualofomaha.com.

Editor's Column: Taking Stock—The Impact of Inflation on History

by Richard Q. Wendt

Richard Q. Wendt, FSA, CFA, is principal at Towers Perrin in Philadelphia, PA. He can be reached at wendtd@ towers.com.

Editor's Note: I would like to thank everyone who responded to our recent and urgent call for papers. We heard from members far and wide and received quite a few submissions. The response from our readers was very gratifying.

It seems like today's markets are particularly uncertain, with accounting issues, terrorism threats and general economic malaise holding down the stock market. Short-term interest rates are at historical lows—some bank money market accounts have even posted rates of 0 percent. With neither stocks nor bonds looking like winners in the short-term, it is a difficult environment for insurance companies, pension plans and other institutional investors. The fortuitous strategies that brought some funds to the top of the heap in recent years are no longer working.

One aspect that tends to confound comparisons of today's markets to history is the current low level of inflation. Although most economists prefer low inflation to high inflation, the dichotomy between real and nominal statistics tends to confuse many observers.

For example, take the dividend yield on the S&P 500 stock index. Is today's dividend yield high or low relative to history? If pressed for a quick answer, most analysts would probably say that current dividend yield is historically low. That's consistent with Figure 1.

However, if we switch to real dividend yield, the picture is quite different. Figure 2 shows that today's real dividend yield is actually quite higher than the level in the early 1980s. And today's level is just about the same as it was from the mid-1980s through the mid-1990s. Depending on which statistic one chooses, the pictures are as different as day and night.

Which measure is the correct one? Actually, both real and nominal statistics should be considered in any historical analysis. Any analysis that ignores the impact of inflation is likely to be flawed.

Figure 1

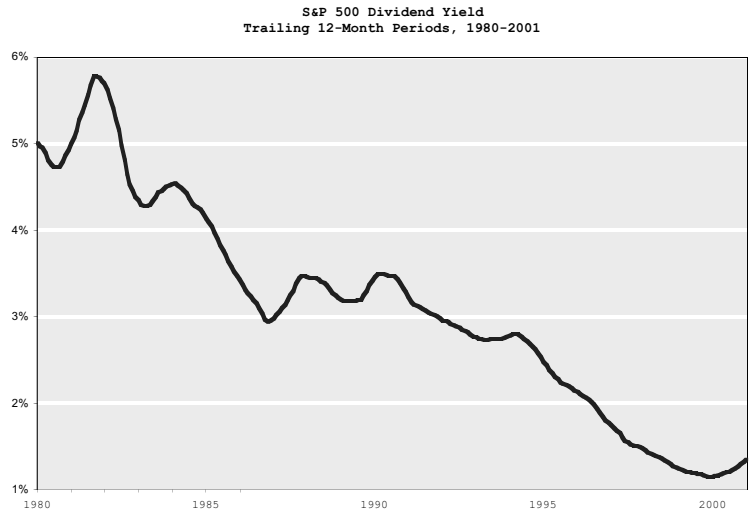
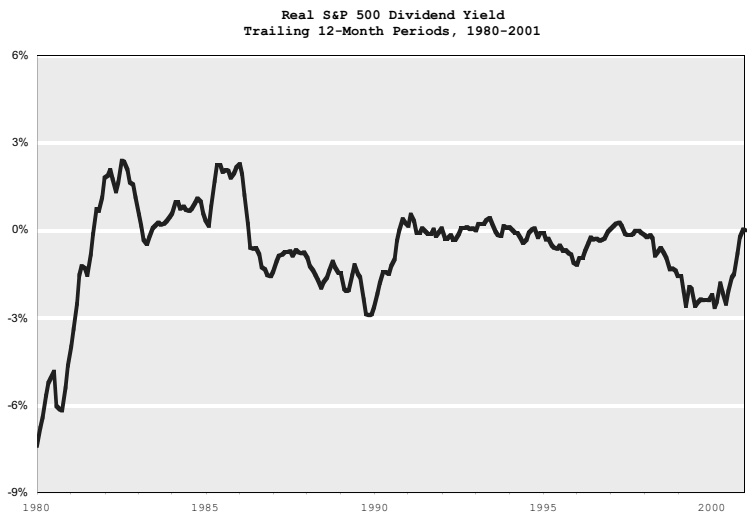


Figure 2



The Impact of Fair Value Accounting on the "Normal" Rate Curve—A Speculation

by Jeremy Gold

The "normal" shape of the rate curve is upward sloping. Not only do we all "know" this, we all know why it is so—because holding long duration bonds is "riskier" than holding short duration. From time to time the observed curve flattens or inverts (long rates below short rates). We "know" this reflects such things as short-term supply/demand imbalance (frequently attributable to Federal Reserve tightening) and changes in inflationary and business cycle expectations.

The International Accounting Standards Board (IASB) hopes to promulgate a new accounting paradigm known as "fair value." Fair value, which may loosely be described as an effort to reflect current market value, is intended to replace "historical cost" for financial instruments circa 2005[1]. Those seeking background information on fair value accounting may wish to read Statement of Financial Accounting Concepts #7 adopted by the U.S.-based Financial Accounting Standards Board in February, 2000.

I speculate that the worldwide promulgation of fair value accounting standards will make the normal shape of the rate curve downward sloping. Upward sloping curves will be the occasional exception rather than the rule.

Why do I so speculate? I hypothesize that fair value accounting will alter perceived risk, which, in turn, will alter both supply and demand along the duration dimension.

The Long and Short of Bond Supply

Presently outstanding bonds are carried at book on the corporate books of account. Corporate profit and loss reflects the coupon cash flow as an expense. Corporations that borrow at fixed rates for extended periods lock in this component of expense. Corporations that borrow short, or at floating rates, experience greater expense volatility. Corporate management views long fixed debt as less risky although somewhat more expensive in an upsloping rate environment[2].

Fair value encourages shareholders to look at corporate assets and liabilities as a portfolio where changes in asset and liability market values directly impact shareholder value. With financial instruments being marked-to-market at each reporting date, long fixed debt (unless matched to very interest sensitive assets[3]) will be a substantial source of volatility in earnings and shareholder value. Short or floating-rate debt tends to experience much smaller market movements.

Thus the supply of low-risk, floating-rate debt (which management will prefer to issue even at some expected cost) will increase while the supply of long fixed-rate debt is likely to decline. Ceteris paribus, higher short rates, lower long rates.

The Short and Long of Bond Demand

Among the primary consumers of long fixed-rate debt are life insurance companies and defined benefit plans. Although most life insurers manage their asset durations to approximate their liability durations, almost every defined benefit plan maintains an asset duration that is far shorter than its liability duration, relying in part on actuarial techniques to understate the volatility attributable to duration mismatches.

The eventual shift to more transparent, more market-oriented accounting for pension plans is quite likely to increase their appetite for longer fixed-rate securities. Ceteris paribus, lower long rates, higher short rates.

Or so I speculate.

Jeremy Gold, FSA, MAAA, MCA, EA, is president of Jeremy Gold Pensions in New York, NY. He can be reached at jeremygold@erols.com.

1) Pension and post-retirement medical plans are currently excepted from this target date and are likely to be subject to fair value standards somewhat later. Similarly, fair value for balance sheet items that are not financial instruments will require separate, and later, study by the accounting authorities.

2) With inflationary expectations factored in it is possible to argue that the expected cost of long fixed-rate debt exceeds that of floating rate even when the curve is inverted at issue.

3) A factory or real property may be economically sensitive to rates, but ordinarily will not be marked-to-market unless it is replaced by a financial instrument (e.g., a sale/leaseback).

The Coming Revolution in Risk Management

by Lilli Segre Tossani

Author's Note: Actuaries have a new tool at their disposal that has the potential to revolutionize the way that insurance companies model and manage risk. The highly sophisticated program produced by Santa Fe, New Mexico-based Assuratech, Inc.(www.assuratech.com) *uses simulation and data mining techniques to take modeling on a quantum leap in accuracy, reliability and versatility.*

If you can look into the seeds of time, And say which grain will grow and which will not, Speak then to me.

Macbeth Act I, Scene 3

Macbeth's challenge might have been addressed to an actuary. Actuaries attempt to project grain growth, as well as many other future events. They may prefer to call their business "analyzing the financial consequences of risk" or "calculating the current business cost of uncertain future events," but they could equally say that they are in the business of examining the seeds of time.

A huge body of science, technology and speculation revolves around defining the best methods of analyzing risk, the breadth of financial consequences that should be studied and the scope of risk that is pertinent to the business being managed. Now, a new technology developed by Assuratech, Inc. allows managers a glimpse at the seeds of time. While they cannot say which seeds will grow, they can say what the field of grain might look like.

Technology to Manage Risk

Recent unimaginable catastrophic events have catapulted enterprise risk management to the forefront of the insurance industry. How can an insurance company be prepared for the inconceivable? Until recently, insurance companies built their theories of the future through mathematical analysis of the statistics of the past. But the past contained no trend lines that pointed to the events of September 11, 2001.

This is the first in a series of articles that will introduce a newly emerging technology for risk management pioneered by Assuratech, Inc., a sophisticated software company that has developed practical applications that use advanced theories of computer science, complexity science and mathematics originating from work done at the Los Alamos National Laboratories and the Santa Fe Institute.

In this article, we will describe some of the industry issues that new-generation risk modeling technologies can address and talk about the emerging technology of simulation as it applies to risk modeling. In the next edition, we will describe the applied complex adaptive systems technology that lies at the core of Assuratech's revolutionary approach to risk management.

Foretelling the Future

The traditional actuaries' toolbox begins and ends with mathematics. Traditionally, actuaries applied mathematical formulae to historical statistics to define a trend and make a projection. An accurate projection, though, depends on an accurate estimate of future contingent events—the ability to descry the future.

Of course, men have sought the ability to foretell future events since the beginning of consciousness. From the hallucinogenic fumes of the Oracle of Apollo at Delphi, to the scrying globe of the Celtic witch, to the casting of coins or twigs that yielded the hexagrams of the I Ching, the earliest "technologies" of foretelling sought answers in the murky realm of the intuitive, with inconsistent, unreliable results.

In the past hundred years, foretelling has moved from the realm of the intuitive to the realm of the scientific, focusing on the use of mathematics and the "law of large numbers" to provide a statistical confidence that actual results would be close to expected results. For a period of time, the technology of mathematics sufficed to provide a high level of confidence in actuarial calculations. By and large, distributions worked well enough to contain risk within acceptable parameters. There remained some discomfort around the tails, but for a long time the discomfort was well within the risk tolerance of most managements.

The Tails Wag the Business

In the past decade, however, the discomfort around the tails has escalated. We can list defining events such as Hurricane Andrew and the attack on the World Trade Center that have brought to light the potential impact of imprecision in traditional risk management techniques.

In the property and casualty industry, the unthinkable and unimaginable are becoming the norm. In the health insurance industry, with its finite resources, the potential for losses is infinite. In the field of life insurance, disintermediation recently put one of the largest U.K. companies out of business. And equity markets that fluctuate from the anemic to the hyperactive pose an ongoing challenge to capital management.

Consolidation in the insurance industry adds to the potential impact of miscalculations in risk management, as does consolidation in the industries that are insured. The scale of operations of global conglomerates and the

scale of a single catastrophe render the potential financial impact of a tail risk miscalculation devastating. Now the task of extreme value management is to accurately plan for the inconceivable.

The magnitude of the problem is quickly told, if less easily comprehended. While the full count is not yet agreed upon, total losses arising from September 11 are assumed to be as high as $90 billion, with insured losses around $58 billion. It is the worst workers' comp disaster in U.S. history. In health care, the largest sector in the U.S. economy, costs continue to escalate at double-digit rates. A.M. Best suggests national health expenditures are expected to climb to $2.6 trillion in 2010, twice as much as they were in 2000. In the face of such staggering numbers, the insurance industry is re-examining every aspect of risk management.

Planning For The Inconceivable

Traditional modeling techniques look at individual risks, examining one aspect of the universe of risks at a time. Yet it has become clear that it is not possible to understand the whole picture of risk and threats by simply examining its parts. It is no longer appropriate to manage different risks independently.

Best's Review's June 2002 article about the Risk and Insurance Management Society's 2002 Annual Conference highlighted the message from experts that another terrorist attack is a virtual certainty. The companies that will not re-emerge from the devastation of September's terrorist attacks, said panelists, will fail because they were ill-prepared to manage a crisis of unprecedented proportions. As an industry, it is imperative that we learn to prepare for the inconceivable before the next catastrophic event occurs.

What is needed is a method of managing uncertainty as a portfolio of risks rather than as a series of independent events. The interaction between financial, hazard, strategic and operational risk must be accounted for, as must the risks of being part of the global insurance community and the interconnectedness that goes along with that.

Assuratech's president, Terry Dunn, has over 30 years of experience in the insurance industry. He proposes that the industry is perched at the edge of a revolution in its approach to risk management, and he proposes to lead the revolution. "By using agent-based simulation, counter-intuitive threats and opportunities emerge as various scenarios are played out," he says. "The use of our simulator suggests possible scenarios that other models ignore. Counter-intuitive 'hedging strategies' can be developed through the use of the 'what if' generator. It provides a 'bird's-eye-view' of the business and its environment. This broad perspective allows managers to truly model risk on an enterprise-wide basis and in a global context."

Modeling: Science and Art

Statistical modeling has been at the heart of risk management for the past century. Industry actuaries develop elaborate modeling formulae or programs that are applied to historical data and resolve to describe a probable future to which a current-dollar price tag can be attached. One reason that there is an almost infinite variety of actuarial models is that each model necessarily incorporates an element of judgment or intuition or speculation in the definition and weighting of probable future events.

A February 2000 article in the *Actuarial Review* quoted this dictum: "An actuary is what you get when you cross a computer with a gypsy fortune teller." The kernel of reality behind this fanciful statement is that, in traditional modeling, the reliability and precision of mathematics is leavened by the need to incorporate untestable hypotheses about future events.

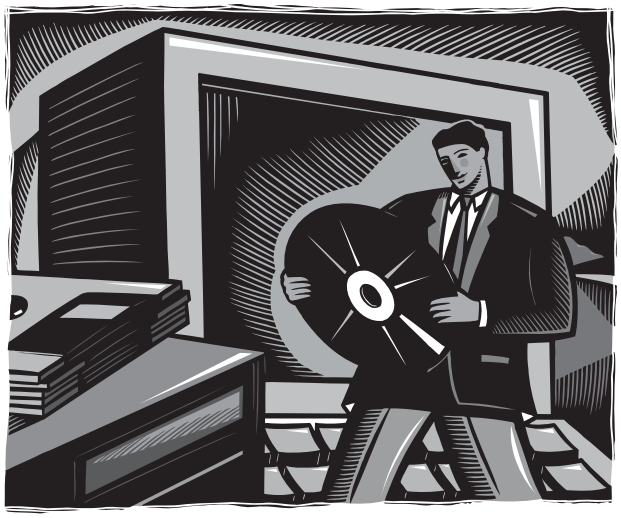
Models come in several varieties of form and purpose. *Would-Be Worlds: How simulation is changing the frontiers of science*, by John Casti[1], contains an excellent discussion of the nature and purposes of models. Casti is a globally recognized science writer, mathematician and complexity science expert and one of the scientists who serves on Assuratech's Board of Directors. He proposes several taxonomies of models. The first taxonomy we will discuss is based on the purpose of a model. In this taxonomy, models are categorized as predictive, explanatory or prescriptive.

Predictive Models

Predictive models, says Casti[1],"enable us to predict what a system's behavior will be like in the future on the basis of the properties of the system's components and their current behavior." A good example is

(continued on page 8)

1) Casti, John L. Would-Be Worlds: How simulation is changing the frontiers of science, New York, John Wiley & Sons, Inc., 1997.



Ptolemy's model for the motion of the planets, which allowed astronomers of his time to accurately predict the location of specific planets. That Ptolemy's model was based on the erroneous assumption that these bodies rotated around the earth was irrelevant to its usefulness as a predictive tool.

A very simple predictive model in insurance, for example, is one based on risk-adjusted return on Capital (RAROC). The prediction here is that if your RAROC is too low (or too high), then you can expect your company to behave poorly (exactly how it will behave poorly requires a more detailed predictive model).

Explanatory Models

Explanatory models, on the other hand, are static descriptions of the framework within which past observations can be understood as part of an overall process. They give reasons and origins, and may or may not make predictions. Newton's First Law of Motion explains the motion of bodies in terms of a "force" that acts on a body. This law explains the "cause" for the motion. The cause for planetary accelerated motion is the gravitational force that draws them to the sun. The First Law can also be integrated in time to predict the location of a planet at the current time given its location and velocity at a previous time. Newton's model serves as both an explanatory and a predictive model.

Like the First Law, dynamic financial analysis (DFA), for example, is a predictive/explanatory model used by actuaries to forecast the probabilities of the various financial outcomes of a company given a universe of risk events.

Prescriptive Models

Prescriptive models offer decisionmakers an explicit prescription to optimize the behavior of the modeled system through targeted interventions. A prescriptive model, for instance, can tell you at what angle to place your cannon so that the cannonball will strike its target. In insurance, a prescriptive model can tell you which markets to enter to minimize your risk profile.

Current modeling techniques present several drawbacks. One is that they do not do a good job of dealing with simultaneous changes to multiple variables in complex environments. Another is that when they are applied to large complex systems such as the national economy, there is no way to validate or test them without incurring additional, unacceptable risk. Is one, for instance, willing to force people out of their jobs in order to test the effect of unemployment on credit card delinquency?

Complexity of Risk

The fact is that the proper objects of risk modeling in today's global economy are what scientists call "complex systems," and traditional modeling techniques have been shown to be poor predictors of the behavior of complex systems. This is because there is an elemental incompatibility between the assumptions that underlie traditional modeling techniques and the nature of complex systems. Let us look first at the nature of complex systems, as defined by complexity scientists.

Complex Systems

Complex systems consist of a large number of individual agents that can change their behavior on the basis of information they receive about what the other agents in the system are doing. Complex systems come as a unified whole; they cannot be studied by breaking them into their component parts and looking at the parts in isolation; and the behavior of the system is determined by the interaction among the parts. Complex systems are unstable, exhibiting many possible modes of behavior, often shifting between these modes as the result of small changes in some factors governing the system. The global insurance market is a complex system.

Roger Jones, Ph.D., is Assuratech's chairman and chief scientific officer. He pioneered many of the dramatic advances in computer and algorithmic capabilities necessary for this type of work. Jones believes that complexity science is the natural handmaiden of insurance risk management. "During the Industrial

Age, science was the servant of business. Science developed products to sell. Now, in the Information Age, modern business-persons manage their firms as much with the science of complexity as with the principles of accounting. Science has become the partner of business."

Data vs. Information

For some time, advances in modeling have focused on adding granularity of data to the mathematical calculation, pre-supposing that more data will yield better modeling. It is true that many modeling systems depend on the availability of large quantities of accurate data. Modern data mining techniques yield enormous amounts of data. We can mine a huge field of available data about complex systems, yet the dilemma of how to extract meaningful information from those terabytes of data remains. More data does not necessarily yield more or better information.

To turn the data into actionable information for insurers and reinsurers, models must somehow account for the interactions and interrelationships between different risk segments. The behavior of this complex system—the global insurance market—depends on the interaction of customers, financial markets, competitors, investors, governments, nature, terrorists and others. Forecasting must incorporate the entire complex universe of interrelated variables that describe all the agents in the global insurance market. To be accessible, the information must be presented in a context that is familiar and understandable to decisionmakers. And finally, the information must be timely and instantaneously available, to accommodate a 24/7 universe.

Granularity

To see why simply increasing the amount of data we have about complex systems will not improve the reliability of traditional modeling, we must return for a moment to Casti's descriptions of models. Alongside the taxonomy that categorizes models based on their purpose, Casti describes a taxonomy based on the granularity of the data that feeds the model. In this taxonomy, models may be high-level, mid-level or low-level.

High- or Mid-Level Modeling

For a variety of reasons, traditional models have focused on high- or mid-level modeling, using statistically aggregated trend data. In this taxonomy, a Keynesian economic model is described as a prescriptive, high-level model. It aggregates several hundred thousand unemployed individuals residing in 54 states and territories into a single percentage unemployment index and uses that datum as one of its variables. A Keynesian economist will then demonstrate that increasing income will decrease unemployment and propose policies to do that.

Low-level modeling has heretofore been limited primarily to scientific disciplines, where researchers have thought nothing of devoting huge quantities of computational resources to the calculation of the path of a single electron. In fact, the perceived limitation imposed by the available technology has been one of the motives for keeping the modeling focus primarily on mid- or high-level granularity. Another has been that there has been relatively little interest in examining the details of lower-level interactions.

TO TURN THE DATA INTO ACTIONABLE INFORMATION FOR INSURERS AND REINSURERS, MODELS MUST SOMEHOW ACCOUNT FOR THE INTERRELATIONSHIPS BETWEEN DIFFERENT RISK SEGMENTS.

If, for example, you want to predict the price of a particular share on the stock market tomorrow, you can get quite a good prediction by looking at aggregate information about the company's earnings and performance, expected interest rate levels and some indicator of market trends. It is not necessary for such an inquiry to examine in detail the trading patterns of every individual trader in the market and his or her strategies, goals and trading patterns.

Scenarios

The purpose of models used in the insurance industry is primarily prescriptive. The question being asked is: what will happen to my financial situation if this or that event takes place, and how can I ensure that the result is not catastrophic for my company?

Until recently, the methodology essentially took a mid-level predictive model, which might be validated and tweaked by using older historical data to generate a prediction and comparing the predicted results to actual newer data. Assuming the future proceeds linearly from the past, such a model would provide reasonably accurate predictions.

To make such a model prescriptive, scenarios would be created, in which one or more variables might be altered and the same model applied. To create the scenarios, actuaries would weight both the

(continued on page 10)

alterations to the variables and the predictive model with probabilities.

The inherent flaw in this methodology is that the future does not proceed linearly from the past. At a very low degree of data granularity (a high-level model), this is not so important. As our investment advisors keep telling us, if you look at the value of a mixed basket of stocks over 50 years, the stock market remains the best investment. But if you increase the granularity of your investigation, you may find that stocks are not the best investment over, say, the next six months, and your ability to predict the status of your market basket in six months is subject to a significant margin of error.

From Modeling to Simulation

In the search for better information, Assuratech, and its parent company Complexica, brought together mathematicians, complexity scientists and experienced insurance industry executives. The original consortium formed to explore applications of complexity science to improve insurance risk management included global reinsurance brokers, research institutes, consulting firms and complexity scientists.

Modeling at any level is an attempt to represent reality. But complexity scientists (and, incidentally, gamers and educators) had leaped to representing reality through simulation. A simulation displays on a computer a surrogate reality that appears to behave exactly like the real thing.

Simulations have been used to train airplane pilots, to select from 10,000 chemical formulas the one most likely to be the next wonder drug and to allow millions of apprentice wizards to slay dragons on their home computers. How would it be if, instead of modeling the behavior of markets, one could simulate a market in its entirety and watch it react to unexpected events?

The work of the consortium resulted in a software package that represented a virtual world in which one could simulate the financial results on five insurers and five reinsurers of two types of catastrophic events over a ten-year period. This crude original package has been built on and refined to produce the sophisticated proprietary simulation capability that Assuratech now provides to the industry.

The Revolution

The explosion in the availability of inexpensive computing power and the experience of complexity scientists who had tested simulations of complex systems in laboratory conditions provided the tools. The consortium provided the impetus and the idea. And the journey towards revolutionizing risk management in the insurance industry was begun.

The technology of this revolution is adaptive agent-based simulation technology. Our next article will describe this technology in some detail; we present a brief summary here.

The technology depends on dissecting statistical patterns to find their causes. The rules that drive individual agents to behave and interact the way they do are mined from the aggregate data. Agents and their rules are programmed into a defined environment. Each agent follows its own rules, interacting with the environment and other agents in response to internal imperatives and stimuli provided by the environment.

Agents can be anything from individuals to companies to governments, consumers, suppliers and so on. As the computer watches and keeps track, these agents pursue their goals, learning from their experience and changing their rules of behavior accordingly, influencing other agents to learn and respond in return. The result is a record of the consequences of the collective behavior of many agents navigating many strategies—in other words, a very close, accurate simulation of the real world insurance market.

Assuratech's product, *Insurance World©*, delivers a simulated insurance market in which all of the pieces interact to collectively affect the capital and bottom-line profits of the ten companies that inhabit the simulated market. With this tool, insurance companies can finally build a comprehensive picture of their entire risk environment. The complexity of the tool is in the programming and the definition of the environment and agents. Once that is accomplished, decisionmakers can build scenarios and see the outcomes as ten years of financial reports—in seconds.

Insurance World© meets all the tests we set out above for turning data into actionable information for insurers and reinsurers. The simulation accounts for the interactions and interrelationships between different risk segments and different agents. In fact, it incorporates the entire complex universe of agents that act in the complex system that is the global insurance market. The results are presented in the familiar and understandable form of financial reports. And the entire program can be run on a PC, in real time.

For further information on Assuratech, visit *www.assuratech.com* or contact *tdunn@assuratech.com.* ŏ

And Then There Were Two...

by David Ingram

The international risk management community is now being served by two professional organizations. The Global Association of Risk Professionals (GARP) and the Professional Risk Managers' Association (PRMIA).

GARP has existed for over five years and continues to administer a testing process to qualify practitioners as financial risk managers (FRM). This fall, they have over 2000 students registered worldwide. GARP boasts a membership list of over 20,000 with almost 2,000 of those being FRMs. GARP also publishes a slick 40–50 page magazine, *GARP Risk Review*, six times per year. The May/June issue featured 16 articles on special purpose vehicles (SPVs), IAS 39, counter-party risk after Enron, non-adaptive FFT-based approximations with Fourier inversion integrals and three articles about various issues in the Russian markets. To receive the magazine, you must be in one of the paid membership categories, which last year meant a $100 membership fee. GARP hosts several large conferences each year in New York, Hong Kong and London. Conferences in the past year have focused on credit risk and operational risk.

Early in 2002, GARP started a major reorganization with the almost complete replacement of the senior administrators of the organization and much of the board of directors. In August, that process was completed when a new GARP board was elected by the membership and a new set of by-laws was adopted. First on the list of bylaws was a statement that GARP was nonprofit and would not change that status without the expressed permission of the membership.

Conflicts over the governance structure and a puzzling series of shifts from nonprofit to profit status had lead to the abandonment of GARP by over a dozen of the former regional directors. Those former regional directors formed the new organization, PRMIA.

PRMIA, which started in the beginning of 2002, has attracted a membership of almost 4,000 people worldwide. Membership is free. PRMIA will be giving a qualifying exam for its PRMIA certified risk manager designation. In addition, they have extended that designation to anyone with an FRM designation obtained prior to the first PRMIA exam. PRMIA has very active local chapters in several areas. For example, the New York chapter has a monthly meeting where attendance usually totals about 60 people. Topics discussed at meetings have included corporate governance and risk management issues and Enron, new product review processes and credit risk management. The new product review discussion included a speaker from the New York State Insurance Department talking about their expedited review process. The Credit Risk discussion attracted almost 200 attendees. PRMIA posts a distribution of its membership by country on their websites which shows that 37 percent of their members are from the U.S., 11 percent from the U.K., 7 percent are from Canada and the other 44 percent are from over 50 other countries on every continent.

Neither organization has yet to incorporate anything directly related to risk management in the life insurance industry, though GARP has made contact with both the CAS and the SOA. Both organizations are including risk management for asset managers who are often pension asset managers.

Here are two sample questions from the new PRMIA exam:

1. Assuming independence and a recover rate of 70 percent, what is the expected loss of the following portfolio:

Bond A – 1000 EUR – probability of default 40 percent
Bond B – 2000 EUR – probability of default 30 percent

a) 300 EUR
b) 900 EUR
c) 1,000 EUR
d) None of the above

2. In a long option straddle strategy, where one buys a put and a call simultaneously at the same strike price,

a) Delta will be zero, regardless of the level of the spot price
b) Gamma will be the highest at the money and approaching zero
c) Delta will be near the 1 at the money and approaching maturity
d) Gamma will be zero at the money and approaching maturity

Answer Key:
1) a
2) b

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‘Funny’ Accounting and White-Collar Ethics Highlights the Two Standards of Crime

by Nino J. Boezio

Thou shalt not steal; an empty feat,
When it’s so lucrative to cheat.
Arthur Hugh Clough, “The Latest Decalogue”

I have been hearing numerous complaints about the current market environment. Investors and portfolio managers generally understand that market declines are inevitable (even though hope that such declines are short-lived). However, they were not expecting that such market declines as the current one to become exaggerated because of gross dishonesty in financial reporting. Asset forecast models were not contemplating such events. In addition, many are adamant that such dishonesty will be rewarded, not punished. Consider the two standards of crime.

Let us say you are desperate for money and you therefore decide to rob a bank. The risk will be high (you will probably get caught) and the reward will be minimal (a small amount of “free” money if you make a successful getaway). So you manage to rip off $5,000 from a local bank branch, but unfortunately get caught by the police. You now face jail time and a criminal record, and have to give the money back. You also receive public humiliation.

Let us now say you are an office manager. You have some unexpected losses—say $50,000. You look around and decide to borrow money from one account to cover losses in another. Or you aggressively value the results of a recent project. The risks are low. You may not get caught, and if you do, you can claim that any fudging of accounts was simply an accounting error (and can blame subordinates), or that any aggressive projections were actually realistic—“such assessments are subjective” it is argued. This office manager also may not stick around with the company long enough to get caught, and probably no one outside of the firm will find out about what he did anyway.

Or let us say your future with the company and your career is tied to the performance of your company or unit. You realize that you may not make your revenue targets. Your bonus is also tied to the financial results, and you can benefit handsomely if you spin the results in a positive fashion. You also know that criminal litigation in such matters has often been low and unsuccessful. You also know that at worst you may face a fine and some restrictions on your ability to practice in your profession (an unlikely outcome), but at least you will not have to give any of the money you earned back.

As we have seen with the Enron/ Arthur Andersen cases and the other litigations now pending, there are shades of truth, shades of dishonesty and finger pointing in every direction. Supposedly concrete evidence gets tainted by claims that there were misunderstandings of what was happening, that information was not completely available, that others were actually the guilty parties and/or also knew what was going on, or that the business models were sound but others ruined them. Unlike the bank-robbing case where the facts are clear, supposedly concrete facts in a white-collar crime often become muddled at best. Ironically, if such unethical positions were taken by a set of teenagers, we would know they are lying—but for some reason credentialed adults wearing ties and holding high-level university degrees are held to a different standard, and are often given the benefit of the doubt.

The scariest and most troubling aspect from these fraudulent cases (and which is now spurring changes in regulation and punishments), is that many of those who were dishonestly engaging in the improper accounting activities will not only get away with it, but also have become rich in the process (and will keep the loot). Very few will be penalized. Even though we are now seeing a strong public backlash against such activity, it is difficult to say how severe the penalties will be for past abuses, and that only severe punishments for future abuses will be put in place.

A Simple Scenario On How It Works

Let us say a senior accountant (call him JJ) wants to cover a substantial write-off on an account. The write-off will be an embarrassment to him and could cause him to be removed from operating in certain practice lines. He decides to take money from a set of obscure and long-term trust funds which no one watches or monitors, and moves the money to cover the write-off.

To protect himself, accountant JJ also tries to get someone else to sign off on the transaction. The other person asked to sign off (call him BJ) understands that this is improper. He protests. JJ promises to protect BJ if anything goes wrong (“but how will anyone find out anyway,” JJ argues). Also, if BJ does not do what he is told, he may no longer work for the firm. Also arguments are presented such as “everyone does it” and

that "it is the duty of BJ to protect JJ—just as a bodyguard takes a bullet to protect the president." BJ is in a dilemma—he now knows about the impropriety, and if he does nothing about it, he could face professional ethics concerns down the road, even if he leaves the company. If BJ blows the whistle, any closed-door conversations will be denied and it will be BJ's word against JJ's, and BJ could even be charged that it was his idea all along (it is not as though BJ knew in advance that he was going to be pressured to do something illegal, so it is not likely he was recording the conversations).

BJ realizes that it is a no-win situation, but decides that blowing the whistle is more appropriate (wants nothing to do with any wrongdoing). He reports it to persons at a level above accountant JJ. JJ is questioned by upper management about what was going on. JJ claims that he did not realize what was happening and claims that it was all a misunderstanding or gaff, and argues that what occurred was actually okay, and tries to discredit BJ as simply a bad apple in the organization.

BJ now knows that there are several approaches that can be taken. Upper management needs to make a choice as to who is telling the truth. This may be easy based on whether what accountant JJ did is normal industry practice. However, upper management also wants to avoid embarrassment so it considers ways to shut-up BJ. This may involve firing BJ, since he may be collecting evidence on JJ. They can also order files to be discarded or revised so if any investigation does take place, it will not bring to light incriminating evidence. Human nature is such that it does not want to admit it did something wrong—the first inclination is to blame someone else and to institute a cover-up.

BJ decides to report the matter to the regulators and the accounting profession. The regulators and accounting profession become concerned, but also realize that it is just another battle they may not want to engage in, given its size relative to other litigations. Also there are just too many relationships existing between the firm, regulators and accounting bodies, that there may be a willingness to downplay the event, at least for this time. There may even be a suggestion of a trade-off among people on disciplinary committees—we'll protect your guy for a return of the favor down the road. Hence, the case is dismissed on a probationary basis.

The above situation may not be as unusual or as far-fetched as we want to believe. One side has tremendous power and influence. And David and Goliath battles are rarely won by the Davids. We see cries for regulation since there are very few alternative ways for such abuses to be corrected under the current system in which honesty plays a major role, and which is often dependent on a few people coming forward.

Why Two Standards?

White-collar crime has advantages since it can allow for subjective judgement in how transactions are reported. And for a set of reviewers, it is possible to throw a great deal of doubt on the facts of the case to make any strong conclusions difficult to reach. With the bank robber, what took place is clear based on the physical actions. But with actions such as accounting, numbers may not always tell the whole story, or so they say. Subjectivity, unclear professional standards and loose definitions can be exploited to the benefit of the guilty parties. As transactions can sometimes be complicated and involve a variety of factors, a dishonest deed when identified can sometimes be portrayed as a gaff, the result of bad communication, or unclear industry policy after the fact. Claims can be made that what took place was the result of a "misunderstanding," a "lapse of judgement," or an "accounting error." Subordinates could be blamed for what had happened, even if these subordinates knew nothing about it. Or claims can be made that others in the firm have done similar things so there is a precedent (safety in numbers). And, unfortunately, any viable witnesses are either unwilling or unable to come forward, due to fear and intimidation, and since their own future in the industry and the company can thereby be irreparably damaged if they speak out.

In cases where someone does squeal, say to a regulator or financial oversight body, one common ploy a company may use in response, is to claim that the investigation is still ongoing (even though it may have been completed already, and in only a few days). In the process, additional evidence from any complaining party can be brought to light (or hints of how they will attack), and thereby the defending firm can have better

(continued on page 14)

information on which to base a defense strategy. Also any prior conversations cited as being made by the guilty parties behind closed doors will be useless, for there will be denials that any such conversations took place (since they will prove incriminating), or such conversations will be "revised" by the guilty parties to claim that they were about different things than what was claimed. Lying becomes part of the game, and it is difficult for a neutral third party to assess who is telling the truth. It is not as though the honest people carry tape recorders to record such conversations, or that anyone really documents unethical conversations in memos.

If one is playing with the numbers, padding revenue through the diversion of trust funds from a obscure and an un-monitored account, or inflating invoices through such practices as premium billing, it should not be expected that one who steals is also not going to lie about it (in other words, one cannot expect the offending party to be honest in one area and a crook in another—there is no such thing as a honest thief). If one who is caught is truly open and honest about what took place, he or she is likely going to get into greater trouble if they truly portray the events surrounding the crime.

Deep Pockets and Industry Dominance

Unlike the bank robber who was down on his luck to begin with, white-collar criminals can be part of a large company with tremendous financial resources. The company can hire the best lawyers. It can afford to litigate for a number of years. The bank robber may only be able to use a lawyer provided at the mercy of the state. Anyone trying to fight a major corporation or industry needs a great deal of guts, money and stamina.

If the company is very dominant as we saw with Enron or Arthur Andersen, they may not only influence the direction of the industry, but also have influence among the regulators, professional associations and government. As we saw with Arthur Andersen, claims were made that everything done on the accounting side was legal, even though the legality of the accounting actions was determined based on policy heavily influenced and lobbied by the accounting industry (an industry which included Arthur Andersen). Very much a circular professional relationship.

Destruction of Documents Often Works

Destroying documents often eliminates incriminating evidence. Even though regulators and professional bodies may find this action to be further suggestion of wrongdoing, they find themselves up against the new dilemma of proof (valuable documents on what took place are now missing). The investigators may lack the teeth to impose significant charges related to document destruction.

Unless investigators can therefore get persons to come forward, they could be running out of options. And any potential persons to come forward may be reluctant to do so—they face issues of time, legal costs if counter-charges are laid against them, and being blackballed in the industry for future employment. Only in cases of a high-stakes and high-profile game such as Enron, is there the potential for persons to come forward in order to preserve their reputations and careers.

Documents need not always be destroyed—they sometimes can be modified and new memorandums added, thus tying up loose ends left over from the questionable activities. And unfortunately, perhaps as much as 80 percent of the discussions related to the conduct of unprofessional activity are not documented—hence it boils down to a "he says, she says" set of circumstances, which is difficult to substantiate. Therefore, when there is reasonable doubt, the crooks win.

What Happens To The Whistleblowers?

The potential whistleblowers always face a dilemma. If they see something wrong or illegal occurring, they

have a choice of blowing the whistle. Changes can then be made by the company internally, but it is likely that any "waves" made by the whistleblower will result in the whistleblower not only putting his or her job on the line, but also having his or her future with the company placed in jeopardy (they are now a prime candidate for termination). This can also affect their future in the industry. The offending company may also begin to build a file on the whistleblower, trying to find some dirt on his or her past actions, events that could somehow discredit them when the needs arise. If abuses become disclosed to any outside parties, there will also be attempts to label the whistleblower as simply a disgruntled and immature employee who is "out to get the firm," or is targeting another individual out of spite, and that the actions complained about are actually normal practices or are simply blown out of proportion. Even though this scenario does not make sense—it is not like the whistleblower planted such incriminating financial information, or had the power to influence others in order to get the company into trouble (it is the other way around), it still can create enough of a diversion from the main issue being reviewed.

The potential whistleblower could decide simply to keep quiet, but such an action could result in his or her own career being ruined if the improper actions someday become disclosed (one is not guilty simply by keeping silent about what they saw). The potential whistleblower could leave the company and not voice any concerns, but this is no guarantee that they will not be somehow blamed or used as a scapegoat down the road.

What Made Enron, Arthur Andersen And Other Cases Different?—Media Attention And Size Was A Key

When the scale of the misdeeds gets too large and public, as was the case with Enron and Arthur Andersen; then regulators, politicians and professional bodies are more inclined to come out condemning the activities and take proper action (they want to be perceived to be doing their job). If a case is not high profile and is not likely to go very far, then the pain of arguing over something for a number of years for uncertain results is not often worth the effort, or better left to someone else who is more passionate about the matter. Regulators will pick the battles they more likely can win, especially if they have limited resources.

What made the current cases of abuse different from what typically happens in the business environment is that they were big events and they made news headlines. For example, despite all the jockeying by the senior people in both organizations such as Arthur Andersen and Enron, it was difficult to put the genie back into the bottle—regulators, investigators, politicians, employee groups—were all on the trail and out for blood. Had this been a small case, the corporate maneuvrings to cover things up, the made up excuses and the "keep things quiet" approach could have worked.

Summary

Fortunately we in North America are governed by a system of laws that is intended to protect the innocent and punish the guilty; laws that are not available in all parts of the world. For example, we have even noticed a great deal of debate on the matter of rights and freedoms for those who were arrested or have committed acts related to the terrorist attacks of September 11, 2001. It is not necessarily a bad thing to have such debates. Unfortunately, however, our legal system also provides protection for those who are accused of crimes where the evidence is not concrete, or where reasonable doubts can be raised about the intents of the parties. In the areas in which we cannot read another's mind, then we do run into problems. Of course, we have noted that many of the improper financial reporting activities are outrageously out-of-sync with what a normal, thinking, competent, professional would do (and ironically, we have seen teams of professionals working on various reporting, and yet misstatements still occurred). Our laws may have to be primarily structured so that in certain instances a person or professional may have to be held to account based on the outcome, not on whether there was criminal intent clearly identified (hence if an honest person simply messed up, that's too bad. We often see this principle applied in accidents and fatalities—when such events arise, someone has to pay). However, we must always be mindful that any changes made to rules and regulations don't also undermine other important principles, such as those underlying limited liability—otherwise fewer new enterprises will start. Certification of financial results by CFOs and CEOs is one positive step in the direction of holding someone accountable and responsible, despite any arguments about prior malicious intent in financial reporting.

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Implementing the Longstaff-Schwartz Model

by Pete Smith

Background

The HJM (Heath-Jarrow-Morton) class of stochastic interest models has been important in finance because the use of forward interest rates enables the development of arbitrage-free periods over expected forward rates, calibration to important markets such as swaptions and reproducing stylized facts well. However, the HJM models typically are not representable as recombining trees, which may lead to computational complexities and inability to express model solutions as closed-form formulas. For example, see Rebonato 1998.

There is another significant problem with the HJM models as they are typically developed as four- or five-factor-forward rate models. This leads to high dimensionality, especially when the HJM models are combined with other models to model more complex situations as f/x quanto models. Defining the model dimensionality as the sum of the independent model factors and using the quick-and-dirty rule of thumb that the number of requisite scenarios for statistical credibility is about 10^s (within perhaps one half an order of magnitude) and s is dimensionality, we see that the number of requisite scenarios may readily exceed a facility's computational capacity, especially with liability models containing numerous cells.

The Longstaff-Schwartz string model is very similar to the BGM (Brace-Gatarek-Musiela) implementation of HJM but with much lower dimensionality. The Longstaff-Schwartz string model has a dimensionality equal to the number of factors less the sum of the correlations of adjacent forward rates. As these correlations tend to be quite high, the Longstaff-Schwartz string model should have a dimensionality not significantly greater than 1.

The Longstaff-Schwartz model produces significantly lower dimensionality than BGM, so considerably fewer scenarios are required at a given level of statistical credibility. However, actual scenario generation computational complexity is about the same as BGM because there are still as many forward factors created as for BGM. Also the statistical calibration of the string model is computationally intense.

Implementation Note

The following overview of the Longstaff string model is obtained from the paper "Throwing Away a Billion Dollars."

Equation 12

Equation 12 on page 12 states,

(12) $dD = r\,D\,dt + J^{-1}\,\sigma\,FdZ$,

where:

D is the vector of the discount bond prices obtained from forward rates.

dD is the derivative of D.

r is the risk-free rate.

J^{-1} is the inverse of the Jacobian matrix, i.e. partial derivatives of discount bond prices, D, with respect to the forward rates f1,…,fn. J is a simple banded diagonal matrix because the partial derivatives are approximated by the finite difference approximation to the derivative by successive $[D(t+1) - D(t)] / [f(t+1) - f(t)]$.

F is the vector of associated fixed coupons for swap contracts of maturities up to 15 years, such that the expected initial swap contracts have a value of zero.

σ is the vector of volatilities of the F(i).

dZ is a vector of Brownian shocks.

Equation 12 provides the definition of changes to the discount bond values from time t to t + 1.

Equation 10 states:

$$dFi = \alpha_I F_i dt + \sigma_{i1} F_i dZ_1 + \ldots + \sigma_{iN} F_i D\Sigma_N$$

Parameterization

Let H be the historical correlation matrix of percentage changes in forward rates. The forward rates are obtained from cubic interpolation of estimated bond prices.

$H = U\Lambda U'$ where,

U:= matrix of eigenvectors, the first four principal eigenvectors are used.

Λ: = diagonal matrix of of eigenvalues

Assume,

$\Sigma = U\Psi U'$

Σ is the implied covariance matrix.

where Ψ is a matrix of non-negative elements that best fits Σ.

Ψ is solved for stochastically by generating the usual set of random shocks and solving equations '10' and '12' for the best fit over the stochastic set.

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F.Longstaff, P. Santa-Clara, E. Schwartz, "The Relative Valuation of Caps and Swpations: Theory and Empirical Evidence", to be published, available at Longstaff's web page.

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Publication Schedule for the Next Three Issues of *Risks and Rewards*

In an effort to even out work flow and assure timely production of section newsletters, the Society of Actuaries has scheduled publication dates for next year's issues of *Risks and Rewards* as follows:

Issue	Editor	Deadline	E-mail
February 2003	Boezio	December 2	*NBoezio@sympatico.ca*
July 2003	Koltisko	May 5	*joseph_koltisko@agfg.com*
October 2003	Wendt	August 4	*Wendtd@towers.com*

Unlike past practice, these deadlines are firm. Articles received after the deadline will be included in the next issue. If you have an article or an idea for article, please contact the editor of the next issue. Reports from seminars or meetings, summaries of interesting books or papers in other publications of interest to the members are welcome.

Results of Investment Section Council Election:

The following three members have been elected to the Investment Section Council for three-year terms beginning October, 2002: Bryan E. Boudreau, Michael J. O'Connor and Steven W. Easson. Bryan Boudreau was elected to the reserved pension seat.

The following officer nominations have been received for the Investment Section Council for a one-year term beginning October 2002:

Chairperson Douglas A. George
Vice Chairperson Mark W. Bursinger
Treasurer Craig Fowler

Pension Reform in Eastern Europe and Central Asia—A Multi-Pillar Approach

by Michael Cohen

While the United States and Western European nations are debating the challenges facing national pay-as-you-go pension schemes, former socialist countries in Eastern Europe and Central Asia have gotten on with the job and have introduced reforms that harness the ability of the financial marketplace to provide superior rates of return in the long run.

The impetus for the reform included the familiar demographic challenges of steadily climbing old-age dependency ratios, common to developed and developing countries alike. However, in the countries of the former Soviet Union and other socialist countries, a more immediate cause was apparent—a collapse in output and in the workforce, as well as a legacy of overgenerous and unsustainable social programs. In the best cases, employment fell by 10 percent in Poland and the Czech Republic and in the worst cases (excluding countries of the ex-Yugoslavia) by 30 percent in Hungary and Bulgaria. With relatively low retirement ages (typically 60 for men and 55 for women) and weak unemployment and disability income systems, many of these displaced workers were eligible for benefits in the pension system. This drove up pension system dependency ratios by 50 percent to 100 percent in most of these countries.

Obvious responses to these changes are to reduce the generosity of the pay-as-you-go system and increase contributions. The first response is being employed throughout the region, by increasing retirement ages, decreasing accrual rates, tightening eligibility rules for disability and survivor benefits and limiting indexation. The second response is not so easily achieved, as contribution rates are already so high as to encourage evasion and growth of the informal economy and further increases in contributions would simply exacerbate this. Combined employer and employee rates of 25 to 30 percent are typical, with rates of over 35 percent in Albania, Bulgaria and Poland.

But simply reforming the mandatory pay-as-you-go system, the first pillar, is not enough. While this might rescue the systems in the short-run, demographic changes will again plunge the systems into crisis, requiring either declining replacement rates, other benefit reductions or an increase in already high contribution rates. The answer is to introduce a funded second pillar, generally by way of individual capitalized accounts. To see why this is, we need to examine the pay-as-you-go system from an investment perspective.

A pay-as-you-go pension system could be looked upon simply as a government program transferring resources from workers to those unable to work because of old-age, disability or death of a working spouse, generally financed by ear-marked payroll taxes. Alternatively, it could be looked at as a savings scheme whereby workers create an entitlement to future income by paying contributions. In this latter schema, we can legitimately ask what is the rate of interest on these savings. In a sustainable pay-as-you-go system, the answer is quite simply the growth in wages plus a component representing the increase in the labor force. Even in transition economies, after they have begun to recover, it is difficult to foresee a level of real wage growth in excess of about 2 percent per year. Also, "growth" in the labor force is likely to follow the same pattern as in developed countries. Due to low family size (1.5 children per couple is typical, although in some Central Asian countries it is a little higher) this component is negative—about minus 0.5 percent. Therefore the real rate of return in a pay as you go system is generally around 1.5 percent per year, whereas in the long run a diversified portfolio can be expected to yield a real return of 3 to 4% percent

Another advantage of a multi-pillar approach is diversification of risks. Clearly a pay-as-you-go system is vulnerable to demographic changes, labour participation rates and other economic phenomena. The financial market is not immune to risks either, but they tend to be different, although there is some correlation among economic risks. A system based on both pay-as-you-go and funded accounts should be less prone to demographic and economic risks. Also, employees like capitalized accounts, and where choice was allowed, an unexpectedly large number of employees switched (current turmoil in the stock market must be testing their mettle!). While Social Security contributions are generally seen as a tax, contributions to capitalized accounts, even if they are mandatory, are often seen as savings. This is expected to have a positive impact on labor markets, reducing evasion and assisting in a shift from the informal to the formal sector. A further advantage is the availability of funds for investment in the economy and the development of capital markets, which are often weak in these countries.

Generally, these countries have also introduced a voluntary "third" pillar, consisting of employer-sponsored plans and individual savings, often with some degree of incentive. Most of these third pillars are still in a rudimentary stage.

Of course the transition to a multi-pillar system is not without its costs. The principal issue is the transitional cost imposed on the "sandwich" generation, which has to continue to fund "pay as you go" benefits for previous generations and begin to build up investments for themselves. This is achieved through various mechanisms, from the savings resulting from compressing current overly generous benefits, to modest contribution increases and budgetary sources, such as privatization receipts and government borrowing.

Other issues that need to be addressed include the questions of international investment and investment in government bonds. While unfettered global investment maximizes the prospective rate of return, developing countries need to weigh that against the need for development capital. Outflow of capital can also cause balance of payment problems. Similarly, enforced investment in government bonds is sometimes a necessary evil to assist in the transition.

As these experiments mature developed countries will have much to learn from transitional economies. Don't be surprised to see the occasional Kazakh or Estonian wandering around the Social Security Administration in a few years time—they will not be on a study tour, they will be participating in some reverse technology transfer!

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Investment Actuary Symposium To Be Held In Chicago

There is still time to sign up for the 2002 Investment Actuary Symposium, to be held November 7-8 at the Chicago Hilton Hotel & Towers. Please check www.soa.org for the current list of speakers and topics. With a three-track program, there is something for everyone. Both the experienced risk management practitioner and the student looking for professional development will find worthwhile sessions.

With al-Quaeda, Enron and Global Crossing, among others, it has been a long year for everyone. It has also been a wake-up year for financial professionals, who now realize the value of scenario testing in playing out what-ifs in advance. We now know that the most bizarre and scary situations we can dream up can happen. It is up to us to have contingency plans in place.

With confirmed speakers including Dennis Gartman ("The Gartman Letter") and John Foehl (Summit Strategies), the IAS is a great forum to discuss current topics with industry leaders. An exhibit hall is a new addition this year. Come early the night before to look over the booths. This will be a great venue to talk to various vendors about their offerings. A buffet lunch and reception will be offered, with additional opportunities to network and view the exhibit hall.

How Many Scenarios?

by David Ingram

As the Risk Management Task Force was forming, we found that we had many more topics that we were curious about than we had time to pursue. One of those topics related to the appropriate number of scenarios. This is how the questions were framed by one of the RMTF members:

"How many scenarios are necessary for various uses of Monte Carlo models? Stochastic simulation models are used to determine values for many nonlinear risk factors. Practical considerations on computer run times have sometimes limited the number of random scenarios that are used. With newer models and more powerful computers, run time is now a smaller constraint. At the same time, work on extreme value theory and fat-tailed distributions has heightened awareness of the importance of looking carefully at low-frequency situations rather than screening them out of consideration as unreliable outliers. Research into the criteria needs to be applied to determine the number of stochastic scenarios that are adequate for different actuarial problems such as ALM, credit loss, mortality, morbidity, operational risk and equity market models when used in pricing, valuation and risk management situations. Does the number of scenarios needed to obtain credible results vary based on the underlying random process that is being modeled and/or the purpose of the model? What is needed to obtain credible results if multivariate models are used where several high correlation and low correlation random variables are used?"

Instead of forming a study group, we decided to try polling *Risk & Rewards* readers to see if the collective wisdom offered any answers. The poll asked the following questions:

1. How many scenarios do you run?
2. How did you determine the number?
3. What confidence interval does your result have?

The model can generate random numbers on the fly (by using a positive seed number) or generate adjusted random numbers to reduce the dependence of the results on the particular seed chosen (by using a negative seed number). The DI Working Group used the latter. For a specific set of assumptions, seven seed numbers were tested under the number of scenarios shown in Table 3.

TABLE 3

	Standard Deviation of Results from Seven Seed Numbers	
Number of Scenarios	On the Fly Generation	Adjusted
1,000	3.17%	2.79%
5,000	1.66%	0.95%
10,000	0.79%	0.49%
20,000	0.82%	0.50%
30,000	0.89%	0.38%
40,000	0.47%	0.22%
50,000	0.53%	0.13%

The seed - 100,000 was close to the average result at all the scenario levels. Our recommendations are based on 50,000 scenarios and a seed of -100,000. A complete description of the aggregate model is in Appendix C. The model is an Excel file, which is available from the Academy.

We only got a few responses (probably not credible to estimate the answer for the entire class of readers), but they were interesting answers.

Max Rudolph, United of Omaha, forwarded some work from a couple of years ago that concluded that "The hybrid Sobol sequence with antithetic variates outperforms other methods of Monte Carlo integration. Even with this method, one still needs in excess of 100 scenarios for an accurate estimate. But this compares with many thousands for pure Monte Carlo. The accuracy of the estimate seems to depend only on the number of scenarios and not the random numbers used in the interpolation." This was regarding modeling of interest rates for evaluation of an SPDA business.

Dennis Lauzon, NY Insurance Department, forwarded the following from the DI RBC Working Group of the JointDI/LTC/SL/LB Task Force Final Report March 22, 2001. Dennis says, "It addresses the two questions of the importance of number of scenarios and the importance of seed number. The power of using variance reduction techniques (the adjusted results) is evident."

Jason Alleyenne said, "I work for a small insurer in a developing country. We use the Canadian Regulatory, so the Canadian approach of seven scenarios that work to identify exposure to understandable duration and convexity mismatch is a starting point.

But to take this further, the use of scenarios should always be used to convey understanding to senior management (non-actuaries) of the potential risk facing the current business model of the enterprise. If the management appetite and knowledge base allows one to present results from 10,000 scenarios and percentile results, then so certainly do so. But my management certainly don't want to see a 100-page report that only tells them their assets are too short."

Fred Travan, Canada Life, responded, "Our company uses 1000 scenarios for products linked to stock market performance. The theory behind this is the same as outlined in your e-mail, so it represents a 95 percent confidence interval. We have rounded the 983 theoretical figure to 1000 for practical reasons."

The e-mail theory that Fred was referring to said that the number of scenarios, n, for a 99 percent confidence interval should be:

$n >= 38{,}416\ s^2/x^2$, where s is the sample variance and x is the sample mean

For example, if you are modeling bond prices, the standard deviation of bond prices was just under 8 percent of the price in 1999. Substituting into the formula above, we get n > = 246. In 1999, stock prices had a standard deviation about 16% of the price. That would lead to n > = 983.

Pete Smith, of AIG sent the following explanation:
"A rule-of-thumb for the number necessary scenarios is that approximately 10^s pseudo-random scenarios are typically necessary for statistical credibility, where s is the dimensionality of the model. When constructing actual models, the statistical credibility of the number of scenarios should be computed based on an estimate of the error term or computationally estimated. However, the 10^s rule-of-thumb is very useful in planning and conceptualizing the complexity and likely feasibility of the model. Quasi-random numbers may significantly reduce the number requisite scenarios. A rough rule-of-thumb is that use of quasi-random sequences, such as Sobol or Faure, reduces the number of requisite scenarios by approximately a factor of 10. Other variance reduction techniques, such as a Brownian Bridge, may potentially reduce the number of requisite scenarios by an additional factor of 10."

In a separate survey of company stress testing procedures, I asked six companies how many scenarios they used for stress testing. The answers from companies ranged from 10 to 10,000. Keep in mind that stress testing does not require a confidence interval and may be a small set of subjectively determined "disaster" scenarios.

As I said at the outset, this is not a large enough response to be able to say what the most common practices are. However, these comments do raise a number of questions that you may want to consider the next time you perform a stochastic simulation.

In physics, Heisenberg postulated that the observer has an impact on the results of any observation. With financial market models, it is most likely true that a good and accurate model will stop being accurate as soon as it is widely used, no matter how many scenarios are used.

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GMDB Pricing:

Comparing a Lognormal Model to a Regime-Switching Lognormal Model

by Robert P. Stone

A paper entitled "A Regime-Switching Model of Long-Term Stock Returns" appears in the April 2001 issue of the *North American Actuarial Journal*. In it, Dr. Mary Hardy describes a model for future equity returns and some reasons why that model might better reflect real equity price movements than the often-used lognormal model. Among her reasons are that the regime-switching model exhibits volatility bunching and generates the occasional extreme return like that seen in October 1987. Several applications of the model are described by Dr. Hardy, including measuring risks associated with Canadian segregated fund contracts. The purpose of this article is to apply a two-regime model to variable annuity guaranteed minimum death benefit (GMDB) pricing and to compare the results to those from a lognormal model.

In short, the two-regime model assumes equity returns arise from two regimes or states. Each state's returns are assumed to be lognormal, with each having different mean and volatility assumptions. A Markov process is assumed to determine which regime the equity price model is in at any given time.

Dr. Hardy fit her model to monthly S&P 500 total return data for the period 1956-1999. Her maximum likelihood estimates (MLEs) for mean monthly log return (0.9 percent) and annual volatility (14.38 percent) are used in this paper for the lognormal model. Parameters for the two-regime model are the ones derived via maximum likelihood estimation by Dr. Hardy (again fitted to the S&P data). Consequently, regime one has a mean monthly log return of 1.26 percent with 12.1 percent annual volatility and regime two has respective parameters –1.85 percent and 25.9 percent. Price processes in regime one are assumed to move to regime two with probability .04 while those in regime two move to regime one with probability .38.

Each model was used to project equity prices, account values, and expected death benefits for a male, age 65, issued a variable annuity having one of four death benefit types: return of premium, 3 percent roll-up, 2-year ratchet and a combination of the ratchet and roll-up. All deposits are assumed to be invested in equity funds, and expected mortality is set equal to the Annuity 2000 Basic table. For simplicity, the effect on GMDB costs of Actuarial Guideline 34 was not included. The present value of calculated costs was converted to an additional mortality and expense charge (account values were projected using a roughly 100 bp MAE charge). Mean results for each benefit as well as 90th percentile results are shown on the following page for each model.

Although the models are fit to the same data, it is evident that the effect of the two-regime approach is significant. The 90th percentile values, often used by companies for setting GMDB costs, are 33-50 percent higher for the two-regime model than for the lognormal model.

TABLE 1

	Cost as Additional Basis Points of MAE			
	Lognormal Model		Two-Regime Model	
Benefit	Mean	90th Percentile	Mean	90th Percentile
Return of Premium	1.2	3.2	1.8	4.8
3% Rollup	2.4	6.5	3.3	9.4
2-Year Ratchet	5.5	10.9	7.0	14.5
Max (Rollup, Ratchet)	6.2	12.5	7.9	16.7

TABLE 2

Lognormal Model: Cost of Return of Premium Benefit				
Annual Volatility	14.4% (MLE)	15.0%	17.0%	20.0%
90th Percentile (bps)	3.2%	3.8%	6.0%	10.4%

The actual basis point costs shown above will vary depending on items such as the level of mortality and expense, the data to which the model parameters are fit, and the age of the insured. What is significant is the comparative difference between the models, given that they were fit to the same data and use otherwise identical assumptions. Also, although not the focus of this article, some companies find it more appropriate to use a current market volatility assumption instead of one based on historical data. Any one of the illustrated values could change markedly depending on the assumptions used.

To illustrate the sensitivity of the lognormal model to a change in volatility assumptions, note the different costs of the return of premium benefit using the following volatilities (assumed mean log returns are held constant at the MLE used in this article).

For this rather common and seemingly inexpensive benefit, cost varies markedly using the lognormal model, depending on assumed volatility.

What approach does your company use? It is appropriate to choose a future equity model that is consistent with history (both the lognormal and two-regime models are fitted to historical data) and which brackets the historical highs and lows, including returns like October 1987. For uses like determining GMDB cost, it is imperative to include and extend beyond such extremes, since it is the rare (and maybe never-before-seen) values that determine whether you have significant cost (or risk) at all. This is where the two-regime model has an advantage over the lognormal model: it captures the extreme values that history has proven are possible. And by including such possibilities, benefits like GMDBs might be viewed as more costly to an insurance company than previously assumed.

Hardy, M. R. 2001. "A Regime-Switching Model of Long-Term Stock Returns." North American Actuarial Journal 5(2): 41-53.

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Modeling of Economic Series Coordinated with Interest Rate Scenarios Project

by Steve Siegel

Editor's Note: the following is reprinted with permission. It last ran in Issue No. 18, June 2002 small talk *newsletter.*

Last year, the SOA and the CAS partnered to jointly sponsor a request for proposals on research involving the modeling of economic series. Both organizations recognized the extreme importance to actuaries of appropriate modeling techniques for generating economic scenarios in a dynamic financial analysis model or a cash flow test. As a consequence, the organizations concluded an end result of this project should be a model for projecting economic indices in a correlated manner.

Of the proposals received, the one submitted by the research team of Kevin Ahlgrim of Bradley University, Stephen D'Arcy of the University of Illinois and Richard Gorvett of Zurich North America was selected.

The researchers initiated their work in January 2002. The broad plan for the project includes the following items:

• **Literature Review—**A comprehensive survey and review of the literature relevant to the topic. The review will include articles from actuarial, financial and other available sources such as econometric and/or statistical journals. A summary of the primary findings and procedures appearing in the review articles will be written. As of the publication of this newsletter, the researchers have largely completed this item.

• **Development and Presentation of an Economic Scenario Generator Model—**There are three aspects associated with this phase of the project. Work is currently underway on each of these:

a) Development of a model to represent economic and financial series—Specific series include the term structure of interest rates, inflation, stock market levels, real estate price levels, unemployment rates and economic growth rates.

b) Parameter Estimation—Relevant historical data will be used to parameterize the model.

c) Provision for Extreme Conditions—Included in the model will be a provision to represent extreme financial and economic conditions through either appropriate parameter values or other means.

• **Creation of software that allows users to model economic and financial series—**Application of the model described above will be available through use of a software program created as part of the project.

• **Report and Articles—**A final report describing all aspects of the project will be written as well as articles intended to appear in pertinent actuarial publications.

The research team expects to complete its work by June 2002. With this and other research projects, the SOA is always interested in your feedback and suggestions as well as ideas for new projects. Please feel free to contact Steve Siegel, SOA research actuary at (847) 706-3578.

Steve Siegel is a research actuary at the Society office in Schaumburg, IL. He can be reached at ssiegel@soa.org.

R&R Announcement—Biannual Award

The Investment Council is pleased to announce the winner of The first bi-annual award for best article in *Risks and Rewards*. Due to the high quality of the articles in the publication, the committee had a difficult time reaching a decision on the winner. Three articles: "Dynamically Hedging Insurance Product Risk" by Marshall Greenbaum in issue 34; "Exploring C-1 Risk in Issues 37 and 38" by Thomas Merfield; and "Understanding Equity Risk Premium" by Richard Wendt in Issue 38 were the three finalists. The winner was Understanding Equity Risk Premium by Richard Wendt. All the authors of *Risk and Rewards* articles are to be congratulated for their excellent contributions to the education of their fellow actuaries.

Current Issues and Trends

by Keith Gustafson

Editor's Note: the following is reprinted with permission. It last ran in the Vol. 3, Number 3, Fall 2001 Market Review *of Chicago Equity Partners newsletter.*

The Sunshine Variable vs. The Werewolf Factor

Astrological factors and their proponent newsletters and Web sites always seemed best suited to late-night infomercials, along with their commodity-trading strategy counterparts. However, certain facets of this black-sheep branch of investing have received some legitimate academic backing.

It seems to be a popular topic at the Univeristy of Michigan these days, spawning two working papers—"Lunar Cycle Effects in Stock Returns" by Ilia Dichev and Troy Janes, and "Are Investors Moonstruck?: Lunar Phases and Stock Returns," by Kathy Yuan, Lu Zheng and Qiaoqiao Zhu.

The first paper finds that stock returns in the 15 days around the new moon are double the stock returns in the 15 days around the full moon. The authors found this to be true in all major U.S. indexes over the past 100 years and for nearly all of the major indexes in 24 other countries over the last 30 years. The second paper reaches similar conclusions based on data from 48 countries. It finds the anomaly to be independent of other calendar effects (i.e., January effect, day-of-week effect, calendar month effect).

This leads Dichev and Janes to conjecture that human behavior is influenced by "moon madness" and investors shun stocks around the full moon, even though psychological studies have established no causal link to date. They propose that this might be because such studies have focused on societal fringe elements, exhibiting extreme behaviors, rather than the minor lunacies of the masses. In contrast, medical studies have found a direct linkage between mood and external environment when it comes to the weather. Sunlight, or the lack of it, has a direct impact on human mood and behavior. This is the subject of another recent paper from well-known behavioral finance authors David Hirshleifer of Ohio State University and Tyler Shumway of the University of Michigan titled "Good Day Sunshine: Stock Returns and the Weather." Hirshleifer and Shumway examined stock returns at 26 stock exchanges internationally from 1982-1997 to find any differences between behavior on days with morning sunshine versus morning cloudiness. They found a strong and direct correlation between positive stock returns and the prevalence of sunshine, and they discovered that after controlling for sunshine, other weather phenomena are irrelevant.

We figure that because we're based in Chicago, we have a distinct advantage in knowing what will happen in the market in a day or two, as our weather subsequently moves east to New York. (This is tongue-in-cheek, folks. We won't be adding any werewolf or sunshine factors to our model any time soon!)

Keith Gustafson, CFA, of Chicago Equity Partners, is the editor of Market Review.

Cognitive Dissonance

In an open letter to actuaries, John Shuttleworth argues that the profession needs to excise its old ways of thinking

by John Shuttleworth

Editor's Note: the following is reprinted with permission. It last ran in the June 2002 issue of The Actuary. *Ed Friend has submitted a response to this article by John Shuttleworth. Ed suggested that we reprint the original article and his response.* The Actuary *is published by the Staple Inn Actuarial Society and is the official publication of the actuarial profession in the United Kingdom.*

This is a plea for change Our exam syllabus has reached its sell-by date. Worryingly for our clients and, I would contend, the public interest, trainee actuaries in this country continue to be taught palpable untruths. It is true that the exam reading today bears little resemblance to what existed when I trained (some 20 years ago). There was no 'financial economics' at all in my time. While it is true that modern finance theory now takes its proper place in the syllabus, we have not at the same time excised our old ways of thinking. It is no wonder that newly qualified actuaries can be confused.

Palpable Untruths

Let me be specific. I will present four examples of 'actuarial howlers' taken from the current course reading. First (and worst) is that actuaries are taught that it is legitimate to discount the assets and liabilities at the same rate. 404-12 says: 'If a stable discount rate is used to determine the asset value then the same approach must be taken to value the liabilities.' This misses a central tenet of finance—riskier cashflows should be discounted at a higher rate to reflect their greater risk.

Second, we are taught that the quantum of the liabilities depends on what investments are bought. Again from 404-12: 'The cost of a defined benefit scheme is affected by investment returns.' This is so egregious it is embarrassing. We ceded thought leadership to the accountants in the development of the pension accounting standard, FRS17. As the accountants had to point out to us: the investments have got nothing to do with it. Pension costs do not magically reduce if trustees sell their gilts and invest in (probably) higher performing junk bonds. (Yes, the expected future cash contributions do reduce, but they are riskier cashflows. There is no free lunch.)

Third, we are taught that equities get less risky the longer you hold them: '… for most immature pension schemes equities will probably produce the best longterm return coupled with the lowest risk. This is investment heaven!' (from Act-Ed 404-20). Actually it is neither heaven nor hell. Real life is more prosaic. Yes, the chance of equities underperforming bonds decreases over time. But this is a comment of no great insight. It is only one dimension; the other is the size of the underperformance. The employment of some simple option pricing mathematics shows that the cost of guaranteeing that equities perform at least as well as bonds increases over time. And if you do not believe this, ask an investment bank how much they would charge you for five- ten- and 15-year put options.

Fourth and last—I could go on, but I will stop here –equities do not match wage-linked liabilities. The logic in the following sentence is flawed: 'UK equities are likely to produce a significant real return in the long term, which makes them broadly suitable for liabilities linked to salary and price inflation' (404-08). A does not imply B. It is probably true that, in the long run, equities are unaffected by inflation. But this is not the same thing at all. There is no demonstrable correlation between wage inflation and equity returns. Indeed, some studies have shown it to have the wrong sign.

These four examples are non-trivial and lie at the very root of our technical expertise—which is why I believe the profession's situation is a matter of concern. On a less serious note, those of us who struggled with the exams can at least take some solace. We need no longer pretend that we had devised a superior study/life balance. We just took longer to brainwash.

I concede that today's course reading represents a major upgrade on that of as recent as five years ago. But we should press on—for many actuaries, reinventing their knowledge base will be pleasurably therapeutic, even cathartic. This is in fact my counsel to the older generation of actuaries who today hold the country's scheme actuary appointments and who largely set their firm's technical policies and who influence Whitehall (witness the sorry mess of the minimum funding requirement). Keynes put it so well in the preface to his landmark General Theory back in 1936: 'The difficulty lies, not in the new ideas, but in escaping from the old ones.'

Finance Theory

According to the conventional actuarial wisdom, there is something sinister, even perverted, about someone who advocates investing the whole of a pension fund in bonds. As a profession, our inclination has been to verbally abuse such people. In the main, we have been intolerant and have not sought to understand. (Incidentally, this is not a sign of a healthy organisation.) And because of this I make no apologies for the judgemental language in this article.

It may appear inflammatory but it is not meant that way. Change is often preceded by the kicking in of a rotten door—an unwarranted reputation for violence can be acquired by those who do the kicking in.

I know that I shall (quite properly) be criticised by financial economists for numerous oversimplifications. Yes, there are second-order effects that I have glossed over. Again, I do not apologise—we need a debate within the profession on where we are. If strong statements cause people to stop and think, then I will have achieved what I set out to do. Without dialogue, there can be no progress.

In essence, all financial economics is teaching is that equities' higher expected return is exact compensation for equities' greater risk. Put another way, £100 of bonds has the same value as £100 of equities. If they did not, there would be arbitrage opportunities in the market. We would see players raising 30-year debt, investing the proceeds in equities, and watching from a beach in the Caribbean. I put it to you that it is significant that we do not.

Financial economics is not some kinky theory or wacky counterculture. It is how investment banks make money. It carries the imprimatur of numerous Nobel prize-winners (Paul Samuelson and William Sharpe, to name but two). And it is what is taught in finance courses at business schools. To the outside world, the inhabitants of our actuarial island can look plain wrong-headed or, possibly worse, just behind the times. I was taught that £100 of equities can be worth more or less than £100 of bonds. From the vantage point of wider reading, I shall limit myself to merely noting the audacity of such a proposition.

Finance theory concludes that while the cash contributions to a pension fund are indeed probably lower if the trustees invest in equities, from the perspective of adding to shareholder value, juggling the investments is futile. The company's worth is unaffected by how pension fund trustees invest. The man in the street instinctively knows this to be so—he does not claim that the value of his house is affected by the type of mortgage that he has. Then take exhibit B: last year, Boots forfeited the alleged free lunch of the equity risk premium, yet its share price was unaffected. And a third example: no company would ever contemplate borrowing money to invest it on the stockmarket. What I conclude is this: it does not matter how trustees invest. So why not go for the easy life and hedge the risks as far as possible? This is all the bond proponents are asserting—the virtues of simplicity.

As a profession, we have mischievously extrapolated this proposition to the quite false one that bond investment is being advocated for every person who has money to save. Not so; individual investors are in the main quite properly prepared to accept some risk, and so they buy equities, perchance to gain. Shareholders are different; they do not want their risk tolerance second-guessed by pension fund trustees whom they never meet. And widget companies are unlikely to have competitive advantage in asset management. Risk-taking unaccompanied by competitive advantage inevitably destroys shareholder value (luck aside).

The Treasury has exhorted trustees to raise their game and refocus their time on where they can make a difference. We actuaries should take note too. It may be going too far to say that we have led trustees and company management up the garden path, but we have certainly not told them it straight—which is that shareholders are indifferent to how trustees invest. This is unfortunate, since most trustees do try very hard to keep all the many stakeholders happy.

And by focusing on cashflows and largely ignoring risk, we have endorsed the existence of a wholly spurious wedge between shareholders (who want the business's risks managed) and company management (who want low cashflows). How has it come to pass that the trustees of the Boots pension fund are almost alone in the UK in having a common-sense objective—to always have enough money to pay all pensions, regardless of movements in financial markets? Somewhere along the way the plot got lost, and we were there to guide our clients.

Privilege Entails Obligation

I suggest that there are wider lessons for the profession from its failure to keep up with academic thinking ('modern' finance theory was largely developed as long ago as the 1960s). The grandees have resisted change and stifled debate. I find it odd that we have little culture of intellectual inquiry post-qualification. Doctors, damaged by recent scandals, are in future to be 'revalidated' every five years to ensure that they 'remain up to date'. It would perhaps be no bad thing if practising actuaries were retested too.

There are also baser reasons for getting it right. It would improve our own business risk management. The failure of a very large pension fund could well be swiftly followed by litigation. And unless we change, we could see a drift of work that we currently do to others—risk managers at banks being just one example.

We could do so much more to break the chronic gridlock that has for so long beset retirement savings in this country. We have a public duty as well as a debt to our own profession.

With our royal charter, we enjoy a privileged position. We have been entrusted by Parliament with the policing of the pensions of this country's population. We are unlikely to lose this privilege, at least in the near future. But nonetheless we have an obligation to the next generation of actuaries. If we do not change, we will have surely failed to make financial sense of our own future, let alone that of our clients. ŏ

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Letter to the Editor of *The Actuary* (UK)

Dear Editor:

This writing responds to the insightful observations of Mr. John Shuttleworth in his article entitled Cognitive Dissonance appearing in The Actuary of June 2002. He asserts ... and we agree ... that investing its associated funds in more volatile instruments with anticipated higher returns (whether by yield or through growth) does not reduce the value of the liabilities of a pension system. The liabilities are the liabilities after all. They are the streams of obligations payable under the plan and independent of how these benefits are to be financed.

With these preliminary observations recorded so as to establish that the author does, indeed, understand the assertions presented by Mr. Shuttlewoth, the following thesis is advanced (i) first to underscore the premise upon which Mr. Shuttleworth builds his case, (ii) second to challenge the irrefutability of the premise upon which he builds his case and, finally, (iii) to suggest the development of a comprehensive standard for the actuarial profession's appraisal of the cost and risks associated with financing a pension scheme which takes into account these "new ideas" while retaining the "old ones" [with all due respect to Mr. Keynes as Mr. Shuttleworth quotes him].

I. Mr. Shuttleworth's Thesis Underscored by a Simplistic Exposure-to-Ruin Analogy

1. Mr. Shuttleworth concedes that the chance of equities underperforming bonds decreases over time. He adds, however, that this is only one dimension. The other is the size of the underperformance.

2. To underscore Mr. Shuttleworth's premise, consider the blackjack gambler who bets $1 and doubles up if he loses, and continues to double up upon each successive loss ... until he wins. With each such series he wins $1 (leaving aside the possibility that the "win" is a blackjack, which offers up a bonus).

3. ... until he can not double up again because he has exhausted his funds.

4. ... at which point he has lost all.

5. Note that if our gambler had $5,000 to invest, he can lose 12 times in succession and still survive.
• If the odds are 50/50 win/lose, the chance of losing it all is $(1/2)^{13}$.
• If our gambler has $100, he can only afford to lose six times in a row with chance of losing it all being $(1/2)^{7}$.
• Clearly the larger the assets, the longer the survival period ... but the more devastating the loss.

II. The Analogy and the Refutation

1. If a pension system has associated assets which are sufficiently robust, inclusive of a positive cash flow or an insufficiently large negative cash flow so that the system is able to withstand a shock wave of asset revaluation (market value falloff) of whatever duration and magnitude, such fall off to be followed by a recovery (net of the impact of any distress selling to pay benefits) and long range returns (whether by yield or through growth) which are more than that of a risk free asset mix arrangement, then the cost of the pension plan is less than the cost using risk free assets.

2. Nevertheless, to enable the opportunity for this lower cost, there must be exposure to ruin or even injury greater than that which would afflict a risk free management.

3. Sponsors of the British, U.S. and pension schemes in other countries have tacitly agreed to accept that exposure to harm without appraisal or recognition of its existence.

4. For his reflection on the subject, Mr. Shuttleworth is to be commended. Nevertheless, his thesis need not be met with a reversal of our thinking, but a reappraisal.

III. The Price ... and the Risk ... of Harm or Ruin ... and the Appropriate Role of the Actuary

1. To put the issue of exposure to harm or ruin in perspective, driving an automobile to one's office from the suburbs of a given morning has a risk of harm or fatality, a risk of loss or injury greater than if we were to walk a half-mile and take the subway and, from our subway, walk to the office.

2. And yet we take the additional risk because it is seemingly routine to do so.

3. To complete the analogy, some of us might be motorcycling to the office, enabling avoidance of traffic tangles.

4. consider the three to be 30.70, 60/40 and 90/10 equity/bond asset mixes.

5. The problem is our failure to evaluate the respective risks of harm or ruin.

6. In fact, the actuarial profession hasn't even attempted to evaluate the difference between 50/50 and 70/30 or other mixes but simply accepted one as "conservative" and the other as "aggressive"

7. As actuaries we have a job to do in the development of standards respecting appraisal of cost/risk of a particular investment program in the financing of a pension scheme ... utilitzing
• Cash outflow and inflow considerations,
• Conjectures as to the probability and depth of adverse and favorable financial events and
• Stochastic analysis

8. We must begin sooner than later. ŏ

Respectfully submitted,

Edward H. Friend

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Subject to Revision

by Abbigail J. Chiodo and Michael T. Owyang

Editor's Note: the following is reprinted with permission. It last ran in the National Economic Trends column that was posted by The Federal Reserve Bank of St. Louis. Please note that the views expressed do not necessarily reflect official positions of the Federal Reserve System.

The overall state of the economy is often judged by economic statistics such as inflation, unemployment and, of course, gross domestic product (GDP). Many of these economic statistics undergo substantial revisions. This is especially true for GDP, which is revised twice in the first three months after its initial release. In the month after each quarter, the Bureau of Economic Analysis (BEA) releases an advance estimate of GDP. In the two subsequent months, the BEA updates this estimate with preliminary and then final estimates. The initial estimates garner quite a bit of attention in the financial world, but how well do they reflect the true state of the economy? How well do they predict final GDP?

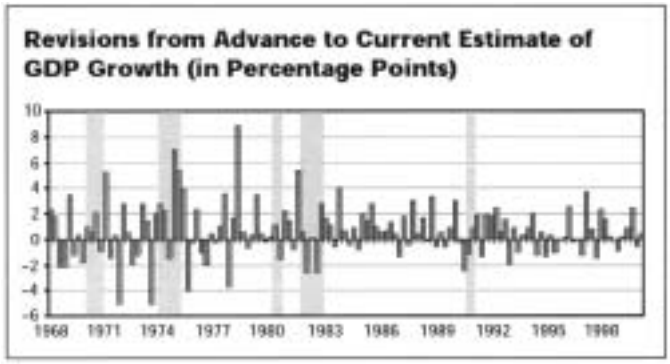
The advance estimate of GDP is calculated with incomplete data from the quarter including business inventories, housing, retail sales and automobile sales. The preliminary estimate is released a month later and incorporates more data from the last month of the quarter. Even final GDP is subject to annual revisions, which have resulted in changes to prior GDP growth rates by more than 1.5 percentage points.[1]

Economists Karen Dynan and Douglas Elmendorf report that, from 1968 to 2001, the average revision of GDP growth from the advance to the final estimate was 0.67 percentage points. During the same period, revisions around peaks and troughs of the business cycle varied greatly. Near business cycle peaks, revisions were—on average—similar in magnitude to those during the rest of the business cycle. Near troughs, however, estimates were revised quite a bit more. When it comes to detecting the end of a recession, therefore, current GDP estimates may not be the best indicator.

The magnitude of the revisions to GDP makes it unclear whether or not the most recent recession will conform to the rule of thumb that a recession includes at least two consecutive quarters of negative GDP growth.

Advance and preliminary GDP estimates for the third quarter of 2001 were –0.4 percent and –1.1 percent, respectively. Final GDP growth was revised down to –1.3 percent. Fourth quarter numbers were revised upward by 1.5 percentage points from the advance (0.2 percent) to the final estimate (1.7 percent). These revisions make it increasingly likely that the third quarter of 2001 was the only quarter in the recession with negative growth.

Revisions aside, from 1978 to 1991, 88 percent of the time the advance estimate correctly established the direction of quarterly change in real GDP growth.[2] Since total revisions do not tend to change the direction of the estimates, the initial numbers may be helpful when determining the direction in which GDP is heading, if not by how much. However, advance and preliminary estimates of GDP around business cycle turning points may be less accurate measures of output. One may take heart, though, that revisions to GDP appear to have gotten smaller (see accompanying figure) during two extended expansions.



1) Dynan, Karen E. and Elmendorf, Douglas W. "Do Provisional Estimates of Output Miss Economic Turning Points?" Working Paper 2001-51, Federal Reserve Board of Governors, November 2001.

2) Young, Allan H. "Reliability and Accuracy of the Quarterly Estimates of GDP." Survey of Current Business, October 1993, pp. 29-43.