EDITORIAL

WE ARE ALL "ACTUARIES OF THE THIRD KIND" NOW

The training of actuaries has traditionally focused on diversifiable risk. Diversifiable risk can be managed, to a large extent, just by writing more business. The more contracts we write in traditional life insurance or casualty insurance, the more closely we can predict the final outcome. The major technical textbooks in actuarial science for the Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS) exams—Bowers et al. (1997) and Klugman, Panjer, and Willmot (2004)—are devoted to the study of diversifiable risk.

Non-diversifiable risk does not go away by writing more contracts. Non-diversifiable risk comes from guarantees or options in contracts where claims and other costs tend to arise for large groups of policyholders at the same time. For example, claims from the guaranteed withdrawal benefit of a variable annuity (VA) policy. Such claims may have a low probability of occurring, but when they do, a whole cohort of policies may be affected at the same time. Deterministic modeling will not capture the risk. The traditional "Actuarial Value" gives no clue of the appropriate level of economic capital, nor will it indicate how to manage or mitigate the risk—a major problem for insurers a few years ago when reinsurance companies became reluctant to take on the non-diversifiable risk of VA type contracts. The appropriate tool for embedded guarantees and options, in most cases, comes from financial economics. Increasingly, actuaries are passing risk to banks, where financial engineers manage the risks that actuaries cannot. This is ceding a dangerous amount of turf. It is also risky to develop contracts with guarantees that are not fully understood. Risk management begins at product design.

The value of basic mathematical finance theory—e.g., option pricing theory and models of stochastic interest rates is therefore not only an asset-side issue—is predominantly a liability issue. Option theory provides the framework for the valuation (and risk management) of embedded guarantees and policyholder options. Nor is it only a topic for actuaries managing long-term risks—many short-term contracts involve options that can and should be analyzed using the newest technology. It is important that actuaries designing contracts, valuing contracts, and managing risk, fully understand the different methodologies for diversifiable and non-diversifiable risk.

Because options and guarantees are now a part of virtually all the risks that actuaries manage, all actuaries need to be aware of the theory of non-diversifiable risk. Not all actuaries need to be an expert—but all actuaries need to know enough to know when more expertise is required. We all need to know what we don't know.

Hans Bülmann (1987) wrote an editorial in the *ASTIN Bulletin* introducing "Actuaries of the Third Kind"—not alien actuaries, but actuaries who had moved beyond the first kind (life insurance and pensions) and the second kind (property and casualty) into the modern field of financial economics. Nearly twenty years later, it is time to recognize financial economics as an essential tool for all actuaries.

In fact, the connection of actuaries with financial economics is not new—rather, as Andrew Cairns (1998) noted in his editorial in the *ASTIN Bulletin*, what we are now talking of is a reunification rather than a brand new relationship. The two disciplines were close once. Frank Redington (1952) is widely recognized for his contribution to what we would now call financial engineering. But sometime after Redington, actuaries moved out of the finance arena—or at least, stopped teaching trainee actuaries about it. As an actuarial student in the 1980s, I learned about immunization—and I learned that the most important thing about Redington's theory was the long list of reasons why it could not work,[1] and should therefore not be taken too seriously.

In more recent times actuaries have made very important contributions to finance, even while finance has not been universally recognized as part

[1]The list did not include the main reason, which is that it breaches the no arbitrage assumption.

of the actuarial discipline. Phelim Boyle[2] (1977) developed the Monte Carlo method for the valuation of options, a technique used in every major finance house in the world, for transactions worth billions of dollars. Jim Tilley (1993) solved a longstanding problem when he devised a method of using Monte Carlo simulation to value American Options. Jacques Carrière (1996) developed further important practical results by applying regression techniques in the valuation of American options. These were huge developments, but were considered outside the mainstream of actuarial work. Relatively few actuaries know of these papers that, between them, have had a huge impact in financial valuation and risk management. Another major contribution is in the area of risk measures, where actuaries have used their training in premium principles to create a new field of study.

To further explore the contribution of these papers, I browsed Google Scholar at www.scholar.google.com (a new tool from Google that searches the Web for scientific papers and counts citations, as well as, the number of times a paper has been cited by other papers in the Web trawl. Phelim Boyle's (1977) Monte Carlo paper has 174 citations listed, of which six are in actuarial journals or proceedings, with the rest predominantly in finance journals, including all the major A-list journals. Jim Tilley's (1993) paper has 83 citations, of which seven are in actuarial publications, the vast majority appearing in finance journals. Jacques Carrière's (1996) paper has 38 citations, of which only a couple are actuarial. These are high citation counts. No NAAJ paper has had more than 32 citations. All three of these actuaries have contributed significantly to the field of computational finance from an actuarial viewpoint. In the case of Tilley's and Carrière's papers, it is more impressive because the original articles appeared in actuarial journals—the *Transactions of the Society of Actuaries* and *Insurance: Mathematics and Economics*, respectively. Neither is a journal that would automatically give a lot of profile within the field of computational finance. Actuaries should be proud of the contributions we have made to financial risk management.

Many other researchers in universities and in practice have applied financial economics and financial engineering principles in their research and in their daily work. In the *North American Actuarial Journal* (*NAAJ*), Volume 9, Number 1, Jeremy Gold described in his editorial the influence of financial economics on pensions management—several papers on the theme were published in that part. These papers were written (for the most part) by and for pensions practitioners. Also, ten of the eleven annual ''best paper'' prizes awarded since the inception of the *NAAJ* in 1997 have been for papers related to financial economics or financial engineering. Prize-winning contributions have appeared from: Boyle and Lin (1997); Gerber and Pafumi (1998, 2000); Yao (1998); Artzner (1998); Boyle, Kolkiewicz, and Tan (2001); Hardy (2001); Girard (2002); Babbel, Gold, and Merrill (2002); Lin and Tan (2003).

Despite this evidence of active actuarial research on topics combining traditional actuarial methods with more modern finance theory, there has been some hesitation by the profession to accept finance theory as an essential tool of actuarial science—as important to actuarial work as life contingencies or loss models. What appears to have happened is a polarization of the profession into actuaries who understand, and value financial economics, and actuaries who do not.

The introduction of the theory of option pricing and fixed interest modeling into the SOA curriculum has proved controversial—and not monotonic. In 2000, Course 6 brought in many of the important concepts. Then, in 2003 the working group report on the 2005 changes (Preliminary and Actuarial Working Groups, 2003) made it clear that financial mathematics (other than interest theory) was to be removed from the syllabus for all candidates except those taking the specialist finance and investment streams. Recently, the Board of Governors of the SOA decided to negotiate with the educational partners (CAS and CIA) to re-insert some mathematical theory into the mathematical parts of the syllabus (either in Course C or Course M of the new system). The introduction ten years ago, of financial economics into the U.K. professional syllabus was similarly controversial, though its place in the ''Core Technical'' exams (equivalent to the PE exams of the SOA and CAS) seems fixed now. Nevertheless, the recent *Morris Review of the Actuarial Profession* in the U.K. blasted the actuarial education syllabus for being slow to take on financial economics and engineering*, inter alia*.

[2]In the spirit of full disclosure, I should state that Phelim Boyle is my husband.

Since few actuaries are trained in mathematical finance, some of the scientific papers can look daunting. Some are designed for specialists with advanced knowledge, but several should be accessible to most actuaries. For general accessibility, from the prize-winning papers listed above, I would recommend the papers by Babbel, Gold, and Merrill (2002) and Girard (2002). For those who have not developed post-exam math-phobia, the papers by Gerber and Pafumi (1998, 2000), Yao (1998) and my own paper, Hardy (2001), may also be of interest. Looking through some of these contributions might help to indicate the potential contribution of finance to actuarial science and why the interface of finance and actuarial science is one of the most vibrant and important areas of research.

References

Babbel, David F., Jeremy Gold, and Craig B. Merrill. 2002. Fair Value of Liabilities: The Financial Economics Perspective. *North American Actuarial Journal* 6(1): 12–27.

Bowers, Newton L., Hans U. Gerber, James C. Hickman, Donald A. Jones, Cecil J. Nesbitt. 1997. *Actuarial Mathematics.* 2nd ed. Schaumburg, Ill.: Society of Actuaries.

Boyle, Phelim P. 1977. Options: A Monte Carlo Approach. *Journal of Financial Economics* 4(4): 323–38.

Boyle, Phelim P., Adam W. Kolkiewicz, and Ken Seng Tan. 2001. Valuation of the Reset Options Embedded in Some Equity-Linked Insurance Products. *North American Actuarial Journal* 5(3): 1–18.

Boyle, Phelim P. and Xiaodong Lin. 1997. Optimal Portfolio Selection with Transaction Costs. *North American Actuarial Journal* 1(2): 27–39.

Bülmann, Hans. 1987. Actuaries of the Third Kind (editorial). *ASTIN Bulletin* 17(2): 137–38.

Cairns, Andrew J. G. 1998. Editorial. *ASTIN Bulletin* 28(1): 1–2.

Carriére, Jacques. 1996. Valuation of the Early Exercise Price of Options using Simulations and Non-parametric Regression. *Insurance: Mathematics and Economics* 19(1): 19–30.

Gerber, Hans U., and Gérard Pafumi. 1998. Utility Functions: From Risk Theory to Finance. *North American Actuarial Journal* 2(3): 74–101.

———. 2000. Pricing Dynamic Investment Fund Protection. *North American Actuarial Journal* 4(2): 28–41.

Girard, Luke N. 2002. An Approach to Fair Valuation of Insurance Liabilities Using the Firm's Cost of Capital. *North American Actuarial Journal* 6(2): 18–46.

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

Klugman Stuart A., Harry H. Panjer,. and Gordon E. Willmot. 2004. *Loss Models: From Data to Decisions.* 2nd ed.: Hoboken, New Jersey: John Wiley and Sons.

Lin, X. Sheldon, and Ken Seng Tan. 2003. Valuation of Equity-Indexed Annuities under Stochastic Interest Rates. *North American Actuarial Journal* 7(4): 72–91.

Preliminary and Actuarial Working Groups. 2003. *Summer 2003 Report to the Membership: Education Redesign*. Online at www.soa.org/ccm/content/?categoryID=3822071.

Redington, Frank M. 1952. Review of the Principles of Life Office Valuations. *Journal of the Institute of Actuaries* 78: 286–315.

Tilley, James. A. 1993. Valuing American Options in a Path Simulation Model. *Transactions of the Society of Actuaries* 45: 83–104.

Yao, Yong. 1999. Term Structure Models: A Perspective from the Long Rate. *North American Actuarial Journal* 3(3): 122–38.

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