In chapter 10, Peter Forsyth, Kenneth Vetzal, and Heath Windcliff discuss so called segregated funds in Canada which provide a guarantee on the initial principal invested after a specified time horizon, therefore offering investors the upside potential of the equity market, while providing a protective floor should the market fall (see p. 214).

Also, Jan Walliser (chapter 11) looks at the costs and benefits of risk protection for retirees in mandatory DC plans. And while Walliser is concerned with state programs, John Turner and David Rajnes (chapter 12) analyze retirement guarantees for voluntary DC plans "that workers must participate in if they work for a particular employer, in a particular industry, or belong to a particular union" (p. 251). Both papers survey different countries.

David Cummins and Christopher Lewis (chapter 13) give a thorough description of new ways to manage risk of institutional investors via asset-backed securities (ABS) and non-traditional ABS such as "Act-of-God bonds," Tobacco bonds or Kelvin Weather Derivatives. Furthermore, they analyze the advantages and disadvantages of holding such complex securities.

In the last chapter, Arthur Fliegelman, Moshe Aye Milevsky, and Scott Robinson focus "on the risks and opportunities for insurers when they convert qualified retirement or other saving into guaranteed payout streams" (p. 309). In particular, they develop a pricing model to quantify the risks to profitability (and solvency) from unexpected increases in longevity (ibid).

IV.

These papers show that the interested groups can develop innovative and creative responses to the challenges posed by the economic and demographic trends leading to a more risky global retirement environment. However, this collection also shows that there is still a lot to do—in educating people while they decide on their retirement products; and in maintaining insurers' financial sustainability, including protection for the long-tailed nature of payout annuity contracts. With respect to the question raised about retirement income security, it is a pity that all papers only use the assumption of "i.i. and n.d." (i.e., the easy-to-handle normal distribution), when we all know that capital markets behave differently.

Modern Actuarial Theory and Practice, 2nd edition, by Philip Booth, Robert Chadburn, Steven Haberman, Dewi James, Zaki Khorasanee, Robert H. Plumb, and Ben Rickayzen, 2005, Chapman & Hall/CRC

Reviewer: Ping Wang, St John's University, wangp1@stjohns.edu.

What is an actuary? Answers abound. However one thing is fundamental to all answers—actuaries deal with risks. On the Web site of "Be an Actuary," actuaries are defined as experts in (1) evaluating the likelihood of future events; (2) finding creative ways to reduce the likelihood of undesirable events; and (3) decreasing the impact of undesirable events that do occur.

To execute the mission, those who want to become career actuaries must acquire the fundamental mathematics of actuarial science and its associated disciplines, which is covered in *Loss Models: from Data to Decision* by Klugman et al. (2004); *Actuarial*

Mathematics authored by Bowers et al. (1997); and the like. However a good mathematician is not necessarily a good actuary. Would-be actuaries will benefit from reading material addressing the practical and professional applications of actuarial science. *Modern Actuarial Theory and Practice*, co-authored by Philip Booth et al., is a contribution in this area. It provides an introduction to the professional applications of modern developments in actuarial science across a range of practice areas, and thus has helped to bridge the gap between the demand and the supply of teaching material on these topics. The subject matter of the book, *Investment and Asset Management* and *Principles of Actuarial Management*, are key elements of the Core Syllabus and Guidelines of the International Actuarial Association (IAA), which is advocating the internationalization of actuarial education. Although the authors of the book are all based in the United Kingdom, the book has been written to present the principles of actuarial applications, rather than the details of practices specific to certain jurisdictions, with various examples taken from the United States and the United Kingdom for illustration.

A crucial role of the actuary is the management of asset liability risk that is critical to financial institutions. This belief explains why *Modern Actuarial Theory and Practice* devotes its first part, comprised of chapter 1 through chapter 5, to issues of investments management and asset allocation. After an overview of financial intermediaries and their economic functions (chapter 1) and the investment instruments available to financial institutions (chapter 2), chapter 3 examines the principles of asset liability management and the management of investment risk. Matching asset and liability by different criteria, relationships between risk and return, institutional and governmental influences like taxation and legal constraints, and policyholder preferences are all discussed. The same chapter then applies the reviewed theory to different types of financial institutions including pension funds, life insurance companies, non-life insurance companies, and personal investments, for comparisons of different investment policies.

Chapters 4 and 5 concentrate more on technical issues, namely, measurement of investment risk and scientific techniques used in portfolio selection and asset allocation, major topics of modern portfolio theory. Utility theory, coherent risk measure, and the use of shortfall constraints are developed for the purpose of risk measurement. The applications of simulation, numerical methods, and stochastic modeling are discussed in the context of asset allocation given the presence of liabilities constraints. The authors, in particular, describe the Wilkie stochastic investment model as an example of statistical modeling of investment return patterns.

Part I of the book can be viewed as a general analysis of asset management, while the remaining four parts demonstrate ways in which the general analysis can be applied to different types of financial institutions, namely, life insurance, general insurance (or property–liability insurance as it is commonly referred to in North America), pensions, and health insurance.

Chapters 6–11 make up the second part of the book, *Life Insurance*. Chapter 6 reviews the basic operation and general nature of life insurance contracts, together with the risks faced by life insurance companies, a topic that is discussed in depth in chapters 10 and 11. The operations of nonparticipating and participating long-term insurance contracts are the subjects of chapter 7 and chapter 8, respectively. Issues examined

include the operation of the fund, reserving approaches, and the cash value of a contract. For participating contracts, the different profit distribution methods are also discussed, such as the contribution method, the uniform reversionary bonus method, revalorization methods, and the accumulating with profits method. Simple numerical examples are employed to illustrate these benefit structures. Here, actuarial students can find applications of formulas with which they have become acquainted in preparation for Society of Actuaries preliminary exams.

Insurance is a business dealing with risks, involves high financial risks, and is heavily regulated. The authors of the book discuss these topics in the context of life insurance. Chapter 9 describes the rationale and ways for solvency regulation, and the significant effects of such regulation on the reserves of life insurers. Chapter 10 discusses various methods and techniques available to control financial risks carried by life insurers, such as underwriting and reinsurance risks. Chapter 11 emphasizes the role of actuary in the process of risk management, from product pricing and analysis of surplus, to monitoring and updating the assumptions. Since actuaries frequently rely on mathematical or statistical models to capture the characteristics of financial variables, modeling errors constitute one more source of risk for insurance businesses, as is noted in the conclusion of chapter 11.

The range of perils to which property–liability insurance contracts are exposed is much broader than that of a typical life insurance contract. Part III of the book, *General Insurance*, aims to demonstrate how scientific procedures for the classification and assessment of risks, and adequate premiums and reserves can safeguard the business and the policyholders. Chapter 12 provides an introduction to the property–liability insurance markets and contracts and chapter 13 offers a framework of the underlying accounting practices, which helps readers appreciate the dynamics of the operation of a property–liability insurance company.

Chapter 14 concentrates on methods for calculating an "actuarial premium," the best estimate of the present value of all the financial components of the insurance contract. Specifically, this chapter reviews risk factors and rating factors needed for and approaches to calculating the expected claims, i.e., the risk premium. Census method, exact method, statistical modeling, and analysis of claims data are in turn discussed in the context of deriving the expected claims. Measuring expenses and experience rating using credibility theory are also presented in this chapter because of their practical importance.

After a discussion of the operation of the reinsurance market in chapter 15, chapter 16 describes basic methods that can be applied in the estimation of claims reserves, the liability of an insurer arising from unexpired insurance policies. The apparent profitability and solvency of a business is highly dependent on the reserve level and the reserving philosophy, as well as regulatory provisions. Chapter 16 introduces classifications of reserves and basic steps in the reserving process. More importantly, the fifth section of the chapter describes different approaches to estimating reserves, for instance, basic chain ladder, separation technique, loss ratio, and Bornheutter-Ferguson method, to name a few. Advances in computing power and statistical modeling have resulted in a proliferation of regression techniques in modeling reserve development. Chapter 16 briefly discusses some of the techniques.

The fourth part of the book is devoted to actuarial issues of pension plans, such as valuation of assets and investment strategies. An overview of different pension plans, namely defined-benefit, defined-contribution, and hybrid plans, is presented in chapter 17. Because the sponsor of a defined-benefit plan is obliged to ensure the promised benefits to its members, a better estimation of future benefits and contribution is helpful in understanding the financial health of a plan. Chapter 18 describes actuarial modeling of defined-benefit plans for the purpose of the determination of levels of plan funding and the valuation of financial status. It reviews the nature of cash-flow projections, the role of actuarial valuation, the range of funding methods, and the different approaches to the valuation of plan assets. Chapter 19 then discusses investment strategy, another important issue to defined-benefit plans. Stochastic asset/liability modeling tools are reviewed as quantitative approaches to optimizing the investment portfolio of a pension fund.

The economic security of individual retirement has been described as being like a three-legged stool (see for instance, chapter 16 of *Life and Health Insurance*, 13th edition, by K. Black and H. D. Skipper). As more employers move from defined-benefit plan to defined-contribution plan and the crisis of the current social security system looms, individuals are, to an increasing extent, responsible for important funding and investment decisions affecting their retirement incomes, and therefore bear the associated risks. Chapter 20 of the book discusses individual pension issues on which pension actuaries can provide advice. Both deterministic and stochastic approaches are reviewed.

The last part, Part V, of the book considers health insurance. This part starts with an introductory chapter that introduces the major types of health insurance and considers the key contract features and the risks facing the insurance provider. The remaining four chapters of the part, as well as of the book, are devoted to each of the four principal products offered within the health insurance market: income protection (disability insurance), critical illness, long-term care, and private medical insurance.

For each of the main policies, product design, underwriting, pricing, claim management, and reserving are discussed. In the section on pricing, the application of multiple-decrement models is reviewed, among other widely used pricing methodologies. In addition, the authors have noted and pointed out that private medical insurance is essentially short-term coverage similar to the property–liability insurance considered in Part III, while the other three major health insurance products are more in line with life insurance because of their long-term characteristics.

The authors have updated the first edition of the book to reflect the developments in the actuarial profession since the publication of the first edition in 1998, to integrate theories and applications in the rapidly growing field of financial economics—for instance, market-consistent valuation methods. Another major development of the new edition is the introduction of a new section on actuarial applications in health insurance. Overall, the second edition of *Modern Actuarial Theory and Practice* touches on most areas of actuarial applications, so that people know more about "what actuaries do." More importantly, it can serve as important study material for actuarial students, as well as a desk reference for actuarial professionals in respect to practical actuarial issues.