Modelling Longevity Dynamics For Pensions And Annuity Business Mathematics Texts

A text aimed at researchers and postgraduates actuarial science, statistics, and actuarial mathematics providing a comprehensive and detailed description of statistical methods for projecting mortality, and an extensive discussion of some important issues concerning the longevity risk in the area of life annuities and pension benefits.

Mandatory pensions are a worldwide phenomenon. However, with fixed contribution rates, monthly benefits, and retirement ages, pension systems are not consistent with three long-run trends: declining mortality, declining fertility, and earlier retirement. Many systems need reform. This book gives an extensive nontechnical explanation of the economics of pension design. The theoretical arguments have three elements: 

- Pension systems have multiple objectives—consumption smoothing, insurance, poverty relief, and redistribution. Good policy needs to bear them all in mind. 
- Good analysis should be framed in a second-best context—simple economic models are a bad guide to policy design in a world with imperfect information and decision-making, incomplete markets and taxation. 
- Any choice of pension system has risk-sharing and distributional consequences, which the book recognizes explicitly. Barr and Diamond's analysis includes labor markets, capital markets, risk sharing, and gender and family, with comparison of PAYG and funded systems, recognizing that the suitable level of funding differs by country. Alongside the economic principles of good design, policy must also take account of a country's capacity to implement the system. Thus the theoretical analysis is complemented by discussion of implementation, and of experiences, both good and bad, in many countries, with particular attention to Chile and China.

This comprehensive examination of pension systems in OECD and selected non-OECD countries looks at recent trends in retirement and working at older ages, evolving life expectancy, design of pension systems, pension entitlements, and private pensions before providing a series of country profiles.

The past 50 years have seen an abundance of research on retirement planning and longevity risk. Reviewed here is the academic side of the research and its varied viewpoints and nuances. The evolution of retirement risk models, retirement portfolio problems and solutions, and annuities are some of the many topics covered.

As pension fund systems decrease and dependency ratios increase, risk management is becoming more complex in public and private pension plans. Pension Fund Risk Management: Financial and Actuarial Modeling sheds new light on the current state of pension fund risk management and provides new technical tools for addressing pension risk from an integrated point of view. Divided into four parts, the book first presents the correct measurement of risk in pension funds, fund dynamics under a performance-oriented arrangement, an attribution model for monitoring the performance and risk of a defined benefit (DB) pension fund, and an optimal investment problem of a defined contribution (DC) pension fund under inflationary risk. It also describes a pension plan from a dynamic optimization viewpoint, the optimal asset allocation of U.S. pension funds, the identification of stakeholders' risks, value-at-risk (VaR) methodology, and various effects on the asset allocation of DB pension schemes. The second section focuses on the effects of uncertainty on employer-provided DB private pension plan liabilities; wage-based lump sum payments by death, retirement, or dismissal by the employer; fundamental retirement changes; occupational pension insurance in Germany; and longevity risk securitization in pension schemes. In the third part, the book examines employers' risks, accountability rules and regulations, useful actuarial analysis instruments, risk-based solvency regime in the Netherlands, and the impact of the 2008 global financial crisis on pension participants. The final part covers DB pension freezes and terminations of plans, the two-pillar social security system of Italy, the Greek social security system, the effect of a company’s unfunded pension liabilities on its stock market valuation, and the returns of Spanish balanced pension plans and portfolio performance. With contributions from well-known, international academics and professionals, this book will assist pension fund executives, risk managers, consultants, and academic researchers in attaining a clear picture of the integration of risks in the pension world. It offers a comprehensive, contemporary account of how to handle the risks involved with pension funds.

This 2006 book introduces and develops the basic actuarial models and underlying pricing of life-contingent pension annuities and life insurance from a unique financial perspective. The ideas and techniques are then applied to the real-world problem of generating sustainable retirement income towards the end of the human life-cycle. The role of lifetime income, longevity insurance, and systematic withdrawal plans are investigated in a parsimonious framework. The underlying technology and terminology of the book are based on continuous-time financial economics by merging analytic laws of mortality with the dynamics of equity markets and interest rates. Nonetheless, the book requires a minimal background in mathematics and emphasizes applications and examples more than proofs and theorems. It can serve as an ideal textbook for an applied course on wealth management and retirement planning in addition to being a reference for quantitatively-inclined financial planners.

Mortality improvements, uncertainty in future mortality trends and the relevant impact on life annuities and pension plans constitute important topics in the field of actuarial mathematics and life insurance techniques. In particular, actuarial calculations concerning pensions, life annuities and other living benefits (provided, for example, by long-term care insurance products and whole life sickness covers) are based on survival probabilities which necessarily extend over a long time horizon. In order to avoid underestimation of the related liabilities, the insurance company (or the pension plan) must adopt an appropriate forecast of future mortality. Great attention is currently being devoted to the management of life annuity portfolios, both from a theoretical and a practical point of view, because of the growing importance of annuity benefits paid by private pension schemes. In particular, the progressive shift from defined benefit to defined contribution pension schemes has increased the interest in life annuities with a guaranteed annual amount. This book provides a comprehensive and detailed description of methods for projecting mortality, and an extensive introduction to some important issues concerning longevity risk in the area of life annuities and pension benefits. It relies on research work carried out by the authors, as well as on a wide teaching experience and in CPD (Continuing Professional Development) initiatives. The following topics are dealt with: life annuities in the framework of post-retirement income strategies; the basic mortality model; recent mortality trends that have been experienced; general features of projection models; discussion of stochastic projection models, with numerical illustrations; measuring and managing longevity risk.

The publication assess how pension funds, annuity providers such as life insurance companies, and the regulatory framework incorporate future improvements in mortality and life expectancy.

This paper looks at the longer-term challenges pension funds face as population age and key issues to address to enhance their risk management practices and their role as long-term investors. The paper focuses primarily on Japan, the Netherlands, Switzerland, the United Kingdom, and the United States, where funded pension plans are most developed. The size of pension savings in these countries, their projected growth, and the recent development of funded pension schemes in other countries highlight the fast-growing importance of pension funds for international capital markets and to financial stability.

In the years since the publication of the best-selling first edition, the incorporation of ideas and theories from the rapidly growing field of financial economics has precipitated considerable development of thinking in the actuarial profession. Modern Actuarial Theory and Practice, Second Edition integrates those changes and presents an up-to-date, comprehensive overview of UK and international actuarial theory, practice and modelling. It describes all of the traditional areas of actuarial activity, but in a manner
that highlights the fundamental principles of actuarial theory and practice as well as their economic, financial, and statistical foundations.

This book proposes neural networks algorithms and advanced machine learning techniques for processing nonlinear dynamic signals such as audio, speech, financial signals, feedback loops, waveform generation, filtering, equalization, signals from arrays of sensors, and perturbations in the automatic control of industrial production processes. It also discusses the drastic changes in financial, economic, and work processes that are currently being experienced by the computational and engineering sciences community. Addresses key aspects, such as the integration of neural algorithms and procedures for the recognition, the analysis and detection of dynamic complex structures and the implementation of systems for discovering patterns in data, the book highlights the commonalities between computational intelligence (CI) and information and communications technologies (ICT) to promote transversal skills and sophisticated processing techniques. This book is a valuable resource for a. The academic research community b. The ICT market c. PhD students and early stage researchers d. Companies, research institutes e. Representatives from industry and standardization bodies


Praise for Pension Revolution "When Keith Ambachtsheer puts his keen mind to work on a problem, watch out! Here he exposes today's fragile arrangements for the most serious social dilemma of our times—financing retirement. Then he provides a compelling and powerful set of solutions. His writings are essential reading for all who care about the future of American living standards."

--Peter Bernstein, founder and President, Peter L. Bernstein, Inc., and author of Capital Ideas and Against the Gods "This book describes one of the most ingenious inventions in the history of mankind: pension funds offering credible promises about old-age income. It reads like a thriller: how can well-governed pension funds be created in an imperfect world in which mortals wrestle with foibles and moral shortcomings? One of the world's leading experts on pensions searches for the answer—and finds it."

--Lans Bovenberg, Scientific Director, Network for Studies on Pensions, Aging, and Retirement, Tilburg University, The Netherlands

"Pension Revolution exposes the inadequacies of current pension systems and persuasively makes the case for the fundamental changes that are needed. It is essential reading for both the pension industry and policymakers."

--Elizabeth Bryan, Chair, Investment Committee, Unisuper Management PM Ltd, Australia "Most analyses of complicated issues deal with complexity by simplifying or only looking at one piece-part, and, in doing so, provide limited value. In stark contrast, Keith Ambachtsheer boldly wades into the complexity in Pension Revolution to come up with a valuable integrative solution. He is a most welcome revolutionary!"

--Roger Martin, Dean, Joseph L. Rotman School of Management, University of Toronto, Canada "We have known Keith for over ten years, and consistently over that time, he has constructively and comprehensively challenged conventional wisdom. He has done this so effectively that many of his initial thoughts have now become universally accepted norms. Such is his energy however that he continues to push the boundaries of pension and investment thinking."

--Peter Moon, Chief Investment Officer, Universities Superannuation Scheme Ltd, UK "Pension Revolution not only explains the shortcomings of the existing pension system and the underlying design features that have resulted in the current pension upheaval. It also offers thoughtful and creative suggestions for prospective pension design. A must-read for anyone interested in the future of retirement finance."

--James Poterba, Professor of Economics, Massachusetts Institute of Technology and a member of the TIAA-CREF Board of Trustees

This book, adopting machine learning techniques for the financial planning field, explores the demand for life insurance as seen in previous literature and both estimates and predicts the demand for the adoption of life insurance using these techniques. Previous studies used diverse perspectives, like actuarial and life span, in order to understand the demand for life insurance, though these approaches have shown inconsistent findings. Employing two theoretical backgrounds—ecological systemic theory and artificial intellectual methodology—this book explores a better estimation and a prediction of the demand for life insurance and will be of interest to academics and students of insurance, financial planning, and risk management.

In a time before bonds, treasury notes, or central banks, there were tontines. These were schemes in which a group of investors lent money to a government, corporation, or king, similar to a modern-day loan syndicate. But unlike conventional debt, periodic interest payments were distributed only to survivors. As tontine nominees died, the income of survivors correspondingly increased. Morbid, perhaps, but this was one of the earliest forms of longevity insurance in which the pool shared the risk. Moshe A. Milevsky tells the story of the first tontine issued by the English government in 1693, known as King William's tontine, intended to finance the war against French King Louis XIV. He explains how tontines work, the financial and economic thinking behind them, as well as why they fell into disrepute. Milevsky concludes with a provocative argument that suitably modified tontines should be resurrected for twenty-first-century retirement income planning.

The individual account-based but unfunded approach to mandated public pension systems is a reform benchmark for all pension schemes, promising fair and financially sustainable benefits. Nonfinancial defined contribution (NDC) pension schemes originated in Italy and Sweden in the 1990s, were then adopted by Latvia, Norway, and Poland, envisaged but not implemented in various other countries, such as Egypt and Russia, and remain under discussion in many nations around the world, such as China and France. In its complete form, the approach also comprises budget-financed basic income provisions and mandated or voluntary funded provisions. Volume 1 of this book offers an assessment of countries that were early adopters before addressing key aspects of policy implementation and design review, including how best to combine basic income provisions with an NDC scheme, how to deal with heterogeneity in longevity, and how to adjust NDC scheme design and labor market policies to deliver on reform expectations. Volume 2 addresses a second set of issues, including the gender pension gap and what family policies can do about it within the NDC framework, labor market issues and how to administer challenges of NDC schemes and how countries are coping, the role of communication in these pension schemes, the complexity of cross-border pension taxation, and much more. Progress and Challenges of Nonfinancial Defined Contribution Pension Schemes is the third in a series of books analyzing the progress, challenges, and adjustment options of this reform revolution for mandated public pension systems. Pension reform is a major issue in many countries. The development of the nonfinancial defined contribution pension plan in the 90's was a major advance in pension design. By reporting actual country experiences and exploring properties of plan designs, this latest collection of essays is a valuable contribution, well worth reading. ' Peter Diamond Professor at Massachusetts Institute of Technology; 2010 winner of the Nobel Memorial Prize in Economic Sciences 'A highly stimulating publication for policy makers and researchers alike. It pushes the analytical frontier for policy challenges that all public pension schemes are confronted with but that the nonfinancial defined
contribution approach promises to handle best.' Noriyuki Takayama President, Research Institute for Policies on Pension and Aging, Tokyo, and professor emeritus, Hitotsubashi University, Tokyo 'In a changing world where pensions are more than ever linked to labor markets, communication tools, and flexibility considerations, this anthology provides a unique up-to-date analysis of nonfinancial defined contribution pension schemes. By mixing international experiences and theoretical studies, it demonstrates the high adaptability of such pension schemes to changing social challenges.' Pierre Devolder Professor of Finance and Actuarial Sciences, Catholic University of Louvain, Belgium

This title looks at water availability and water demand in various sectors, estimating the water gap today and through the year 2050. It presents a methodology to prioritise options to bridge the gap, using the marginal cost of water approach. Entrepreneurial Ecosystems and the Diffusion of Startups addresses, for the first time, the emerging role of entrepreneurial ecosystems. Chapters from leading scholars in the fields of entrepreneurship and strategy explore new ideas and provoke debate in both academia and practice. Covering the emergence, dynamics and management of entrepreneurial ecosystems and offering conceptual tools, experimental evidence and practical examples, this book will be invaluable to those seeking a greater understanding of entrepreneurship and startup strategies, both practitioners and students.

Modelling Longevity Dynamics for Pensions and Annuity Business Mathematics

This book summarizes the state of the art in generalized linear models (GLMs) and their various extensions: GAMs, mixed models and creditbility, and some nonlinear variants (GNMs). In order to deal with tail events, analytical tools from Extreme Value Theory are presented. Going beyond mean modeling, it considers volatility modeling (double GLMs) and the general modeling of location, scale and shape parameters (GAMLSS). Actuaries need these advanced analytical tools to turn the massive data sets now at their disposal into opportunities. The exposition alternates between methodological aspects and case studies, providing numerical illustrations using the R statistical software. The technical prerequisites are kept at a reasonable level in order to reach a broad readership. This is the first of three volumes entitled Effective Statistical Learning Methods for Actuaries. Written by actuaries for actuaries, this series offers a comprehensive overview of insurance data analytics with applications to P&C, life and health insurance. Although closely related to the other two volumes, this volume can be read independently.

Focusses on litigation damages, economic and non-economic, including punitive damages; their definitions, calculations, and applications in the US and EU. This book examines areas of convergence and divergence in the academic and practical

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treatment of damages issues in the US and EU.

This book examines the challenges for the life insurance sector in Europe arising from new technologies, socio-cultural and demographic trends, and the financial crisis. It presents theoretical and applied research in all areas related to life insurance products and markets, and explores future determinants of the insurance industry’s development by highlighting novel solutions in insurance supervision and trends in consumer protection. Drawing on their academic and practical expertise, the contributors identify problems relating to risk analysis and evaluation, demographic challenges, consumer protection, product distribution, mortality risk modeling, applications of life insurance in contemporary pension systems, financial stability and solvency of life insurers. They also examine the impact of population aging on life insurance markets and the role of digitalization. Lastly, based on an analysis of early experiences with the implementation of the Solvency II system, the book provides policy recommendations for the development of life insurance in Europe.

This book brings together in one volume what researchers have learned about workers, employers, and retirees that is important for formulating retirement income policies. As the U.S. population ages, there is increasing uncertainty about the solvency of the Social Security and Medicare systems and the adequacy of private pensions to provide for people’s retirement needs. The volume covers such critical behaviors as workers’ decisions to retire, people’s choices of saving over consumption, and employers’ decisions about hiring older workers and providing pension and health care benefits. Also covered are trends in mortality, health status, and health care costs that are key to projecting the likely costs and effects of alternative retirement income security policies and a strategy for combining data and research knowledge into a policy modeling framework.

This paper provides the first empirical assessment of the impact of life expectancy assumptions on the liabilities of private U.S. defined benefit (DB) pension plans. Using detailed actuarial and financial information provided by the U.S. Department of Labor, we construct a longevity variable for each pension plan and then measure the impact of varying life expectancy assumptions across plans and over time on pension plan liabilities. The results indicate that each additional year of life expectancy increases pension liabilities by about 3 to 4 percent. This effect is not only statistically highly significant but also economically: each year of additional life expectancy would increase private U.S. DB pension plan liabilities by as much as $84 billion.

Countries around the world are increasingly relying on individual pension savings accounts to provide income in old age for their citizens. Although these funds have now been in place for several decades, their performance is usually measured using methods that are not meaningful in relation to this long-term objective. The recent global financial crisis has highlighted the need to develop better performance evaluation methods that are consistent with the retirement income objective of pension funds. Compiling research derived from a partnership among the World Bank, the Organisation for Economic Co-operation and Development (OECD), and three private partners, ‘Evaluating the Financial Performance of Pension Funds’ discusses the theoretical basis and key implementation issues related to the design of performance benchmarks based on life-cycle savings and investment principles. The book begins with an evaluation of the financial performance of funded pension systems using the standard mean variance framework. It then provides a discussion of the limitations inherent to applying these methods to pension funds and outlines the many other issues that should be addressed in developing more useful and meaningful performance measures through the formulation of pension-specific benchmark portfolios. Practical implementation issues are addressed through empirical examples of how such benchmarks could be developed. The book concludes with commentary and observations from several noted pension experts about the need for a new approach to performance measurement and the impact of the recent global financial crisis on pension funds.

The interaction between mathematicians, statisticians and econometricians working in actuarial sciences and finance is producing numerous meaningful scientific results. This volume introduces new ideas, in the form of four-page papers, presented at the international conference Mathematical and Statistical Methods for Actuarial Sciences and Finance (MAF), held at Universidad Carlos III de Madrid (Spain), 4th-6th April 2018. The book covers a wide variety of subjects in actuarial science and financial fields, all discussed in the context of the cooperation between the three quantitative approaches. The topics include: actuarial models; analysis of high frequency financial data; behavioural finance; carbon and green finance; credit risk methods and models; dynamic optimization in finance; financial econometrics; forecasting of demographic and economic phenomena; fund performance evaluation; insurance portfolio risk analysis; interest rate models; longevity risk; machine learning and soft-computing in finance; management in insurance business; models and methods for pension time series analysis, models for financial derivatives; multivariate techniques for financial markets analysis; optimization in insurance; pricing; probability in actuarial sciences, insurance and finance; real world finance; risk management; solvency analysis; sovereign risk; static and dynamic portfolio selection and management; trading systems. This book is a valuable resource for academics, PhD students, practitioners, professionals and researchers, and is also of interest to other readers with quantitative background knowledge.

This paper discusses a study analyzing aging populations and public pension schemes. An aging society is characterized by a growing proportion of the retired to the active working population. The study examines the pension-related aging problem primarily from a fiscal perspective. It analyzes how prospective demographic developments that affect the proportion of the pensionable elderly affect pension outlays. It confirms that very serious fiscal stresses are in prospect for most industrial economies. Addressing such problems satisfactorily will require major actions early, given the long lead times involved in reforming a pension fund’s financial position.

Old age income support will be one of the biggest social and economic challenges facing Asia in the twenty-first century. The growing spotlight on old age income support is largely due to exceptionally rapid population aging which is fundamentally reshaping Asia’s demographic profile. A young continent reaping the demographic dividend of a large youthful workforce is giving way to a greying continent where the ratio of retirees to workers is on the rise. In contrast to industrialized countries, most Asian countries do not yet have mature, well-functioning pension systems. As a result, they are ill-prepared to provide economic security for the large number of retirees who loom on the region’s horizon. This book takes a close look at the pension systems of eight countries in East and Southeast Asia – namely, China, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand and Vietnam – which encompass a wide range of income and development levels. The book provides a comprehensive overview of the pension systems in the eight countries, including an in-depth diagnosis to identify their major weaknesses and shortcomings. On the basis of the diagnosis, the book sets forth concrete and specific policy options for reforming Asia’s pension systems. Many policy options for reform are country-specific. For example, a top priority in China is to extend the pension system to rural areas. At the same time, a number of reforms – such as the need to extend coverage – resonate across the entire region. Appropriate reform will enable the region’s pension systems to deliver affordable, adequate and sustainable old-age economic security.

Worldwide life expectancy has increased and, as such, this book examines different aspects of aging from societal and political perspectives. Written by reputable academics working at universities around the world (Australia, New Zealand, Portugal, Taiwan, Tanzania, Russia), this book takes a kaleidoscope view of how different societies handle their aging population. While not attempting to train readers as professional economists, this book aims to provide a secure grounding in the theory and practice of economics insofar as it deals with pension matters. From reading this book, the user will understand: * The key types of pension scheme *
The role of pensions in maximizing individual lifetime welfare * The role of pensions in individual savings and retirement decisions * The role and consequences of the pension plan from the company's viewpoint * The role of pensions in promoting aggregate savings * The role of pensions and retirement in overlapping generations models * The economics of ageing and intergenerational accounting * The social welfare implications of pensions * The lessons of behavioural economics for pensions

Originally published in 2005, Weather Derivative Valuation covers all the meteorological, statistical, financial and mathematical issues that arise in the pricing and risk management of weather derivatives. There are chapters on meteorological data and data cleaning, the modelling and pricing of single weather derivatives, the modelling and valuation of portfolios, the use of weather and seasonal forecasts in the pricing of weather derivatives, arbitrage pricing for weather derivatives, risk management, and the modelling of temperature, wind and precipitation. Specific issues covered in detail include the analysis of uncertainty in weather derivative pricing, time-series modelling of daily temperatures, the creation and use of probabilistic meteorological forecasts and the derivation of the weather derivative version of the Black-Scholes equation of mathematical finance. Written by consultants who work within the weather derivative industry, this book is packed with practical information and theoretical insight into the world of weather derivative pricing.

This second edition expands the first chapters, which focus on the approach to risk management issues discussed in the first edition, to offer readers a better understanding of the risk management process and the relevant quantitative phases. In the following chapters the book examines life insurance, non-life insurance and pension plans, presenting the technical and financial aspects of risk transfers and insurance without the use of complex mathematical tools. The book is written in a comprehensible style making it easily accessible to advanced undergraduate and graduate students in Economics, Business and Finance, as well as undergraduate students in Mathematics who intend starting on an actuarial qualification path. With the systematic inclusion of practical topics, professionals will find this text useful when working in insurance and pension related areas, where investments, risk analysis and financial reporting play a major role.

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