



Conference in Celebration of David Wilkie's 90th Birthday

Date: Thursday 11th April 2024, between 09.15 and 18.00.

Venue: The Guildhall, York.

Organising Committee: Prof. Alexander McNeil and Dr. Şule Şahin

Time	Welcome (09.15 - 10.30)
09.15 - 09.30	Registration
09.30 – 10.10	Welcome Speeches
	Şule Şahin
	Bob Doherty (Dean of SBS)
	Alexander McNeil
	Kalpana Shah (IFoA President)
10.10 - 10.30	Honorary Title Ceremony
	A. D. Wilkie

10.30 – 11.00	Coffee break
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Time	Session 1 (11.00 – 12.30) Mortality, Longevity and Pensions
Chair	Alexander McNeil
11.00 – 11.30	Andrew Cairns (Heriot-Watt University, Edinburgh) <i>Higher-Age US Mortality by Education and Cause of Death: Trends, Inequality and Controllable Risk Factors</i>
11.30 – 12.00	Mary Hardy (University of Waterloo, Canada) <i>Fairness and Sustainability of Target Benefit Pension Plans</i>
12.00 – 12.30	Moshe A. Milevsky (York University & The IFID Centre, Canada) <i>The Religious Origins of Longevity Risk Pooling</i>

12.30 – 13.45	Lunch break
Time	Session 2 (13.45 – 14.45) Economic Scenario Generators
Chair	Şule Şahin
13.45 – 14.15	Andrew Smith (University College Dublin, Ireland) <i>Do Advanced Features of Economic Scenario Generators Matter?</i>
14.15 – 14.45	Alasdair Thompson (Moody's Analytics, Edinburgh) <i>How to Incorporate Climate into Scenario Generators</i>

Time	Session 3 (14.45 – 15.45) Continuous Mortality Investigation (CMI)
Chair	Torsten Kleinow
14.45 – 15.15	Stuart McDonald and Vivienne Maclure (Continuous Mortality Investigation, London) <i>CMI – 100 years of insight</i>
15.15 – 15.45	Hande Love (Hymans Robertson, London) <i>Critical Illness Rates Then and Now: A Comparative Commentary on the CMI's Tables</i>

15.45 – 16.15	Coffee break
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Time	Session 4 (16.15 – 17.30) Contributed Talks
Chair	Paul Sweeting
16.15 – 16.30	Aniketh Pittea (Grant Thornton UK LLP) and Alex Diana (University of Essex) <i>A Bayesian framework for flexible mortality modelling: Integrating Diverse Effects for Comprehensive Assessment of Longevity Risks</i>
16.30 – 16.45	Kyu Hyung Park (ARC Centre of Excellence in Population Ageing Research (CEPAR), University of New South Wales) <i>Developing private long-term care insurance in Australia: Pricing analysis for healthy and ill Australian retirees</i>

16.45 – 17.00	Oliver Lockwood (Independent Consultant) <i>Real-time updating of mortality projections</i>
17.00 – 17.15	Michelle Dong (The Australian National University, Australia) <i>A Compositional Approach to Modelling Cause-Specific Mortality with Zero Counts</i>
17.15 – 17.30	Phelim P. Boyle (University of Waterloo, Canada) <i>Ponzi Schemes</i>

17.30 – 17.40	Closing Ceremony
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Individual Donor:

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ABSTRACTS

Session 1 (11.00 – 12.30)

Mortality, Longevity and Pensions

Andrew Cairns (Heriot-Watt University, Edinburgh)

Higher-Age US Mortality by Education and Cause of Death: Trends, Inequality and Controllable Risk Factors

Abstract: We will present the results of an empirical analysis of US mortality over the period 1989 to 2017 by gender, age, education level, and by cause of death. The use of 51 causes of death, rather than a much smaller number, allows us to focus on the roles of controllable, preventable, and non-preventable risk factors as determinants of mortality inequality.

A wide range of graphical diagnostics can be used to highlight particular features of the data that might not be clear if we were to rely on a small number of standard mortality plots. These are used in a number of vignettes that allow us to gain new insights into various groups of causes of death. In broad terms, we find considerable variation in improvement rates by cause, considerable variation in levels of mortality inequality by education level linked to the presence of controllable risk factors, and generally increasing levels of inequality over time.

Mary Hardy (University of Waterloo, Canada)

Fairness and Sustainability of Target Benefit Pension Plans

Authors: Mary Hardy, David Saunders (University of Waterloo) and Mike Xiaobai Zhu (Chinese University of Hong Kong)

Abstract: In this talk we explore a form of target benefit (TB) plan that allows for structured, transparent intergenerational risk sharing. We adapt results from mathematical analysis of stylized TB plans to explore the real world implications of different benefit designs and demographics, through stochastic simulation. We consider five broad areas of comparison: affordability (average cost), sustainability (volatility of costs), efficiency, adequacy of benefits, and fairness.

Moshe A. Milevsky (York University & The IFID Centre, Canada)

The Religious Origins of Longevity Risk Pooling

Abstract: This presentation is about the history of financing the cost & risk of longevity, and the rather surprising role of religion in that process. The focus is on the Presbyterian Church of Scotland's annuity scheme for widows and orphans, whose genesis took place 280 years ago.

The renowned economist Adam Smith was among the notable figures who participated in this annuity scheme which has gained much notoriety among actuaries. Indeed, many have praised the 1744 annuity scheme as a revolutionary development in actuarial science, probability, and statistics. Some authors, such as Niall Ferguson (2008) and Yuval Noah Harari (2014) have gone so far as to argue that 1744 was a breakthrough moment and an enlightened “victory of science over superstition.” However, a closer look at the archival records reveals a more nuanced account. The documentary evidence suggests that Protestant beliefs, practices and institutions played a vital role in developing best practices for managing the annuity scheme and the embedded longevity risk. These 18th-century “financial engineers” and fund trustees were devoutly religious individuals, many of whom believed mortality rates followed “divine probabilities” and that stochastic modelling was another branch of theology. In sum, I argue that the tenets and institutions of religious faith should be granted (additional) credit for the origins of retirement annuity financing, and for providing the confidence to make century-long actuarial projections. At the time these forecasts bordered on prophecies.

Session 2 (13.45 – 14.45)

Economic Scenario Generators

Andrew Smith (University College Dublin, Ireland)

Do Advanced Features of Economic Scenario Generators Matter?

Abstract: This talk explores two ESG applications: the dynamic hedging of a guarantee and the funding of a defined benefit pension scheme. We compare results from a random walk asset model to those of more sophisticated auto-regressive scenario generators. The latter permit serial correlations between asset returns in different years, while random walks assume returns are independent. We explain the impact of ESG choices using the concept of resonance, that the pattern of sales and purchases generated by hedging or funding algorithms may incidentally exploit trading opportunities within an auto-regressive asset model. The resonance effect causes a fund's money-weighted returns to diverge from the time-weighted returns typically disclosed as ESG assumptions.

Alasdair Thomson (Moody's Analytics, Edinburgh)

How to Incorporate Climate into Scenario Generators

Abstract: Climate change is one of the defining challenges for this century, and increasingly a key consideration is long-term financial planning and forecasting. I will discuss how long term expectations for financial variables such as interest rates, inflation and equity returns can be embedded within a standard calibration for a stochastic scenario generator, and then explain how these can be adjusted to account for different potential climate pathways in the future, taking account of the varied risks and uncertainties involved in this process.

Session 3 (14.45 – 15.45)

Continuous Mortality Investigation (CMI)

Stuart McDonald and Vivienne Maclure (Continuous Mortality Investigation, London)

CMI – 100 years of insight

Abstract: As the CMI celebrates its centenary year, we look back at the key milestones (including those where David Wilkie played a large part) that have contributed to the evolution of the CMI into the organisation as we currently know it. We will also summarise some key outputs and themes that are relevant to the CMI, and its subscribers, today.

Hande Love (Hymans Robertson, London)

Critical Illness Rates Then and Now: A Comparative Commentary on the CMI's Tables

Abstract: This presentation aims to provide a brief history of the construction of critical illness tables, followed by a comparison of the rates published throughout their evolution. Additionally, the future outlook of critical illness tables will be explored, shedding light on what lies ahead in this field.

Session 4 (16.15 – 17.30)

Contributed Talks

Aniketh Pittea (Grant Thornton UK LLP) and **Alex Diana** (University of Essex)

Authors: Aniketh Pittea (Grant Thornton UK LLP), Alex Diana (University of Essex) and Jackie Wong Siaw Tze (University of Essex)

A Bayesian framework for flexible mortality modelling: Integrating Diverse Effects for comprehensive Assessment of Longevity Risks

Abstract: Mortality models play a central role for insurance and annuity providers in understanding and quantifying longevity risks. In the UK, with the Bulk Purchase Annuities (BPA) market booming, significant reliance is being placed on mortality models to understand the annuity risks on businesses worth several millions of pounds. This creates a need for mortality models which can provide an accurate and comprehensive view of the longevity risks whilst being flexible enough to capture specific effects practitioners may be interested in.

Mortality models have a long history, and widely accepted models in the literature include the Lee-Carter, P-splines models and CMI models. These models tend to capture age, period, and cohort effects on longevity. In recent years, significant research has gone into extending mortality models to capture additional effects such as climate change or GDP-related effects. These extensions are usually achieved by adding new terms to existing mortality models, which leads to many combinations of models to be considered. However, this leaves practitioners with the issue of model selection. Traditionally, model selection in the context of mortality modelling has been achieved by fitting all the models under consideration and ranking them using a model selection criterion, such as AIC. This has certain disadvantages; for example, this requires practitioners to fit many different models and manually compare them. Another disadvantage is that considering only one final model necessarily leads to loss of information since other models may also be informative.

In this paper, we propose a general and flexible modelling framework for extending mortality models to allow for additional effects, such as duration, gender or insurance products. First, we build a comprehensive model which encompasses a wide variety of models considered in the literature. Next, we provide a novel inference approach where selection among these models is an integrated part of model fitting. This eliminates the need for manual model selection and provides a general framework which includes a variety of models. We achieve this by using a Bayesian model selection procedure, which is an established technique for selecting different variables or different model variations. The approach allows the full model to tailor itself towards specific terms as informed by the data while discarding terms that are not relevant.

Finally, we have implemented our model in an R package so that practitioners can easily consider additional effects (either continuous or categorical) into their mortality modelling and select the model variation which is more strongly supported by the data. We demonstrate our framework by focusing specifically on product and duration-related effects on mortality using data provided by the CMI.

Kyu Hyung Park (ARC Centre of Excellence in Population Ageing Research (CEPAR), University of New South Wales)

Developing private long-term care insurance in Australia: Pricing analysis for healthy and ill Australian retirees

Abstract: Establishing a private long-term care insurance (LTCI) market in Australia requires calculation of LTCI product costs based on a reliable actuarial model suited to the local population. Utilising our existing five-state Markov model on functional disability and chronic illness, we estimated premiums for various LTCI products, encompassing stand-alone LTCI and life care annuity (LCA), and assessed the impact of these products on an individual's utility. The model was estimated using Australian data from 1998 to 2018, and considers factors including age, sex, and (optionally) trend. For product design and assumptions, we factored in the public aged care co-payment requirement, comfortable consumption level and aged pension for Australian retirees, the Solvency II capital requirement (SCR), and insights gained from our systematic literature review on LTCI pricing methods and outcomes. The stand-alone LTCI was devised to provide a \$1,500 monthly disability benefit, capped at \$76,000 over a lifetime. The LCA combined a \$1,000 monthly life annuity payment with the stand-alone LTCI. The estimated premiums were influenced by greater mortality among ill

retirees compared to healthy counterparts, longer life expectancy of female than male, and the trend of increasing life expectancy but decreasing time spent with disability. The SCR component amounts to 14% to 24% of the stand-alone LTCI premiums, and 5% to 7% of the LCA premiums. In most cases, purchasing an LTCI product increased individual's utility, although the degree relied on factors like expense loading and the extents of individual's risk aversion, wealth, and bequest motive. The development of an Australian private LTCI market requires meticulous attention to population structure, customer preferences, insurability and trend associated with ageing in Australia.

Oliver Lockwood (Independent Consultant)

Real-time updating of mortality projections

Abstract: The Continuous Mortality Investigation (CMI) Mortality Projections Model, the standard tool used in the United Kingdom pensions and life insurance industry to specify longevity improvement assumptions, is updated by the CMI only once a year. As a result, pension and life insurance providers can incur substantial impacts upon their financial positions on an annual basis from updating these assumptions. However, the England and Wales population mortality data underlying the Model can be updated more frequently using, in particular, the weekly deaths data published by the Office for National Statistics (ONS). This paper investigates the impact upon sample expectations of life of recalibrating the Model regularly based on the weekly deaths data. Such a procedure will enable pension and life insurance providers to manage longevity and mortality risk in a manner more akin to market risks, in respect of which their reported financial position is calculated based on the latest available data. The analysis necessitates reconsideration of the approach to allowing for the COVID-19 pandemic in the CMI Mortality Projections Model.

Michelle Dong (The Australian National University)

A Compositional Approach to Modelling Cause-Specific Mortality with Zero Counts

Abstract: In this talk we discuss ways to model trends in cause-specific deaths using compositional data analysis (CODA). We consider the alpha transformation as a method to address a common drawback in CODA methods: the inability to handle zero values, which frequently occurs in cause-of-death mortality modelling, e.g., when studying new or emerging causes of death or at older ages. The alpha transformation is a compositional power transformation, which offers a statistically rigorous approach to handling zero-value subgroups in CODA compared to ad-hoc techniques such as adding an arbitrarily small amount. We apply the alpha-transformation to 16 years of England and Wales data from the Human Cause-of-Death database (2001-2016), disaggregated for cardiovascular-related causes of death. Results demonstrate the alpha-transformation leads to more accurate forecasts of cause-specific life-table death counts compared with log-ratio-based CODA transformations, with forecasts suggesting declines in the proportion of deaths due to major cardiovascular causes (myocardial infarction and other IHD) are offset by proportional increases in other cardio causes.

Phelim P Boyle (Adjunct Professor University of Waterloo)

Ponzi Schemes

Abstract: A Ponzi scheme is a type of financial fraud wherein a promoter promises superior returns to attract investors. However, the monies collected are not invested in securities or real assets, but used to perpetuate the scam and fund the promoter's life style. The funds from the later investors are used to pay for the benefits of earlier investors who withdraw. To sustain the scheme, the number of new investors has to increase above a certain threshold rate. In addition, the scheme has to avoid detection to survive. This talk will describe the main features of these scams and discuss how investors can protect themselves.
