UK Mortality and Longevity Update Nov 2016 1

Thanks to the many people who have contributed. If you have any comments or further news, or would like to be put on the circulation list, please email me – address at bottom.

It would be helpful to have your advice on whether these Updates are useful to you and what changes you would like to see: please do complete the very short questionnaire **here**.

Contents

1. Highlight: International Mortality and Longevity Symposium 2016

A record-breaking 180 people attended this symposium, held in Royal Holloway College in Sept 2016.

Papers and presentations are individually hyperlinked below

Plenary 1: Can we live forever?
Plenary 2: Causal model for mortality, morbidity and longevity
Plenary 3: Longevity and Fiscal Policies
Plenary 4: Health and longevity - can we have both?
Plenary 5: Big Data & longevity, morbidity or mortality
Plenary 6: How do you know if you're ageing faster than others?

A1: Coherent Mortality Projections for the Netherlands Taking into Account Mortality Delay and Smoking
A2: Extreme Scenarios for Pandemic Risk
A3: Forecasting Mortality by Cause of Death
A4: Use of Routinely Collected Primary Care Data to Model Longevity and Longevity Improvement
B1: Inferences for Maximum Country Life Expectancy using Provincial Data
B2: Explaining the Female Longevity Puzzle
B3: CMI Update on Longevity Modelling and High Age Mortality
B4: Stochastic Mortality Forecasting with Smoothing and Overdispersion
B5: Introduction of China Life Insurance Mortality Table 2010-2013
C2: When is a Cohort Not a Cohort? Spurious Parameters in Stochastic Longevity Models
C3: Semi-Parametric Extensions of the Cairns-Blake-Dowd Model: A One-Dimensional Kernel Smoothing Approach

C4: Socioeconomic Differentials in Multimorbidity and Health Expectancy Using Electronic Health Records - Methodological Challenges
C5: Parameter Risk in Time-Series Mortality Forecasts
D1: Forecasting Socio-Economic Differences in the Mortality of Danish Males
D2: Evidence and Implications of Socioeconomic Differences in Mortality
D4: Behavioural and Psychological Drivers of Mortality
D5: Does Money Buy you Longevity?

ARC Session Thursday: Coherent mortality forecasting: the multilevel functional principal component analysis approach
ARC Session Thursday: Model Independent Price Bounds for Catastrophic Mortality Bonds
ARC Session Wednesday: Bayesian Inference for Small Population Longevity Risk Modelling
ARC Session Wednesday: Multi-population mortality models

One session that attracted a great deal of interest was C2, Jon Palin's: "When is a Cohort Not a Cohort? Spurious Parameters in Stochastic Longevity Models"

2. Institute and Faculty of Actuaries

Continuous Mortality Investigation (CMI)

Reviewing the Mortality Projections Model

The CMI Mortality Projections Model is used extensively by UK actuaries in pensions and life insurance work. The Mortality Projections Committee has been reviewing the Model and in June released Working Paper 90 describing its proposed changes.

The Committee released a further technical working paper, Working Paper 91, and illustrative software in August.

The working papers, slides from consultation meetings and software are all publicly available from the CMI pages of the IFoA website. (Please note that Working Paper 90 was reissued with revised illustrative life expectancy values in July).

Assurances (critical illness and mortality)

The Assurances Committee has issued proposed graduations of the 2007-2010 **term mortality data**. These are described in CMI Working Paper 92 which was published in October 2016. The paper and the accompanying spreadsheets are available to Authorised Users only but an Executive Summary of the paper is publically-available.

The Committee has updated CMI Working Paper 89 which was originally published in May 2016 and describes proposed graduations of the 2007-2010 **accelerated critical illness data**.

The deadline for responses to the consultation for both sets of tables is 30 November 2016.

IFoA Mortality Research Steering Committee (MRSC)

The Human Mortality Database (HMD)

The HMD is a unique open- access collection of detailed mortality and population data for 38 countries with relatively complete and reliable vital registration and census data. It is much used by researchers and practitioned throughout the world.

The IFoA's Research and Thought Leadership Committee has committed to funding a grant to the HMD for up to 5 years subject to progress, and Joseph Lu, Chair of the MRSC is working with Magali Barberi of HMD to found a User Group.

Following the publication of **Longevity Bulletin 8: Antimicrobial resistance**, the profession organised a multi-disciplinary conference: **Antibiotic Resistance: An Evolving Threat, May 2016**
It covered the scale and impacts of the factors driving antibiotic resistance and the risk associated consequences; and considered ideas on what government, health practitioners, businesses and the actuarial profession can do to address this global problem

Papers and presentations are individually hyperlinked below

Antibiotic resistance and longevity improvements
Clinical implications of AMR
Current developments and research in creating new antibiotics

Opening up the IFoA journals and conference proceedings to the world

From January 2017, the IFoA will open up future volumes of the British Actuarial Journal (BAJ) for all to view for free, making IFoA research more accessible to a wider audience.

The IFoA makes a wide variety of its residential conference papers and presentations freely available to the public three months after each conference. The Conference paper archive is here:
https://www.actuaries.org.uk/learn-and-develop/conference-paper-archive/2016

Additionally, the IFoA's Youtube channel has a number of presentations recorded at meetings
https://www.youtube.com/user/actuarialprofession/videos?sort=dd&view=0&shelf_id=2

3. Other UK papers, presentations and articles

Office for National Statistics

National life tables, UK: 2013–2015, published Sept 2016
UK life expectancy at birth was: males 79.1 females 82.8 (based on three-year rolling average 2013–2015s). Life expectancy at birth has increased by 13.1 weeks per year on average since 1980–1982 for males and 9.5 weeks per year on average for females in the UK.

UK life expectancy at 65 was: males 18.5 females 20.9.

Life expectancy in England is higher than the other three constituent countries for both sexes and both ages.

Estimates of the Very Old, including centenarians (EVOs), published Sept 2016
"The number of centenarians in the UK continues to increase year on year reaching just over 14,500 in 2015. Although the majority of the very old are women the number of men reaching the oldest ages is increasing as male mortality improves."

Other

Mis-estimation risk: measurement and impact - Abstract of the Edinburgh Discussion BAJ Oct 2016
Stephen Richards' paper was discussed in Edinburgh and the transcript is here.

Modelling the reverse select and ultimate mortality experience of UK ill-health retirement occupational pension scheme members, Hall and Daly, Annals of Actuarial Science (2016) 10(2) : 222-235. [RKN: 48515]
Models the mortality of ill-health retirements from occupational pension schemes in the United Kingdom in the period immediately following retirement (reverse select mortality) and over the longer term (ultimate mortality) allowing for age at retirement. Females experience a longer reverse select period than males and for both males and females the improvement in mortality rates over the reverse select period is greatest at younger ages.

Can aging be programmed? A critical literature review, Kowald and Kirkwood Aug 2016
"Over recent years a number of articles have appeared that propose the existence of specific aging genes; that is, that the aging process is genetically programmed. If this view were correct, it would have serious implications for experiments to understand and postpone aging. Therefore, we studied in detail various specific proposals why aging should be programmed. We find that not a single one withstands close scrutiny of its assumptions or simulation results. Nonprogrammed aging theories … are still the best explanation for the evolution of the aging process. We hope that this analysis helps to clarify the problems associated with the idea of programmed aging."

DNA methylation-based measures of biological age: meta-analysis predicting time to death. Brian H Chen et al. Aging, Volume 8, Issue 9. Sept 2016
"Estimates of biological age based on DNA methylation patterns, often referred to as "epigenetic age", "DNAm age", have been shown to be robust biomarkers of age in humans."

"This study a) strengthens the evidence that epigenetic age predicts all-cause mortality above and beyond chronological age and traditional risk factors, and b) demonstrates that epigenetic age estimates that incorporate information on blood cell counts lead to highly significant associations with all-cause mortality."

Effect of Dietary Patterns on Muscle Strength and Physical Performance in the Very Old: Findings from the Newcastle 85+ Study Granic et al, March 2016. PLoS ONE 11(3): e0149699. doi:10.1371/journal.pone.0149699
This paper investigates the determinants of decline in muscle strength and physical performance, particularly diet, in the very old (aged 85+) and concludes that dietary patterns high in red meats, potato and gravy, or butter may adversely affect muscle strength and physical performance in later life, independently of important covariates and cognitive status.

'Future of an ageing population' Foresight report from the UK Government Office for Science July 2016
"The Government Office for Science published their 'Future of an ageing population' report. The report, 3 years in the making, brought together evidence about today's older population, with future trends and projections, to identify the implications for the UK. This evidence will help government to develop the policies needed to adapt to an ageing population."

An investigation into inequalities in adult lifespan, Mayhew and Smith, Cass, May 2016
"People in the UK are living longer than ever but the gap between the oldest and shortest lived

appears to be increasing…. Since chronic disease is often attributable to life choices such as smoking and diet, the blame for the widening must be laid increasingly at the door of individual lifestyles rather than ambient risks and hazards. Article: Investigating the widening gap in life expectancy between richest and poorest

Modelling Socio-Economic Differences in the Mortality of Danish Males Using a New Affluence Index, Cairns et al, June 2016
Investigates and models how the mortality of Danish males aged 55-94 has changed over the period 1985-2012 using ten socio-economic subgroups based on affluence. Article "A new Affluence Index to help governments and pension providers improve forecasts of mortality rates", Blake et al, June 2016 states: "the research can be applied to any country with reliable measures of income and wealth at high ages, including the UK. ….. The improved forecasts would be very useful for both policy makers planning national pension budgets and private-sector providers of financial products."

The new arms race against bacteria. Article by Edwards and Oliver, The Actuary June 2016 Page 28
Reviews the emergence of antibiotic-resistant bacteria, their plausible effects on mortality and recent progress in the development of new drugs.

Making sense of senescence, Article by Gavin Ritchie
"One way to target simultaneous progress against multiple diseases of aging would be to find plausible common factors to act against. Increasingly, researchers believe a plausible common factor is systemic inflammation"
Article provides hyperlinks to a variety of papers on relevant aspects of Inflammation.

Pensioners – the youth of today, Article by Iain Currie
Examines mortality improvements for males aged 50 to 95 between 1961 and 2012 in four countries: UK, USA, Netherlands and Japan. Comments: "From the immediate actuarial perspective, the greatest improvements, particularly in the UK, occur just where they will have the greatest impact on pensions and annuity profitability. For the very old, mortality improvements are harder to come by. But who knows what impact regenerative medicine may have on old-age mortality some time in the future?"

4. International papers, presentations, articles and websites

WHO Framework Convention on Tobacco Control's Report: **Electronic Nicotine Delivery Systems and Electronic Non-Nicotine Delivery Systems (ENDS/ENNDS)** Aug 2016 will be discussed in Delhi, 7-12 November. The report dismisses studies of the effectiveness of E-cigarettes as a smoking cessation aid as "of low certainty" and suggests that the increase in use among young non-smokers may be a precursor to smoking. Delegates will be asked inter alia to consider introducing into national laws to prevent the initiation of ENDS/ENNDS by non-smokers and youth.

This has caused some criticism from the UK where an evidence review from Public Health England, **E-cigarettes: a new foundation for evidence-based policy and practice**, 2015, found that: "There has been a rise in e-cigarette use that has been matched by a corresponding decrease in smoking", "Over recent years, e-cigarettes have risen in popularity to become the number one quitting aid used by smokers", and that "the current best estimate is that e-cigarette use is around 95% less harmful to health than smoking"

The Association Between Income and Life Expectancy in the United States, 2001-2014
Chetty et al. *JAMA.* 2016;315(16):1750-1766. doi:10.1001/jama.2016.4226
"They document large and growing gaps in life expectancy between the poorest and richest Americans and show that these differences vary greatly across areas within the United States, offering a new lens to study the determinants of disparities in health in the United States."

Assessing implicit hypotheses in life table construction, Lledó et al., Scandinavian Actuarial Journal
"General population life tables are constructed from aggregated statistics, an issue that usually entails adopting some (implicit) assumptions in their construction , such as the hypothesis of closed demographic system or the hypotheses of uniform distributions of death counts (and migration events) by age and calendar year." Argues that more efficient estimators (based on microdata) should be promoted, as differences persist depending on the estimator computed.

Convergence in male and female life expectancy: Direction, age pattern, and causes
Seligman et al, Demographic Research. Vol 34, Article 38
Exemining the Lee Carter model, concludes inter alia: "Lee-Carter forecasts have significantly underestimated gains in male life expectancy without major changes to the model's assumptions."

Evidence for a limit to human lifespan, Dong et al. Oct 2016 Nature doi:10.1038/nature19793
"By analysing global demographic data, we show that improvements in survival with age tend to decline after age 100, and that the age at death of the world's oldest person has not increased since the 1990s. Our results strongly suggest that the maximum lifespan of humans is fixed and subject to natural constraints."

The European Life and Health Underwriters' Association (ELHUA) held its conference in September 2016. Papers are not available to non-members.

Longevity 12: Twelfth International Conference on Longevity Risk and Capital Market Solutions
was held in Sept 2016 in Chicago
The full set of presentations are now online **here,** and are well worth a browse. **A**nd a special issue of the North American Actuarial Journal will publish a selection of the best academic papers presented at the conference.

2016 annual report of the board of trustees of the Federal old-age and survivors insurance and Federal disability insurance trust funds

A report from the actuaries of the U.S. Social Security Administration regarding U.S. mortality. It covers a wide range of mortality-related issues. It indicates that the range of mortality by income (at least for those retired between 65 and 69) is getting wider, at least between 1990 and 2000.
Issue Brief on the above: Actuarial Perspective on the 2016 Social Security Trustees Report" from the American Academy of Actuaries, concludes: "Social Security's Financial Soundness Should Be Addressed Now"

The World report on ageing and health: a policy framework for healthy ageing. Beard et al, Lancet Volume 387, No. 10033, p2145–2154, 21 May 2016
"Although populations around the world are rapidly ageing, evidence that increasing longevity is being accompanied by an extended period of good health is scarce. A coherent and focused public health response that spans multiple sectors and stakeholders is urgently needed." The report provides a public health framework for action built around a redefinition of healthy ageing that centres on the notion of functional ability. Sign up (free) to read full text.

Old Age Security Program Mortality Experience: Actuarial Study No. 17 from the Chief Actuary of Canada. Describes the mortality assumption in setting the liability and sustainability of the CDN Public Pension Plan (CPP)
"In 2013, beneficiaries with low income live on average about 2 and half years less than those with higher income. The differential in life expectancies at age 65 by level of income has shown little variability over the last 15 years."

Significant life extension by ten percent dietary restriction (*in rodents*), Richardson et al, Annals of the NYAcademy of Sciences
The researchers suggest that this rodent study "has important translational implications because it suggests that a modest reduction in calories might have significant health benefits for humans." (Previous research focused on substantial diet reductions: eg 40%)

5. Forthcoming events

International Longevity Centre – UK: The Future of Ageing Conference 2016
The International Longevity Centre - UK hosts an annual full day conference to bring together representatives from Government, business, academia and civil society to discuss the Future of Ageing.

Conference Perspectives on Actuarial Risks in Talks of Young researchers (PARTY). Organized by Séverine Arnold and Corina Constantinescu for young actuarial researchers, it will take place in Ascona, Switzerland, on January 8-13 2017. It focuses on Ageing & Risk Management

Sixth **Living to 100 Symposium,** January 4 – 6 2017, Orlando, Florida. Still open for booking.

IFoA's 2017 Spring Lecture, 27 April 2017 will be delivered by Dame Sally Davies, Chief Medical Officer for England. Expect antibiotic rsistanc to be a key subject. The Lecture will be webcast internationally.

……About this note……

This is a note **for** the UK Actuarial profession and others, and **for** the International Actuarial Association (IAA). The last six-monthly report is **here**

The most recent UK version of the report **from** the IAA Mortality Working Group is **here**

The web page for the Institute and Faculty of Actuaries Mortality Research Hub is **here.**

Please don't forget to complete the short questionnaire **here**.

See below for a Reading list of articles on mortality provided by the IFoA Library Services

Brian Ridsdale
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Appendix: Compiled by the Institute and Faculty of Actuaries Library service, with thanks to librarians.

If you are a non-member researching in actuarial science, a member of another actuarial body or an academic for example, access to a wide variety of actuarial papers in peer-reviewed journals can be granted on a case by case basis: contact the library for more details.

INSTITUTE AND FACULTY OF ACTUARIES LIBRARY SERVICES

Reading list:
Journal articles on mortality/longevity added to IFoA Library catalogue, March to October 2016

THE ACTUARY

Edwards, Matthew; Oliver, Nicola (**2016**). ***The new arms race.*** [magazine article].
The Actuary (**2016**) **June** : 28-30. [RKN: 76724]
The emergence of antibiotic resistant bacteria (antimicrobial resistance) and the possible effect on **mortality**
Internet URL: http://www.theactuary.com/archive/2016/

ANNALS OF ACTUARIAL SCIENCE

Hall, Mary; Daly, Linda (**2016**). ***Modelling the reverse select and ultimate mortality experience of UK ill-health retirement occupational pension scheme members.***
Annals of Actuarial Science (**2016**) **10(2)** : 222-235. [RKN: 48515]
Retirements from the workforce can be split between those who are forced to retire early specifically for health reasons referred to as ill-health retirements and all other retirements referred to as normal-health retirements. Rates of ill-health retirement increase with age and are higher for females than males. Consequently, the **mortality** experience of ill-health retirement pensioners will become more important in the future as pension schemes increase their normal retirement age in line with increases in life expectancy and the proportion of women in the workforce and therefore in occupational pension schemes increases. This paper seeks to model the **mortality** of ill-health retirements from occupational pension schemes in the United Kingdom in the period immediately following retirement (reverse select **mortality**) and over the longer term (ultimate **mortality**) allowing for age at retirement. Females experience a longer reverse select period than males and for both males and females the improvement in **mortality** rates over the reverse select period is greatest at younger ages. Post the reverse select period the effect of age at retirement decreases over time with ultimate **mortality** rates converging by the mid-eighties for males and females.
DOI: http://dx.doi.org/10.1017/S1748499516000063 (access via Athens login http://www.openathens.net/)

Adamic, Peter; Guse, Jenna (**2016**). ***LOESS smoothed density estimates for multivariate survival data subject to censoring and masking.***
Annals of Actuarial Science (**2016**) **10(2)** : 285-302. [RKN: 48518]
Actuaries often encounter censored and masked survival data when constructing multiple-decrement tables. In this paper, we propose estimators for the cause-specific failure time density using [LOcal regrESSion] LOESS smoothing techniques that are employed in the presence of left-censored data, while still allowing for right-censored and exact observations, as well as masked causes of failure. The smoothing mechanism is incorporated as part of an expectation-maximisation algorithm. The proposed models are applied to a bivariate African sleeping sickness data set.
DOI: http://dx.doi.org/10.1017/S1748499516000099 (access via Athens login http://www.openathens.net/)

ASTIN BULLETIN

Pla-Porcel, Javier; Ventura-Marco, Manuel; Vidal-Meliá, Carlos (**2016**). ***Life care annuities (LCA) embedded in a notional defined contribution (NDC) framework.*** [journal article].
ASTIN Bulletin (**2016**) **46(2)** : 331-363. [RKN: 47914]
DOI: http://dx.doi.org/10.1017/asb.2015.27 (access via Athens login http://www.openathens.net/)

Wang, Hsin Chung; Yue, Jack C; Tsai, Yi-Hsuan (**2016**). ***Marital status as a risk factor in life insurance: an empirical study in Taiwan.*** [journal article].
ASTIN Bulletin (**2016**) **46(2)** : 487-505. [RKN: 47919]
DOI: http://dx.doi.org/10.1017/asb.2016.3 (access via Athens login http://www.openathens.net/)

Christiansen, Marcus C; Schinzinger, Edo (**2016**). ***A credibility approach for combining likelihoods of generalized linear models.*** [journal article].
ASTIN Bulletin (**2016**) **46(3)** : 507-530. [RKN: 48574]
DOI: http://dx.doi.org/10.1017/asb.2016.11 (access via Athens login http://www.openathens.net/)

Milevsky, Moshe Arye; Salisbury, Thomas S (**2016**). ***Equitable retirement income tontines: mixing cohorts without***

discriminating.
ASTIN Bulletin (**2016**) **46(3)** : 571-604. [RKN: 48575]
DOI: http://dx.doi.org/10.1017/asb.2016.19 (access via Athens login http://www.openathens.net/)

AUSTRALIAN JOURNAL OF ACTUARIALPRACTICE

Sneddon, Thomas; Zhu, Zili; O'Hare, Colin (2016). ***Modelling defined contribution retirement outcomes: a stochastic approach using Australia as a case study.*** [journal article].
Australian Journal of Actuarial Practice (2016) **4** : 5-19. [RKN: 48594]
Internet URL: http://www.actuaries.asn.au/knowledge-bank/australian-journal-of-actuarial-practice

Shi, Xu; Browne, Bridget (2016). ***A "simple" stochastic model for longevity risk revisited through bootstrap.*** [journal article].
Australian Journal of Actuarial Practice (2016) **4** : 21-34. [RKN: 48595]
Internet URL: http://www.actuaries.asn.au/knowledge-bank/australian-journal-of-actuarial-practice

BRITISH ACTUARIAL JOURNAL

Aggarwal, Ankur; Beck, Michael Bruce; Cann, Matthew; Ford, Tim; Georgescu, Dan; Morjaria, Nirav (chair); Smith, Andrew; Taylor, Yvonne; Tsanakas, Andreas; Witts, Louise; Ye, Ivy; Model Risk Working Party (2015). (**2016**). ***Model risk: daring to open up the black box.*** - London: Institute and Faculty of Actuaries, 2015. - 78 pages.
BAJ (**2016**) **21(2)** : 229-296. [RKN: 46245]
Paper presented to IFoA, London, 23 March 2015 by the Model Risk Working Party -- Paper awarded the Peter Clark Prize 2015.
With the increasing use of complex quantitative models in applications throughout the financial world, model risk has become a major concern. Such risk is generated by the potential inaccuracy and inappropriate use of models in business applications, which can lead to substantial financial losses and reputational damage. In this paper we deal with the management and measurement of model risk. First, a model risk framework is developed, adapting concepts such as risk appetite, monitoring, and mitigation to the particular case of model risk. The usefulness of such a framework for preventing losses associated with model risk is demonstrated through case studies. Second, we investigate the ways in which different ways of using and perceiving models within an organisation both lead to different model risks. We identify four distinct model cultures and argue that in conditions of deep model uncertainty, each of those cultures makes a valuable contribution to model risk governance. Thus the space of legitimate challenges to models is expanded, such that, in addition to a technical critique, operational and commercial concerns are also addressed. Third, we discuss through the examples of proxy modelling, **longevity** risk and investment advice, common methods and challenges for quantifying model risk. Difficulties arise in mapping model errors to actual financial impact. In the case of irreducible model uncertainty, it is necessary to employ a variety of measurement approaches, based on statistical inference, fitting multiple models, and stress and scenario analysis.
DOI: http://dx.doi.org/10.1017/S1357321715000276 (access via Athens login http://www.openathens.net/)

EUROPEAN ACTUARIAL JOURNAL

Huber, Joel; Wüthrich, Mario V (**2016**). ***Case study of Swiss mortality using Bayesian modeling.***
European Actuarial Journal (**2016**) **6(1)** : 25-59. [RKN: 47981]
DOI: http://dx.doi.org/10.1007/s13385-015-0119-2 (access via Athens login http://www.openathens.net/)

Salhi, Yahia; Thérond, Pierre-E; Tomas, Julien (**2016**). ***A credibility approach of the Makeham mortality law.***
European Actuarial Journal (**2016**) **6(1)** : 61-96. [RKN: 47982]
DOI: http://dx.doi.org/10.1007/s13385-016-0125-z (access via Athens login http://www.openathens.net/)

INSURANCE: MATHEMATICS & ECONOMICS

Sanders, Lisanne; Melenberg, Bertrand (**2016**). ***Estimating the joint survival probabilities of married individuals.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **67** : 88-106. [RKN: 47854]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2015.12.006 (access via Athens login http://www.openathens.net/)

Cadena, Meitner; Denuit, Michel M (**2016**). ***Semi-parametric accelerated hazard relational models with applications to mortality projections.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **68** : 1-16. [RKN: 47921]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.02.003 (access via Athens login http://www.openathens.net/)

Risk, J; Ludkovski, M (**2016**). ***Statistical emulators for pricing and hedging longevity risk products.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **68** : 45-60. [RKN: 47924]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.02.006 (access via Athens login http://www.openathens.net/)

Benusan, Harry; El Karoui, Nicole; Loisel, Stéphane; Salhi, Yahia (**2016**). ***Partial splitting of longevity and financial risks: The longevity nominal choosing swaptions.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **68** : 61-72. [RKN: 47925]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.02.001 (access via Athens login http://www.openathens.net/)

Schinzinger, Edo; Denuit, Michel M; Christiansen, Marcus C (**2016**). ***A multivariate evolutionary credibility model for mortality improvement rates.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **69** : 70-81. [RKN: 47965]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.04.004 (access via Athens login http://www.openathens.net/)

Godínez Olivares, Humberto; del Carmen Boado-Penas, Maria; Haberman, Steven (**2016**). ***Optimal strategies for pay-as-you-go pension finance: a sustainability framework.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **69** : 117-126. [RKN: 47969]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.05.001 (access via Athens login http://www.openathens.net/)

Wang, Ting; Young, Virginia R (**2016**). ***Hedging pure endowments with mortality derivatives.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **69** : 238-255. [RKN: 47979]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.05.006 (access via Athens login http://www.openathens.net/)

Bayraktar, Erhan; Young, Virginia R (**2016**). ***Optimally investing to reach a bequest goal.*** [journal article].
Insurance: Mathematics & Economics (**2016**) **70** : 1-10. [RKN: 48532]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.05.015 (access via Athens login http://www.openathens.net/)

Goudenège, Jane; Molent, Andrea; Zanette, Antonino (**2016**). ***Pricing and hedging GLWB in the Heston and in the Black-Scholes with stochastic interest rate models.***
Insurance: Mathematics & Economics (**2016**) **70** : 38-57. [RKN: 48535]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.05.018 (access via Athens login http://www.openathens.net/)

Leng, Xuan; Peng, Liang (**2016**). ***Inference pitfalls in Lee-Carter model for forecasting mortality.***
Insurance: Mathematics & Economics (**2016**) **70** : 58-65. [RKN: 48536]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.05.016 (access via Athens login http://www.openathens.net/)

Young, Virginia R; Zhang, Yuchong (**2016**). ***Lifetime ruin under ambiguous hazard rate.***
Insurance: Mathematics & Economics (**2016**) **70** : 125-134. [RKN: 48542]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.06.007 (access via Athens login http://www.openathens.net/)

Liang, Xiaoqing; Tsai, Cary Chi-Liang (**2016**). ***Valuing guaranteed equity-linked contracts under piecewise constant forces of mortality.***
Insurance: Mathematics & Economics (**2016**) **70** : 150-161. [RKN: 48545]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.06.004 (access via Athens login http://www.openathens.net/)

Alai, Daniel H; Landsman, Zinoviy M; Sherris, Michael (**2016**). ***Modelling lifetime dependence for older ages using a multivariate Pareto distribution.***
Insurance: Mathematics & Economics (**2016**) **70** : 272-285. [RKN: 48556]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.06.016 (access via Athens login http://www.openathens.net/)

Ignatieva, Katja; Song, Andrew; Ziveyi, Jonathan (**2016**). ***Pricing and hedging of guaranteed minimum benefits under regime-switching and stochastic mortality.***
Insurance: Mathematics & Economics (**2016**) **70** : 286-300. [RKN: 48557]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.06.014 (access via Athens login http://www.openathens.net/)

Liu, Yanxin; Li, Johnny Siu-Hang (**2016**). ***It's all in the hidden states: a longevity hedging strategy with an explicit measure of population basis risk.***
Insurance: Mathematics & Economics (**2016**) **70** : 301-319. [RKN: 48558]
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.07.001 (access via Athens login http://www.openathens.net/)

JOURNAL OF PENSION ECONOMICS & FINANCE

Delprat, G; Leroux, M-L; Michaud, P-C (**2016**). ***Evidence on individual preferences for longevity risk.*** [journal article]. - 18 pages.
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