ASTIN AFIR/ERM COLLOQUIA

JUNE 21-23, 2022

PARALLEL SESSION INFORMATION

(Document will be updated as more information becomes available.)

Each presentation is 30 minutes.

Tuesday, Parallel Sessions 1, 10:00-11:00 CEST

Session Start: 06/21/2022 10:00 AM, Session End: 06/21/2022 11:00 AM

Section: AFIR/ERM

Title: AI in longevity risk management: improved long-term projections by machine learning

While human mortality has decreased significantly, several authors have noted a historical pattern of diminishing mortality decline at relatively younger ages along with accelerating improvements among the elderly, a phenomenon called the 'rotation' of the age pattern of mortality decline. Ignoring this may lead to a severe and systematic underestimation of the old-aged population, thus exacerbating longevity risk in actuarial practice.

The popular Lee-Carter (LC) model does not allow for rotation at all, however, Li, Lee and Gerland (2013) introduced a variant of the model including rotation (LCR).

We use age-specific mortality rates of all countries by gender from the Human Mortality Database to optimize two hyperparameters of the LCR model, propose deep neural networks to produce even more data-driven rotation schedules, and also propose a generalized additive model involving bivariate spline approximations of the residuals of the LC model.

We point out which approach works best

Speakers: Peter Vekas, associate professor, Corvinus University of Budapest
Ronald Richman, Chief Actuary, Old Mutual Insure
Laszlo Kovacs, PhD student, Corvinus University of Budapest

Tuesday, Parallel Sessions 1, 10:00-11:00 CEST

Session Start: 06/21/2022 10:00 AM, Session End: 06/21/2022 11:00 AM

Section: AFIR/ERM

Title: Suicide Death Number Estimation for Insurers by Neural Networks: Grasping trend changes

Institute of Actuaries of Japan AFIR study group started a project to examine how actuaries make use of Artificial Intelligence. Here a specific research result is presented. The annual number suicide deaths in Japan is notoriously high among developed countries. In such a condition, in general, Japanese life insurance policies are not completely excluding suicide from death benefit. Although estimation of the number of suicide deaths, its trend, and its sensitivity of economic factors is important for Japanese insurers, so far, the task was a tough. Above that, recent economic and social/demographic changes in Japan have made and are making its trend suddenly and largely changed, and the task more difficult. Recent neural network programing (NN) is solving these issues. This research performs forecast of the number of suicide deaths and its trend in Japan by a NN and compare a typical regression method. This research includes economic and others' sensitivity analysis by both methods.

Speakers: Miwaka Yamashita, ,

Tuesday, Parallel Sessions 1, 10:00-11:00 CEST

Session Start: 06/21/2022 10:00 AM, Session End: 06/21/2022 11:00 AM

Section: ASTIN

Title: A new framework of prediction error decomposition for the machine learning era

Research on predictive modeling methods has been remarkable in recent years, and the models that we actuaries use are advancing day by day. Actuaries are interested not only in prediction accuracy but also in evaluating prediction errors and interpreting what the source of the error is.

A lot of previous research about error decomposition into parameter error and process error has been conducted for traditional actuarial modeling, such as GLM. However, there is not enough research about error decomposition for various predictive modeling method including machine learning.

In this study, we, Data Science Related Basic Research Working Group of The Institute of Actuaries of Japan(IAJ), propose a new framework decomposing prediction errors into process errors, parameter errors, and other errors, which is widely applicable to lots of predictive modeling methods.

In this framework, we reconsider the basic concepts of process error to deal with the error decomposition of machine learnin

Speakers: Kazuki Kuriyama, Actuary, The Institute of Actuaries of Japan
Hirokazu Iwasawa, Guest Professor, Waseda University

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Section: ASTIN

Title: Estimating the effect on payment due to COVID-19 by machine learning method using causal inference

Due to the outbreak of Covid-19, many countries have implemented lockdowns to control the infection.

In Japan, a mild lockdown was implemented without coercion, and people's activities were suppressed.

Based on data on over three million Japanese people, we analyze the occurrence of mental illness which is considered as a major reason for insurance for unemployment. It is found that during the mild lockdown period, the number of diagnoses had sharply declined, then started to increase.

It is assumed that the payment of insurance claims to those who would have been diagnosed and paid by insurance was postponed during the lockdown period.

For insurance companies, it is important to estimate how much payment is being postponed in the term of risk management and reserving.

We introduce the method to estimate the postponed payment by creating a counterfactual model of what would have happened in the absence of Covid-19, using a machine learning method based on the concept of causal

Speakers: Fumihiro Endo, , JMDC.Inc
Yuji Hiramatsu, ,

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Section: ASTIN

Title: Stochastic Ensemble Loss Reserving

Stochastic loss reserving models are crucial tools for general insurers to predict outstanding claims for meeting regulation requirements and risk management, and they have been widely studied in literature. However, previous studies often focus on identifying a single model that can generate superior predictive performance. This model selection approach may not fully utilize the strengths offered by different models and may generate volatile prediction outcomes. Although combining models is not new in practice, the model weights are usually

selected subjectively based on previous business experience, which is not always suitable when updating models for new data.

Therefore, this study aims to develop a rigorous way to combine notable loss reserving models such that the strengths offered by different models can be utilized effectively. To optimize the predictive performance of the ensemble over the distribution of claims, the weights allocated to the component models are determined by

Speakers: Yanfeng Li, ,
Benjamin Avanzi, Professor, University of Melbourne
Bernard Wong, Professor, University of New South Wales

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Section: ASTIN

Title: Stochastic Loss Reserving with a Bi-directional Neural Network Algorithm

This paper proposes a flexible machine learning approach for stochastic loss reserving in general insurance. The new approach uses a special bi-directional neural network to model the temporal sequences of claim losses presented in the run-off triangle. Unlike the original bi-directional recurrent NN which trains the model in both forward and backward time directions, the proposed model uses input information from the top and left neighbours of the run-off triangle in the training procedure. Hence, the proposed approach can capture both the accident period and development period dynamics in loss reserving. Besides, it can also incorporate the practical experience by including projection constraints in the model regularization process. The model performance is assessed using a growing triangle technique and is compared with existing models in different simulated datasets under various complexity settings. Eventually, the proposed model addresses the loss reserve of the one-period time h

Speakers: Yuning Zhang, ,

Tuesday, Parallel Sessions 2, 11:30-12:30 CEST

Session Start: 06/21/2022 11:30 AM, Session End: 06/21/2022 12:30 PM

Section: AFIR/ERM

Title: Risk management for climate change and catastrophes in Asia

Since the Industrial Revolution, greenhouse gas emissions have been increasing rapidly. This has caused climate change such as rising global temperatures and changes in precipitation,

leading to an increase in natural disasters. This has also led to a dramatic increase in payouts for insurers related to natural disasters.

The Asian region is particularly impacted by climate change. Climate change in Asia is expected to cause not only an increase in natural disasters such as heatwaves, floods and typhoons, but also an increase in pandemics due to the hot and humid climate and high population density. How should insurers underwriting in Asia manage the various risks posed by climate change?

This presentation will provide an overview of the current impacts of climate change in Asia and possible future scenarios, and discuss how insurers should manage risks when underwriting in Asia.

Speakers: Wataru Hirose, , Fukoku Mutual Life Insurance Company

Tuesday, Parallel Sessions 2, 11:30-12:30 CEST

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Section: AFIR/ERM

Title: Sustainable Financial Risk Modelling Fitting the SDGs: Some Reflections

This paper argues that any sustainable finance theory devised to fit the Sustainable Development Goals (SDGs) needs a paradigm shift in the morphology of randomness underlying financial risk modelling, by integrating the characteristics of “nature” and sustainability into the modelling carried out. It extends the common diagnosis of the 2008 financial crisis with considerations on the morphology of randomness and the reasons why neoclassical finance theory is not sustainable from this perspective. It argues that the main problem with unsustainable neoclassical finance risk modelling is its underlying morphology of randomness that creates a dangerous risk culture. It presents Leibniz’s principle of continuity and Quetelet’s theory of average as cornerstones of classical risk culture in finance, acting as a mental model for financial experts and practitioners. It links the notion of sustainability with the morphology of randomness and presents a possible alternative approach to financial

Speakers: Christian WALTER, Professor, Kedge Business School

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Section: ASTIN

Title: Anti-discrimination Insurance Pricing: Regulations, Fairness Criteria, and Models

On the issue of insurance discrimination, a grey area in regulation has resulted from the growing use of big data analytics by insurance companies – direct discrimination is prohibited, but indirect discrimination using proxies or more complex and opaque algorithms can be tolerated without restrictions. This phenomenon has recently attracted the attention of insurance regulators all over the world, and stricter insurance discrimination regulations are being discussed and considered by regulators. Meanwhile, various fairness criteria have been proposed and flourish in the machine learning literature with the rapid growth of artificial intelligence (AI) in the past decade, which mostly focus on classification decisions. However, there is little research on insurance applications, particularly on insurance pricing as a regression problem. In this paper, we introduce the fairness criteria that are potentially applicable to insurance pricing to the actuarial field, match them with different

Speakers: Xi Xin, PhD Student, UNSW Sydney
Fei Huang, Senior Lecturer, UNSW Sydney

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Section: ASTIN

Title: Capital market effects of full fair value insurance accounting

Solvency II came into effect as the prudential supervisory regime for EU-based insurers in 2016. It introduced a full fair value measurement of insurance assets and liabilities, while annual IFRS reports remained on a conservative basis of valuation during the observation period. Using value relevance models, we show that the disclosure of Solvency II information has significant capital market effects. As opposed to the assumption that the fair value measurements of Solvency II convey more relevant information than IFRS, we do not find any different market effects. Moreover and in line with the functional fixation hypothesis, investors are not able or willing to understand the IFRS-SII reconciliation. Our findings are robust to a variety of specifications. With the introduction of IFRS 9 for reporting on financial instruments and IFRS 17 for insurance contracts in 2023, international insurance accounting will move into the direction of full fair value accounting with some delay, and we

Speakers: Stefan Veith, Professor, University of Applied Sciences Bremen

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Section: ASTIN

Title: Deep Composite Regression

A main difficulty in actuarial claim size modeling is that there is no simple off-the-shelf distribution that simultaneously provides a good distributional model for the main body and the tail of the data. In particular, covariates may have different effects for small and for large claim sizes. To cope with this problem, we discuss a deep composite regression model whose splicing point is given in terms of a quantile of the conditional claim size distribution rather than a constant. To facilitate M-estimation in such models, we consider and characterize the class of strictly consistent scoring functions for the triplet consisting of the quantile, as well as the lower and upper expected shortfall beyond that quantile. In a second step, this elicitability result is applied to fit deep neural network regression models.

Speakers: Mario Wuthrich, Prof, RiskLab, ETH Zurich

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Section: ASTIN

Title: Multivariate matrix-exponential affine mixtures and their applications in risk theory

In this presentation, we propose a class of multivariate matrix-exponential affine mixtures with matrix-exponential marginals. The class is shown to possess various attractive properties such as closure under size-biased Esscher transform, order statistics, residual lifetime and higher order equilibrium distributions. This allows for explicit calculations of various actuarial quantities of interest. The results can be applied in a wide range of actuarial problems including multivariate risk measures, aggregate loss, large claims reinsurance and risk capital allocation. If time permits, a calibration scheme based on complete data will also be briefly discussed.

Speakers: Eric Cheung, Associate Professor, University of New South Wales

Tuesday, Parallel Sessions 3, 13:30-14:30 CEST

Session Start: 06/21/2022 01:30 PM, Session End: 06/21/2022 02:30 PM

Section: AFIR/ERM

Title: Efficient Monte Carlo simulation of portfolio value, value-at-risk and other portfolio metrics

This presentation (and an accompanying paper) explores benefits that can be provided by splitting a Monte Carlo simulation set into two parts, one part being used to derive an approximation to how the portfolio payoff value depends on the simulated economic drivers and the other part being used to correct for inaccuracy in this approximation. Such an approach appears capable for many types of portfolio of materially reducing runtimes (for a given level of

accuracy) versus a basic Monte Carlo simulation approach. Analogies between this and other approaches for improving Monte Carlo convergence properties and for creating proxy models are explored, as are heuristics for choosing a suitable form for the payoff value approximation.

Speakers: Malcolm Kemp, Actuary, Nematrian Limited

Tuesday, Parallel Sessions 3, 13:30-14:30 CEST

Session Start: 06/21/2022 01:30 PM, Session End: 06/21/2022 02:30 PM

Section: AFIR/ERM

Title: Pension accounting forecasts based on nested stochastic modelling

"Under the International Accounting Standard, IFRS, employers have to account for a Defined Benefit (DB) plan by recognising a gap between their plan liabilities (DBO) and assets on the company's own balance sheet and a loss or gain in the company's profit and loss statement (P&L).

DBO liability of Swiss cash balance plans is very volatile due to discount rate assumptions based on high quality corporate bond yields that were even negative in August 2019. That is why the employer balance sheet and P&L are extremely affected by this interest rate level.

To support companies in planning for the financial year-end and preparing budgets for next years, it is worth estimating positions of the company's own balance sheet and the P&L over the next 2-3 years using Monte Carlo simulation. Our approach is based on a nested stochastic valuation engine for the pension fund membership and their liabilities, implemented with company specific HR policies. Discount rate and interest credit assumptions

Speakers: Ljudmila Bertschi, Senior Consultant, allea Ltd

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Section: ASTIN

Title: Estimation of the mean square error of a product of random variables

We show how the unconditional and the conditional mean square error of a product of random variables (r.v.) can be estimated by use of the telescope formula.

First we develop estimators in a simple model with independent r.v.. Next we consider a model with uncorrelated r.v. which applies to several situations in insurance pricing as well as to the Mack chain-ladder (CL) reserving model. The use of the telescope formula yields additional insight and new results. Looking at the Mack Cl-model from this broader perspective reveals

that the "BBMW" estimator proposed in 2006 in a joint paper by Bühlmann, Buchwalder, Merz and Wüthrich is not asensible alternative to the Mack estimator derived by Mack in 1993.

Speakers: Alois Gisler, Professor emeritus, ETH Zurich

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Section: ASTIN

Title: Modelling Insurers Cyber Risk by Hybrid Methodology – Scenario Analysis and LDA

We present a hybrid methodology by combining loss distribution approach (LDA) and scenario analysis (SA) to model the cyber risk. Although, there is a growing demand of cyber insurance products, insures struggle to price cyber risk as the dynamics of cyber risk is yet to understood. This is mainly due to the lack of reliable and adequate cyber loss historical data. In this study, we generated a database of 320,000 hypothetical cyber-attacks using LDA and aggregated them with a set of historical data obtained from four case studies using SA. The methodology creates an aggregate loss distributions and measure the Cyber Risk (CyVaR) at several preferred level of confidence. The modelling technique that we propose in this paper can help insurers to develop better cyber risk products by adjusting traditional pricing parameters at different levels of risk appetite. Additionally, this methodology can quantify the solvency capital for insurers' cyber risk.

Speakers: Madhu Acharyya, , Glasgow Caledonian University (London Campus)

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Section: ASTIN

Title: The Skewness of Bornhuetter-Ferguson

The Bornhuetter-Ferguson method is among the most popular methods used to project non-life paid or incurred triangles. For this method, T. Mack (2008) developed a stochastic model allowing the estimation of the prediction error resulting from such projections. This stochastic model involves a parametrization of the Bornhuetter-Ferguson method based on incremental triangles of incurred or paid. Hence, this parametrized method differs from the usual way in which the Bornhuetter-Ferguson is usually applied on cumulative triangles of incurred or paid. Based on this proposed stochastic model, this article provides a first approach for the estimation of the third moment, i.e. the skewness, of the resulting reserving distribution. An estimate of the third moment is useful in the context of IFRS 17 where the quantile

corresponding to the addition of a risk margin on top of the best estimate will have to be disclosed. In order to apply the proposed method, a few numerical examples are provided.

Speakers: Eric Dal Moro, Head Quantitative Risk Management, Assura

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Section: ASTIN

Title: Thinning of loss counts and the Mixed Contagion model

We investigate representations of loss count distributions that are largely invariant to thinning: where most parameters do not change when we, e.g., go from ground-up losses to the subset of losses exceeding a certain threshold. An important thinning-invariant parameter is the contagion, which is well known for the Panjer (a,b,0) class of distributions, but can be defined in general.

We show that one can find loss count representations where all parameters are thinning-invariant but one. Such representations help compare heterogeneous models or data sets, like loss records having different reporting thresholds.

As an example, we study the Mixed Contagion model, which strongly generalizes the common Poisson-Gamma loss count model, by allowing both for global and local fluctuations. We estimate its parameters by combining two data sources.

Speakers: Michael Fackler, consulting actuary, self-employed

Tuesday, Parallel Sessions 4, 15:00-16:00 CEST

Session Start: 06/21/2022 03:00 PM, Session End: 06/21/2022 04:00 PM

Section: AFIR/ERM

Title: Analysis of financial contagion among economic sectors through Dynamic Bayesian Networks

Crises severely impact various economies and may spread across regions or sectors in a process called contagion. Understanding this process allows foreseeing crises' impacts and anticipating actions that reduce their effects. Specific economic sectors may be major crisis propagators: banking and insurance are often considered decisive in this context. In this paper, we aim to model the U.S. economy's sectorial interdependence using Dynamic Bayesian Networks on nine industrial Dow Jones' indices, daily between 2000 and 2020. As a secondary objective, we evaluate whether the insurance industry plays a central role in spreading crises. Several crisis

periods are analyzed, from dot-com bubble to current Covid-19 pandemic. The results reveal the subprime crisis, European debt crisis and the 2016 presidential election as the main contagious periods. The last analyzed period – Covid-19 pandemic – was divided in two phases, showing, on phase 1, an interconnected economic system with three main

Speakers: João Vinícius Carvalho, Assistant Professor, University of São Paulo
Nathalia Costa Fonseca, Pricing and Underwriting Actuary,

Tuesday, Parallel Sessions 4, 15:00-16:00 CEST

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Section: ASTIN

Title: GEMAct: a comprehensive actuarial package for non-life (re)insurance

GEMAct is an actuarial Python package, based on the collective risk theory framework, that offers a comprehensive set of tools for insurance and reinsurance pricing, stochastic claims reserving, risk theory modeling, and risk aggregation.

For example, the package considers a collective risk model apparatus to price non-life non-proportional reinsurance contracts, including individual and aggregate conditions and allowing for reinstatements, and to estimate loss reserves. Furthermore, it is possible to compute quantiles of the risks aggregate distribution, via an efficient implementation of the AEP algorithm, to implement multi-annual ruin theory analysis, and to perform profitability tests over the selected time-horizon.

The variety of available functionalities makes GEMAct modeling very flexible and provides actuarial scientists and practitioners with a powerful tool that fits into the expanding community of Python programming language.

Speakers: Gabriele Pittarello, ,

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Section: ASTIN

Title: One-year and ultimate reserve risk in Mack Chain Ladder model

We investigate the relation between one-year reserve risk and ultimate reserve risk in Mack Chain Ladder model in a simulation study. The first goal is to validate the socalled linear emergence pattern formula, which maps the ultimate loss to the one-year loss, in case when we measure the risks with Value-at-Risk. The second goal is to estimate the true emergence pattern of the ultimate loss, i.e. the conditional distribution of the one-year loss given the

ultimate loss, from which we can properly derive a risk measure for the one-year horizon from the simulations of ultimate losses. Finally, our third goal is to test if classical actuarial distributions can be used for modelling of the outstanding loss from the ultimate and the one-year perspective. In our simulation study we investigate several synthetic loss triangles with various duration of the claims development process, volatility, skewness and distributional assumptions of the individual development factors. We quantify the res

Speakers: Marcin Szatkowski, , SGH Warsaw School of Economics / STU ERGO Hestia SA

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Section: ASTIN

Title: Social inclusion in the world of modern predictive analytics

"The volume of digital data is increasing by around 61 % annually. The rapidly developing techniques of predictive analytics make it possible to use this data in underwriting and pricing of insurers. These novel technologies present huge opportunities for societies to utilize pooling of risks better and better. For insurers better techniques help not only to cover risks more efficiently but also to better manage adverse selection and moral hazard, and also to combat insurance fraud.

With these benefits we also have threats. Does increasingly exact risk-based underwriting lead to a decrease in the inherent solidarity, existing not only in mandatory or social insurance but also in voluntary insurance? Do we end up in a situation where lack of insurance leads to a larger part of the population being socially excluded (recognizing that modern techniques, when used responsibly, can also reduce exclusion)?

The paper looks at the problem of avoiding social exclusion in the context of evolving

Speakers: Esko Kivisaari, Deputy Managing Director, Finance Finland

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Section: ASTIN

Title: Stable Dividends are Optimal under Linear-Quadratic Optimization

Stability is a desirable criteria for dividends of a risky business. Usually optimal strategies in actuarial risk such as the barrier strategy do not result in stable dividends. Attention is given to

affine dividend strategies which have the property of being stable, but are not the optimal solution to previous considered optimal control problems in a Cramér-Lundberg framework.

It is well known that affine strategies are optimal in the linear quadratic optimal control problem, where the object function punishes quadratic deviations of the controlled process from some benchmark. This is almost always formalized in diffusion models and have been considered in the context of pension funds. We consider when affine dividend strategies are optimal in an actuarial risk theory context based on a surplus model following a Lévy process, and show that the structure of the controls is stable for the expanded underlying process as long as the object function is quadratic.

Speakers: Debbie Kusch Falden, PhD, University of Copenhagen