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, university researcher/lecturer, 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: Yamashita Miwaka, Office worker, Tokai Tokyo Financial Holdings, Inc.

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 learning

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

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

**Speakers:** Fumihiro Endo, Actuary/Data scientist, JMDC.Inc
Yuji Hiramatsu, Chief Data Scientist, AXA Life Insurance Co.,Ltd. (On secondment to the University of Tokyo)

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

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, Student, University of New South Wales  
Benjamin Avanzi, Professor, University of Melbourne  
Bernard Wong, Professor, University of New South Wales  
Alan Xian, Professor, Macquarie University

**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:** Stochastic Loss Reserving with a Special Bi-directional Recurrent 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 recurrent neural network (SBRNN) to model the temporal sequences of claim losses presented in the run-off triangle. Unlike the original BRNN which trains the model in both positive and negative time directions, the SBRNN 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 SBRNN model addresses the loss reserve of the one-period time horizon

**Speakers:** Yuning Zhang, PhD student, The University of Sydney Business School  
Boris Choy, Senior Lecturer, The University of Sydney  
Junbin Gao, Professor, The University of Sydney

**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

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: 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

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: 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

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: 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 several proxies, we show that the disclosure of Solvency II information has significant capital market effects. Large differences between Solvency II and IFRS capital are associated with low levels of value relevance and liquidity, and with high levels of risk. This is in line with the assumption that the fair value measurements of Solvency II convey new information that improve capital market properties. 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 expect this ch

Speakers: Stefan Veith, Professor, University of Applied Sciences Bremen
Christian Fieberg, Senior Researcher, University of Bremen

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
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

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

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

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, Swiss Pension Fund Expert, Senior Consultant, allea Ltd

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: 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 CI-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 a sensible alternative to the Mack estimator derived by Mack in 1993.

**Speakers:** Alois Gisler, Prof. emeritus, ETH Zurich

**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:** 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, insurers struggle to price cyber risk as the dynamics of cyber risk is yet to be 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:**

**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:** 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:**

**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: 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, 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 Fonseca, Undergraduate student, University of Sao Paulo

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: Using Machine learning for financial analysis

Actuaries were the first data scientists but unfortunately, their usefulness in wider areas is understated. Finance and investment is the area where actuaries can do wonders with their statistical knowledge combined with business sense. It is a perfect time to enter other territories and not be limited to reserving and pricing. Starting from the fundamentals of using Data Science programs like Python, this presentation will be about applications of AI/ML in financial analysis. As a part of ERM, it is perfect for anyone who wants to harness the power of AI to optimize business processes, maximize revenue, and reduce costs. It will cover the Capital Asset Pricing model, Markowitz portfolio optimization, and efficient frontier. It will cover deep neural networks such as LSTM to perform stock market predictions. Furthermore, it will cover K means clustering to perform Segmentation or Clustering. It will also explore NLP to perform stock sentiment analysis.

Speakers:

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: 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 so-called 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, Assistant, SGH Warsaw School of Economics

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: ASTIN

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

PyAct 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 both proportional and non-proportional reinsurance 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 PyAct modeling very flexible and provides actuarial scientists and practitioners with a powerful tool that fits into the expanding community of Python programming languag

Speakers: Gabriele Pittarello, Ph.D. student, Università di Roma La Sapienza
Manfred Marvin Marchione, Ph.D. student, actuarial consultant, Università di Roma La Sapienza
Edoardo Luini, Quantitative Model Developer, Università di Roma La Sapienza

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: 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

**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:** 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, Ph.d., University of Copenhagen