SCHOOL OF COMPUTING & DATA SCIENCE
The University of Hong Kong

Department of 統計及精算學系
Statistics & Actuarial Science
THE UNIVERSITY OF HONG KONG

Symposium on Actuarial and Risk Sciences

Date: Jan 9, 2026
Venue: 301 Run Run Shaw Building, HKU

Speakers

Eric Chi Kin Cheung	University of New South Wales
Alfred Wing Fung Chong	The University of Hong Kong
Derrick Fung	The Hang Seng University of Hong Kong
Matteo Malavasi	University of New South Wales
Zijia Wang	The Chinese University of Hong Kong
Jae Kyung Woo	University of New South Wales
Jiacheng Zhang	The Chinese University of Hong Kong
Yiying Zhang	Southern University of Science and Technology

Organizing Committee

Tim Boonen	The University of Hong Kong
Ka Chun Cheung	The University of Hong Kong
Phillip Yam	The Chinese University of Hong Kong

9:50 - 10:00	*Opening*	
Session 1 10:00 - 10:40	Eric C.K. Cheung	Modeling discrete common-shock risks through matrix distributions
Session 2 10:40 – 11:20	Alfred W.F. Chong	Strategic Risk Reduction by Self-Protection and Self-Insurance
Session 3 11:20 – 12:00	Jiacheng Zhang	Continuous-time mean field games: a primal-dual characterization
Session 4 2:00 – 2:40	Jae Kyung Woo	Actuarial modelling under dependence in life and nonlife Insurance: Applications to joint life equity-linked Products and bonus-malus systems
Session 5 2:40 – 3:20	Zijia Wang	Life-Cycle Portfolio Choice with GLWB Variable Annuities
3:20 – 3:40	*Coffee Break*	
Session 6 3:40 – 4:20	Yiying Zhang	Robust Pareto-optimal reinsurance design under preference ambiguity
Session 7 4:20 – 5:00	Derrick Fung	The Impact of IFRS 17 on Global Insurers' Risk-Taking: Transparency, Market Discipline, and Strategic Shifts
Session 8 5:00 – 5:40	Matteo Malavasi	Cyber Risk Taxonomies: Statistical Analysis of Cybersecurity Risk Classifications

Session 1: 10:00 - 10:40

Eric C.K. Cheung *University of New South Wales*

Modeling discrete common-shock risks through matrix distributions

Abstract: In this presentation, we introduce a novel class of bivariate common-shock discrete phase-type (CDPH) distributions to describe dependencies in loss modelling, with an emphasis on those induced by common shocks. By constructing two jointly evolving terminating Markov chains that share a common evolution up to a random time corresponding to the common shock component, and then proceed independently, we capture the essential features of risk events influenced by shared and individual-specific factors. We provide explicit expressions for the joint distribution of the termination times and demonstrate various class and distributional properties such as closure under mixtures and sums. We also consider random sums where aggregate claims are sums of continuous phase-type random variables with counts determined by these termination times, and show that their joint distribution belongs to the multivariate phase-type or matrix-exponential class. Via an EM fitting algorithm we are able to estimate the latent common shock component present in a bivariate dataset. This is joint work with Martin Bladt, Oscar Peralta and Jae-Kyung Woo.

Session 2: 10:40 – 11:20

Alfred Wing Fung Chong *The University of Hong Kong*

Strategic Risk Reduction by Self-Protection and Self-Insurance

Abstract: A risk holder can reduce their risk through self-protection, by decreasing the frequency of incurring a loss, and self-insurance, by decreasing the severity of the potential loss. Ehrlich and Becker (1972) were the first to formalise these two concepts and study their interaction with market insurance for risk-averse risk holders. Recent emerging and large-scale risks, such as extreme weather events, pandemics, and cyber threats, have led to a renewed interest in self-protection and self-insurance, both in practice as well as in risk and insurance economics literature. In this talk, I will present new results on designing risk reduction strategies of self-protection and self-insurance, setting aside the availability of market insurance.

Session 3: 11:20 – 12:00

Jiacheng Zhang *The Chinese University of Hong Kong*

Continuous-time mean field games: a primal-dual characterization

Abstract: This paper establishes a primal-dual formulation for continuous-time mean field games (MFGs) and provides a complete analytical characterization of the set of all Nash equilibria (NEs). We first show that for any given mean field flow, the representative player's control problem with measurable coefficients is equivalent to a linear program over the space of occupation measures. We then establish the dual formulation of this linear program as a maximization problem over smooth subsolutions of the associated Hamilton-Jacobi-Bellman (HJB) equation, which plays a fundamental role in characterizing NEs of MFGs. Finally, a complete characterization of all NEs for MFGs is established by the strong duality between the linear program and its dual problem. This strong duality is obtained by studying the solvability of the dual problem, and in particular through analyzing the regularity of the associated HJB equation. Compared with existing approaches for MFGs, the primal-dual formulation and its NE characterization require neither the convexity of the associated Hamiltonian nor the uniqueness of its optimizer, and remain applicable when the HJB equation lacks classical or even continuous solutions.

Session 4: 2:00 – 2:40

Jae Kyung Woo *University of New South Wales*

Actuarial modelling under dependence in life and nonlife Insurance: Applications to joint life equity-linked Products and bonus-malus systems

Abstract: This talk addresses the role of dependence structures in the design and valuation of insurance products. In the life insurance setting, we introduce new equity-linked products for couples whose benefits depend on both lifetimes. Recognizing the empirical dependence between spouses' mortality, valuation is conducted via the discounted density function approach, yielding closed-form expressions for various benefit types including income, death, and withdrawal guarantees.

In the nonlife context, we explore dependence between claim frequency and severity in Bonus-Malus Systems (BMS). A bivariate random effects model is proposed, incorporating symmetric and asymmetric absolute error objective functions to derive optimal relativities. The resulting framework provides new insights into the performance and fairness of BMS designs.

Overall, the analysis highlights how incorporating dependence enhances actuarial modelling accuracy in both life and nonlife domains. This is joint work with Kelvin Tang and Eric Cheung.

Session 5: 2:40 – 3:20

Zijia Wang *The Chinese University of Hong Kong*

Life-Cycle Portfolio Choice with GLWB Variable Annuities

Abstract: In this study, we examine a life-cycle consumption and portfolio choice model where individuals allocate wealth among stocks, bonds, and a variable annuity (VA) with a Guaranteed Lifetime Withdrawal Benefit (GLWB) that includes a long-term care (LTC) option. The hybrid design of the VA provides a lifelong income floor that protects individuals against longevity risk while also hedging against health-related expenditure risk. To solve the associated high-dimensional stochastic optimization problem, we formulate it as a finite-horizon Markov Decision Process (MDP) and propose a generalized Proximal Policy Optimization (PPO) algorithm. Additionally, we derive a policy improvement lower bound for finite-horizon MDPs and develop an efficient gradient estimation method to enhance sample efficiency.

Session 6: 3:40 – 4:20

Yiying Zhang *Southern University of Science and Technology*

Robust Pareto-optimal reinsurance design under preference ambiguity

Abstract: This paper investigates the optimal reinsurance contract problem from the perspective of Pareto optimality, where the insurer and the reinsurer both apply distortion risk measures for reinsurance negotiation. We focus on the case where the risk preferences of both parties are only partially known, and the admissible distortion functions are restricted by elicited preference information such as confidence intervals for the risk of a list of lotteries, as well as possible structural requirements including concavity. Under a general premium principle, we derive analytical forms for the optimal reinsurance indemnity, which only depend on the corresponding worst-case distortion functions from the perspectives of the two negotiating parties. We further show that when only individual-specific preference information is available for both parties, a pair of worst-case distortion functions is step-like and is uniquely determined by the associated uncertainty sets. When additional generic information is incorporated, a worst-case distortion function becomes piecewise linear, with parameters that can be computed by solving a constrained finite-dimensional optimization problem. Finally, we illustrate the main findings through numerical examples.

Session 7: 4:20 – 5:00

Derrick Fung *The Hang Seng University of Hong Kong*

The Impact of IFRS 17 on Global Insurers' Risk-Taking: Transparency, Market Discipline, and Strategic Shifts

This study examines whether and how international financial reporting standards affect the risk-taking behaviors of insurance companies globally. Effective January 1, 2023, International Financial Reporting Standards 17 (IFRS 17) introduces significant changes to the accounting treatment of insurance contracts, aiming to improve transparency and consistency in financial reporting. Drawing on the Coordinated Risk Management Hypothesis, we argue that IFRS 17's influence on insurers' risk-taking behavior depends on the degree of market discipline associated with various types of risks. Using a difference-in-difference approach, we empirically analyze a sample of global insurers from 2018 to 2024. Our findings indicate that, after adopting IFRS 17, insurers tend to lower their asset risk—an aspect that is easily assessed by the public. This strategy helps them present a low-risk profile that aligns with the public's perceptions of risk. To compensate for the reduced returns associated with lower asset risk, insurers increase their exposure to product and financial risks, which are more difficult for the public to evaluate. The results remain consistent across multiple robustness checks, including in-space placebo test, in-time placebo test, and falsification test. Overall, our findings contribute to the ongoing debate on how international accounting standards influence firms' risk-taking behaviors.

Session 8: 5:00 – 5:40

Matteo Malavasi *University of New South Wales*

Cyber Risk Taxonomies: Statistical Analysis of Cybersecurity Risk Classifications

Abstract: Cyber risk classifications are widely used in the modeling of cyber event distributions, yet their effectiveness in out of sample forecasting performance remains underexplored. In this paper, we analyze the most commonly used classifications and argue in favor of switching the attention from goodness-of-fit and in-sample predictive performance, to focusing on the out of sample forecasting performance. We use a rolling window analysis, to compare cyber risk distribution forecasts via threshold weighted scoring functions. Our results indicate that business motivated cyber risk classifications appear to be too restrictive and not flexible enough to capture the heterogeneity of cyber risk events. We investigate how dynamic and impact-based cyber risk classifiers seem to be better suited in forecasting future cyber risk losses than the other considered classifications. These findings suggest that cyber risk types provide limited forecasting ability concerning cyber event loss severity distribution, and cyber insurance rate-makers should utilize cyber risk types only when modeling the cyber event frequency distribution. Our study offers valuable insights for decision-makers and policymakers alike, contributing to the advancement of scientific knowledge in the field of cyber risk management.