# Symposium on Actuarial and Risk Sciences

**Department of Statistics and Actuarial Science**
**School of Computing and Data Science**
**The University of Hong Kong**

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Date : **Thursday 25 June, 2026**
Time : **10:30 – 18:30**
Venue : **301, 3/F, Run Run Shaw Building, HKU**

## Speakers

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| **Debora Daniela Escobar** | *Heriot-Watt University* |
| **Tak Wa Ng** | *The University of Hong Kong* |
| **Zhaojie Ren** | *The Chinese University of Hong Kong* |
| **Chi Chung Siu** | *The Hang Seng University of Hong Kong* |
| **Patrick Wong** | *Monash University* |
| **Phillip Yam** | *The Chinese University of Hong Kong* |

## Organizing Committee

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| **Tim Boonen** | *The University of Hong Kong* |
| **Alfred Chong** | *The University of Hong Kong* |
| **Phillip Yam** | *The Chinese University of Hong Kong* |

| Opening & Sessions 1 and 2 Chair: **Ka Chun Cheung** | | |
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| **Session 1**<br>**10:30 – 11:30** | Phillip Yam | A Way of Quantifying Cyber Risk: from Model Building to Product Pricing |
| **Session 2**<br>**11:30 – 12:30** | Patrick Wong | Valuation of Variable Annuities in a General Stochastic Environment |
| **12:30 – 14:00** | *Lunch Break* | |
| Sessions 3 and 4 Chair: **Tim Boonen** | | |
| **Session 3**<br>**14:00 – 15:00** | Zhaojie Ren | Optimal Reinsurance Under Endogenous Default and Background Risk |
| **Session 4**<br>**15:00 – 16:00** | Tak Wa Ng | Pareto and Bowley Reinsurance Games in Peer-to-Peer Insurance |
| **16:00 – 16:30** | *Coffee Break* | |
| Sessions 5 and 6 Chair & Closing: **Phillip Yam** | | |
| **Session 5**<br>**16:30 – 17:30** | Debora Daniela Escobar | Pareto Optimal Centralized Risk Sharing with Multiple Agents: Inclusivity and Fairness |
| **Session 6**<br>**17:30 – 18:30** | Chi Chung Siu | Optimal Consumption-Portfolio Rules with Informational and Trading Frictions |

**Session 1: 10:30 – 11:30**

**Phillip Yam** *The Chinese University of Hong Kong*

**A Way of Quantifying Cyber Risk: from Model Building to Product Pricing**

Abstract: As a major challenge in emerging risk modelling in FinTech and InsurTech, the actuarial community is so eager for more effective methods in predicting claim numbers/severities of cyber attacks based on limited real data; indeed, conventional statistical tools fail to apply for these cyber risk datasets due to the dominant presence of categorical covariates. To address this challenge, our talk proposes a novel superposed marked Hawkes process integrating categorical covariate information to infer hidden clustering structures; particularly, by employing classifiers such as CIBer, CART, and MLP, we iteratively optimize both model parameters and cluster partitions using common machine learning tools, such as mini-batch stochastic gradient descent method. The effectiveness of this approach is demonstrated through empirical studies with benchmark cyber risk datasets, leading to notably improven prediction for frequencies (also for severities). Meanwhile, we can also provide a statistical diagnosis of the underlying model parameters. Last but not least, with this new process, all existing pricing methods should be revisited; while we here highlight the use of Fourier-COS method to effectively price different insurance products against cyber risk, namely via a finite series involving the Laplace functional of the corresponding compound process.

**Session 2: 11:30 – 12:30**

**Patrick Wong** *Monash University*

**Valuation of Variable Annuities in a General Stochastic Environment**

Abstract: This work develops an exact analytical framework for pricing variable annuity products, specifically Guaranteed Minimum Maturity Benefits (GMMB), within a stochastic environment featuring general dependencies. The model assumes stochastic dynamics for jump intensity, interest rates, and volatility, explicitly incorporating interdependencies among these risks through a common matrix-valued state variable. A significant contribution of this research is the derivation of analytical, closed-form solutions, facilitating efficient and accurate pricing. We also compute the first- and second-order sensitivities to the parameters of these products, which is achieved thanks to the use of the Frechet derivative of the matrix exponential map. The resulting analytical gradient and Hessian are validated against finite differences and applied to reserve approximation under parameter uncertainty, showing that second-order corrections are essential for long-dated contracts. Despite the matrix nature of the model, our method allows us to efficiently price and manage risk for these products.

**Session 3: 14:00 – 15:00**

**Zhaojie Ren** *The Chinese University of Hong Kong*

**Optimal Reinsurance Under Endogenous Default and Background Risk**

Abstract: In this talk, we study an optimal reinsurance problem for a utility-maximizing insurer, subject to the reinsurer's endogenous default and background risk. Endogenous default occurs when the insurer's contractual indemnity exceeds the reinsurer's available reserve, which is random due to the background risk. We obtain an analytical solution to the optimal contract for two types of reinsurance contracts, differentiated by whether their indemnity functions depend on the reinsurer's background risk. The results shed light on the joint effect of the reinsurer's default and background risk on the insurer's reinsurance demand.

**Session 4: 15:00 – 16:00**

**Tak Wa Ng** *The University of Hong Kong*

**Pareto and Bowley Reinsurance Games in Peer-to-Peer Insurance**

Abstract: We propose a peer-to-peer (P2P) insurance scheme comprising a risk-sharing pool and a reinsurer. A plan manager determines how risks are allocated among members and ceded to the reinsurer, while the reinsurer sets the reinsurance loading. Our work focuses on the strategic interaction between the plan manager and the reinsurer, and this focus leads to two game-theoretic contract designs: a Pareto design and a Bowley design, for which we derive closed-form optimal contracts. In the Pareto design, cooperation between the reinsurer and the plan manager leads to multiple Pareto-optimal contracts, which are further refined by introducing the notion of coalitional stability. In contrast, the Bowley design yields a unique optimal contract through a leader–follower framework, and we provide a rigorous verification of the individual rationality constraints via pointwise comparisons of payoff vectors. Comparing the two designs, we prove that the Bowley-optimal contract is never Pareto optimal and typically yields lower total welfare. In our numerical examples, the presence of reinsurance improves welfare, especially with Pareto designs and a less risk-averse reinsurer. We further analyze the impact of the single-loading restriction, which disproportionately favors members with riskier losses.

**Session 5: 16:30 – 17:30**

**Debora Daniela Escobar** *Heriot-Watt University*

**Pareto Optimal Centralized Risk Sharing with Multiple Agents: Inclusivity and Fairness**

Abstract: This talk studies centralized risk sharing with endogenous prices. Multiple policyholders transfer risks to a central insurer through indemnity decisions, while prices are determined by pricing functionals applied to ceded risks. The resulting problem is multiobjective, with Pareto optimality as the natural efficiency criterion. We show that classical Pareto optimality may fail to reveal whether all agents are represented in a balanced decision process that scalarized objectives may assign zero weight to some agents, and group aggregates may obscure individual risk positions. Motivated by bilateral Pareto characterizations through sequential optimization, we introduce inclusive and fair Pareto optimality, a representation-based refinement requiring every agent to appear exactly once, either individually or as part of a group, in a finite ordered sequence of optimizations. Our main result proves equivalence between this concept and balanced sequential optimization, placing it between Geoffrion-proper Pareto optimality and classical Pareto optimality. An illustrative example demonstrates the framework using the Expected Shortfall.

**Session 6: 17:30 – 18:30**

**Chi Chung Siu** *The Hang Seng University of Hong Kong*

**Optimal Consumption-Portfolio Rules with Informational and Trading Frictions**

Abstract: In this talk, we study the optimal consumption-portfolio choice problems that incorporate both informational and trading frictions. The utility-maximizing agent strategically allocates resources between consumption and investments to mitigate uninsurable labor risk while contending with trading costs and limited information processing capabilities. Our results indicate that trading frictions diminish consumption and investment, negatively affecting welfare, whereas informational frictions increase precautionary savings. Improvements in the agent's information-processing capacity amplify wealth effects, resulting in higher consumption and investment targets. We also introduce an endogenized information processing constraint: rising information costs reduce processing capabilities, leading to lower consumption and a shift toward less ambitious portfolios. Crucially, the impact of informational frictions persists even when conditional variance stabilizes, underscoring the complexities in optimal consumption and investment behaviors.