

Research School of Finance, Actuarial Studies and Statistics 2024 Summer Research Camp

Tuesday, 3rd December

6.00 pm Welcome Dinner (QT Hotel Eureka Room)

Wednesday, 4th December

- 9.00 am Coffee/tea
- 9.20 am Welcome message (Westend Room)
- 9.30 am Keynote Session 1 (Westend Room)

Introduction by Andrew Wood

Speaker: <u>Bin Yu</u> (University of California, Berkeley) Title: Veridical data science and alignment in medical AI

10.30 am Morning tea

11.00 am Parallel Session 1

Finance (Westend Room) Chair: Phong Ngo

Speaker: <u>Chicheng Ma</u> (U. Hong Kong) Title: The Modernizing Effect of Financial Crises: Evidence from Early 20th Century China Discussant: Le Zhang (ANU) Speaker: <u>Howard Bondell</u> (U. Melbourne) Title: Density ratio estimation, importance sampling, and covariate shift via information geometry

Statistics (Eastend Room)

Chair: Luca Maestrini

Actuarial Studies (Walters Room) Chair: Adam Butt

Speaker: <u>Zhuo Jin</u> (Macquarie U.) Title: Optimal Timing of Investment in Cybersecurity Technology Speaker: <u>Mike Gallmeyer</u> (U. Virginia) Title: Optimal Housing Decisions with Mean-Reversion in House Prices Discussant: <u>Xiang Fang</u> (U. Hong Kong) Speaker: <u>Christopher Drovandi</u> (QUT) Title: Simulation-based Bayesian inference and model misspecification Speaker: <u>Brnic Van Wyk</u> (Australian Retirement Trust) Title: Australian Retirement Trust Lifetime Pension

Speaker: <u>Le Zhang</u> (ANU) Title: A Picture or a Thousand Words? Director Portrait on Proxy Statement Discussant: <u>Tim Liu</u> (U. Utah)

12.45 pm Lunch

1.45 pm - **Keynote Session 2** (Westend Room) 2.45 pm

Introduction by Ding Ding

Speaker: <u>Holger Mueller</u> (New York University) Title: Firms' Internal Networks

- 3.00 pm Mount Stromlo Visit/ Hotel rest
- 6.00 pm Dinner (Monster Kitchen & Bar, Ovolo Nishi)

Thursday, 5th December

9.00 am Coffee/tea

9.15 am Parallel Session 2

Finance (Westend Room) Chair: Jo Drienko

Speaker: <u>Antje Berndt</u> (ANU) Title: The Impact of Introducing a (Nearly) Redundant Security: Evidence from Malaysian Corporate Bonds Discussant: <u>Mike Gallmeyer</u> (U. Virginia)

Speaker: <u>Zheng Sun</u> (UC Irvine) Title: Trading in Twilight: Sleep, Mental Alertness, and Stock Market Trading Discussant: <u>Qiaoqiao Zhu</u> (ANU)

Speaker: <u>Arnan Viriyavejkul</u> (ANU) Title: R&D Tax Credits and Inventor Corporate Directors Discussant: <u>Thao Hoang</u> (UWA) **Statistics** (*Eastend Room*) Chair: Andrew Wood and Luca Maestrini

Speaker: <u>Lyndon Ang</u> (ANU) Title: Overlap-excluded estimation of participation probabilities for nonprobability samples

Speaker: <u>Sumonkanti Das</u> (ANU) Title: A Metropolis-Hastings algorithm for group testing in biosecurity with imperfect test accuracy

Speaker: <u>Laurence Field</u> (ANU) Title: Brownian motion and permeable boundaries

Speaker: <u>Yonghe Lu</u> (ANU) Title: Benign complexity in mean-variance portfolio optimization

Speaker: <u>Emi Tanaka</u> (ANU) Title: Building computational frameworks for enhanced practice of statistics

Speaker: <u>Jiazhen Xu</u> (ANU) Title: Change point detection for random objects with possibly periodic behaviors Actuarial Studies (Walters Room) Chair: Ning Wang

Speaker: <u>Hailiang Yang</u> (Xi'an Jiaotong-Liverpool U.) Title: Hedging and Valuation of Guaranteed Minimum Death Benefits

Speaker: <u>Guy Thorburn</u> and <u>Oliver</u> <u>Bruhl</u> (Australian Government Actuary) Title: Australian Life Tables 2020-22

11.00 am Morning tea

11.30 am Parallel Session 3

| | Finance (Westend Room) Chair: Shasta Shakya | Statistics (Eastend Room) Chair: Xuan Liang | Actuarial Studies (Walters Room) Chair: Aaron Bruhn |
|---------|---|---|--|
| | Speaker: <u>Nhan Le</u> (ANU) Title: A Redistribution Effect between Employee Health Benefits and CEO Compensation: Evidence from Paid Sick Leave Mandates Discussant: Thanh Hyunh (Monash) | Speaker: <u>Ming-Yen Cheng</u> (Hong Kong Baptist U.) Title: Changing periodicity, smooth trend and covariate effects in time series | Speaker: <u>X. Sheldon Lin</u> (U. Toronto) Title: Modelling Heterogeneousness and Variability of Insurance Portfolios Via Mixtures, Random Effects and Beyond |
| | Speaker: <u>Qifei Zhu</u> (NUS) Title: Equity Lender Base and Limits to Arbitrage: Position-level Evidence from Mutual Funds Discussant: <u>Terry Zhang</u> (ANU) | Speaker: <u>Bing-yi Jing</u> (Southern University of Science and Technology) Title: Data selection in large model training | Speaker: <u>Rade Thomas Musulin</u> (Finity) Title: Stressed Out: Challenges to the Financial System from Climate Risk and More |
| 1.00 pm | Lunch + school-wide thanks | | |
| 2.00 pm | Parallel Session 4 | | |
| - | | | |
| | Finance (Westend Room) Chair: Chao Gao | Statistics (Eastend Room) Chair: Francis Hui | Actuarial Studies (Walters Room) Chair: Gaurav Khemka |
| | Finance (Westend Room) Chair: Chao Gao Speaker: <u>Thanh Hyunh</u> (Monash) Title: Fund Investor Attention: Unveiling the Links Between Connected Funds Discussant: <u>Anna von Reibnitz</u> (ANU) | Statistics (Eastend Room) Chair: Francis Hui Speaker: <u>Gillian Heller</u> (U. Sydney and Macquarie U.) Title: Parameter orthogonality and the GAMLSS family of distributions Speaker: <u>Berwin Turlach</u> (UWA) | Actuarial Studies (Walters Room) Chair: Gaurav Khemka Speaker: <u>Qihe Tang</u> (UNSW) Title: Two-Stage Distributionally Robust Optimization Speaker: <u>Matthew Crane</u> (EY) Title: Challenges with Funding Private |

PRESENTATION TITLES AND ABSTRACTS (in order of appearance)

FINANCE

Title: Firms' Internal Networks

Presenter: Holger Mueller (New York University)

Abstract: Internal capital markets and within-firm knowledge sharing create natural linkages between establishments (e.g., manufacturing plants, retail stores) within a firm. When firms have establishments in multiple regions, these linkages imply that local shocks may spread from one region to another. In this keynote, I discuss several applications of the idea that firms' internal networks of establishments act as a mechanism through which local shocks may propagate and amplify. Applications include the collapse in house prices during the Great Recession, large industrial plant openings, and knowledge spillovers across inventors in high-tech clusters.

Title: The Modernizing Effect of Financial Crises: Evidence from Early 20th Century China

Presenter: Chicheng Ma (Hong Kong U.)

Abstract: We examine how financial crises can spur financial modernization, particularly during the early development of financial market. We focus on the Shanghai Rubber Stock Crisis in 1910 China. The crisis unprecedentedly panicked traditional Chinese banking (money houses) that unlimitedly speculated the rubber stocks, while modern banks were less affected by the crisis thanks to their limited liability and other institutional advantages. This prompted the Chinese elites to modernize financial institutions. By analysing a panel data set across 287 prefectures over 28 quarters (1908 to 1914), we find that prefectures exposed heavily to the crisis developed more new modern banks thereafter.

Title: Optimal Housing Decisions with Mean-Reversion in House Prices

Presenter: Mike Gallmeyer (U. Virginia)

Abstract: Returns on owner-occupied homes are impacted by mean-reversion in rent-to-price ratios and house return autocorrelation. We explore a life-cycle model that includes these factors and show that the rent-to-price ratio and autocorrelation influence the optimal timing of homeownership. Our findings suggest that neglecting these factors underestimates long-term housing risks, leading to higher homeownership rates. Early-life housing market conditions impact lifetime outcomes. Empirically, lower rent-to-price ratios correlate with higher homeownership rates, contrary to our model's recommendations.

Title: A Picture or a Thousand Words? Director Portrait on Proxy Statement

Presenter: Le Zhang (ANU)

Abstract: We study the use of director portraits in DEF 14A filings (proxy statement) of U.S. public firms. Firms with female or minority board members are more likely to feature these images. We identify the underlying mechanisms driving this trend using the Black Lives Matter (BLM) movement and the introduction of board gender quotas in California. We also find that director portraits affect retail investor participation and firm valuation. Our findings highlight the unique informational value of photos in corporate disclosures.

Title: The Impact of Introducing a (Nearly) Redundant Security: Evidence from Malaysian Corporate Bonds **Presenter:** Antie Berndt (ANU)

Abstract: Redundant securities should face zero investor demand, which raises the question of why they exist. Using a comprehensive trading dataset from the Malaysian central bank, we investigate the impact of Islamic corporate bonds on their conventional counterparts over 1997-2017. We find that these redundant securities are attractive to both nonreligious and religious investors, allowing for greater risk-sharing. However, conventional corporate bond liquidity declined, as issuance fell and banks switched some trading to the Islamic market. Nonetheless, the lower conventional bond liquidity did not lead to measurably higher bond yields. These results have implications for the assessment of central bank and other financial authority policies to develop Islamic bond markets.

Title: Trading in Twilight: Sleep, Mental Alertness, and Stock Market Trading

Presenter: Zheng Sun (UC Irvine)

Abstract: We study how mental alertness affects investor trading performance. To capture exogenous variation in mental alertness, we focus on the effect of sunset time on sleep disruption. Using a regression discontinuity design based on time zone borders and differential effects across seasons, we find a large negative and causal relationship between sleep disruption and trading performance. In a basic test, retail investors who are on the later sunset side of time zone borders on average earn 12.1 basis points lower daily abnormal returns on their trades over the next 10 days. Further exploration suggests that the underperformance derives from decreased investor attention

Title: Can Nonprofits Save Lives Under Financial Stress? Evidence from the Hospital Industry

Presenter: Tim Liu (U. Utah)

Abstract: We compare the effects of external financing shocks on patient mortality at nonprofit and for-profit hospitals. Using confidential patientlevel data, we find that patient mortality increases to a lesser extent at nonprofit hospitals than at for-profit ones facing exogenous, negative shocks to debt capacity. Such an effect is not driven by patient characteristics or their choices of hospitals. It is concentrated among patients without private insurance and patients with higher-risk diagnoses. One potential economic mechanism is that nonprofit hospitals' have deeper cash reserves and thus greater ability to maintain spending on medical staff and equipment, even at the expense of lower profitability. Overall, our evidence suggests that nonprofit organizations can better serve social interests during financially challenging times.

Title: A Redistribution Effect between Employee Health Benefits and CEO Compensation: Evidence from Paid Sick Leave Mandates **Presenter:** Nhan Le (ANU)

Abstract: This paper investigates the effect of Paid Sick Leave (PSL) mandates on CEO compensation. We find a significant reduction in CEO pay following state-level PSL mandates, particularly in states with higher maximum PSL hours, competitive industries, and firms with low profit margins, high labor intensity, and elevated health risks. Additionally, we observe increased firm value and improved income disparity post-PSL mandates. Given that the U.S. is the only industrialized nation without a national paid sick leave policy, our findings offer valuable insights for regulatory reforms that can balance between employee welfare, CEO pay, and corporate performance.

Title: Equity Lender Base and Limits to Arbitrage: Position-level Evidence from Mutual Funds

Presenter: Qifei Zhu (NUS)

Abstract: We provide the first comprehensive analysis on equity lender base utilizing newly available fund-stock level lending data. We find that short sellers predominantly borrow from a small set of repeated lenders whose composition differs across stocks. We argue that this lender base structure indicates inelastic lending supply, which limits arbitrage. When existing lenders exit, short sellers struggle to find replacement lenders, even though conventional lending supply measures appear slack. Consequently, lending fees surge, exacerbating mispricing in the equity market. Ex ante, risks implied by lender concentration are priced. Our results suggest that lending-side frictions are an important source of market inefficiency.

Title: Fund Investor Attention: Unveiling the Links Between Connected Funds

Presenter: Thanh Hyunh (Monash)

Abstract: Before investing in a managed fund, investors typically research multiple funds. These search activities offer insights into their perceptions of similarity between funds. Using a dataset of investors' search activities, this study proposes a new measure of investor attention to managed funds and explores whether this attention reveals insights into fund connectedness. I construct a novel, dynamic network of connected funds based on the common attention they receive from potential investors. The study yields several novel findings. First, at the fund-pair level, common investor attention predicts future correlations in both fund flows and returns. At the individual fund level, funds receiving higher levels of common attention exhibit greater sensitivity to their peers' performance. Second, peer funds' returns positively predict a focal fund's future flows and performance, indicating that attention-based networks capture economically meaningful relationships. Third, funds connected through common attention are susceptible to contagion effects, where shocks to one fund can spill over to others within the network. Finally, I find that focal funds reduce their holdings in stocks that are particularly vulnerable to peer funds' flows, suggesting that fund managers actively adjust their portfolios to mitigate contagion risks. Overall, these findings offer important insights into systemic risk and fragility within the asset management industry, highlighting the role of investor attention and fund networks in shaping market dynamics.

Title: R&D Tax Credits and Inventor Corporate Directors

Presenter: Arnan Viriyavejkul (ANU)

Abstract: This paper studies the impact of R&D tax credits on the presence of inventor directors on corporate boards. We find that R&D tax credits are associated with a higher likelihood of having an inventor director on corporate boards. The effect is more pronounced in firms operating within high-tech industries, those with substantial R&D expenditures, and larger size. We show that the positive relationship is causal and robust based on a battery of empirical tests including staggered difference-in-differences (DID) designs to explore the dynamic effects of R&D tax credits. Further analysis indicates that inventor directors, influenced by R&D tax credits, typically serve as internal directors, particularly within the C-suite, and enhance firm's innovation outputs. Furthermore, our research has documented that R&D tax credits are associated with increased director compensation, serving as a significant incentive mechanism. Overall, our findings bridge fiscal policy and corporate governance, showing how R&D tax incentives can strategically influence board composition and innovation, offering valuable insights for policymakers, corporate leaders, and academics focused on the synergy between fiscal incentives, governance structures, and innovation performance.

STATISTICS

Keynote speaker: Prof. Bin Yu (University of California, Berkeley)

Title: Veridical data science and alignment in medical AI

Abstract: Alignment and trust are crucial for the successful integration of AI in healthcare including digital twin projects, a field involving diverse stakeholders such as medical personnel, patients, administrators, public health officials, and taxpayers, all of whom influence how these concepts are defined. This talk presents a series of collaborative medical case studies where AI algorithms progressively become, from transparency to more opaque thus with increasing difficulty of alignment assessment. These range from tree-based methods for trauma diagnosis, to LLM-based emergency department co-pilot, and mechanistic circuits for structured data extraction from pathology reports. They are guided by Veridical Data Science (VDS) principles – Predictability, Computability, and Stability (PCS) – for the goal of building trust and interpretability, enabling doctors to assess alignment. The talk concludes with a discussion on applying VDS to medical foundation models and next steps for evaluating AI algorithm alignment in healthcare.

Speaker: Prof. Howard Bondell (University of Melbourne)

Title: Density ratio estimation, importance sampling, and covariate shift via information geometry

Abstract: The density ratio of two probability distributions is a fundamental tool in statistics and machine learning, having a variety of applications. It plays essential roles in optimal classification methods, importance sampling algorithms, and adaptation to the problem of covariate shift, the case where the distribution of the covariates in the test data differs from that of the training data. In this respect, density ratio estimation based on finite samples is an important task. However, it is known to be unstable when the distributions do not have significant overlap within the samples. To address this problem, incremental mixtures of the distributions have been proposed as intermediate steps towards density ratio estimation. We show that these approaches can be viewed geometrically as iterating on the Riemannian manifold along a particular curve between the two probability distributions. Making use of the geometry, we propose to consider incremental density ratio estimation along generalized geodesics on this manifold. Additionally, we use these generalised geodesics to unify some existing approaches to covariate shift adaptation and, in the process, create a broader class of methods that can improve performance.

Speaker: Prof. Christopher Drovandi (Queensland University of Technology)

Title: Simulation-based Bayesian inference and model misspecification

Abstract: Simulation-based Inference (SBI) methods are very useful for fitting complex statistical models to data, as they only rely on the ability to simulate from the model, rather than evaluating its likelihood function, which is often intractable. However, many SBI methods are known not to be robust to model misspecification, that is, when the model is unable to recover all the key features of the data. This talk will discuss some recent methods we have developed for considerably improving the robustness of SBI methods to model misspecification. This is joint work with various collaborators.

Speaker: Prof. Ming-Yen Cheng (Hong Kong Baptist University)

Title: Changing periodicity, smooth trend and covariate effects in time series

Abstract: Traditional analysis of a periodic time series assumes its pattern remains the same. However, some recent empirical studies in climatology and other fields find that the amplitude may change over time, which has important implications. We develop a formal procedure to detect and estimate change-points in the periodic pattern. Often, there is also a smooth trend, and sometimes the period is unknown, with potential other covariate effects. Based on a new model that takes all of these factors into account, we propose a three-step estimation procedure to estimate them all accurately. First, we adopt penalized segmented least squares estimation for the unknown period, with the trend and covariate effects approximated by B-splines. Then, given the period estimate, we construct a novel test statistic and use it in binary segmentation to estimate change-points in the periodic component. Finally, given the period and change-point estimates, we estimate the entire periodic component, trend, and covariate effects. Asymptotic results for the proposed estimators are derived, including consistency of the period and change-point estimators, and the asymptotic normality of the estimated periodic sequence, trend and covariate effects. Simulation results demonstrate the appealing performance of the new method, while empirical studies highlight its advantages.

Speaker: Prof. Bing-yi Jing (Southern University of Science and Technology)

Title: Data selection in large model training

Abstract: At present, the training of large models usually requires the use of massive amounts of data at the Internet level. As data quality is critical to model performance, how to screen high-quality samples from these massive data becomes a key issue. To address this challenge, we redesigned the lifecycle of the data during the training process from the underlying training framework. This allows us to introduce different data selection strategies at different stages of training so that the model can choose the data that best suits it. In addition, we have implemented a learning-based exploration strategy that enables the model to perform data screening autonomously, which further improves training efficiency and model performance. These improvements optimize the data filtering process while providing a more flexible and intelligent solution for large model training. This research is not only of theoretical significance, but also shows great potential in practical application.

Speaker: Prof. Gillian Heller (University of Sydney and Macquarie University)

Title: Parameter orthogonality and the GAMLSS family of distributions

Abstract: Parameter orthogonality is a desirable property of statistical distributions having more than one parameter. When parameters are orthogonal then their maximum likelihood estimates are asymptotically independent. Within the exponential family, the mean and dispersion parameter are orthogonal; however in general this is not the case. This work is motivated by a trial in Parkinson's disease patients in which one of the outcomes is the number of falls. Inspection of the data reveals that the Poisson-inverse Gaussian (PiG) distribution is appropriate, and that the experimental treatment reduces not only the mean, but also the variability, substantially. Conventional analysis assumes a treatment effect on the mean, either adjusted or unadjusted for covariates, and a constant dispersion parameter. We find that we reach quite different conclusions on the treatment effect on the mean, depending on whether or not a model is specified for the dispersion parameter.

The parameters of the PiG distribution, in the parametrization used in GAMLSS, are severely non-orthogonal. We show that if we use an orthogonal parametrization of the PiG, estimates of the mean model are robust to misspecification of the dispersion model. We examine the orthogonality of several other GAMLSS distributions, and give a method for reparametrization of any distribution to an orthogonal version.

Speaker: A./Prof. Berwin Turlach (University of Western Australia)

Title: On extreme value copulas

Abstract: Univariate extreme value theory is well established. But in some applications one has observations on several extremes that may be correlated with each other. The question arises how to model such dependencies. Copulas are a useful tool to model dependencies between the component of a multivariate random vectors. Various family of copulas have been proposed, with these families being further classified according to the principle by which the family was constructed (e.g., elliptical copula, Archimedean copula). To model multivariate random vectors whose components are all extremes extreme values copulas (also known as max-stable copulas) should be used. We will discuss extreme value copulas, concentrating on the bivariate case. Existing families of extreme value copulas are reviewed and several new families will be proposed. We will also discuss how to simulate data from these new families, and how to fit them to data using maximum likelihood estimation.

RSFAS Statistics Speakers

Speaker: Lyndon Ang

Title: Overlap-excluded estimation of participation probabilities for non-probability samples

Abstract: Quasi-randomization approaches are one way of addressing selection bias when using non-probability datasets to produce statistical inferences. In these approaches, it is assumed that there exists an underlying random mechanism driving the participation of units in the non-probability sample, and that the mechanism can be deduced via a model. Estimated participation probabilities are produced using the model, and then applied as part of an inverse probability weighting approach to produce population estimates. In this presentation, we propose to estimate these participation probabilities by combining the non-probability sample with an available probability sample, and excluding the overlapping units in the two samples. We compare the performance of this approach with several alternative methods in a simulation setting.

Speaker: Dr. Sumonkanti Das

Title: A Metropolis-Hastings algorithm for group testing in biosecurity with imperfect test accuracy

Abstract: Group testing plays a critical role in biosecurity operations, especially in minimizing the risk of introducing exotic pests and pathogens through imported agricultural products. In biosecurity inspections for exported prawns, random groups of prawns (a pool of five prawns from a bag of 40) are selected from a consignment and tested for contamination, yielding either positive or negative results for each group. The only observation available per consignment is the number of groups (out of 13) that tested positive. Beta-binomial models are used to account for variability in contamination levels across consignments and estimate both the probability of contamination and the level of undetected contamination (also referred to as leakage), based on group test results, assuming perfect test accuracy. However, this study explores the implications of group testing when tests are imperfect. Given that the biosecurity data for exported prawns are extremely sparse — over 98% of approximately 3,000 consignments show no contamination — the No-U-Turn Sampler (NUTS), an advanced Hamiltonian Monte Carlo algorithm, struggles to produce consistent results. Consequently, we developed a Metropolis-Hastings algorithm that incorporates a weighted likelihood approach along with numerical integration, rather than calculating the likelihood separately for each consignment with identical outcomes. Our findings show that noninformative uniform priors for the beta parameters, as well as priors for test sensitivity and specificity, provide stable and reliable results in this context.

Speaker: Dr. Laurence Field

Title: Brownian motion and permeable boundaries

Abstract: We review various measures derived from planar Brownian motion and how the total masses of these measures, which can be thought of as normalised random walk partition functions, provide natural conformal invariants of planar domain configurations. We extend the discussion of boundary conditions to allow permeable boundaries and describe what this can tell us about conformal mappings.

Speaker: Yonghe Lu

Title: Benign complexity in mean-variance portfolio optimization

Abstract: The literature suggests that the out-of-sample performance of mean-variance portfolios deteriorates as the number of assets increases due to the curse of dimensionality, leading to various methods being proposed to reduce dimensionality. We identify a different phenomenon. We recover the "double-descent" in prediction loss and "double-ascent" in the Sharpe ratio within the context of mean-variance portfolio optimization problem. Our analysis provides a theoretical explanation for why large over-parameterized models can outperform traditional methods.

Speaker: Dr. Emi Tanaka

Title: Building computational frameworks for enhanced practice of statistics

Abstract: Statistics is practised by a diverse set of people who each possess a varying degree of statistical competency. By leveraging thoughtful interface design, computational tools can encourage masses to align to a particular mental framework. In this talk, I present a computational framework referred to as "the grammar of experimental designs", implemented as the edibble R package, that considers specifying an experimental design by its basic components. This framework encourages users to think critically about their experimental setups. I will also demonstrate a proof-of-concept framework that uses large language models to automate context-aware simulations from the given experimental design, thereby alleviating the cognitive burden of users having to specify their simulation schemes from scratch. Through these tools, I hope to encourage better statistical practices by enabling a broader range of practitioners to think more critically about their experimental designs.

Speaker: Jiazhen Xu

Title: Change point detection for random objects with possibly periodic behaviors

Abstract: We introduce a new, powerful scan statistic and corresponding test for the precise identification and localization of abrupt changes in the distribution of non-Euclidean random objects with possibly periodic behaviors. Our approach is nonparametric and effectively captures the entire distribution of these random objects, such as transportation networks. Remarkably, it operates with minimal tuning parameters, requiring only the specification of cut-off intervals near endpoints where change points are assumed not to occur. Our theoretical contributions include deriving the asymptotic distribution of the test statistic under the null hypothesis of no change points, establishing the consistency of the test in the presence of change points under contiguous alternatives and providing rigorous guarantees on the near-optimal consistency in estimating the number and locations of change point, whether dealing with a single change point or multiple ones. We demonstrate that the most competitive method in the literature for change point detection in random objects is degraded by periodic behaviors, as periodicity blurs the changes that the procedure aims to discover. Through comprehensive simulation studies on graph Laplacians, we demonstrate the superior power and accuracy of our approach in both detecting change points and pinpointing their locations, across scenarios involving both periodic and nonperiodic random objects. In real-world applications, our method delivers highly interpretable results, as evidenced by the identification of meaningful change points in the New York City Citi Bike sharing system that align with significant historical events.

Actuarial Studies

Speaker: Zhuo Jin (Macquarie University)

Title: Optimal Timing of Investment in Cybersecurity Technology

Abstract: In this paper, we investigate the optimal timing for a company to invest in cybersecurity technology to reduce cyberattack losses. We consider cyber losses following a jump process model, addressing the fat-tailed behavior observed in loss distributions due to cyberattacks. The investment required for implementing cybersecurity technology is also highly variable over time due to ongoing innovations in the field. To account for this uncertainty, we model the evolution of investment costs using a compound Poisson process. Our objective is to minimize the company's total cost. We convert the optimal stopping problem into a free boundary problem. Using the dynamic programming approach, we solve the associated Hamilton-Jacobi-Bellman equations and obtain semi-closed form solutions for the value function and the optimal investment strategies. Finally, we present numerical examples to illustrate the effect of critical parameters on the optimal investment decision.

Speaker: Brnic van Wyk (Australian Retirement Trust)

Title: Australian Retirement Trust Lifetime Pension

Abstract: In 2021 ART (then QSuper) launched the first innovative retirement income stream in Australia. It is effectively an experience-based marketlinked group self-annuitisation product. This presentation will describe the product's features, operation and initial experience observations, allowing for open two-way discussions.

Speaker: Hailiang Yang (Xi'an Jiaotong-Liverpool University)

Title: Hedging and Valuation of Guaranteed Minimum Death Benefits

Abstract: Guaranteed Minimum Death Benefits (GMDBs) are a class of equity-linked insurance products with payments linked to the performance of the equity market. Nowadays, these kinds of products are popular in the insurance industry. The valuation and hedging of these types of products are theoretically interesting and practically important. In this talk, I will provide an introduction and summary of some of my research with my co-authors. For the hedging of these types of products, I will present a super-hedging strategy for GMDBs. In the valuation part, I will summarize some ideas and results on the GMDBs.

Speaker: Guy Thorburn and Oliver Bruhl (Australian Government Actuary)

Title: Australian Life Tables 2020-22

Abstract: The Australian Government Actuary produces the Australian Life Table every five years, based on the three years of experience around the Australian Census. This is a series of life tables, the first of which was based on 1881-1890. ALT 2020-22 will be the 20th table in this series. This presentation will present results from this investigation.

Speaker: X. Sheldon Lin (University of Toronto)

Title: Modelling Heterogeneousness and Variability of Insurance Portfolios Via Mixtures, Random Effects and Beyond

Abstract: Most insurance portfolios, especially in Property and Casualty (P&C) insurance are policy specific and policyholders possess different risk characteristics. As a result, they are highly heterogeneous. Furthermore, certain risks from insurance policies are unobservable or uncontrollable, which adds additional variability/randomness of an insurance portfolio. Hence, modelling and analyzing the claims, risk classification, ratemaking and reserve determination entail many challenges, especially from a data-driven modelling perspective. In this presentation, I will share some recent works from our team on how to address these challenges using real insurance data. I will begin with the use of a simple Mixture of Experts model that enables to capture the heterogeneousness of an auto insurance portfolio and the nonlinear relationship between policy attributes and claims, and show how the model can be used for policy selection for the Risk-Sharing Pool of the Facility Association of the Province of Ontario, Canada. We further add random effects to the model to address the temporal dependence of the claim history within each of the policies and show such an approach provides better risk classification for the portfolio. We then turn our focus to the problem of IBNR reserving, which is significantly impacted by both systematic and unsystematic variability in reporting delays. This variability is addressed through a hierarchical modeling framework, incorporating a Dirichlet distribution on reporting delay. Our real data application shows that the approach improves the accuracy and reliability of IBNR reserving.

Speaker: Rade Thomas Musulin (Finity)

Title: Stressed Out: Challenges to the Financial System from Climate Risk and More

Abstract: After a long period of relative calm after the end of the cold war, the world has been severely disrupted by an unprecedented series of events, including a pandemic, climate change, artificial intelligence, political upheaval, and wars. Successfully navigating through this time will require new ways of thinking and an ability to rapidly adjust to events. This session will focus on one part of this puzzle, how climate risk and decarbonization may impact the financial system. The speaker will have just returned from COP 29 in Azerbaijan and will provide an update on what was discussed, how the US elections may impact policy, and what all this means for Australia.

Speaker: Qihe Tang (University of New South Wales)

Title: Two-Stage Distributionally Robust Optimization

Abstract: Decision-making based on empirical distributions suffers from the notorious issue of distributional uncertainty, which we refer to as ambiguity. To address this issue, an active strand of research utilizes distributionally robust optimization, which aims to make data-driven decisions by considering the worst-case scenario within an ambiguity ball believed to contain the true distribution. Consider two agents – such as an investor and a regulator, a policyholder and an insurer, or a retailer and a supplier – who possess different levels of access to information about a risky project. Consequently, after Agent 1 makes a distributionally robust decision regarding the risk project, Agent 2 needs to further robustify it due to their exposure to additional ambiguity. We investigate this two-stage robustification problem. Ambiguity balls are constructed using well-known distances such as the φ divergence and the Wasserstein metric. Our study highlights the divergence-based risk measure, defined by taking the supremum of the expectation over an ambiguity ball described by the φ divergence. A series of analytic results are derived, most of which become fully explicit in the case of linear portfolios.

Speaker: Matthew Crane (EY)

Title: Challenges with Funding Private Hospitals

Abstract: It is well documented that the private hospital sector in Australia is facing sustainability challenges. However, hospitals are one part of a complex web of funding flows, incentives, demand pressures and regulations that apply across the private healthcare sector more broadly, which makes it a difficult challenge to solve. This presentation will dip into the complexity of the challenge and potential ways forwards.