THE UNIVERSITY OF MELBOURNE

Now we r_{60}

A conference in honour of Professor David Dickson

5-6 December 2019

Mawby Theatre
Melbourne Business School
200 Leicester St, Carlton VIC 3053

Centre for Actuarial Studies
The University of Melbourne

Welcome

It is both a pleasure and an honour for me to welcome everyone to this conference. I am most indebted to colleagues for organizing this event, and to everyone who is contributing in some way.

For those of you who have travelled a long distance to be here, I'd like to extend a warm welcome to Melbourne, the city I have called home for the last twenty-seven years. Both the city and the university have changed greatly in that time, as has the Centre for Actuarial Studies. In particular, it has very much become an international centre for actuarial research and research training, and it is great to see some of our graduates carving out academic careers, including some of our conference presenters.

Retirement is an event that marks the end of one chapter of life and the beginning of another, and it is perhaps inevitable that a certain amount of reflection takes place at a conference like this. That is the approach I have taken for my presentation, so I will leave reminiscing until then. Looking ahead, I certainly hope that my emeritus appointment will allow me to continue to contribute to the research activities of the Centre for Actuarial Studies.

We have an interesting and varied program for the two days of the conference and I'm looking forward to the presentations and to some lively discussion.

— *David Dickson*

Programme

DAY ONE

8:30 – 9:00	**Registration**
9:00 – 9:10	Opening Remarks
9:10 – 9:50	David Dickson (University of Melbourne) Thirty-five years of ruin theory
9:50 – 10:30	Hansjörg Albrecher (Université de Lausanne) Optimal ratcheting of dividends in insurance
10:30 – 11:00	**Coffee Break**
11:00 – 11:40	Kostya Borovkov (University of Melbourne) The exact asymptotics of the large deviation probabilities in the multivariate boundary crossing problem
11:40 – 12:20	Alfredo Égidio dos Reis (Universidade de Lisboa) Ruin probabilities and capital requirement for open automobile portfolios with a Bonus-Malus system based on claim counts
12:20 – 1:40	**Lunch**
1:40 – 2:20	Jackie Li (Macquarie University) Bayesian vine copula modelling for actuarial applications
2:20 – 3:00	Han Li (Macquarie University) An EVT approach to modeling joint extremes in climate and mortality
3:00 – 3:30	**Coffee Break**
3:30 – 4:10	Jae Kyung Woo (University of New South Wales) On finite-time ruin probabilities and other related quantities in a Sparre Andersen model
4:10 – 4:50	Jingchao Li (Shenzhen University) Calculations of ruin probabilities for the classical risk model under reinsurance
4:50 – 5:30	Marcin Rudź (Lodz University of Technology) Multidimensional ruin probabilities in regime-switching models
6:30 – 9:00	**Dinner**
	Matthaei Room, University House at Professors Walk

DAY TWO

9:00 – 9:40	Zhimin Zhang (Chongqing University) A novel method for solving some finite-time ruin problems by Laguerre series expansion
9:40 – 10:20	Eric Cheung (University of New South Wales) On David Dickson's works and their inspiration to my academic journey
10:20 – 10:50	**Coffee Break**
10:50 – 11:30	Jun Cai (University of Waterloo) Risk management with TVaR-based expectiles
11:30 – 12:10	Runhuan Feng (University of Illinois at Urbana-Champaign) Dickson-Hipp operator and decentralized insurance plans
12:10 – 12:50	Qihe Tang (University of New South Wales) Liquidation risk in insurance under contemporary regulatory frameworks
12:50 – 1:00	Closing Remarks
1:00 – 2:00	**Lunch**

Titles and Abstracts

Thirty-five years of ruin theory

DAVID DICKSON — University of Melbourne

This will be a review talk in which I will discuss some of my favourite papers and results from my work in ruin theory over the last 35 years.

Optimal ratcheting of dividends in insurance

HANSJÖRG ALBRECHER — Université de Lausanne

In this talk, a long-standing open problem in risk theory is studied, namely finding the optimal strategy to pay out dividends from an insurance surplus process, if the dividends are paid according to a dividend rate that is not allowed to decrease. The optimality criterion here is to maximize the expected value of the aggregate discounted dividend payments up to the time of ruin. In the framework of the classical Cramér-Lundberg risk model, the corresponding two-dimensional optimal control problem is solved and optimal strategies are numerically determined for several concrete examples. The implementations illustrate that the restriction of ratcheting does not lead to a large efficiency loss when compared to the classical un-constrained optimal dividend strategy. This is joint work with P. Azcue and N. Muler.

The exact asymptotics of the large deviation probabilities in the multivariate boundary crossing problem

KOSTYA BOROVKOV — University of Melbourne

For a multivariate random walk with i.i.d. jumps satisfying the Cramér moment condition and having mean vector with at least one negative component, we derive the exact asymptotics of the probability of ever hitting the positive orthant that is being translated to infinity along a fixed vector with positive components. This problem is motivated by and extends results from a paper by F. Avram et al. (2008) on a two-dimensional risk process. Our approach combines the large deviation techniques from a series of papers by A. Borovkov and A. Mogulskii from around 2000 with new auxiliary constructions, which enable us to extend their results on hitting remote sets with smooth boundaries to the case of boundaries with a "corner" at the "most probable hitting point". We also discuss how our results can be extended to the case of more general target sets. (Joint work with Yuqing Pan.)

Ruin probabilities and capital requirement for open automobile portfolios with a Bonus-Malus system based on claim counts

ALFREDO ÉGIDIO DOS REIS — Universidade de Lisboa

For a large motor insurance portfolio, on an open environment, we study the impact of experience rating in finite and continuous time ruin probabilities. We consider a model for calculating ruin probabilities applicable to large portfolios with a Markovian Bonus-Malus System (BMS), based on claim counts, for an automobile portfolio using the classical risk framework model. New challenges are brought when an open portfolio scenario is introduced. When compared with a classical BMS approach ruin probabilities may change significantly. By using a BMS of a Portuguese insurer, we illustrate and discuss the impact of the proposed formulation on the initial surplus required to target a given ruin probability. Under an open portfolio setup, we show that we may have a significant impact on capital requirements when compared with the classical BMS, by having a significant reduction on the initial surplus needed to maintain a fixed level of the ruin probability.

Bayesian vine copula modelling for actuarial applications

JACKIE LI — Macquarie University

Vine copulas are a class of graphical models for building multivariate copulas from a cascade of bivariate copulas. As different pairs of random variables can be modelled by different copula structures, vine copulas provide ample flexibility for modelling the dependency structure in a multi-dimensional setting. In this research, we adopt a Bayesian framework to construct C-vine and D-vine copulas. Besides setting a prior density for the copula parameters, we also incorporate a prior density for the choice between potential copula candidates. In this way, copula selection is inherently performed in the Bayesian estimation, and all of process, parameter, and model uncertainties are allowed for in the framework. We demonstrate some possible applications in general insurance and life insurance modelling.

An EVT approach to modeling joint extremes in climate and mortality

HAN LI — Macquarie University

This paper aims to contribute to insurance risk management by modeling extreme climate risk and extreme mortality risk in an integrated manner via the extreme value theory (EVT). Our key objective is to model joint extremes in temperature and mortality using the cutting edge multivariate peaks over threshold (POT) approach, so as to quantify the directional causality between climate change and mortality experience. Based on the estimated bivariate generalized Pareto distribution, we calculate tail risk measures of the death counts conditional on the temperature index exceeding a high threshold. We conduct an empirical study using temperature and death data in the U.S., and find that the joint extremes in the frequency of cold weather and old-age death counts exhibit the strongest level of dependence. Our results provide new insights into pricing in the longevity capital market, where various mortality-linked securities are "triggered" by extreme mortality events. Moreover, the proposed EVT approach to modeling joint extremes is readily applicable to a wide range of areas such as multi-peril insurance and insurance portfolio management.

On finite-time ruin probabilities and other related quantities in a Sparre Andersen model

JAE KYUNG WOO — University of New South Wales

In this talk, finite-time ruin probabilities in a Sparre Andersen model are discussed. With the help of Lagrange's implicit function theorem, the approach utilized by Dickson and Willmot (2005), Laplace transform inversion of the compound geometric tail yields the density of the time of ruin. In turn, moments of the time of ruin are also obtained. Furthermore, the analysis of the marginal defective distribution for the number of claims until ruin is provided. This is joint work with G.E. Willmot.

Titles and Abstracts

Calculations of ruin probabilities for the classical risk model under reinsurance

JINGCHAO LI — Shenzhen University

In this paper, we derive and solve integro-differential equations for ruin probabilities under both the proportional and excess of loss reinsurance. We also show that multinomial approximation scheme can be used to calculate the finite time ruin probabilities for the classical risk model under reinsurance. In numerical examples, we compared calculations using different approximation methods for both finite and infinite time ruin probability for the classical risk model with reinsurance. Finally, we show that ruin probabilities under the excess of loss reinsurance is lower than those under the proportional reinsurance by some given conditions.

Multidimensional ruin probabilities in regime-switching models

MARCIN RUDŹ — Lodz University of Technology

We will discuss a model with a regime-switching mechanism which enables effective modelling of an insurer's claims. Under the methodology, several discrete- and continuous-time risk models can be treated simultaneously and in a unified way. A suitably defined multidimensional risk operator $\mathbf{L}$ and the envelopes of generalized moment generating functions will be applied to bound vector-valued finite-horizon ruin probabilities $\boldsymbol{\Psi}_n$. Using a fast algorithm of numerical iterations of $\mathbf{L}$, we will also show how to calculate exact values of $\boldsymbol{\Psi}_n$ in a Markov-switching framework. Numerical examples will also be given.

A novel method for solving some finite-time ruin problems by Laguerre series expansion

ZHIMIN ZHANG — Chongqing University

In this paper, we solve some finite-time ruin problems in the (perturbed) compound Poisson risk model. Instead of using the well-known inverse Laplace transform method, we shall derive some infinite series expressions for the density of the time to ruin and the finite-time expected discounted penalty function by Laguerre series expansion. When the individual claim size density function is a combination of finite exponentials, we show that each Laguerre coefficient can be explicitly computed. Numerical experiments demonstrate the accuracy and efficiency of the proposed method.

On David Dickson's works and their inspiration to my academic journey

ERIC CHEUNG — University of New South Wales

In this presentation, I will talk about David's works in ruin theory and how these have inspired me since my PhD study. Topics include some of the techniques he used (e.g. Dickson-Hipp operator, Lagrange implicit function theorem), the ideas he proposed (e.g. Dickson-Waters modification in connection to reinsurance and capital injections), and his computational algorithms (e.g. discretisation scheme in relation to finite-time ruin problems). I will discuss how these have been extended to tackle more general research problems over the years.

Risk management with TVaR-based expectiles

JUN CAI — University of Waterloo

In this talk, we introduce TVaR-based expectiles and consider their applications in risk management. We discuss how to measure risks with the TVaR-based expectiles when only the partial distribution information of the risks is available. We also investigate the asymptotic behavior of the TVaR-based expectiles for heavy-tailed risks. Moreover, we present consistent non-parametric estimators for the TVaR-based expectiles.

Dickson-Hipp operator and decentralized insurance plans

RUNHUAN FENG — University of Illinois at Urbana-Champaign

The first topic is presented in honor of Professor David Dickson's contributions to ruin theory. Dickson-Hipp operator has been a useful and artful mathematical tool in solving many classic ruin problems. This first part of the talk is to provide an overview of classic Dickson-Hipp operator, its matrix extension and various applications in the literature. The second topic reviews recent development on the decentralization and disintermediation of insurance plans in the InsurTech industry. What is the role of academic actuaries in shaping the direction of this booming industry? We present a new framework for the design and engineering of various types of existing business models and innovative proposals from academics.

Liquidation risk in insurance under contemporary regulatory frameworks

QIHE TANG — University of New South Wales

In traditional research in insurance and finance, a firm is subject to immediate liquidation when its asset value process drops to an absorbing low barrier. This treatment greatly simplifies research but largely ignores the complexity of the liquidation procedure in the real world. In banking and finance, many researchers have taken into account the features of Chapter 7 liquidation and Chapter 11 reorganization of the U.S. Bankruptcy Code. Also, there have been similar discussions in insurance regulation, but few works have been done to achieve a quantitative understanding of the liquidation risk in insurance under contemporary regulatory frameworks. We quantify the rehabilitation proceeding in insurance, which is akin to Chapter 11 reorganization of the U.S. Bankruptcy Code, and we conduct a probabilistic analysis of the liquidation risk of an insurance company having the option of rehabilitation. In doing so, we construct a three-barrier model to describe the solvent and insolvent states in which the surplus process follows different time-homogeneous diffusions. We derive analytical expressions for the liquidation probability and the Laplace transform of the liquidation time with a fixed grace period and then extend the study to the case with an independent exponentially distributed grace period. If further restricted to the constant elasticity of variance (CEV) framework, the obtained formulas become completely explicit. This talk is based a working paper joint with Xin Li, Haibo Liu, and Jinxia Zhu.


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