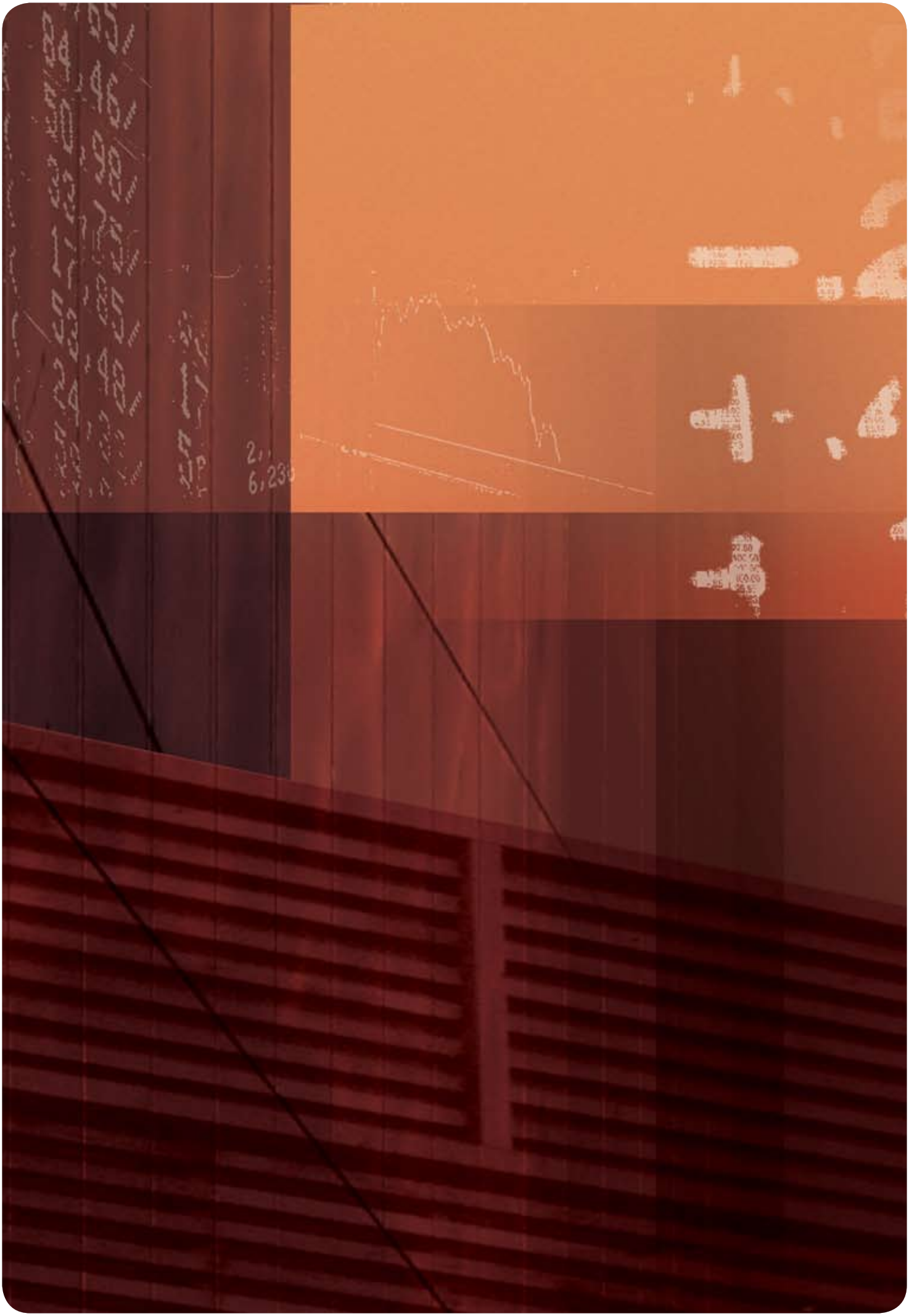
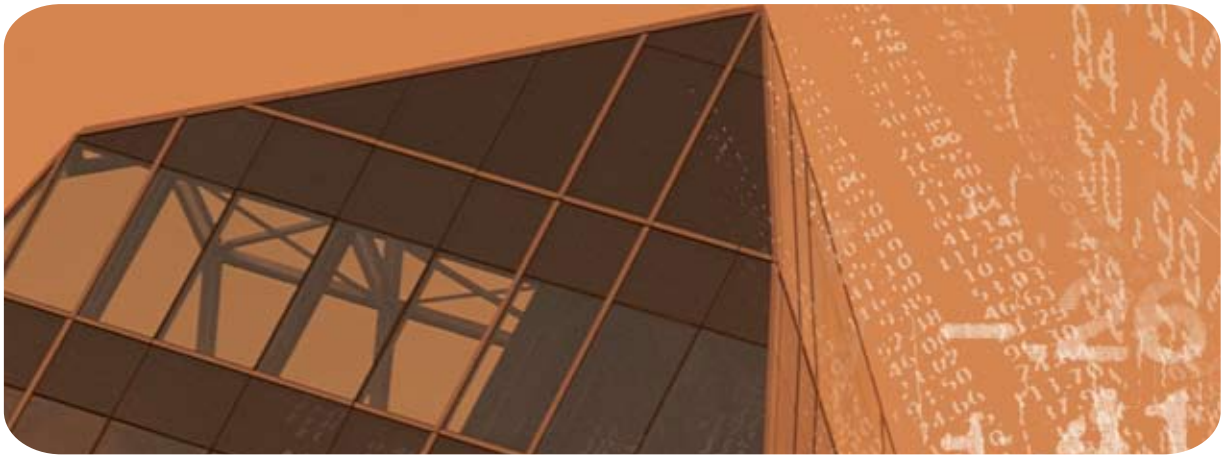
THE UNIVERSITY OF
MELBOURNE

Centre for Actuarial Studies >

2005

Annual Report





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INTRODUCTION

The Centre for Actuarial Studies continues to be the focal point for actuarial education in Victoria. It attracts the support of the actuarial profession in Australia and produces quality applied and theoretical research. It also maintains strong international links as well as contributing to the local actuarial community. The Centre is designated as a Centre of Excellence by the Institute of Actuaries of Australia.

STAFF NEWS

Dr Mark Joshi joined the Centre as an associate professor in November. Previously Mark has lectured at Cambridge University and prior to joining the Centre he worked for the Royal Bank of Scotland for six years as a quantitative analyst at a variety of levels, finishing as the Head of Quantitative Research for Group Risk Management. Mark has written two books on mathematical finance, "The concepts and practice of mathematical finance," and "C++ design patterns and derivatives pricing", both of which were published by Cambridge University Press.

Dr Xueyuan Wu joins the Centre as a lecturer at the beginning of 2006. Xueyuan completed a PhD in risk theory at the University of Hong Kong, having previously studied at Nankai University. He has lecturing experience in the School of Mathematics and Statistics at the University of South Australia.

Daniel Dufresne spent six months on study leave in the second half of the year, visiting Concordia University in Montreal and the University of Paris VI.

RESEARCH ACTIVITIES

Research continued in a variety of areas. Staff continue to publish in quality journals and to present their research at seminars and conferences around the world.

Edward Leung became the university's first PhD graduate in actuarial studies, his thesis being entitled "Long term care in Australia".

Details of publications and additions to the Centre's Research Paper Series can be found later in this report.

TEACHING ACTIVITIES

Overall enrolments were down slightly from their 2004 level. However, enrolments at 3rd year level and in the honours year were strong, with a record number of 52 students completing honours. Details of enrolments are given later in this report.

The Centre introduced a new suite of subjects at 3rd year level in order to align its subjects with the content of professional actuarial subjects, so that students can continue to gain exemption from professional exams. These new subjects include the non-exmption subject Models for Insurance and Finance which provides students with the rigorous background required to tackle honours level actuarial subjects.

Teaching activities were supported by a number of external actuaries including Mr Iain Ross (Introduction to Actuarial Studies), Mr Ron Weatherhead (Introduction to Actuarial Studies), Mr Andrew P Gale (Actuarial Practice and Control I) and Mr Cary Helenius, Mr William Higgins, Mr Robert Thomson and Mr Chris White (Actuarial Practice and Control II). Mr Jackie Li, who is a PhD student in the Centre, lectured the subject Financial Mathematics I.

VISITORS

Student exchange again took place with the Department of Actuarial Mathematics and Statistics at Heriot-Watt University, with two Melbourne students returning in July and three Heriot-Watt students spending the year in Melbourne.

PROFESSIONAL ACTIVITIES

David Pitt is a member of the Prizes and Awards Committee of the Institute of Actuaries of Australia. During the year he also served as an examiner in Part III of the Institute's exams.

Two honours graduates from 2004, Sam Killmier and Aaron McGovern, gave presentations based on their honours research essays at the August Horizons Meeting of the Institute of Actuaries of Australia, on the topics of catastrophe risk modelling and inflation, investment returns and the Wilkie model respectively.

AWARDS

David Pitt was awarded the Dean's Outstanding Lecturer award for 2005.

Shuanming Li was awarded the Dean's Prize for Exceptional Distinction in Research and Research Training for 2005.

Richard Fitzherbert was awarded the JASSA Prize for 2005 for the best original article for his paper "What causes the equity premium?"

Edward Leung was awarded the A M Parker prize for 2005 by the Institute of Actuaries of Australia for his paper "Projecting the needs of long term care in Australia".

Jackie Li was awarded the A H Pollard PhD Scholarship by the Institute of Actuaries of Australia.

Honours students Daniel Antioch and Emily Tao were awarded two of four Brian Gray Scholarships by the Australian Prudential Regulatory Authority (APRA). These scholarships are open to honours students in Australia who are studying in a discipline of interest to APRA such as actuarial studies, economics and finance.

Academic Activities >

Publications

Books

Dickson, D.C.M., Insurance Risk and Ruin, Cambridge University Press.

Chapters in Books

Dufresne,D., Bessel Processes and Asian Options, "Numerical Methods in Finance," New York, Kluwer Academic.

Journal Articles

Dickson, D.C.M., Hughes B.D., and Lianzeng, Z., The Density of the Time to Ruin for a Sparre Andersen Process with Erlang Arrivals and Exponential Claims, *Scandinavian Actuarial Journal,* 2005, 5.

Dickson, D.C.M. and Willmot, G.E., The Density of the Time to Ruin in the Classical Poisson Risk Model, *ASTIN Bulletin,* 35, 1.

Fitzherbert, R.M., What Causes the Equity Premium?, Journal of the Securities Institute of Australia, Securities Institute of Australia, 2005, 3.

Joshi, M.S., Applying Importance Sampling to Pricing Single Tranches of CDOs in a One-Factor Li Model, Wilmott Magazine, 2005, March.

Li, S., Discussion of the Time Value of Ruin in a Sparre Andersen Model, North American Actuarial Journal, 9, 2.

Li, S., On a Class of Discrete Renewal Risk Models, Scandinavian Actuarial Journal, 2005, 4.

Li, S., Distributions of the Surplus Before Ruin, the Deficit at Ruin and the Claim Causing Ruin in a Class of Discrete Time Risk Model, Scandinavian Actuarial Journal, 2005, 4.

Li, S. and Garrido, J., On the Gerber-Shiu functions in a Sparre Andersen Risk Model Perturbed by Diffusion, Scandinavian Actuarial Journal, 2005, 3.

Li, S. and Garrido, J., On a General Class of Risk Processes: Analysis of the Gerber-Shiu Function, Advances in Applied Probability, 37, 3.

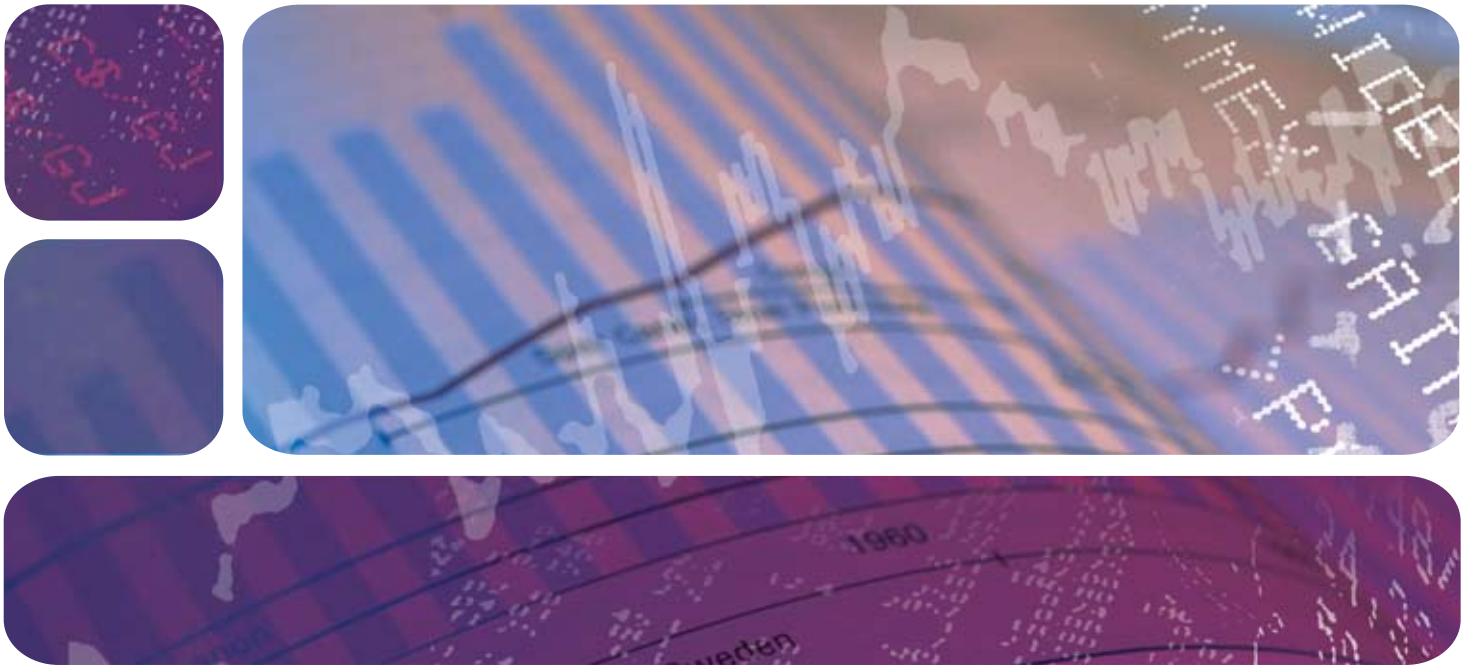
Li, S. and Garrido, J., Ruin Probabilities for Two Classes of Risk Processes, ASTIN Bulletin, 35, 1.

Li, S. and Lu, Y., On the Expected Discounted Penalty Functions for Two Classes of Risk Processes, Insurance: Mathematics & Economics, 36, 2.

Lu, Y. and Li, S., On the Probability of Ruin in a Markov-Modulated Risk Model, Insurance: Mathematics & Economics, 37, 3.

Pitt, D., O'Neill, T. and Puza, B., The Monty Hall Three Doors Problem, Teaching Statistics, 27, 1.

Rebonato, R., Mahal S., Joshi, M.S. and Bucholz L., Evolving Yield Curves in the Real-World Measures: a Semi-Parametric Approach, Journal of Risk, 7, 4.



Other Publications

Dickson D.C.M., Book Review of "Risk Analysis in Theory and Practice", Economic Record, 81, 254.

Dufresne, D., Two Notes in Financial Mathematics, Actuarial Research Clearing House, Vol 2005,2.

Gribble, J.D., An Update from Australia, International News, Society of Actuaries 36.

Gribble, J.D., ICP19B Insurance Activity – Statistical Basis for Insurance (Insurance Core Principle 19), Supporting Insurance Supervision: Devlopment of the Core Curriculum for Insurance Supervisors, Joint project by the World Bank, IAIS and FSI, 2005, May.

Gribble, J.D., and McGing, S., Modelling Risk: Right Model + Wrong Doing = Wrong Answer, Proceedings of the Institute of Actuaries of Australia Convention.

Involvement as referees

During the year members of the Centre acted as referees for the following journals

Agenda

Advances in Applied Probability

ASTIN Bulletin

Insurance: Mathematics & Economics

Journal of Banking and Finance

Journal of Futures Markets

Journal of Risk

Management Science

North American Actuarial Journal

Quantitative Finance

Risk Magazine

Scandinavian Actuarial Journal

Science China

Other Activities

David Dickson is an associate editor of Insurance: Mathematics & Economics and of British Actuarial Journal, and is a member of the editorial board of ASTIN Bulletin and North American Actuarial Journal.

David Dickson is Adjunct Professor at the University of Waterloo.

Richard Fitzherbert is an associate editor of Australian Actuarial Journal.

Jules Gribble participated in The MRC Capacity Building Initiative, as Academic Director of Training Programs and Faculty Leader, Life Insurance and Pensions, Melbourne, a one week residential program, Asia Pacific regional capacity building program in financial services endorsed by APEC Finance Ministers.

Jules Gribble gave presentations on Life Insurance and Risk Management, AFSPC/IMF Regional Seminar, Insurance, Pensions and Banking – Overview, hosted by Bank of Papua New Guinea, Port Moresby,.

Greg Taylor is an associate editor of Insurance: Mathematics and Economics.

Conference, Seminar & Lecture Presentations >

Dickson, D.C.M., Dividend strategies for a modified risk process, Heriot-Watt University, June.

Dickson, D.C.M., Optimal Dynamic Reinsurance, Quebec (Insurance: Mathematics & Economics Congress), July.

Dickson, D.C.M., Dividend strategies for a modified risk process, Hawaii (IFORS Triennial Conference), July.

Dufresne, D., Stochastic life annuities, Conference on Stochastic Modelling of Complex Systems 2005, Daydream Island (Qld), July.

Dufresne, D., Stochastic life annuities, Concordia University, Montreal, September.

Dufresne, D., Stochastic life annuities, Workshop on Asian Options, Boston University, September.

Dufresne, D., On a stochastic difference equation, Concordia University, Department of Mathematics and Statistics, Montreal, October.

Dufresne, D., Nouveaux resultats sur l'equation X(n)=B(n)(X(n-1)+C(n)), Universite Paris VI, November.

Dufresne, D., Fourier transforms for options and insurance premiums, Courant Institute, NYU, New York, December.

Dufresne, D., Fitting combinations of exponentials to probability distributions, Bloomberg, New York, December.

Dufresne, D., Fourier transforms for options and insurance premiums, Actuarial Day, Concordia University, Montreal, December.

Gribble, J.D., Modelling Risk: Right Model + Wrong Doing = Wrong Answer, Institute of Actuaries of Australia Convention, May

Gribble, J.D., Actuarial Practice and Control: Presentation for IAIS, IAIS Basel, June.

Gribble, J.D., The risk process of risk, ASFA Lunchtime Series, Melbourne, July.

Gribble, J.D., A risk taxonomy, RMIA Conference, FSR-SIG, Adelaide, November.

Joshi, M.S., IG: a new approach to pricing portfolio credit derivatives, Isaac Newton Institute, Cambridge, February.

Joshi, M.S., Intensity Gamma: a new approach to pricing portfolio credit derivatives, QMF 2005 Manly, December.

Li, S., On the perturbed classical risk model with a dividend barrier, Department of Mathematics and Statistics, University of Melbourne, March.

Pitt, D., Mixture models and claim termination rates for disability income insurance, Quebec (Insurance: Mathematics & Economics Congress) July.

Pitt, D., Mixture models and claim termination rates for disability income insurance, University of Melbourne. Department of Mathematics and Statistics, August.

Taylor, G.C., Modelling mortgage insurance as a muti-state process. University of New South Wales Actuarial Symposium, November.

Other conferences attended

Taylor, G.C., ASTIN Colloquium, Zurich, September.

Conferences and Seminars Organised

Dufresne, D., Co-Organiser of "Workshop on Asian Options", Boston University.

Melbourne Seminar Series

The Melbourne Seminar Series is a joint initiative with the Institute of Actuaries of Australia. Seminars are held in a downtown location in Melbourne.

The speakers in 2005 were:

Greg Taylor: "A few basics of credibility theory".

Howard Waters: "Valuing liabilities with embedded options".

Research Paper Series >

The Centre has an established Research Paper Series and abstracts of the papers published in 2005 are given below. Electronic forms of papers are available on the World Wide Web at:

http://www.economics.unimelb.edu.au/actwww/papers.html

No 119: The Maximum Surplus before Ruin in an Erlang(n) Risk Process and Related Problems

By Shuanming Li and David C.M.Dickson

Abstract: We study the distribution of the maximum surplus before ruin in a Sparre Andersen risk process with the inter-claim times being Erlang(n) distributed. This distribution can be analysed through the probability that the surplus process attains a given level from the initial surplus without first falling below zero. This probability, viewed as a function of the initial surplus and the given level, satisfies a homogenous integro-differential equation with certain boundary conditions. Its solution can be expressed as a linear combination of n linearly independent particular solutions of the homogeneous integro-differential equation. Explicit results are obtained when the individual claim amounts are rationally distributed. When n = 2, all the results can be expressed explicitly in terms of the non-ruin probability. We apply our results by looking at (i) the maximum severity of ruin and (ii) the distribution of the amount of dividends under a constant dividend barrier.

No 120: The Distribution of the Dividend Payments in the Compound Poisson Risk Model Peturbed by Diffusion

By Shuanming Li

Abstract: We consider a diffusion perturbed classical compound Poisson risk model in the presence of a constant dividend barrier. An integro-differential equation with certain boundary conditions for the n-th moment of the discounted dividend payments prior to ruin is derived and solved. Its solution can be expressed in terms of the expected discounted penalty (Gerber-Shiu) functions due to oscillation in the corresponding perturbed risk model without a barrier. When the discount factor δ is zero, we show that all the results can be expressed in terms of the non-ruin probability in the perturbed risk model without a barrier.

No 121: Fitting Combinations of Exponentials to Probability Distributions

By Daniel Dufresne

Abstract: Two techniques are described for approximating distributions on the positive half-line by combinations of exponentials. One is based on Jacobi polynomial expansions, and the other on the log-beta distribution. The techniques are applied to some well-known distributions (degenerate, uniform, Pareto, lognormal and others). In theory the techniques yield sequences of combination of exponentials that always converge to the true distribution, but their numerical performance depends on the particular distribution being approximated. An error bound is given in the case the log-beta approximations.

No 122: An n- Year Roll Forward Reserve Model for Social Long Term Care Insurance in Australia

By Edward Leung

Abstract: We propose an n-year roll forward reserve model for a social LTC insurance scheme that may be introduced in Australia. Using the projected future needs and costs of LTC as derived in Leung (2004a), we calculate the likely contribution requirements to maintain 1-year, 2-year and 4-year level roll forward reserves for a hypothetical Australian Commonwealth government administered social LTC insurance scheme in Australia and to derive short term reserve profiles for such a fund over the next 50 years.

No 123: Exploring Unknown Quantities. Development and Application of a Stochastic Catastrophe Model with Output and Sensitivities

By Sam Killmier

Abstract: Stochastic catastrophe models are now widely used to assess and manage catastrophe exposure. In Australia, natural perils are the focus of modelling, having historically caused substantial insured losses. The proprietary nature of commonly used models has resulted in limited public scrutiny of their workings – despite the existence of significant inconsistencies in cross-model output. This paper adds to the currently limited body of publicly available literature regarding the detail of catastrophe model development. This is done through a thorough presentation of a theoretical model and the application of this model to the peril of hailstorm in the Sydney region for commercial property insurance. It is found that data is difficult to obtain, placing constraints on the model design. Additionally, the sensitivity of output to changes in assumptions and parameters is highly significant – supporting the argument for greater cross-model comparison. Finally, it is suggested that increased co-operation and openness would help to address the causes of model inconsistency and improve the overall standard of catastrophe modelling.

No 124: Synchronous Bootstrapping of Seemingly Unrelated Regressions

By Greg Taylor and Gráinne McGuire

Abstract: Consider the seemingly unrelated regression framework, in which regression models are applied to a number of data sets, with stochastic dependencies between them. The regression models are not restricted to general linear models (eg GLMs). Forecasts are required, with estimates of prediction errors that account for the dependencies between data sets.

Bootstrapping is used to estimate prediction errors. Specialised forms of bootstrapping that capture the dependencies are constructed.

Insurance and banking applications are mentioned. The former is investigated with numerical examples. The specific context is insurance loss reserving under the requirement that the entire distribution of loss reserve be estimated, where this reserve is aggregated across a number of stochastically dependent lines of business.

No 125: Second Order Bayesian Revision of a Generalised Linear Model

By Greg Taylor

Abstract: It is well known that the exponential dispersion family (EDF) of univariate distributions is closed under Bayesian revision in the presence of natural conjugate priors. However, this is not the case for the general multivariate EDF.

This paper derives a second order approximation to the posterior likelihood of a naturally conjugated generalised linear model (GLM), i.e. multivariate EDF subject to a link function (Section 5.5). It is not the same as a normal approximation. It does, however, lead to second order Bayes estimators of parameters of the posterior.

The family of second order approximations is found to be closed under Bayesian revision. This generates a recursion for repeated Bayesian revision of the GLM with the acquisition of additional data.

The recursion simplifies greatly for a canonical link. The resulting structure is easily extended to a filter for estimation of the parameters of a dynamic generalised linear model (DGLM) (Section 6.2). The Kalman filter emerges as a special case.

A second type of link function, related to the canonical link, and with similar properties, is identified. This is called here the companion canonical link. For a given GLM with canonical link, the companion to that link generates a companion GLM (Section 4). The recursive form of the Bayesian revision of this GLM is also obtained (Section 5.5.3).

There is a perfect parallel between the development of the GLM recursion and its companion. A dictionary for translation between the two is given so that one is readily derived from the other (Table 5.1).

The companion canonical link also generates a companion DGLM. A filter for this is obtained (Section 6.3).

No 126: Two Notes on Financial Mathematics

By Daniel Dufresne

Abstract: This note is aimed at students and others interested in mean variance portfolio theory. Negative correlations are desirable in portfolio selection, as they decrease risk. It is shown that there is a mathematical limit to how negative correlations can be among a given number of securities. In particular, in an "average correlation model" (where the correlation coefficient between different securities is constant) the correlation has to be at least as large as $-1/(n-1)$, n being the number of securities.

No 127: Optimal Dividends under a Ruin Probability Constraint

By David C.M.Dickson and Steve Drekic

Abstract: We consider a classical surplus process modified by the payment of dividends when the insurer's surplus exceeds a threshold. We use a probabilistic argument to obtain general expressions for the expected present value of dividend payments, and show how these expressions can be applied for certain individual claim amount distributions. We then consider the question of maximising the expected present value of dividend payments subject to a constraint on the insurer's ruin probability.

No 128: Fourier Inversion Formulas in Option Pricing and Insurance

By Daniel Dufresne, Jose Garrido and Manuel Morales

Abstract: Several authors have used Fourier inversion to compute option prices. In insurance, the expected value of $\max(S-K, 0)$ also arises in excess-of-loss or stop-loss insurance, and similar techniques may be used. Lewis (2001) used Parseval's theorem to find formulas for option prices in terms of the characteristic function of the log-price. This paper aims at taking the same idea further: (1) formulas requiring weaker assumptions; (2) relationship with classical inversion theorems; (3) formulas for payoffs which occur in insurance.

Undergraduate and Honours Teaching >

The numbers enrolled in each subject for the last three years are shown below

Subject Name	2003	2004	2005
300-101 Introduction to Actuarial Studies	165	156	126
300-203 Financial Mathematics I	189	218	175
300-204 Financial Mathematics II	147	151	117
300-205 Introduction to Actuarial Practice	91	82	49
300-312 Actuarial Modelling I	-	-	121
300-313 Actuarial Modelling II	-	-	121
300-314 Contingencies	-	-	100
300-315 Actuarial Statistics	-	-	100
300-316 Models for Insurance and Finance	-	-	93
300-330 Survival Models: Theory and Applications	89	121	-
300-331 Modelling in Insurance and Finance I	85	122	-
300-332 Modelling in Insurance and Finance II	68	110	-
300-334 Financial Mathematics III	67	111	114
300-341 Actuarial Mathematics I	77	110	-
300-342 Actuarial Mathematics II	76	109	-
300-400 Actuarial Studies Research Essay	37	12	26
300-406 Risk Theory I	33	30	53
300-407 Risk Theory II	28	30	51
300-408 Advanced Financial Mathematics	34	25	47
300-409 Actuarial Studies Projects	-	19	40
300-410 Actuarial Practice and Control	50	59	55
300-411 Actuarial Practice and Control	53	55	54
Total Enrolments	1289	1520	1442

Honours Results and Theses Topics

The following students successfully completed a Bachelor of Commerce (Honours) with a specialisation in Actuarial Studies:

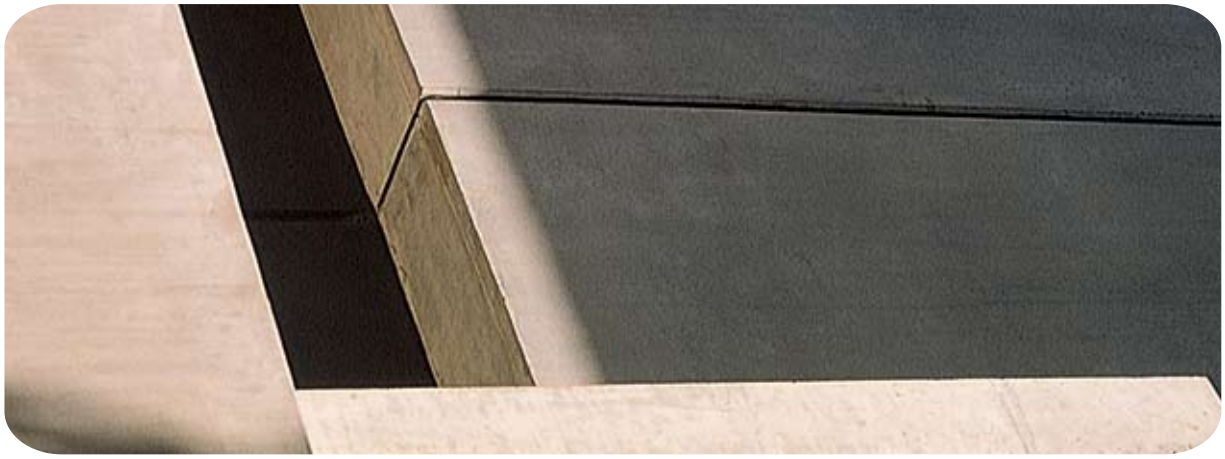
Daniel Antioch
Yun Bai
Tanawong Boonyasiriwong
Vincent Chan
Kuang Hsian Chang
Feng Chen
Min Chen
Li Jane Cheng
Tiong Eng Chuah
Ee Lin Foo
Chao Gan
Siliang Silvia He
Ka Ki Ho
Lucian Keong
Chien Lin Dennis Koh
Kwok Wai Nora Lam
Stephen Lau
Mandy Hoi Man Lee
Shen-Yi Charlene Lee
Ling Li
Ron Li
Juat Hwa Liang
Xueer Cheryl Lin
Wen Liu
Chatapiwa Mokgopo
Sat-Jing Ronald Ng
Alistair Ong
Shan Shah
Michell Hoi San Shek
Suet Yin Siew
Jarad Spowart
Emily Tao
Ye Tao
Min Wen Toh
Michael Turner
Chun Wing Wan
Andrew Wee
Xin Sophia Wei
Teresa Willcox
Lloyd Williams
Chun Wing Wong
Amanda Xie
Claudia Yan
Yinghua Yu
Yan Zhu

The following lists includes topics of honours essays submitted by honours students. An honours research essay is about 10,000 words and counts as 25% of the final assessment for a student's honours grade.

- Value at risk
- Patterns of health care usage
- General insurance valuation methods
- Comparison of methods for valuing general insurance liabilities
- On the equilibrium distributions of counting random variables
- Mortality investigation for disabled lives
- General insurance premium liabilities
- Arithmetic versus geometric mean returns
- Market indexed annuities
- Reinsurance and ruin
- Approximations in the individual risk model

The table below shows the numbers of students awarded each classification of honours in the last three years.

	H1	H2A	H2B	H3	Total
2003	12	9	9	4	34
2004	8	14	9	1	32
2005	14	14	16	8	52



Prize Winners >

Actuarial Awards

The Comminsure Prize

for Introduction to Actuarial Studies

Abhimannyu Narenthiran

The Tillinghast Towers Perrin Prize

for Risk Theory I and II

Emily Tao

The Trowbridge Deloitte Prize

for Actuarial Practice and Control I and II

Stephen Lau

The Institute of Actuaries Prize

for Research

Feng Chen

Pei Shan Lee

Actuarial Honours Prize

Kuang Hsian Chang

Faculty of Economics & Commerce Awards

The A.C. Morley Prize

for the best first year student in the Bachelor of Commerce degree

Emily Chong

The Paton Advertising Service Exhibition

for the best student in the second year of the Bachelor of Commerce degree

Christopher Yu

The J.F. Major Memorial Scholarship

for the best third year student intending to undertake the Bachelor of Commerce honours degree

Matthew Sibbison

Staff >

Professor of Actuarial Studies

DAVID C M DICKSON: BSc (Hons), PhD, FFA, FIAA

Professorial Fellow in Actuarial Studies

DANIEL DUFRESNE: BSc (Hons) PhD, FSA

Associate Professor

MARK JOSHI: BA, PhD

Senior Lecturers in Actuarial Studies

RICHARD FITZHERBERT: BSc (Hons), FIAA, FIA, FFin

SHUANMING LI: BSc, MEc, PhD

DAVID PITT: BEc, BSc, PhD, FIAA

Professional Associate

GREG C. TAYLOR: BA, PhD, PhD, FIA, FIAA, FIMA, CMath, AO

Honorary Senior Fellows

JULES GRIBBLE: BSc (Hons), PhD, FIAA, FCIA, FSA

GRANT HARSLETT: BSc (Hons), FIA, FIAA, ASA

ALLEN TRUSLOVE: BSc (Hons), PhD, MBA, FIAA, FIA

Tutors

Margaret E Atkinson, BA (Hons), MPhil, PhD

Vincent Chan

Ashley Evans, BCom (Hons)

Stephen Lau

Pei Lee

Aaron McGovern, BCom (Hons)

Peter Raymond BCom (Hons)

Lloyd Williams

Ron Weatherhead, BSc, CertEd, FIAA

Advisory Board >

The membership of the Advisory Board is as follows

EXTERNAL MEMBERS

Mr Rob Donaghy	Aviva
Mrs Helen McLeod	AIG
Professor Greg Taylor	Taylor-Fry Consulting Actuaries
Mr Chris White	

UNIVERSITY MEMBERS

Professor Maragret Abernethy	Dean, Faculty of Economics and Commerce
Professor Jeff Borland	Department of Economics
Professor Rob Brown	Department of Finance
Professor David Dickson	Centre for Actuarial Studies
Professor Daniel Dufresne	Centre for Actuarial Studies
Professor Vance Martin	Department of Economics

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