

Centre for Actuarial Studies
Annual Report 2004

THE YEAR IN REVIEW

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

Shuanming Li joined the Centre as a senior lecturer in November, having completed his PhD in risk theory at Concordia University, Montreal, earlier in the year. Prior to that, Shuanming was a lecturer at Renmin University in China.

David Pitt joins the Centre as a senior lecturer at the beginning of 2005. David is a Fellow of the Institute of Actuaries of Australia whose previous academic experience is at the Australian National University. During his five years there David was awarded the Vice-Chancellor's Prize for Teaching Excellence, and most recently he submitted a PhD thesis on modelling of disability income insurance.

David Dickson spent five months on study leave, visiting the University of Waterloo in March and April, and Heriot-Watt University in May, June and July.

Both Hye-Sun Lim and Edward McEllin resigned during the year. We thank them for their contributions to the Centre and wish them well in the future.

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.

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

TEACHING ACTIVITIES

Student enrolments increased by around 18% over their 2003 level. Details of enrolments are given on page xx.

One new subject was introduced, namely 300-409 Actuarial Studies Projects. Students completing the honours year must complete either this subject or

300-400 Actuarial Studies Research Essay. The new subject requires students to complete three short research reports on diverse topics during the year.

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 Robert Thomson (Actuarial Practice and Control II).

VISITORS

Mr Mikkel Dahl and Ms Helle Simonsen who are respectively PhD and Cand Act students from the Laboratory of Actuarial Mathematics at the University of Copenhagen visited the Centre from August until October. Mikkel gave a presentation of his work as part of the Melbourne seminar series.

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 two 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 2003, Flora Chan and Tomasz Dudek, gave presentations based on their honours research essays at the August Horizons Meeting of the Institute of Actuaries of Australia, on the topics of ruin theory and longevity risk in allocated annuities.

AWARDS

Honours student Sam Killmier was awarded one 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.

Edward Leung who is a PhD student in the Centre was again awarded the A H Pollard PhD Scholarship by the Institute of Actuaries of Australia.

Greg Taylor was awarded the Michelbacher Prize of the Casualty Actuarial Society for the paper "Loss reserving with GLMs: a case study", which was co-authored by Grainne McGuire.

ACADEMIC ACTIVITIES

PUBLICATIONS IN REFEREED JOURNALS

Cai, J. and Dickson D.C.M., Ruin probabilities with a Markov chain interest model. *Insurance: Mathematics & Economics* 35, 513 – 525.

Dickson, D.C.M. and Drekić, S., The joint distribution of the surplus prior to ruin and the deficit at ruin in some Sparre Andersen models. *Insurance: Mathematics & Economics* 34, 97 – 107.

Dickson, D.C.M. and Waters, H.R., Some optimal dividends problems. *ASTIN Bulletin* 34, 49 -74.

Dickson, D.C.M. and Wong, K.S., De Vylder approximations to the moments and distribution of the time to ruin. *Australian Actuarial Journal* 10, 707-724.

Drekić, S., Dickson, D.C.M., Stanford, D.A. and Willmot, G.E., On the distribution of the deficit at ruin when claims are phase-type. *Scandinavian Actuarial Journal* 2004, 105 – 120.

Dufresne, D., The log-normal approximation in financial and other computations. *Advances in Applied Probability* 36, 747 – 773.

Leung, E., Projecting the needs and costs of long term care in Australia. *Australian Actuarial Journal* 10, 343-385.

Li, S. and Garrido, J., On ruin for Erlang(n) risk process. *Insurance: Mathematics & Economics* 34, 391-408.

Li, S. and Garrido, J., On a class of renewal risk models with a constant dividend barrier. *Insurance: Mathematics & Economics* 35, 691-701.

Taylor, G.C., Risk and discounted loss reserves. *North American Actuarial Journal* 8, 1, 37-44.

Taylor, G.C. and McGuire, G., Loss reserving with GLMs: a case study. *Casualty Actuarial Society 2004 Discussion Paper Program*, 327-392.

Willmot, G.E., Dickson, D.C.M., Drekić, S. and Stanford D.A. The deficit at ruin in the stationary renewal risk. *Scandinavian Actuarial Journal* 2004, 241 – 255.

OTHER PUBLICATIONS

Dickson D.C.M., Dividends. Encyclopedia of Actuarial Science (Teugels, J. and Sundt, B. (eds)), John Wiley & Sons, 576-579.

Dickson D.C.M., Risk Process. Encyclopedia of Actuarial Science (Teugels, J. and Sundt, B. (eds)), John Wiley & Sons, 1361-1362.

Dickson D.C.M., Proportional Reinsurance. Encyclopedia of Actuarial Science (Teugels, J. and Sundt, B. (eds)), John Wiley & Sons, 1355-1356.

Dickson D.C.M., Quota-share reinsurance. Encyclopedia of Actuarial Science (Teugels, J. and Sundt, B. (eds)), John Wiley & Sons, 1508-1511.

Fitzherbert, R.M., Price conversion factors for historians. Australian Actuarial Journal 10, 617-622.

Fitzherbert, R.M., Investment Principles for Actuaries. The Institute of Actuaries of Australia, 187pp.

Gribble, J.D., The Australian Actuarial Profession. International News, Issue 32, Society of Actuaries.

Gribble, J.D., Insurance Activity: A Primer on Introduction to and Assessment of Reinsurance (Insurance Core Principle 19). Supporting Insurance Supervision: Development of the Core Curriculum for Insurance Supervisors, Joint Project by the World Bank, IAIS and FSI.

Gribble, J.D., Equity in Unit Pricing. Institute of Actuaries of Australia Financial Services Forum.

INVOLVEMENT AS REFEREES

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

- *Agenda*
- *Annals of Applied Probability*
- *ASTIN Bulletin*
- *Australian Actuarial Journal*
- *British Actuarial Journal*
- *Insurance: Mathematics and Economics*
- *Journal of Accounting Research*
- *Journal of Mathematical Analysis and Applications*
- *Journal of Statistical Computation and Simulation*
- *North American Actuarial Journal*
- *Quantitative Finance*
- *Statistics and Probability Letters*

Additionally, members of the Centre acted as referees for the Natural Sciences and Engineering Research Council (Canada).

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 the *ASTIN Bulletin*.

David Dickson is Adjunct Professor at the University of Waterloo.

Daniel Dufresne is a member of the scientific committee for Luxembourg Economic Papers.

Daniel Dufresne is a member of the Scientific Committee for the Stochastic Modelling of Complex Systems Conference in 2005.

Richard Fitzherbert is an associate editor of *Australian Actuarial Journal*.

David Pitt acted as a consultant to the Reserve Bank of Fiji and the Australian Competition and Consumer Commission.

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

CONFERENCE, SEMINAR & LECTURE PRESENTATIONS

PRESENTATIONS BY MEMBERS OF THE CENTRE

Dickson, D.C.M., "The distribution of the time to ruin", Concordia University, April.

Dickson, D.C.M., "The distribution of the time to ruin", University of Western Ontario, April.

Dickson, D.C.M., "The distribution of the time to ruin", University of Waterloo, April.

Dickson, D.C.M., "The density of the time to ruin in the classical risk model", Heriot-Watt University, June.

Dufresne, D., "Pricing Asian options in the Black-Scholes framework", Monash University, March.

Dufresne, D., "Bessel processes and Functionals of Brownian Motion", Workshop on Mathematical Methods in Finance, Melbourne, June.

Dufresne, D., "The lognormal distribution in financial and other computations", National Symposium on Financial Mathematics, Melbourne, June.

Dufresne, D., "The lognormal approximation in financial and other computations", Bachelier Congress, Chicago, July.

Dufresne, D., "The lognormal approximation in financial and other computations", QGroup, Melbourne, August.

Fitzherbert, R.M., "Strategic asset allocation: estimating long-term risks and returns", IIR, Sydney, July.

Gribble, J.D. "Operational Risk: Management", Australian APEC Study Centre Course in Prudential Regulation and Risk Management for the Asian Bankers Association, Melbourne, February, March & April.

Leung, E., "A multiple state model for pricing and reserving private long term care insurance in Australia", Heriot-Watt University, July.

Li, S., "On the time value of ruin in a Sparre Andersen risk process perturbed by diffusion", York University, Toronto, February.

Li, S., "On a class of risk processes", Middle Tennessee State University, March.

Li, S., “On a class of risk processes”, University of Montreal, April.

Li, S., “On a class of discrete time renewal risk models”, 39th Actuarial Research Conference, The University of Iowa, August.

McEllin, E.B., “Actuarial implications of environmental tobacco smoke”, San Diego, June.

Pitt, D.G.W., “Modelling the experience of disability income insurance policyholders”, Macquarie University, May.

Pitt, D.G.W., “Actuarial Modelling of disability income insurance – mixture models and flowgraph models”, Sydney, December.

Taylor, G.C., “Loss reserving with GLMs: a case study”, Casualty Actuarial Society Spring Meeting, Colorado Springs, May.

Taylor, G.C., “Principles of financial economics in insurance pricing”, Institute of Actuaries of Australia Seminar on the Economic Theory of Profit Margins, Sydney, July.

Taylor, G.C., “Implications for insurance pricing. Where to from here?” Institute of Actuaries of Australia Seminar on the Economic Theory of Profit Margins, Sydney, July.

Taylor, G.C., “Bayesian revision of a GLM”, University of New South Wales, November.

CONFERENCES ATTENDED

Gribble, J.D., RMIA Annual Conference, Hobart, November.

Pitt, D.G.W, Australian Statistical Conference, Cairns, July.

Taylor, G.C., Casualty Actuarial Society Discussion Paper Program, Colorado Springs, May.

Taylor, G.C., Q-Group Colloquium, Sydney, August.

SEMINARS IN THE CENTRE

Shuanming Li: “On a class of discrete time renewal risk models”

David Pitt: “Modelling the experience of disability income insurance policyholders”

KC Tan: “Demographic issues in Singapore”

MELBOURNE SEMINAR SERIES

The Melbourne Seminar Series is a joint initiative with the Institute of Actuaries of Australia. Seminars are held at a downtown location in Melbourne. The speakers in 2004 were:

Mikkel Dahl: "A continuous time model for reinvestment rates in bond markets"

Edward Leung: "A multiple state model for pricing and reserving private long term care insurance in Australia"

Richard Fitzherbert: "Penetrating new fields: the need for paradigms"

RESEARCH PAPER SERIES

The Centre has an established Research Paper Series and abstracts of the papers published in 2004 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. 113: Loss reserving with GLMs: a case study

by Greg C Taylor and Grainne McGuire

Abstract: This paper provides a case study in the application of generalised linear models (“GLMs”) to loss reserving. The study is motivated by approaching the exercise from the viewpoint of an actuary with a predisposition to the application of the chain ladder (“CL”). The data set under study is seen to violate the conditions for applications of the CL in a number of ways. The difficulties of adjusting the CL to allow for these features of the data are noted (Section 3). Regression, and particularly GLM regression, is introduced as a structured and rigorous form of data analysis. This enables the investigation and modelling of a number of complex features of the data responsible for the violation of the CL conditions. These include superimposed inflation and changes in the rules governing the payment of claims (Sections 4 to 7). The development of the analysis is traced in some detail, as is the production of a range of diagnostics and tests used to compare candidate models and validate the final one. The benefits of this approach are discussed in Section 8.

No. 114: De Vylder approximations to the moments and distribution of the time to ruin

by David C M Dickson and Kwok Swan Wong.

Abstract: De Vylder (1978) proposed a method of approximating the probability of ultimate ruin in the classical risk model. In this paper we show that his ideas can be extended to approximate the moments and distribution of time to ruin.

No. 115: The density of the time to ruin in the classical Poisson risk model

by David C M Dickson and Gordon E Willmot

Abstract: We derive an expression for the density of the time to ruin in the classical risk model by inverting the Laplace transform. We then apply the result when the individual claim amount distribution is a mixed Erlang distribution, and show how finite time ruin probabilities can be calculated in this case.

No. 116: Bessel processes and a functional of Brownian motion

by Daniel Dufresne

Abstract: The goal of this paper is to give a concise account of the connection between Bessel processes and the integral of geometric Brownian motion. The latter appears in the pricing of Asian options. Bessel processes are defined and some of their properties are given. The known expressions for the probability density function of the integral of geometric Brownian motion are stated, and other related results are given, in particular the Geman & Yor (1993) Laplace transform for Asian option prices.

No. 117: A multiple state model for pricing and reserving private long term care insurance in Australia

by Edward Leung

Abstract: We seek to develop a model for pricing LTC insurance contracts in Australia using the disability prevalence rates contained in the 1998 Australian Bureau of Statistics (ABS) Survey of Disability, Ageing and Carers. We perform premium and reserve calculations by applying generalisations of Thiele's differential equation for a multiple state model within a Markov framework. Several sets of results are presented that both capture a varying range of possible scenarios and demonstrate the flexibility of the model.

No. 118: Stochastic life annuities

by Daniel Dufresne

Abstract: This paper aims at finding explicit approximations to the distribution of a stochastic life annuity. It is assumed that returns follow a geometric Brownian motion (lognormal process). The distribution of the stochastic annuity may be used to answer questions such as "What is the probability that an amount F is sufficient to fund a pension with annual amount y to a pensioner aged x ?" The main idea is to approximate the future lifetime distribution with a combination of exponentials, and then apply a known formula related to the integral of geometric Brownian motion.

UNDERGRADUATE & HONOURS TEACHING

The numbers enrolled in each subject for the last three years are shown below.			
Subject Name	2002	2003	2004
300-101 Introduction to Actuarial Studies	145	165	156
300-203 Financial Mathematics I	127	189	218
300-204 Financial Mathematics II	97	147	151
300-205 Introduction to Actuarial Practice	-	91	82
300-330 Survival Models: Theory and Applications	78	89	121
300-331 Modelling in Insurance and Finance I	67	85	122
300-332 Modelling in Insurance and Finance II	59	68	110
300-334 Financial Mathematics III	-	67	111
300-341 Actuarial Mathematics I	60	77	110
300-342 Actuarial Mathematics II	64	76	109
300-400 Actuarial Studies Research Essay	36	37	12
300-406 Risk Theory I	34	33	30
300-407 Risk Theory II	32	28	30
300-408 Advanced Financial Mathematics	34	34	25
300-409 Actuarial Studies Projects	-	-	19
300-410 Actuarial Practice and Control I	45	41	41
300-410 Actuarial Practice and Control I – Distance	16	9	18
300-411 Actuarial Practice and Control II	38	43	38
300-411 Actuarial Practice and Control II – Distance	11	10	17
Total Enrolments	943	1,289	1,520

The number of students enrolled in actuarial subjects continues to increase. There is strong demand from overseas, with close to 40% of actuarial students being overseas students.

The number of students enrolled for honours fell slightly below the levels of the previous two years, but the number of honours enrolments in 2005 will be significantly higher.

As in previous years, distance students received lectures through cds and video streaming. The Centre now allows local Melbourne students to enrol as distance education students. The other distance students came from overseas locations such as Singapore, Hong Kong and Tokyo.

HONOURS RESULTS AND THESES TOPICS

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

Reagan Chai
Wai Kuan Cheng
Chi Ling Cheong
Fui Hai Choong
Henry Kwun Hang Chow
Keat Li Chuah
Wai Kei Chung
Yao Lun Chung
Ashley Evans
Han-Kee Gan
Shikha Gupta
Umashankar Jegasothy
Sei Lim Khong
Sam Killmier
Jolene Ee Leen Koay
Daniel Lavender
Christina Hye Min Lee
Yung Lee
Bi Yu Li
Wei Yin Lim
Ke Lin
My Ly
Allan Christian Madoc
Aaron McGovern
Daniel Edwin Morris
Mei Lin Ong
Andrew Samaratunge
Peter Richard Sinkis
Hui Yen Tai
Siaw Shing Tan
Chit Wai Wong
Ying Erica Wong

The following list 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.

- Stochastic catastrophe models
- Dynamic hedging strategies for equity-linked annuities
- Arithmetic versus geometric means: forecasting long term investment performance
- US mortality and the Lee-Carter model
- Dividends, shares, property, bank accepted bills, bonds and inflation
- Stochastic volatility: the Heston model
- Pricing barrier options
- Approximation methods for pricing Asian options
- Approximating the sum of continuous IID random variables
- Inflation, investment returns and the Wilkie model
- Analysis of a credit migration model
- Reset convertible preference shares

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

	H1	H2A	H2B	H3	Total
2002	11	11	12	4	38
2003	12	9	9	4	34
2004	8	14	9	1	32

PRIZE WINNERS

ACTUARIAL SUBJECT PRIZES

The AXA Australia Prize for *Financial Mathematics I and II*
Siang Yee Ng

The Commisure Prize for *Introduction to Actuarial Studies*
Yan Min Jiang

The NSP Buck Prize for *Survival Models: Theory and Applications*
Pei Shan Lee

The NSP Buck Prize for *Actuarial Mathematics I and II*
Pei Chin Lim

The Tillinghast Towers Perrin Prize for *Risk Theory I and II*
Sam Killmier

The Trowbridge Deloitte Prize for *Actuarial Practice and Control I and II*
Sam Killmier

The Institute of Actuaries of Australia Prize for research
Sam Killmier

Actuarial Honours Prize
Sam Killmier

FACULTY OF ECONOMICS AND COMMERCE AWARDS

The A.C. Morley Prize for the best first year student in the Bachelor of Commerce degree
Christopher Yu

The Paton Advertising Service Exhibition for the best student in the second year of the Bachelor of Commerce degree
Chen Pung Yong

The William Noall & Son Prize for the top honours graduate in the Faculty of Economics and Commerce
Sam Killmier

STAFF

PROFESSOR OF ACTUARIAL STUDIES

David C M Dickson, BSc (Hons), PhD, FFA, FIAA

PROFESSORIAL FELLOW IN ACTUARIAL STUDIES

Daniel Dufresne, BSc, PhD, FSA

SENIOR LECTURERS IN ACTUARIAL STUDIES

Richard M Fitzherbert, BSc (Hons), FIA, FIAA, ASIA

Shuanming Li, BSc, MEc, PhD

David G W Pitt, BEc, BSc, FIAA

PROFESSORIAL ASSOCIATE

Greg C Taylor, BA, PhD, PhD, FIA, FIAA, FIMA, CMath, AO

HONORARY SENIOR FELLOWS

Julian D Gribble, BSc (Hons), PhD, FIAA, FCIA, FSA

Grant Harslett, BSc (Hons), FIAA, FIA, ASA

Allen L Truslove, BSc (Hons), PhD, MBA, FIAA, FIA

TUTORS

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

Ashley Evans

Han Kee Gan

Shikha Gupta

Sam Killmier

Edward Leung, BCom (Hons), LLB (Hons), AIAA

Ka Ki Li, BCom, FIAA

Peter Raymond, BCom (Hons)

Marianne Watt, BSc, DipEd, FIAA

Ron Weatherhead, BSc, CertEd, FIAA

RESEARCH STUDENTS

Edward Leung, BCom (Hons), LLB (Hons), AIAA

Ka Ki Li, BCom, FIAA

Peter Raymond, BCom (Hons)

Manabu Sato, MCom(Hons), AIAA

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 Margaret Abernethy (Chair)	Dean, Faculty of Economics and Commerce
Professor Jeff Borland	Department of Economics
Professor Robert Brown	Department of Finance
Professor David Dickson	Centre for Actuarial Studies
Professor Daniel Dufresne	Centre for Actuarial Studies
Professor Vance Martin	Department of Economics