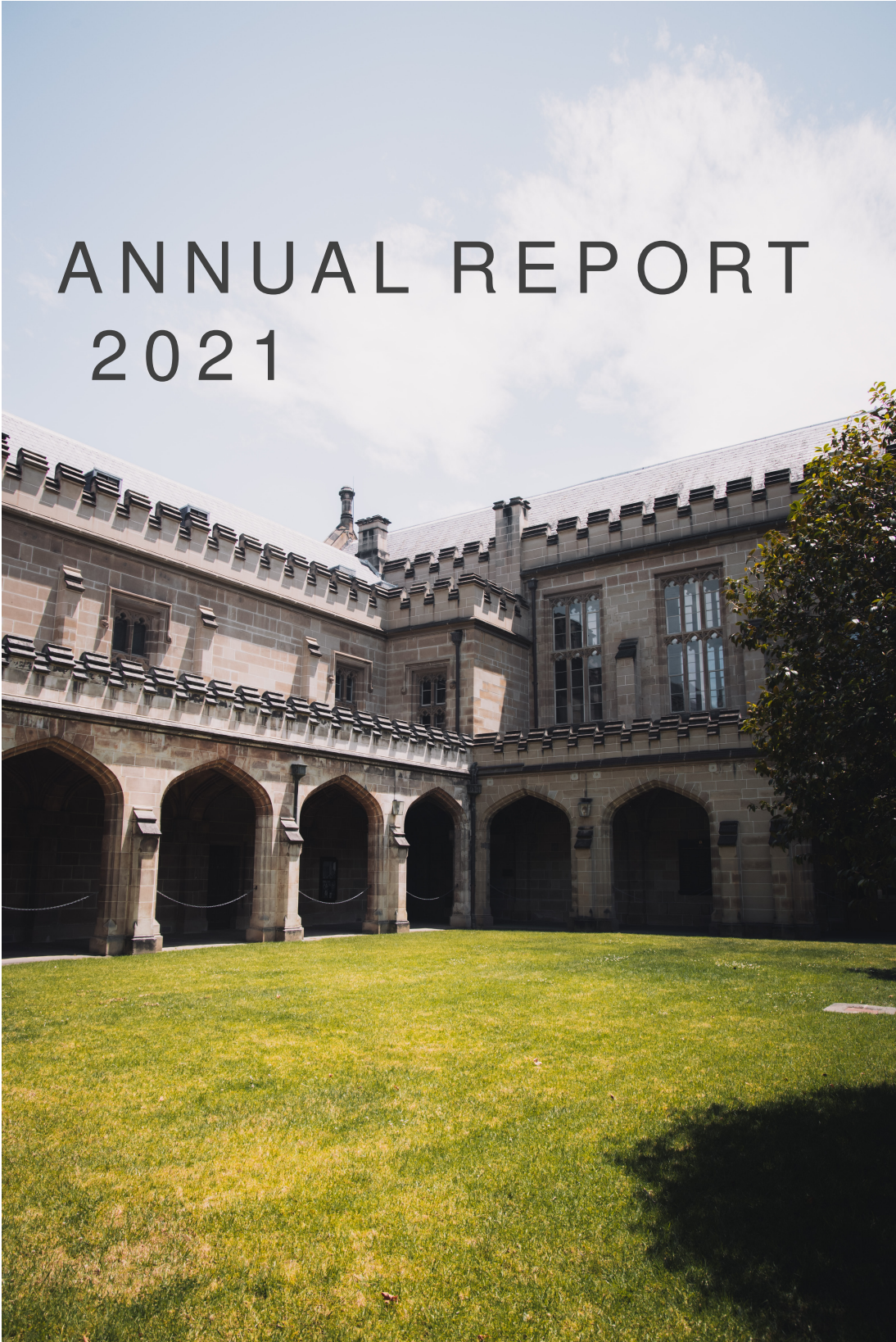


CENTRE FOR ACTUARIAL STUDIES

ANNUAL REPORT 2021



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The Year in Review

Introduction

THE CENTRE FOR ACTUARIAL STUDIES¹ is a teaching and research unit located within the Department of Economics, Faculty of Business and Economics at the University of Melbourne. It has the support of the actuarial profession in Australia and produces research of high quality. It also maintains strong international links and contributes to the local actuarial community.

OUR UNDERGRADUATE AND MASTERS STUDENTS primarily study to become actuaries, but a number of our students find employment in the banking or investment sector. Our PhD students have research topics in general insurance, risk theory, investment models, survival analysis, financial mathematics, derivative pricing and applied probability. The Centre attracts high achieving students; many of the faculty's participants in the prestigious Chancellor's Scholars Program (admission to which is based on university entrance score) are students majoring in actuarial studies.

WE ARE FULLY ACCREDITED by the Australian Actuaries Institute, meaning that its students can obtain exemptions from all of "Foundation" and "Actuary" components of the Institute's path to qualification.

The University of Melbourne's actuarial studies program has been a Society of Actuaries (SOA) Center of Actuarial Excellence (CAE) since 2015. Actuarial science school programs must meet eight rigorous criteria and specific CAE requirements to qualify for the CAE designation. These criteria involve the degree, curriculum, graduate count, faculty composition, graduate quality, appropriate integration, and connection to industry and research/scholarship. Only 37 colleges and universities around the world have attained the CAE designation, amongst which 4 are in Australia.

¹ Centre website

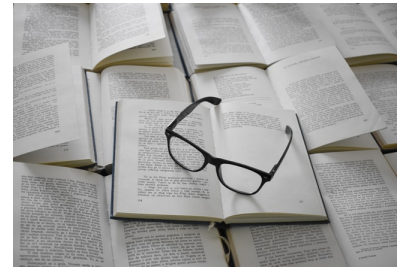


OUR STAFF are globally recognised for their contribution to actuarial scholarship. The Centre has nine full-time academic positions and several part-time lecturers from the Melbourne actuarial community.

THE YEAR 2021 was still disrupted by the COVID-19 pandemic. The university planned to offer courses in a hybrid mode, but had to revert to fully online delivery during lockdowns. This allowed overseas students to continue their studies and mitigate health risks.

In terms of research, staff remained active, but most interactive activities such as conferences, research visits, and seminars, were still significantly cut back from usual levels, and when they happened, were usually held online. Nevertheless, Centre staff published in top journals and presented their research at seminars and conferences in Australia and overseas².

AT THE END OF 2021, THE CENTRE FOR ACTUARIAL STUDIES RECEIVED A 5-YEAR RENEWAL OF THE SOCIETY OF ACTUARIES CENTER OF ACTUARIAL EXCELLENCE (CAE) DESIGNATION following a virtual peer review team visit in late December. In quoting from the report: *“The SOA was impressed with the strong connection students have with one another, faculty members, and industry professionals. Faculty research is also of particular note. Aside from the impressive number of papers published on average per year, we applaud the fact that evaluation of faculty research is based on its practicality and innovation . . .”*



² Details of publications, as well as a list of conference and seminar presentations, can be found later in this report.

Staff News

MOVEMENTS:

- Professor David Pitt joined the Centre on 1 April 2021.
- Dr Kevin Fergusson left the Centre on 15 April 2021 to join Bond University. We wish him the best for the remainder of his career.

PROMOTIONS:

- Dr Zhuo Jin was promoted to Associate Professor effective from 1 January 2021.
- Dr Rui Zhou was promoted to Associate Professor effective from 1 January 2021.

Research Highlights

DESPITE COVID-19, staff remained active, but most travel-dependent activities such as conferences, research visits, and seminars, were significantly cut back from usual levels.

THE CENTRE WAS RANKED NUMBER 4 on the *Business School Actuarial Science worldwide rankings* by the University of Nebraska-Lincoln³ for the period 2017–2021. This ranking is consistent with recent rankings as exhibited in the margin.

This ranking is based on publications in *Insurance: Mathematics and Economics*, the *ASTIN Bulletin*, the *Scandinavian Actuarial Journal*, and the *North American Actuarial Journal*.

CENTRE STAFF PUBLISHED 28 journal articles, with 9 in the above-mentioned list of top 4 actuarial journals, of which 6 in the top actuarial journal *Insurance: Mathematics and Economics* (A* in the Australian Business Deans' Council Journal Quality List). They also publish in top journals in other (connected) fields (e.g., *European Journal of Operational Research*).

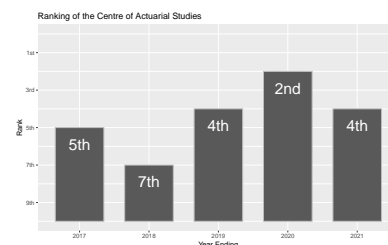
NEWLY AWARDED COMPETITIVE RESEARCH GRANTS included:

- Dr Ping Chen is a Co-Investigator on “Research on Systemic Risk Measure and Asset Allocation based on Data-Driven Distributionally Robust Approach” funded by the Natural Science Foundation of China (2021–2024, CNY 480,000)

Teaching Highlights

THE YEAR 2021 SAW A CONSIDERATION of blended and online teaching in the Centre of Actuarial Studies. The Centre continued its adjustment to the new environment, especially around assessment.

AFTER THE PERFECT STORM OF 2020, COVID-19 RESTRICTIONS KEPT HAVING A MAJOR IMPACT ON TEACHING. We hoped to move to a blended delivery in Semester 1 2021, but this did not eventuate, and most of the year was still taught online. This allowed overseas students to continue their studies remotely.



³ [Link to UNL actuarial rankings](#)



Teaching

IN THIS CHAPTER we will provide some more details about the teaching activities in the Centre for Actuarial Studies in 2021:

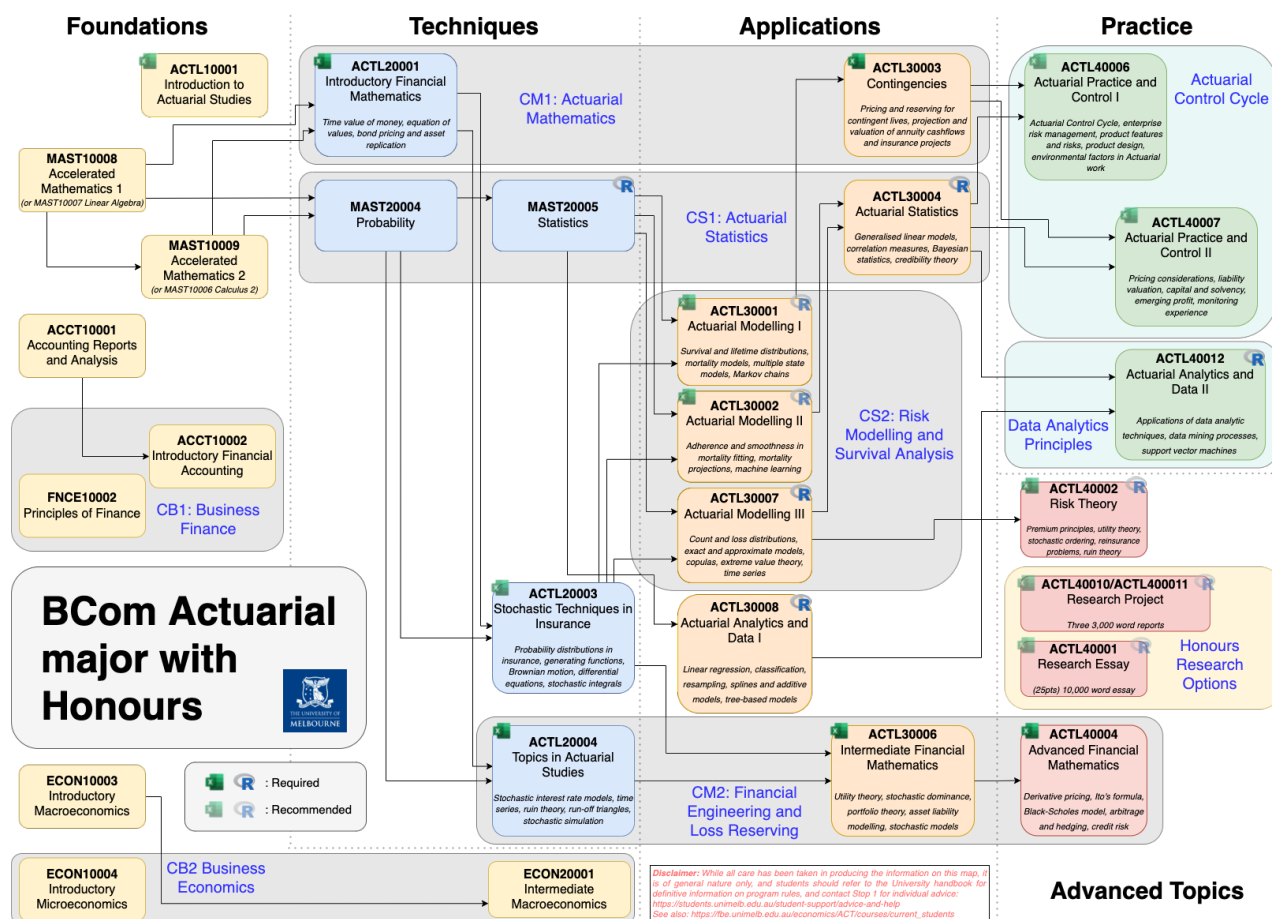
- major course and subject changes due to changes in the actuarial education requirements;
- undergraduate and honours enrolment data;
- honours results;
- masters enrolment data;
- research topics for honours and masters research components;
- student prize winners;
- guest lectures.

Current curriculum structure

UNDER THE CURRENT ACTUARIES INSTITUTE PROFESSIONAL CURRICULUM, the Foundation Program is composed of the following six subjects: **CB1 Business Finance**, **CB2 Business Economics**, **CS1 Actuarial Statistics**, **CS2 Risk Modelling and Survival Analysis**, **CM1 Actuarial Mathematics**, and **CM2 Financial Engineering and Loss Reserving**.

Furthermore, the professional subjects (**CS1**, **CS2**, **CM1**, **CM2**) include computer-based learning outcomes.

A map of the current actuarial undergraduate structure is provided below:



The fourth column (“Practice”) would typically be covered during an honours degree (when completed at the undergraduate level).

AT THE POSTGRADUATE LEVEL, the Centre for Actuarial Studies offers two coursework degrees:

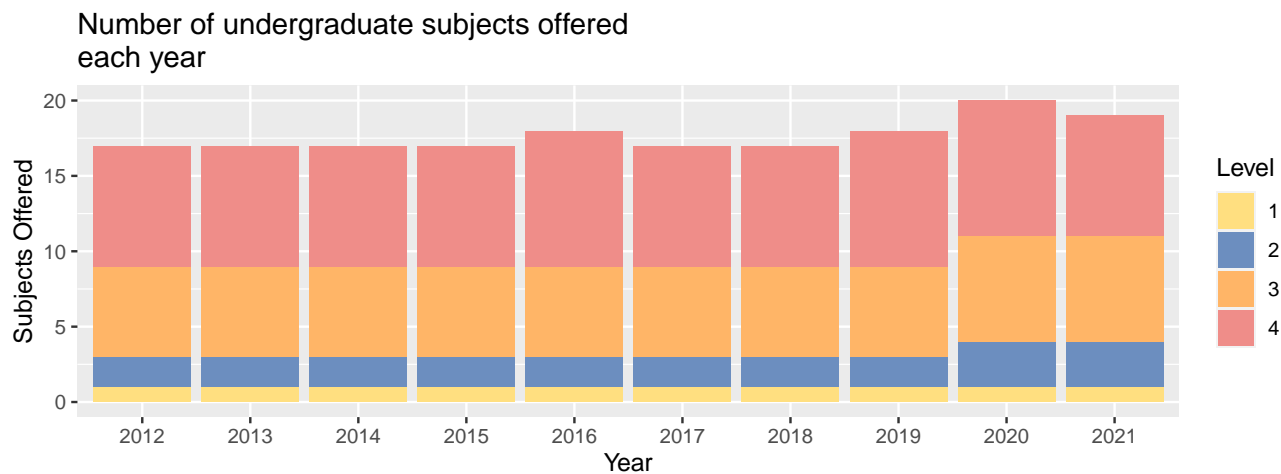
- Master of Actuarial Science
- Master of Commerce (Actuarial Studies)

While the Master of Actuarial Studies allows students from a different background to complete the “Foundation Program”, the Master of Commerce (Actuarial Studies) is targeted at students who already have an actuarial background, and who wish to complete the “Actuary Program” (leading to the “Actuary” designation) and acquire deeper knowledge in actuarial studies and related disciplines.

Undergraduate and Honours enrolment data

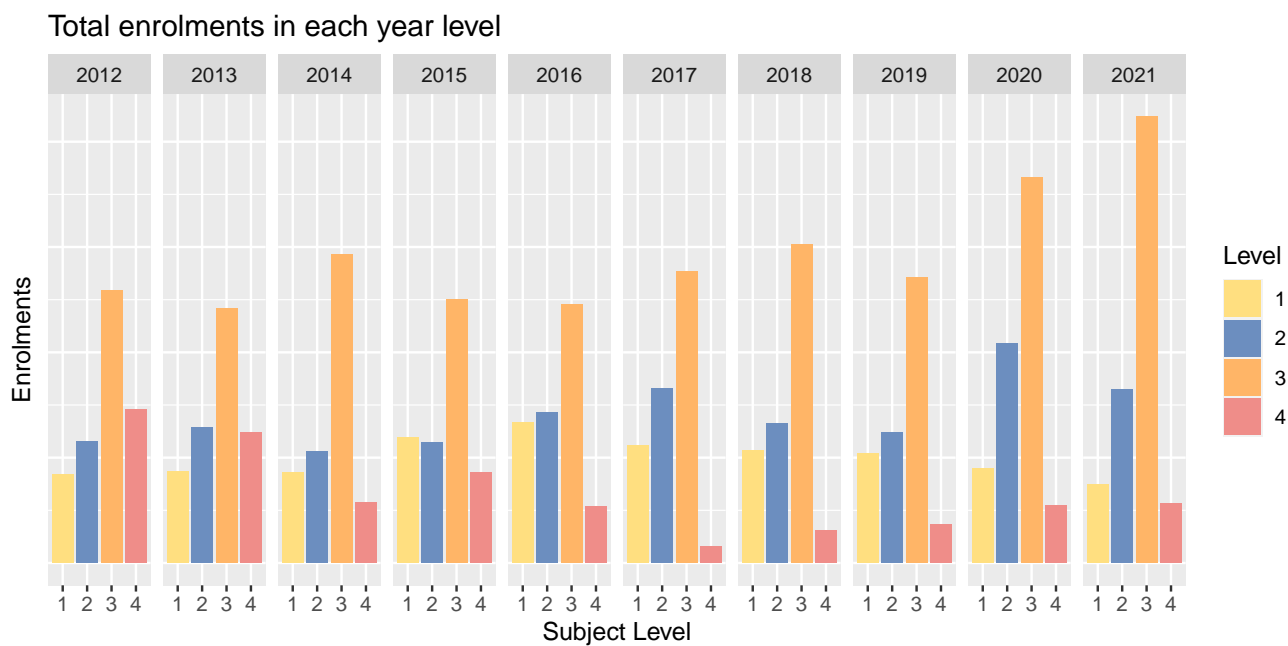
Number of undergraduate subjects offered

As a direct result of new accreditation requirements, the number of courses that the Centre offered increased significantly since 2019.



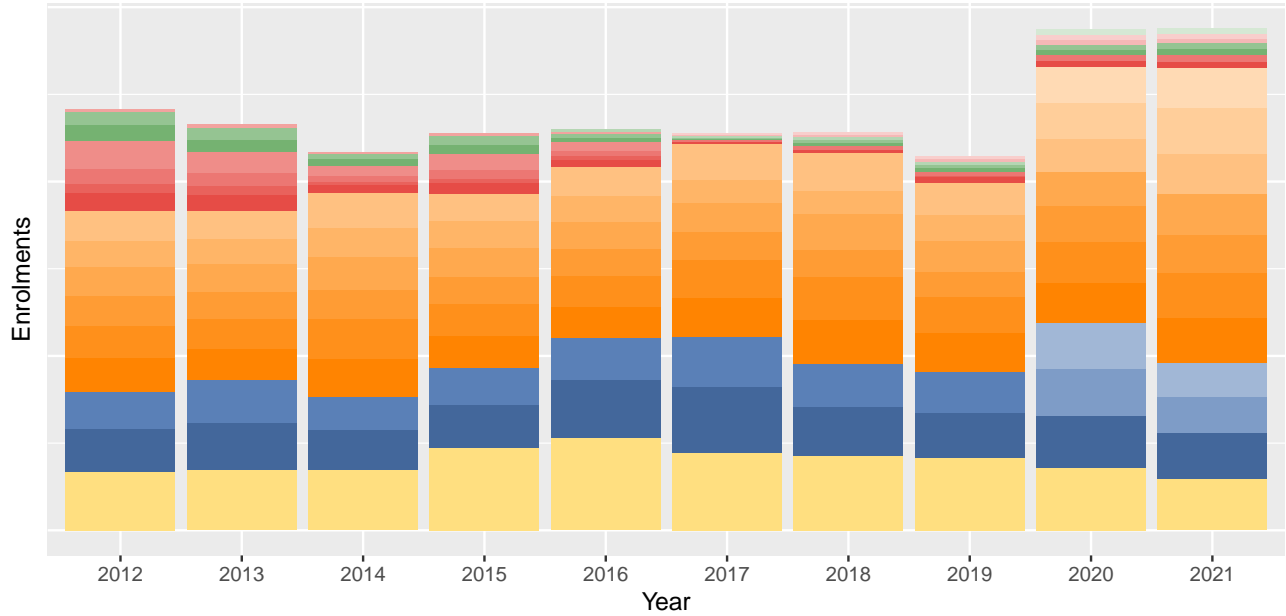
Total undergraduate enrolments

In the following graph one can see the evolution of enrolment per year level.



This is then displayed here by subject (note a full table of subjects with codes and titles is available at the end of this report).

Enrolments in each Undergraduate subject over time



ACTL10001	ACTL30001	ACTL30006	ACTL40003	ACTL40008
ACTL20001	ACTL30002	ACTL30007	ACTL40004	ACTL40009
ACTL20002	ACTL30003	ACTL30008	ACTL40005	ACTL40010
ACTL20003	ACTL30004	ACTL40001	ACTL40006	ACTL40011
ACTL20004	ACTL30005	ACTL40002	ACTL40007	ACTL40012

In 2020: ACTL20003, ACTL20004, ACTL30007, ACTL30008, ACTL40012 were introduced, and ACTL20002, ACTL30005 and ACTL40008 were discontinued.

Completion rates

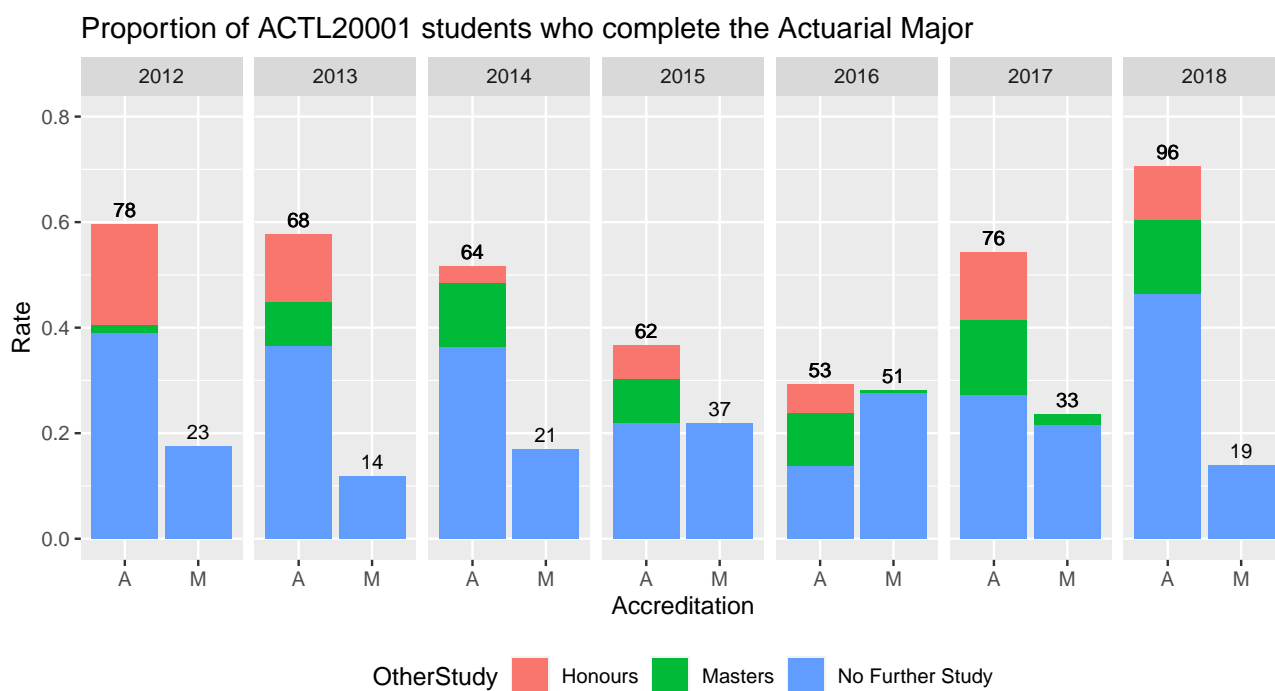
Students completing an actuarial major in the Bachelor of Commerce must complete ACTL20001, and hence it is interesting to see how many of those students eventually complete the actuarial major.

There are two possible types of completion:

- *accredited* actuarial major, which means that all level 3 subjects are completed;
- *non-accredited* actuarial major, which means that the major is completed according to the university requirements, but some subjects may be missing for full recognition by the Actuaries Institute.

Furthermore, for each type of completion, students may continue on to do an Honours or a Masters degree. These are usually students with an accredited major. Data are provided in the following graph.

Note that while the columns below correspond to aggregate percentages, the numbers on top of the columns are head counts.



A: Accredited actuarial major (all level 3 subjects completed)

M: Non-accredited actuarial major

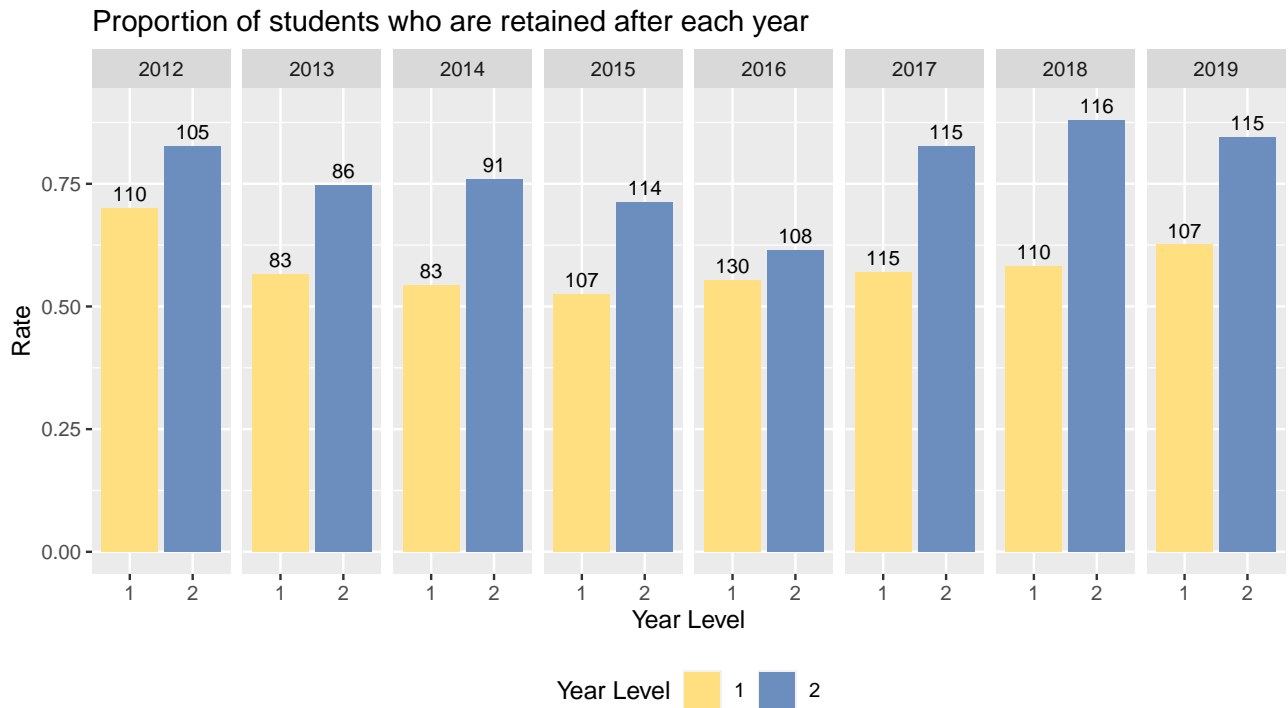
Note: Passing all level 3 subjects does not necessarily equate to receiving exemptions from the corresponding professional actuarial examinations

We see that the proportion of students completing an accredited major has increased from the 2016 cohort to the 2018 cohort, suggesting higher retention rates amongst students completing ACTL20001.

Retention rates between year levels

Here, we are interested in tracking retention (or progression) rates:

- from Year 1 to Year 2: proportion of students who attempted ACTL10001 and who continued and passed ACTL20001 (note we excluded students who are enrolled in ACTL10001 as “breadth” students—typically from other faculties);
- from Year 2 to Year 3: proportion of students who passed ACTL20001 and who subsequently passed *any* level 3 ACTL subject.



*Notes:
 1: BCom ACTL10001 students (non-breadth) who complete ACTL20001
 2: ACTL20001 students who complete a Level 3 ACTL subject

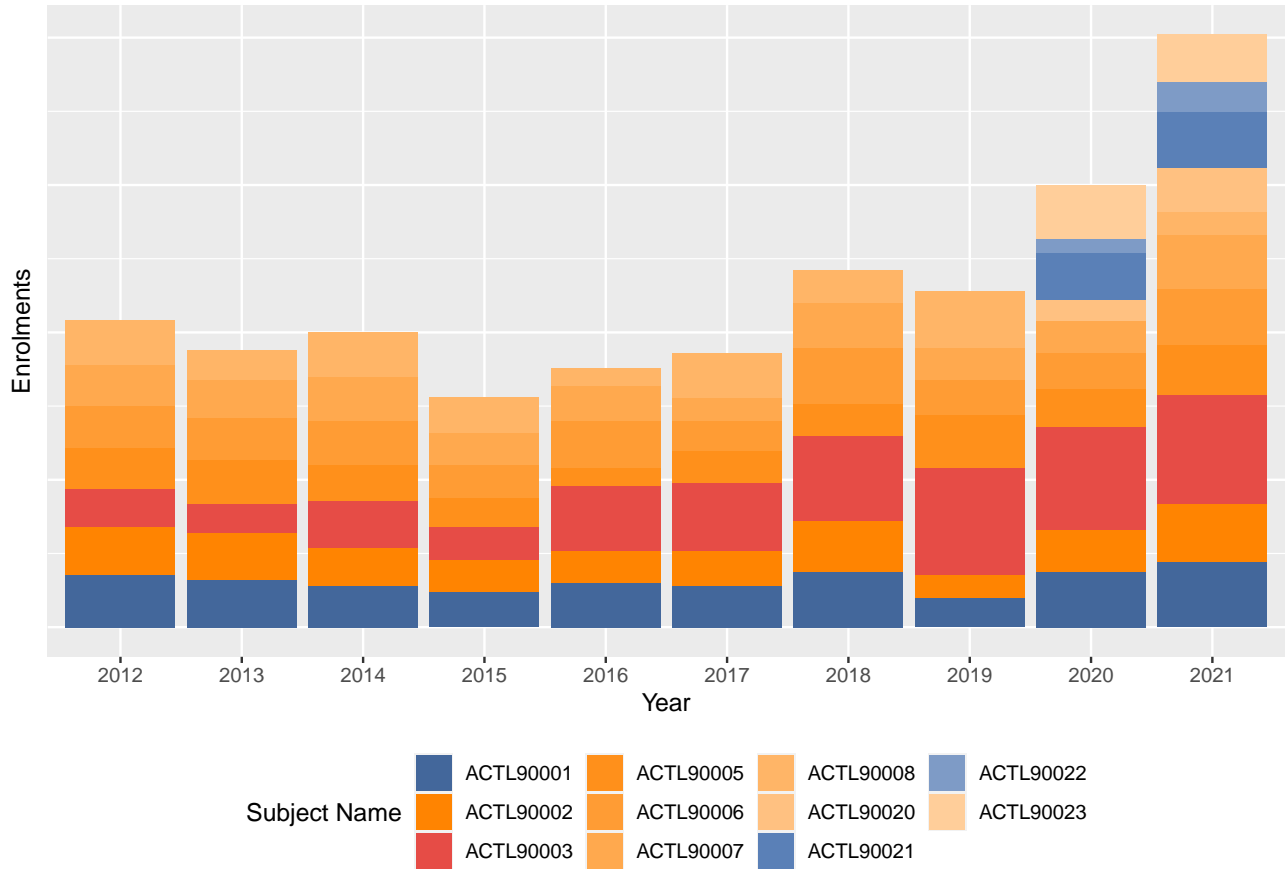
Proportions are quite stable.

Masters enrolment data

Total postgraduate enrolments

For the Master of Actuarial Science (which covers the “Foundation” and “Actuary” programs), enrolments evolved in the following way.

Enrolments in each Master of Actuarial Science subject over time

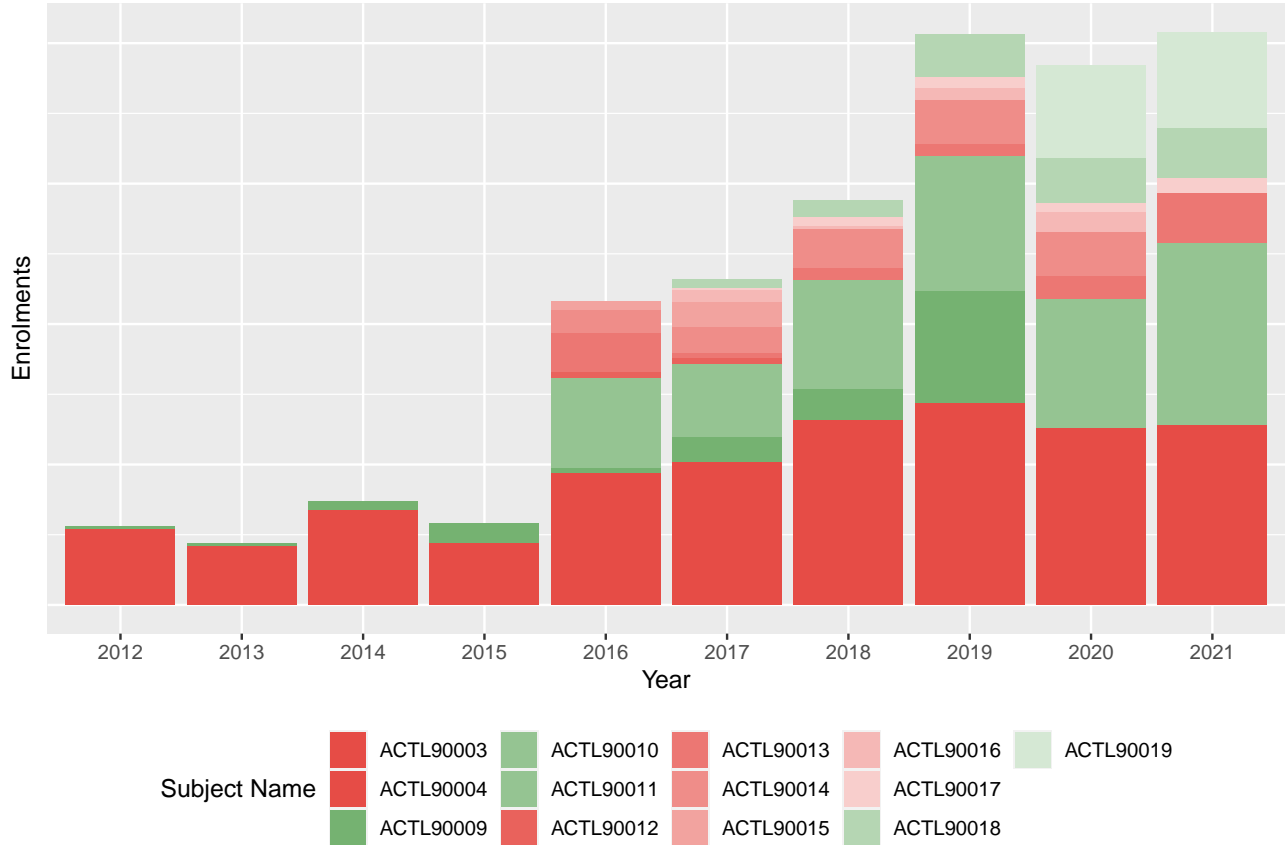


In 2020: ACTL90020, ACTL90021, ACTL90022, ACTL90023 were introduced.

We can observe a large increase, with enrolments almost doubling from 2019 to 2021.

The Master of Commerce (Actuarial Science) allows students with existing actuarial training to continue their actuarial studies. Enrolments evolved as follows.

Enrolments in each Master of Commerce (Actuarial Science) subject over time



In 2020: ACTL90019 was introduced, and ACTL900015 was discontinued.

Here, the increase in enrolments happened in 2019, and has remained stable since then.

Essay and Project Topics

There were 17 students who successfully completed a Bachelor of Commerce (Honours) with a specialisation in Actuarial Studies. In 2021, 14 students completed three research projects:

- Numerical studies on insurance insolvency risk with premiums adjusted according to claim experience;
- Poisson extensions for claim counts—applications in risk classification and insurance ratemaking;
- Converting a pension plan from defined benefit to defined contribution.

The essay counts 25% towards the Honours grade. Three Honours and six Masters students wrote an essay in 2021, and the topics were:

Name	Degree	Supervisor	Thesis title
Sovann Eu	Masters	Zhou, R.	Analysis of Australian natural catastrophe time series and their relationship with the Australian Actuaries Climate Index
Yuxin Han	Honours	Calderin, E.	Research on Auto-Insurance Claim Frequency Modeling and Prediction Based on PSO-BP Neural Network
Rong He	Masters	Li, J. and Jin, Z	Asymmetric bond percolation of cyber loss on LAN with tree-based topology in small and medium-sized enterprises
Joanna John	Honours	Pitt, D. and Jin, Z	Lowering carbon risk in portfolios: can investors decarbonize and still maintain high performing portfolios?
Zherui Li	Honours	Jin, Z.	Optimal Tontine Schemes under a Volterra Mortality Model
Xuanan Lin	Masters	Wu, X.	A projection of future hospitalisation needs in an ageing society: Australian Experience
Boyuan Ma	Masters	Jin, Z.	Application of clustering method in cyber risk: frequency and severity analysis
Xingyun (Claire) Tan	Masters	Avanzi, B.	Actuarial analysis of dynamic reporting delays in cyber data
Chang Zhai	Masters	Chen, P. and Jin, Z	The Epidemiological Model Application in Insurance Industry

Student Prize Winners

The UniSuper Prize

for Introduction to Actuarial Studies

Margaretha Devina Kurniawan

The Martin Jilovsky Prize

for best third year results by an Australian student

Haobin Liu

The Mark Joshi Memorial Prize

for Intermediate Financial Mathematics and Advanced Financial Mathematics (UG students) or Mathematics of Finance II and Mathematics of Finance III (PG students)

Chang Zhai

Deloitte Actuaries & Consulting Prize

for Actuarial Practice and Control

Jessica Zhong

Honours Medal in Actuarial Studies

Zhengtao Lu

The **KPMG Prizes** for Introductory Financial Mathematics & Stochastic Techniques in Insurance and Second Year Actuarial Studies were discontinued in 2021.

Guest lectures

Jessica Leong FIAA FCAS, alumna from the University of Melbourne, Lead Data Scientist at Zurich North America, President of the Casualty Actuarial Society, was a guest lecturer in ACTL10001 in Semester 2, 2021. She talked about the future of the actuarial profession, and professionalism in general.

Research and Engagement

IN THIS CHAPTER, after an overview of the research conducted in the Centre, we will provide some more details about its research activities in 2021:

- refereed journal publications;
- other publications;
- active competitive external research funding;
- PhD students and their research topics;
- Editorial activities;
- Journal article reviews;
- Conference and seminar presentations;
- Engagement and professional activities.

Overview

Centre members are actively researching in most areas of actuarial studies, with particular strengths as follows:

- statistical modelling of risks (e.g. dependence modelling, robust estimation, grouped data)
- climate risk (e.g. mortality, extreme value theory, heavy tails, applications of climate indices)
- cyber (e.g. reporting delays, pricing)
- reserving
- applications of stochastic optimisation (e.g. optimal reinsurance, portfolio management)
- applications of machine learning (e.g. reserving, discrimination free pricing)

We have members in the *Actuaries Institute (AI) COVID-19 Mortality Working Group*, and the *Institute and Faculty of Actuaries (IFoA) Statistical Learning in Actuarial Applications Working Party*.

Future projects, including a number of major grant applications, are connected with the challenges imposed by climate change and climate risk in general.

Formal projects with funding include

- collaborations with leading actuarial groups in the world
 - joint PhD project with KU Leuven, which consists of a package of 6 projects and 2 PhD students in emerging and global actuarial risks (from 2021)
- *Australian Research Council (ARC) discovery projects*
 - “EVT approaches to insurance in a catastrophic environment” (from 2020)
 - “Quantitative analysis of systemic risk in insurance” (from 2022)
- Industry funding
 - *Casualty Actuarial Society (CAS) 2022 individual grants on “Catastrophe loss prediction”*

Some past successful submissions were suspended due to COVID-19 (such as *Society of Actuaries (SoA) individual grants*, and CAE group-wide research funding).

Refereed journal articles

Authors	Publication
Avanzi, B., Beaulieu, GB., de, Micheaux., Ouimet, F., Wong, B.	<i>A counterexample to the existence of a general central limit theorem for pairwise independent identically distributed random variables</i> <u>JOURNAL OF MATHEMATICAL ANALYSIS AND APPLICATIONS</u> , Vol. 90, pp. 35-45 https://dx.doi.org/10.1016/j.jmaa.2021.124982
Avanzi, B., Lau, H., Wong, B.	<i>Optimal periodic dividend strategies for spectrally negative Levy processes with fixed transaction costs</i> <u>SCANDINAVIAN ACTUARIAL JOURNAL</u> , Vol. 8, Issue 1 https://dx.doi.org/10.1080/03461238.2020.1869069
Avanzi, B., Lau, H., Wong, B.	<i>On the optimality of joint periodic and extraordinary dividend strategies</i> <u>European Journal of Operational Research</u> , https://dx.doi.org/10.1016/j.ejor.2021.04.033
Avanzi, B., Taylor, G., Wang, M., Wong, B.	<i>SynthETIC: An individual insurance claim simulator with feature control</i> <u>Insurance: Mathematics and Economics</u> , Vol. 24, Issue 2, pp. 228-250 https://dx.doi.org/10.1016/j.insmatheco.2021.06.004
Avanzi, B., Taylor, G., Wong, B., Xian, A.	<i>Modelling and understanding count processes through a Markov-modulated non-homogeneous Poisson process framework</i> <u>European Journal of Operational Research</u> , Vol. 93, pp. 50-71 https://dx.doi.org/10.1016/j.ejor.2020.07.022
Avanzi, B., Taylor, G., Wong, B., Yang, X.	<i>On the modelling of multivariate counts with Cox processes and dependent shot noise intensities</i> <u>Insurance: Mathematics and Economics</u> , Vol. 2020 https://dx.doi.org/10.1016/j.insmatheco.2021.01.002
Avanzi, B., Taylor, GC., Phuong, AV., Wong, B.	<i>On unbalanced data and common shock models in stochastic loss reserving</i> <u>Annals of Actuarial Science</u> , Vol. 93, pp. 315-332 https://dx.doi.org/10.1017/S1748499520000196
Bhati, D., Calderín-Ojeda, E.	<i>On the rBell family of distributions with actuarial applications</i> <u>ASTIN Bulletin</u> , https://dx.doi.org/10.1017/asb.2021.14
Gomes, C., Jin, Z., Yang, H.	<i>Insurance fraud detection with unsupervised deep learning</i> <u>JOURNAL OF RISK AND INSURANCE</u> , https://dx.doi.org/10.1111/jori.12359
Gomez-Deniz, E., Calderin-Ojeda, E.	<i>Modeling the Conditional Dependence between Discrete and Continuous Random Variables with Applications in Insurance</i> <u>MATHEMATICS</u> , Vol. 39, Issue 1, pp. 37-46 https://dx.doi.org/10.3390/math9010045

- Gomez-Deniz, E.,
Calderin-Ojeda, E. *A Priori Ratemaking Selection Using Multivariate Regression Models Allowing Different Coverages in Auto Insurance Risks*, Vol. 16, Issue 2, pp. 531-551
<https://dx.doi.org/10.3390/risks9070137>
- Gomez-Deniz, E.,
Sarabia, JM.,
Calderin-Ojeda, E. *Bimodal normal distribution: Extensions and applications* JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS,
<https://dx.doi.org/10.1016/j.cam.2020.113292>
- Jin, Z., Yang, H., Yin,
G. *A hybrid deep learning method for optimal insurance strategies: Algorithms and convergence analysis* Insurance: Mathematics and Economics, Vol. 2, Issue 1, pp. 7-21
<https://dx.doi.org/10.1016/j.insmatheco.2020.11.012>
- Kyng, T., Pitt, D.,
Purcal, S., Zhang, J. *Financial metrics for comparing Australian retirement villages* Accounting and Finance, Vol. 93, pp. 1-26
<https://dx.doi.org/10.1111/acfi.12768>
- Liu, G., Jin, Z., Li, S. *Household Lifetime Strategies under a Self-Contagious Market* European Journal of Operational Research, Vol. 2020
<https://dx.doi.org/10.1016/j.ejor.2020.05.060>
- Liu, G., Jin, Z., Li, S. *Optimal investment, consumption, and life insurance strategies under a mutual-exciting contagious market* Insurance: Mathematics and Economics, Vol. 280, Issue 3, pp. 1130-1143
<https://dx.doi.org/10.1016/j.insmatheco.2021.09.004>
- Osatakul, D., Wu, X. *Discrete-Time Risk Models with Claim Correlated Premiums in a Markovian Environment* RISKS, Vol. 16, Issue 2, pp. 813-834
<https://dx.doi.org/10.3390/risks9010026>
- Prieto, F., Sarabia,
JM., Calderin-Ojeda,
E. *The nonlinear distribution of employment across municipalities* Journal of Economic Interaction and Coordination, Vol. 14, Issue 2, pp. 278-301
<https://dx.doi.org/10.1007/s11403-020-00294-2>
- Reyes, J.,
Gomez-Deniz, E.,
Gomez, HW.,
Calderin-Ojeda, E. *A Bimodal Extension of the Exponential Distribution with Applications in Risk Theory* Symmetry, Vol. 50, Issue 2, pp. 381-417
<https://dx.doi.org/10.3390/sym13040679>
- Rivera, PA.,
Calderin-Ojeda, E.,
Gallardo, DL., Gomez,
HW. *A Compound Class of the Inverse Gamma and Power Series Distributions* Symmetry, Vol. 91, pp. 12-25
<https://dx.doi.org/10.3390/sym13081328>

- Wang, N., **Jin, Z.**, Siu, TK., Qiu, M. *Household consumption-investment-insurance decisions with uncertain income and market ambiguity*
 SCANDINAVIAN ACTUARIAL JOURNAL,
<https://dx.doi.org/10.1080/03461238.2021.1886981>
- Wang, N., Zhang, N., **Jin, Z.**, Qian, L. *Reinsurance-investment game between two mean-variance insurers under model uncertainty*
 JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS,
 Vol. 91, pp. 244-256
<https://dx.doi.org/10.1016/j.cam.2020.113095>
- Wang, N., Zhang, N., **Jin, Z.**, Qian, L. *Stochastic differential investment and reinsurance games with nonlinear risk processes and VaR constraints*
 Insurance: Mathematics and Economics, Vol. 50, Issue 2, pp. 449-477
<https://dx.doi.org/10.1016/j.insmatheco.2020.11.004>
- Wang, W., **Wu, X.**, Chi, C. *Optimal implementation delay of taxation with trade-off for spectrally negative Levy risk processes*
 European Actuarial Journal, Vol. 11, pp. 285-317
<https://dx.doi.org/10.1007/s13385-020-00246-x>
- Zhang, J., **Chen, P.**, **Jin, Z.**, Li, S. *Open-loop equilibrium strategy for mean-variance portfolio selection: A log-return model*
 Journal of Industrial and Management Optimization,
<https://dx.doi.org/10.3934/jimo.2019133>
- Zhang, J., **Chen, P.**, **Jin, Z.**, Li, S. *On a class of non-zero-sum stochastic differential dividend games with regime switching*
 APPLIED MATHEMATICS AND COMPUTATION, Vol. 90, pp. 35-45
<https://dx.doi.org/10.1016/j.amc.2021.125956>
- Zhang, N., Qian, L., **Jin, Z.**, Wang, W. *OPTIMAL STOP-LOSS REINSURANCE WITH JOINT UTILITY CONSTRAINTS*
 Journal of Industrial and Management Optimization, Vol. 2021, Issue 4, pp. 335-361
<https://dx.doi.org/10.3934/jimo.2020001>
- Zhong, W., Zhao, Y., **Chen, P.** *EQUILIBRIUM PERIODIC DIVIDEND STRATEGIES WITH NON-EXPONENTIAL DISCOUNTING FOR SPECTRALLY POSITIVE LEVY PROCESSES*
 Journal of Industrial and Management Optimization, Vol. 91, pp. 12-25
<https://dx.doi.org/10.3934/jimo.2020087>
- Zhou, R.**, Ji, M. *Modelling Mortality Dependence: An Application of Dynamic Vine Copula*
 Insurance: Mathematics and Economics, Vol. 380, pp. 112951-112951
<https://dx.doi.org/10.1016/j.insmatheco.2021.03.022>
-

Other publications

There were no non-journal publications in 2021.

Active competitive external research funding

Funding Period	Researchers	Information
2021—2024	Chen, P., Co-Investigator	Research on Systemic Risk Measure and Asset Allocation based on Data-Driven Distributionally Robust Approach Natural Science Foundation of China. 480,000 (CNY)
2020—2024	Avanzi, B., Co-Partner Investigator, Zhou, R., Co-Partner Investigator	VALERIA: Valuation and Advanced Learning methods for Emerging, global Risks In Actuarial science Global PhD Partnership KU Leuven/Melbourne GPP/21/003. 30,000 (AUD) Other investigators include Professors Katrien Antonio and Jan Dhaene from KU Leuven, Belgium. Involves 2 full PhD scholarship with travel budget, and about AUD 50,000 cash support for Partner Investigators.
2020—2023	Avanzi, B, Chief Investigator	Extreme Value Theory Approaches to Insurance in a Catastrophic Environment Australian Research Council (ARC) Discovery Project DP200101859. 310,000 (AUD) https://dataportal.arc.gov.au/NCGP/Web/Grant/Grant/DP200101859
2019—2022	Chen, P., Co-Investigator	Research on Optimal Investment, Consumption and Life Insurance Strategies under the Pension Risk: From the Life Cycle's Perspective National Natural Science Foundation of China. 480,000 (CNY)
2021—2021	Li, S., Chief Investigator	Network for Australia-China Risk Management and Actuarial Excellence National Foundation for Australia-China Relations. 348,997 (AUD) Pending Approval.

Higher Degree Research

The following table lists current PhD students within the Centre.

Name	Supervisors	Thesis title
Atibhav Chaudhry	Zhou, R., Avanzi, B.	VALERIA: Valuation and Advanced Learning methods for Emerging, global Risks In Actuarial science
Giovani Gracianti	Zhou, R., Li, J., Wu, X.	Weather Risk management in the renewable energy sector for developing countries
Suyuan He	Zhou, R., Li, S.	A practice of applying copula-based approach to multi-population mortality dependence modelling and longevity derivative pricing
Rong He	Li, S., Pitt, D., Jin, Z., Li, J.	Cyber risk modelling
Guo Liu	Jin, Z., Li, S.	Household lifetime strategies and optimal dividend policies under a contagious financial market
Ming Qiu	Jin, Z., Li, S.	On analytical and numerical methods to ruin-related quantities and statistical approaches to actuarial problems
Xingyun (Claire) Tan	Calderin, E., Avanzi, B. Taylor, G., Wong, B.	Cyber risk modelling
Fan Zhang	Chen, P., Wu, X.	The application of age-structured model in actuarial studies

There was two new starts (Fan Zhang and Rong He) and four completions in 2021. Completing students were:

Name	Supervisors	Thesis title
Qingwei Liu	Xia, A. and Li, S.	On moderate deviations in Poisson approximation and its applications
Dhiti Osatakul	Wu, X., Li, S.	On discrete-time risk models with premiums adjusted according to claims
Pengcheng Zhang	Wu, X., Li, S., Calderín, E.	Multivariate Count Regression Models with Applications in Insurance
Jiannan Zhang	Li, S., Chen, P., Jin, Z.	Optimal Investment and Reinsurance Problems under Mean-Variance and Game Framework

Editorial activities

Professor Benjamin Avanzi is an Editor for the *ASTIN Bulletin*, an Associate Editor for *Insurance: Mathematics and Economics* and is a member of the Editorial Board for the open access journal *Risks*.

Dr Enrique Calderin is an Associate Editor of the *Spanish Journal of Statistics*. He was also a Guest Editor of the *Special Issue: Symmetrical and Asymmetric distributions: Theoretical Developments and Applications II*.

Professor Shuanming Li was a member of the Reviewer Board of *Risks*, a member of the Reviewer Board of *Journal of Risk and Financial Management*, Member of the Editorial Board for the *Journal of Insurance Markets and Companies*. Professor Shuanming Li was also a guest Editor for the *Special Issue 'Stochastic Process Theory and Its Applications for Mathematical Problems in Engineering*.

Journal article reviews

Journal	Referees
Agricultural Finance Review	Zhou, R.
Annals of Actuarial Science	Pitt, D., Zhou, R.
Applied Mathematical Modelling	Calderín, E.
ASTIN Bulletin	Calderín, E., Zhou, R.
Australian and New Zealand Journal of Statistics	Pitt, D.
European Journal of Operation Research	Jin, Z.
Insurance: Mathematics and Economics	Avanzi, B., Chen, P., Jin, Z., Li, S., Zhou, R.
Journal of Applied Statistics	Calderín, E.
Journal of Computational and Applied Mathematics	Calderín, E., Jin, Z.
Journal of Industrial & Management Optimization	Chen, P.
Journal of Statistical Planning and Inference	Li, S.
Journal of the Royal Statistical Society Series C	Pitt, D.
Mathematical Methods in the Applied Sciences	Avanzi, B.
Mathematics and Computers in Simulation	Calderín, E.
MathSciNet	Li, S.
Methodology and Computing in Applied Probability	Li, S.
North American Actuarial Journal	Wu, X., Zhou, R.
Physica A: A Statistical Mechanics and its Applications	Calderín, E.
Probability in the Engineering and Informational Sciences	Li, S.
Risk Management and Insurance Review	Calderín, E.
Risks	Wu, X., Zhou, R.
Scandinavian Actuarial Journal	Avanzi, B., Calderín, E., Chen, P., Jin, Z., Li, S., Wu, X., Zhou, R.
SIAM Journal on Control and Optimization	Avanzi, B., Jin, Z.
Soft Computing	Calderín, E.
Spanish Journal of Statistics	Calderín, E.
Statistics and Probability Letters	Wu, X.

Conference and seminar presentations

Presenter	Topic	Conference
Al-Mudafer, M.T., Avanzi, B., Taylor, G., Wong, B	Neural Networks in Reserving: how and why are they worth considering?	Conference presentation, 2021 All-Actuaries Virtual Summit: Thriving in an Age of Extremes, Australia. 18 May 2021
Avanzi, B.	Optimal reinsurance under terminal value constraints	Seminar presentation, UNSW Sydney Actuarial Seminar Series, Sydney, Australia. 21 November 2021
Jin, Z.	A Hybrid Deep Learning Markov Chain Approximation Method	Seminar presentation, Heriot-Watt University, Online. 17 November 2021
Jin, Z.	Asymmetric Bond Percolation of Cyber Losses in a Tree-based Local Area Network: Implications to Cyber Insurance Pricing	Seminar presentation, East China Normal University, Online. 27 December 2021
Jin, Z.	A Hybrid Deep Learning Markov Chain Approximation Method	Invited speaker, NUS-USyd-NUSRI workshop, Online. 16 December 2021
Li, S.	On a family of log-gamma generated Archimedean copulas and actuarial applications	Invited speaker, Statistics Canada 2021, Concordia University, Montreal, Canada. 15 July 2021
Zhou, R.	A Multi-parameter-level Model for Simulating Future Mortality Scenarios with COVID-alike Effects	Invited speaker, The Australian National University RSFAS Seminar Series, Online. 11 April 2021
Zhou, R.	The Role of Longevity Annuities in Different Socioeconomic Classes: A Canadian Case Study	Invited speaker, One World Actuarial Research Seminar, Online. 21 April 2021

Engagement and professional activities

Professor Benjamin Avanzi was an external PhD examiner for a PhD thesis at the University of Lausanne, Switzerland.

Professor Shuanming Li was external referee for academic promotion applications at Macquarie University, the University of New South Wales, and Purdue University.

Professor Shuanming Li was also a PhD thesis examiner for a thesis from Macquarie University and a reviewer for a book proposal submitted to Word Scientific Publishing.

Professor David Pitt was an external examiner for a PhD thesis for Heriot-Watt University. He also was an external referee for promotions at Macquarie University, as well as external referee for job applicants at The University of New South Wales. Besides, he was Chief examiner of the New South Wales Education Standards Authority, and Examiner with the Actuaries Institute Fellowship and Actuary Programs.

Associate Professor Xueyuan Wu was the external examiner for the Bachelor of Science (Hons) in Actuarial Studies at Sunway University in Malaysia. He was also a member of the External Review Panel for Master of Actuarial Studies (B6014), Monash Business School. Associate Professor Xueyuan Wu joined the Statistical Learning in Actuarial Applications Working Party of the Institute and Faculty of Actuaries (UK) in 2021. He was also a PhD thesis examiner for a thesis from The University of New South Wales.

Associate Professor Rui Zhou was an external examiner for Actuarial programs at the UCSI University Kuala Lumpur.

Staff

Director of the Centre for Actuarial Studies

SHUANMING LI:⁴ *BSc (Tianjin), MEd (Renmin), PhD (Concordia)*

⁴ S. Li Profile

Research interests: Risk and ruin theory, stochastic modelling in insurance and finance, actuarial science

Professors of Actuarial Studies

BENJAMIN AVANZI:⁵ *Lic.Oec. (Lausanne), PhD (Lausanne), MAICD*

⁵ B. Avanzi Profile

Research interests: General insurance, Insurance capital modelling, Risk theory, Modelling and statistical analysis of big data, Social security and pensions, Risk modelling in operations management

SHUANMING LI:⁶ *BSc (Tianjin), MEd (Renmin), PhD (Concordia)*

⁶ S. Li Profile

Research interests: Risk and ruin theory, stochastic modelling in insurance and finance, actuarial science

DAVID PITT:⁷ *BEd, BSc (Macquarie), PhD (ANU), FIAA*

⁷ D. Pitt Profile

Research interests: Income protection insurance, applied statistics, actuarial science, education

Associate Professors of Actuarial Studies

ZHUO JIN:⁸ *BS, MS (HUST), MA, PhD (WSU), ASA*

⁸ Z. Jin Profile

Research interests: Numerical methods for stochastic systems, mathematical finance, actuarial science

XUEYUAN WU:⁹ *BS, MS (Nankai), PhD (Hong Kong), AIAA*

⁹ X. Wu Profile

Research interests: Risk and ruin theory, discrete-time risk models, phase-type distributions in risk theory

RUI ZHOU:¹⁰ *BSc (Remin), MMath (Waterloo), PhD (Waterloo), FSA, ACIA*

¹⁰ R. Zhou Profile

Research interest: Longevity/mortality risk measurement and management, mortality modeling and forecasting, longevity annuity, weather derivatives

Senior Lecturers in Actuarial Studies

ENRIQUE CALDERIN:¹¹ *BS, MS (UNED, Spain), PhD (ULPGC, Spain)*

¹¹ E. Calderin Profile

Research interests: Bayesian inference, statistical robustness, distribution theory, actuarial statistics

PING CHEN:¹² *BAM (Qufu), MSc (CAS), PhD (Hong Kong), AIAA*

¹² P. Chen Profile

Research interests: Actuarial science, financial mathematics, statistics and information

KEVIN FERGUSSON: *BSc (Hons), MSc, PhD, PhD, FIAA, CERA*

Research interests: Stochastic analysis and modelling, valuation and hedging of long-dated derivatives, quantitative modelling of asset and liability portfolios of pension funds and insurers

Honorary Senior Fellow

DAVID HEATH: *BSc (Hons) (Monash), FIAA, CPA, FFin*

External Lecturers

ANDREW BROWN: *BSc, DipEd (Melbourne), FIAA, FFin*

DONALD CAMPBELL: *BCom (Melbourne), FIAA*

ANDREW GALE: *BSc (Melbourne), FIAA*

External Examiners for the Actuary Program

NIKI APPLETON (Actuarial Practice and Control I and II)

Appendix

Undergraduate subjects

Subject Code	Subject Title
ACTL10001	Introduction to Actuarial Studies
ACTL20001	Introductory Financial Mathematics
ACTL20003	Stochastic Techniques in Insurance
ACTL20004	Topics in Actuarial Studies
ACTL30001	Actuarial Modelling I
ACTL30002	Actuarial Modelling II
ACTL30003	Contingencies
ACTL30004	Actuarial Statistics
ACTL30006	Intermediate Financial Mathematics
ACTL30007	Actuarial Modelling III
ACTL30008	Actuarial Analytics and Data I
ACTL40001	Actuarial Studies Research Essay
ACTL40002	Risk Theory I
ACTL40004	Advanced Financial Mathematics
ACTL40006	Actuarial Practice and Control I
ACTL40007	Actuarial Practice and Control II
ACTL40010	Actuarial Studies Projects Part 1
ACTL40011	Actuarial Studies Projects Part 2
ACTL40012	Actuarial Analytics and Data II

Postgraduate subjects

Subject Code	Subject Title
ACTL90001	Mathematics of Finance I
ACTL90002	Mathematics of Finance II
ACTL90003	Mathematics of Finance III
ACTL90004	Insurance Risk Models
ACTL90005	Life Contingencies
ACTL90006	Life Insurance Models 1
ACTL90007	Life Insurance Models 2
ACTL90008	Statistical Techniques in Insurance
ACTL90010	Actuarial Practice and Control I
ACTL90011	Actuarial Practice and Control II
ACTL90013	Actuarial Studies Projects
ACTL90017	Actuarial Science Research Report Part 2
ACTL90018	General Insurance Practice
ACTL90019	Data Analytics in Insurance 2
ACTL90020	General Insurance Modelling
ACTL90021	Topics in Insurance and Finance
ACTL90022	Economics for Actuaries
ACTL90023	Data Analytics in Insurance 1

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