ACST356

Mathematical Theory of Risk

S1 Day 2016

Dept of Applied Finance and Actuarial Studies

Contents

Disclaimer

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General Information

Unit convenor and teaching staff
Unit convenor and lecturer
Leonie Tickle
Contact via Dialogue tool on the teaching website or during consultation
E4A608
Mondays 1-3 during teaching weeks or by appointment

Lecturer
Jackie Li
Contact via Dialogue tool on the teaching website or during consultation
E4A610
Wednesday 12-2 during teaching weeks

Credit points
3

Prerequisites
39cp including STAT272

Corequisites

Co-badged status
ACST861

Unit description
This unit examines the use of statistical models in the insurance context. Statistical models of the number of claims and the sizes of the claims are studied. These models are used as a basis for the study of risk theory, ruin theory and the effect of reinsurance. Decision theory and simulation are also studied. Students gaining a grade of credit or higher in both ACST356 and ACST357 are eligible for exemption from subject CT6 of the professional exams of the Institute of Actuaries of Australia.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Describe, develop, apply and analyse the modelling of loss distributions both with and

without limits and risk-sharing arrangements

Derive, apply, explain and analyse the concepts of Bayesian statistics including Empirical Bayes models

Construct risk models involving frequency and severity distributions and calculate the moment generating functions and moments both with and without risk-sharing arrangements

Use Monte Carlo simulation to model observations from various loss models, calculate the number of simulations required and extend these techniques to more complex scenarios

Define, explain and analyse the concept of ruin and describe the relationships between different probabilities of ruin including the effect of simple reinsurance arrangements

Explain and apply the concepts of decision theory

General Assessment Information

It is the responsibility of students to view their marks for each within session assessment on iLearn within 20 working days of posting. If there are any discrepancies, students must contact the unit convenor immediately. Failure to do so will mean that queries received after the release of final results regarding assessment marks (not including the final exam mark) will not be addressed.

In the tests and exam, no dictionaries are permitted, and non-programmable calculators with no text storage/retrieval capacity are permitted. A Formulae Sheet will be provided, which must be returned.

Assessment Tasks

Name	Weighting	Due
Assignment	15%	11.55 pm Sunday 22 May
Final exam	70%	Exam period
Class Test	15%	Tuesday 5 April

Assignment

Due: **11.55 pm Sunday 22 May**
Weighting: **15%**

Written assignment worked on in groups of 3, 4 or 5 students, submitted in hardcopy to BESS.

No extensions will be granted. There will be a deduction of 10% of the total available marks made from the total awarded mark for each 24 hour period or part thereof that the submission is late (for example, 25 hours late in submission – 20% penalty). This penalty does not apply for

cases in which an application for disruption of studies is made and approved. No submission will be accepted after solutions have been posted.

On successful completion you will be able to:

- Describe, develop, apply and analyse the modelling of loss distributions both with and without limits and risk-sharing arrangements
- Derive, apply, explain and analyse the concepts of Bayesian statistics including Empirical Bayes models
- Construct risk models involving frequency and severity distributions and calculate the moment generating functions and moments both with and without risk-sharing arrangements
- Use Monte Carlo simulation to model observations from various loss models, calculate the number of simulations required and extend these techniques to more complex scenarios
- Define, explain and analyse the concept of ruin and describe the relationships between different probabilities of ruin including the effect of simple reinsurance arrangements

Final exam

Due: **Exam period**
Weighting: **70%**

Three hour written exam held during the university exam period. To be eligible to pass this unit, a pass is required in the final examination.

On successful completion you will be able to:

- Describe, develop, apply and analyse the modelling of loss distributions both with and without limits and risk-sharing arrangements
- Derive, apply, explain and analyse the concepts of Bayesian statistics including Empirical Bayes models
- Construct risk models involving frequency and severity distributions and calculate the moment generating functions and moments both with and without risk-sharing arrangements
- Use Monte Carlo simulation to model observations from various loss models, calculate the number of simulations required and extend these techniques to more complex scenarios
- Define, explain and analyse the concept of ruin and describe the relationships between different probabilities of ruin including the effect of simple reinsurance arrangements
- Explain and apply the concepts of decision theory

Class Test

Due: **Tuesday 5 April**
Weighting: **15%**

In-class test covering Sections 1 to 5 inclusive.

On successful completion you will be able to:

- Describe, develop, apply and analyse the modelling of loss distributions both with and without limits and risk-sharing arrangements
- Derive, apply, explain and analyse the concepts of Bayesian statistics including Empirical Bayes models

Delivery and Resources

The **timetable** for classes can be found on the University web site at:

https://timetables.mq.edu.au/2016/

Lectures are held on Tuesdays from 2 to 4 in E7BT5 and on Wednesdays from 11 to 12 in E7BT5. Tutorials are held on Wednesdays from 1 to 2, 4 to 5 and 5 to 6.

For **Sections 1 to 6 inclusive**, Lecture Handouts (i.e. notes with gaps) will be available for downloading from the iLearn website. You will need to print the relevant section of the Lecture Handout in advance of the relevant lecture, and bring it to classes to complete. Complete Notes including solutions to Lecture Exercises and solutions to Section Exercises will be available for downloading from the iLearn page within 24 hours after the relevant tutorials covering that material have all been completed. This schedule is fixed and will not be varied for individual students unless the formal grounds for Disruption to Studies or Equity Support are met.

For **Sections 7 to 11** inclusive, the required text is:

Dickson, D. (2005). *Insurance risk and ruin*, Cambridge University Press: Cambridge

ActEd CT6 notes are not set as required or recommended reading for this unit, since the unit notes are comprehensive and detailed. The ActEd CT6 notes will also NOT be set as recommended reading for ACST357. If you decide to purchase the ActEd CT6 notes, please buy directly from ActEd. Those who want to view a copy of the ActEd CT6 notes during the session should contact the teaching assistant. Arrangements will be made for you to view them in the Department of Applied Finance and Actuarial Studies. The notes are not available in the library. This reference copy of the notes cannot under any circumstances be photocopied.

Other useful references:

Hossack, I.B., Pollard, J.H. and Zehnwirth, B. (1999). *Introductory statistics with applications in general insurance,* second edition. Cambridge University Press: Cambridge

Klugman, S.A., Panjer, H.H. and Willmot, G.E. (2004). *Loss models: from data to decisions*, second edition. Wiley: New York

Casualty Actuarial Society (2001). *Foundations of Casualty Actuarial Science*, 4th edition.

Technologies Used and Required

MS Excel and MS Word will be used throughout the unit. Students will be required to use a non-programmable calculator in the final examination and in the class test.

Unit Schedule

Week	Start date	Lecturer	Lecture (Tues)	Lecture (Wed)	Tutorial
1	29 Feb	LT	Section 1: Loss Models I	Section 1 (cont)	Section 1
2	7 March	LT	Section 2: Loss Models II	Section 2 (cont)	Section 2
3	14 March	LT	Section 3: Loss Models III	Section 3 (cont)	Section 3
4	21 March	LT	Section 4: Loss Models IV	Section 5: Reinsurance and Deductibles	Section 4
5	28 March	LT	Section 5 (cont); Section 6: Simulation	Section 6 (cont)	Section 5
6	4 April	LT	Test	Section 6 (cont)	Section 6
BREAK	11 April	-	-	-	-
BREAK	18 April	-	-	-	-
7	25 April	JL	Section 7: Premium Principles	Section 7 (cont)	Section 7
8	2 May	JL	Section 8: Collective Risk Model	Section 8 (cont)	Section 8
9	9 May	JL	Section 9: Classical Risk Process	Section 9 (cont)	Section 9 - I
10	16 May	JL	Section 9 (cont)	Section 9 (cont)	Section 9 - II
11	23 May	JL	Section 9 (cont)	Section 9 (cont)	Section 9 - III
12	30 May	JL	Section 10: Credibility Theory	Section 11: Decision Theory	Sections 10, 11
13	6 June	LT	Exam information; Revision	Revision	-

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Further information regarding supplementary exams, including dates, is available here

http://www.businessandeconomics.mq.edu.au/current_students/undergraduate/how_do_i/special_consideration

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Describe, develop, apply and analyse the modelling of loss distributions both with and without limits and risk-sharing arrangements
- Derive, apply, explain and analyse the concepts of Bayesian statistics including Empirical Bayes models
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- Explain and apply the concepts of decision theory

Assessment tasks

- Assignment
- Final exam

- Class Test

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Describe, develop, apply and analyse the modelling of loss distributions both with and without limits and risk-sharing arrangements
- Derive, apply, explain and analyse the concepts of Bayesian statistics including Empirical Bayes models
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Assessment tasks

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Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Describe, develop, apply and analyse the modelling of loss distributions both with and without limits and risk-sharing arrangements
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