ACST356
Mathematical Theory of Risk
S1 Day 2016
Dept of Applied Finance and Actuarial Studies

Contents

General Information .......................................................... 2
Learning Outcomes ............................................................ 2
General Assessment Information ............................................. 3
Assessment Tasks .............................................................. 3
Delivery and Resources ......................................................... 5
Unit Schedule ................................................................ 6
Policies and Procedures ........................................................... 7
Graduate Capabilities ............................................................ 8

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## General Information

<table>
<thead>
<tr>
<th>Unit convenor and teaching staff</th>
<th>Unit convenor and lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leonie Tickle</td>
<td>Jackie Li</td>
</tr>
<tr>
<td>Contact via Dialogue tool on the teaching website or during consultation</td>
<td>Contact via Dialogue tool on the teaching website or during consultation</td>
</tr>
<tr>
<td>E4A608</td>
<td>E4A610</td>
</tr>
<tr>
<td>Mondays 1-3 during teaching weeks or by appointment</td>
<td>Wednesday 12-2 during teaching weeks</td>
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<table>
<thead>
<tr>
<th>Credit points</th>
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<table>
<thead>
<tr>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>39cp including STAT272</td>
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<table>
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<tr>
<th>Corequisites</th>
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<table>
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<tr>
<th>Co-badged status</th>
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<tbody>
<tr>
<td>ACST861</td>
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<table>
<thead>
<tr>
<th>Unit description</th>
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<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at [http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/](http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/)

## Learning Outcomes

1. Describe, develop, apply and analyse the modelling of loss distributions both with and without limits and risk-sharing arrangements
2. Derive, apply, explain and analyse the concepts of Bayesian statistics including Empirical Bayes models
3. Construct risk models involving frequency and severity distributions and calculate the moment generating functions and moments both with and without risk-sharing arrangements
4. 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
5. Define, explain and analyse the concept of ruin and describe the relationships between different probabilities of ruin including the effect of simple reinsurance arrangements
6. 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**

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment</td>
<td>15%</td>
<td>11.55 pm Sunday 22 May</td>
</tr>
<tr>
<td>Final exam</td>
<td>70%</td>
<td>Exam period</td>
</tr>
<tr>
<td>Class Test</td>
<td>15%</td>
<td>Tuesday 5 April</td>
</tr>
</tbody>
</table>

**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.

This Assessment Task relates to the following 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
• 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.

This Assessment Task relates to the following 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
• 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.

This Assessment Task relates to the following 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

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:

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:

Unit Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Start date</th>
<th>Lecturer</th>
<th>Lecture (Tues)</th>
<th>Lecture (Wed)</th>
<th>Tutorial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29 Feb</td>
<td>LT</td>
<td>Section 1: Loss Models I</td>
<td>Section 1 (cont)</td>
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<tr>
<td>2</td>
<td>7 March</td>
<td>LT</td>
<td>Section 2: Loss Models II</td>
<td>Section 2 (cont)</td>
<td>Section 2</td>
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<tr>
<td>3</td>
<td>14 March</td>
<td>LT</td>
<td>Section 3: Loss Models III</td>
<td>Section 3 (cont)</td>
<td>Section 3</td>
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<tr>
<td>4</td>
<td>21 March</td>
<td>LT</td>
<td>Section 4: Loss Models IV</td>
<td>Section 5: Reinsurance and Deductibles</td>
<td>Section 4</td>
</tr>
<tr>
<td>5</td>
<td>28 March</td>
<td>LT</td>
<td>Section 5 (cont); Section 6: Simulation</td>
<td>Section 6 (cont)</td>
<td>Section 5</td>
</tr>
<tr>
<td>6</td>
<td>4 April</td>
<td>LT</td>
<td>Test</td>
<td>Section 6 (cont)</td>
<td>Section 6</td>
</tr>
<tr>
<td>BREAK</td>
<td>11 April</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>BREAK</td>
<td>18 April</td>
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<td>-</td>
<td>-</td>
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<tr>
<td>7</td>
<td>25 April</td>
<td>JL</td>
<td>Section 7: Premium Principles</td>
<td>Section 7 (cont)</td>
<td>Section 7</td>
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<tr>
<td>8</td>
<td>2 May</td>
<td>JL</td>
<td>Section 8: Collective Risk Model</td>
<td>Section 8 (cont)</td>
<td>Section 8</td>
</tr>
</tbody>
</table>
Week | Start date | Lecturer | Lecture (Tues) | Lecture (Wed) | Tutorial
--- | --- | --- | --- | --- | ---
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:


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/](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](http://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](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/](http://students.mq.edu.au/support/).

Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://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 Enquiry Service

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au).

Equity 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.

IT Help

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

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
- 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

**Assessment tasks**

- Assignment
- Final exam
- Class Test

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

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