

MACQUARIE  
UNIVERSITY



FACULTY OF  
BUSINESS AND ECONOMICS

**ACST 356 / 861**  
**Mathematical Theory of Risk**

**Semester 1, 2010**

*Department of Actuarial Studies*

**MACQUARIE UNIVERSITY  
FACULTY OF BUSINESS AND ECONOMICS  
UNIT OUTLINE**

<b>Year and Semester:</b>	<b>Semester 1, 2010</b>
<b>Unit convenor:</b>	<b>Associate Professor Leonie Tickle</b>
<b>Prerequisites (for ACST356):</b>	<b>STAT272 (P)</b>
<b>Corequisites (for ACST861):</b>	<b>STAT810 (P)</b>

Students in this unit should read this unit outline carefully at the start of semester. It contains important information about the unit. If anything in it is unclear, please consult the unit convenor.

### **ABOUT THIS UNIT**

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. The use of no claim discount systems as a method of experience rating is described. Decision theory and simulation are also studied.

This unit relies heavily on your statistics studies (STAT 272 or STAT 810) and you should ensure that you revise this work if necessary. In particular, you should be familiar with:

- the theory of statistical distributions, including the meaning of a random variable, discrete and continuous random variables, density functions, cumulative density functions;
- basic results relating to expectation, variance, covariance, and moment and cumulant generating functions;
- joint random variables and marginal density functions;
- the use of Normal Distribution and Chi-Squared distribution tables;
- probability theory, including conditional probability; and
- some mathematical techniques and results including integration by parts and the binomial, logarithmic, exponential, and Taylor series approximations.

### **TEACHING STAFF**

A/Prof Leonie Tickle is the unit convenor and will be taking 10 weeks of classes, and Dr Jiwook Jang will be taking 3 weeks of classes.

Minh Phan is the teaching administrator for this unit. Administrative questions that are not covered in this unit outline should be directed to him via the private Mail facility of the website. If the questions are of interest to everyone, the question and the reply will be posted to the website, so you should specifically request if you want your message to remain private.

Questions about unit content should be sent to the Discussion Board of the website or raised during tutorials or lectures.

If you need to contact lecturing staff, including to arrange for an in-person meeting, please do so via the private Mail facility of the website.

## REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

### Required texts

Lecture Handouts (ie. notes with gaps) are available for downloading from the ACST356 / 861 teaching website. Set One is now available and covers Sections 1 to 6; Set Two will be made available later in the semester. It is recommended that you 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 ACST356 / 861 teaching website on Friday at 10 am in the week that the Section is completed (Week 1 for Section 1, ..., Week 4 for Section 4, Week 6 for Section 5, Week 7 for Section 6, ..., Week 13 for Section 12). This schedule is fixed and will not be varied for individual students unless the formal grounds for Special Consideration or Equity Support are met.

If you decide to purchase the optional texts (the ActEd CT6 notes and / or the Dickson text – see below), it is recommended that you read the relevant sections in advance of the lecture. During the lecture you can then work through the Lecture Handout, which will cover similar ground but expressed in a different way.

### Optional recommended text

The following text may be helpful for some sections of the unit, but is not required reading.

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

This book is available from the Macquarie University Co-op Bookshop. Copies are also available in the Reserve section of the library.

### Optional ActEd material

The ActEd CT6 are not set as required or recommended reading for this unit, since the unit notes are comprehensive and detailed. However, the ActEd CT6 notes will be set as a recommended reading for ACST357 / 862. If you plan to use them in ACST357 / 862 it may be useful to buy them now, at the start of the year, so that you can also use them as an additional reading for ACST356 / 861. Please make your order on the ASSOC webpage [www.mqassoc.org](http://www.mqassoc.org) by going to the “Order ActEd Notes” tab on the left.

Those who want to view a copy of the ActEd CT6 notes during the semester should contact the teaching assistant using private Mail on the ACST356 / 861 website. Arrangements will be made for you to view them in the Department of 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*. Casualty Actuarial Society.

These texts are available in the library, with a single copy of each also available in the Reserve section of the library.

## UNIT WEB PAGE

To access the website, go to <http://learn.mq.edu.au> and login using your usual login and password. You will then have access to the websites for all the units in which you are enrolled. If you have any trouble logging in (e.g. you have forgotten your password), please contact the Student IT Helpdesk.

Before logging in, you should follow the link labelled “Technical Information” and read all the information there, including the Information Technology Security Policy and Rules and the Information Technology Usage Rules. This technical information also mentions a number of “plugins” that may be required. Of those listed, in this unit you will only need Acrobat Reader. Remember to close your browser when you have finished using the site. If you don't, another person can use the still running browser to access the website with your account.

The web site will be used as an integral part of this unit. The main components of the website (listed on the left hand side toolbar) are:

### Course Content

- Unit Outline 2010: You can download this unit outline from here.
- Unit Notes: Two sets of Lecture Handouts, and Complete Notes for each Section, including solutions to Lecture Exercises, and solutions to Section Exercises (posted Friday 10 am according to the schedule given previously) will be posted here for downloading.
- Assignment: Any data or information that you need to complete the online assignments will be made available here.
- Revision exercises: Additional revision exercises will be made available here.
- Mock tests: Mock tests and solutions will be made available here.
- Tests and exams: Previous examinations and tests for ACST356 / 861 are available here.
- Links: Any web links you need to use will be made available here.

**Announcements.** Ensure that you keep up to date with announcements posted here.

**Assessments.** Enter this section to submit your weekly quizzes and online assignments.

**Calendar.** The calendar will list the dates that some items of assessment become available; however it is your responsibility to familiarise yourself with all assessment requirements including those not listed on the calendar.

**Discussions.** You should use the Discussion facility, along with the tutorial time, as your resource for asking questions about the content of the unit. Please address your questions to your fellow students – if there is no response or an incorrect response from the class the teaching staff will post a response. You are encouraged to post answers to other students' questions – this is one of the most effective ways to clarify your own understanding of the material. You should consult the Discussions frequently, to contribute to questions and see answers to queries.

**Mail.** You should use private Mail to send administrative queries to the unit convenor or teaching administrator. Staff will also use Private Mail to contact you individually, if necessary. You may also use this facility to contact your fellow students. It is your responsibility to check the website regularly to make sure that you are up-to-date with messages sent to your Private Mail address.

**Search.** Use this tool to search the website.

**Video iLecture.** In 2010, video iLecture will be available for ACST 356 / 861 for the first time. The recording captures video output from the lecturer's PC and visualiser, and combines and synchronises the video with audio of the lecture.

## LEARNING OBJECTIVES AND OUTCOMES

The learning objectives of this unit are summarised in the Lecture Handouts / Complete Notes at the start of each section of work. You should review these in advance of each lecture and after completing each section of work.

In addition to the discipline-based learning objectives, all academic programs at Macquarie seek to develop students' generic skills in a range of areas. One of the aims of this unit is that students develop their skills in the following: *Critical analysis skills; Problem-solving skills; Creative thinking skills.*

## CLASSES

The timetable for classes can be found on the University web site at [www.timetables.mq.edu.au](http://www.timetables.mq.edu.au).

**Lectures** are held Tuesday 2 – 4 in C5CT2 and Wednesday 11 – 12 in C5CT1. The unit material is covered in the three hours of lectures each week.

**Tutorials** are held Wednesday 12–1, 1–2 and 2–3 and Thursday 10–11, commencing in week 1. **You must attend the tutorial class in which you are enrolled.** The tutorial is an opportunity for you to attempt the section exercises given at the end of each section of work, and to discuss problems with the tutor.

## CLASS ETIQUETTE

Mobile phones should be switched off during all lectures and tutorials. If there is a reason for you to keep your phone on you should request to be allowed to do so before the start of the class. Lectures commence at 5 minutes past the hour and you are expected to be punctual. You are expected to keep talking to a minimum during classes so as not to disrupt your fellow students (and the lecturer!).

## TEACHING AND LEARNING STRATEGY

A preliminary outline of classes is given on the following page. Any alterations to classes will be advised in lectures and / or via the website.

## RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES

### Introduction

This unit is assessed using two class tests, regular short quizzes, two online assignments and a final examination. The assessment structure is suitable given the problem-solving and technical nature of the unit, and is also aimed at encouraging you to regularly review the material. An assessment schedule is given in the following pages and any changes to the assessment or assessment due dates will be advised in classes.

In addition to tasks that count for assessment, you will be provided with Lecture Exercises, Section Exercises to attempt during the tutorials and / or in your own time, and two Mock Tests held during the Wednesday class prior to each class test.

Week	Week Beginning	Due Monday 5 pm	Lecturer	Tuesday 2-4 class	Wednesday 11-12 class	Tutorial
1	22 Feb	-	LT	Lecture: Section 1 <i>Loss Models – I</i>	Lecture: Section 1 (cont)	Section 1 Exercises
2	1 March	Quiz 1	LT	Lecture: Section 2 <i>Loss Models – II</i>	Lecture: Section 2 (cont)	Section 2 Exercises
3	8 March	Quiz 2	LT	Lecture: Section 3 <i>Loss Models - III</i>	Lecture: Section 3 (cont)	Section 3 Exercises
4	15 March	Quiz 3	LT	Lecture: Section 4 <i>Loss Models - IV</i>	Lecture: Section 4 (cont)	Section 4 Exercises
5	22 March	Quiz 4	LT	Lecture: Section 5 <i>Reinsurance and Deductibles</i>	Mock Test 1	Mock Test 1 Solutions
6	29 March	-	LT	Test 1	Lecture: Section 5 (cont)	Section 5 Exercises
<b>STUDY BREAK</b>	5 April 12 April	Quiz 5 Assignment 1				
7	19 April	-	LT	Lecture: Section 6 <i>Simulation</i>	Lecture: Section 6 (cont)	Section 6 Exercises
8	26 April	Quiz 6	JJ	Lecture: Section 7 <i>Individual Risk Model</i>	Lecture: 8 <i>Collective Risk Model</i>	Section 7 Exercises
9	3 May	Quiz 7; Assignment 2	JJ	Lecture: Section 8 (cont)	Lecture: Section 8 (cont)	Section 8 Exercises
10	10 May	Quiz 8	JJ	Lecture: Section 9 <i>Ruin Theory</i>	Mock Test 2	Mock Test 2 Solutions and Section 9 Exercises
11	17 May	-	JJ / LT	Test 2	Lecture: Section 10 <i>Credibility Theory</i>	Section 10 Exercises
12	24 May	Quiz 9; Quiz 10	LT	Lecture: Section 11 <i>Decision Theory</i>	Lecture: Section 11 (cont)	Section 11 Exercises
13	31 May	Quiz 11	LT	Lecture: Section 12 <i>Rating and No Claim Discount</i>	Unit surveys, Exam information, Revision	Section 12 Exercises

Quiz questions, Lecture Exercises and Section Exercises are aimed at helping you to understand the fundamental concepts before moving on to more difficult material. **They are not necessarily indicative of the difficulty of questions you could expect in the class tests and on the final exam** (ie. they are mostly easier, to assist your initial learning). Past class tests and examinations with full solutions are available from the website, and give you a good source of practice questions that are of examination difficulty.

### **Non-assessable Tasks: Lecture Exercises, Section Exercises, Mock Tests**

The Lecture Exercises and Section Exercises are aimed at developing your understanding of the unit material so that you are able to successfully complete the assessable tasks.

**Any student coming to lectures or tutorials is expected to do so with the intention of actively participating. This includes bringing all necessary materials (Lecture Notes, calculators etc.) and making a sincere and engaged attempt at Lecture and Section Exercises during class time.**

The Mock Tests are held in the Wednesday lecture class prior to each class test. The aim of the Mock Tests is to give you practice at attempting questions under examination conditions, so that you test your understanding of the content as well as your ability to manage your time and stress. **You should only attend these sessions if you are prepared to sit the Mock Tests under examination conditions**, otherwise you can choose to sit the tests in your own time.

Past class test and examination questions and revision questions, all with fully worked solutions, are also available from the website.

### **Quizzes and Assignments**

There are 11 online quizzes to complete. Quiz 1 is based on material in Section 1, Quiz 2 is based on material in Section 2, ... Quiz 11 is based on material in Section 11 (Section 12 is not assessed by quiz); however each quiz may also rely on earlier work. The quizzes in total are worth 5% of the final assessment for the unit; the weighting of each quiz varies according to the length of the Section on which it is based.

Please use quizzes 1 and 2 as early diagnostic tools to assess how well you are understanding the unit material and whether you need to revise pre-requisite material or to reconsider your enrolment in the unit. Please contact the unit convenor if you need advice.

There are two assignments in this unit, both to be made available under the Assignments section of the website and to be submitted online.

- Assignment 1 will involve fitting models to data for claim numbers and amounts, based on material covered in sections 1 to 4. It is due 5 pm Monday 12 April and is worth 3.75% of the assessment for the unit.
- Assignment 2 involves simulating a total claims cost using the models developed in Assignment 1, based on the material covered in section 6. It is due 5 pm Monday 3 May and is worth 1.25% of the assessment for this unit.

At the start of each quiz / assignment you are required to certify that the answers you are submitting are totally your own work, and that you have not made available, to classmates or others, your answers to the quiz / assignment. **Making this certification when it is not true will be regarded as a serious breach of the assessment conditions.**

Quizzes and assignments are to be submitted online by the due dates shown on the schedule. You will notice that there is an assignment or quiz due every Monday at 5 pm - with the exception of the first week of term, the first week after the break, and the weeks in which there is a class test – and that there are two items due in weeks 9 and 12. Quiz 5 is due on Easter Monday so you should plan to submit this quiz earlier if you will not be able to submit it on this day.

You should not leave the submission of quizzes or assignments to the last minute in case there are IT problems that cause delays. (In the rare case of prolonged University-wide technology problems, allowances will be made for all students). You should ensure that you fully Submit each item of assessment and receive the acknowledgement “Thank you for submitting Quiz 1” etc., otherwise you may not receive credit.

You must ensure that you answer quiz / assignment questions in the correct format (details are given in the certification at the start of each quiz) and with the rounding specified. Answers will not score credit unless they are in the correct format and with the correct rounding. **Marks cannot be reinstated for these errors so please do not request this.**

Feedback on each quiz / assignment will be available online once the assessment has been submitted and the deadline for the assessment has passed. In order to be able to access quiz / assignment questions, solutions and feedback later in the semester, you must submit the quiz / assignment. Therefore please ensure that you submit an attempt if you want to be able to access this material. **Quizzes / assignments cannot subsequently be made available to students who do not submit an attempt, so please do not request this.**

### **Class tests**

There will be two class tests, each worth 10% of the final assessment for the unit.

- Test 1 will be held Tuesday 30 March at 2 pm. It will cover Sections 1, 2, 3 and 4.
- Test 2 will be held Tuesday 18 May at 2 pm. It will cover Sections 5, 6, 7 and 8.

Marked papers including individual feedback will be returned to BESS. Class feedback and a marking guide will be provided on the website. It is hoped that marked papers and feedback will be returned within 12 working days of the class test date.

### **Exam**

The final examination is worth 70% of the final assessment for the unit. It will be a three-hour written paper with ten minutes reading time held during the University Examination period.

The University Examination period in First Half Year 2010 is from 9 June to 25 June. You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in Draft form approximately eight weeks before the commencement of the examinations and in Final form approximately four weeks before the commencement of the examinations from <http://www.timetables.mq.edu.au/exam>.

You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period.



## **SPECIAL CONSIDERATION FOR ASSESSMENTS AND EXAMS**

If illness or unavoidable disruption affects your ability to submit an assessment task or sit the tests or exam, you should read the information at

[http://www.businessandconomics.mq.edu.au/for/new\\_and\\_current\\_students/undergraduate/admin\\_central/special\\_consideration](http://www.businessandconomics.mq.edu.au/for/new_and_current_students/undergraduate/admin_central/special_consideration)

immediately. Allowances may be made where a formal application for Special Consideration is approved. For your application to be considered, you must ensure that you meet the requirements specified, including providing a Professional Authority Form for applications based on medical grounds.

The only exception to sitting an examination at the designated time is where an application for Special Consideration due to documented illness or unavoidable disruption is approved. By submitting a request for special consideration you are agreeing to be available to sit a Supplementary Examination if required. If a Supplementary Examination is granted as a result of the Special Consideration process then

- The examination will be scheduled after the conclusion of the official examination period.
- You do not have the right to request an alternative time, unless the scheduled time clashes with another Macquarie University supplementary exam that you are required to attend.
- Your performance in the Supplementary Examination replaces your performance in the original examination (if any). You do NOT have the right to subsequently request that your result be based on the original examination rather than the Supplementary Examination.
- If you fail to attend the Supplementary Examination you will be awarded the grade of "Fail – Absent".

## **RULES REGARDING TESTS AND EXAMINATIONS**

Normal examination rules apply to the conduct of class tests and the final examination. These rules are set out under the heading "Conduct of Examinations" in the Student Information–Assessment section of the current Macquarie University Handbook of Undergraduate Studies. Students are responsible for familiarising themselves with these rules prior to the class test and final examination.

You should ensure that your handwriting in the class tests and in the final examination is legible. Sections of work that are not legible will not be marked. For true/false questions, answers that are not clearly legible as either T or F will be assumed to be wrong and marked accordingly.

Calculators will be allowed in the class tests and the final examination but a clear indication of the steps involved in every calculation must be shown. Any machines that have a text-retrieval capacity, whether or not they have a full alphabet on the keyboard, are not allowed. Calculators may be checked at the commencement of the class tests and final exam, and the make/model may be recorded.

Dictionaries will not be permitted in the class tests or the final examination.

A Formulae Sheet will be provided in the class tests and final examination. No other reference material is permitted. This Formulae Sheet will be identical to the one provided on the teaching website.

Academic Senate has resolved that mobile phones should not be used in classrooms or be brought into examination rooms. Communication devices, including but not restricted to mobile phones, text message receivers, pagers and wireless-equipped calculators, may not be brought into the class tests or exam. If a student is found to have brought such a device into the examination room, the argument that the device was turned off will NOT be regarded as an acceptable excuse.

## UNIVERSITY POLICY ON GRADING

Macquarie University uses the grades HD, D, Cr, P, PC and F for grading the achievements of students in units of study. The meaning of each symbol is explained in section 9 of the Bachelor Degree Rules in the current Macquarie University Handbook of Undergraduate Studies; these are available from <http://universitycouncil.mq.edu.au/legislation.html>.

Your final result will include one of these grades plus a standardised numerical grade (SNG). The numerical marks resulting from assessment of your work in this unit will be used as an initial indicator of the quality of your learning and understanding. The use of these numerical marks is, however, only a starting point in determining the appropriate grade. **In particular, note that the SNG ranges mentioned in the Handbook of Undergraduate Studies are not the raw marks. To obtain a grade you must satisfy the qualitative definition of that grade. Once your grade has been determined, you are allocated an SNG indicating your approximate position amongst students assigned that grade.**

## EXEMPTIONS

The units ACST356 / 861 and ACST357 / 862 together correspond to the professional subject CT6. The exemption will be recommended if and only if a SNG of at least 60 is achieved in both units and the average SNG is at least 65.

## EXAM VIEWING AND GRADE APPEALS

First semester results are scheduled to be released on 13 July. Following the release of the results, some students ask to see their exam paper. You will need to view the FBE web site at <http://businessandconomics.mq.edu.au/> immediately after the results are released to determine how to request to view your paper. There will be a very limited time to make this request, and this must be done through the formal process rather than by a request to the unit convenor.

Please note that marks will not be recorded on exam scripts in this unit. Instead, marks and marker notes / comments are recorded in detailed spreadsheets (which are not provided to individual students). **You will not, therefore, gain access to your raw marks by viewing your exam scripts.** You will be able to compare your answers with the sample solutions to identify where you showed a lack of understanding.

## PLAGIARISM

The University defines plagiarism in its rules: "Plagiarism involves using the work of another person and presenting it as one's own." Plagiarism is a serious breach of the University's rules and carries significant penalties. You must read the University's practices and procedures on plagiarism. These can be found in the *Handbook of Undergraduate Studies* or on the web at: <http://www.student.mq.edu.au/plagiarism/>.

The policies and procedures explain what plagiarism is, how to avoid it, the procedures that will be taken in cases of suspected plagiarism, and the penalties if you are found guilty. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

## ELECTRONIC COMMUNICATION AND YOUR STUDENT FILE

Every business keeps a record of its correspondence with its customers. The University is no exception and it maintains a file for every student. Staff are required to ensure that copies of all correspondence with you are added to your file. Historically, "correspondence" meant letters, but nowadays it also includes electronic communication such as email. Staff have some discretion here and might not file copies of trivial emails, but it is difficult to define precise boundaries here, so it is safer to assume that any email you send to a staff member will be added to your file.

Some people regard email as more ephemeral than a letter and thus tend to take less care with issues such as clarity of expression, grammar and spelling. Before sending an email to a staff member, a good question to ask yourself is: "If a member of staff is reviewing my student file prior to writing a reference for me, and they see a copy of this email, would that staff member gain a favourable impression of my level of communication skills?"

In this context, email includes communications you send to staff with the mail tool in the unit's web site. It does not normally include postings you make to the discussion area. However, in those very rare cases where a student makes an inappropriate posting to the discussion area, a copy of the posting would be added to that student's file.

## STUDENT SUPPORT SERVICES

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at <http://www.student.mq.edu.au>.

**BESS.** Business and Economics Student Services (BESS) is located in room E4B106 and offers photocopying facilities, reading areas and reference material. Class tests will be returned to BESS. Information about facilities and services is at [http://businessand economics.mq.edu.au/for/new and current students/undergraduate/bess](http://businessand economics.mq.edu.au/for/new_and_current_students/undergraduate/bess).

**ACSTINFO.** This ACSTINFO site is used to distribute information to all students majoring in actuarial studies. The information supplied may include administrative information and job advertisements. You will retain access to this site during the vacation following the end of this semester. It is to your advantage to ensure you read information on this web site regularly. You should not assume that information posted there will also be repeated in lectures. To access the site, login at: <http://learn.mq.edu.au/> and the site should appear among your list of units. When you first login, please read the section labelled "How to use this site." This contains useful information which will help you determine when there is new information on the site which you should read.

## **INSTITUTE OF ACTUARIES OF AUSTRALIA**

You should consider joining the Institute of Actuaries of Australia, if you haven't done so already. The Institute of Actuaries of Australia has recently introduced a new FREE university subscription for full-time undergraduate university students who are members of a student actuarial society. For information and to sign-up, go to <http://www.actuaries.asn.au/UniversitySubscriber.htm>

## **FEEDBACK**

I would welcome your feedback on any aspect of the unit. If you see that something could be improved, don't sit back and complain to your friends! Come and see me and let me know your ideas and if I agree that your ideas are good I will make changes. You can give me feedback in lectures or by contacting me via Mail on the website.

I have made significant changes to the unit in recent years in response to feedback, including changing the format of tutorials, introducing Mock Tests, introducing iLecture and introducing quizzes. I will discuss these changes in more detail in classes.

I hope not to see any feedback in the end-of-semester unit evaluations that I haven't heard about already and therefore had the opportunity to incorporate to improve the unit. Please get involved in making this unit as useful and rewarding as possible.

Leonie Tickle  
8 February 2010