ACST358
Survival Models
Semester 1, 2012

Department of Applied Finance
and Actuarial Studies
Year and Semester: 2012 Semester 1

Unit convenor: Dr. Xian Zhou

Prerequisites: ACST255 (P); ACST212 (P); STAT271 (P); or equivalent
Co-requisites: None

Credit points: 3

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

ABOUT THIS UNIT

• Unit description: This unit provides sophisticated statistical and probabilistic models for survival, sickness, insurance losses and other actuarial problems based on survival data. Techniques of survival analysis are used to estimate survival and loss distributions and evaluate risk factors in actuarial applications. Methods of both nonparametric and parametric estimation are utilised. Advanced models based on Markov chains and processes will also be introduced to capture the features of stochastic transitions between different survival or loss states and to estimate the transition rates.

• Unit rationale: The unit is a core unit of the degree program for actuarial studies. It covers a large part of the materials in the UK Institute of Actuaries (IA) syllabus for Subject CT4, and a prerequisite to units ACST359 Actuarial Modelling. Units ACST358 and ACST359 together cover the CT4 syllabus.

TEACHING STAFF

• Convenor: Dr. Xian Zhou, Room E4A 607, Ex 8566, xian.zhou@mq.edu.au

• Tutors: Celeste Chai celeste.chai@mq.edu.au
          Daniel Ciarliero daniel.ciarliero@students.mq.edu.au

• Teaching Assistant:

CONTACTING STAFF

• Consultation times:
  Xian Zhou: Wed 8-10am during teaching weeks, in room E4A 607
You are encouraged to seek help at a time that is convenient to you from a staff member teaching on this unit during their regular consultation hours. In special circumstances, an appointment may be made outside regular consultation hours. Staff will not conduct consultations by email. You may, however, phone staff during their consultation hours.

In order to gain access to staff located at levels 1, 2 and 3 of building E4A during their consultation hours please ring the staff member from the phones available in the lobby (phone numbers of relevant staff members will be provided on Blackboard and are available next to the phones).

- **Other ways of contacting staff:**
  
  Xian Zhou: Email to xian.zhou@mq.edu.au or via the unit website.

Students experiencing significant difficulties with any topic in the unit must seek assistance immediately.

### CLASSES

- **Lectures are held on**
  
  Mondays from 2:00pm to 4:00pm in W5A T2  
  Wednesdays from 2:00pm to 3:00pm in E7B T3

- **Lecturer:** Xian Zhou

- **The lectures will NOT be recorded using i-lecture.**

- **Tutorials are held on**
  
  Wednesdays 11:00am in W6B 282  Tutor: Daniel Ciarliero  
  Wednesdays 12:00pm in C5A 313  Tutor: Celeste Chai  
  Wednesdays 1:00pm in C5A 307  Tutor: Celeste Chai  
  Thursdays 3:00pm in W6B 282  Tutor: Daniel Ciarliero

- **Tutorials start in Week 2.**

- **Tutorial exercises will be available from the unit web site each week before tutorials.**

- **Tutorial exercises will not be assessed, but they form a very important part of the study and are closely related to the assessed components (tests and examination).**

- **Tutorials are important opportunities for you to work on the week’s tutorial questions and to obtain help with them as needed. The more preparation you do for the tutorial, the more you will benefit from the session.**

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

- **Any alterations to classes will be advised in lectures and/or on the unit webpage.**
**Prizes**

**Prizes for this unit:** The Hubert Vaughan Prize will be awarded for the most meritorious performance in ACST358; see: [http://www.businessandeconomics.mq.edu.au/undergraduate_degrees/prizes_scholarships](http://www.businessandeconomics.mq.edu.au/undergraduate_degrees/prizes_scholarships)

**Required and Recommended Texts and/or Materials**

- The primary texts for the unit are the Lecture Notes provided by the Lecturer.
- Lecture Notes will be posted on the unit website before the lectures.
- The main additional reading materials are the ActEd CT4 notes (2012 edition).
- The ActEd CT4 notes can be purchased through ASSOC. More information about ASSOC can be found at its website [http://www.mqassoc.org](http://www.mqassoc.org)

**Technology Used and Required**

You will need access to the internet to obtain course information and download teaching materials.

**Unit Web Page**

- Course material is available on the learning management system (iLearn)
- The web page for this unit can be found at: [http://ilearn.mq.edu.au](http://ilearn.mq.edu.au)
- You will find administrative updates, lecture notes, tutorials and assignments posted there. Materials posted on the website may be updated from time to time.
- It is your responsibility to check the website regularly to make sure that you are up-to-date with the information for the unit.

**Learning Outcomes**

The learning outcomes of this unit are:

1. Understand different types of survival models and key concepts of survival analysis.
2. Able to connect the concepts of survival models and statistical inference with practical actuarial problems.
3. Master the skills of nonparametric and parametric methods to estimate parameters and probability distributions.
4. Understand the ideas and concepts of Markov properties and processes.
5. Able to solve Markov transition probabilities via matrix theory and differential equations and to estimate the transition rates.

**Graduate Capabilities**

In addition to the discipline-based learning objectives, all academic programs at Macquarie seek to develop the capabilities the University's graduates will need to develop to address the challenges, and to be effective, engaged participants in their world.
This unit contributes to this by developing the following graduate capabilities:

1. **Discipline Specific Knowledge and Skills:**
   - The role of probability and statistical methods in actuarial modelling
   - Model development, evaluation and selection
   - Estimation of model parameters and probability distributions in survival models
   - Assessment and evaluation of the relationship between survival probabilities and risk factors via Cox proportional hazards models
   - Solving Kolmogorov differential equations in Markov processes to obtain transition probabilities
   - Ability to apply survival analysis and Markov processes to solve actuarial and financial problems in the real world

2. **Critical, Analytical and Integrative Thinking**

3. **Problem Solving and Research Capability**

4. **Effective Communication**

5. **Capable of Professional and Personal Judgement and Initiative**

**LEARNING AND TEACHING ACTIVITIES**

- The unit is taught through 3 hours of lectures and 1 hour of tutorial per week. Lectures will cover the topics and materials in accordance with the syllabus of Subject CT4 of Institute of Actuaries (IA). Tutorials will discuss exercise questions covered by the lectures.

- Students are expected to listen carefully to all lectures and tutorials; participate in discussions during tutorials, read relevant materials in advance; review the knowledge learnt in classes; and complete the Assignment and all Practice Tasks independently.

- A planned week-by-week list of the topics is as follows:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle of actuarial modelling; Probability models</td>
</tr>
<tr>
<td>2</td>
<td>Survival analysis; Estimation of survival distributions</td>
</tr>
<tr>
<td>3</td>
<td>Estimation of survival distributions</td>
</tr>
<tr>
<td>4</td>
<td>Variance estimation</td>
</tr>
<tr>
<td>5</td>
<td>Confidence intervals; Cox proportional hazards models</td>
</tr>
<tr>
<td>6</td>
<td>Cox proportional hazards models</td>
</tr>
<tr>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Stochastic processes; Markov properties</td>
</tr>
<tr>
<td>8</td>
<td>Markov chains</td>
</tr>
<tr>
<td>9</td>
<td>Markov chains; Markov jump processes</td>
</tr>
<tr>
<td>10</td>
<td>Markov jump processes</td>
</tr>
<tr>
<td>11</td>
<td>Markov jump processes; Applications of Markov processes</td>
</tr>
<tr>
<td>12</td>
<td>Applications of Markov processes</td>
</tr>
<tr>
<td>13</td>
<td>Revision</td>
</tr>
</tbody>
</table>

**Note:** This is only a tentative schedule. Alterations to the timing of the Class Test and Assignment, if any, will be advised in advance in lectures and/or via the unit website.
This unit gives you opportunities to conduct your own research.

### Relationship Between Assessment and Learning Outcomes

<table>
<thead>
<tr>
<th>Title/Name</th>
<th>Assessment Task 1</th>
<th>Assessment Task 2</th>
<th>Assessment Task 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Class Test</td>
<td>Assignment</td>
<td>Final Examination</td>
</tr>
<tr>
<td>45 minutes; with 10 multiple choice questions</td>
<td>5 problem-solving questions requiring detailed answers; due in one day after being distributed</td>
<td>3 hours plus 10 minutes reading; including both multiple choice and problem-solving questions</td>
<td></td>
</tr>
<tr>
<td>Due date (tentative)</td>
<td>Wednesday 21/03/2012</td>
<td>Thursday 10/05/2012</td>
<td>To be arranged by central time tabling</td>
</tr>
<tr>
<td>% Weighting</td>
<td>10%</td>
<td>20%</td>
<td>70%</td>
</tr>
<tr>
<td>Grading method</td>
<td>According to correctness of answers</td>
<td>Based on level of understanding and problem solving skills; full solutions are expected.</td>
<td>Based on level of understanding and problem solving skills; full solutions are expected for problem-solving questions</td>
</tr>
<tr>
<td>Submission method</td>
<td>Answer sheet</td>
<td>Answer sheets</td>
<td>Answer book</td>
</tr>
<tr>
<td>Feedback (type, method, date)</td>
<td>Through marked scripts (within one week after the due date), consultations and/or class discussions</td>
<td>Through marked scripts (within 3 weeks after the due date), consultations and/or class discussions</td>
<td>No feedback will be provided on the final examination in line with university policies</td>
</tr>
<tr>
<td>Estimated student workload (hours)</td>
<td>5 – 10 hours</td>
<td>10 – 15 hours</td>
<td>20 – 25 hours</td>
</tr>
<tr>
<td>Learning outcomes assessed (max 6)</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Graduate capabilities assessed (max 4)</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

- **Practice tasks:** There will be three Practice tasks for this unit. They will not be assessed, but should be completed independently. Solutions will be provided.
• **Extension**: Not applicable

• **Late submissions**: Late submissions of answers will not be accepted.

• **Attendance**: Attendance of lectures and tutorials is essential to the success of studying this unit, although it will not be recorded.

• **Examinations**: A final examination is included as an assessment task for this unit to provide assurance that:
  
  i) the product belongs to the student and
  
  ii) the student has attained the knowledge and skills tested in the exam

A 3 hour final examination for this unit will be held during the University Examination period.

The University Examination period in First Half Year 2012 is from 12 June to 29 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.

[http://exams.mq.edu.au/](http://exams.mq.edu.au/)

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. The University’s policy on special consideration process is available at


If a Supplementary Examination is granted as a result of the Special Consideration process the examination will be scheduled after the conclusion of the official examination period. (Individual Faculties may wish to signal when the Faculties’ Supplementary Exams are normally scheduled.)

The Macquarie university examination policy details the principles and conduct of examinations at the University. The policy is available at:


**ACADEMIC HONESTY**

The nature of scholarly endeavour, dependent as it is on the work of others, binds all members of the University community to abide by the principles of academic honesty. Its fundamental principle is that all staff and students act with integrity in the creation, development, application and use of ideas and information. This means that:

• all academic work claimed as original is the work of the author making the claim
• all academic collaborations are acknowledged
• academic work is not falsified in any way
• when the ideas of others are used, these ideas are acknowledged appropriately.

Further information on the academic honesty can be found in the Macquarie University Academic Honesty Policy at

Macquarie University uses the following grades in coursework units of study:

HD - High Distinction  
D - Distinction  
CR - Credit  
P - Pass  
F - Fail

Grade descriptors and other information concerning grading are contained in the Macquarie University Grading Policy which is available at:  

**GRADING APPEALS AND FINAL EXAMINATION SCRIPT VIEWING**

If, at the conclusion of the unit, you have performed below expectations, and are considering lodging an appeal of grade and/or viewing your final exam script please refer to the following website which provides information about these processes and the cut off dates in the first instance. Please read the instructions provided concerning what constitutes a valid grounds for appeal before appealing your grade.

http://www.businessandeconomics.mq.edu.au/new_and_current_students/undergraduate_current_students/how_do_i/grade_appeals

**SPECIAL CONSIDERATION**

The University is committed to equity and fairness in all aspects of its learning and teaching. In stating this commitment, the University recognises that there may be circumstances where a student is prevented by unavoidable disruption from performing in accordance with their ability. A special consideration policy exists to support students who experience serious and unavoidable disruption such that they do not reach their usual demonstrated performance level. The policy is available at:  
http://www.mq.edu.au/policy/docs/special_consideration/policy.html

**STUDENT SUPPORT SERVICES**

Macquarie University provides a range of Academic Support Services. Details of these and other services for students can be accessed at http://www.student.mq.edu.au.

**BESS:** Business and Economics Student Services (BESS) is located in room E4B106. Information about facilities and services is at:  
http://businessandeconomics.mq.edu.au/for/new_and_current_students/undergraduate/bess  
In this unit, answers to quizzes and class test will be returned via BESS.

**Consultation room:** Consultation sessions with tutors will be held in the FBE Consultation Room E4B 104 at the times outlined previously under Consultation Times.
Access to all student computing facilities within the Faculty of Business and Economics is restricted to authorised coursework for approved units. Student ID cards must be displayed in the locations provided at all times.

Students are expected to act responsibly when using University IT facilities. The following regulations apply to the use of computing facilities and online services:

- Accessing inappropriate web sites or downloading inappropriate material is not permitted. Material that is not related to coursework for approved units is deemed inappropriate.
- Downloading copyright material without permission from the copyright owner is illegal, and strictly prohibited. Students detected undertaking such activities will face disciplinary action, which may result in criminal proceedings.

Non-compliance with these conditions may result in disciplinary action without further notice.

Students must use their Macquarie University email addresses to communicate with staff as it is University policy that the University issued email account is used for official University communication.