ACST3058
Survival Models
Session 1, Online-scheduled-In person assessment, North Ryde 2023
Department of Actuarial Studies and Business Analytics

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# General Information

<table>
<thead>
<tr>
<th>Credit points</th>
<th>10</th>
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<tbody>
<tr>
<td>Prerequisites</td>
<td>(ACST255 or ACST2055) and (STAT272 or STAT2372)</td>
</tr>
<tr>
<td>Corequisites</td>
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<tr>
<td>Co-badged status</td>
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### 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 be introduced to capture the features of stochastic transitions between different survival or loss states and to estimate the transition rates. Methods for valuing cashflows that are contingent upon multiple transition events and methods of projecting and valuing such expected cashflows will also be covered.

Students gaining a weighted average of credit across all of ACST3058, ACST3060 and the CS2-related components of the assessment in ACST3059 (minimum mark of 60% on all three components) will satisfy the requirements for exemption from the professional subject CS2 of the Actuaries Institute.

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# 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](https://www.mq.edu.au/study/calendar-of-dates)

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# Learning Outcomes

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

- **ULO1**: Apply and analyse different types of survival models and justify their connections with practical actuarial problems.
- **ULO2**: Apply statistical inference technique to estimate parameters and probability
distributions of survival models.

**ULO3:** Demonstrate an understanding of the concepts and properties of Markov processes.

**ULO4:** Solve Markov transition probabilities via matrix theory and differential equations.

**ULO5:** Perform valuation of cashflows that are contingent upon multiple transition / decrement events.

### General Assessment Information

#### Late Assessment Submission Penalty (written assessments)

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of ‘0’ will be awarded even if the assessment is submitted. Submission time for all written assessments is set at 11.55pm. A 1-hour grace period is provided to students who experience a technical concern.

For any late submissions of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for **Special Consideration.**

### Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Hurdle</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment</td>
<td>20%</td>
<td>No</td>
<td>Week 7</td>
</tr>
<tr>
<td>Class Test</td>
<td>20%</td>
<td>No</td>
<td>Week 8</td>
</tr>
<tr>
<td>Final Exam</td>
<td>60%</td>
<td>No</td>
<td>Examination Period</td>
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### Assignment

Assessment Type 1: Quantitative analysis task  
Indicative Time on Task 2: 20 hours  
Due: **Week 7**  
Weighting: **20%**

Problem-solving questions requiring detailed solutions using the statistical package R.

On successful completion you will be able to:

- Apply and analyse different types of survival models and justify their connections with practical actuarial problems.
• Apply statistical inference technique to estimate parameters and probability distributions of survival models.
• Solve Markov transition probabilities via matrix theory and differential equations.
• Perform valuation of cashflows that are contingent upon multiple transition / decrement events.

Class Test
Assessment Type ¹: Quiz/Test
Indicative Time on Task ²: 17 hours
Due: Week 8
Weighting: 20%

The test will be approximately 90 minutes, to be held during class time.

On successful completion you will be able to:
• Apply and analyse different types of survival models and justify their connections with practical actuarial problems.
• Apply statistical inference technique to estimate parameters and probability distributions of survival models.
• Demonstrate an understanding of the concepts and properties of Markov processes.

Final Exam
Assessment Type ¹: Examination
Indicative Time on Task ²: 28 hours
Due: Examination Period
Weighting: 60%

The final examination will be a three-hour written paper with ten minutes reading time, to be held during the University Examination period.

On successful completion you will be able to:
• Apply and analyse different types of survival models and justify their connections with practical actuarial problems.
• Apply statistical inference technique to estimate parameters and probability distributions of survival models.
Unit guide ACST3058 Survival Models

- Demonstrate an understanding of the concepts and properties of Markov processes.
- Solve Markov transition probabilities via matrix theory and differential equations.
- Perform valuation of cashflows that are contingent upon multiple transition / decrement events.

1 If you need help with your assignment, please contact:
   - the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
   - the Writing Centre for academic skills support.

2 Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources
Please refer to iLearn for details.

Unit Schedule
Week 1: Probability models (revision); Survival analysis
Week 2: Estimation of survival distributions
Week 3: Variance estimation and confidence intervals
Week 4: Cox proportional hazards models
Week 5: Cox proportional hazards models; Stochastic processes;
Week 6: Markov chains
Week 7 (last week before session break): Markov chains; Due of Individual Assignment
Week 8 (first week after session break): Markov jump processes; Mid-term test
Week 9: Markov jump processes
Week 10: Applications of Markov processes
Week 11: Applications of Markov processes
Week 12: Competitive risks and multiple decrement tables
Week 13: Revision

Note: This is only a tentative schedule. The actual schedule will be adjusted from time to time in accordance with the progress of lectures.

Policies and Procedures
Macquarie University policies and procedures are accessible from Policy Central (https://policie
Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

**Student Code of Conduct**

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

**Results**

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) 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 or if you are a Global MBA student contact globalmba.support@mq.edu.au

**Academic Integrity**

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

**Student Support**

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

**The Writing Centre**

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.
• Workshops
• Chat with a WriteWISE peer writing leader
• Access StudyWISE
• Upload an assignment to Studiosity
• Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

• Subject and Research Guides
• Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

• IT Support
• Accessibility and disability support with study
• Mental health support
• Safety support to respond to bullying, harassment, sexual harassment and sexual assault
• Social support including information about finances, tenancy and legal issues
• Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

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.

Changes since First Published

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>06/02/2023</td>
<td>Minor adjustments</td>
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