



# ACST3058

## Survival Models

Session 1, In person/Online-scheduled-weekday, North Ryde 2022

*Department of Actuarial Studies and Business Analytics*

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## General Information

Unit convenor and teaching staff

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Credit points

10

Prerequisites

(ACST255 or ACST2055) and (STAT272 or STAT2372)

Corequisites

Co-badged status

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.

## 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:

**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 submissions of assessments** Unless a Special Consideration request has been submitted and approved, no extensions will be granted. There will be a deduction of 10% of the total available assessment-task marks made from the total awarded mark for each 24-hour period or part thereof that the submission is late. Late submissions will only be accepted up to 96 hours after the due date and time.

No late submissions will be accepted for timed assessments – e.g., quizzes, online tests.

**Table 1: Penalty calculation based on submission time**

| Submission time after the due date (including weekends) | Penalty (% of available assessment task mark) | Example: for a non-timed assessment task marked out of 30 |
|---------------------------------------------------------|-----------------------------------------------|-----------------------------------------------------------|
| < 24 hours                                              | 10%                                           | 10% x 30 marks = 3-mark deduction                         |
| 24-48 hours                                             | 20%                                           | 20% x 30 marks = 6-mark deduction                         |
| 48-72 hours                                             | 30%                                           | 30% x 30 marks = 9-mark deduction                         |
| 72-96 hours                                             | 40%                                           | 40% x 30 marks = 12-mark deduction                        |
| > 96 hours                                              | 100%                                          | Assignment won't be accepted                              |

### Special Consideration

To request an extension on the due date/time for a timed or non-timed assessment task, you must submit a Special Consideration application. An application for Special Consideration does not guarantee approval.

The approved extension date for a student becomes the new due date for that student. The late submission penalties above then apply as of the new due date.

## Assessment Tasks

| Name                       | Weighting | Hurdle | Due                |
|----------------------------|-----------|--------|--------------------|
| <a href="#">Class Test</a> | 20%       | No     | 07 April 2022      |
| <a href="#">Assignment</a> | 20%       | No     | 1 June 2022        |
| <a href="#">Final Exam</a> | 60%       | No     | Examination Period |

### Class Test

Assessment Type <sup>1</sup>: Quiz/Test

Indicative Time on Task <sup>2</sup>: 17 hours

Due: **07 April 2022**

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.

### Assignment

Assessment Type <sup>1</sup>: Quantitative analysis task

Indicative Time on Task <sup>2</sup>: 20 hours

Due: **1 June 2022**

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.

## Final Exam

Assessment Type <sup>1</sup>: Examination

Indicative Time on Task <sup>2</sup>: 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.
- 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.

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<sup>1</sup> 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.

<sup>2</sup> 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

### Classes

- This unit is taught through 3 hours of lectures and 1 hour of tutorials per week.

- The timetable for classes can be found on the University web site at: <http://www.timetables.mq.edu.au/>
- Tutorials start from Week 2.

### **Unit Web Page**

- The web page for this unit can be found at: <http://ilearn.mq.edu.au>

### **Technology Used and required**

- You will need access to the internet to obtain course information and download teaching materials from the unit website.
- It is your responsibility to check the unit website regularly to make sure that you are up-to-date with the information for the unit.
- The statistical package R will be extensively employed in this unit. The application of R is essential to completing the Assignment.
- Application of R will be introduced in the weekly lecture/tutorial.
- Students are expected to understand and properly use R outputs in all assessment tasks.

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

- Lecture Notes are the required materials and will be posted on the website before the lectures.
- The main additional reading materials are the ActEd CS2 notes. This will also be used as background reading for ACST3059.

## **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:** Class test; Markov chains

**Semester break**

**Week 8:** Markov jump processes

**Week 9:** Markov jump processes

**Week 10:** Applications of Markov processes

**Week 11:** Applications of Markov processes

**Week 12:** Multi-state insurance models and multiple decrement tables

**Week 13:** Assignment and 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 \(https://policies.mq.edu.au\)](https://policies.mq.edu.au). 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 \(https://students.mq.edu.au/support/study/policies\)](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 \(https://policies.mq.edu.au\)](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](https://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto: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 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/](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.