



# ACST8088

## Quantitative Asset and Liability Modelling 2

Session 2, In person-scheduled-weekday, North Ryde 2022

*Department of Actuarial Studies and Business Analytics*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

Unit Convenor

Zhuo Jin

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Room 731, 4 Eastern Rd

Credit points

10

Prerequisites

(STAT810 or STAT8310 or STAT806) and (ACST881 or ACST8081)

Corequisites

Co-badged status

Unit description

The topics covered in this unit include: an introduction to stochastic processes; martingales; an introduction to stochastic calculus; Ito's lemma; forwards, futures, swaps and options; arbitrage-free pricing via replicating portfolio and risk neutral probability measures; the Girsanov theorem; the Black-Scholes option pricing model for European options; the 'Greeks' and dynamic hedging; term structure of interest rates; relations among short rates, forward rates and default-free zero-coupon bonds; interest rate models; firm-value and intensity-based credit risk models; ruin theory; valuation of basic guarantees. Students gaining a credit average in both ACST8087 and ACST8088 (minimum mark of 60 on both units) will satisfy the requirements for exemption from the professional subject CM2 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:** Understand the use of stochastic calculus in modelling security prices and valuation of option pricing approaches

**ULO2:** Demonstrate an understanding of the Black-Scholes option pricing model via both the partial differential equation approach and the risk-neutral pricing approach.

**ULO3:** Describe the use of interest models in term of structure modelling and pricing of

zero-coupon bonds.

**ULO4:** Describe the different approaches to modelling credit risk.

**ULO5:** Apply ruin theory to insurance problems.

**ULO6:** Explain various concepts in stochastic calculus in the risk-neutral valuation approach.

## 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

Name	Weighting	Hurdle	Due
<a href="#">Assignment</a>	20%	No	29/09/2022, 11:55pm
<a href="#">Class Test</a>	20%	No	20/10/2022, 10am
<a href="#">Final Exam</a>	60%	No	University examination period

## Assignment

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

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

Due: **29/09/2022, 11:55pm**

Weighting: **20%**

This is an individual assignment which focuses on problem solving using Excel spreadsheet.

On successful completion you will be able to:

- Understand the use of stochastic calculus in modelling security prices and valuation of option pricing approaches
- Demonstrate an understanding of the Black-Scholes option pricing model via both the

partial differential equation approach and the risk-neutral pricing approach.

- Describe the use of interest models in term of structure modelling and pricing of zero-coupon bonds.
- Explain various concepts in stochastic calculus in the risk-neutral valuation approach.

## Class Test

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

Indicative Time on Task <sup>2</sup>: 12 hours

Due: **20/10/2022, 10am**

Weighting: **20%**

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

On successful completion you will be able to:

- Understand the use of stochastic calculus in modelling security prices and valuation of option pricing approaches
- Demonstrate an understanding of the Black-Scholes option pricing model via both the partial differential equation approach and the risk-neutral pricing approach.
- Describe the use of interest models in term of structure modelling and pricing of zero-coupon bonds.
- Explain various concepts in stochastic calculus in the risk-neutral valuation approach.

## Final Exam

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

Indicative Time on Task <sup>2</sup>: 28 hours

Due: **University examination period**

Weighting: **60%**

The final examination will be closed book, 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:

- Understand the use of stochastic calculus in modelling security prices and valuation of option pricing approaches
- Demonstrate an understanding of the Black-Scholes option pricing model via both the

partial differential equation approach and the risk-neutral pricing approach.

- Describe the use of interest models in term of structure modelling and pricing of zero-coupon bonds.
- Describe the different approaches to modelling credit risk.
- Apply ruin theory to insurance problems.

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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

Please refer to iLearn for further details.

### Required and Recommended Texts and/or Materials

#### Required texts

Detailed lecture notes and tutorial exercises are available on the unit's iLearn site.

#### Recommended Textbooks

- *Options, Futures and Other Derivatives (9th edition)*; John Hull
- *An Introduction to the Mathematics of Financial Derivatives (2nd edition)*; Salih N. Neftci
- *Interest Rate Models: An Introduction*; Andrew J. G. Cairns
- *Insurance Risk and Ruin (2nd edition)*; David C. M. Dickson

A copy of these books is available in the Reserve section of the Library.

### Technology Used and Required

Students need to be able to use computer softwares (such as Excel, R) to analyse financial problems. Although the unit does not aim to teach students how to use these softwares, you are encouraged to make use of spreadsheets and other software packages for the assignment.

### Unit Webpage

The webpage for this unit can be accessed via the iLearn site at: [iLearn](#)

### Teaching and Learning Strategy

The unit is taught using two-hour lecture and one-hour tutorial each week. You are expected to

read lecture materials in advance of the lectures. The tutorial is an opportunity for you to attempt questions for each section of work, or to ask questions. It is highly recommended to try to solve questions in advance of the tutorials.

## 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.

## Changes since First Published

Date	Description
17/07/2022	The class test has been changed to the second seminar in week 11.