



# ACST888

## Quantitative Asset and Liability Modelling 2

S2 Day 2019

*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, Lecturer  
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Contact via [chongit.tan@mq.edu.au](mailto:chongit.tan@mq.edu.au)  
4ER 609  
Wednesdays 5pm-6pm

Credit points  
4

Prerequisites  
STAT810 or STAT806 and ACST881

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; binomial lattice models; arbitrage-free pricing via replicating portfolio and risk neutral probability measures; the Girsanov theorem; the Black-Scholes option pricing model for European options; the Girsanov theorem; the 'Greeks' and dynamic hedging; American and exotic option pricing; 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; methods for calculating outstanding claims provisions in general insurance; valuation of basic guarantees.

## 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:

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 the risk-

neutral pricing approach.

Describe the use of interest models in term structure modelling and pricing of zero-coupon bonds.

Describe the different approaches to modelling credit risk.

Apply ruin theory to insurance problems.

## General Assessment Information

Self-assessment exercise question(s) will be released in Week 3. The solutions will be provided before the census date in Week 4. Please use the self-assessment exercise as an indicator of whether you are progressing satisfactorily in the unit. If you are having difficulties, please see the Unit Convenor before the census date on Friday of week 4 and consider withdrawing from the unit.

Macquarie University uses the grades HD, D, Cr, P and F for grading the achievements of students in units of study. The meaning of each symbol is explained in Schedule 1 of the Assessment Policy, available at: <https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/assessment>

It is the responsibility of students to view their marks for each within session assessment on iLearn within 20 working days of posting. If there are any discrepancies, students must contact the unit convenor immediately. Failure to do so will mean that queries received after the release of final results regarding assessment marks (not including the final exam mark) will not be addressed.

Assessment criteria for all assessment tasks will be provided on the unit iLearn site.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#"><u>Class Test</u></a>	20%	No	16 October
<a href="#"><u>Assignment</u></a>	20%	No	30 October 2pm
<a href="#"><u>Final Examination</u></a>	60%	No	University Examination period

### Class Test

Due: **16 October**

Weighting: **20%**

The class test is of 110 minutes duration, with no additional reading time, to be held during the normal lecture time. It will cover topics in weeks 1 to 8.

Students are permitted to use non-programmable calculators with no text-retrieval capacity. Dictionaries are not permitted. A prescribed formula sheet will be provided. No other materials are permitted.

Students who have not sat the test will be awarded a mark of 0 for the task, except for cases in which an application for Special Consideration is made and approved.

Where a Special Consideration application is approved, the student may be offered an alternative assessment or may receive a mark based on the percentage mark achieved by the student in one or more other assessment tasks, at the Unit Convenor's discretion.

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 the risk-neutral pricing approach.
- Describe the use of interest models in term structure modelling and pricing of zero-coupon bonds.

## Assignment

Due: **30 October 2pm**

Weighting: **20%**

Assignment has to be submitted via the iLearn site.

No extensions will be granted. There will be a deduction of 10% of the total available marks made from the total awarded mark for each 24 hour period or part thereof that the submission is late (for example, 25 hours late in submission – 20% penalty). This penalty does not apply for cases in which an application for special consideration is made and approved. No submission will be accepted after solutions have been posted.

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

## Final Examination

Due: **University Examination period**

Weighting: **60%**

The final examination will be a three-hour written exam with ten minutes reading time, to be held

during the University Examination period.

Students are permitted to use non-programmable calculators with no text-retrieval capacity. Dictionaries are not permitted.

A prescribed formula sheet will be provided. No other materials are permitted.

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

## **Delivery and Resources**

### **Classes**

There are 4 hours of face-to-face teaching per week.

The timetable for classes can be found on the University website at:

<https://timetables.mq.edu.au/2019/>

### **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

Each copy of these books is available in the Reserve section of the Library and can be purchased from the Macquarie University Co-op bookshops.

#### Advanced Textbooks

- Risk-Neutral Valuation - Pricing and Hedging of Financial Derivatives (1st Edition); N. H. Bingham and R. Kiesel
- Quantitative Risk Management; Alexander J. McNeil, Rüdiger Frey and Paul Embrechts

- The Theory of Stochastic Processes; D. R. Cox and H. D. Miller
- Introduction to Probability Models (8th edition); Sheldon Ross

### **Technology Used and Required**

Students need to be able to use a computer softwares (such as Excel or 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: <http://ilearn.mq.edu.au>.

## **Unit Schedule**

Please refer to the week 1's lecture slides for the outline of topics.

## **Policies and Procedures**

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). 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](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

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

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

## **Student Code of Conduct**

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/study/getting-started/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](mailto:globalmba.support@mq.edu.au)

## Student Support

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

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](#)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## 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.

## Graduate Capabilities

### PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

## Learning outcomes

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

## Assessment tasks

- Class Test
- Assignment
- Final Examination

## PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

## Learning outcomes

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

## Assessment tasks

- Class Test
- Assignment
- Final Examination



## PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

### Learning outcomes

- 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 the risk-neutral pricing approach.
- Describe the use of interest models in term structure modelling and pricing of zero-coupon bonds.
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### Assessment tasks

- Class Test
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- Final Examination