ACST307

Quantitative Asset and Liability Modelling 2

S2 Day 2015

Dept of Applied Finance and Actuarial Studies

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
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E4A 613
Weekly Discussion Board

Tutor and Teaching Assistant
Andrew Xu
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Credit points
3

Prerequisites
ACST306

Corequisites

Co-badged status
This unit is co-badged with ACST817.

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 and exotic options; the 'Greeks' and dynamic hedging; term structure of interest rates; relations among short rates, forward rates and zero-coupon bonds; interest rate models; firm-value; and intensity-based credit risk models. Students gaining a grade of credit or higher in both ACST306 and ACST307 are eligible for exemption from subject CT8 of the professional exams of the Institute of Actuaries of Australia.

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:

Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.

Understanding of forward, futures, option and swap.

Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).

Hedging portfoilo via the Greeks.

Pricing default-free zero-coupon bond using short rate of interest models.

Defaultable zero-coupon bond pricing based on firm-value and default intensity.

General Assessment Information

GradeBook

Assignment and class test mark are available on GradeBook. 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 Tasks

Name	Weighting	Due
Assignment	20%	Monday 7 Sep. 3:00pm
Class Test	10%	Monday 19 Oct. 11:00am
Final Examination	70%	University Examination Period

Assignment

Due: **Monday 7 Sep. 3:00pm**
Weighting: **20%**

Assignment has to be submitted to ACST307/817 Assignment Box in BESS (E4B 106).

No extensions will be granted. Late tasks will be accepted up to 72 hours after the submission deadline. There will be a deduction of 20% 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 – 40% penalty). This penalty does not apply for cases in which an application for special consideration is made and approved.

On successful completion you will be able to:

- Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.

- Understanding of forward, futures, option and swap.
- Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).

Class Test

Due: **Monday 19 Oct. 11:00am**
Weighting: **10%**

You are permitted ONE A4 page of paper containing reference material printed on both sides. The material may be handwritten or typed. The page will not be returned at the end of the class test. Non programmable calculators with no text-retrieval capacity are allowed. Dictionaries are not permitted. No extensions will be granted. Students who have not submitted the task prior to the deadline will be awarded a mark of 0 for the task, except for cases in which an application for special consideration is made and approved.

On successful completion you will be able to:

- Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Understanding of forward, futures, option and swap.
- Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).
- Hedging portfoilo via the Greeks.
- Pricing default-free zero-coupon bond using short rate of interest models.

Final Examination

Due: **University Examination Period**
Weighting: **70%**

You are permitted ONE A4 page of paper containing reference material printed on both sides. The material may be handwritten or typed. The page will not be returned at the end of the final examination. Non-programmable calculators with no text-retrieval capacity are allowed. Dictionaries are not permitted.

On successful completion you will be able to:

- Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Understanding of forward, futures, option and swap.
- Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).
- Hedging portfoilo via the Greeks.

- Pricing default-free zero-coupon bond using short rate of interest models.
- Defaultable zero-coupon bond pricing based on firm-value and default intensity.

Delivery and Resources

Classes

This unit will consist of 2 hours of lectures and 1 hour tutorial per week. Lectures are held at the following times:

Day	Time	Location
Monday	11:00 am – 1:00 pm	E7B T4

ACST 307 Tutorials are held at the following times, commencing in week **2**:

Day	Time	Location	Tutor
Monday	1:00 pm – 2:00 pm	C5A 401	Andrew Xu
Monday	2:00 pm – 3:00 pm	C5A 401	Andrew Xu
Monday	3:00 pm – 4:00 pm	E6A 108	Andrew Xu

You must attend the tutorial class in which you are enrolled. The tutorial is an opportunity for you to attempt the section exercises given at the end of each section of work, and to discuss problems with the tutor.

There is **no** tutorial held during Week 1. Tutorials commence in Week 2.

Any alterations to the class times or locations will be advised in lectures and via the website - the link to the Timetables portal: http://timetables.mq.edu.au

Required and Recommended Texts and/or Materials

Required texts

Lecture materials are available for downloading from ACST307/817 teaching website.

Recommended Textbooks

•Options, Futures and Other Derivatives (7th 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

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

Optional ActEd material

• The ActEd CT8, that can be purchased directly from ActEd.

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 to analyse financial problems. You should be able to use a word processing package (such as WORD), a spreadsheet (such as EXCEL), a statistical package (such as MINITAB) and a programming language (such as Visual Basic or Matlab). Although the unit does not aim to teach students how to use computers, as this is covered in prerequisite units, you are encouraged to make use of spreadsheets and other software packages for the assignment.

Unit Web Page

To access the website, go to http://ilearn.mq.edu.au and login using your usual login and password.

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. In addition to the tutorial, you should use the Discussion Board to ask questions or discuss concepts covered in the unit.

Changes since the Last Offering of this Unit

Nil.

Unit Schedule

Week	Lecture Topics
1	Introduction of Stochastic Processes
2	Introduction of Stochastic Processes
3	Martingale, Introduction of Stochastic Calculus, Ito's lemma
4	Black-Scholes Option Pricing Model via Replication
5	Black-Scholes Option Pricing Model via Risk Neutral Probability Distribution, Combination of options
6	Greeks and Dynamic Hedging, Exotic Option Pricing
7	Interest Rate Models I (Short Rate Models) **(Assignment due: Monday 7 September 3:00pm)**
	Semester Break
8	Interest Rate Models I (Short Rate Models), Interest Rate Models II (Forward Rate Models)
9	Interest Rate Models II (Forward Rate Models) (Or **Guest Lecture** on Options, Market Making and Arbitrage by Mr. Jordan Brell in Optiver if it can be arranged)
10	Credit Risk Models I (Firm-Value Model)
11	**Class Test (Monday 19 October 11:00am)**
12	Credit Risk Models II (Intensity-based Model)
13	Revision

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/student_conduct/

Results

Results shown in *iLearn*, 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.

Supplementary Exams

Further information regarding supplementary exams, including dates, is available here: http://www.businessandeconomics.mq.edu.au/current_students/undergraduate/how_do_i/disruption to studies.

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) 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

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/hel

p/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Understanding of forward, futures, option and swap.
- Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).
- Hedging portfoilo via the Greeks.
- Pricing default-free zero-coupon bond using short rate of interest models.
- Defaultable zero-coupon bond pricing based on firm-value and default intensity.

Assessment tasks

- Assignment
- Class Test
- Final Examination

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.

- Understanding of forward, futures, option and swap.
- Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).
- Hedging portfoilo via the Greeks.
- Pricing default-free zero-coupon bond using short rate of interest models.
- Defaultable zero-coupon bond pricing based on firm-value and default intensity.

Assessment tasks

- Assignment
- Class Test
- Final Examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito’s lemma.
- Understanding of forward, futures, option and swap.
- Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).
- Hedging portfoilo via the Greeks.
- Pricing default-free zero-coupon bond using short rate of interest models.
- Defaultable zero-coupon bond pricing based on firm-value and default intensity.

Assessment tasks

- Assignment
- Class Test
- Final Examination

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in

order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Understanding of forward, futures, option and swap.
- Pricing European, American and Exotic options via the Black-Scholes option pricing model (continuous time model).
- Hedging portfoilo via the Greeks.
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- Defaultable zero-coupon bond pricing based on firm-value and default intensity.

Assessment tasks

- Assignment
- Class Test
- Final Examination

Research and Practice

· This unit uses research from external sources:

- Black, Fischer and Scholes, Myron. (1973): "The Pricing of Options and Corporate Liabilities". Journal of Political Economy, 81 (3): 637–654.

- Harrison, J. M., Kreps, D. M. (1979): "Martingales and arbitrage in multiperiod markets". J. Econ. Theory, 20, 381–408.

- Cox, J.C., J.E. Ingersoll and S.A. Ross (1985). "A Theory of the Term Structure of Interest Rates", Econometrica, 53: 385–407.

- Heath, D., Jarrow, R. and Morton, A. (1992). Bond Pricing and the Term Structure of Interest Rates: A New Methodology for Contingent Claims Valuation, Econometrica, 60(1), 77-105.

- Merton, Robert C. (1974): "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", Journal of Finance, Vol. 29, No. 2, 449-470.

- Jarrow, R. A., Lando, D. and Turnbull, S. M. (1997), A Markov Model for the Term Structure of Credit Risk Spreads, Review of Financial Studies, 10(2), 481–523.

· This unit gives you opportunities to conduct your own research.

· Professional practice in the area of options, market making and arbitrage will be covered by the guest lecturer, Mr. Jordan Brell in Optiver.