ACST817

Quantitative Asset and Liability Modelling 2

S2 Day 2014

Applied Finance and Actuarial Studies

Contents

General Information

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

Credit points
4

Prerequisites
ACST601 and ACST603 and ACST604

Corequisites
ACST851 and STAT810

Co-badged status
This unit is co-badged with ACST307.

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 and exotic 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. Students gaining a grade of credit or higher in both ACST816 and ACST817 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 portfolio 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.

Pricing default-free zero-coupon bond using forward rate of interest model.

Assessment Tasks

Name	Weighting	Due
Class Test 1	5%	Friday 5 September 1:00pm
Assignment	15%	Thursday 18 September 3:00pm
Class Test 2	10%	Thursday 30 October 10:00am
Final Examination	70%	University Examination period

Class Test 1

Due: **Friday 5 September 1:00pm**
Weighting: **5%**

No materials will be allowed to take into the class test 1. 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).

Assignment

Due: **Thursday 18 September 3:00pm**
Weighting: **15%**

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

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).

Class Test 2

Due: **Thursday 30 October 10:00am**
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 2. 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 portfolio 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 portfolio 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.
- Pricing default-free zero-coupon bond using forward rate of interest model.

Delivery and Resources

Classes

This unit consist of 2 hours of lectures and 2 hours tutorial per week, Lectures are held at the following times: Wednesday 8:00-10:00am W5A T2.

ACST817 Tutorials are held at the following times, commencing in Week 2:

Wednesday 1:00-3:00pm C5A 229 (Jiwook Jang)

You must attend the tutorial class. 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. Tutorial commences in Week 2.

Any alterations to the class times or locations will be advised in lectures and via the website.

Required and Recommended Texts and/or Materials Prescribed

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

Two quizzes will be replaced by class test 1.

Previously, a Formulae Sheet was provided for class test 2 and final exam. This year students will be allowed to take one A4 page into class test 2 and final exam (handwritten or typed and filled in one or two sides).

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 **(Class Test 1 - Friday 5 September 1:00pm)**

6. Greeks and Dynamic Hedging, Exotic Option Pricing

7. Interest Rate Models I (Short Rate Models) **(Assignment due: Thursday 18 September 3:00pm)**

Semester Break

8. Interest Rate Models II (Forward Rate Models)

9. **Guest Lecture** on Options, Market Making and Arbitrage by Mr. Jordan Brell in Optiver

10. Credit Risk Models I (Firm-Value Model)

11. **Class Test 2 (Thursday 30 October 10:00am)**

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/

Academic Honesty

The nature of scholarly endeavour, dependent as it is on the work of others, binds all members of the University community to abide by the principles of academic honesty. Its fundamental principle is that all staff and students act with integrity in the creation, development, application and use of ideas and information. This means that:

- all academic work claimed as original is the work of the author making the claim

- all academic collaborations are acknowledged

- academic work is not falsified in any way

- when the ideas of others are used, these ideas are acknowledged appropriately.

Further information on the academic honesty can be found in the Macquarie University Academic Honesty Policy at http://www.mq.edu.au/policy/docs/academic_honesty/policy.html

Grades

Macquarie University uses the following grades in coursework units of study:

- HD - High Distinction

- D - Distinction

- CR - Credit

- P - Pass

- F - Fail

Grade descriptors and other information concerning grading are contained in the Macquarie University Grading Policy which is available at:

http://www.mq.edu.au/policy/docs/grading/policy.html

A Standardised Numerical Grade (SNG) gives you an indication of how you have performed within the band for your descriptive grade. The SNG is not a mark, and you may not be able to work it out based on your raw examination and other assessment marks. Nor are you able to determine you are "one mark away" from a different grade.

GradeBook

Assignment mark 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."

Grading Appeals and Final Examination Script Viewing

If, at the conclusion of the unit, you have performed below expectations, and are considering lodging an appeal of grade and/or viewing your final exam script please refer to the following website which provides information about these processes and the cut off dates in the first instance. Please read the instructions provided concerning what constitutes a valid grounds for appeal before appealing your grade.

http://www.businessandeconomics.mq.edu.au/new_and_current_students/undergraduate_current_students/how_do_i/grade_appeals/

Supplementary Exams

Further information regarding supplementary exams, including dates, is available here

http://www.businessandeconomics.mq.edu.au/current_students/undergraduate/how_do_i/special_consideration

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

BESS. Business and Economics Student Services (BESS) is located in room E4B 106. In this unit, assignment and class test will be returned via BESS.

Consultation room. Consultation sessions with tutors will be held in the FBE Consultation room E4B 104. The consultation times will be confirmed on the website and in the lectures.

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/help/.

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

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

- 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 portfolio 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.
- Pricing default-free zero-coupon bond using forward rate of interest model.

Assessment tasks

- Class Test 1
- Assignment
- Class Test 2
- 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

- 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 portfolio via the Greeks.
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- Defaultable zero-coupon bond pricing based on firm-value and default intensity.
- Pricing default-free zero-coupon bond using forward rate of interest model.

Assessment tasks

- Class Test 1
- Assignment
- Class Test 2
- 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

- 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 portfolio 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.
- Pricing default-free zero-coupon bond using forward rate of interest model.

Assessment tasks

- Class Test 1

- Assignment
- Class Test 2
- 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.