ACST817

Quantitative Asset and Liability Modelling 2

S2 Day 2019

Department of Actuarial Studies and Business Analytics

Contents

General Information

Unit convenor and teaching staff
Unit Convenor, Lecturer, Tutor
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4ER 609
Wednesdays 11am-12pm

Credit points
4

Prerequisites
ACST603 or (admission to MActPrac post 2014)

Corequisites
ACST851 and (STAT806 or STAT810)

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 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:

Demonstrate an understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.

Describe the characteristics and the use of forward, futures, option and swap.

Perform the valuation of European and exotic options via the Black-Scholes option pricing model in continuous time as well as option Greeks.

Describe the valuation of default-free zero-coupon bond using short rate interest models.

Describe the valuation of defaultable zero-coupon bond based on firm-value and default intensity models.

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
Class Test 1	5%	No	27 August
Assignment	15%	No	1 October 2pm
Class Test 2	20%	No	23 October
Final Examination	60%	No	University Examination period

Class Test 1

Due: **27 August**
Weighting: **5%**

The class test 1 is of 50 minutes duration, with no additional reading time, to be held during the tutorial time. It will cover topics in weeks 1 to 3.

No materials will be allowed to take into the class test 1. Students are permitted to use non-programmable calculators with no text-retrieval capacity. Dictionaries are not 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:

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

Assignment

Due: **1 October 2pm**
Weighting: **15%**

Assignment has to be submitted via both iLearn and ACST307/817 Assignment Box in BESS.

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 considereation is made and approved. No submission will be accepted after solutions have been posted.

On successful completion you will be able to:

- Demonstrate an understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Describe the characteristics and the use of forward, futures, option and swap.
- Perform the valuation of European and exotic options via the Black-Scholes option pricing model in continuous time as well as option Greeks.

Class Test 2

Due: **23 October**
Weighting: **20%**

The class test 2 is of 100 minutes duration, with no additional reading time, to be held during the normal lecture time. It will cover topics in weeks 1 to 9.

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 to the students at the end of the class test. Students are permitted to use non-programmable calculators with no text-retrieval capacity. Dictionaries are not 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:

- Demonstrate an understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Describe the characteristics and the use of forward, futures, option and swap.
- Perform the valuation of European and exotic options via the Black-Scholes option pricing model in continuous time as well as option Greeks.
- Describe the valuation of default-free zero-coupon bond using short rate interest models.

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.

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 to the students at the end of the class test. Students are permitted to use non-programmable calculators with no text-retrieval capacity. Dictionaries are not permitted.

On successful completion you will be able to:

- Demonstrate an understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Describe the characteristics and the use of forward, futures, option and swap.
- Perform the valuation of European and exotic options via the Black-Scholes option pricing model in continuous time as well as option Greeks.
- Describe the valuation of default-free zero-coupon bond using short rate interest models.
- Describe the valuation of defaultable zero-coupon bond based on firm-value and default intensity models.

Delivery and Resources

Classes

There are 4 hours of face-to-face teaching per week consisting of 2 hours of lectures and 2 hours of tutorials (tutorials commence in week 2).

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

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, R, Visual Basic or Matlab) 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

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 make use of the weekly Discussion Board to ask questions or to discuss concepts covered in the unit.

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). 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). 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).

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

Supplementary exams

Information regarding supplementary exams, including dates, is available at:

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://stu

dents.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

If you are a Global MBA student contact 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/.

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

- Demonstrate an understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito’s lemma.
- Describe the characteristics and the use of forward, futures, option and swap.
- Perform the valuation of European and exotic options via the Black-Scholes option pricing model in continuous time as well as option Greeks.
- Describe the valuation of default-free zero-coupon bond using short rate interest models.

- Describe the valuation of defaultable zero-coupon bond based on firm-value and default intensity models.

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

- Demonstrate an understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Describe the characteristics and the use of forward, futures, option and swap.
- Perform the valuation of European and exotic options via the Black-Scholes option pricing model in continuous time as well as option Greeks.
- Describe the valuation of default-free zero-coupon bond using short rate interest models.
- Describe the valuation of defaultable zero-coupon bond based on firm-value and default intensity models.

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

- Demonstrate an understanding of random walk, Brownian motions, martingale, stochastic calculus and Ito's lemma.
- Describe the characteristics and the use of forward, futures, option and swap.
- Perform the valuation of European and exotic options via the Black-Scholes option pricing model in continuous time as well as option Greeks.
- Describe the valuation of default-free zero-coupon bond using short rate interest models.
- Describe the valuation of defaultable zero-coupon bond based on firm-value and default intensity models.

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.