



# ECFS881

## Derivatives Valuation

AFC Term 2 CBD 2015

*Dept of Applied Finance and Actuarial Studies*

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#### Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

Unit convenor and teaching staff

Unit Convenor / Lecturer

Rob Trevor

[rob.trevor@mq.edu.au](mailto:rob.trevor@mq.edu.au)

Contact via Email

Credit points

2

Prerequisites

(Admission to MAppFin or PGCertAppFin or GradDipAppFin) and (AFCP801 or ECFS865) and ECFS867

Corequisites

Co-badged status

Unit description

This unit deals with important quantitative issues for derivatives market practitioners. The aim is to extend the student's understanding of derivatives valuation. This unit looks at key numerical techniques and applies them to value exotic, GARCH and interest rate options in cases where classical Black-Scholes assumptions are inappropriate. Teaching uses both lectures and hands-on sessions with computer software. This unit complements ECFS882, which gives comprehensive treatment of exotic options in a Black-Scholes setting.

## 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 how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.

Understand key analytical and numerical techniques for derivatives valuation including their appropriate applications and limitations.

Implement and apply appropriate techniques to value exotic, GARCH, bond and interest rate options in cases where classical Black-Scholes assumptions are inappropriate.

Critically evaluate the biases in Black-Scholes and know when its use is inappropriate.

Apply appropriate options and hedging valuation techniques to various situations.

Develop skills in communicating complex technical concepts.

## General Assessment Information

To pass this unit (requires a Standardised Numerical Grade of 50 or better) the student must pass the final examination.

## Assessment Tasks

Name	Weighting	Due
<u>Pre-Unit Assignment</u>	10%	First Lecture
<u>Assignment</u>	35%	Refer to iLearn
<u>Final Exam</u>	55%	Refer to Timetable

### Pre-Unit Assignment

Due: **First Lecture**

Weighting: **10%**

#### Summary of Assessment Task

**Individual / Group:** Individual

**Due Date:** First lecture

**Grading Method:** Refer to 'Standards Required to Complete the Unit Satisfactorily' section

**Submission Method:** In first lecture

**Duration:** Maximum 12 standard pages

#### Extension Requests:

- No extensions are permitted.
- Late submission will result in zero marks, unless special consideration is approved by the Director of Studies under the University's Disruption to Studies Policy.

**Other Information:** The assignment is distributed with the lecture notes.

On successful completion you will be able to:

- Understand how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.

## Assignment

Due: **Refer to iLearn**

Weighting: **35%**

### Summary of Assessment Task

**Individual / Group:** Individual

**Due Date:** Refer to the Unit's iLearn site

**Grading Method:** Refer to 'Standards Required to Complete the Unit Satisfactorily' section

**Submission Method:** Online via Turnitin on the Unit's iLearn site

**Duration:** Maximum 16 standard pages plus code

### Extension Requests:

- If you have extenuating circumstances that prevent you from submitting your assignment by the due date, please make arrangements with your Lecturer prior to the due date.
- Unless prior arrangements have been made, any late submission of assignments will automatically be penalised. In the absence of special circumstances, the penalty will be 10% of the available marks for the assessment for each business day (or part thereof) they are late.

**Other Information:** The assignment is distributed during the weekend classes.

On successful completion you will be able to:

- Understand how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.
- Understand key analytical and numerical techniques for derivatives valuation including their appropriate applications and limitations.
- Implement and apply appropriate techniques to value exotic, GARCH, bond and interest rate options in cases where classical Black-Scholes assumptions are inappropriate.
- Apply appropriate options and hedging valuation techniques to various situations.
- Develop skills in communicating complex technical concepts.

## Final Exam

Due: **Refer to Timetable**

Weighting: **55%**

### Summary of Assessment Task

**Individual / Group:** Individual

**Due Date:** Refer to Timetable. Assessments: Different Class Groups have different deadlines.

Students should find the timetable and dates relevant to their group at [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au)

**Grading Method:** Refer to 'Standards Required to Complete the Unit Satisfactorily' section

**Submission Method:** As per MAFC Program Rules & Procedures at [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au)

**Duration:** 2 hours plus 10 minutes reading time

**Examination Conditions:**

- The exam will be a closed book exam. More details will be given in class.
- Exam times and locations are noted in the unit timetable at [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au).
- Refer to MAFC Program Rules & Procedures at [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au).

**Extension Requests:**

- You are expected to present yourself for examination at the time and place designated in the relevant MAFC Timetable at [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au).
- Deferral of an examination is not permitted, unless special consideration has been approved by the Director of Studies under the University's Disruption to Studies Policy.
- Refer to MAFC Program Rules & Procedures at [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au) for information on the University's Disruption to Studies Policy or non-attendance at an examination.

On successful completion you will be able to:

- Understand how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.
- Understand key analytical and numerical techniques for derivatives valuation including their appropriate applications and limitations.
- Implement and apply appropriate techniques to value exotic, GARCH, bond and interest rate options in cases where classical Black-Scholes assumptions are inappropriate.
- Critically evaluate the biases in Black-Scholes and know when its use is inappropriate.
- Apply appropriate options and hedging valuation techniques to various situations.
- Develop skills in communicating complex technical concepts.

## **Delivery and Resources**

### **CLASSES**

**Face-to-Face Teaching:** Generally 20 hours

**Timetable:** Detailed timetable for classes are on the Centre's web site [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au)

**Consultation Times:**

Students who wish to contact any of the teaching staff may do so through:

- The Unit's iLearn site, in relation to general queries (so that all students may benefit); or
- Individual consultation with the lecturer by email in the first instance, if necessary.

## **REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS**

**Text:** Nil

### **Additional Readings:**

- Additional readings are included in the unit notes
- **Students should assume these readings are examinable unless otherwise advised.**

**Lecture Notes:** Available in printed form and electronically via iLearn.

**Pre-Unit Materials:** Information papers on statistics, regression, accounting and other material may be found at <http://www.mafc.mq.edu.au/applications/minimum-knowledge-requirement/pre-course-materials1/>. Students should work through this material prior to commencing the degree. The material will remain a useful reference as students progress through the program.

### **Useful Article References:**

- John C. Hull Options, *Futures, and Other Derivative Securities*, Prentice-Hall 8<sup>th</sup> Edition, 2012.
- Other books which may be of some value for parts of the Unit include:
  - Robert Jarrow and Stuart Turnbull, *Derivatives Securities*, South-Western Publishing 2<sup>nd</sup> Edition, 2000. (This is now out of print.)
  - McDonald, Robert L. *Derivatives Markets (3rd edition)*. Pearson Education/Addison Wesley/Prentice Hall (they're all the same), Boston 2013.
  - Kerry Back, *A Course in Derivative Securities: Introduction to Theory and Computation*, Springer Finance, 2005. (Note: This is a bit more mathematical than Hull, but still accessible for some Students and much more accessible than many such books.)

### **Calculators:**

- In examinations, any of the following calculators are permitted but not required:
  - Hewlett Packard hp17bII+
  - Hewlett Packard hp12c platinum or hp12c
  - Texas Instruments BAI PLUS (also the PROFESSIONAL version).
- No other calculators, mobile phones or computers are permitted in examinations.

### **Assumed Knowledge:**

- To complete the assignment, students will have to modify some Excel macros, written in

Microsoft's VBA language.

- Students are not required to have VBA experience, but will need to be comfortable with learning how to modify the supplied macros. You will be shown how to do such modifications during the hands-on sessions.
- Support will also be provided via iLearn.

#### Assumed Access:

- Access to a computer with word processing and MS Excel (with VBA) spreadsheet capability is assumed, as is general student computer literacy.
- Almost any version of MS Office (back to Office 95) on either Mac or Windows, will do. If you have a Mac, you will need Office 2004 or earlier, or Office 2011 (with Service Pack 1) or later. (**Office 2008 won't suffice since it doesn't have VBA.**)
- About one third of the class will need to bring a laptop computer to the weekend classes for the hands-on sessions. If you have one, or can arrange to borrow one from a friend or your employer for the weekend, please bring it provided it has an appropriate version of MS Excel installed.

## TECHNOLOGY USED AND REQUIRED

#### Unit iLearn Site:

- Found by logging on to iLearn [ilearn.mq.edu.au](http://ilearn.mq.edu.au), then clicking on **Derivatives Valuation**.
- This is where you will find forums, downloadable resources and links to important pages.
- The forum allows you to communicate with other students and lecturer(s) and may provide supplementary material.
- You are requested to post your questions on the forums at least 24 hours prior to the assignment submission date or the examination date. Questions posted after that time may not be answered. **Please try to not leave your questions to the last few days.**

#### Important Notice:

- It is important that you familiarize yourself with the Unit's iLearn site.
- Students should check the Unit's iLearn site regularly (minimum twice a week and prior to all lectures) and look for updates and distribution of materials (including case studies) related to the unit or assessments and, if relevant, participate in forum discussions.

## Unit Schedule

### NUMERICAL TECHNIQUES IN OPTION PRICING

#### Topics:

- the process behind the Black Scholes formula
- the Black-Scholes differential equation and the “risk-neutralised” process
- using simulation and binomial trees to approximate this process
- implementing Monte Carlo valuation with variance reduction
- Quasi–Monte Carlo
- more general trees and lattices, improving convergence
- finite difference schemes
- analytical approximations

### PRICING AND HEDGING EXOTIC OPTIONS

#### Topics:

- digital, gap, paylater, compound, chooser, exchange and rainbow options
- barriers, lookback and average (Asian) options
- special cases where pricing formula or approximations exist
- applying the numerical techniques

### GARCH OPTIONS—EXPLAINING THE BIASES IN BLACK SCHOLES

#### Topics:

- the GARCH model for spot prices
- pricing options under a GARCH process
- Monte Carlo approaches
- the Ritchken & Trevor lattice
- how well does it account for the strike price and maturity biases?

### INTEREST RATE OPTIONS

#### Topics:

- the Black model for bond and interest rate options
- caps, floors, collars, swaptions
- problems in using the Black model
- simple term structure models—Vasicek and single factor models
- Black-Derman–Toy, Hull and White and time varying parameter models
- the Heath, Jarrow, Morton paradigm, volatility structures and generalised Vasicek



## Learning and Teaching Activities

### Strategy

The Master of Applied Finance degree adopts a deep teaching and learning strategy, in which Students acquire and retain knowledge and also are able to make sense of the issues and concepts and apply them in the “real world”. The degree relies heavily on student engagement and participation by: (a) Continuous learning throughout the semester. This is encouraged through a combination of students undertaking prescribed reading throughout the units and / or completion of practice problems, case studies, assignments, class presentations etc and interaction via forums in the unit’s iLearn site; and (b) Assessments, which enable the student to demonstrate his / her understanding of the learning objectives achieved through the continuous learning.

### Student Participation

Students participate in this unit by: (a) Attending lectures and participating in class discussion; (b) Before each class, completing the recommended readings of notes and text, and working systematically through suggested problem sets; (c) Interacting on the unit’s iLearn site; and (d) Completing all assessment tasks and exams. On average the unit will require students to complete, for every hour of class time, approximately 3 hours private study.

## 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](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](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](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/](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](#).

Students should also consult the MAFC Program Rules & Procedures found at <http://www.mafc.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 enquiry service (MAFC-specific)

For all student enquires, please contact [studentsupport@mafc.mq.edu.au](mailto:studentsupport@mafc.mq.edu.au)

## 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.

## Learning Skills

Learning Skills ([http://www.students.mq.edu.au/support/learning\\_skills/](http://www.students.mq.edu.au/support/learning_skills/)) 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 Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://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

### PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

#### Learning outcomes

- Understand how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.
- Understand key analytical and numerical techniques for derivatives valuation including their appropriate applications and limitations.
- Implement and apply appropriate techniques to value exotic, GARCH, bond and interest rate options in cases where classical Black-Scholes assumptions are inappropriate.
- Critically evaluate the biases in Black-Scholes and know when its use is inappropriate.
- Apply appropriate options and hedging valuation techniques to various situations.
- Develop skills in communicating complex technical concepts.

#### Assessment tasks

- Pre-Unit Assignment
- Assignment
- Final Exam

### 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 how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.

- Understand key analytical and numerical techniques for derivatives valuation including their appropriate applications and limitations.
- Implement and apply appropriate techniques to value exotic, GARCH, bond and interest rate options in cases where classical Black-Scholes assumptions are inappropriate.
- Critically evaluate the biases in Black-Scholes and know when its use is inappropriate.
- Apply appropriate options and hedging valuation techniques to various situations.
- Develop skills in communicating complex technical concepts.

## **Assessment tasks**

- Pre-Unit Assignment
- Assignment
- Final Exam

## **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 how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.
- Understand key analytical and numerical techniques for derivatives valuation including their appropriate applications and limitations.
- Implement and apply appropriate techniques to value exotic, GARCH, bond and interest rate options in cases where classical Black-Scholes assumptions are inappropriate.
- Critically evaluate the biases in Black-Scholes and know when its use is inappropriate.
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- Develop skills in communicating complex technical concepts.

## **Assessment tasks**

- Pre-Unit Assignment
- Assignment
- Final Exam

## **PG - Engaged and Responsible, Active and Ethical Citizens**

Our postgraduates will be ethically aware and capable of confident transformative action in

relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

## Learning outcomes

- Understand how to appropriately adjust and apply discounted expected cash flow valuation to a derivative context.
- Understand key analytical and numerical techniques for derivatives valuation including their appropriate applications and limitations.
- Implement and apply appropriate techniques to value exotic, GARCH, bond and interest rate options in cases where classical Black-Scholes assumptions are inappropriate.
- Critically evaluate the biases in Black-Scholes and know when its use is inappropriate.
- Apply appropriate options and hedging valuation techniques to various situations.
- Develop skills in communicating complex technical concepts.

## Assessment tasks

- Pre-Unit Assignment
- Assignment
- Final Exam

## Important Notice

This Unit Guide may be subject to change. The latest version is on the Centre's web site [www.mafc.mq.edu.au](http://www.mafc.mq.edu.au).

Students should read the Unit Guide carefully at the start of semester. It contains important information about the Unit. If anything is unclear, please consult one of the unit lecturers.

## Standards Required to Complete the Unit Satisfactorily

### University Policy on Grading:

- Macquarie University's Academic Senate has established a Grading Policy available at <http://www.mq.edu.au/policy/docs/grading/policy.html>. Your final result will include:
  - A grade ranging from Fail to High Distinction; and
  - A Standardised Numerical Grade (SNG). A SNG is not a summation of the individual assessment components, but is allocated on the basis of the performance in all assessment items, providing the examination component is passed.

- It is important to note:
  - The Policy does not require that a minimum or maximum number of students are to be failed in any unit;
  - Grades will not be allocated to fit a predetermined distribution; and
  - The process of allocating SNGs does not change the rank order of marks among students who pass the unit.

### Specific Unit Grading:

- To pass this unit (requires a Standardised Numerical Grade of 50 or better) the student must pass the final examination.
- All final grades in the Applied Finance Centre are determined by a grading committee and are not the sole responsibility of the unit convenor.
- The core criteria used to assess student work in this unit are:
  - Knowledge and understanding: Understanding key ideas, knowledge and use of concepts.
  - Application: Ability to apply theoretical ideas and frameworks in practice and in a critically reflective way.
  - Reasoning and analysis: Ability to analyse, use critical reasoning and principles to formulate a position, balancing theory and personal reflection.
  - Professional literacy and research: Understanding of professional factors (language and landscape) and ability to undertake appropriate research.
  - Communication and presentation: Ability to communicate and present effectively (written and oral, as relevant).
  - Use of mathematical and statistical ideas: Ability to use mathematical and statistical ideas, methods and formulae appropriately.
- Performance in relation to each of these criteria are assessed against the University's grading descriptors:

Grade	Expectation
High Distinction	Provides consistent evidence of deep and critical understanding in relation to the learning outcomes. There is substantial originality and insight in identifying, generating and communicating competing arguments, perspectives or problem solving approaches; critical evaluation of problems, their solutions and their implications; creativity in application as appropriate to the discipline.
Distinction	Provides evidence of integration and evaluation of critical ideas, principles and theories, distinctive insight and ability in applying relevant skills and concepts in relation to learning outcomes. There is demonstration of frequent originality in defining and analysing issues or problems and providing solutions; and the use of means of communication appropriate to the discipline and the audience.

Grade	Expectation
Credit	Provides evidence of learning that goes beyond replication of content knowledge or skills relevant to the learning outcomes. There is demonstration of substantial understanding of fundamental concepts in the field of study and the ability to apply these concepts in a variety of contexts; convincing argumentation with appropriate coherent justification; communication of ideas fluently and clearly in terms of the conventions of the discipline.
Pass	Provides sufficient evidence of the achievement of learning outcomes. There is demonstration of understanding and application of fundamental concepts of the field of study; routine argumentation with acceptable justification; communication of information and ideas adequately in terms of the conventions of the discipline. The learning attainment is considered satisfactory or adequate or competent or capable in relation to the specified outcomes.
Fail	Does not provide evidence of attainment of learning outcomes. There is missing or partial or superficial or faulty understanding and application of the fundamental concepts in the field of study; missing, undeveloped, inappropriate or confusing argumentation; incomplete, confusing or lacking communication of ideas in ways that give little attention to the conventions of the discipline.

### Review of Grade and final examination Script viewing:

- A student who has been awarded a final grade for a unit and who does not believe it is an accurate reflection of their performance, and has grounds for such a claim and can demonstrate those grounds, may apply to have their grade reviewed.
- For information on requesting a review of grade and/or viewing your final exam script, please refer to the University's Grade Appeal Policy at <http://www.mq.edu.au/policy/docs/gradeappeal/policy.html> and MAFC Program Rules & Procedures at <http://www.mafc.mq.edu.au>.