ACE Network Subject Information Guide

Math4511 Arbitrage pricing in continuous time

Semester 1, 2022

Administration and contact details

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Host institution	The University of Sydney
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Subject details

Handbook entry URL	https://www.sydney.edu.au/units/MATH4511
Subject homepage URL	https://canvas.sydney.edu.au/courses/40208
Honours student hand-out URL	https://canvas.sydney.edu.au/courses/40208
Start date:	February 21, 2022
End date:	May 25, 2022
Contact hours per week:	4
ACE enrolment closure date:	March 31, 2022
Lecture day(s) and time(s):	**Monday and Wednesday, 11am-1pm.**
Description of electronic access arrangements for students (for example, WebCT)	Online lectures will be given via zoom. Course materials, including lecture notes, will be posted on Canvas.

Subject content

1. **Subject content description**

We explore in this course theoretical pricing methods, which are widely used by the financial industry to value derivative securities and mitigate (hedge) financial risks inherent in derivatives. Content of this course includes: Black-Scholes model, market completeness, fundamental theorems of asset pricing, martingale approach to arbitrage pricing, foreign market derivatives, path-dependent options, American options, etc.

2. Week-by-week topic overview

W1: Ito's formula, stochastic integral and stochastic differential equations.
W2: stochastic differential equations, arbitrage pricing and Black-Scholes model.
W3: Black-Scholes model, market completeness, fundamental theorems of asset pricing.
W4: fundamental theorems of asset pricing, martingale representation, Girsanov Theorem
W5: Girsanov theorem, multidimensional models, change of numeraire
W6: dividends, forward and futures contracts
W7: futures contracts, mid-semester review
W8: Currency derivatives, barrier options
W9: barrier options, optimal stopping theory
W10: optimal stopping theory
W11: optimal stopping theory, American options
W12: American options
W13: final review

3. Assumed prerequisite knowledge and capabilities

Familiarity of basic probability theory, stochastic processes, and differential equations.

4. Learning outcomes and objectives

1. Demonstrate a coherent and advanced knowledge of the concept of arbitrage and martingale measure and how they provide a unified approach to a wide variety of problems in finance
2. Formulate real-world financial problems in mathematical terms and determine the most suitable framework to analyse the resulting mathematical problem
3. Generate analytic and computational solutions to diverse problems of finance
4. Communicate mathematical analyses and solutions to mathematical and practical problems of financial mathematics clearly in a variety of media to diverse audiences
5. Take responsibility for their own learning by seeking out and using material from the research literature and elsewhere to extend their knowledge of methods of financial mathematics

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject
Insert Program Learning Outcome here	K1,K2,S1,S2,S3,A1,A2
Insert Program Learning Outcome here	K1,K2,S1,S2,S3,S5,A1,A2,A3
Insert Program Learning Outcome here	K1,K2,S1,S2,S3,S5,A1,A2,A3
Insert Program Learning Outcome here	K1,K2,S1,S2,S3,A1,A2
Insert Program Learning Outcome here	K1,K2,S1,S2,S3,S5A1,A2,A3

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

Textbook: Arbitrage Theory in Continuous Time, 3rd or 4th edition, by T. Bjork.

Other materials will be uploaded on canvas.

6. Assessment

Exam/assignment/classwork breakdown					
Exam	60%	**Assignments (3)**	40%	**Class work**	0
Assignment due dates		TBA	TBA	TBA	TBA
Assignment 1: 13.33%, due in Week 5 **Assignment 2:** 13.33%, due in Week 9 **Assignment 3:** 13.34%, due in Week 13 **Exam:** 60%, during exam period					
Approximate exam date				TBA	

Institution honours program details

Weight of subject in total honours assessment at host department	12.5%
Thesis/subject split at host department	50% coursework, 50% thesis
Honours grade ranges at host department	**0-100**
H1	80-100
H2a	75-79
H2b	70-74
H3	65-69

Institution masters program details

Weight of subject in total masters assessment at host department	6.25%
Thesis/subject split at host department	75% coursework, 25% thesis
Masters grade ranges at host department	**0-100**
H1	Enter range %
H2a	Enter range %
H2b	Enter range %
H3	Enter range %