



1. General Information

Course Subject	FINA
Course Number	3350
Course Title	Mathematical Finance
Academic Years	2024-2025
Grading Method	Letter

2. Instructors

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Subclasses: 2A

4. Course Description

Course Description	This course provides students with the necessary mathematical techniques used in continuous-time finance. It covers stochastic calculus, partial differential equation and applied probability. After taking this course, one should be able to fully understand no-arbitrage theory, the Black-Scholes equation, risk-neutral probability and martingales. The purpose of this course is to lay down a solid mathematical foundation for students to learn more advanced topics in financial engineering and risk management, such as exotic options, interest rate derivatives and credit risk models.
Prerequisites	FINA2322: Derivatives
Mutually exclusive	MATH2906/MATH3906 Financial calculus
Free Elective	Yes

5. Course Objectives

1. To fully understand no-arbitrage theory, risk-neutral probability, martingale, and Black-Scholes equation
2. To lay down a solid mathematical foundation for students to learn more advanced topics in financial engineering and risk management, such as exotic options, interest rate derivatives and credit risk models

6. Faculty Learning Goals

- Goal 1: Acquisition and internalization of knowledge of the programme discipline
- Goal 2: Application and integration of knowledge
- Goal 3: Inculcating professionalism
- Goal 4: Developing global outlook

6. Faculty Learning Goals	
Goal 5: Mastering communication skills	
Goal 6: Cultivating leadership	

7. Course Learning Outcomes						
Course Teaching and Learning Activities	Aligned Faculty Learning Goals					
	1	2	3	4	5	6
CLO1. Understand the concept and properties of a standard Brownian motion. Be able to derive probability distribution of a function of Brownian motion.	✓	✓				
CLO2. Understand stock price model with a lognormal process. Understand the Ito's Lemma. Be able to derive a process for option price by using the Ito's Lemma.	✓	✓				
CLO3. Understand the concept of martingale. Be able to justify whether a process is a martingale or not.	✓	✓				
CLO4. Be able to price an option using risk-neutral probability approach.	✓	✓		✓		
CLO5. Understand no-arbitrage principle. Be able to derive put-call parity, forward price formula, and the Black-Scholes equation by using the no-arbitrage principle.	✓	✓				
CLO6. Understand heat equation and Green's function. Be able to solve the Black-Scholes equation with an arbitrary payoff.	✓	✓		✓		
CLO7. Memorize the Black-Scholes formula. Be able to derive Greek letters from the Black-Scholes formula. Understand the asymptotic behavior of the Black-Scholes formula.	✓	✓				

8. Course Teaching and Learning Activities		
Course Teaching and Learning Activities #	Expected Study Hours	Study Load (% of study)
T&L1. Lecture	36	30
T&L2. Tutorial	12	10
T&L3. Self-study	72	60
	Total: 120	Total: 100

9. Assessment Methods			
Assessment Methods	Description	Weight %	Aligned Course Learning Outcomes
A1. Assignments		30%	1,2,3,4,5,6,7
A2. Class/Tutorial participation		10%	1,2,3,4,5,6,7
A3. Exam I		20%	1,2,3,4,5,6,7

9. Assessment Methods

A4. Exam II		40%	1,2,3,4,5,6,7
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Assessment Rubrics

A1. Assignments	
A+,A,A-	Students demonstrate very good to excellent performance in the defined assessment criteria.
B+,B,B-	Students demonstrate good to very good performance in the defined assessment criteria.
C+,C,C-	Students demonstrate fair to good performance in the defined assessment criteria.
D+,D	Students demonstrate fair performance in the defined assessment criteria.
F	Students fail to show understanding of core materials in this course.
A2. Class/Tutorial participation	
A+,A,A-	Students demonstrate very good to excellent performance in the defined assessment criteria.
B+,B,B-	Students demonstrate good to very good performance in the defined assessment criteria.
C+,C,C-	Students demonstrate fair to good performance in the defined assessment criteria.
D+,D	Students demonstrate fair performance in the defined assessment criteria.
F	Students fail to show understanding of core materials in this course.
A4. Exam II	
A+,A,A-	Students demonstrate very good to excellent performance in the defined assessment criteria.
B+,B,B-	Students demonstrate good to very good performance in the defined assessment criteria.
C+,C,C-	Students demonstrate fair to good performance in the defined assessment criteria.
D+,D	Students demonstrate fair performance in the defined assessment criteria.
F	Students fail to show understanding of core materials in this course.

10. Course Grade Descriptors

A+,A,A-	Students demonstrate very good to excellent performance in the defined assessment criteria.
B+,B,B-	Students demonstrate good to very good performance in the defined assessment criteria.
C+,C,C-	Students demonstrate fair to good performance in the defined assessment criteria.
D+,D	Students demonstrate fair performance in the defined assessment criteria.
F	Students fail to show understanding of core materials in this course.

11. Course Content and Tentative Teaching Schedule

Topic/ Session	Content
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11. Course Content and Tentative Teaching Schedule

	Lecture 1: Introduction and lattice model I
	Lecture 2: Lattice model II
	Lecture 3: Review of probability
	Lecture 4: Stochastic differential equations
	Lecture 5: Martingale approach I
	Lecture 6: Martingale approach II
	Lecture 7: Partial differential equation approach I
	Lecture 8: Partial differential equation approach II
	Lecture 9: Asymptotic analysis
	Lecture 10: Deriving and hedging with Greeks

12. Required/Recommended Readings & Online Materials

Textbook	Reference books <ul style="list-style-type: none">• Baxter, Martin, and Andrew Rennie, 1996, Financial calculus: an introduction to derivative pricing, Cambridge University Press.• Buchanan, J. Robert, 2008, An undergraduate introduction to financial mathematics, 2nd edition, NJ : World Scientific Publishing Company.• Hull, John, 2011, Options, Futures, & Other Derivatives, 8th edition, Prentice Hall.
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13. Means / Processes for Student feedback on Course

	Conducting mid-term survey in additional to SETL around the end of the semester
	Online response via Moodle site
✓	Others
	Course Evaluation at the end of the course

14. Course Policy

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