MATH0060 Stochastic Processes

Year:	2022–2023
Code:	MATH0060
Value:	15 credits (= 7.5 ECTS credits)
Term:	2
Structure:	On campus
Assessment:	100% examination. Students must achieve at least 50% to pass this course.
Normal Prerequisites:	Measure-theoretic probability theory.
Lecturer:	Prof C Marinelli

Course Description and Objectives

This is a 30-hour introductory course on stochastic calculus for continuous semimartingales with applications to continuous-time finance. Some fundamental concepts of mathematical finance will first be treated in discrete time and on a finite probability space, to avoid subtle issues typical of the general setting.

Recommended Text

Steven E. Shreve, *Stochastic Calculus for Finance*, Springer, 2004.

Detailed Syllabus

Models of discrete-time finance markets on finite probability spaces: trading strategies, arbitrage opportunities, contingent claims, hedging, pricing. The fundamental theorem of asset pricing: equivalence between absence of arbitrage and existence of risk-neutral measure. Pricing by no-arbitrage.

Elements of stochastic calculus: integration with respect to continuous martingales, Ito's formula, Girsanov's theorem, stochastic differential equations with Lipschitz continuous coefficients.

Models of financial markets in continuous time. Fair price as expectation under the equivalent risk-neutral measure, connection with partial differential equations. Black-Scholes formula.

Portfolio optimization problems in complete markets by techniques of convex duality.

If time permits: Optimal stopping and American options. Elements of stochastic calculus for jump processes and corresponding models of asset prices.