

This is archived information. Please visit <http://www.maths.manchester.ac.uk> for current course unit information

MATH49102

Stochastic Modelling in Finance

Unit code:	MATH49102
Credit Rating:	15
Unit level:	Level 4
Teaching period(s):	Semester 2
Offered by	School of Mathematics
Available as a free choice unit?:	N

Requisites

Prerequisite

- [MATH20701 - Probability 2](#) (Compulsory)
- [MATH47201 - Martingales Theory for Finance](#) (Compulsory)
- [MATH37001 - Martingales with Applications to Finance](#) (Compulsory)

Additional Requirements

Please note

Students are not permitted to take, for credit, MATH49102 in an undergraduate programme and then MATH69012 in a postgraduate programme at the University of Manchester, as the courses are identical.

Aims

The unit aims to provide a concise mathematical formulation of the main characteristics of financial instruments, with an emphasis on quantitative aspects of stock price, options, and other financial derivatives.

Overview

Derivative securities (such as options) depend on the values of primary securities (such as stock or bond prices). During the last thirty years trading in derivative securities have undergone a tremendous development, and nowadays derivative securities are traded on markets all over the world in large numbers. The purpose of the course is to exhibit basic features of advanced financial derivatives, starting with basic model specifications, introducing the concept of arbitrage, and ending with a risk-neutral valuation formula and its analysis.

Assessment Further Information

End of semester examination: three hours weighting 100%.

Learning outcomes

On successful completion the students will have acquired active knowledge and understanding of some basic concepts and results in financial mathematics including:

- hedging strategies and managing market risk using derivatives;
- discrete and continuous time security markets;
- arbitrage, risk-neutral valuation, the fundamental theorem of asset pricing;
- European options, exotic options, American options;
- interest rate models and interest rate derivatives;

Future topics requiring this course unit

None.

Syllabus

1. Modern portfolio theory: variance minimisation; diversification; efficient frontier. [2]
2. Discrete-time security markets: The Cox-Ross-Rubinstein model; self-financing portfolios; contingent claims; arbitrage; martingale measures; risk-neutral valuation. [4]
3. Continuous-time security markets: The Black-Scholes model; self-financing portfolios; contingent claims; arbitrage; martingale measures; risk-neutral valuation; the fundamental theorem of asset pricing; the efficient market hypothesis. [12]
4. American options (put and call); Exotic options: forward start, chooser, compound, binary/digital, barrier, lookback, shout, Asian, basket, quantile. [7]
5. Interest rate models; Vasicek, Cox-Ingersoll-Ross and Hull-White models; the Heath-Jarrow-Morton framework. [5]
6. Credit risk: structural models; reduced form models; intensity based models. [3]

Recommended reading

- Lamberton, D. and Lapeyre, B., Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall 1996.
- BjÅrk, T., Arbitrage Theory in Continuous Time, Oxford University Press 1998.
- Etheridge, A., A Course in Financial Calculus, Cambridge University Press, 2002.
- Musiela, M. and Rutkowski, M., Martingale Methods in Financial Modelling, Springer 2005.
- Shiryaev, A. N., Essentials of Stochastic Finance, World Scientific 1999.

Feedback methods

Tutorials will provide an opportunity for students' work to be discussed and provide feedback on their understanding.

Study hours

- Lectures - 33 hours
- Tutorials - 11 hours
- Independent study hours - 106 hours

Teaching staff

Tusheng Zhang - Unit coordinator