

MATH571 – Mathematical Models of Financial Derivatives (Fall 2010)

Course objective

This course is directed to those students who would like to acquire an introduction to the pricing theory of financial derivatives. The course starts with the exposition of basic derivative instruments. We then discuss the fundamental concepts of financial economics, like the fundamental theorem of asset pricing, risk neutral valuation principle. The renowned Black-Scholes pricing theory and martingale pricing theory are introduced. Extended option pricing models, like stochastic volatility models, defaultable bond models, quanto options, are considered.

Prerequisite and exclusion

A course on stochastic calculus (MAFS501) should be taken concurrently or earlier.

No prior knowledge in finance is required.

Instructor

Professor Kwok Yue-Kuen, Office: Room 3445, Tel: 2358-7418; E-mail: maykwok

Textbook

“Mathematical Models of Financial Derivatives” second edition, by Yue Kuen KWOK, Springer Verlag (2008), 530 pages.

The text can be purchased from Springer Hong Kong at Euro 23, two-thirds of the listed price.

Meeting hours and venue

Class hours: Saturday: 14:30am – 17:20pm; Room 2302

Office hours: Saturday: 17:30pm – 18:30pm or by appointment

Course content

1. Introduction to Derivative Instruments
 - 1.1 Basic instruments: bonds, forward contracts, futures, swaps, and options
 - 1.2 Rational boundaries of option values
 - 1.3 Early exercise policies of American options

2. Single-period securities model
 - 2.1 Dominant trading strategies and linear pricing measure
 - 2.2 No-arbitrage theory and risk neutral probability measure
– Fundamental Theorem of asset Pricing
 - 2.3 Valuation of contingent claims and complete markets
 - 2.4 Binomial option pricing model

3. Filtrations, martingales and multi-period models
 - 3.1 Information structures and filtrations
 - 3.2 Notion of martingales
 - 3.3 Discounted gain process and self-financing strategy under multiperiod

securities models

3.4 No-arbitrage principle and martingale measure

3.5 Multiperiod binomial models

4. Black-Scholes-Merton framework and Martingale Pricing Theory

4.1 Review of stochastic processes and Ito calculus

4.2 Change of measure – Girsanov’s Theorem

4.3 Riskless hedging principle and dynamic replication strategy

4.4 Martingale pricing approach

4.5 European option pricing formulas and their greeks

5. Extended option models

5.1 Continuous dividend yield models

5.2 Time dependent parameters

5.3 Exchange options

5.4 Quanto options – equity options with exchange rate risk exposure

5.5 Implied volatility and volatility smiles

5.6 Local volatility and Dupire’s equation

5.7 Stochastic volatility models

5.8 Merton’s models of risky debts

Grading policies

Three tests

75-minute Test 1 (Oct 23): Topic 1 and first half of Topic 2 30%

75-minute Test 2 (Nov 20): Second half of Topic 2 and Topic 3 30%

100-minute Test 3 (Dec 11): Topics 4 and 5 40%

Five sets of homework 0%

* Proper submission of all 5 sets of homework may help improve one minor grade.