UNIVERSITY OF PENNSYLVANIA
The Wharton School

FNCE 206/717:
FINANCIAL DERIVATIVES

Prof. Domenico Cuoco — Fall 2004

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Course Description:

This course focuses on *derivatives* (such as forwards, futures, swaps, options and similar securities). These instruments offer a direct way of trading the risk associated with the change in interest rates, exchange rates, stock and commodity prices, and other market variables. They are widely used by both individuals and corporations to hedge existing market risks, to speculate on the future movements of market variables, or, more generally, to taylor the return distribution of a portfolio.

This course is a rigorous study of how derivatives are priced and how they are used for risk management. In order to properly cover this material, the course will be VERY quantitative.

Prerequisites

The prerequisites for FNCE 206 are FNCE 100, FNCE 101, STAT 101 and STAT 102. The prerequisites for FNCE 717 are FNCE 601 or FNCE 621 and STAT 621. In addition, the course requires familiarity with the basic tools of calculus and statistics and with a software package that can be used for numerical computation (such as Excel VBA, Mathematica, Maple or MatLab).

Course Material:

The required textbook is:

> John C. Hull, *Options, Futures, and Other Derivatives*, 5th edition, Prentice Hall, 2002.

Lecture notes (copies of the overheads used in class) will be made available before each class through Web Cafe.

Class Format:

The main class format will be lectures (the exception being two mini-cases).

Requirements and Grading:

The course grade will be based on homework assignments, one midterm exam, one final exam, and class participation. Homework, the midterm and the final will count for 30% of the grade each, with class participation counting for 10%. However, if you do better in the final than in the midterm, your midterm will count for 10% and your final for 50%. The final will be cumulative.

You can complete homework assignments in groups of no more than four people.

Schedule of Exams:

The schedule of the exams is as follows

Midterm Exam:	Monday, November 1, 6:00pm to 8:00pm
Final Exam:	Friday, December 17, 4:00pm to 6:00pm

Please make sure that you do not have any conflict with these dates.

Office Hours:

Office hours will be on Monday and Wednesday from 4:30pm to 5:30pm or by appointment. The course teaching assistant will also hold regular office hours. The schedule will be announced in class.

Preparing for Classes:

The nature of the course is such that it needs to be absorbed slowly. You should find it helpful to read the relevant chapters from the textbook before we cover the material in class. After the lecture, you should go through the notes, read the textbook again, and finally check your understanding of the material by completing the related homework assignments.

Review Sessions:

Review sessions will be held occasionally by teaching assistants. These sessions are optional. They provide an opportunity to go over questions related to the homework assignments or to review background material when needed. The schedule of the review sessions will be announced in class.

Course Outline:

I. Introduction (Hull: ch. 1)

- I.1. Derivatives and contingent claims
- I.2. Forwards, futures, swaps and options
- I.3. Derivatives markets
- I.4. Reasons for trading derivatives
- I.5. Pricing derivatives: the no-arbitrage approach and the risk-neutral approach

II. Forwards and Futures (Hull: ch. 2, 3, 5.1-5.12)

- II.1. The market for forwards and futures
- II.2. The operation of margin accounts
- II.3. Pricing forward contracts
- II.4. Convenience yields and the cost of carry
- II.5. Pricing futures contracts
- II.6. The relationship between forward prices, futures prices and expected future spot prices
- II.7. Forward rate agreements

III. Swaps (Hull: ch. 6)

- III.1. The market for swaps
- III.2. Pricing swap contracts

IV. Options (Hull: ch. 7, 8, 9)

- IV.1. Plain-vanilla and exotic options
- IV.2. The market for plain-vanilla options
- IV.3. Payoffs from plain-vanilla option positions
- IV.4. The put-call parity
- IV.5. Factors affecting option prices
- IV.6. Early exercise of American options: the exercise boundary
- Case: RJR Nabisco options

V. A First Look at the Binomial Model (Hull: ch. 10.1-10.6)

- V.1. The binomial model
- V.2. Deltas and dynamic replication
- V.3. Recursive valuation of European options and the binomial formula
- V.4. Recursive valuation of American options
- V.5. Recursive valuation of path-dependent options

VI. Modeling the Evolution of Market Prices (Hull: ch. 11)

- VI.1. Stochastic processes
- VI.2. The no-memory property of market prices
- VI.3. Random walks and binomial processes
- VI.4. Drift and volatility of a random walk
- VI.5. Wiener processes and Brownian motions

VI.6. Geometric Brownian motions and Ito processes
VI.7. Ito's lemma

VII. The Black-Scholes Model (Hull: ch. 12, 13.1-13.5, 13.7-13.9)

VII.1. The Black-Scholes model
VII.2. Derivation of the Black-Scholes formula for European calls
VII.3. The Black-Scholes formula for European puts
VII.4. Binary options and their pricing
VII.5. Generalization of the Black-Scholes formula for non-flat term structure and non-constant volatility
VII.6. Volatility estimation and implied volatilities
VII.7. Generalization of the Black-Scholes formula for dividends
VII.8. Using the Black-Scholes formula to price options on stock-indices and currencies
VII.9. Futures options: put-call parity and Black's formula
VII.10. Warrants

VIII. A Second Look at the Binomial Model (Hull: ch. 10.7-10.8, 18.1-18.4)

VIII.1. Convergence of the binomial model to the Black-Scholes model
VIII.2. Dividends and other generalizations
VIII.3. The control-variate technique for valuing American options
VIII.4. Valuing futures options in the binomial model

IX. Beyond Black-Scholes (Hull: ch. 15, 18.6, 20.1-20.4)

IX.1. Empirical evidence on the Black-Scholes formula: volatility smiles and skews
IX.2. Stochastic volatility: the CEV model
IX.3. More general stochastic volatility models
IX.4. Pricing derivatives in stochastic volatility models: Monte Carlo simulation
IX.5. Price jumps: the jump-diffusion model

X. Hedging and the "Greeks" (Hull: 4, 14)

X.1. The basic principle: delta-hedging
X.2. Delta-hedging using forwards: maturity mismatches
X.3. Delta-hedging using futures: tailing the hedge
X.4. Hedging multiple cash flows: strip versus stack hedges
X.5. Asset mismatches, basis risk and minimum-variance hedging
X.6. Dynamic hedges and the effect of discrete rebalancing
X.7. Delta-Gamma hedging
X.8. Vega and Rho hedging
X.9. Portfolio insurance
Case: Metallgesellschaft

XI. Assessing the risk of derivatives portfolios: Value at Risk (Hull: 16.1-16.7)

XI.1. The problem with traditional risk measures
XI.2. Definition of VaR
XI.3. VaR estimation