

# Hong Kong University of Science & Technology

## Derivative Securities (FINA 222, 2A & 2B)

Fall 2005

Instructor: Prof. Nengjiu Ju  
Office: Room 2379  
Phone: 2358-8318  
Email: nengjiu@ust.hk  
Office hours: Tuesday & Thursday 15:00 – 17:00 or by appointment

Lectures: Tuesday & Thursday 9:00–10:20 (2A), 10:30–11:50 (2B) Rm1402

Course Website: <http://webct.ust.hk/>

Demonstrator: Victor Yip  
Office: Room 3392  
Phone: 2358-7674  
E-mail: victory@ust.hk  
Office hours: Monday & Wednesday 11:00 – 12:00 or by appointment

### Course Description

Derivative securities are used by individuals and by institutions to achieve a variety of purposes. This course provides an introduction to various basic derivative securities such as futures, swaps and options and the necessary skills to value and to employ them. The course is quantitatively oriented and requires some backgrounds in finance and statistics. The topics include valuation of options on common stocks, valuation of futures contracts on stock indices and commodities, trading and hedging strategies with respect to these derivatives. The celebrated Black-Scholes formula will be introduced and explained. The elegant binomial tree option pricing model will be introduced as a workhorse computational technique. If time permits, more sophisticated products such as credit derivatives and volatility swaps will be covered.

### Course Text

John Hull, *Fundamentals of Futures and Options Markets*, 5th Edition, Prentice Hall

## **GRADING**

Your final grade will be based on homework assignments and two exams. The relative weightings are as follows.

Homework assignments	20%
Midterm exam	30%
Final exam	50%

Note: the final exam is inclusive, meaning that it includes materials before the midterm. However, the focus will be on the materials after the midterm.

## **Course Requirements**

### **1. Lectures:**

I teach two sections of this class (2A & 2B). Both lectures will cover identical topics. If for whatever reason a student must miss his or her registered section, he or she can make up the lecture in the other section, as long as class space permits.

### **2. Homework Assignment:**

The homework assignments are to be done on a team basis with three people in each group. Your team should stay together until the end of the term. Each team needs to submit only one write-up of each homework assignment, and all team members will receive the same grade for their work. Therefore it is important that all team members contribute equally to the homework assignments. If you feel that some team members do not contribute their fair share to the assignments you should talk to me. I will treat any complaints fully confidential.

Please inform me of your team members before the start of the class on September 8.

Each homework assignment must contain a cover page that lists the group number, the names and student id numbers of the members of the group that contributed to the assignment. Only those students whose names appear on the cover page will receive credit for their homework assignment. All homework assignments should be written in an easily readable fashion. Therefore, I encourage you to type the assignment. If your handwriting is difficult to decipher you may lose 5-10% of homework grade, depending on the severity of the problem.

Homework assignments have to be submitted before the start of class on the due date. For each day late you will incur a penalty of 20% of the maximum grade of the assignment.

## **EXAMS**

There are two comprehensive exams, a midterm and a cumulative final, which will mostly consist of numerical problems, NOT multiple choice problems.

Absence from the exams will not be excused except for serious medical illness. A doctor's letter must be provided within one week of the exam.

Cheating will not be tolerated. Any student caught cheating during the exams will receive zero credit and may face further disciplinary action.

### **MID-TERM MAKEUP**

There will be **NO** makeup for midterm, even for legitimate absence. Instead, the final will count for 80%, rather than 50%. I strongly encourage you to take the midterm by any means. If you miss it, you only have one shot (the final exam).

### **CLASS PARTICIPATION**

Active class participation is important for your learning experience and highly encouraged. It helps you to think actively rather than passively. Your class participation also provides me with feedback to gauge whether you understand the material. Often students ask me to write a letter of reference on their behalf. Please keep in mind that if you have never participated in class, I will not be able to write a letter for you.

### **IMPORTANT DATES**

Homework Assignments: Due before the class on the due date

- First Homework Assignment Due (Sept 20)
- Second Homework Assignment Due (Oct. 6)
- Third Homework Assignment Due (Oct 20)
- Fourth Homework Assignment Due (Nov. 8)
- Fifth Homework Assignment Due (Nov. 17)
- Sixth Homework Assignment Due (Dec. 1)

Exams

- Midterm: Oct. 26, 6:30-9pm at LTD
- Final: time and room to be announced

### **COURSE OUTLINE AND READING ASSIGNMENTS**

Topic 1: Introduction of Derivatives Markets and Future Preliminaries (Sept. 1, 6)

- Types of derivatives contracts
- Types of traders
- Differences between futures and forward contracts;
- Open Interest, Daily Settlement, marking to market
- Offsetting and physical delivery
- Price of futures on expiration day
- Profits and Losses for futures contracts
- Difference between price and value of futures contracts

Readings: Chapters 1 and 2

Topic 2: The determination of Futures Price (Sept. 8)

- Introduction of the concept of no-arbitrage
- Futures Price Formation: how to get price of stock index futures
- Forward contract prices and futures prices: Are they necessarily the same?

Readings: Chapter 5

Topic 3: Options Preliminaries and Trading Strategies involving Options (Sept. 13, 15)

- Definitions of Options
- Profits and Losses from Call Options
- Profits and Losses for Put Options
- Factors affecting Call Price
- Factors affecting the Put Price
- Leverage and Options: variance of investing in calls and puts are higher than investing in underlying instruments.
- Structure of options markets in Hong Kong, USA
- Structure of over-the counter options

Readings: Chapters 8, 10

First Homework Assignment Due (Sept 20)

Topic 4: Properties of Stock Options (Sept. 20)

- Introduction of no-arbitrage principle again
- Bounds of option prices
- Put-call parity
- Early exercise of non-dividend stock
- Effects of dividend

Readings: Chapter 9

Topic 5: Introduction to the Binomial Tree and Applications (Sept. 22, 27, 29, Oct. 4)

- No-arbitrage principle one more time
- One-step binomial tree
- Risk-neutral valuation
- Two-period binomial tree
- Multi-period binomial tree
- A lot of examples

Readings: Chapters 11 and 16

Second Homework Assignment Due (Oct 6)

Topic 6: Black-Scholes (Oct. 6)

- Estimating Volatility from historical data
- From binomial tree to Black-Scholes
- Risk-neutral valuation

Readings: Chapter 12

Topic 7: Futures strategies (Oct. 13)

- Learn how to do arbitrage if there is mispricing of stock index futures price
- Learn about execution of Program trading
- Hedging stock portfolios using Stock Index Futures
- Recognize that equity futures can be used to increase or decrease beta of stock – portfolios.
- Advantages and disadvantages of using futures and forwards to execute risk – management transactions

Readings: Chapter 3

Third Homework Assignment Due (Oct 20, hand back on Oct 25 before the Midterm)

Topic 8: Left-over materials, reviews, examples, Q&A before Midterm (Oct. 18, 20, 25)

**MIDTERM:** Oct. 26, 6:30-9 pm at LTD

**No class on Oct. 27 due to the exam on the previous day (Wednesday, a no-class day)**

Topic 9: Interest Rate Futures (Nov. 1, 3)

- Forward contract prices from forward rates
- Calculate gains and losses from futures and forward contracts
- Pricing of Eurodollar futures based on forward LIBOR rates
- Pricing of T-bill futures based on forward rates
- Calculate gains and losses from trading T-note, T-bond futures (no pricing)
- Pricing HIBOR futures based on forward rates
- Arbitrage if there is mispricing of interest rate futures
- Arbitrage if there is mispricing of forward contracts
- Hedging using Interest rate futures, with regards to issuing bonds, hedging floating rate debt securities, managing portfolios of bonds.

Readings: Chapter 6

Fourth Homework Assignment Due (Nov 8)

Topic 10: Interest rate swaps (Nov. 8)

- Cash flow for fixed and floating legs

- Pricing and Valuation of a swap, with reference to floating-rate bonds
- Interpretations of interest rate swaps as a pair of capital market transactions and forward contracts.
- Forward rate agreements
- Uses of Swaps: Convert fixed rate liability to floating rate liability and vice versa

Readings: Chapter 7

Topic 11: Interest Rate Options (Nov. 10)

- Structure of interest-rate options markets
- Calculate gains and losses from trading call and put options on treasury notes, bonds
- Calculate gains and losses from trading call and put options on treasury bonds futures
- Calculate gains and losses from trading call and put options on Eurodollar futures
- Gains and Losses from Caps, floors, collars.
- Hedging Using interest rate options

Readings: Chapter 19

Topic 12: Options on Stock Indices and Currencies (Nov. 15)

- The pricing formulas
- The Binomial tree model
- Stock index options
- Currency options

Readings: Chapter 13

Fourth Homework Assignment Due (Nov 17)

Topic 13: Futures Options (Nov. 17, 22)

- Put-call parity
- Bounds on futures options
- Valuation using binomial tree
- Black's model for futures option pricing

Readings: Chapter 14

Topic 14: The Greeks (Nov. 24, 29)

- Definitions of Delta, Gamma, and Theta
- The relationship between these Greeks
- Definition of Vega and Rho
- Synthesizing options for Portfolio Insurance
- Stock Market Volatility

Readings: Chapter 15

Sixth Homework Assignment Due (Dec. 1, hand back on the last class before Final)

Topic 15: Left-over materials, reviews, examples, Q&A before Final (Dec. 1, 6)

**Final Exam:** time and room to be announced