IEOR 4620  
Wednesday 7:00 – 9:30 PM  
Autumn 2016  
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DRAFT
Pricing Models for Financial Engineering

This is a course on pricing models that are common in the field of finance, with emphasis on those useful for derivatives. We will be concerned with how these models work under both normal market conditions and abnormal market conditions.

The textbook is John Hull’s 9th edition of Options, Futures, and Other Derivatives. There will be a midterm (25%) and final (50%) exams. Reading materials and teaching notes are posted on www.courseworks.columbia.edu. Homework consists of 5 micro projects that will be graded and will count for 25% of the grade. All homework must be turned in at the start of the class following the relevant lecture to obtain credit.

The pre-requisites for this course are IEOR 4700 plus basic accounting, finance, investments theory and statistics.

Please do not use computers, I-pads, I-phones, or other such devices during class for any purpose other than following lectures and taking notes.

Lecture 1 Wednesday September 7

Part I: Introduction to Course  
Basic Concepts

Teaching notes:  
Introduction to Pricing Models  
Basic Tools and Tools for Pricing Models

Hull Chapter 1

Part II: Introduction to Rates – LIBOR, OIS Rates, and other short-term interest rates.

Teaching note:  
Short-Term Rates: LIBOR, and the OIS Rate

Hull Chapter 4
Reading:
FED Points: Federal Funds and Interests on Reserve
FRB H15 Report
St. Louis Fed: What the LIBOR-OIS Spread as a Summary Indicator
St. Louis Fed: What the LIBOR-OIS Spread Says
WSJ Feb 2 2015 Calculation of Fed Funds Benchmark

Lecture 2 Wednesday September 14

Part I: Forward Rates in Interest Rate Markets and Foreign Exchange

  Interest parity; Forwards and Futures; Valuation of a Forward Contract; The Cost of Carry; Carry Trade; Expectational Markets

Teaching Notes:
  Forward Rates and Forward Contracts
  Hull Chapter 5

Part II: Introduction to Equity Index Derivatives.

Teaching Notes:
  Stock Index Futures
  Futures to Cash Spread October 1987

Hull Chapters 2 and 3

Readings:


Micro Project 1: Mexican Peso Structured Note (due September 30th)
Lecture 3 Wednesday September 21

Part I: Bonds, Fixed Income Trading, and the Term Structure of Interest Rates

Teaching Notes:
- Fixed Income Basics
- Bond Margin and Repo

Part II: Currency Crises and Liquidity Squeezes: 2008

Teaching Notes:
- Departures from Covered Interest Parity
- The 2008 Dollar Squeeze and the Fed’s Dollar Swaps

Readings

Micro Project 2 : Basic Bond Math (due October 7th)

Lecture 4 Wednesday September 28

Swaps
- Interest Rate Swaps; ISDA; Swap Rates; Valuation of Interest Rate Swaps
- Caps and Floors
- Equity Linked Swaps
- Cross Currency Basis Swaps

Teaching Note:
- Swaps, Caps and Floors
- Cross Currency Basis Swaps

Readings
Lefeuvre, Evariste, Natixis, What Basis Swaps Tell Us about the Need for Dollars,” March 2009


Hull Chapter 7 and 9

**Lecture 5 Wednesday October 5**

Part I: The Efficient Market Hypothesis

Analysis of Rates of Return
Weak Form, Semi-Strong Form, and Strong Form EMH
Anomalies
Reformulation of the EMH
FFJR and Event Studies

Teaching Note:
   The EMH Hypothesis

Part II: Eurodollar Futures and FRAs

Forward Rates; FRA Contracts; Eurodollar futures

Teaching Notes:
   Euro-dollar Futures and FRAs

Hull Chapter 6

Readings:


Lecture 6  Wednesday Oct 12

Mechanics of Options Markets
Option Basics

Properties of Stock Options
Boundary Conditions; Put-Call Parity; Volatility Value; Early Exercise
Trading Strategies Involving Options
    Single Option Strategies; Spreads; Combos; ATM, Butterfly; Risk Reversals

Reading:
Hull Chapters 10, 11, and 12

Teaching Note:
Option Basics

MIDTERM EXAM Wednesday October 19

Lecture 7  Wednesday October 26

Part I: Securitization and Mortgage-Backed Securities

Part II:
Binomial Trees
No Arbitrage; Tree Models

Reading: Hull Chapter 13

Teaching Notes:
    Securitization and Mortgage-Backed Securities
    Binomial Option Pricing Models

Lecture 8 Wednesday Nov 2

Wiener Processes and Ito's Lemma
Black-Scholes-Merton

The distribution of Rates of Return; Volatility; The BS Differential Equation; The BSM model; Risk Neutrality; Implied Volatility

Readings:

Black, Fischer, “How We Came Up with the Option Formula,” The Journal of Portfolio Management, Winter 1989, pp. 4-8

Hull Chapters 14 and 15

Teaching Notes
Stochastic Processes
The Black-Scholes-Merton Model

Micro Project 3: Option Risk (November 18)

Lecture 9 Wednesday November 9

Options on Stock Indices and Currencies
Stock index options; currency options; American exercise
Futures Options and the Black 1976 Model

American Exercise Models
Numerical methods: Finite Differences

Teaching notes:
Currency Options
Finite Differences

Micro Project 4: Foreign Exchange Basket Option (due November 25)

Readings:

Hull Chapters 17 and 18

Lecture 10 Wednesday November 16

Part I: The “Greeks”
Delta, gamma, theta, rho, vega, vanna, and volga and more.
Market Making: Equity Derivatives

Teaching Notes:
The Greeks
Equity Derivatives Market Making

Hull Chapter 19

Part II: Value at Risk – and Other Risk Measurement Techniques

Teaching Notes:
Value at Risk

Hull Chapter 22

Lecture 11 Wednesday November 23

The Volatility Surface

- The smile
- ATM, Risk Reversals, and Butterflies
- The Volatility Surface
- The Vanna Volga Procedure

Teaching Notes:
Topics on Volatility
The Pricing of Currency Options and the Volatility Surface

Hull Chapter 20
Lecture 12  Wednesday November 30

Barrier Options
Binary Options
Static Replication
Analytic solutions
Binomial and Trinomial Models

Hull Chapter 26

Teaching Notes:
  Barrier Options
  Binary Options
  Static Replication

Micro Project 5: Digital Options (due Dec 9th)

Lecture 13 Wednesday December 2

Stochastic Volatility Models

Jump Process Models

Correlation Trading

Hull 27

Teaching Notes:
  Stochastic Volatility
  Stochastic Local Volatility
  Correlation Trading

Final exam: Time and Place TBA.