Course Overview
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. The textbook is John Hull’s 9th edition of Options, Futures, and Other Derivatives. There will be a midterm (25%) and final (50%) exams. There will be a great amount of reading materials and teaching notes posted on www.courseworks.columbia.edu. Homework 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. There are also 5 micro projects that count as double-credit homework assignments.

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

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

Lecture 1 Monday September 8

Part I: Introduction to Course and Basic Concepts
Part II: Introduction to interest rates – LIBOR, Repo Transactions, OIS Swap Rates, and other short-term interest rates.

Lecture 2 Monday September 15

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 Trades; Expectational Markets

Part II: Eurodollar Futures and FRAs
Forward Rates; FRA Contracts; Eurodollar futures; Determination of Forward and Futures Prices
Lecture 3 Monday September 22

Part I: Bonds and the term structure of interest rates

Part II: Crisis Markets:
   Currency Crises: Spot and Forward
   The 2008 Market History

Lecture 4 Monday September 29

Interest Rate Swaps and Related Topics
   Interest Rate Swaps; ISDA; Swap Rates; Valuation of Interest Rate Swaps
   Caps and Floors
   Role of the OIS Swap Rates
   Valuation and Collateral
   Cross Currency Swaps

Lecture 5 October 6

Part I: The Efficient Market Hypothesis

Part II: Analysis of Rates of Return
   Mean, variance, SD, correlation
   Random Walks; Martingales; Weak form Efficiency; Autocorrelation; the Market Model; Normal Distribution; Leptokurtosis; bivariate normal; Law of large numbers; properties of normal; log normal; Diffusion Processes

Part III: Equity Index Derivatives.

Lecture 6 Monday October 13

Options
   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
Lecture 7 Monday October 20

Part I: MIDTERM

Part II: Binomial Trees
   No Arbitrage; Tree Models

Lecture 8 Monday Oct 27

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

NO CLASS NOV 3th

Lecture 9 Monday November 10

Options on Stock Indices and Currencies
Stock index options; currency options; American exercise
Futures Options
Future Options; Put-Call parity; Black’s Model

American Exercise Models
Numerical methods: Finite Differences

Lecture 10 Monday November 17

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

Part II: Risk Measurement and Value at Risk
Lecture 11 Monday November 24
The Volatility Surface
Smiles; ATM, Risk Reversals, and Butterflies; The Volatility Surface; Vanna Volga

Lecture 12 Monday December 1
Barrier Options and Binary Options
Static Replication
Analytic solutions
Binomial and Trinomial Models

Lecture 13 Monday December 8
Second and Third Generation Option Models

Final exam: Time and Place TBA.