Selected Topics in Finance - Options and Risk Management (29:390:685)

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Rutgers Business School — Fall 2007

Course Overview and Objectives

This is a course to introduce the option pricing theory to the doctoral students and master students with adequate preparations. The alternative title for this course can be continuous-time finance. Contents include no-arbitrage pricing principle, the Black-Scholes-Merton (BSM) model, the equivalent martingale measures, the extensions to the BSM model such as stochastic volatility, poison jumps and Levy innovations, the term structure models, pricing and hedging of interest rate derivatives, and credit risk modeling. Probability and stochastic calculus are to be introduced or reviewed when necessary with course contents.

This course can serve as the first course in quantitative financial modeling and prepare the students for working with the state-of-art techniques in derivative pricing and risk management. Targeting the finance majors, this course focuses on the finance theory behind the development of the various models with less stress in the mathematical rigor. We will first introduce the concept of state price density and no-arbitrage pricing principle in a static setting, linking the equilibrium results as well. CAPM and APT are introduced as special cases. We will then move to the continuous time setting starting with the BSM model. We will cover both the partial differential equation and probabilistic approaches. The Fundamental Theorems of Asset Pricing will be introduced through the discussion of the equivalent martingale measures. Afterwards, applications of the BSM variations to more complicated types of derivative contracts will be studied, as well as more current extensions like stochastic volatility, poison and Levy jumps. Term structure models will then be covered, dynamic term structure models and Heath-Jarrow-Morton models. We will then show how to price the interest rate derivatives with these models. The final section of the class will be spent on the credit risk modeling. Both reduced-form and structural models will be studied, as well as the extensions in the current literature. Credit derivatives will be covered at last.

Course Materials

The main text book for this course is *Dynamic Asset Pricing Theory,* by Darrell Duffie, Princeton University Press Third Edition.

Other useful references include:
Stochastic Calculus for Finance II: Continuous-Time Models by Steven E. Shreve, Springer 1st edition

Martingale Methods in Financial Modeling by Marek Musiela and Marek Rutkowski, Springer 2nd ed.

I will also distribute additional research papers throughout the semester.

Prerequisites
The study of continuous finance is highly quantitative. You must be equipped with calculus, matrix algebra and basic probability theory before taking this class.

Class Participation, Homework, Exams and Grading
Class participation is highly encouraged and will positively affect your grade. Homework assignments will be given throughout the semester. It is crucial for your learning experience. They will be discussed in class. There is one take-home exam at the end of semester. There is also one project presentation before the end of the semester. Your grade for the entire course will be determined by all these components.

Office Hours: Thursday 2:30pm-4:30pm and by appointment, MEC 114

Course Schedule

Week 1&2
Introduction and Course Overview
State Prices and Arbitrage
Duffie: Ch. 1-2

Week 2&3
The Black-Scholes-Merton Model

Duffie: Ch. 5
Shreve: Ch. 5
MR: Ch. 5

Week 4&5
Equivalent Martingale Measures
Fundamental Theorems of Asset Pricing

Duffie: Ch. 6
Shreve: Ch. 5
MR: Ch. 10

Week 6&7
Option Pricing Models: Applications and Extensions

Duffie: Ch. 8
Shreve: 7-9, 11
MR: 6-9

Week 8 & 9
Term Structure Models

Duffie: Ch. 7
Shreve: Ch. 10
MR: Ch. 11, 12

Week 9&10
Interest Rate Derivatives
MR: Ch. 13, 14, 16

Week 11&12
Credit Risk Models
Duffie: Ch. 11

Week 13&14
Credit Derivatives – CDS, CDO, etc.

Week 15&16
Presentation and Exam