Course Overview

This course introduces and applies various computational techniques useful in quantitative finance. Among them are transform techniques for option pricing, finite difference methods for partial differential equations (PDE), and partial integro-differential equations (PIDE), Monte Carlo simulation techniques and its applications, calibration techniques, and filtering and model parameter estimation techniques. The computational platform will be C++/Java/Python. The primary application focus will be the pricing of financial derivatives. These techniques are useful for various other problems in financial modeling/engineering and practical implementations from the theory of mathematical finance.

Required Textbook:

Computational Methods in Finance (Chapman & Hall/CRC Financial Mathematics Series) by Ali Hirsa

Required Work and Grading Policy:

Assignment: 3 case studies (C++/Java/Python programming)

In-Class Examination

Grading is based on the following weighting schemes:

60% Case Studies, 40% In-class Examination

Teaching Assistant:

Helen Chien

e-mail: TBA

Office Hours:

Ali Hirsa on Tuesdays 12:00pm-1:10pm Room #318

Helen Chien by appointment
Class Schedule (subject to change):

Lecture 01. – Overview; option pricing using transform techniques (e.g. FFT) (Chapter 2 - Pages 35–47)

Lecture 02. – Option pricing using transform techniques (Cont’d) (Chapter 2 - Pages 47–63)

Lecture 03. – Introduction to finite differences; discussing various schemes; stability analysis of the schemes (Chapter 3 - Pages 83-105)

Lecture 04. – Pricing various options in diffusion framework; issues in implementation; nonuniform grids; coordinate transformation (Chapter 4 - Pages 115–146)

Lecture 05. – Finite differences in higher dimensional; numerical solution of the partial-integro differential equations (Chapter 4 - Pages 146–158, Chapter 5 - Pages 171–180)

Lecture 06. – Numerical solution of the partial-integro differential equations (Cont’d) (Chapter 5 - Pages 180–199)

Lecture 07. – Introduction to Simulation; Sampling from various distributions Chapter 6 - Pages 203–210)

Lecture 08. – Simulation in finance; integration via simulation; simulation of diffusion and pure jump processes (Chapter 6 - Pages 211–239)

Lecture 09. – Variance reduction techniques in simulation (Chapter 6 - Pages 240–254)

Lecture 10. – Pricing of financial derivatives via simulation (Chapter 6 - Pages 240–254)

Lecture 11. – Calibration formulation and techniques (Chapter 7 - TBD)

Lecture 12. – Calibration examples; model risk (Chapter 7 - TBD)

Lecture 13. – Parameter estimation via likelihood (Chapter 8 - TBD)

Lecture 14. – Various filtering techniques (Chapter 8 - TBD)

Lecture 15. – Parameter estimation using filtering (Chapter 8 - TBD)