CS 798 Advanced Computational Finance Fall 07

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Class time: T&Th 2:30pm-4:00pm DC3313 Office hours: Monday: 2:30-3:30pm

Course Description

Institutional investors and individual investors have new and potentially profitable investment opportunities, including trading in complex derivative instruments and hedge funds. Computational finance provides tools to analyze, quantify, and manage hidden risks of these investment opportunities and facilitate risk management and optimal allocation decisions. We discuss computational methods for option pricing, hedging, including exotic options. Optimal asset allocations under various risk measures such as VaR and CVaR will be considered. Computational methods, including PDE methods, Monte Carlo, and mathematical programming will be presented.

A sample syllabus is given below.

week 1-2 Introduction to computational finance: no-arbitrage option pricing under a binomial model, Brownian motion and asset price model, Ito's lemma, Black-Scholes partial differential equation

week 3 PDE pricing model, finite difference methods, efficiency, accuracy, and stability

week 4-5 Monte Carlo, simulating SDE, Discrete hedging, risk measures: VaR and CVaR, linear programming: theory and software

week 6-7 Implied volatility, volatility smile, pricing model calibration, nonlinear programming

week 8 Pricing American options, linear complementarity problems, pricing exotic options

week 9-10 Portfolio optimization, quadratic programming, robust optimization

week 11-12 Student projects and presentations

Reference Material: Relevant research papers will be provided. References for basic material include :

- *Options, Futures, & Other Derivatices*, John Hull,
- *The Mathematics of Financial Derivatives*, Wilmott, Howison and Dewynne, and
- *Optimization in Finance*, Gerard Cornuejols and Reha Tütücü.

Prerequirements: It is assumed that you have the following background: basic calculus and linear algebra, an introductory course in numerical analysis, an introductory course in statistics, and ability to program in Matlab. **No finance background is assumed**.

Course Work: The grade for this course will be determined by a project which includes an assigned component (50%) and research topic component (50%).