CS 774 - Fall 2009

Advanced Computational Finance

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Outline

The past several decades have witnessed an explosion in the trading of financial derivatives. One of the most common derivatives is an option, which gives the holder the right, but not the obligation, to buy or sell the underlying security for a fixed price at a future date. Derivatives can be used by financial institutions to hedge risk, and hence can be viewed as a form of financial insurance.

Determination of the fair market value of this insurance, and the hedging strategy used to reduce the risk in selling this insurance, is a problem in option pricing. Modern financial institutions rely on risk management software to optimally manage portfolios and set up dynamic hedging strategies.

Recently, we have seen the results of poor or non-existent hedging practices in financial institutions. This has resulted in many bank and insurance company failures. In fact, many academics warned that the models used by banks were inadequate, and underestimated risk. Why did the banks use such models?

Any model which underestimated risk allowed bank CEOs to boast of large (apparent) profits, which then triggered rich bonuses to executives and traders. The CEOs and traders get to retire rich while the shareholders and the taxpayers take the losses.

This course will cover such topics as: Monte Carlo methods, lattice methods, and numerical PDE (Partial Differential Equation) techniques for pricing and hedging options. Methods for valuing exotic options (Asian, Parisian, barrier, and shout) will be presented. Particular attention will be paid to models which more accurately represent real markets: jump processes, regime switching, the effect of trading price impact and transaction costs, and optimal decision making. This will lead us to a discussion of algorithms for partial integro differential equations, and optimal stochastic control (dynamic programming, Hamilton Jacobi Bellman equations).

Course Evaluation

The course grade will be based on two short assignments, and a project involving a simulated trading strategy. This will require programming (i.e. at least using Matlab for example). The project will be *semi-structured* with a list of required tasks, and some additional exploratory/research issues.

Prerequisite

It will be assumed that the student has completed an introductory course in numerical computation, and is comfortable using Matlab or C++. *No knowledge of finance will be assumed.* Everything you need to know about finance will be covered in the lectures. A detailed set of course notes, describing current research issues, can be purchased in the DC library. Check out my Web site for more information on computational finance.

Organizational Meeting and First Class

Class times are MWF 3:30-4:30, MC 2036. The first class will be on Monday September 14, 2009.