CS 774 Fall 2009
Advanced Computational Finance

Instructors:
Peter Forsyth, *paforsyt@uwaterloo.ca* Office: DC3631
Office Hours: Tues: 4:00-5:00; Thurs: 11:00-12:00
Lectures:MWF 3:30-4:20 MC2036

CS 774 Web Site: www.student.cs.uwaterloo.ca/∼cs774/

Week of Sept 14	Introduction to options Random walks on a lattice	
Week of Sept 21	Ito's Lemma Black Scholes Equation	
Week of Sept 28	No-arbitrage Lattice Monte Carlo I	
Week of Oct 5	Monte Carlo II Hedging	Assignment 1 out
Week of Oct 12	Finite Difference I	**No Monday Class, Thanksgiving**
Week of Oct 19	Finite Difference II Positive Coeffs	Assignment 2 out
Week of Oct 26	Stability American Options	Project out
Week of Nov 2	Jump Diffusions PIDEs	Research Proposal in (Due Friday, Nov 6, in class)
Week of Nov 9	Nonlinear HJB Equations Viscosity solutions	
Week of Nov 16	Continuous time asset allocation Gas Storage	
Week of Nov 23	Variable Annuities	
Week of Nov 30	Path Dependent options Asian, Parisian	

- **Reference Material** Course notes are on sale in the DC library. There is a list of references in the course notes. There are also several papers on my Web site.
- **Academic Integrity, Grievance, Discipline, Appeals** Please see the course Web site.
- **Disabilities** Please see the course Web site.
- **Background Assumed** You should have taken
  - An introductory course in numerical computation, similar to CS370.
  - An introductory course in statistics.
  - Basic calculus and linear algebra.

  I will assume you know nothing about finance.
- **Previously taken CS476/CS676** If you have previously taken CS476/676, you will find the first six weeks of the lectures a review. You can treat this as an opportunity to get started on the project, or, if there is enough popular demand, I will give a separate set of lectures (at a mutually agreeable time) covering some the material on HJB equations and jump diffusions to those of you interested.

- **Course Accounts** You will need to register in the course to obtain a computing account on the CS student computing environment. You should register in CS774. After you do this, you can obtain a password by going to see the Math Faculty consultants in MC3011 (you must be registered in the course and have a Watcard). If you have a problem which can't be resolved by the consultants, see Lori Suess in MC3011b. By being on the student environment, you will get a license to use matlab. If you use a research machine, you may not have a license for matlab (depending on your supervisor).

- **Class Grade** The grade for this course will be determined by a project (100%). In order to prepare for the project, I will also hand out two assignments (which you do not have to hand in), which will involve Monte Carlo simulation and a numerical PDE method for American options (an implicit penalty method). Projects must be individual, no group projects permitted.

  The project will involve certain assigned tasks (50%), and some open ended research questions (50%). The basic task will be to simulate the path of an asset and then carry out discrete Delta hedging for an American option (based on a PDE solution for the hedging parameters). A second task will be to simulate discrete Delta hedging (for a European option), under the assumption that the hedger thinks the asset follows GBM, while in reality the asset follows a jump diffusion.

  For the research project, you will have to hand in a two page summary of your project idea by November 6. The two pages will consist of a one page summary of the literature, and a one page outline of what you are going to do.

  Both parts of the project must be handed in by Monday December 21 noon (hard copy, not electronic). Incompletes will not be given out except in the case of medical problems. Hand in what you have done by the due date.

  To aid you in this project, I will hand out two *assignments* which you do not have to hand in, and will not be marked. The first assignment will involve using a Monte Carlo method for pricing options, and the second assignment will involve development of code for pricing an American option with a PDE method. You are encouraged to come and see me about these problems. Note that the project will involve putting together some of your code for Assignments 1 and 2, so do these assignments as soon as possible.

- **Programming Languages** You can do the project in either Matlab or C++. I will assume that you are familiar with one of these languages. Matlab tutorials can be found on the CS371 Web page:

  `http://www.student.cs.uwaterloo.ca/~cs371`