Course Syllabus

MA 796 - Computational Methods of Mathematical Finance

Spring Semester 2000

PROF. ANDREW LYASOFF

Time and place:
Tuesday and Thursday, 4:00 PM - 5:30 PM in Room MCS B31

Office:
Room MCS 228 (Math and Comp. Sci. Building, 111 Cummington St.)

My office telephone # is (617) 353-5785. The most efficient way to get in touch with me is by e-mail. My e-mail address is alyasoff@math.bu.edu. You can also leave a message for me in my mailbox in the main office of the Math Dept. (Room MCS 142).

Office hours:
Tuesday 12:30-2:00 and Wednesday 9:30-11:00

Text:

(1) THE MATHEMATICS OF FINANCIAL DERIVATIVES: A STUDENT INTRODUCTION by P. WILMOTT, S. HOWISON and J. DEWYNNE

(*) In addition, I will post regularly on my home page various supplementary materials, lecture notes, exercises, hints, etc. Note however, that those materials will be accessible only to officially registered students.

1. What is Computational Finance?

Suppose that one has to determine the present value of a contract, such as an option on a common stock, say, which brings rewards some time in the future. The amount of the reward is uncertain, but a reasonable assumption about its probability distribution can be made. The usual common sense implies that (well, roughly speaking) today's value of such a contract is some "discounted average" (or "discounted expected value") of all future rewards. Now, if the future rewards are time-functions (i.e., paths), one needs to work with probability distributions and expected values on path-spaces, known as random (stochastic) processes. The computation behind this sort of averaging (and it is not trivial by far), is the object of Mathematical Finance. There is a subtle relationship between expected values of certain functionals of stochastic processes and solutions of associated Partial Differential Equations (PDEs), encoded in the famous Feynman-Kac
formula. This makes it possible, under some reasonable conditions, to reduce the problem for valuation of contracts to the problem of solving some special PDEs and, consequently, use certain numerical procedures. This is what Computational Finance is all about.

2. Course Function

The main objective of MA 796 is to endow its students with capstone experience in the realm of Financial Derivatives. It will present fairly complex and, in some cases, nonstandard problems from Computational Finance. MA 796 is designed as the culmination of the Math Finance course-sequence offered at Boston University. However, it assumes no preliminary knowledge in this field and could be taken also by students who concentrate in other areas. Just as its title suggests, compared to other courses in Mathematical Finance offered at BU, MA 796’s main focus is on numerical procedures. It could be an excellent complement to any course-sequence in numerical methods, especially in numerical methods for PDE’s. The course will focus mostly on the practical aspects of Computational Finance and on finite difference methods with a considerable amount of computer programming and software development.

3. About the Course, its Prerequisites and Format

MA 796 will be build around three major projects, which students will need to develop and present at special sessions. Most of the class-work will have the form of a seminar with students presenting some new topics. Students registered for MA 796 will be expected to (know how to, or able to quickly learn to) work with programs like, MATLAB and C++. Inevitably, some programming "tricks" will be discussed during the lectures and, in general, it will be possible for a student with a good general knowledge of computers to follow the course without difficulty. PREREQUISITES: Calculus (including Multivariate Calculus – MA 225), Linear Algebra – MA 242, Differential Equations – MA 226 and Probability – MA 581.

4. Course Plan

Please refer also to §6 below.

Week 1: Introduction to options and markets.
Week 2: A simple model for asset prices and the role of Ito's lemma.
Week 3: Basic option theory.
Week 4: American options as free boundary problems.
Week 5: American options as variational problems.
Week 6: Dividends and time dependent parameters.
Week 7: Exotic and path-dependent options - general theory.
Week 8: Barrier options.
Week 9: Arian options I.
Week 10: Arian options II.
Week 11: Look-back options.
Week 12: Options with transactions costs.
Week 13: Interest rate derivative products.
Week 14: Convertible bonds with random interest rate.
5. Homework and Grading

Homework problems will be assigned every week. Your final grade will reflect 30% of the average grade from homework and 70% of the average grade from projects and presentations.

6. Academic Calendar for Spring 2000

Instruction Begins
Monday, January 10, 2000

Holiday, Classes Suspended
Monday, January 17, 2000

Holiday, Classes Suspended
Monday, February 21, 2000
Substitute Monday Schedule of Classes
Tuesday, February 22, 2000

Spring Recess
Saturday, March 4, 2000 through Sunday, March 12, 2000

Instruction Resumes
Monday, March 13, 2000

Registration for Fall 2000
Wednesday, March 29, 2000, for select schools

Holiday, Classes Suspended
Monday, April 17, 2000

Instruction Ends
Wednesday, May 3, 2000

Study Period
Thursday and Friday, May 4 and 5, 2000

Final Exams Begin
Monday, May 8, 2000

Final Exams End Tuesday,
May 16, 2000

COMMENCEMENT
Sunday, May 21, 2000