STOCHASTIC CALCULUS AND MATHEMATICAL FINANCE

MA530a (Fall 2015)

Professor Jin Ma

Office: KAP 250
Office hours: WF: 11:00am-12:30pm (or by appointment)
Phone: 0-3771
email: jinma@usc.edu
URL: http://www-bcf.usc.edu/~jinma

Course Description

This course is the first part of a two-semester sequence designed to provide an introduction to the mathematical tools and techniques of modern finance theory. The first half of the semester will be devoted to a thorough review and quick access to the basic probability theory, stochastic processes, and elementary stochastic analysis. The concepts of Brownian motion, martingale theory, stochastic integrals, and stochastic differential equations will be introduced and explored to a level that will be sufficient for the study the continuous time financial market models. The basic mathematical descriptions of financial instruments, such as stock prices, contingent claims, option prices, and important concepts such as arbitrage, market completeness, hedging strategies, will be discussed in both discrete time and continuous time, at a rigorous but elementary level. All discussions will be mainly restricted in the Black-Scholes world, that is, the mean return and the volatility of the market will be assumed to be constants. If time permits, we will start the study stochastic portfolio optimization and/or more general stochastic control theory, which will be explored fully in the Spring semester, along with many other topics in mathematical finance.

Textbook:

Arbitrage Theory in Continuous Time, by Tomas Bjork, Oxford U. Press, 2004.

Suggested Reading:

- *Stochastic Calculus for Finance II, Continuous-Time Models*, by Steven E. Shreve, Springer, 2004 (Second printing, 2008)

- *Probability Essentials*, by Jean Jacod and Philip Prottor, Springer, 2000.

Subjects to be presented:

- Review of probability theory and stochastic processes (Class Notes, 4 weeks)
- Some aspects of differential equations (Class Notes, 1 week)
- The binomial model (Chap. 2, 4 weeks)
- Basics of stochastic analysis (including stochastic integrals and stochastic differential equations) (Chap.3-4, 2 weeks)
- Black-Scholes pricing (Chap. 5-6, 2 weeks)
- Black-Scholes hedging (Chap. 7-9, 2 weeks)

Grading Policy

- Homework/quizzes 20%
- Midterm/Class project 40%
- Final Exam 40%

Classroom Policy

The assessment of a student's performance for the course will be based on the total score of all the graded assignments, which include homowork, quizzes, exams, and projects, if any. During the semester no letter grades (such as "A", "B",...) will be given for any of the tests/projects. However, a "progress report" of the whole class will be handed out periodically, usually after a midterm exam or class project, so that each student can find his/her ranking in the class. The final letter grade will depend largely on the ranking in a natural way.

While it is acceptable to work in groups for homework and/or projects, each students must turn in an individual assignment. Plagiarism (copying other people's work) will not be tolerated.

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.-5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: `http://www.usc.edu/dept/publications/SCAMPUS/gov/`. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: `http://www.usc.edu/student-affairs/SJACS/`.