MATH 5760/6890, Fall 2011
Introduction to Mathematical Finance I

Time and Place: TH 9:10-10:30 am, LCB 121

Instructor: Jingyi Zhu, Telephone: 801-581-3236, E-mail: zhu@math.utah.edu

Office Hours: TH 12:00-2:00 pm or by appointment, LCB 335

Text: S. M. Ross, *An Elementary Introduction to Mathematical Finance,* Third Edition (2011), Cambridge University Press, ISBN 978-0-521-19253-8.

Prerequisites: Introduction to Probability (Math 5010) and Differential Equations (Math 2280)

Programming: Computer implementation is an essential component of this subject, and you will be required to do some of your coursework with computer programs. Either Matlab or Excel will be acceptable, but we strongly encourage you to start with some basic Matlab programming if you have no prior experience with any computer programming.

Outline: This is the first part of a two-semester sequence course on mathematical finance. In the Fall semester, we will examine the fundamental principles of financial derivatives from both financial and mathematical perspectives, and demonstrate how the mathematical tools from stochastic calculus, differential equations and numerical methods join forces to form an essential part in modern finance. The emphasis of the course is a mathematical understanding of the intrinsic relationships among various financial instruments, which serves as a basis for investment decisions and trading strategies. The central theme of the Fall semester is the classic Black-Scholes-Merton model, and we plan to give a thorough treatment of the original model, with extensive discussions on the practical extensions in response to various disadvantages of the original model. One of the most intuitive and transparent approaches to illustrate that is also extensively used in practice is the binomial tree model. It contains most of the essential idea of the Black-Scholes-Merton methodology, and it can be naturally extended to build more general continuous-time models. Time permitting, we will include as much real life examples as possible to make this a rewarding experience for those who plan to pursue a career in this direction, as well as those who are just intrigued by the subject and its impact on our society.

Topics to be Covered:

- Introduction to investment securities and financial derivatives
- Random walk and Brownian motion
- Interest rates and present value analysis
- Concept of arbitrage and pricing based on no-arbitrage principle
- Binomial models (one-period and multi-period)
- Black-Scholes formula
- Practical issues in option pricing: dividend, American put, adding jumps, and volatility estimates

- Incomplete market and utility valuation
- Optimization models
- Stochastic dynamic programming
- Exotic options
- Autoregressive models and return analysis

Grading:

- Homework assignments (60%): taken from the textbook;
- Midterm Project (10%): a project that will require handling practical data;
- Take-Home Final (30%): a comprehensive exam that covers all the materials and it will be made available at the beginning of the last week of class.

For Students Registered for Math 6890: If you are a PhD student in a non-mathematics program, you may register at the 6000 level. However, you will be required to do extra work for the course which may include: more theoretical exercises in homework assignments and exams, and research oriented projects. Grading curve for Math 6890 is separated from the rest of the class.

Other references:

- *Options, Futures, and Other Derivatives,* John Hull, 8th Edition (2011), Prentice Hall.
- *Financial Calculus: An Introduction to Derivative Pricing,* M. Baxter and A. Rennie, (1996), Cambridge University Press.
- *Dynamic Asset Pricing Theory,* Darrell Duffie, 3rd Edition (2001), Princeton University Press.
- *The Mathematics of Financial Derivatives: A Student Introduction,* Paul Wilmott, Sam Howison, Jeff Dewynne, (1995), Cambridge University Press.
- *Derivatives in Financial Markets with Stochastic Volatility,* J-P Fouque, G. Papanicolaou, and K. R. Sircar, (2000), Cambridge University Press.
- *The Volatility Surface,* Jim Gatheral, (2006), John Wiley and Sons.

ADA Statement: The American with Disabilities Act requires that reasonable accommodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. Please contact the instructor at the beginning of the semester to discuss any such accommodations you may require for this course.