MATH 5760/6890, Fall 2013
Introduction to Mathematical Finance I

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

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

Office Hours: TH 3:00-4:00 pm or by appointment, LCB 335

Text: M. S. Joshi, *The Concepts and Practice of Mathematical Finance,* 2nd Edition (2008), Cambridge University Press, ISBN 978-0-521514088

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

Course Objectives: Mathematical finance is one of the recent notable subjects and also a fast-growing branch in applied mathematics. In this introductory course, we will start with a discussion of financial risks and the ideas of leveraging and hedging. This leads to the emergence of a class of financial instruments: the financial derivatives, which require a thorough understanding of the relationships among those financial assets when the market moves. The fundamental ideas behind market pricing and therefore the methodologies are the great achievements of modern finance. Some of the important concepts based on market behavior will be introduced and extensively explored, so we can learn about the rationales, as well as the business aspects, of the workings of a very important part of modern day finance. It is hoped that you can benefit from this class whether you are interested in pursuing a career in finance, or just educating yourself in personal investments.

Course Outline: This is the first part of a two-semester sequence course, and 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 concept of risk in financial investment and the classic Black-Scholes-Merton 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 the essential idea of the Black-Scholes-Merton methodology, and also provides a natural motivation to introduce stochastic calculus to study continuous-time models. We will include as many 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.

Programming: Computer implementation is an essential component in this field, 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 learn some basic Matlab programming if you have no prior experience with any computer programming.

Grading:

- Homework assignments (60%): taken from the textbook;
- Midterm Project (10%): a project that will require handling real world data sets;
- Final exam (30%): Friday, Dec 20, 2013, 8:00 - 10:00 am, in LCB 121. This is a comprehensive exam that will cover all the materials, and it is based on homework exercises. The scheduled time is set by the University Scheduling and we may find an earlier date if it is necessary and accommodating for everyone. You must take the final exam in order to receive a grade of "C" or better.

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.

Tentative Schedule

Week	Date	Chapter	Topic
1	Aug 27, 29	1	introduction to investment risk
2	Sept 3, 5	2	concepts of hedge and arbitrage
3	Sept 10, 12	3	trees and binomial model
4	Sept 17, 19	3	log-normal model
5	Sept 24, 26	4	volatility and Greeks
6	Oct 1, 3	5	Brownian motion
7	Oct 8, 10	5	Itô calculus
8	Oct 15, 17	none	fall break
9	Oct 22, 24	6	risk-neutrality
10	Oct 29, 31	6	martingale measures
11	Nov 5, 7	7	practical pricing
12	Nov 12, 14	7	Monte Carlo methods
13	Nov 19, 21	8	reflection principle and barrier options
14	Nov 26	8	digital options
15	Dec 3, 5	9	path-dependent options
16	Dec 10, 12	9	multi-look options