MATH 5765/6895, Spring 2019
Introduction to Mathematical Finance II

Time and Place: MW 1:25 - 2:45 pm, LS 107

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

Text: A. Petters and X. Dong, *An Introduction to Mathematical Finance with Applications*, 1st Edition (2016), Springer Undergraduate Texts in Mathematics and Technology, ISBN-13:978-1493937813, ISBN-10: 1493937812
Lecture notes will be available for materials not covered in the textbook.

Prerequisites: Introduction to Mathematical Finance I (Math 5760), or instructor's consent.

Course Objectives: This is the continuation of Math 5760, in which the basic ideas and practice in financial markets are introduced. In this semester we will formally use the tools of continues-time stochastic calculus, in particular the concepts of Brownian motion and Itô calculus, to introduce the Black-Scholes pricing theory and its various extensions. The power of continuous-time models is demonstrated in their ease and transparency in dealing with many aspects of the models to incorporate realistic factors. The second half of the semester will be devoted to some other aspects of financial markets, including interest rate derivatives, credit markets, foreign exchange products, optimal portfolios, trading strategies, market liquidity, and environmental finance. Specifically, we will target the following objectives:

- Understand the fundamental concepts in using stochastic processes to model security price movements.
- Understand the concepts of Brownian motion, and be familiar with some of the basic calculations involved in Itô processes.
- Understand the general Black-Scholes-Merton model and its limitations.
- Understand various risks involved in financial markets and become familiar with various products intended to transfer those risks, which lead to trading of specific instruments.
- Explain early exercise privilege in American options and understand the formulation for pricing and early exercise policies.
- Understand the concept of value function and its connection with dynamic programming, learn about the derivation and methods to solve the Bellman equation.
- Understand the basic ideas behind statistical arbitrage strategies involved in high-frequency trading.
- Learn about efforts to use environmental investments to tackle climate change, and understand real options to impact emission dynamics.

- Understand the trading structures and the impact of asymmetric information.
- Design and perform Monte Carlo simulations to price various products with a specific model, improve the performance with variance reduction techniques.

Programming: Computer implementation is an essential component in this field, and you will be required to do some of your coursework with computer programs. Any of Matlab, R, Python, Java 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:

- Biweekly homework assignments (50%);
- Five projects (50%): they will require handling real world data sets and programing;

For Students Registered in Math 6895: Extra work for the course which may include: more theoretical exercises in homework assignments and exams, and more research oriented projects.

Other References:

- *Options, Futures, and Other Derivatives,* John Hull, 10th Edition (2017), Prentice Hall. ISBN-13:978-0134472089
- *Financial Mathematics: A Comprehensive Treatment*, G. Campolieti and R. Makarov, 1st Edition (2014), Chapman and Hall/CRC Financial Mathematics Series, ISBN-13 978-1-4398-9242-8
- *The Concepts and Practice of Mathematical Finance,* M. S. Joshi, 2nd Edition (2008), Cambridge University Press, ISBN-13: 978-0521514088
- *Financial Decisions and Markets: A Course in Asset Pricing,* J. Y. Campbell, (2018), Princeton University Press, ISBN 978-0691160801

Table 1: Grading Scales

%-age	90-100	85-89	80-84	75-79	70-74	65-69	60-64	55-59	45-54	0-44
Grade	A	A-	B+	B	B-	C+	C	C-	D	E

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	Topic
1	Jan 7 - 9	Recap of Math 5760, Binomial Tree Model
2	Jan 14 - 16	Brownian motion and Itô's formula
3	Jan 23	Continuous-time stochastic calculus
4	Jan 28 - 30	Derivative securities
5	Feb 4 - 6	Risk-neutral pricing and managing portfolio risk
6	Feb 11 - 13	American options
7	Feb 20	Interest-rate derivatives
8	Feb 25 - 27	Credit and energy derivatives
9	Mar 4 - 6	Volatility and multi-asset models
10	Mar 10 - 17	Spring break
11	Mar 18 - 20	Value function and Bellman equation
12	Mar 25 - 27	Statistical arbitrage
13	Apr 1 - 3	High frequency trading strategies
14	Apr 8 - 10	Alpha trading
15	Apr 15 - 17	Asymmetric information and liquidity
16	Apr 22	Review