

Financial Engineering with Stochastic Calculus II (ORIE 5610)

Spring 2017

Lectures: Tue and Thu 10:10am - 11:25am in Phillips 407

Recitations: Thu 2:55 - 4:25pm in Hollister 206

Office hours:

Andreea Minca (Instructor): Tue 11:30am - 12:30 pm in RHD 222. Email: acm299@cornell.edu

Xiaoyang Lu (Teaching Assistant): Rhodes 420, Wed from 14:30 - 15:30 - Only during the weeks that the HW is due or by appointment. Email: xl562@cornell.edu

Contents: Building on the foundation established in ORIE 5600, this course uses stochastic calculus tools to analyze continuous-time equity and fixed-income models in financial engineering. Topics include

- I: Pricing in Markovian models: stochastic differential equations, Feynman-Kac Theorem, PDE pricing methods, local volatility and stochastic volatility
- II: Exotic options: distribution of Brownian motion, path-dependent options in the Black-Scholes model (barrier, lookback, asian options)
- III: American derivative securities: stopping times, optional sampling theorem, American call and put options
- IV: Change of numeraire: pricing measures, the forward measure
- V: Interest rate models: stochastic interest rates, short rate models, HJM framework for term structure models, LIBOR market model

Prerequisites: Strong background in probability theory, stochastic calculus and financial engineering is required (ORIE 5600, ORIE 6510 or equivalent). This includes martingales, Brownian motion, Itô calculus, and the Black-Scholes model.

Assignments: Homework assignments sheets will be posted on the course homepage at <http://www.blackboard.cornell.edu/>. There are five assignments. Due dates can be found on the assignment sheets. Homeworks should be uploaded in a single pdf or word file.

Grading: The final grade will be based on homework assignments (40%), a mid-term exam (30%) and a peer-graded final presentation of a project based on Premia in groups of two (30%).

Mid-term exam will be in-class.

Literature: The course is based on chapters 6 to 10 of the textbook

- [Shr04] S. Shreve, *Stochastic Calculus for Finance II – Continuous-Time Models* (2004).

Further reading:

- [Dur96] R. Durrett, *Stochastic Calculus – A practical Introduction* (1996).
- [KS88] I. Karatzas and S. Shreve, *Brownian Motion and Stochastic Calculus* (1988)
- [RW00] C. Rogers, D. Williams, *Diffusions, Markov Processes and Martingales*, Vol. 1 & 2 (2000)
- [Bjo03] T. Björk, *Arbitrage Theory in Continuous Time* (2003)
- [KS98] I. Karatzas and S. Shreve, *Methods of Mathematical Finance* (1998)
- [BM06] D. Brigo and F. Mercurio, *Interest Rate Models - Theory and Practice*, 2nd ed (2006)