ORIE 5600 Financial Engineering with Stochastic Calculus I
Fall 2019, 4 credits

Andreea Minca
acm299@cornell.edu
222 Rhodes Hall

Lectures: T/Th 10:10 - 11:25am in Phillips Hall 101
Recitations: Wed 8:40 - 9:55 am PHL 407, Th 2:55-4:10pm in PHL403
TA
Karen Grigorian kgg44@cornell.edu
Lucy Huo dh622@cornell.edu
Prof. Sid Banerjee will teach the lectures on Oct 1, 2, 8, 10, 17 (Brownian Motion)

Recitations will start on Tue, 2 September.

Office hours:
Andreea Minca (Instructor): Thursday before the class 9-10 a.m. in RHD 222. Email: acm299@cornell.edu
Karen Grigorian: Friday, 4-5:30 pm, Rhodes Hall 431

Lucy Huo: Thursday, 5-6 pm, Rhodes Hall 431

Prelim exam : 10/24/2019 during class time.
Final exam: 12/14/2019 9:00 AM
Website: The course website is available through http://blackboard.cornell.edu/. Please register with the site and check it regularly.

Contents: This course provides an introduction to continuous-time models of financial engineering and the mathematical tools behind them. It develops a practical knowledge of stochastic calculus, culminating in the analysis and first applications of the Black-Scholes model

Topics of Financial Engineering with Stochastic Calculus I include

I: Introduction: financial engineering, binomial model

II: Background in probability: information and σ-algebras, independence, general conditional expectations, martingales, fundamental theorem of asset pricing

III: Brownian motion (BM): scaled random walks, definition of BM, distribution of BM, filtration for BM, martingale property of BM, quadratic variation

IV: Stochastic calculus: stochastic integral, Itô processes, Itô-Doeblin formula, Black-Scholes-Merton equation, multivariable stochastic calculus

V: Risk-neutral pricing: Girsanov's theorem, risk-neutral measure, martingale representation, fundamental theorems of asset pricing

VI: Miscellaneous topics: Dividend paying stocks, Forwards and Futures, Exotic Options

Learning Outcomes: After taking this course, you should be able to 1. Have a rigorous method for obtaining the price of financial derivatives, and understand the assumptions under which your model applies. 2. Implement hedging strategies for vanilla options. 3. Add layers of sophistication to the basic model of Black and Scholes, understand how to extend the model while keeping tractability. 4. Understand how practitioners use the models.
Prerequisites: A very strong knowledge of stochastic processes required (ORIE 3510 or equivalent, recommended above B+). This includes Markov chains.

Literature: The course is based on chapters 1 to 5 of the textbook

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

Assignments: Assignment sheets will be posted on the course homepage at `http://www.blackboard.cornell.edu/`. The homework sets will be due on Mondays (approx 6 HW). They are to be submitted in the course box in Rhodes Hall, second floor.
One homework will have computational assignments and there is a small project. You can choose any programming language. The working code, commented, will be sent by email to Karen Grigorian.

Questions : are best responded to during office hours (as opposed to email). Clarifying questions regarding the material are particularly welcome during lectures.

Late homework policy : No late homework is accepted.

Grading: The final grade will be based on homework assignments (30%), 10% the project, the midterm exam (25%) and the final exam (35%).

In an effort to link the course material to practitioner interest, we have collected in past years some questions that arise in quantitative interviews. These will be made available to you after the fall break. You will also contribute and your contribution must be typed (preferably in Latex). For the quantitative interview questions you may work in groups of three.

The deadline for submitting the contribution (by Email to Lucy) is the last day of classes.

If there is a dispute about grading, you may turn in the work with a written request for a regrade within a week of the work being returned. **All** *of the work, and not just the disputed question, will be regraded.*

Attendance: at both the lecture, the recitations and check-in sessions is required. You are responsible for being aware of the announcements and content of lectures and recitations.

Exams: You may bring the textbook, your classroom notes and your homework. You may not bring a computer, but may bring a calculator that does not have any communication capability.

Make-up Exam: If you miss an exam for medical reasons (with documentation), you are allowed to take a make-up exam.

Academic Conduct: Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any homework should be the student's own work, unless otherwise specified. In particular:

- You may not discuss with other students other than the level of a corridor discussion. No notes should be taken away from such discussions.
- You may not work through solutions with others and cannot share computer files.
- You may not discuss the homework with past students who have significant knowl-

edge of the details of the problem set.

- You are not allowed to derive advantage in any way from the existence of solutions prepared in prior years, whether they are instructor-supplied or a student's own work.

If you violate this policy then you risk failing the course. If you have any questions about this policy, please do not hesitate to contact me.