INSTRUCTOR: Professor Steven Kou

POINTS and HOURS: 3 points, Tuesday from 9:30 am-11:30 am

PREREQUISITES: Probability theory and advanced stochastic models at the IEOR E6709, STAT-IEOR W6501 level. A basic knowledge about finance is recommended but not required.

AUDIENCE: Ph. D. students from the IEOR Department, Business, Statistics, Mathematics, and Economics, interested in doing research in financial engineering. Advanced master students if they are also interested in research. All students will be subject to the same requirements.

METHOD: This is a research seminar in Financial Engineering, not a typical lecturing course. There will be no homework and no exam. The only requirements are a final paper and a presentation based on the paper.

FINAL PAPER: The best grade should be given to research papers with new results, possibly suitable for publication after some extra work. Then the next category is that of lecture-notes-type survey papers. Hopefully the survey papers might bring new insights to existing results, for example, by providing a new proof or derivation to papers that might be otherwise difficult to be understood, or by providing new links to existing papers that may inspire further research in the area. In other words, the basic criterions are: what is the result, why is it interesting, is the exposition clear, and, most importantly, “what is new”.

PRESENTATION: Students must give a presentation to the class about their papers. All the students must also attend the presentations. Extra credits will also be given to students who can ask interesting and critical questions.

STYLE: At the end of each lecture, we attempt to suggest some open research problems.

PAPER TOPICS: In addition to the open problems provided at the of each lectures, some additional possible topics for both research and survey papers are, for example, Equilibrium pricing of options; Weather options; Credit derivatives; Environmental options; Mathematical models of market psychology. Of course, you can select your own topics.

FINAL GRADE: Your final grade will be determined by both the paper and the presentation.
REMARK: This course is different from the course FE II that I taught last year. FE II taught you what the formulae are, without teaching your how do we get the results, and why the results are true, and more importantly, how do we improve the results and find some new ones. That is a main difference between a regular course and a research course.

COURSE WEB: www.columbia.edu/~sk75/E6703

E-MAIL: sk75@columbia.edu

OUTLINE:

1. Basic Mathematics and Finance, including the concepts of arbitrage and hedging stochastic calculus.
2. Basic Models, including binomial model, martingale approach to Black-Scholes formula, optimal stopping and American options, and pricing of continuous exotic options.
3. Discrete Exotic Options, including renewal theory and its application to pricing of discrete barrier and lookback options.
4. Jump Diffusion Models, including both normal and double exponential jump models.
5. Term Structure Models, including HJM and BGM LIBOR models.
7. Modeling Growth Stocks.
8. Presentations by Students.

Grading policy about the final project (a paper and a presentation based on the paper).

The policy aims at encouraging people to create new knowledge rather than to learn existing knowledge.

A+: Original research or high quality survey paper that may be suitable for possible publication, after some extra work.
A: Having some interest research ideas (such as a research proposal) or a survey with some novel ideals that may lead to new research.
A-: A survey with a good understanding of the survey subject, including both economic intuition and mathematical derivation.
B or lower: Without a good understanding of the subject.