MATH 6910: STOCHASTIC CALCULUS IN FINANCE - WINTER 2009

This course will introduce the basic ideas and methods of stochastic calculus and apply these methods to financial models, particularly the pricing and hedging of derivative securities. We start by introducing the concepts of arbitrage and risk-neutral pricing in a discrete-time setting, then move to more sophisticated continuous-time models. Along the way we cover the following mathematical topics: Brownian motion, stochastic integration, Ito's formula, martingales and Girsanov's transformations.

Prerequisites: A solid knowledge of calculus and basic probability theory (random variables, distribution, expectation, variance) will be assumed. Necessary concepts from measure theory and stochastic processes will be introduced as they are needed. A quick review sheet is posted on the course website.

Instructor: Hanna Jankowski
Email: hkj@mathstat.yorku.ca (Please include [6910] in the subject heading, text only - no html).
Office: Ross N621B
Office Hours: TBA, or by appointment. No drop-ins, please. Other aid hours may be announced as the course progresses.

Lectures: Mondays 9:00-12:00, in ACW303. The first lecture is held on March 9th, and the last is on ???.

Grading Scheme: Assignments (2-3): 30%, Term test 30%, Final exam: 40%. Dates, times, locations TBA.

Course web-page: http://www.math.yorku.ca/∼hkj/Teaching/6910/
Important course information will be posted on the website. I expect that you will check the site on a regular basis.

Textbook (required): Steve Shreve, *Stochastic Calculus for Finance II (Continuous-Time Models)*. Springer Verlag, 2006.

Time-permitting, I hope to cover Chapters 1-6.

COURSE POLICIES:

- All homework must be handed in at the **beginning** of the lecture on the day on which it is due. Late homework will not be accepted. Exercises will be assigned on a regular basis (see website), and many of these will become part of your assignment eventually.
- There will be no make-up tests scheduled. In case of illness supported by medical documentation, the final grade will be pro-rated based on the assignment and final exam grades.
- You must write the final exam in order to get a passing grade in the course.
- You are encouraged to discuss the homework problems with others, since this is often a good way to learn. However, you must write up your own solutions, and what you turn in should reflect your own understanding of the material. If two or more student papers appear to be copies, **all** will receive a zero grade.
- Class attendance is required. If you do miss a class, it is your responsibility to find out what was covered (from a fellow student) and wether any important announcements were made. Class participation is strongly encouraged – if you don't get something, ask!

OTHER REFERENCES (thanks to Tom Salisbury):

- Financial Calculus by Baxter and Rennie; Cambridge 1996. A nice survey of the ideas behind risk neutral valuation. Not much detail about stochastic calculus though.
- A Course in Financial Calculus by Alison Etheridge, Cambridge, 2002. Baxter and Rennie, but more mathematically.
- Stochastic Calculus and Financial Applications by J.M. Steele, Springer Verlag 2001 A good introduction, at a similar level to Shreve's book. If we weren't using Shreve's book as a text, we'd be using this one.
- Textbook-level treatments of stochastic calculus:
  - Introduction to Stochastic Integration by Chung and Williams, 2nd edition, Birkhauser 1990. A nice introduction to the theoretical side of stochastic calculus.
  - Stochastic Calculus by Rick Durrett, CRC Press. A more extensive treatment, though still at a textbook-level.
  - Stochastic Differential Equations by Oksendal, Springer Verlag Emphasis on applications, mostly not financial though.
- Advanced reference books for stochastic calculus, doing much more than we'll have time for:
  - Brownian Motion and Stochastic Calculus by Karatzas and Shreve, Springer.
  - Continuous Martingales and Brownian Motion by Revuz and Yor, Springer.
  - Diffusions, Markov Processes, and Martingales, Vol 1,2 by Rogers and Williams, Wiley.
- A more extensive treatment of mathematical finance:
  - Methods of mathematical finance by Karatzas and Shreve, Springer 1998.
- Financial engineering (with less emphasis on the mathematical aspects):
  - Options, Futures, and other Derivatives by Hull, Prentice Hall.
  - Derivatives by Paul Wilmott, Wiley 1998