

STA2503H/MMF1941H Stochastic Analysis for Finance Fall Term 2003

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Office Hours: 9-11am, Tuesdays or by appointment. You may also drop in anytime. I usually arrive in my office at 8:30am and leave at 4:20pm everyday.

Class times: Wednesdays 1-4pm in LA240

Overview

The aim of this course is to provide stochastic tools for financial modelling and pricing. It covers the basic theories of stochastic processes and stochastic calculus, with a focus on financial applications. I will use a manuscript entitled *Stochastic Calculus with Financial Applications* I wrote recently as a main textbook. If time permits, I will also cover Chapter 14 Stochastic Optimal Control of *Arbitrage Theory in Continuous Time* by Tomas Björk. The optimal control theory is useful for portfolio analysis.

Prerequisites

A solid background in probability theory is assumed. Understanding the measure theory would be a great asset but is not required.

Lectures

There will be 12 lectures which are tentatively scheduled as follows:

- Sept 10 probability review: probability spaces, information structures(σ -algebras), random variables, moments and transforms, multivariate distributions
- Sept 17 conditional probability, conditional distributions, conditional expectation, the central limit theorem.
- Sept 24 discrete-time stochastic processes: time-dependent information structures(filtrations), random walk, financial applications of random walks
- Oct 1 Discrete-time Markov chains, martingales, change of probability measure stopping times.
- Oct 8 continuous-time stochastic processes: general description of continuous-time stochastic processes, Brownian motion, the reflection principle, barrier hitting probabilities
- Oct 15 Poisson process, compound Poisson Process, martingales, stopping times, the optional sampling theorem
- Oct 22 stochastic (Ito) integration, stochastic differential equations, one-dimensional Ito's lemma

- Oct 29 the Black-Scholes option pricing formula, the stochastic version of integration by parts,
- Nov 5 exponential martingales, the martingale representation theorem,
- Nov 12 the Feynman-Kac formula, the Black-Scholes partial differential equation, the Girsanov theorem
- Nov 19 barrier hitting probabilities revisited, two-dimensional stochastic differential equations
- Nov 26 stochastic optimal control, applications to portfolio analysis
- Dec 3 no class
- Dec 10 final examination(in class)

Grading Scheme

Grades for the course will be based on two requirements. First, five problem sets (10% each) will be assigned every two weeks. I will try to hand out the first assignment in class before or on Sept 17. Second, the final exam will account for 50%.

TA Office Hours

Hanna Jankowski will be the teaching assistant for this course. She will hold weekly office hours in the MMF lecture room for Mondays, 10-12, beginning the 15th of September.