UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
Department of Mathematics and Statistics

Applied Mathematics 581 / Mathematics 681	Stochastic Calculus for Finance

(see Course Descriptions for the applicable academic year: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics	**Time**
Introduction: basics of probability, stochastic processes and math finance	1
Conditional expectation, martingales in discrete and continuous times, examples	2
Discrete-time (B,S)-security markets: capital, portfolio, arbitrage, completeness, self-financing, risk-neutral valuation and measure, options, Cox-Ross-Rubinstein option pricing formula	3
Brownian motion: definition and properties, quadratic variation, Markov property, reflection principle and application to first passage time distribution	6
Stochastic calculus: Ito integral, Ito processes, Ito formula, integration by parts formula, multivariable stochastic calculus, stochastic differential equations, examples	8
Continuous-time (B,S)-security markets: equivalent probability measures and the Girsanov Theorem; financial capital, self-financing portfolios, arbitrage, market completeness; risk-neutral valuation and measure, first and second fundamental theorems of asset pricing, applications to option pricing, Black-Scholes-Merton formulas	8
Stopping times, American options	1
Stochastic interest rates and their derivatives	2
Stochastic models in energy and commodity markets, derivatives	2
Value-At-Risk and risk management	2
Poisson processes, jump diffusions and applications to finance	1
	36

Course Outcomes for AMAT 581

Students successfully completing this course will be able to:

1. Define Brownian motion and analyze its behavior using basic probability and stochastic process theory
2. Construct Ito's integral and stochastic differential equations (SDE) based on Brownian motion
3. Develop Ito's formula, and use it as a tool to analyze the stochastic dynamics of functions of Brownian motion
4. Formulate and analyze the most important elements of a financial model using Ito calculus
5. State the fundamental theorems of asset pricing and recreate the key steps in their derivations; use these theorems to distinguish important features of a financial model
6. Derive the risk neutral evaluation formula and use it to calculate the prices of contingent claims on financial assets modeled as Ito processes
7. Survey a list of advanced topics (American options, stochastic interest rate models, commodity markets, risk management, Poisson processes, jump diffusion and Levy processes) and summarize the key points.

* * * * * * * * * *

2016:08:11
JM