UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
Department of Mathematics and Statistics

Applied Mathematics 583 / 683 Computational Finance

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

Syllabus

Topics	**Number of Hours**
Asset price models: the lognormal model; other models (including, for example, mean-reversion, stochastic volatility, jump-diffusion)	6
Option valuation: options as discounted expectations; the Black-Scholes PDE and formulae	4
Model calibration: maximum likelihood and moment matching; implied volatility	5
Tree-based methods (review)	1
Finite-difference methods: relationship with trinomial trees; implicit methods; methods for American options; exotic option pricing	8
Fourier methods for option pricing	4
Monte Carlo simulation: high-dimensional valuation problems; variance reduction; path-dependent problems; quasi-Monte Carlo methods	8
TOTAL HOURS	**36**

AMAT 583: Introduction to computational finance

Course Outcomes:

By the end of this course, students will be able to:

1. Describe how option values can be expressed both as conditional expectations and as functions that solve certain partial differential equations, and list numerical methods that are appropriate in each case.
2. Describe (for example using formulae or pseudo code) a range of numerical methods for option valuation, such as binomial/trinomial trees, finite difference methods, finite element methods, Monte Carlo and quasi-Monte methods or FFT-based methods.
3. Create computer code (in Matlab or Python) to perform numerical computations of European, American and exotic option values using various numerical methods.
4. Describe the sources of error in a range of computational methods for derivative valuation and explain how they can be controlled.
5. Explain the meaning of the output of a Monte Carlo computation.
6. Discuss the relative advantages and disadvantages of various computational methods for derivative valuation and computation of other financial quantities in terms of accuracy, efficiency and their use in practice.
7. Determine appropriate models for financial time series and select and implement appropriate calibration methods.

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