APS 1022 Financial Engineering II

Prerequisite: APS 1002 or equivalent, multi-variate calculus, probability and statistics, MATLAB programming or equivalent.

Required: Investment Science by David Luenberger (first or second edition)

Course is in two parts:

Part 1 Advanced Portfolio Optimization May 12-16 (Course Instructor:Roy H. Kwon, rkwon@mie.utoronto.ca)

Major Topics:

(1) Mean-Variance Optimization (MVO): MVO with and without short selling, alternative forms of MVO, practical issues in large-scale applications (overconcentration, complexity of parameter estimation, transaction costs (turnover constraints)), factor-model approach (single and multi-factor), mean-absolute deviation linear programming equivalent to MVO. Black-Litterman Portfolio Optimization

(2) Quadratic Optimization (aka quadratic programming QP): MVO as a QP, MVO requirements(positive-semi definite and positive definite covariance matrices), general non-linear optimization theory: unconstrained and unconstrained optimality conditions, KKT conditions for QP and MVO. Convex optimization.

(3) Discrete Choice in Portfolio Optimization: MVO with cardinality constraints and Index Tracking.

(4) Portfolio Optimization under uncertainty: maximum expected utility portfolio optimization, stochastic programming, robust optimization, CVaR optimization.

Exam May 16 from 1-4PM 80% of Part 1 Marks (Exam will be held in BA 2185 from 1-4PM, you will be allowed two sides of a 3 by 5 inch note card, otherwise exam is closed book and closed notes, a non-programmable and non-financial calculator is permitted)

Computational Projects 20% of Park 1 Marks Details (will be due after the 23rd of May other specific due date TBD) First project must be done individually and the second will a group (you can form a group of 2-3 students).

Note: Total Marks from Part 1 is 50% of overall course mark.

Part 2: Derivative Securities and Pricing

Instructor: Prof: Chi-Guhn Lee, cglee@mie.utoronto.ca

Office: MC322 (416-946-7867)

Textbook and Reading

Required: Investment Science by David Luenberger (first or second edition)

Readings: Ch 10, Ch 11, Ch 12, Ch 13

Main topics:

(1) Asset dynamics, lattice and Monte Carlo simulation
Stochastic processes to model asset price dynamics such as Markov process, wiener process and geometric Brownian motion. As a computational tool, lattice and Monte Carlo simulation will be discussed.

(2) Derivatives: forwards, futures, options and swaps
Basic derivatives, such as forwards, futures, options, and swaps, are introduced along with their pricing methods. Also covered is hedging (the perfect hedging and the minimum-variance hedging) using derivatives.

(3) Option theory
Options will be discussed in more detail including types of option, put-call parity, risk-neutral valuation, the Black-Scholes formula, and exotic options.

Course evaluation

(1) Exam (80%)
   a. Exam will be held in class on the last day of the second week
   b. You will be allowed two sides of a letter paper
   c. Otherwise, exam is closed book and closed notes, a non-programmable and non-financial calculator is permitted

(2) Computational Project (20%)
   a. Derivative pricing using lattice and Monte Carlo simulation
   b. Group project
   c. Final report with less than 20 pages (excluding appendix)