MATH362 – Fundamentals of Mathematical Finance (Fall 2007)

Course objective
This course is directed to those students who would like to acquire an introduction to fundamental principles of quantitative finance and financial economics. The topics include portfolio analysis, capital asset pricing models, arbitrage pricing models, utility theory, stochastic dominance, asset pricing theory and investment-consumption models.

Prerequisite
No prior knowledge in finance is required. Familiarities with basic probability theory are **absolutely necessary**. You cannot take this course without taking an earlier course in Probability or Statistics. Basic topics include

1. Probability distribution of a random variable [LECT1C; MATH246]
2. Gaussian and Poisson distributions [LECT2B, LECT2C; MATH246]
3. Moments of a single random variable [LECT2D; MATH246]
4. Sum of several random variables [LECT3A, LECT3B, LECT3C; MATH246]

To review the materials by yourselves, please download the lecture notes from MATH246 – Probability and Random Processes.

Instructor
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Office hours: 3:30pm - 5:00pm (Monday, Wednesday and Friday, or by appointment)

Reference text
"Investment Science," by D.G. Luenberger

Course content
1. Mean variance portfolio theory
    - 1.1 Mean and variance of portfolio return
    - 1.2 Markowitz's mean-variance formulation
    - 1.3 Two-fund theorem
    - 1.4 Inclusion of the risk free asset: One-fund Theorem
    - 1.5 Addition of risk tolerance factor
    - 1.6 Asset-liability model

2. Capital asset pricing model and factor models
    - 2.1 Capital asset pricing model and beta values
    - 2.2 Interpretations and uses of capital asset pricing models
    - 2.3 Arbitrage pricing theory and factor models

3. Utility theory and utility maximization for portfolio choices
    - 3.1 Optimal long-term investment criterion – log utility criterion
    - 3.2 Axiomatic approach to the construction of utility function
    - 3.3 Maximum expected utility criterion
    - 3.4 Characterization of utility functions
    - 3.5 Quadratic utility and mean-variance criteria

3.6 Generalization of CAPM under utility framework

4. Choices over probability distributions and stochastic dominance
   - 4.1 Choices of a probability distribution on consequences
   - 4.2 Stochastic dominance
   - 4.3 Two-asset portfolio analysis

5. Valuation of contingent claims and investment-consumption models
   - 5.1 Dominant trading strategies and law of one price
   - 5.2 Arbitrage opportunities and risk neutral probability measure
   - 5.3 Valuation of contingent claims
   - 5.4 Investment, consumption and endowment

Grading policies

Two one-hour mid-term tests	25% x 2
Two-hour final examination	50%
Five sets of homework	0%

Dates of mid-term tests

8 October (Monday) during lecture hour
5 November (Monday) during lecture hour