# Mathematics for Financial Economics
# Syllabus - September 2009

August 14, 2009

## Course Objectives

The course is focused on continuous time models and their use in financial economics. Our objective is to study the tools employed in solving dynamic optimization and valuation problems. We will illustrate each technique with a financial application.

## Contact Information

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## Course Evaluation

Final Exam : 70%
Problem sets: 30%

## Course Outline

- Introduction
    1. Probability space, random variable
    2. Expectations as integrals
    3. Manipulations with integrals
    4. Solving non-linear equations, perturbation theory
- Stochastic processes in discrete time: filtrations, conditional expectations, stopping times
- Brownian motion
    1. Definition and basic properties
    2. Stochastic integral: contraction, properties
    3. Stochastic calculus: Ito's lemma
    4. Stochastic Differential Equations
    5. Change of Measure, Girsanov Theorem
    6. Martingale Representation Theorem
    7. Feynman Kac Formula. Links of PDEs, ODEs and SDEs. Calculating expectations and stopping time distributions
    8. Kalman-Bucy Filter
- Dynamic Optimization
    1. Solving dynamic optimization problems in discrete time, dynamic programming, contraction mapping principle
    2. Hamilton Jacobi Bellman Equations and Verification Theorems
    3. Another Approach to Optimization: Stochastic Maximum Principle
    4. Application to Kyle's Model
- Optimal Stopping