Mathematics of Finance

Department of Information, Risk and Operations Management

McCombs School of Business

RM 391 - Spring 2013

Course information

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Class times: Monday, 5-8:00pm, CBA 4.338
Office hours: Monday 10-12, Thursday 10-11 and by appointment.

Description: This is a doctoral-level course, intended to prepare students for research in Quantitative Finance. The course will provide an introduction to continuous time Finance. The topics covered include portfolio management, derivative pricing, risk measures and equilibrium asset pricing, both in complete and incomplete markets. If time permits, we will also cover term structure models and credit risk. In the first two weeks of the course we will cover elements from stochastic calculus that will be used throughout the class.

Prerequisites: There are no formal course prerequisites, but this course is the continuation of FIN 395.3, "Asset Pricing Theory".

While FIN 395.3 dealt with discrete time models, RM 391 deals with models in continuous time. Some basic knowledge of real analysis, partial differential equations and stochastic processes will be very helpful.

Depending on the technical background of the students, extra classes will be given to cover some technical material on stochastic calculus.
**Grading:** Grades will be based on homework assignments, one midterm take-home exam and one take-home final exam. (40% homework assignments, 20% midterm and 40% final exam).

All work is individual. You will receive 6-8 homework assignments throughout the semester.

Assigned homework should be turned in through Blackboard by the beginning of class on the listed due date. No late homework will be accepted.

**Textbook:** There will not be a textbook for the course, but we will rely on the following books. I will also distribute notes for each topic.

- *Stochastic Calculus for Finance II*, by S. Shreve
- *Continuous Time Finance*, by R. Merton
- *Martingale methods in financial modelling*, by M. Musiela and M. Rutkowski
- *Theory of Asset Pricing*, by G. Pennacchi

**List of Topics**

**Mathematics Tools**

- **Monday, January 14**
  Random variables, probability spaces, distributions
  Filtrations and conditional expectation.
  Martingales, Brownian motion
  Ito's calculus
- **Monday, January 28**
  Stochastic differential equations
  Feynmac-Kac formula
  Hitting times and reflection principle
Portfolio choice

- **Monday, February 4**
  
  Expected utility models
  
  Portfolio choice
  
  Hamilton-Jacobi-Bellman equation

- **Monday, February 11**
  
  Duality methods

- **Monday, February 18**
  
  Optimal portfolio choice in incomplete markets

- **Monday, February 25**
  
  Transaction costs
  
  Robustness of risk preferences and duality multipliers
  
  Portfolio choice under alternative criteria
  
  (long-term growth, entropic, risk-sensitive criteria, etc.)

Behavioral finance

- **Monday, March 4**
  
  Continuous time behavioral finance models
  
  Ambiguity, loss aversion, robustness

Derivative valuation

- **Monday, March 18**
  
  Derivative pricing
  
  Fundamentals of derivative valuation in complete markets
-  **Monday, March 25**
  Valuation of European-type derivatives
  Black and Scholes equation
  Sensitivities, greeks

-  **Monday, April 1**
  Valuation of early exercise claims
  Optimal stopping

-  **Monday, April 8**
  Valuation of path-dependent claims
  Exotic derivatives

**Indifference valuation and risk measures**

-  **Monday, April 15**
  Indifference valuation
  Dynamic certainty equivalent

-  **Monday, April 22**
  Risk measures

**Asset price equilibrium**

-  **Monday, April 29**
  Asset price equilibrium