Mathematics of Finance

Department of Information, Risk and Operations Management

McCombs School of Business

<u>RM 391 - Spring 2013</u>

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, <u>extra</u> 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