

## Continuous Time Financial Economics

Academic Year: 2012-2013

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### Course description

This course builds on the material covered in the course on Financial Economics, which is set in discrete time. This course develops the economic and mathematical foundations of asset pricing and portfolio selection in *continuous time*. The course starts by introducing the mathematical tools required for modeling financial decision-making in continuous time. The course then applies these tools to the pricing of financial derivatives, modeling the term structure of interest rates and valuing interest-rate sensitive claims, optimal consumption and portfolio choices, and dynamic asset pricing in general equilibrium.

### Course objective

The objective of the course is to give you a deep understanding of modern finance. The material learnt in this course will provide you with the mathematical tools and theoretical foundations of financial economics that will help you understand the academic literature in finance and to write your dissertation.

### Course method

The course method consists of lectures in class, readings from the academic literature, and homework exercises that will allow you to test your understanding and extend the material covered in class.

### Course assessment

One set of homework problems will be given at the end of the first half of the course in March to be handed in May, at the beginning of the second week of the course, the second set given in May to be handed in late summer. The assignments will make up 100% (50% each) of the course mark. If an assignment is handed in late, a penalty of 30% will be applied to the mark. If an assignment is not submitted two months after the deadline, a 100% penalty will apply. If neither assignment is submitted, the student will be deemed to have failed the course. A failure prevents the student from taking the comprehensive exam. *The final exam for this course is closed book.*

### Textbooks for the course

The first book is the one that we will focus on; the others are useful for background reading.

1. Back, Kerry, 2010, *Asset Pricing and Portfolio Choice Theory* (Financial Management Association Survey and Synthesis Series).
2. Pennacchi, George, 2008, *Theory of Asset Pricing*, Addison-Wesley, MA.
3. Cvitanic, Jaksa and Fernando Zapatero, 2004, *Introduction to the Economics and Mathematics of Financial Markets*, MIT Press, MA.

### Prerequisites

The prerequisite for the course is a knowledge of probability and calculus, in addition to a solid understanding of the material in the Financial Economics course. You should prepare for this course by reading Chapters 1–11 of Kerry Back's book, "Asset Pricing and Portfolio Choice Theory," which focuses on discrete-time models.

## List of Topics Covered

### 1. Overview, Mathematical Background, and No-Arbitrage Pricing

- 1.1. Overview of Asset Pricing, and Asset Pricing in Discrete Time (Back Ch 1–11)   Lecture# 1
- 1.2. Mathematics for Continuous Time Finance (Back Ch 12)   Lecture# 2
- 1.3. Stochastic Discount Factor and Returns (Back Ch 13)   Lecture# 3
- 1.4. Change of Measure/Numeraire and Change of Drift (Back Ch 15, 16)   Lecture# 3

### 2. Valuation and Hedging of Options on Equities, Currencies, and Commodities

- 2.1. The Black-Scholes Model of Option Pricing (Back Ch 15)   Lecture# 4
- 2.2. Extensions of the Black-Scholes Model to Options on  
Forwards, Futures, Currencies, and Commodities (Back Ch 16)   Lecture# 5

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### 3. Valuation and Hedging of Options on Interest Rates

- 3.1. Fixed Income Securities (Back [2005], Ch 11, 12)   Lecture# 6
- 3.2. Terms Structure of Interest Rates and Interest Rate Derivatives (Back Ch 17)   Lecture# 7

### 4. Single Agent Portfolio Selection

- 4.1. Portfolio Selection Using Martingale Methods (Back Ch 14)   Lecture# 8
- 4.2. Portfolio Selection Using Dynamic Programming (Back Ch 9, 14)   Lecture# 9

### 5. Equilibrium Asset Pricing

- 5.1. Asset Pricing in Partial and General Equilibrium (Back Ch 10, 14, 20–22)   Lecture# 10

## **Other Textbooks** (arranged alphabetically by author's last name)

1. Back, Kerry, 2005, *A Course in Derivative Securities: Introduction To Theory and Computation*, Springer, NY.
2. Campbell, J., A. Lo, and C. MacKinlay, 1997, *The Econometrics of Financial Markets*, Princeton University Press, Princeton, NJ.
3. Cochrane, J., 2005, *Asset Pricing*, Princeton University Press, Princeton, NJ.
4. Duffie, D., 2001, *Dynamic Asset Pricing Theory*, Princeton University Press.
5. Gollier, Christian, 2001, *The Economics of Risk and Time*, MIT Press, Cambridge, MA
6. Hull, J.C., 2005, *Options, Futures, and Other Derivatives*, Prentice Hall, Upper Saddle River, NJ.
7. Ingersoll, J., 1987, *Theory of Financial Decision Making*, Rowman & Littlefield, Totowa, NJ.
8. LeRoy, Stephen F. and Jan Werner, 2001, *Principles of Financial Economics*, Cambridge University Press, Cambridge, UK.
9. Merton, R.C., 1993, *Continuous-Time Finance*, Blackwell Publishers, Cambridge, MA.

## **Review Articles**

1. Campbell, J., 2000, Asset Pricing at the Millennium, *Journal of Finance* 55, 1515-1567.
2. Sundaresan, S., 2000, Continuous-Time Methods in Finance: A Review and an Assessment, *Journal of Finance* 55, 1569-1622.

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