



University of Zurich  
Institute of Banking and Finance

# Financial Economics: Dynamic Portfolio Theory and Asset Pricing

## Objective

Most individual and institutional investors have an investment horizon of several years, sometimes several decades. At the same time, these investors can modify the composition of their portfolios at much shorter intervals. The aim of this course is to investigate optimal portfolio choice and the determinants of equilibrium asset prices in such a dynamic setting, i.e., explicitly accounting for the long-term nature of the investment problem and the possibility of portfolio revisions along the way. Although the course will cover discrete-time dynamic models to provide some intuition, the focus will be on continuous-time models. The course will consist of lectures and homework assignments.

## Organization

The course will take place in room PLD-E-04 every Monday from 10:15 to 12:00. Teaching notes will be distributed at the beginning of the lectures. You are also expected to prepare for class by reading the references provided in the “Tentative Schedule” section of this document. The most important ones are marked with asterisks.

Mastering the material covered in this course takes some time and practice. The lectures will therefore be complemented by problem sets that will be distributed at the end of class the week before they must be handed in. The expected dates at which you will have to hand in problem sets is shown in the “Tentative Schedule” section of this document. Although I have done my best to get the dates right, I may need to adjust them somewhat depending on the speed at which we cover the material.

# Contact Information

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# Course Outline

## 1. Mathematical Tools

- Differential Equations
- Dynamic Programming
- Stochastic Processes
- Brownian Motion
- Ito's Lemma

## 2. Intertemporal Portfolio Selection with Constant Investment Opportunities

- Introduction
- General Assumptions
- Asset Prices
- Investor Preferences
- The Budget Equation
- Optimal Portfolio Choice
- An Example

## 3. Intertemporal Portfolio Selection with Random Investment Opportunities

- Introduction
- Asset Price Assumptions
- The Investor's Problem
- Optimal Portfolio Choice
- Wealth versus Consumption
- The  $M + 2$ -Fund Theorem

- An Example
- Hedging Demand in Practice
- Complete versus Incomplete Markets

#### 4. The Intertemporal CAPM

- Introduction
- Derivation of Equilibrium
- Interpretation
- Complete versus Incomplete Markets

#### 5. The Consumption CAPM

- Introduction
- Derivation of Equilibrium
- Interpretation

#### 6. State-Price Deflator Methods

- Introduction
- A Discrete-Time Example
- Properties of State-Price Deflators
- The Continuous-Time Case
- Link with Dynamic Programming
- Re-Deriving the CCAPM
- Pricing Example

#### 7. Portfolio Choice and Asset Pricing under Parameter Uncertainty

- Introduction
- Filtering
- Consumption and Portfolio Choice
- Asset Pricing

#### 8. Transactions Costs

## Grading

The final grade will be based on a final examination and on the grades achieved in the six problem sets that must be handed in before class as described in the tentative schedule below.

For complete transparency, the final grade will be computed based on the following index:

$$I = \text{Number of points achieved in final exam} \times \left( 1 + 0.25 \times \frac{\sum_{i=1}^6 \text{Homework grade}_i / 6}{6} \right)$$

In words, you can achieve a bonus of 25% of the points you score in the final exam if you solve all six problem sets perfectly.

The final examination will be a written open-book examination that will last two hours and take place during the official examination period at the end of the semester (the examination is currently scheduled for Friday, June 10 in room KO2-D-54). You are allowed to take a non-programmable calculator.

## References

The main references for this class are:

- Duffie, Darrell (2001): *Dynamic Asset Pricing Theory*, Princeton University Press, Third Edition.
- Merton, Robert C. (1992): *Continuous-Time Finance*, Basil Blackwell, Second Edition.

References to the relevant chapters in these books and to a number of relevant papers are provided in the tentative schedule below.

## Tentative Schedule

### Monday, February 21

Mathematical Tools

### Monday, February 28

Finish up Mathematical Tools

*Read before class:*

1. Stokey, Nancy L. and Robert E. Lucas (1989). *Recursive Methods in Economic Dynamics*, Harvard University Press, Chapters 1-4.
2. Benveniste, L. M. and J. A. Scheinkman (1979): On the Differentiability of the Value Function in Dynamic Models of Economics, *Econometrica* 47, 727-732.

## Monday, March 7

Intertemporal Portfolio Selection with Constant Investment Opportunities

*Hand in:* Problem Set 1

*Read before class:*

1. \*Duffie, Chapter 9, Sections A-D.
2. \*Merton, Robert C. (1971): Optimum Consumption and Portfolio Rules in a Continuous-Time Model, *Journal of Economic Theory* 3, 373-413. (Chapter 5 in the book.)

## Monday, March 14

Finish up Intertemporal Portfolio Selection with Constant Investment Opportunities

*Read before class:*

Karatzas, Ioannis, John P. Lehoczky, Suresh P. Sethi and Steven E. Shreve (1986): Explicit Solution of a General Consumption/Investment Problem, *Mathematics of Operations Research* 11, 261-294.

## Monday, March 21

Intertemporal Portfolio Selection with Random Investment Opportunities

*Hand in:* Problem Set 2

*Read before class:*

\*Merton, Robert C. (1973): An Intertemporal Capital Asset Pricing Model, *Econometrica* 41, 867-887. (Chapter 15 in the book.)

## Monday, March 28

Portfolio Selection with Random Investment Opportunities

*Read before class:*

1. Kim, Tong Suk and Edward Omberg (1996): Dynamic Nonmyopic Portfolio Behavior, *Review of Financial Studies* 9, 141-161.

2. Liu, Jun (2007): Portfolio Selection in Stochastic Environments, *Review of Financial Studies* 20, 1-39.

### **Monday, April 4**

Finish up Portfolio Selection with Random Investment Opportunities

*Read before class:*

\*Brennan, Michael J., Eduardo S. Schwartz and Ronald Lagnado (1997): Strategic Asset Allocation, *Journal of Economic Dynamics & Control* 21, 1377-1403.

### **Monday, April 11**

The Intertemporal CAPM

*Hand in:* Problem Set 3

*Read before class:*

\*Merton, Robert C. (1973): An Intertemporal Capital Asset Pricing Model, *Econometrica* 41, 867-887. (Chapter 15 in the book.)

### **Monday, April 18**

The Consumption CAPM

*Read before class:*

1. \*Breedon, Douglas (1979): An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities, *Journal of Financial Economics* 7, 265-296.
2. Duffie, Darrell and William Zame (1989): The Consumption-Based Capital Asset Pricing Model, *Econometrica* 57, 1279-1297.

### **Monday, May 2**

State-Price Deflator Methods

*Hand in:* Problem Set 4

*Read before class:*

1. Duffie, Chapter 6.
2. \*Duffie, Chapter 9, Sections E-G, and Chapter 10.
3. Lucas, Robert E. (1978): Asset Prices in an Exchange Economy, *Econometrica* 46, 1429-1445.

## **Monday, May 9**

Finish up State-Price Deflators

*Read before class:*

1. Cox, John C. and Chi-Fu Huang (1989): Optimal Consumption and Portfolio Policies when Asset Prices Follow a Diffusion Process, *Journal of Economic Theory* 49, 33-83.
2. Cox, John C. and Chi-Fu Huang (1991): A Variational Problem Arising in Financial Economics, *Journal of Mathematical Economics* 20, 465-487.

## **Monday, May 16**

Parameter Uncertainty

*Hand in:* Problem Set 5

*Read before class:*

1. \*Genotte, Gérard (1986): Optimal Portfolio Choice under Incomplete Information, *Journal of Finance* 41, 733-746.
2. \*Feldman, David (1989): The Term Structure of Interest Rates in a Partially Observable Economy, *Journal of Finance* 44, 789-812.

## **Monday, May 23**

Finish up Parameter Uncertainty

*Read before class:*

1. Honda, Toshiki (2003): Optimal portfolio Choice for Unobservable Regime-Switching Mean Returns, *Journal of Economic Dynamics and Control* 28, 45-78.

2. Veronesi, Pietro (2000): How Does Information Quality Affect Stock Returns?, *Journal of Finance* 55, 807-837.
3. Veronesi, Pietro (2000): Stock Market Overreaction to Bad News in Good Times: A Rational Expectations Equilibrium Model, *Review of Financial Studies* 12, 975-1007.

**Monday, May 30**

Transactions costs; Questions

*Read before class:*

Davis, M. H. A., and A. R. Norman (1990): Portfolio Selection with Transaction Costs, *Mathematics of Operation Research* 15, 676-713.

*Hand in:* Problem Set 6