DTU

Nina Lange
Management Science
Operations Research Group
Building 358-134

Lyngby, December 3, 2019
Introduction to
Financial Engineering
Autumn 2019

Course Overview

Readings (and other material for class preparations) will be available approximately one week before class. Slides and exercises will be available the day before. Solutions for exercises will be posted with a delay. Exercises often build on previous weeks, so it is strongly encouraged to do them during or just after class.

Week 36 Introduction to the course. Financial markets and securities. Returns.
Main material: *Ruppert & Matteson*: Chapter 1-2, *Elton, Gruber, Brown, & Goetzmann*: Chapter 2 (uploaded).
Exercise: Finding and working with financial data.

Week 37 Fixed income.
Main material: *Ruppert & Matteson*: Chapter 3.
Exercise: Bonds I.

Week 38 Fixed income.
Main material: *Ruppert & Matteson*: Chapter 11.3. Note on duration/convexity.
Exercise: Bonds II.
Project handed out – due Monday week 40.

Week 39 Project work – TAs available during class

Week 40 Portfolio choice and the efficient frontier.
Main material: *Ruppert & Matteson*: Chapter 16.5. *Lando & Poulsen*: Chapter 9 until 9.1.2.
Exercise: The efficient frontier.

Week 41 More on portfolio optimization.
Main material: *Ruppert & Matteson*: Chapter 16-16.6. *Lando & Poulsen*: Chapter 9.1.2.
Exercise: Portfolio selection.

Week 43 Financial data analysis and visit from Danske Bank.
Main material: *Ruppert & Matteson*: Chapter 4-4.4 and chapter 5-5.4.
Exercise: Data analysis.
Project handed out – due Monday week 45.

Week 44 Project work – help available during class

Week 45 Capital Asset Pricing Model.
Main material: Grinblatt-Titman Chapter 5 from 5.7 and until the end (uploaded).
Ruppert & Matteson: Chapter 17
Exercise: CAPM.

Week 46 Capital Asset Pricing Model and extensions.
Main material: *Ruppert & Matteson*: Chapter 18.1, 18.3-18.5.
Exercise: Estimating factor models.

Week 47 Capital Asset Pricing Model and beyond. Guest lecture from QBlue Balanced.
Main material: Frazzini & Pedersen: Betting Against Beta.
Exercise: N/A.
Project handed out – due Monday week 49.

Week 48 Project work – help available during class

Week 49 Q&A for the course including run-through of last year's exam.
Main material: Everything.
Exercise: Exam 2018.

Office hours

Please email me for an appointment.

Exam

The exam is a written exam taking place on the course allocated date.

In order to participate in the exam, three small group projects (max. three students per group) must be approved.

The exam will be based on the syllabus and contain (smaller) calculations, multiple choice questions and shorter exercises requiring short written answers similar to what has been discussed in class and worked on during exercises and project (but without the programming).

Programming language

To complete the course, it is necessary to hand in projects based on calculations made in R and/or Matlab. The choice of programming language is up to the students. I do examples and most of my work in Matlab and the teaching assistant is quite good with R. As this is not a programming or computer language course, the important thing is that R/Matlab is a tool to work with financial data in order to do analysis and/or test theory. Students are not required to have prior knowledge of R/Matlab, but should have a basic knowledge of programming. The course will not require efficient or beautiful programming, but it is required to use R/Matlab to perform relevant financial calculations and to import/analyse data.

Curriculum

- Ruppert, D., and Matteson, D.S. (2015). Statistics and Data Analysis for Financial Engineering, Springer.
- Elton, E.J., Gruber, M.J., Brown, S.J., and Goetzmann, W.N. (2014). Modern Portfolio Theory and Investment Analysis, Wiley. Chapter 2.

- Grinblatt, M., and Titman, S. (2011). Financial Markets and Corporate Strategy, McGraw-Hill. Chapter 5.7-end. (particular 5.8).
- Lando, D., Nielsen, S.E., and Poulsen, R. (2015). Lecture Notes for Finance 1 (and More): Chapter 9, University of Copenhagen http://web.math.ku.dk/ rolf/ifnotes.pdf
- Frazzini, A. and Pedersen, L.H. (2014). Betting against beta, Journal of Financial Economics, Volume 111, Issue 1, January 2014, Pages 1-25.
- Slides and exercises used in the lectures

Course Content, Structure, and Teaching

The format of the course is based on the following elements:

- Lectures
- Discussions in class
- Exercises
- Group project

Classes run Wednesdays from 8-12. The class will start with an overview of new material including small discussions and finish with independent work on computer exercises. It is therefore encouraged to bring a laptop to class or to team up with someone who has brought their laptop. During computer exercises, teaching assistants will be available for help.

Learning Objectives

A student who has met the objectives of the course will be able to:

- Explain the working and role of different assets traded in financial markets
- Use of Matlab or R to analyze financial data
- Explain and use the basic theory of fixed income markets
- Build an optimal portfolio based on modern portfolio theory
- Use Capital Asset Pricing Model (CAPM) in a number of examples
- Analyzing basic statistical properties of financial data
- Measure performance of a financial portfolio