

Introduction to Financial Engineering

Week 36

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Week 36



1 Introduction to course

- The lectures
- Course material
- Exam
- Prerequisites
- Contents of the course
- Recording or photography of lectures

2 Introduction to finance

3 Next week

Lectures Wednesdays 8-12

Classes will have the following (rough) structure:

- $\sim 3 \times 30$ minutes of lecturing and sometimes with small classroom discussion/exercises
- \sim two hours of supervised group work doing exercises in R or Matlab

Expected preparation:

- Required readings will be listed \sim one week before class
- Slides and exercises be uploaded \sim one day before class
- Solutions (not always full) for exercises are published with a two-three week delay
- Therefore, make sure to have solved the previous week's exercises before class

Textbook

- Mathematics for Finance: An Introduction to Financial Engineering by Marek Capinski and Tomasz Zastawniak, Springer, 2011
- We will use parts of the book (chapters 1, 2, 3, 5, 6, 9, 10)
- The parts we are not using give an introduction to some of the other finance-courses at DTU
- The book is a "mathematical approach" to finance
- This implies that there is less information and details about financial markets in the book and more equations
- Therefore, the textbook is supplemented with videos and additional readings

Additional readings

- Lando & Poulsen: Lecture notes for Finance 1 and more, Chapter 9
- Elton, Gruber, Brown & Goetzmann: Modern Portfolio Theory and Investment Analysis, Chapter 2 (at least)
- Sections of books, web referenecs and papers uploaded or linked to on Campusnet

Videos

- Khan Academy: Short videos explaining different concepts
- The Ascent of Money: A bit on the history of finance and assets – good for watching while on the bus, ironing or being tired after a long week of studying

Exam

- Group project: Handed out in week 45. Due December 1 at noon. The project needs to be approved in order to take the exam. If the project is not approved, there will be an opportunity to redo it and hand-in again by December 12 at noon.
- A written exam on which your course grade is based. The exam takes place on the course allocated exam day.
- Hint: The exam will be easier, if you do the project well.

Calculus

- Derivatives and partial derivatives
- Finding minima/maxima of functions
- Lagrange multipliers
- Taylor expansions

Probability

- Random variables/probability distributions
- The normal distribution
- Expected values and variance/covariance

Linear algebra

- Solving systems of linear equations
- Add, multiply, transpose and invert matrices, and compute determinants

Programming

- In the course and in the project, most calculations will be done in R/Matlab and very few by hand
- You will be required to make small scripts and function to calculate various quantities, import and process financial data, illustrate results in plots etc.
- I don't care if you use R or Matlab. I do most of my work in Matlab. The TAs are very good (and probably a better source than me) with R.

Course topics

- What are stocks and bonds
- Working with financial data
- Key concepts in bond analysis
- Portfolio choice – risk vs. return (Markowitz-framework)
- Capital Asset Pricing Model
- Analysis/evaluation of portfolios

Recordings

- You may not record the lectures and share them with others.
- Sharing these via Facebook, Dropbox etc. is a violation of the GDPR
- The same goes for photographing examples on the board
- And; it is MUCH better to draw your own notes/drawings step by step while the examples are explained rather than having the final picture

- 1 Introduction to course
- 2 Introduction to finance
 - Core financial assets
 - Basic calculations
- 3 Next week

Stocks

What is a stock?



<https://www.khanacademy.org/economics-finance-domain/core-finance/stock-and-bonds/modal/v/what-it-means-to-buy-a-company-s-stock>

Bonds

What is a bond?

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<https://www.khanacademy.org/economics-finance-domain/core-finance/stock-and-bonds/modal/v/introduction-to-bonds>

Other financial assets

Derivatives

- Financial assets whose value is *derived* from something else
- Examples are options, forwards, futures
- The underlying actually doesn't have to be a financial asset, it could be rainfall or the price of a physical good

Funds

- Mutual funds: Pool of money from many investors. Investments in many different assets and professionally managed
- Exchange traded funds: Similar to a mutual fund, but trades on exchanges

The rate of return

- The rate of return (or just the **return**) over a time-period is defined as the difference in stock price at the two points in time measured as a fraction of initial value:

$$K_S = \frac{S(1) - S(0)}{S(0)}$$

- Often in finance, log returns are used instead:

$$k_S = \log \frac{S(1)}{S(0)}$$

Note: log means the natural logarithm, sometimes denoted as \ln in some computer programs or calculators

When/why are these two expressions (almost) the same?

Calculating average returns

- Stock 1 increase by 10% every year for three years
- Stock 2 increase by 60% the first year, decrease by 50% the next year and increase by 20% the third year
- Which stock do you prefer? Why?

Geometric average

- The arithmetic average of the two stocks are both 10%
- But the questions is really; at which rate \bar{K}_S does my stock grow per time period (here a year) on average?

$$(1 + \bar{K}_S)^3 = (1 + K_S(1))(1 + K_S(2))(1 + K_S(3))$$

- Or in more general terms: The average rate of return per time period is:

$$\bar{K}_S = \left(\prod_{i=1}^N (1 + K_S(i)) \right)^{(1/N)} - 1$$

- What is \bar{K}_S for the two stocks on the previous slide?

- 1 Introduction to course
- 2 Introduction to finance
- 3 Next week
 - Topics

Next week we will talk about

- annualising returns
- measuring risk in terms of standard deviations
- log returns vs actual returns