TIØ4146 Finance for Science and Technology Students

Chapter 1 - Introduction

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January 10, 2024

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Practical information

Finance as science

Difference with natural sciences

What is the course about?

- The course introduces students to finance, both as a scientific discipline and as a practical tool for financial decision-making.
- It presents the major insights from finance in a way that assumes no previous knowledge of finance but utilizes the quantitative skills that science and technology students have acquired.

The course assumes no previous knowledge in finance

Basic elements are recapitulated in first chapter:

- time value of money
- accounting concepts
- a bit of micro-economics
- emphasis is on finance, not calculation/accounting

Course assumes students have some quantitative background:

- most of you have seen and used models and formulae before
- they tell you more than pages of text
- you will be addressed as future scientists

Course's main orientation

- Is conceptual - not technical:
  - How should investment decisions be made?
  - What determines the cost of capital for a project?
  - What is market efficiency?
  - What determines option prices and how?
- But with some technical excursions:
  - gives you a better understanding
  - gives you easy access to literature

Don’t be misled by deceptively simple calculations!

- Answer to a typical exam question could be:
  - first we calculate the return on equity: $r_e = 0.06 + 1.4 \times 0.08 = 0.172$
  - return on assets can then be found as: $0.172 = r_a + (r_a - 0.09)\frac{0.5}{0.5} \Rightarrow r_a = 0.131$
- This course is not about whether you can multiply 0.08 by 1.4 and add 0.06!
- It is about choosing the proper inputs for a Cost of Capital model and combining the models to find the proper CoC

Don’t be misled by the occasional large formula!

- All formulae are easy to use
- incl. the Black and Scholes’ option pricing formula
  - option pricing has image of difficulty (among some students)
  - image is wrong: all you need is a calculator (for ln) and a simple table (for probability)
- Proper use of formulae is required for this course

What topics does the course discuss?

The course deals with subjects and questions such as the following:

- What risks are there? Are all risks equally bad? Is risk always bad?
  - We will see that some risks don't count and that risk can even be beneficial to some investments and people.
- Portfolio theory and the valuation models based on it
  - They demonstrate which risks don't count and why investments should not be evaluated alone but in combination.
- Market efficiency
  - That explains why you, and your pension fund, cannot quickly get rich if markets function properly.

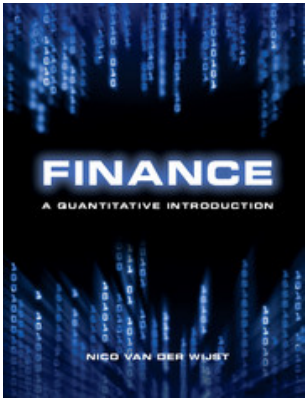
What topics does the course discuss? Continued.

- The variety of financial instruments
  - and how they helped to create the credit crunch.
- Capital structure
  - or why some projects are easy to finance and others not.
- The wild beasts of finance: options and other derivatives
  - why options are difficult to price and why most projects and firms can be valued as options.
- Real options analysis
  - how flexibility can make unprofitable projects profitable and why strategic value now has its price.

Subject matter of teaching:

- Book: Finance: A Quantitative Introduction (Cambridge University press, 2013)
  http://www.cambridge.org/9781107029224
  - Available online and at local bookshops
- Chapters selected for this course: 1-9
- Presentations (as this one) used in teaching
- The exercises and their solutions

  The self-test questions (quizzes) are supplied as study aid



Practical details:

- The course will be taught in English
- Teaching hours (week 2-15):

Day	Time	Place	Activity
Friday	9.15-12.00	GL-SB2 S7	teaching
Wednesday	12.15-14.00	GL-SB2 S6	exercises

- Sessions will be in-person (no recording or streaming).
- Exercises are included on a voluntary basis.
- Presentations, quizzes and other material on Blackboard.
- Discussion forum on Blackboard

Exam:

One final exam

- open book exam, written
- exam will be provided in English and should be answered in English
- all calculators allowed

Exam details:

- Taken on INSPERA
- Date: 2024-05-15
- Duration: 09:00-13:00 (4h)

More information will be made public once the dates are finalized.

Reference Group

Your feedback is important!

- 3 volunteers needed
- Two meetings (more if necessary). **There will be cake!**

Legal background information on quality of teaching in Norway:
https://innsida.ntnu.no/wiki/-/wiki/Norsk/Kvalitetssikring+av+utdanning

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Finance

Studies how people choose between **uncertain future values**

- it is part of economics (social science)
  - studies how people **allocate scarce resources among competing goals**
- finance studies economic problems for alternatives that involve
  - **time, money and uncertainty**
- As a science, finance is 100+ years old.

Finance went from **descriptive** (what is..) to **analytic** (what should be..if..) and **quantitative**.

The course combines two angles of approach:

1. Managerial Finance
   toolbox for solving decision problems in practice
   - gives "the approximate answer to the precise problem" [1]
   - this is where money is earned

2. Theory of Finance (or Financial Economics)
   seeks to generate knowledge of general validity
   - gives "the precise answer to the approximate problem" [1]
   - this is where Nobel prizes are earned

[1] The terminology is based on Hastie (1982).

Nobel prizes for financial economists

Year	Name	Topics
1970	Paul Samuelson	Dynamic economic theory
1972	Kenneth Arrow	General economic equilibrium theory
1983	Gerard Debreu	Theory of general equilibrium
1985	Franco Modigliani	Analyses of financial markets
1990	Harry Markowitz Merton Miller William Sharpe	Pioneering work in the theory of financial economics
1994	John Nash	Game theory
1997	Robert Merton Myron Scholes	New method to determine the value of derivatives

We will be standing on the shoulders of these giants

Main tools of finance

are similar to those of other scientific disciplines:

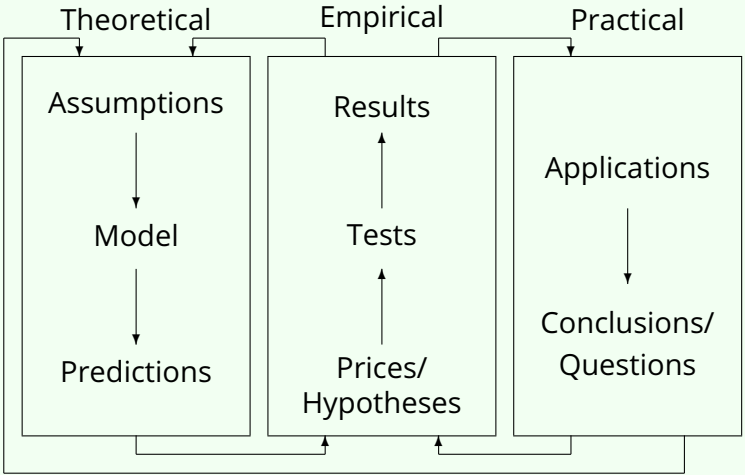
1. the formulation (mathematical modelling) of theories
2. their empirical testing through confrontation with real-life data
3. the application of results

Finance is special among social sciences in all three elements:

- it stands closer to the natural sciences than most other social sciences do (cf. 'rocket scientists' on Wall Street)
- financial markets lend themselves very well for modelling, testing and application

Enables a full cycle of scientific research, from formal theory to tests and practical applications.

The interlocking cycles of scientific and applied research



Finance as a **theoretical science**:

- takes actual, relevant problem
- makes the problem manageable by simplifying assumptions
  - about investors (e.g. greediness)
  - about financial markets (e.g. no transaction costs)
- translates stylized problem into mathematical terms
- uses the analytical power of mathematics to formulate predictions in terms of:
  - hypotheses
  - prices

Example: option pricing

- Actual, relevant problem:
  what is the proper price of a stock option?
- Simplifying assumptions:
  interest rate, volatility is constant, frictionless markets, etc.
- Translation in mathematical terms:
  formulate stock price as stochastic differential equation and option's payoff as boundary condition
- Analytical power of mathematics:
  solve the 'boundary value problem' to find proper option price
- Result is the famous Black & Scholes formula!

Finance as an **empirical science**:

- tests financial theories
- by confronting their conclusions with real-life data:
  - prices on financial markets for stocks, bonds, derivatives, etc.
  - accounting and other data
- empirical relations in finance are 'special' (see later)

Example: option pricing

To tests option pricing theory:

- Confront theoretical prices with market prices:
  - *run model 'in reverse' to calculate implied volatilities*
  - *see if implied volatility is constant across different exercise dates/prices*

Finance as an **applied science** uses results of not rejected theories to:

- buy or sell on financial market
- accept or reject investment proposal
- choose a capital structure for project or company

Example: option pricing

If model prices are acceptable, use them to:

- Trade in options on the exchange
- Find price of a new option you want to create and sell ('write' an option)
- Hedge (i.e. neutralize) obligations from another contract, e.g. if you have to deliver a stock in 3 months time

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Natural sciences study phenomena that can be:

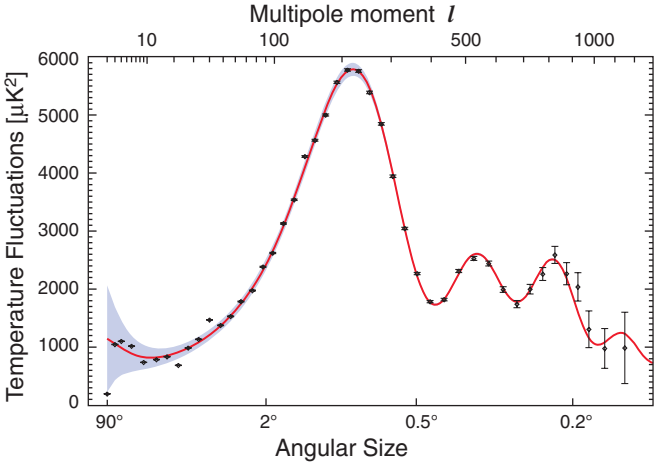
- measured very precisely in controlled experiments
- predicted accurately from laws of nature

$\Rightarrow$ observations show little dispersion around (predicted) relations

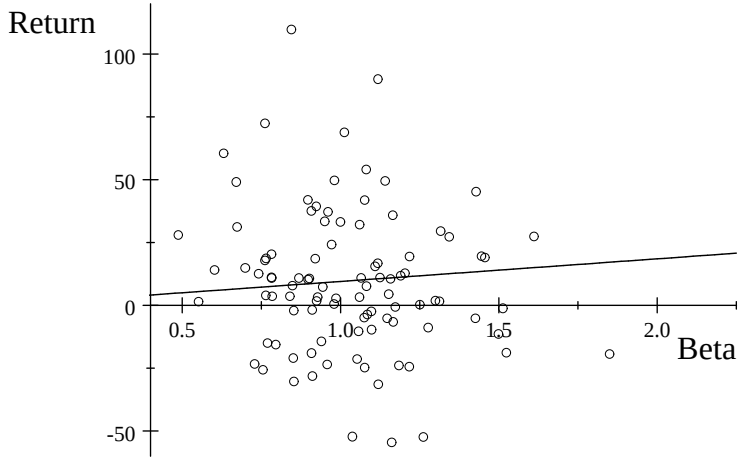
Finance is social science, studies human behaviour:

- no controlled experiments, only noisy real-life data
- incomplete models: cannot contain all relevant information
- both are used in statistical estimation of relations

$\Rightarrow$ observations show large dispersion around (predicted) relations



Relative brightness (temperature) of spots vs size (angle). Credit: NASA / Wilkinson Microwave Anisotropy Probe Science Team



Risk-return relationship for Nasdaq-100 companies, October 2010 to September 2011