Administrative

- Please check course web site often (messages, exercises, etc.):
- `http://www.uio.no/studier/emner/sv/oekonomi/ECON4515/h04/`
- 13 lectures of 90 minutes, once weekly
- 6 seminars of 90 minutes, every second week, starting on 30 and 31 August
- Seminars in two parallel groups, one Mondays, the other Tuesdays
- Grade based only on final exam; three hours, closed book
- After first nine weeks: One week's break 18–22 Oct., no lecture or seminar, exercise ("term paper") to hand in, will be covered in lecture later
- Apart from this compulsory term paper, all lectures, seminars and exercises are optional
- But: Essential to work with exercises to learn material and prepare for exam
- Transparencies are distributed on web site before each lecture, before 15:00 hrs. on Tuesdays
- Many diagrams missing in transparencies, to be drawn during lectures
- Lectures in English, but Norwegian translation when asked for

Finance Theory: Overview

- Main topic: What are the values of various assets?
- Both financial and real assets: Securities (shares of stock, bonds, options, etc.), investment projects, property
- Central feature of theories: Uncertainty about future income streams connected to the assets, or their values in the future
- Equilibrium models: Supply and demand determine values
- Applications in firms and business:
  - Determine values for trading assets
  - Decision tool for investment projects
  - Answer questions like: Should firms diversify?
- Applications in government:
  - Privatization
  - Decision tool for investment projects
  - Regulation of markets
  - Taxation of firms

Overview, contd.

- You will *not* learn how to make money in the markets
- In fact, you will learn why that is very difficult
- You will learn basic theory about what determines (and what does *not* influence) security equilibrium prices
- You will also learn about the role of these markets in the economy
  - Desynchronize (separate consumption from income) in time
  - Desynchronize between outcomes (states of nature)
  - Welfare consequences

Topics to be found in other courses:

- This course does not cover control of firms, or conflicts due to asymmetries of information between management, shareholders, and lenders. Those topics: ECON 4245 Economics of the Firm.
- This course is more concentrated on theory than ECON 4420 International Credit and Financial Markets, and more concentrated on business risk, as opposed to credit risk

Required background and overlap

- This course builds on mathematics at the level of ECON 3120/4120; those who do not have it, should take that course in parallel
- This course builds on undergraduate statistics at the level of ECON 2130
- More math, such as ECON 4140/4145, and statistics, such as ECON 4130 or ECON 4135, is an advantage
- This course overlaps with ECON 3210/4210 and ECON 1810 on the topic of decisions under uncertainty, "expected utility", but full credit is given anyhow

Consequences of overlap, of parallel math course, and 2003 reform

- Will start at fairly basic level mathematically
- Will increase math level when, e.g., integration and linear algebra are taught in ECON 3120/4120
- Perhaps somewhat confusing: Will soon jump to p. 86 in Danthine & Donaldson
- Lectures will be self-contained, and will cover pp. 26–86 later
- Start with theory of choice under uncertainty, in particular with choice based only upon mean (expectation) and variance

Choice under uncertainty

- In order to construct theoretical model of asset markets: Need theory of people's behavior in these markets
- "Choice under uncertainty" since choice between uncertain (risky) alternatives
- Example:
  - May buy government bonds and earn interest at a known rate
  - May alternatively buy shares in the stock market with risky returns
  - E.g., invest everything in one company, such as Norsk Hydro
  - One certain, one uncertain alternative
- In reality many uncertain alternatives: Shares in different companies
- May also diversify: Invest some money in one company, some in another
- May also invest outside of asset markets, "real investment" projects
- Outcome one year into the future of each choice is uncertain
- Assume the outcome in each alternative can be described by a probability distribution
- Exist also theories of choice under "total uncertainty" without probabilities, but much more difficult

Choice under uncertainty, contd.

- Choice between probability distributions of consumption in future periods
- Simplification in finance: Only one good, money (but theory in chapters 1 and 7 D&D can deal with vectors of different goods)
- To begin with: Uncertainty in *one period* only
- Choices are made now (often called period zero), with uncertainty about what will happen next (period one)
- Only one future period: Consumption = wealth in that period
- Each choice alternative gives one probability distribution of outcomes in period one
- *All consequences* and the total situation of the decision maker should be taken into consideration when choices are described; for instance:
  - Choose between (a) keeping \$10 and (b) spending it on a lottery ticket with 1 per cent probability of winning \$1000 and 99 per cent of loss
  - This is *different* from the problem of choosing between \$10010 on one hand and on the other a 1 per cent probability of \$11000 and 99 per cent probability of \$10000

Expected utility versus choice based on mean and variance

- Some of you know a theory of choice under uncertainty proposed by John von Neumann and Oscar Morgenstern (1947)
- Known under name "expected utility"
- Will return to this later in the course
- Start instead with simplifying assumption:
- Individuals choose between different probability distributions based on two characteristics of these, the mean (also known as the expected value) and the variance
- These are important characteristics of a probability distribution, but those two numbers alone do not fully characterize the distribution
- The assumption is thus only a useful simplification, and has its limitations
- A person may very well strictly prefer one distribution to another, even though both have the same mean and the same variance
- But in the beginning of this course, we shall neglect that possibility
- Assume also all individuals prefer higher mean ("non-satiation") and lower variance ("risk aversion")

About individuals' mean-variance preferences

- Is it better to consume 1000 with certainty than an uncertain consumption with mean 1200 and variance 10 000?
- Perhaps mean 1400 and variance 30 000 is better than both of these?
- Assume each individual is able to choose between such alternatives
- For each individual: Indifference curves in mean-variance diagram
- By convention draw diagram with mean (of consumption) on vertical axis
- Instead of variance, use standard deviation = $\sqrt{\text{variance}}$
- Reason for using standard deviation: Will simplify some later discussions
- Indifference curves are increasing curves in diagram
- Assume they are convex (more on this later in course)

Mean-variance portfolio choice

- One individual, mean-var preferences
- Has a given wealth W_0 to invest at $t = 0$
- Regards probability distribution of future ($t = 1$) values of securities as exogenous; values at $t = 1$ include payouts like dividends, interest
- Today also: Regards security prices at $t = 0$ as exogenous
- Later: Include this individual in equilibrium model of competitive security market at $t = 0$

Notation: Investment of W_0 in n securities:

$$W_0 = \sum_{j=1}^{n} p_{j0} X_j = \sum_{j=1}^{n} W_{j0}$$

Value of this one period later:

$$\tilde{W} = \sum_{j=1}^{n} \tilde{p}_{j1} X_j = \sum_{j=1}^{n} \tilde{W}_j = \sum_{j=1}^{n} p_{j0} \frac{\tilde{p}_{j1}}{p_{j0}} X_j$$

$$= \sum_{j=1}^{n} p_{j0}(1 + \tilde{r}_j) X_j = \sum_{j=1}^{n} W_{j0}(1 + \tilde{r}_j)$$

$$= W_0 \sum_{j=1}^{n} \frac{W_{j0}}{W_0}(1 + \tilde{r}_j) = W_0 \sum_{j=1}^{n} w_j(1 + \tilde{r}_j) = W_0(1 + \tilde{r}_p)$$

(D&D (e.g., p. 93) use R for return on portfolio, here: r_p)

Mean-var preferences for rates of return

$$\tilde{W} = W_0 \sum_{j=1}^{n} w_j(1+\tilde{r}_j) = W_0\left(1+\sum_{j=1}^{n} w_j\tilde{r}_j\right) = W_0(1+\tilde{r}_p)$$

- $\tilde{r}_p$ is rate of return for investor's portfolio
- If each investor's W_0 fixed, then preferences well defined over $\tilde{r}_p$, may forget about W_0 for now
- Let $\mu_p \equiv E(\tilde{r}_p)$ and $\sigma_p^2 \equiv \text{var}(\tilde{r}_p)$; then

$$E(\tilde{W}) = W_0(1+E(\tilde{r}_p)) = W_0(1+\mu_p),$$

$$\text{var}\,\tilde{W} = W_0^2\,\text{var}(\tilde{r}_p),$$

$$\sqrt{\text{var}(\tilde{W})} = W_0\sqrt{\text{var}(\tilde{r}_p)} = W_0\sigma_p$$

Increasing, convex indifference curves in $(\sqrt{\text{var}(\tilde{W})}, E(\tilde{W}))$ diagram imply increasing, convex indifference curves in (σ_p, μ_p) diagram

But: A change in W_0 will in general change the shape of the latter kind of curves ("wealth effect")