Decision making and problem solving - Introduction

- *Why this course?*
- *Learning outcomes*
- *Practical information*

Why this course?

Think of different decision making situations

❑ Decisions by individuals / companies / public bodies etc.

❑ Everyday decisions / major decisions etc.

Write them down on a piece of paper

❑ Are these decisions making situations difficult?

❑ If so, why?

What is operations research?

" Operations research is the attack of modern science on complex problems arising in the direction and management of large systems of men, machines, materials and money in industry, business, government and defense."

" Its <u>distinctive</u> approach is to develop a scientific <u>model of the system</u>, incorporating measurements of factors such as change and risk, with which to predict and <u>compare the outcomes of alternative decisions, strategies or controls</u>.

" The purpose is to help management determine its policy and actions scientifically."

OR Quarterly **3(3): 282, 1962**

Why this course?

In decision-making situations

- ❑ The decision-maker (DM) may have multiple objectives
- ❑ The impacts of the decision with regard to these objectives may be uncertain
- ❑ Decisions may need to be taken sequentially such that later decisions depend on the outcomes of earlier decisions
- ❑ There may be multiple DMs whose views need to be taken into account

Complex decision problems call for formal decision modelling

- ❑ 'Divide and conquer': ❶ identify the key elements of the decision problem ❷ analyze these elements ❸ synthesize the results

Prescriptive modelling   **= What decision should be taken?**

Descriptive modelling   **= How are (unaided) decisions made?**

What benefits does decision modelling offer?

❑ **The decision outcome(s) can be better (but not necessarily)**

❑ **The modelling process forces one to think harder, which contributes to decision quality**

❑ **All alternatives will be treated on equal terms**

❑ **The decision model serves as a communication tool**

❑ **The model provides defensible decision recommendations**

Learning outcomes

After the course, you can:

❑ Recognize real-life decision problems where the use of decision models brings added value

❑ Build decision models to support the solution of such problems

❑ Solve these models using suitable software tools

❑ Interpret the results of these models to generate defensible decision recommendations

❑ Understand the results of analyses produced by others

You will also become aware of:

❑ The possible discrepancies between formal normative models and actual human decision behavior

❑ Ways to mitigate the adverse effects of this discrepancy

Timetable

Two lectures a week (12.9.-19.10.)

- ❑ Mon 10.15-12 & Wed 12.15-14 in lecture hall M1
- ❑ Lecturer: Prof. Ahti Salo

Two exercise sessions a week (13.9.-21.10.)

- ❑ Tue 12.15-14 & Fri 12.15-14 in computer class Y344
- ❑ Course assistant: M.Sc. Pekka Laitila

Course content

1. **Preliminaries:** Probabilities, Monte Carlo simulation ~ 1 lecture
2. **Decisions with one objective:** Decision trees, expected utility theory (EUT), stochastic dominance, risk measures ~ 3 lectures
3. **Decisions with multiple objectives:** Multi-attribute utility / value theory (MAUT & MAVT), Analytic Hierarchy Process (AHP), outranking methods ~ 5 lectures
4. **Multiple decision makers:** Group techniques, voting, aggregation of utilities / values ~ 1 lecture
5. **Supporting decision-making by optimization:** Multi-objective optimization (MOO), value function methods in MOO ~ 1-2 lectures
6. **Efficiency and productivity analysis:** Data Envelopment Analysis ~ 1 lecture

Course material

❑ Lecture slides will cover all required topics

❑ Yet especially those who cannot attend the lectures will benefit from additional reading material:
  – Clemen, R.T. (1996): *Making Hard Decisions: An Introduction to Decision Analysis*, 2nd edition, Duxbury Press, Belmont.
  – Eisenführ, F., M. Weber, T. Langer (2010): *Rational Decision-Making*, Springer.
  – French, S. (1988): *Decision Theory: An Introduction to the Mathematics of Rationality*, Ellis Horwood Limited, Chichester.

Course assessment

Three home assignments

❑ Related to the main parts of the course

❑ Will teach you how to solve decision problems

Exam

❑ Problems similar to those in the assignments

"Problem making and decision solving"

❑ Real life is not full of decision models in need of solution

❑ The framing and scoping of the decision problem are both crucial

- Framing: What is the problem?
- Scoping: What must be taken into account in order to address the problems?

❑ MS-2177 Seminar on Case Studies in Operations Research

Some links

INFORMS Decision Analysis Society

https://www.informs.org/Community/DAS

Decision Analysis Journal

https://www.informs.org/Community/DAS/Decision-Analysis-Journal

EURO Working Group on Multiple Criteria Decision Aiding

https://www.euro-online.org/web/ewg/1/ewg-mcda-multiple-criteria-decision-aiding