Aalto University
School of Science

# MS-E2135
# Decision Analysis
## Course practicalities

## Ahti Salo

- *Motivation*
- *Course practicalities*

Salo, Liesiö, Punkka, Vilkkumaa

# Ahti Salo

## Professor


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| **Email:** | ahti.salo@aalto.fi |
| **Phone:** | +358-50-383 0636 |
| **Room:** | Y217 |
| **Reception:** | wed 15-16 |
| **Visiting address:** | Otakaari 1, Espoo Finland |
| **Postal address:** | Aalto University School of Science, Systems Analysis Laboratory, P.O.Box 11100, 00076 Aalto, Finland |


http://sal.aalto.fi/ahti

Professor Salo has worked extensively on the development of decision analytic methods and their uses in resource allocation, innovation management, risk management, technology foresight, and efficiency analysis. He has published widely in leading international journals (including *Management Science* and *Operations Research*) and received awards for his research from the Decision Analysis Society of the Institute for Operations Research and the Management Sciences (INFORMS). In 2019, he won the MCDM Edgeworth-Pareto Award, the highest distinction of the International Society for Multiple Criteria Decision Making. He serves on the Editorial Boards of several refereed journals.

Professor Salo has directed a broad range of basic and applied research projects funded by leading industrial firms, industrial federations, and funding agencies. He has been visiting professor at the London Business School, Université Paris-Dauphine, and the University of Vienna. He has been the President of the Finnish Operations Research Society (FORS) for two biennial terms. In 2010-11, he was the European and Middle East representative on the International Activities Committee of INFORMS. In 2010-16, he was a jury member of the EDDA Doctoral Dissertation Award of the Association of European Operational Research Societies (EURO) and chaired this jury in 2016. He served on the Board of the Association of Parliament Members and Researchers (Tutkas) in 1999-2019. In spring 2020, he was a member of the Science Panel, appointed by the Prime Minister's Office for obtaining scientific support for the management of the COVID-19 pandemic. In 2020-2023, he is a member of the Government Foresight Group, appointed by the Prime Minister's Office of Finland.

# What is Decision Analysis?

- Representative definitions
  - "Decision Analysis is a framework within which analyses of diverse types are applied to the formulation and characterization of decision alternatives that best implement the decision-maker's priorities given the decision-maker's state of knowledge." (NASA)
  - "Decision analysis (DA) is the discipline comprising the philosophy, methodology, and professional practice necessary to address important decisions in a formal manner." (Wikipedia)
  - "Decision analysis is a normative method for selecting among actions that have uncertain outcomes" (Borsuk, 2008)

# When is Decision Analysis most helpful?

- Commitments and/or consequences are important
  - Non-consequential decisions may not merit that much attention
  - But many small repeated decisions may still have large impacts (i.e., policies)
- It is possible to produce an informative analysis on the problem
  - Alternatives, uncertainties, decision objectives, decision criteria can be elaborated
- Enough time and resources are available for a formal analysis
  - Opportunities may be missed if the analysis comes too late
  - In expectation, the benefits of the analysis should outweigh costs
- The decision is required to be justifiable and rational
  - Often the case in public decision making (e.g., environmental decisions)
- "Divide and conquer"

# Why study Decision Analysis?

In decision-making,

- The decision-maker (DM) may have multiple objectives
- The impacts of the decision with regard to the objectives may be uncertain
- Decisions may have to be taken sequentially so that later decisions depend on the outcomes of earlier decisions
- There may be multiple DMs (or stakeholder groups) whose views need to be taken into account
- The DMs may find difficult to express preferences

**Complex decision problems can benefit from the development of formal decision models**

# Learning outcomes

After this course, you will

- Recognize real-life problems in which the use of decision models brings added value
- Build **decision models which incorporate DMs' preferences** in such problems
- **Solve** the resulting models with suitable software tools
- **Interpret the results** to provide defensible decision recommendations

You will also become aware of

- The discrepancies between formal models and human behaviour
- Ways to mitigate the adverse effects of this discrepancies

# Schedule

**One lecture per week for in periods I-II**

- Thu 10.15-12 in lecture hall D (8.9.), U4 (15.9.-13.10.), U1 (27.10.-1.12)

**One exercise session per week for in periods I-II**

- Tue 12.15-14 in R2

Information about **possible changes** in MyCourses

# Grading (tentative)

**Maximum 40 points – min 17 to pass the course**

1. **Three home assignments (max 4 + 7 + 11 = 22 points)**
   - Assignment 1 published 9/2022, DL **15.9.ay**
   - Assignment 2 published **15.9.**, DL **13.10.**
   - Assignment 3 published **13.10.**, DL around **1.12.**
2. **Exam (max 16 points) – min 7 points to pass the course**
3. **Participation in the guest lecture 1 point (to be confirmed)**
4. **Submission of course feedback 1 point**

# Course material

- Lecture slides cover all the required course content, but…

- Yet those who cannot attend lectures may wish to read 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 content

1. **Preliminaries:** Probabilities
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. **Supporting decision-making by optimization:** Multi-objective optimization (MOO), value function methods in MOO ~ 2-3 lectures
5. **Multiple decision makers:** Group techniques, voting, aggregation of utilities / values ~ 1 lecture