

Decision Support and Decision Modeling

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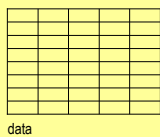
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Purpose and Goals

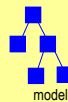
- General understanding of methods, techniques, and systems for supporting complex real-life decision-making tasks
- Decision Analysis
 - Decision Modeling
 - Multi-Attribute Modeling
 - Software
- Decision Support and Data Mining

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knowledge discovery from data

Data Mining



Use of models:

- classification
- clustering
- evaluation
- analysis
- visualization
- explanation
- ...



modelling

Decision Support



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Overview

1. Introduction:
 - What is decision-making?
 - What is decision support?
2. Decision Analysis
 - Decision Modeling:
 - stages
 - types of models
 - Multi-attribute Modeling
 - quantitative
 - qualitative
 - Software
 - Case studies
3. Decision Support and Data Mining
 - Ways to combine and integrate DS and DM
 - Case studies

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Literature



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What is Decision-Making?

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Decision Problem as the Problem of Choice

options
(alternatives) goals



- FIND the option that best satisfies the goals
- RANK options according to the goals
- ANALYSE, JUSTIFY, EXPLAIN, ..., the decision

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Questions

1. Find and describe some real-life decision problems? What are alternatives and goals in this case? What is the task?
- 2a. Have you been involved in a *difficult* decision-making problem? Which one? Why was it difficult?
- 2b. How did you make the decision? What did you do before and after the decision?
- 2c. Have you been satisfied with the decision? Was it a good or bad decision? Why?

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Exercise

Identify some typical (but difficult) decision problems related to:

- your study and personal development
- management of a company
- project management
- research management
- ecology
- medicine
- economy

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Types of Decisions

- Easy (routine, everyday) vs. Difficult (complex)
- One-Time vs. Recurring
- One-Stage vs. Sequential
- Single Objective vs. Multiple Objectives
- Individual vs. Group
- Structured vs. Unstructured
- Tactical, Operational, Strategic

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Types and Levels of Decisions



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Organisational Level of Decisions

<i>Properties of information</i>	<i>Operational level</i>	<i>Strategic level</i>
Exactness	high	low
Level of detail	detailed	aggregated
Time span	presence	future
Frequency of use	high	low
Sources	inside	outside
Viewpoint	narrow	wide
Type	quantitative	qualitative

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Characteristics of Complex Decisions

- Novelty
- Unclearness: Incomplete knowledge about the problem
- Uncertainty: outside events that cannot be controlled
- Multiple objectives (possibly conflicting)
- Group decision-making
- Important consequences of the decision
- Limited resources

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So, What is Decision Support?

- No commonly agreed definition
- Very broad area, narrow definitions
- Involves or is related to disciplines:
 - Decision Sciences, Decision Theory, Decision Support Systems, Decision Analysis, Management Science, Operations Research, Artificial Intelligence
- Some keywords:
 - *Theory*: Utility Theory, Game Theory, Theory of Choice
 - *Data*: Databases, Data Warehouses
 - *Models*: Deterministic, Stochastic, Decision Structuring Models
 - *Analysis*: Trend Analysis, What-If Analysis, OLAP, Data Mining
 - *Simulation, Optimisation*
 - *Decision Support Systems*: DSS, MIS, EIS
 - *Group Decision Support*: GDSS, Groupware, CSCW

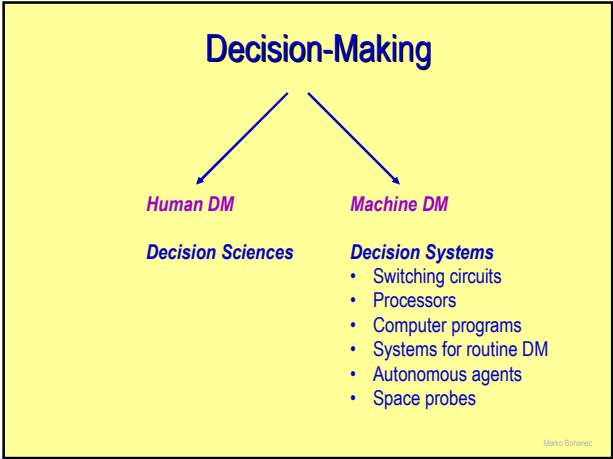
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Decision-Making

Decision:
The choice of one among a number of alternatives

- Decision-Making:**
A process of making the choice that includes:
- Assessing the problem
 - Collecting and verifying information
 - Identifying alternatives
 - Anticipating consequences of decisions
 - Making the choice using sound and logical judgement based on available information
 - Informing others of decision and rationale
 - Evaluating decisions

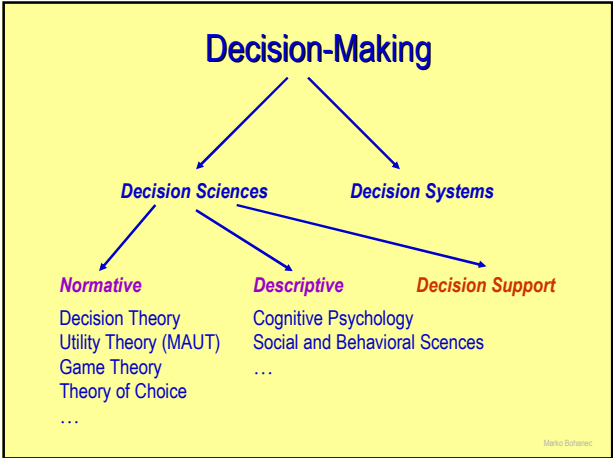
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Decision Sciences

Decision Sciences is an interdisciplinary field that draws on economics, forecasting, statistical decision theory, and cognitive psychology. Broadly speaking, Decision Sciences addresses three fundamental and inter-related questions. First, how should a "rational" person make decisions? This question is at the heart of economics, and often serves as a baseline for evaluating human decision making. Second, how do people really make decisions? Recent research has explored the ways in which people are "boundedly rational," and utilize rules-of-thumb and shortcuts to formulate judgements and to choose among alternatives. Often these shortcuts do well, but equally often they lead to systematic biases and serious errors. Finally, given what we know about rational decision making and actual behaviour, how can we help people, especially managers, improve their decision making? Decision researchers employ a variety of techniques to improve decision making, ranging from sharpening statistical intuition to quantitative decision analysis.

<http://www.insead.fr/phd/decisions.htm>
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Decision Support

Decision Support: Methods and tools for supporting people involved in the decision-making process

Central Disciplines:

- Operations Research and Management Sciences
- Decision Analysis
- Decision Support Systems

Contributing and Related Disciplines:

- Decision Sciences (other than DS itself)
- Statistics, Applied Mathematics
- Computer Sciences (Information Systems, Databases)
- Artificial Intelligence (Expert Systems, ML, NN, GA)
- Knowledge Discovery from Databases and Data Mining

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Operations Research

• **Operations Research** is concerned with optimal decision making in, and modeling of, deterministic and probabilistic systems that originate from real life

- OR/MS are the professional disciplines that deal with the application of information technology for informed decision-making
- OR/MS Professionals aim to provide rational bases for decision making by seeking to understand and structure complex situations and to use this understanding to predict system behavior and improve system performance. Much of this work is done using analytical and numerical techniques to develop and manipulate mathematical and computer models of organizational systems composed of people, machines, and procedures
- OR/MS draws upon ideas from engineering, management, mathematics, and psychology to contribute to a wide variety of application domains; the field is closely related to several other fields in the "decision sciences" – applied mathematics, computer science, economics, industrial engineering, and systems engineering

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Decision Support Systems

DSS: Interactive computer-based systems intended to help decision makers utilize data and models to identify and solve problems and make decisions.

Characteristics:

- Incorporate both data and models
- Designed to assist managers in semistructured or unstructured decision-making processes
- Support, rather than replace, managerial judgment
- Aimed at improving the effectiveness (rather than efficiency) of decisions

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Decision Support Systems

Overview

Decision support system (DSS) covers a wide variety of systems, tools and technologies. Some people think the term DSS is dated and that it has been replaced by a "new type" of system called on-line analytical processing or OLAP. Others seem to emphasize creating knowledge-based DSS as the "state-of-the-art" in decision support systems. Operations researchers primarily focus on optimization and simulation models as the "real" DSS. In my opinion the term decision support system and its acronym DSS remains a useful and inclusive term for many types of information systems that support decision making.

Keep in mind as you read articles in the DSS literature that if a computerized system is NOT an on-line transaction processing system (OLTP), someone will be tempted to call it a DSS. If a software program runs on a PC and can help a manager make a decision then someone will likely refer to it as a DSS. EIS, ESS, geographic information systems (GIS), OLAP, software agents, knowledge discovery systems and group DSS can all be lumped into the category of systems we call DSS.

D.J. Power, *What is a DSS?*
<http://dsaresources.com/papers/whatloads/index.html>

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DSS Categories

MIS: Management Information System

OLTP: On-Line Transaction Processing

DSS:

- Data-, Model-, Knowledge-, and Communication-Based
- DSS Generators

EIS: Executive Information Systems

EES: Executive Support Systems

GIS: Geographic Information Systems

GDSS: Group DSS, Groupware

OLAP: On-Line Analytical Processing (Data Warehouses)

Distributed Support Systems and Software Agents

Knowledge Discovery Systems (KDD and Data Mining)

Expert Systems

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What Else is Decision Support?

- Methods and tools for organising data, facts, thoughts, ...
 - "pencil and paper"
 - brainstorming
 - concept mapping, mind mapping
- Data storage, search and retrieval
 - Query By Example
- Representation and visualisation tools
 - reports
 - charts
- Communication technology
- Mediation systems
- ...

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