

Systems and Techniques of Decision Support

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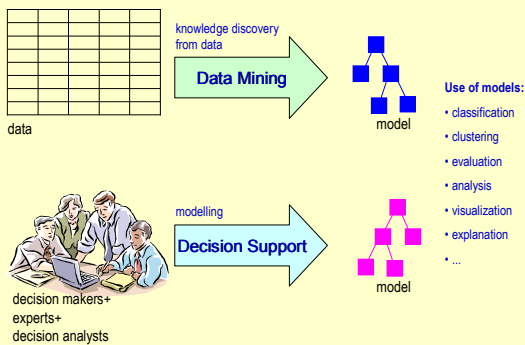
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Purpose and Goals

- 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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Overview

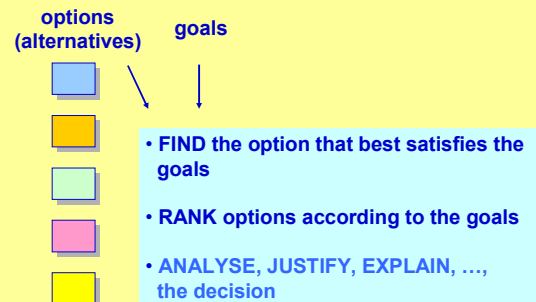
1. Introduction:
 - What is decision-making?
 - What is decision support?
2. Decision Analysis
 - Decision Modeling:
 - stages
 - types of models
 - Multi-attribute Modeling
 - quantitative
 - qualitative
 - Software
 - Case studies
3. Decision Support and Data Mining
 - Ways to combine and integrate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

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What is Decision-Making?

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Decision Problem as the Problem of Choice



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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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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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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

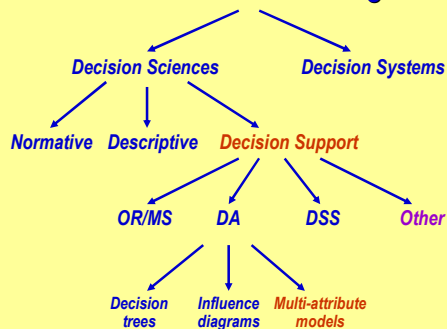
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Types and Levels of Decisions



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Decision-Making



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Decision Analysis

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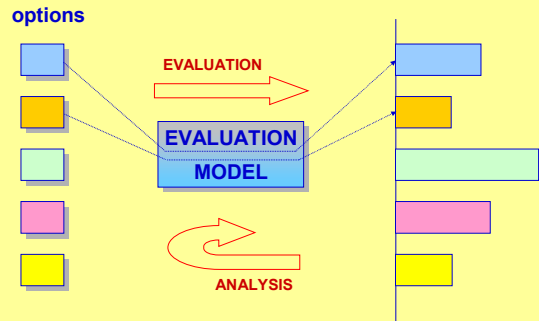
Decision Analysis

Decision Analysis: Applied Decision Theory

- Provides a framework for analyzing decision problems by
- structuring and breaking them down into more manageable parts,
 - explicitly considering the:
 - possible alternatives,
 - available information
 - uncertainties involved, and
 - relevant preferences
 - combining these to arrive at optimal (or "sufficiently good") decisions

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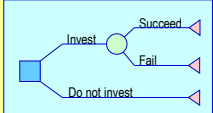
Evaluation Models



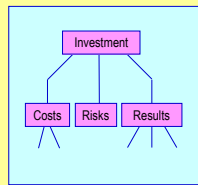
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Types of Models in Decision Analysis

Decision Trees

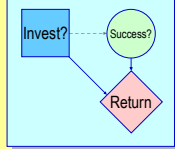


Multi-Attribute Utility Models



Analytic Hierarchy Process

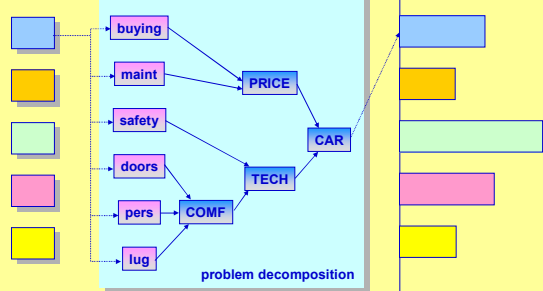
Influence Diagrams



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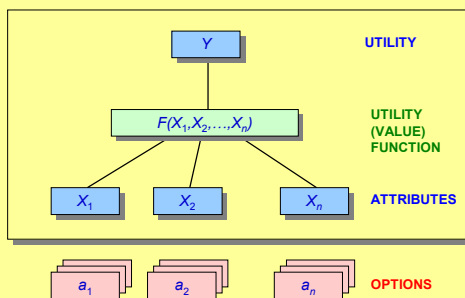
Multi-Attribute Models

cars



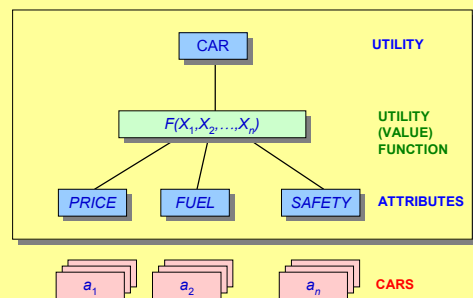
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Multi-Attribute Model Structure

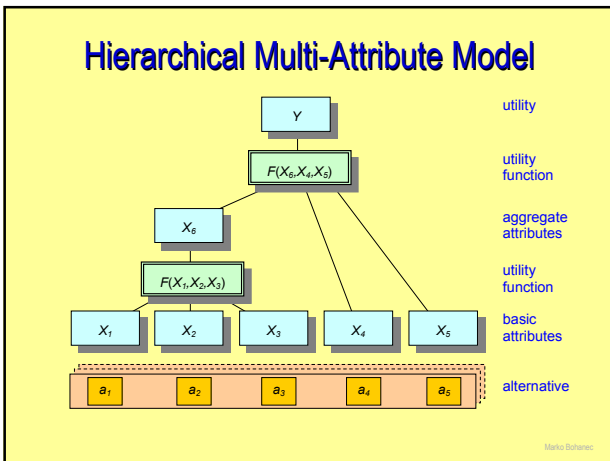
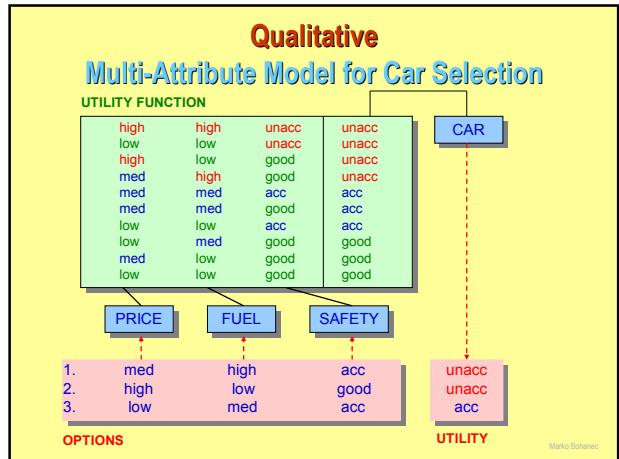
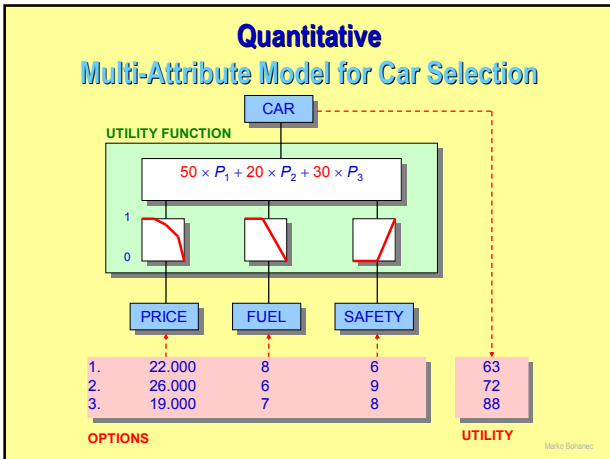


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Multi-Attribute Model for Car Selection



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- ### Multi-Attribute Modelling: Why?
- Systematic, structured approach (to difficult real-life problems)
 - Model development:
 - problem decomposition into smaller, less-complex subproblems
 - requires understanding and careful elaboration of the problem
 - facilitates and motivates communication and knowledge interchange
 - Evaluation:
 - selection of a single option
 - option ranking
 - Analysis:
 - “what-if” analysis
 - sensitivity analysis
 - explanation:
 - how? (evaluation procedure)
 - why? (selective explanation of advantages/disadvantages)
 - option generation
 - Contributes to better decisions:
 - understanding, justification, explanation, documentation

- ### Multi-Attribute Modelling: How?
0. Problem identification
 1. Tree (or hierarchy) of attributes
 2. Utility functions
 3. Evaluation and analysis of alternatives
 - 4+ Implementation

- ### MADM Tools
1. “Paper and Pencil” (Abacon)
 2. Spreadsheets and mathematical modelling software (MS Excel)
 3. Specialized MADM software

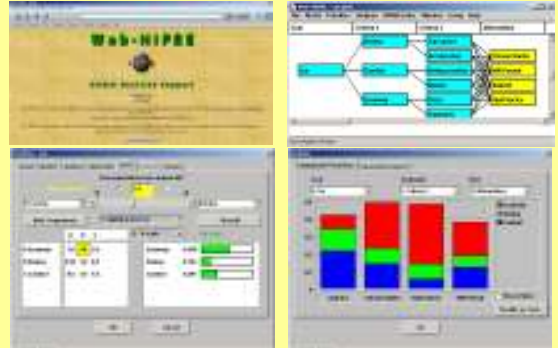
Spreadsheet Modelling



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Specialized Software

Web-HIPRE <http://www.hipre.hut.fi/>



DEXi

Computer Program for
Multi-Attribute Decision Making

A simple computer program for MADM that facilitates:

- Creation and editing of
 - model structure (tree of attributes)
 - value scales of attributes
 - decision rules (incl. using weights)
 - options and their descriptions (data)
- Evaluation of options (can handle missing values)
- Presentation of evaluation results with:
 - tables
 - charts
- "What-if" analysis
- Preparing a report

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Real-Life Examples of MADM Applications

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Some Application Areas

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. INFORMATION TECHNOLOGY <ul style="list-style-type: none"> • evaluation of computers • evaluation of software • evaluation of Web portals 2. PROJECTS <ul style="list-style-type: none"> • evaluation of projects • evaluation of proposal and investments • product portfolio evaluation 3. COMPANIES <ul style="list-style-type: none"> • business partner selection • performance evaluation of companies | <ol style="list-style-type: none"> 4. PERSONNEL MANAGEMENT <ul style="list-style-type: none"> • personnel evaluation • selection and composition of expert groups • evaluation of personal applications 5. MEDICINE and HEALTH-CARE <ul style="list-style-type: none"> • risk assessment • diagnosis and prognosis 6. OTHER AREAS <ul style="list-style-type: none"> • assessment of technologies • assessments in ecology and environment • granting personal/corporate loans |
|---|--|

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Summary of Applications

1. Loan Allocation
 2. Evaluation/Selection of Projects
 3. Medicine: Risk Assessment
 4. Evaluation/Selection of Locations
 5. Advising in Sports
 6. Application ranking (in Housing)
 7. Business partner selection (in Housing)
 8. Assessment of Life-Event Portals
 9. Assessment of Cropping Systems
- Other areas:**
- evaluation of technology (cars, computers, software, Web pages and services, ...)
 - evaluation of investment proposals, tenders
 - production portfolio evaluation
 - performance evaluation of companies
 - personnel management
 - ...

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