DEXi:
Methodology and Software

DEX:
Expert System Shell for
Multi-Attribute Decision Making
1987–1999, DOS

DEX:
“DEX for Education”
Computer Program for
Multi-Attribute Decision Making
1999 →, Windows

DEX
Based on:
• multi-attribute decision making
• expert systems
• machine learning
• fuzzy logic

Qualitative decision modelling:
• qualitative attributes
• decision rules

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DEX and DEXi: Background

1. Multi-Attribute Decision Making
   - Modeling using criteria and utility functions
   - Problem decomposition and structuring
   - Option evaluation and analysis

2. Expert Systems
   - Qualitative (symbolic) variables
   - "If-then" decision rules
   - Decision model = knowledge base
   - Emphasis on the explanation of results (DEX)

DEXi

Computer Program for Multi-Attribute Decision Making

A simple computer program for MADM that performs:
- Creation and editing of:
  - Problem structure (tree of attributes)
  - Value scales of attributes
  - Decision rules (including using weights)
  - Options and their descriptions (data)
- Evaluation of options (can handle missing values)
- Presenting the evaluation results with:
  - Tables
  - Charts
- "What-if?" analysis
- Preparing a report

Stages of MADM (with DEXi)

0. Problem Identification
   a. Problem formulation
   b. Formation of a decision-making group
   c. Selection of a decision-making methodology

1. Identification of Attributes
   a. Unstructured list of attributes
   b. Hierarchy (tree) of attributes
   c. Measurement scales

2. Definition of Utility Functions (Decision Rules)

3. Evaluation and Analysis of Options
   a. Description of options (categorization)
   b. Evaluation of options
   c. Programs

4. Implementation
Stages of MADM (with DEXi)

0. Problem Identification
   a. problem formulation
   b. formation of a decision-making group
   c. selection of decision-making team

1. Identification of Attributes
   a. unstructured list of attributes
   b. hierarchy tree of attributes
   c. measurement scales

2. Definition of Utility Functions (Decision Rules)

3. Evaluation and Analysis of Options
   a. description of options (data, qualitative)
   b. evaluation of options
   c. graphics

4. Implementation

1.a: Unstructured List of Attributes

**Problem in Personnel Management:**
Select a Candidate for a Job (e.g., a project manager)

- education
- age
- experience
- references
- knowledge
- work approach
- ability to work in a group
- leadership
- organizational abilities
- loyalty
- intelligence
- communicational
- character
- health
- ...

*Do not overlook important attributes!

1.b: Tree of Attributes

Create meaningful related groups
Avoid aggregate attributes having more than three descendants
1.b: Tree of Attributes

1.c: Scales

Scales are discrete, typically ordered from bad to good. Values should distinguish between importantly different characteristics. Their number should gradually increase from bottom to the root.
### 2: Decision rules

**Utility Functions, Bottom-Up Aggregation**

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**Diagram:**

- Personal
- A/E/I
- Test
- Comm
- Leader

### 3.a: Description of Options

**Diagram:**

- Candidate
  - Formal
  - Exp.
  - Age
  - Abil/1
  - Test

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3.a: Description of Options

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3.bc: Evaluation and Analysis of Options

1. Evaluation
   - projected from bottom (basic attributes to the root)
   - result: qualitative evaluation of each option
   - feed as input for (DEX) or improves (DEX) option values

2. Analysis
   - input to inspection of results
   - what-if analysis
   - analysis:
     - compare options
     - "11" analysis
     - select the explanation
     - reports
     - charts

3.b: Evaluation of an Option

Candidate A

- Education: acc
- Years: acc
- Personal: good
- Formal: MSc
- For Lang: pass
- Exp: 15/year
- Age: 21-25
- Abil: 7
- Test: good
- Leader: more
- Comm: good
3.b: Evaluation of Options

3.c: What-If Analysis
3.c: What-If Analysis

3.c: “±1” Analysis

3.c: Compare options
3.c: Selective Explanation

Candidate B

- **Employ**: unacc
- **Educat**: good
- **Years**: good
- **Personal**: unacc
- **Formal**: PND
- **For Lang**: act
- **Expert**: more
- **Age**: 25-40
- **Able1**: over
- **Test**: less

3.c: Selective Explanation

- **Weak points**
  - Attribute: B
    - **Display**: unacc
    - **Personal**: unacc
    - **Able1**: less
- **Strong points**
  - Attribute: B
    - **Educat**: good
      - **Formal**: PND
    - **Years**: good
      - **Expert**: more

Charts and Reports
DEX and DEXi: Experience

- Wide applicability to various application areas
- Usually, solutions are specific (non-general)

1. Model development time
   - Highly problem-dependent: from hours to months
   - Time: 3 to 15 days

2. Most difficult stage
   - Designing the tree of attributes

3. Appropriate decision problems
   - Many attributes (> 10)
   - Many options (> 10)
   - Prevalent qualitative decision-making, judgment
   - Incomplete or missing data
   - Group decision making (communication and explanation)
   - Sufficient resources available (expertise, time)

DEX in DEXi: Future

- Combined qualitative and quantitative models
- Extensions:
  - Data Mining (e.g., machine learning of models by HINT)
  - Database, Data Warehouses, OLAP
- Software:
  - "Dex Machine": Low-level OI library for OI models
  - Various types and levels of GUI

DEX and DEXi: Summary

1. Combination of
   - Multi-attribute decision making and expert systems

2. Characteristics:
   - Qualitative (symbolic) decision making
   - Explanation and analysis
   - Active support in the acquisition of decision rules

3. Applicability:
   - For complex real-world problems
   - Over 50 real-life applications
Exercise

1. Take one of the already defined "empty" models shown on the next slide
2. Define all utility functions (decision rules) in that model
3. Define and describe a few (about 4) options
4. Evaluate and analyse the options
5. Extend the model:
   - add and/or refine a few attributes
   - repeat the steps 2, 3, and 4.
6. Prepare and print out (or save) a report

Models

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<th>Programmer's Performance</th>
<th>Performance Evaluation of Companies</th>
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