

Decision Analysis Part 4: Multi-Attribute Models

Mark A. Behlmer

Motivation for Multi-Attribute Modeling

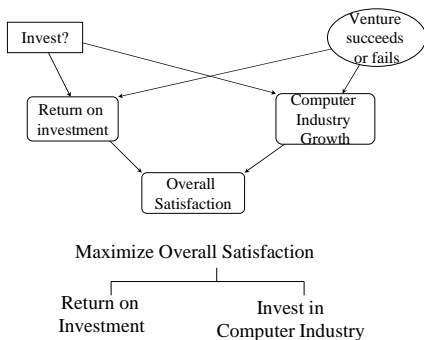
So far we have considered single-objective models, but most of real-life decisions are multiple-objective: e.g.: price + performance (conflicting)

Influence diagrams facilitate multi-objective modeling to some degree. However, more is needed in terms of model development and analysis of decisions. Thus, specialised models and software.

Multi-attribute modeling is very useful and practical.

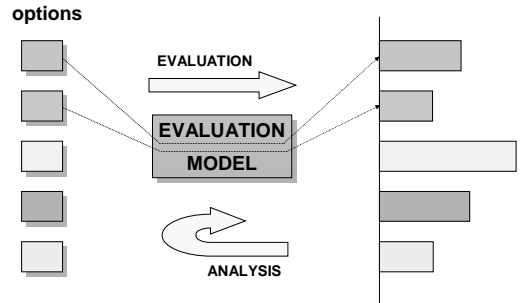
Mark A. Behlmer

ID's and Multiple Objectives



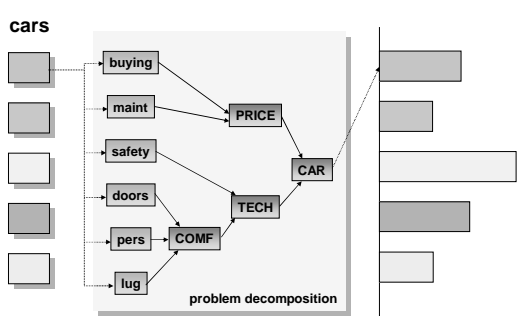
Mark A. Behlmer

Evaluation Models



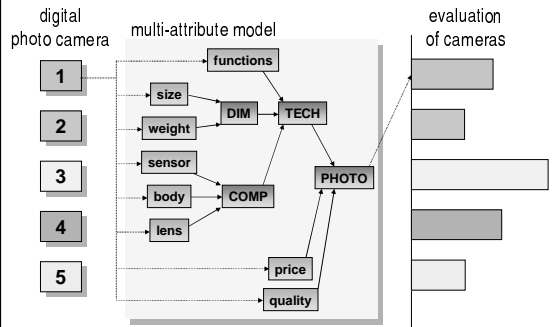
Marko Bohar ec

Multi-Attribute Models



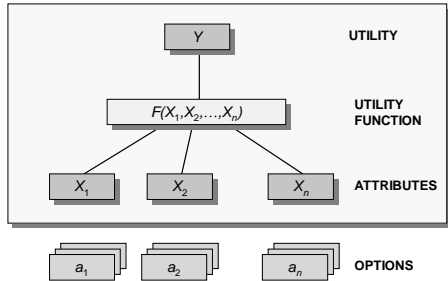
Marko Bohar ec

Multi-Attribute Models



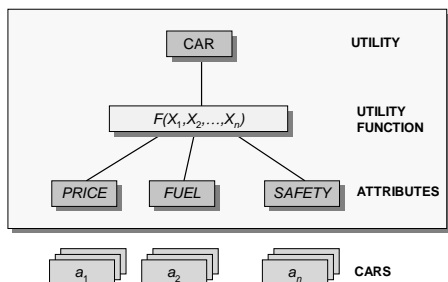
Marko Bohar ec

Multi-Attribute Model Structure



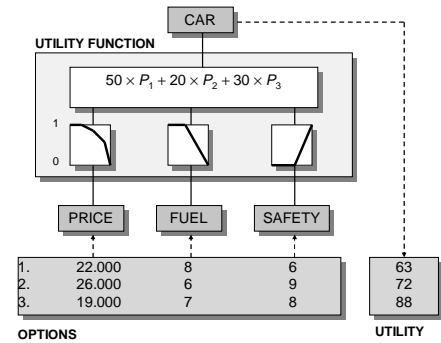
Marko Boharac

Multi-Attribute Model for Car Selection

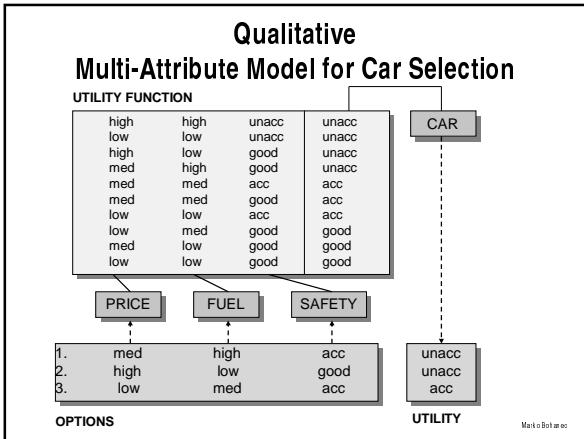


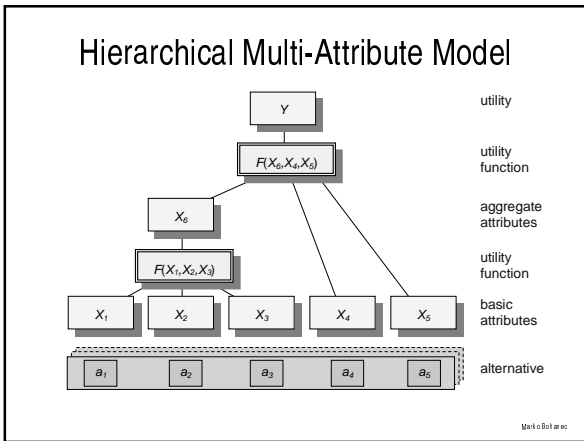
Marko Boharac

Quantitative Multi-Attribute Model for Car Selection



Marko Boharac





Questions

1. Have you ever encountered a:
 - multi-objective decision problem?
 - multi-attribute model?

When, where, for what kind of problems?
2. Compare multi-attribute models with:
 - decision trees
 - influence diagrams
3. Suggest types of decision problems suitable for the application of multi-attribute models

Marko Boharac

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

Markus Bohmer

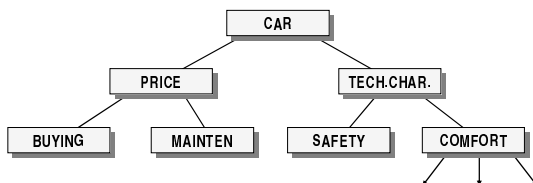
Multi-Attribute Modelling: *How?*

0. Problem identification
 1. Tree (or hierarchy) of attributes
 2. Utility functions
 3. Evaluation and analysis of alternatives
- 4+ Implementation

Markus Bohmer

1. Tree of Attributes

Decomposition of the problem to sub-problems (“*Divide and Conquer!*”)

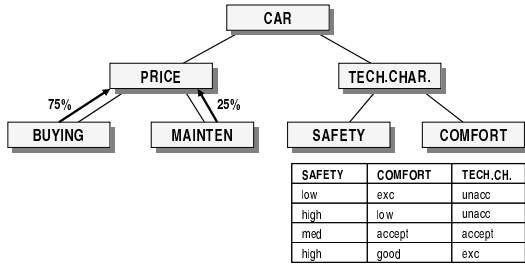


The most difficult stage!

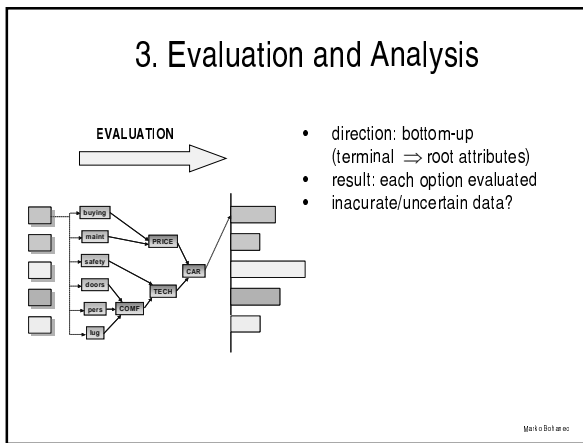
Markus Bohmer

2. Utility Functions (Aggregation)

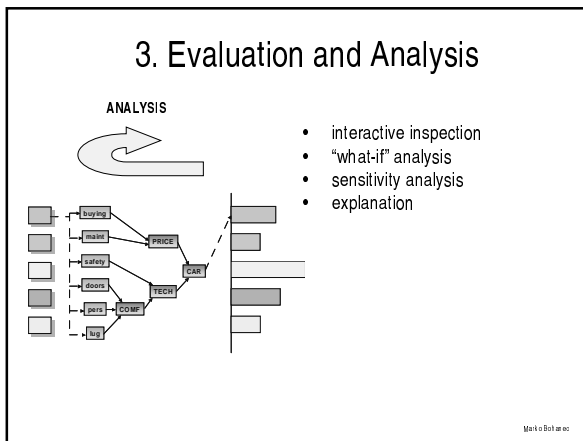
Aggregation: bottom-up aggregation of attributes' values



3. Evaluation and Analysis



3. Evaluation and Analysis

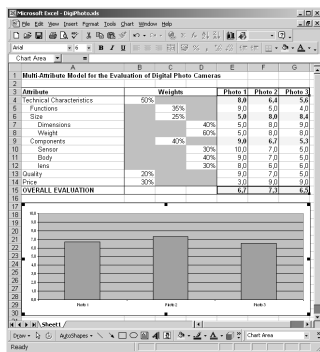


MADM Tools

1. "Paper and Pencil" (Abacon)
2. Spreadsheets and mathematical modelling software (MS Excel)
3. Specialized MADM software

Marko Bohar.ec

Spreadsheet Modelling

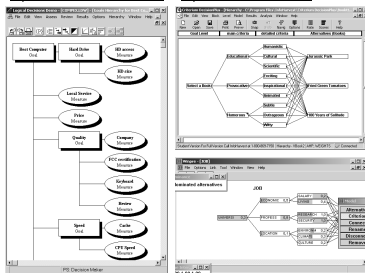


Marko Bohar.ec

Specialized Software (1/4)

Logical Decisions
<http://www.logicaldecisions.com/>

Criterion DecisionPlus
<http://www.infoharvest.com/>



Marko Bohar.ec

Exercise

You would like to buy a new laptop computer for your own purposes (study, internet, fun, ...).

Suggest a suitable set of attributes and create a tree of attributes.

Consider the guidelines presented on the next two slides.

Markus Behr 2002

Developing Attribute Structure

Three basic strategies:

- *Top-Down*: Start with the overall evaluation (target objective), decompose it to sub-goals.
- *Bottom-Up*: Start with desirable characteristics, sub-goals. Group them into connected, meaningful sub-trees.
- *Middle-Out*: Combining the two above. Iteratively decompose (refine) and group (generalise) attributes.

Markus Behr 2002

Developing Attribute Structure

Desirable features of attributes and their structure:

- *Completeness*: Do not overlook important attributes
- *Relevance (non-redundancy)*: Use only relevant attributes, omit redundant attributes
- *Minimality*: Use a minimal number of attributes
- *Orthogonality*: Basic attributes should be independent of each other
- *Operativity*: Basic attributes should be easy to assess or measure
- *Comprehensibility*: Create meaningful sub-trees of inter-related attributes

Markus Behr 2002
