Complex decisions

multiple value dimensions,
which may be in conflict

1

2

Which apartment?

Each apartment has pro and cons …

different ratings on different attributes

common characteristic of each alternative

Complex decisions

Non-compensatory vs. compensatory strategies

A negative value on one attribute **cannot** be compensated by an equal or higher value on another attribute

A negative value on one attribute **can** be compensated by an equal or higher value on another attribute

Complex decisions

Non-compensatory strategies

based on decision rules to shortcut or simplify the process
"***Elimination by Aspect***" strategy (Tversky 1972)
"*Lexicographic rule*" (Svenson 1979)

Example
a high rent for one apartment eliminates that option from the consideration set, with the better location unable to compensate for the negative high-rent attribute

Complex decisions

Non-compensatory strategies

based on decision rules to shortcut or simplify the process
"*Elimination by Aspect*" strategy (Tversky 1972)
"***Lexicographic rule***" (Svenson 1979)

Example

Weird?

The location is the most important attribute for us, so we choose the apartment with the better location

Complex decisions

Compensatory strategies

The alternative options are evaluated on a number of different relevant attributes
A negative value on one attribute can be compensated by an equal or higher value on another attribute

Example
A high rent (negative attribute) for one apartment may be compensated by the better location (positive attribute) of that apartment

Complex decisions

Compensatory strategies

The alternative options are evaluated on a number of different relevant attributes
A negative value on one attribute can be compensated by an equal or higher value on another attribute

Multi **A**ttribute **U**tility **T**heory

MAUT

Technique to support decision making
when there is a limited number of available alternatives

AIM:

To assist decision makers make better choices by helping them to achieve greater understanding and insight into the decision they are facing

MAUT

Technique to support decision making
when there is a limited number of available alternatives

Step 1. List of defining alternatives and value-relevant attributes

Step 2. Evaluating each alternative separately on each attribute

Step 3. Assigning relative weights to the attributes

Step 4. Aggregating the weights of attributes and the single-attribute evaluations of alternatives (overall evaluation)

MAUT

Step 1. List alternatives and value-relevant attributes

Very demanding and time consuming

- Complete — All important aspects have to be covered
- Operational — They can be transformed into numbers
- Decomposable — They allow to consider simplified parts of the decision
- Non redundant — No double counting should take place
- Minimal — Their number should be as small as possible

MAUT

Step 1. List alternatives and value-relevant attributes

We can operationalize attributes as we prefer

as long as the value scale is satisfied

n. of square meters

n. of rooms

Prize

Qualitative description

→ Not always linear and monotone

MAUT

Step 2. Evaluate each alternative separately on each attribute

Different elicitation methods:

Direct rating
(assigned a score from 0 to 100)

Difference standard sequences
(a sequence of stimuli that are equally spaced in value)

Bisection method
(the most and least preferred option are identified and a midpoint is found that is equidistant in value from both extremes)

MAUT

Step 3. Assign relative weights to the attributes

Different elicitation methods:

Ranking
(attributes are ranked in order of importance)

Direct rating
(in which a rating from 0 to 100 is allocated to each criteria)

Point allocation
(in which a total budget of 100 points is divided among criteria)

MAUT

Step 3. Assign relative weights to the attributes

Once all ratings are collected,
relative weights are calculated by dividing the rating of each attribute
by the sum of all ratings

$$w_i = \frac{w'_i}{\sum_{i=1}^{n} w_i}$$

Not-normalized weight

Relative weight

MAUT

Step 3. Assign relative weights to the attributes

	Attribute	Score	Weight
Price	A	80	?
N. of rooms	B	40	?
Size of backyard	C	20	?
Size of living room	D	50	?
Type	E	30	?

MAUT

Step 3. Assign relative weights to the attributes

	Attribute	Score	Weight	
Price	A	80	.36	(80/220)
N. of rooms	B	40	.18	(40/220)
Size of backyard	C	20	.09	(20/220)
Size of living room	D	50	.23	(50/220)
Type	E	30	.14	(30/220)
		220		

MAUT

Step 4. Obtain the overall evaluation

Multiply the weight * attribute value
and sum these weighted attribute values over all attributes
(*weighted linear additive function*)

$$v(x) = \sum_{i=1}^{n} w_i \; v_i \, (x_i)$$

→ Compensatory technique

MAUT

Step 4. Obtain the overall evaluation

Option	Attribute A	Attribute B	Attribute C	Total utilities
A	20	20	20	
B	90	10	10	
C	0	90	80	
Weights	0,5	0,2	0,3	

MAUT

Step 4. Obtain the overall evaluation

Option	Attribute A	Attribute B	Attribute C	Total utilities
A	20	20	20	20
B	90	10	10	50
C	0	90	80	42
Weights	0,5	0,2	0,3	

MAUT

EXERCISE

MAUT

A household consisting of two parents (Paul and Laura) and three small daughters decides to search for a new dwelling because their current dwelling doesn’t have enough room since the birth of their third daughter. The couple requires an owner-occupied home with a backyard for their small children.

After a thorough search with the use of some internet sites proposing available dwellings, the couple finds out that there are **six available dwellings** within their selected region that satisfy their requirements.

These dwellings differ with respect to their characteristics (so called attributes).

The couple decides to examine which alternative they should choose using a Multi-Attribute Utility method.

MAUT

Firstly, they decide which attributes are important to them.

After some deliberation, they come up with the following ones:

MAUT
A household consisting of two parents (Paul and Laura) and three small daughters decides to search for a new dwelling because their current dwelling doesn't have enough room since the birth of their third daughter. The couple requires an owner-occupied home with a backyard for their small children.
After a thorough search with the use of some internet sites proposing available dwellings, the couple finds out that there are six available dwellings within their selected region that satisfy their requirements.
These dwellings differ with respect to their characteristics (so called attributes).
The couple decides to examine which alternative they should choose using a Multi-Attribute Utility method

dwelling type

costs

size of the living room

number of rooms

size of the backyard

architectural style

residential environment

MAUT

Six dwellings profiles on the basis of their attribute levels

	Dwelling type	Costs	Size living room	Number of rooms	Size backyard	Architectural style	Residential environment
A	Semi-detached	€ 220,000	20 m^2	2 rooms	5 m	Innovative	Rural
B	Semi-detached	€ 140,000	20 m^2	4 rooms	15 m	Traditional	Sub-urban
C	Terraced/corner	€ 300,000	40 m^2	4 rooms	10 m	Traditional	Rural
D	Terraced/corner	€ 140,000	40 m^2	2 rooms	15 m	Innovative	Urban
E	Apartment	€ 220,000	20 m^2	3 rooms	10 m	Traditional	Rural
F	Semi-detached	€ 220,000	30 m^2	2 rooms	10 m	Modern	Urban

MAUT

Next, they determine the values of the attributes of each alternative using a rating scale with two anchors.

On the left side the rating scale is anchored by “extremely unattractive” (0) and on the right side by “extremely attractive” (100).

	Laura	Paul	Couple
Dwelling type			
Apartment (ground floor)	50	90	70
Terraced house/corner house	70	60	65
Semi-detached house	90	40	65
Purchase costs			
€ 140,000	40	50	45
€ 220,000	70	100	85
€ 300,000	60	25	42
Size living room			
20 m^2	70	40	55
30 m^2	90	70	80
40 m^2	100	100	100
Number of rooms			
2	60	20	40
3	70	80	75
4	80	100	90
Backyard size			
5 m	70	100	85
10 m	90	50	70
15 m	100	10	55
Architectural style			
Traditional	80	90	85
Innovative	50	20	35
Modern	80	70	75
Residential environment			
Urban	60	10	35
Sub-urban	80	60	70
Rural	90	100	95

MAUT

Next, the couple decides to assign a score to each of the attributes according to their importance. They use a rating scale with numerically scaled endpoints of 0 (not important at all) and 100 (extremely important). Thus, the higher the importance, the higher the score for that particular attribute.

	Importance scores		
	Laura	Paul	Couple
Dwelling type	95	55	75
Purchase costs	100	100	100
Size living room	80	55	67.5
Number of rooms	95	100	97.5
Backyard size	95	35	65
Architectural style	80	55	67.5
Residential environment	80	55	67.5
Total	625	455	540

MAUT

What is the dwelling that should be chosen according to

LAURA’s analysis?

PAUL’s analysis?

The COUPLE’s analysis?