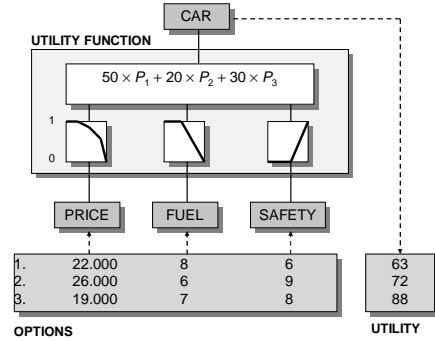


# Notes on Aggregation and Utility Functions

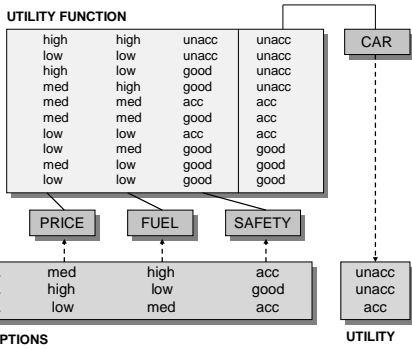
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## Quantitative Multi-Attribute Model for Car Selection



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## Qualitative Multi-Attribute Model for Car Selection



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## Aggregation Functions in Math

$$y = \text{Aggreg}(x_1, x_2, \dots, x_n)$$

$$\text{Aggreg} : [0,1]^n \rightarrow [0,1]$$

Conditions:

1. Identity when unary:

$$\text{Aggreg}(x) = x$$

2. Boundary conditions

$$\text{Aggreg}(0, \dots, 0) = 0$$

and

$$\text{Aggreg}(1, \dots, 1) = 1$$

3. Non-decreasing

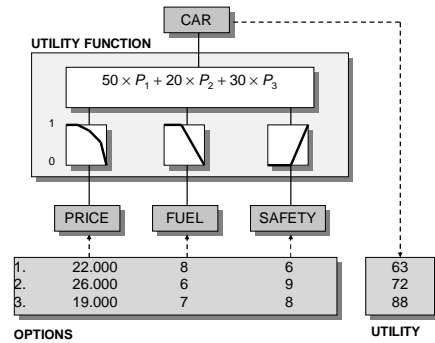
$$\text{Aggreg}(x_1, \dots, x_n) \leq \text{Aggreg}(y_1, \dots, y_n) \text{ if } (x_1, \dots, x_n) \leq (y_1, \dots, y_n)$$

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## Utility Functions

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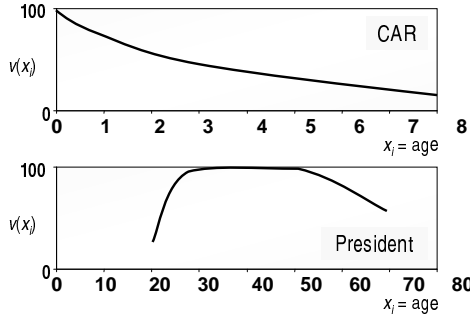
## Quantitative Multi-Attribute Model for Car Selection



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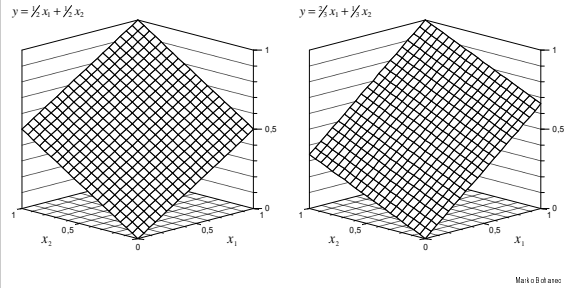
### Utility Function of a Single Attribute

#### Modelling of Preferences



### Linear Aggregation Functions

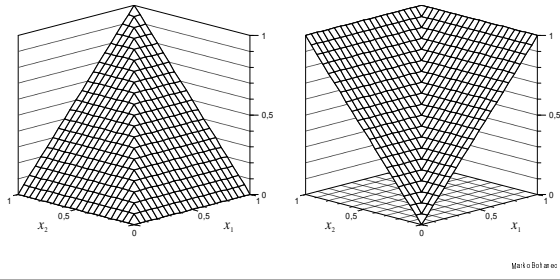
$$y = v(x_1, x_2, \dots, x_n) = \sum_{i=1}^n w_i x_i \quad \sum_{i=1}^n w_i = 1$$



### Minimum and Maximum

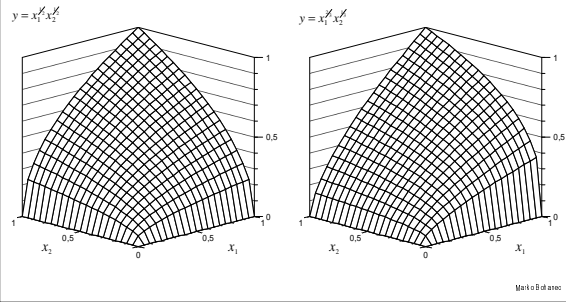
$$y = \min(x_1, x_2)$$

$$y = \max(x_1, x_2)$$



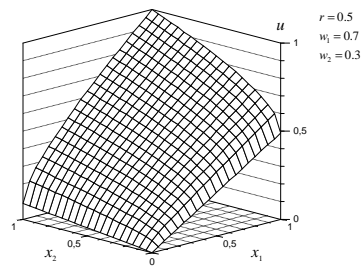
### Multiplicative Aggregation Functions

$$y = v(x_1, x_2, \dots, x_n) = \prod_{i=1}^n x_i^{w_i} \quad \sum_{i=1}^n w_i = 1$$



### Continuous Logic Functions

$$y = v(x_1, x_2, \dots, x_n) = \left( \sum_{i=1}^n w_i x_i^r \right)^{\frac{1}{r}} \quad \sum_{i=1}^n w_i = 1$$



### Linear Aggregation of Partial Utility Functions

$$y = v(p_1(x_1), p_2(x_2), \dots, p_n(x_n))$$

