Lab: M-MACBETH

The goal of this session is to use the software M-MACBETH to build preference criteria from different types of variables.

A demo can be downloaded at: http://www.m-macbeth.com/downloads.html
In the classroom, the software is already installed and prepared to be used.
You can change the language in the tab Settings.

Problem

Let us consider that we want to select an American University for studying a master. We will consider the following 4 variables: *Location, Number of Applicants, Quality of live* and *Faculty/students ratio*.

The preferences that we want to model are the following ones:

- ***Quality of Live*:** Qualitative variable with 4 possible values {A,B,C,D}. Preferences are the following: A > B >>> C >>>>> D.
- ***Faculty/students ratio*:** Range from 5 to 25. The value that the DM prefers is 10. Preference decreases linearly if you separate from the value 10.

Definition of the criteria

A utility criterion will be defined on the basis of each of those variables, using M-MACBETH. All criteria will be at the same level (no hierarchical structure).
Before starting, it is necessary to define the type of each criterion appropriately. Option: "Basis for comparison", which has two possibilities:

- Qualitative performance levels: categories must be introduced from the best to the worst.
- Quantitative performance levels: introduce the numerical values that will be used as reference, from best to worst (with respect to their evaluation).

Once the scales of measurement of the variables have been introduced, the reference values must be determined (superior and inferior). Use the right button in the mouse.

The next step consists on generating the utility functions.

1. For the categorical variables, you fill in the matrix giving values to the difference of attractiveness as indicated above.
2. For the numerical variables, you can use either the matrix or the direct translation into a numerical preference scale.

Next, the weights of each criterion must be defined (Weighting → Judgements). To start, just give 50 points to each criterion (equal weights).

Finally, some alternatives must be introduced into the system (Options → Define). The values given to each alternative appear in the "Table of Performances". In the next table you

have some data extracted from the UCI repository[1]. The performance scores for each criterion and the overall rating are given in "Table of Scores". Introduce a subset of those alternatives into the system and test them (only the two first columns).

	QualityOfLive	*FacultyStudent*	*NumApplicants*	*Location*
Adelphi	D	15,0	5,5	City
ArizonaState	A	20,0	18,0	City
BostonCollege	C	20,0	11,5	small_city
BostonUniversity	C	12,0	15,0	City
Brown	A	11,0	11,5	City
CalTech	C	10,0	3,0	Country
CarnegieMellon	C	10,0	5,5	big_city
CaseWestern	C	9,0	3,0	big_city
CCNY	D	15,0	3,0	big_city
Colgate	C	13,0	5,5	small_city
Columbia	C	9,0	5,5	City
CooperUnion	C	6,0	3,0	big_city
Cornell	D	7,0	19,0	small_city
Dartmouth	C	7,0	9,0	small_city
FloridaTech	C	20,0	3,0	small_city
Floridastate	C	20,0	8,0	small_city
GeorgiaTech	D	20,0	6,0	big_city
Harvard	B	10,0	18,0	big_city
Hofstra	D	10,0	5,0	Country
IllinoisTech	C	25,0	3,5	City
JohnsHopkins	C	10,0	4,0	City
MIT	C	5,0	5,5	City

Tasks

- Define the 2 criteria and a subset of universities (at least 6).
- Introduce the values of the universities given in the table above.
- Analyze if the overall performance obtained is correct, according to the decision-maker's points of view for the criteria (Overall thermometer, XY map).
- Find the dominance relations between these universities. Then: Add a new university that dominates all the rest. Define a university that dominates CarnegieMellon but it is dominated by ArizonaState.

- *Additionally*, if you have time, you can add two more criteria and compare the results.

    - ***Location:*** Qualitative variable with 4 terms {small_city, city, big_city, country}. Decision maker preferences are: small_city > city > country = big_city.
    - ***NumApplicants*:** Range from 3 to 20. The DM has different given his preferences in intervals of values, defining 4 reference points with their corresponding utility:

Num Applicants	Utility score
14	100
10	80
10	30
3	10

[1] http://archive.ics.uci.edu/ml/