A presentation of a new web service and its integration into diviz

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The following work is based on two main problems in the MCDA domain:

- How to obtain method parameters, as criteria significance weights, thresholds, ...?
- How to ensure credibility for a solution?
Outranking methods

- An alternative $a$ outranks an alternative $b$ when a significant majority of criteria validates the fact that $a$ is performing at least as good as $b$ and there is no criterion where $b$ seriously outperforms $a$ [Roy]
- ELECTRE and Rubis methods are example of outranking methods
Outranking methods

Problems:

- A slight difference between two close set of weights may not be significant for a decision-maker, but we can have important consequences on the overall outranking, validating or invalidating some statements.

⇒ We need to propose a measure of the "quality" of an outranking statement.
Preliminary definitions

Criteria weights preorder:

- Two sets of criteria weights are preorder-compatible if they have the same preorder on their criteria weights.
- Ex: $W = \{3, 7, 5, 1, 7\}$ and $W' = \{4, 6, 5, 2, 6\}$ have the same preorder $\{w_2, w_5\} \succ \{w_3\} \succ \{w_1\} \succ \{w_4\}$
Preliminary definitions

Robustness of an outranking:

- We analyze the impact on an outranking statement of some little modifications on the weights.
- A solution is said to be robust if some little weight variations don’t affect it.
  - When the outranking statement stays the same for all sets of weights having the same preorder than the original one.
  - When modifying the criteria weights on some intervals.
Condorcet denotation

We introduce the following denotation [Bisdorff 2004]:

\[
Cond_W(x, y) = \begin{cases} 
3 & \text{if all criteria } \textit{unanimously warrant} \text{ the outranking situation between } x \text{ and } y; \\
2 & \text{if a } \textit{significant majority} \text{ of criteria } \textit{warrants} \text{ the outranking situation between } x \text{ and } y \\
& \text{for all set of weights having the same preorder than } W; \\
1 & \text{if a significant majority of criteria } \textit{warrants} \text{ this outranking situation for } W \text{ but not for all } \\
& \text{sets of weights having the same preorder than } W; \\
0 & \text{if } W \text{ raises an indetermination; } \\
-1 & \ldots \\
-2 & \ldots \\
-3 & \ldots 
\end{cases}
\]
Condorcet denotation

\[
\begin{array}{|c|c|c|c|}
\hline
 & g_1 & g_2 & g_3 \\
\hline
 W & 3.0 & 1.5 & 2.0 \\
 a & 10 & 4 & 8 \\
b & 5 & 6 & 4 \\
c & 7 & 2 & 3 \\
d & 5 & 7 & 2 \\
\hline
\end{array}
\]

Outranking digraph
Condorcet denotation

\[
\begin{array}{|c|c|c|c|}
\hline
 & g_1 & g_2 & g_3 \\
\hline
W & 3.0 & 1.5 & 2.0 \\
a & 10 & 4 & 8 \\
b & 5 & 6 & 4 \\
c & 7 & 2 & 3 \\
d & 5 & 7 & 2 \\
\hline
\end{array}
\]

\[
\begin{array}{|c|c|c|c|}
\hline
Cond & a & b & c & d \\
\hline
a & 3 & 2 & 3 & 2 \\
b & -2 & 3 & 1 & 2 \\
c & -3 & -1 & 3 & 2 \\
d & -2 & 2 & -2 & 3 \\
\hline
\end{array}
\]
Condorcet denotation

\[ \begin{array}{cccc}
W & g_1 & g_2 & g_3 \\
4.0 & 1.5 & 2.0 \\
a & 10 & 4 & 8 \\
b & 5 & 6 & 4 \\
c & 7 & 2 & 3 \\
d & 5 & 7 & 2 \\
\end{array} \]

\[ \begin{array}{cccc}
\text{Cond} & a & b & c & d \\
a & 3 & 2 & 3 & 2 \\
b & -2 & 3 & -1 & 2 \\
c & -3 & 1 & 3 & 2 \\
d & -2 & 2 & -2 & 3 \\
\end{array} \]
Condorcet denotation and robustness

- The robustness improves the strength of an outranking:
  - A decision-maker can more easily validate a preorder on the criteria weights
  - Alternatives pairs with Condorcet value equal to 2 or −2 are much more robust
- The denotation helps the decision-maker to focus on sensitive outrankings.
Our objective

Question: Is it possible, knowing a list of criteria, a list of alternatives, the performance table and the Condorcet relation associated to an unknown set of criteria weights $W$, to recapture $W$ or another $W'$ satisfying the Condorcet relation?

- For the moment, we work on theoretical problems
**Web service properties**

- Written in Python
- The web service solves a mixed integer linear program
- For each ordered pair of alternatives, we create constraints associated to the Condorcet value
- The weights have to be integers
A live demo
Future work

• Obtain the Condorcet relation by questioning the decision-maker
  • What are the relevant questions?
  • How to deal with indecision?
  • How to deal with incompatibilities answers?
  • how to infer a part of the Condorcet relation?

• Add the possibility in the web service to take into account decision-maker preferences on the criteria weights

• Take into account non-numeric performance table.
Thanks a lot

http://decision-deck.org/ws/wsd-weightsFromCondorcetRelation.html