Criteria weights assessment through prioritizations (WAP) software tool

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Structure

Robustness Concern in Criteria Weights Inference

Robust Simos Method Approach

Robustness Analysis Tools and Feedbacks

WAP Tool

What’s next
To assess the criteria importance weights for non-compensatory MCDA models like the outranking methods (ELECTRE, PROMETHEE, …) or some multiobjective optimization methods (goal programming, compromise programming, …) we use two kinds of methods:

i. direct assessment procedures, where the DM is asked to explicitly express the criteria weights in terms of percentages, and

ii. indirect methods aiming to infer the weights from pairwise comparisons of the criteria or reference alternatives. (eg. Simos Cards Method).
Collecting the information:

• **STEP 1:** We give to the DM a set of cards with criterion name on it. We also give a set of white cards with the same size.

• **STEP 2:** We ask the DM to rank these cards from the least important to the most important. If some criteria have the same importance (i.e., the same weight), DM should build a subset of cards holding them together with a clip. Consequently, we obtain a complete pre-order on the whole of the $n$ criteria.

• **STEP 3:** We ask the DM to introduce white cards in between of two successive subsets of criteria for increasing the difference of importance of criteria. The greater the difference between the mentioned weights of the criteria (or the subsets), the greater the number of white cards.
Simos Algorithm

The information provided by the DM is utilized by the Simos method for the determination of the weights, according to the following algorithm:

i. ranking of the subsets of ex aequo from the least important to the most important, considering also the white cards,

ii. assignment of a position to each criterion/card and to each white card,

iii. calculation of the non-normalized weights, and

iv. determination of the normalized weights.
**Simos Method – Pros + Cons**

**Pros**
- Simplicity → Convenient for the DM to express his/her preference
- Easy calculations

**Cons**
- Robustness issues:
  - Arbitrarily calculation of a *unique weighting vector*
  - Even though there exist infinitely more weight vectors, also satisfying DM’s preferential statements
Simos Method – LP Model

For every \( j = 1, 2, \ldots, n - 1, \text{ and } h = 1, 2, \ldots, k \):

- If \( g_j \) is followed by \( g_{j+1} \), and \( g_{j+1} \) belongs to the same importance class as \( g_j \), write:
  \[ p_j = p_{j+1} \]

- If \( g_j \) is followed by \( g_{j+1} \), and \( g_{j+1} \) belongs to a most importance class, write:
  \[ p_j < p_{j+1} \iff p_{j+1} - p_j \geq \delta \]

- If between \( g_j \) and \( g_{j+1} \) a white card \( wc_h \) is placed, write:
  \[ p_j < w_h \text{ and } w_h < p_{j+1} \iff w_h - p_j \geq \delta \text{ and } p_{j+1} - w_h \geq \delta \]

- \( p_1 + p_2 + \ldots + p_n = 1 \)

- \( p_1 \geq 0, p_2 \geq 0, \ldots, p_n \geq 0; w_1 \geq 0, w_2 \geq 0, \ldots, w_k \geq 0 \)

- In case of the revised Simos method, the following equation should be added:
  \[ p_n = zp_1 \]

Then all the Simos weighting solutions belong to the polyhedral set:

\[ P = \{ p \in R^n / p \text{ satisfies the system of these linear relations} \} \]
Robust Simos Method – Robustness Rules

1. **Compute the ranges of variation** of each separate criterion, by solving $2n$ (where $n$ the number of criteria) linear programs of the following type (MAX-MIN approach): $\text{Min } p_j \& \text{Max } p_j$, for $j = 1, 2, \ldots, n \quad \text{s.t. } \quad p \in P$

2. **Compute the average weighting vector** (“barycenter”) of all different vectors (from the $2n$ solutions obtained in the former rule) - representative solution.

3. **Find and record all the vertices of the polyhedron** $P$, by using the Manas-Nedoma (1968) analytical algorithm.

4. **Implement a random weight sampling** algorithm/technique to produce and statistically analyze a great number of weighting sets from the polyhedron.

5. **Visualize the ranges of variation** of the criteria weights and/or the polyhedron they define, in order to perceive the extent of the instability.

6. **Calculate the ratio of the volume of the criteria polyhedron** by following the implementation of recommendation 4, and the unconstrained criteria area.

7. **Compute the robustness measure ASI** (Average Stability Index), which is the mean value of the normalized standard deviation of the estimated weights:

$$\text{ASI} = 1 - \frac{1}{n} \sum_{i=1}^{n} \sqrt{\frac{m \sum_{j=1}^{m} p_{ij}^2 - \left( \sum_{j=1}^{m} p_{ij} \right)^2}{\frac{m}{n} \sqrt{n-1}}}$$
Robust Simos Method – Robust decision aiding

1. **Built** on a two distinct outranking relations, the **necessary outranking** \( aS^N b \Leftrightarrow aSb, \) i.e. action a outranks action b, for every weighting vector \( p \in P \), and the **possible outranking** \( aS^P b \Leftrightarrow \) there is at least one weighting vector \( p \in P \) for which \( aSb \); (see Figueira et al. (2009) (Greco et al. 2008) for definitions and properties of these outranking relations.

2. **Define the maximum and minimum possible ranking positions for every action** in A with mixed integer linear programming techniques (see Kadzinski et al., 2012).

3. **Statistically compute the possibility/probability that an action a belongs to the kernel of the outranking graph** in the cases of ELECTRE I and ELECTRE IS choice methods.

4. **Following a random sampling** in \( P \), **compute entropy measures** associated to outranking relations between actions in A and ranking positions for each action separately (see Greco et al., 2013).
Suite of RA Tools (1)

Robust Simos (RS)
Robust Simos Method – SW Tool
Robust Simos Method – Example (1)

The calculated range of the weights using different algorithms (2 white cards)
The calculated range of the weights using different algorithms (2 white cards) (Revised Simos)
Ranking of 6 alternatives using ELECTRE II with PROMETHEE II sorting procedure (case with 2 white cards).

<table>
<thead>
<tr>
<th></th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simos</td>
<td>B,D</td>
<td>–</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>Max–Min average</td>
<td>B</td>
<td>D</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>Manas–Nedoma average</td>
<td>B,C,D</td>
<td>–</td>
<td>–</td>
<td>A</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>1st vertex of the polyhedron</td>
<td>C</td>
<td>D</td>
<td>B</td>
<td>A</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>2nd vertex of the polyhedron</td>
<td>B,D</td>
<td>–</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>3rd vertex of the polyhedron</td>
<td>B,D</td>
<td>–</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>4th vertex of the polyhedron</td>
<td>E</td>
<td>F</td>
<td>A</td>
<td>B</td>
<td>D</td>
<td>C</td>
</tr>
</tbody>
</table>

Ranking of 6 alternatives using ELECTRE II with PROMETHEE II sorting procedure (case with 2 white cards and revised Simos).

<table>
<thead>
<tr>
<th></th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revised Simos</td>
<td>B,D</td>
<td>–</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>Max–Min average</td>
<td>B,D</td>
<td>–</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>Manas–Nedoma average</td>
<td>B,D</td>
<td>–</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>1st vertex of the polyhedron</td>
<td>C,D</td>
<td>–</td>
<td>B</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>2nd vertex of the polyhedron</td>
<td>B,D</td>
<td>–</td>
<td>C</td>
<td>A,F</td>
<td>–</td>
<td>E</td>
</tr>
<tr>
<td>3rd vertex of the polyhedron</td>
<td>E</td>
<td>F</td>
<td>A</td>
<td>B</td>
<td>D</td>
<td>C</td>
</tr>
</tbody>
</table>
Extreme ranking positions of alternatives (case with 2 white cards)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P^*(a)$</td>
<td>3rd</td>
<td>1st</td>
<td>1st</td>
<td>1st</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>$P_*(a)$</td>
<td>4th</td>
<td>4th</td>
<td>6th</td>
<td>5th</td>
<td>6th</td>
<td>5th</td>
</tr>
</tbody>
</table>

Extreme ranking positions of alternatives (case with 2 white cards 7 revised Simos)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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</tr>
</thead>
<tbody>
<tr>
<td>$P^*(a)$</td>
<td>3rd</td>
<td>1st</td>
<td>1st</td>
<td>1st</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>$P_*(a)$</td>
<td>4th</td>
<td>4th</td>
<td>6th</td>
<td>5th</td>
<td>6th</td>
<td>4th</td>
</tr>
</tbody>
</table>

ASI of the different algorithms

<table>
<thead>
<tr>
<th></th>
<th>No white card</th>
<th>2 white cards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manas–Nedoma</td>
<td>Max–Min</td>
</tr>
<tr>
<td>Manas–Nedoma (no z)</td>
<td>0.662</td>
<td>0.672</td>
</tr>
<tr>
<td>Max–Min (no z)</td>
<td>0.659</td>
<td>0.677</td>
</tr>
<tr>
<td>Manas–Nedoma (z = 6)</td>
<td>0.844</td>
<td>0.844</td>
</tr>
<tr>
<td>Max–Min (z = 6)</td>
<td>0.677</td>
<td>0.842</td>
</tr>
</tbody>
</table>
Suite of RA Tools (2)

Robust Simos (RS)

Robustness Analysis
Robustness Analysis Tools and Feedbacks

- Visualisation of the hyper-polyhedron (robustness rules 1 & 5)

- Measurement of the robustness (robustness rule 1 & 7)

- Tomographical analysis (robustness rule 1 & 4)
Visualisation of the hyper-polyhedron in a 3-D graphical interface so as to provide a view of the solution's hyper-space for the selected 3 dimensions.
Measurement of the robustness

A set of indices and special data handling features utilised and designed in order to provide a clear and precise view of the robustness level.

\[ \mu_i = (\max(p_{ij}) - \min(p_{ij})), \text{ where} \]

\[ p_{ij} \text{ the weight of the } i \text{ criterion in the } j \text{ vertex, resulted by post optimal analysis,} \]

\[ i = 1, 2, ..., n, j = 1, 2, ..., m, \text{ } n : \text{number of criteria and } m : \text{number of hyper-polyhedron vertices} \]

\[
S = \frac{\sum_{i=1}^{n} \mu_i}{n}, \quad S_d = \sqrt{\frac{\sum_{i=1}^{n} (\mu_i - S)^2}{n - 1}}, \quad n : \text{number of criteria}
\]

\[
\sum_{i=1}^{n} \sqrt{\left( m \left( \sum_{j=1}^{m} (p_{ij})^2 \right) - \left( \sum_{j=1}^{m} p_{ij} \right)^2 \right)}
\]

\[ ASI = 1 - \frac{\sum_{i=1}^{n} \sqrt{\left( m \left( \sum_{j=1}^{m} (p_{ij})^2 \right) - \left( \sum_{j=1}^{m} p_{ij} \right)^2 \right)}}{m \sqrt{(n - 1)}}, \]

where \( n : \text{number of criteria and } m : \text{number of hyper-polyhedron vertices} \).
Measurement of the robustness
Tomographical approach constitutes a way to picture the degree of robustness into the hyper-polyhedron. Discretisation approach by using n-1 dimensional cutting hyper-planes, creating half-spaces in the n-dimensional space estimated hyper-polyhedron of the criteria weights.

- **Manually inspection** of the robustness of the hyper-polyhedron by selecting a criterion and a step \( t \), for the discretisation, from a list of predefined values (0.001, 0.005, ..., 0.1).

- **Automatic running of the topography** for all the criteria with a pre-selected step \( t \), for the construction of cutting hyper-planes and calculation of the corresponding indices for the robustness evaluation and the presentation of the results.
Tomographical analysis (manually)
Tomographical analysis (auto-ASI)
Tomographical analysis (auto-PR)
Within this feedback process the DM is asked to provide further information concerning the priority of the criteria for a selected pair \((g_i, g_j)\) triggered from the existence of a priority rank reversal in the estimated hyper-polyhedron.
The additional preference information concerning extreme points of the criteria weights sets new lower and upper limits of the criteria weights by inserting new constraints in the LPs of post-optimality analysis.
Suite of RA Tools (3)

Robust Simos (RS)

Robustness Analysis

WAP
WAP vs Simos method

It enriches the preferential information used in a friendly and comprehensive by the DM way and at the same time it leads to the estimation of weighting vectors with higher robustness.

<table>
<thead>
<tr>
<th>WAP Method</th>
<th>Simos Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritise Criteria (linear constraints)</td>
<td>Prioritise Criteria (using cards)</td>
</tr>
<tr>
<td>Increase $z_r$ indices to increase weights difference</td>
<td>Insert white cards to increase weights difference</td>
</tr>
<tr>
<td>Solving LP to calculate weights</td>
<td>Calculate weights using Simos algorithm</td>
</tr>
<tr>
<td>Perform Robustness Analysis</td>
<td>NA</td>
</tr>
<tr>
<td>Continue with feedbacks if necessary</td>
<td>NA</td>
</tr>
</tbody>
</table>
The WAP method includes several robustness rules proposed by Siskos and Tsotsolas (2015) concerning the production of tangible and adequately supported results when Simos method is used. In particular the following rules are followed:

- Computation of the variation range of the weight of each one of the \( n \) criteria by solving \( 2n \) linear programs of Max-Min type (rule 1)

- Computation of the average weighting vector (“barycenter”) of all different vectors (from the \( 2n \) solutions obtained in the former rule), as a more representative weighting solution in the hyper-polyhedron (M-N Average) (rule 2)

- Visualisation of the ranges of variation of the criteria weights for a more comprehensively perceive the extent of the possible instability (rule 5)

- Computation of the robustness measure ASI (Average Stability Index) (rule 7)

Additionally to the aforementioned rules the WAP method includes a process for receiving extra information from the DM concerning the difference between the weights of the criteria (feedbacks).
The key point of the proposed approach is the use of the $z_r$ indices for every pair of successive criteria or sets of ex aequo criteria sorted according to their ranking.

$z_r$: how many times a criterion is more important than the previous one in the ranking

DM is not asked to identify precisely these $z_r$ indices but instead a range of value $[z_{min_r}, z_{max_r}]$.

For two successive criteria or sets of ex aequo criteria, (ex. $g_r, g_{r+1}$) the range $[z_{min_r}, z_{max_r}]$ is identified, so as:

\[
z_{min_r} \leq z_r \leq z_{max_r},
\]

\[
p_r = z_r p_{r+1}, \text{ where } p_r \text{ is the weight of } g_r \text{ and } p_{r+1} \text{ is the weight of } g_{r+1}.
\]

The z index, used in revised Simos, can be directly calculated by the product of the $z_i$ indices:

\[
z_1 z_2 \ldots z_{m-1} = (p_1/p_2)(p_2/p_3)\ldots(p_{m-1}/p_m) = p_1/p_m = z.
\]
In order to make the whole process easier for the DM to identify these values, special visual interactive techniques were developed and implemented in the WAP tool.

Through visual techniques the DM is asked to express the borders of the ranges of the relative importance between two consecutive criteria or set of ex aequo criteria for all of the pairs.

![Graphs showing z_r indices in the WAP tool](image-url)
WAP – Flow diagram

- Criteria Modeling
- Ranking of the criteria
- Sorting of criteria and sets of ex aequo criteria
- Insert white cards?
- Identification of \( z_{\min}, z_{\max} \)
- Insertion of white cards
- Solving Linear Programme
- Presentation of the results (criteria weights)
- Is the Robustness level satisfactory?
- Calculation of Robustness Indices:
  - ASI
  - \( \mu = \max(p_i) - \min(p_i) \)
- Is the solution satisfactory?
- Estimation of barycentric solution to be used as working vector of weights
- Post optimality analysis to achieve acceptable results
- No
- Yes
- Yes
- No
Having identified the \( z_{\min} \) and \( z_{\max} \) for all the pairs of the successive classes The following L.P. is constructed and solved.

\[
\begin{align*}
\text{Min } p_i & \text{ & Max } p_i, \text{ for } i = 1, 2, \ldots, n \\
\text{s.t. } & p_i - p_{i+1} = 0, \quad \text{if } g_{i+1} \text{ is followed by } g_i, \text{ and } g_{i+1} \text{ belongs to the same importance class (j) as } g_i, \\
& w_h - p_j \geq \delta \text{ and } p_{j+1} - w_h \geq \delta, \quad \text{if the DM inserts a white card } w_h \text{ between criteria i and } i+1. \delta \text{ is a very small number, let’s say 0.01} \\
& p_i - p_{i+1} \geq z_{\min}, p_i - p_{i+1} \leq z_{\max}, \quad \text{if } g_r \text{ is followed by } g_{i+1}, g_i \text{ belongs to a higher importance class j and } g_{i+1} \text{ belongs to class j+1} \\
p_1 + p_2 + \ldots + p_n = 1, \quad \text{(normalization rule)} \\
p_1 \geq 0, p_2 \geq 0, \ldots, p_n \geq 0
\end{align*}
\]
\[ \mu_i = \left( \max(p_{ij}) - \min(p_{ij}) \right), \]

\( p_{ij} \) the weight of the \( i \) criterion of the \( j \), \( i = 1, 2, \ldots, n \), \( j = 1, 2, \ldots, m \), \( n \): the number of criteria and \( m \): the number of vertices of hyper-polyhedron.

\[ ASI = 1 - \frac{\sum_{i=1}^{n} \sqrt{\left( m \left( \sum_{j=1}^{m} (p_{i}^{j})^2 \right) - \left( \sum_{j=1}^{m} p_{i}^{j} \right)^2 \right)}}{m \sqrt{(n - 1)}} \]

\( n \): the number of criteria, \( m \): the number of vertices of hyper-polyhedron
<table>
<thead>
<tr>
<th>Ranking</th>
<th>Criteria</th>
<th>Criterion</th>
<th>Min $z_i$</th>
<th>Max $z_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>crit.1</td>
<td>$z_1$: crit.1 $P$ (crit.2, crit.5)</td>
<td>1.1978</td>
<td>1.4096</td>
</tr>
<tr>
<td>2</td>
<td>crit.2, crit.5</td>
<td>$z_2$: (crit.2, crit.5) $P$ crit.3</td>
<td>1.8169</td>
<td>1.9851</td>
</tr>
<tr>
<td>3</td>
<td>crit.3</td>
<td>$z_3$: crit.3 $P$ crit.4</td>
<td>2.5088</td>
<td>2.7037</td>
</tr>
<tr>
<td>4</td>
<td>crit.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{Min } p_i \text{ & Max } p_i, \text{ for } i = 1, 2, \ldots, 5 \]

\[ \text{s.t. } \]

\[ p_1 - p_2 \geq 1.1978, \quad p_1 - p_2 \leq 1.4096 \]
\[ p_2 - p_5 = 0, \]
\[ p_5 - p_3 \geq 1.8169, \quad p_5 - p_3 \leq 1.9851 \]
\[ p_3 - p_4 \geq 2.5088, \quad p_3 - p_4 \leq 2.7037 \]
\[ p_1 + p_2 + \cdots + p_5 = 1 \]
\[ p_1 \geq 0, \quad p_2 \geq 0, \ldots, \quad p_5 \geq 0 \]
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Min</th>
<th>Max</th>
<th>Barycentric</th>
<th>$\mu_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>crit.1</td>
<td>0.3019</td>
<td>0.3438</td>
<td>0.3228</td>
<td>0.0419</td>
</tr>
<tr>
<td>crit.2</td>
<td>0.2393</td>
<td>0.2572</td>
<td>0.2481</td>
<td>0.0179</td>
</tr>
<tr>
<td>crit.3</td>
<td>0.1224</td>
<td>0.1393</td>
<td>0.1307</td>
<td>0.0168</td>
</tr>
<tr>
<td>crit.4</td>
<td>0.0454</td>
<td>0.0553</td>
<td>0.0503</td>
<td>0.0098</td>
</tr>
<tr>
<td>crit.5</td>
<td>0.2393</td>
<td>0.2572</td>
<td>0.2481</td>
<td>0.0179</td>
</tr>
</tbody>
</table>
The example, used for comparison purposes, of Revised Simos and RSM includes the 5 criteria (named crit.1, crit.2, ..., crit.5) and 3 white cards (named Wc.1, Wc.2, Wc.3). The ranking of the criteria and white cards are:

<table>
<thead>
<tr>
<th>No</th>
<th>Position of criteria (increasing importance)</th>
<th>Preferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>crit.1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>crit.2, crit.5</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Wc.1</td>
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<tr>
<td>4</td>
<td>2</td>
<td>crit.3</td>
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<tr>
<td>5</td>
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<td>Wc.2</td>
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<td>Wc.1</td>
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<td>7</td>
<td>1</td>
<td>crit.4</td>
</tr>
<tr>
<td>Criteria</td>
<td>Ranking</td>
<td>Revised Simos Weights</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>crit.1</td>
<td>1</td>
<td>0.290</td>
</tr>
<tr>
<td>crit.2</td>
<td>2</td>
<td>0.249</td>
</tr>
<tr>
<td>crit.3</td>
<td>3</td>
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<tr>
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<td>4</td>
<td>0.045</td>
</tr>
<tr>
<td>crit.5</td>
<td>2</td>
<td>0.249</td>
</tr>
</tbody>
</table>
The newly estimated weighting vector by the WAP method, after feedbacks

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Min</th>
<th>Max</th>
<th>BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>crit.1</td>
<td>0.3019</td>
<td>0.3124</td>
<td>0.3071</td>
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<tr>
<td>crit.2</td>
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<td>0.2572</td>
<td>0.2538</td>
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<tr>
<td>crit.3</td>
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<tr>
<td>crit.4</td>
<td>0.0476</td>
<td>0.0553</td>
<td>0.0514</td>
</tr>
<tr>
<td>crit.5</td>
<td>0.2505</td>
<td>0.2572</td>
<td>0.2538</td>
</tr>
</tbody>
</table>
Suite of RA Tools (4)

- DSS
  - TALOS (UTA, Stochastic UTA, SMAA, Extreme Ranking)
    - MIDAS
    - MINORA
    - ....

- Robust Simos (RS)

- Robustness Analysis

- WAP

- Criteria Weights

....
The need

Extensible:

- Support new processes or extend the existing ones
- Incorporate new algorithms
- Accept new forms of data schemas
- Produce new forms of data schemas
Fast in development:

- Adopt a solid architecture scheme based on popular and fully supported standards
- Re-use code modules for repeated tasks
- Extended use of libraries for basic and common tasks
- Use a standard vocabulary
Interoperable:

- Fully open and transparent to the external world
- Use well-accepted standards for the description of the modules – entities
- Use of a very well defined and extensible vocabulary
- Adopt a stable and open framework for modular development → diviz
The tools

A set of appropriate elements will be used to build this modular DSS:

- Elements (algorithms) from our already developed DSSs:
  - Stochastic UTA (TALOS)
  - MUSA-DSS
  - MIDAS
  - MINORA
  - .....

- XMCDA, a standardized XML vocabulary
- SOAP protocol for exchanging structured information – Web services
- Libraries (such as Kappalab box for capacity calculation and integral manipulation on a finite setting)
Let’s see for example the transformation of an existing module found in two DSSs of our team:

The architecture
The architecture

The new module of the Manas- Nedoma Algorithm (M-N):

- Parameters
- Polytope
- Basic solution
- Tableau (optional)
- Messages
- Vertices
- Running statistics
How M-N module collaborates with other modules to implement a whole procedure:
Next Steps

1. Adjust the DSS shell based on XMCDA standards.
2. Transform the elements of the DSS into modules compatible with XMCDA. Create web services.
3. Add any necessary new modules – algorithms.
Questions