PROMETHEE

METHODS

Performance Analysis Using VISUAL PROMETHEE

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http://www.promethee-gaia.net

Summary

1. Performance analysis.
2. MCDA vs. DEA
3. A multicriteria approach with the PROMETHEE & GAIA methods.
4. Implementation in Visual PROMETHEE.
5. Numerical example.
6. Conclusions & Developments.

Objective

- Compare different units (DMU's) with respect to their relative performance level given:
  - A set of input variables:
    - Resources used by the units.
  - A set of output variables:
    - Products generated by the units.
- Compute a global performance measurement.
- Analyze the performance of the units.

MCDA vs. DEA

MCDA

- A set of actions to evaluate and compare.
- Several evaluation criteria:
  - Single group of criteria
- Pareto-optimality.
- Fixed weights (preference parameters).
- Preference-based.

DEA

- A set of DMU's to evaluate and compare.
- Several evaluation criteria:
  - Input vs. Output criteria
- DEA Efficiency.
- Variable weights (no priorities)
- Evidence-based.

Multicriteria Approach

- Using **PROMETHEE** to measure performance?
- Based on two groups of criteria (input and output criteria).
- Taking into account priorities (fixed weights).
- Two proposals:
  - Performance Aggregated Score.
  - I/O Efficiency Analysis.

PROMETHEE & GAIA methods

- Outranking methods.
- Pairwise comparison of actions.
- Preference modeling:
  - Preference functions (scales),
  - Weights (priorities).
- Prescriptive and descriptive:
  - **PROMETHEE**: ranking, net flow score,
  - **GAIA**: visual representation of actions and criteria.

Performance Aggregated Score

- Based on **PROMETHEE** net flow score for the two groups of criteria:
  - "Input" criteria (resources): ϕ^{IN}
  - "Output" criteria (activities): ϕ^{OUT}
- Multicriteria performance score:

$$MPI(a) = \frac{1}{MPI_{\max}} \times \frac{\phi^{OUT}(a)+1}{1-\phi^{IN}(a)}$$

I/O Efficiency Analysis

- 2 dimensional graphical representation of the actions: ϕ^{IN} vs. ϕ^{OUT} .
- "Efficient" actions and "efficient" frontier in the (ϕ^{IN} , ϕ^{OUT}) plane.
- Determination of "reference" actions for improving the performance of non-"efficient" actions: goals (reduce input or increase output).

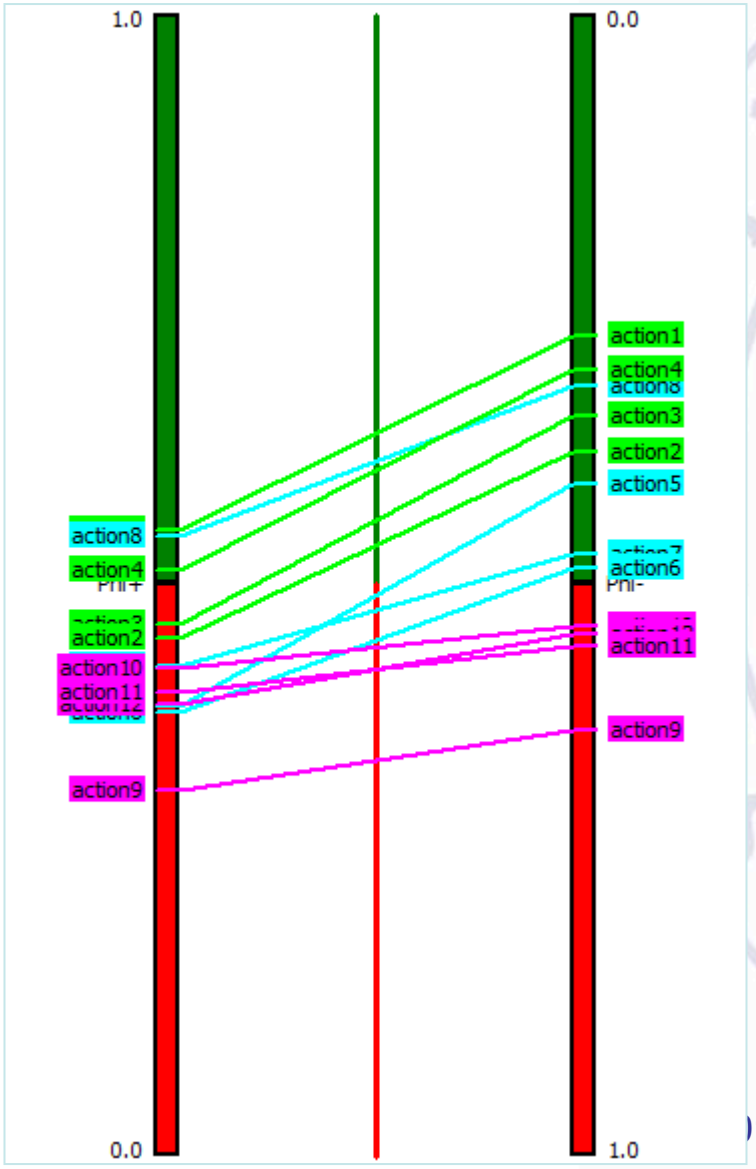
Implementation in Visual PROMETHEE

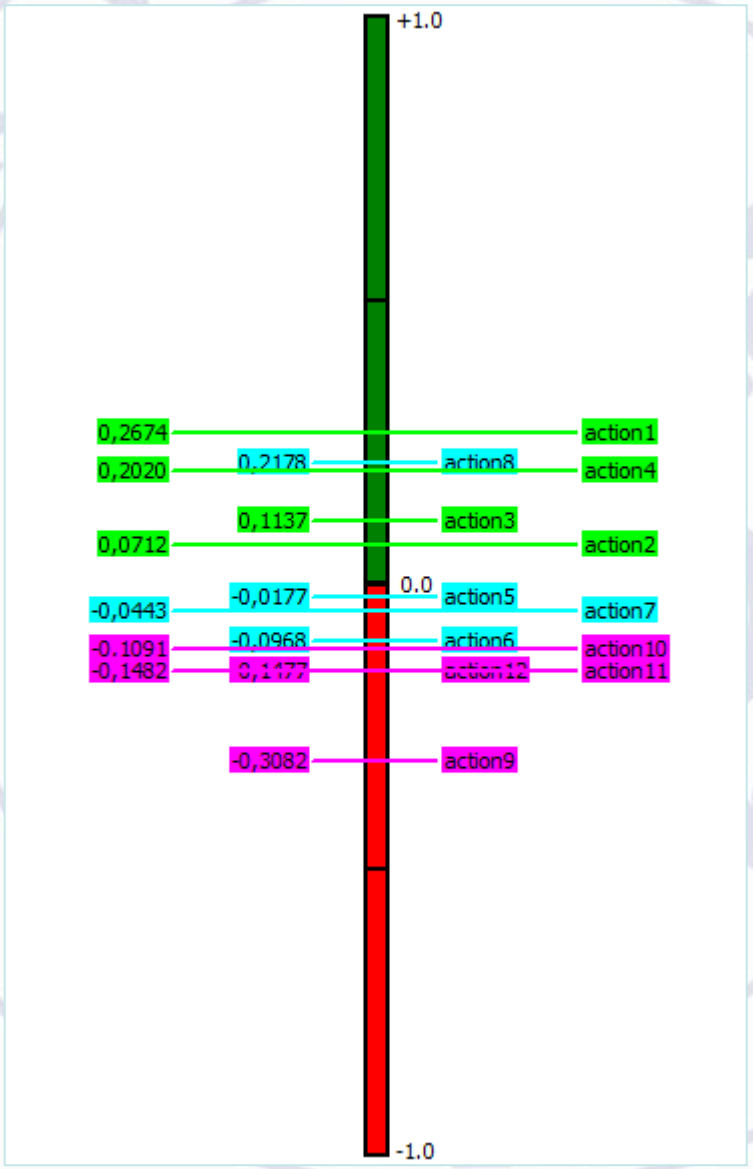
- Complete **PROMETHEE-GAIA** software:
  - **PROMETHEE** rankings
  - **GAIA** 2D/3D analysis
  - Interactive sensitivity analysis tools
  - **PROMETHEE V** selection under constraints
  - **PROMETHEE Sort**
  - Google Maps GIS integration
- Innovative interface, model management, preference modeling assistants and visual tools.

Numerical Example

- 12 actions
- 5 criteria:
  - 3 input criteria
  - 2 output criteria

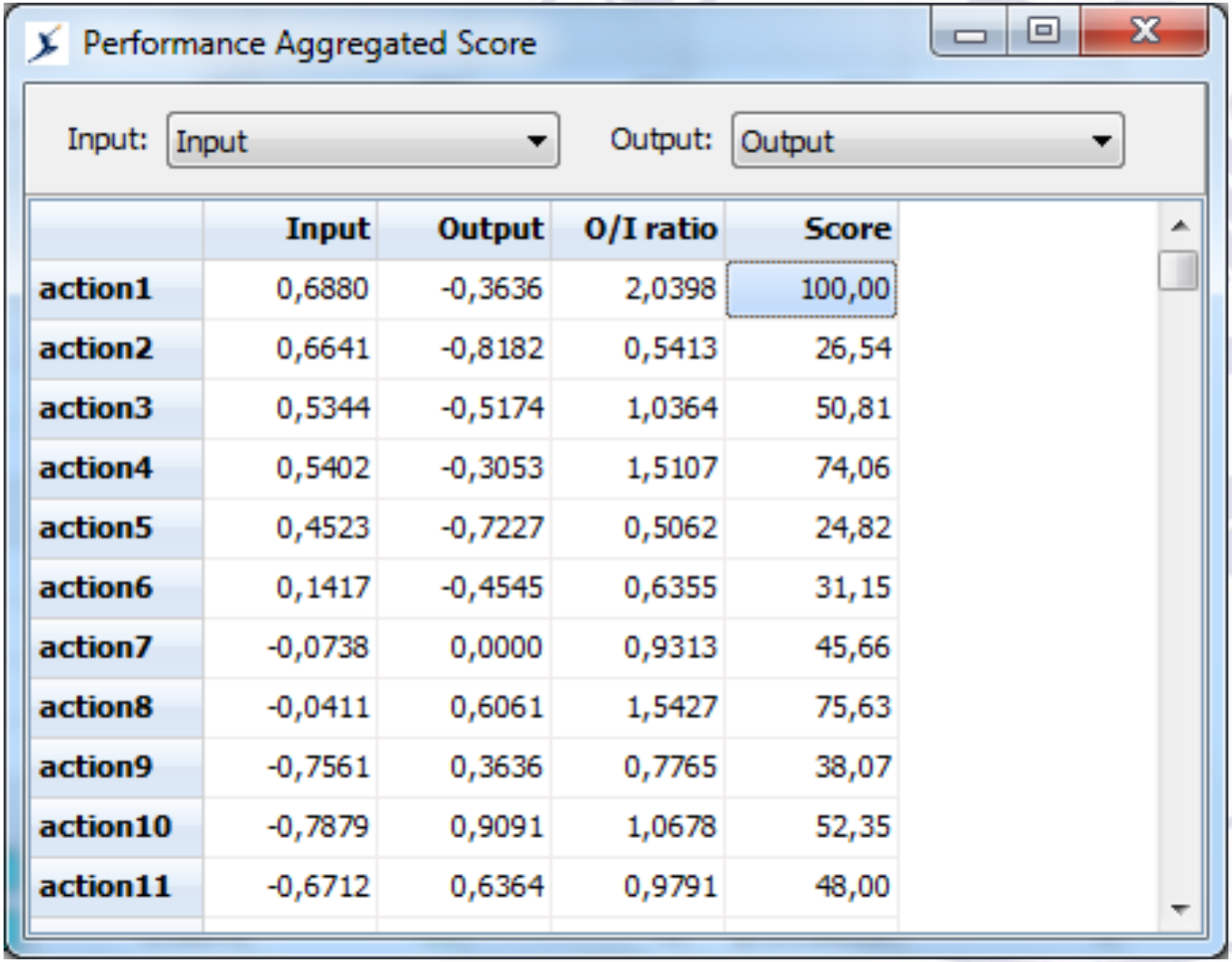
PROMETHEE Rankings





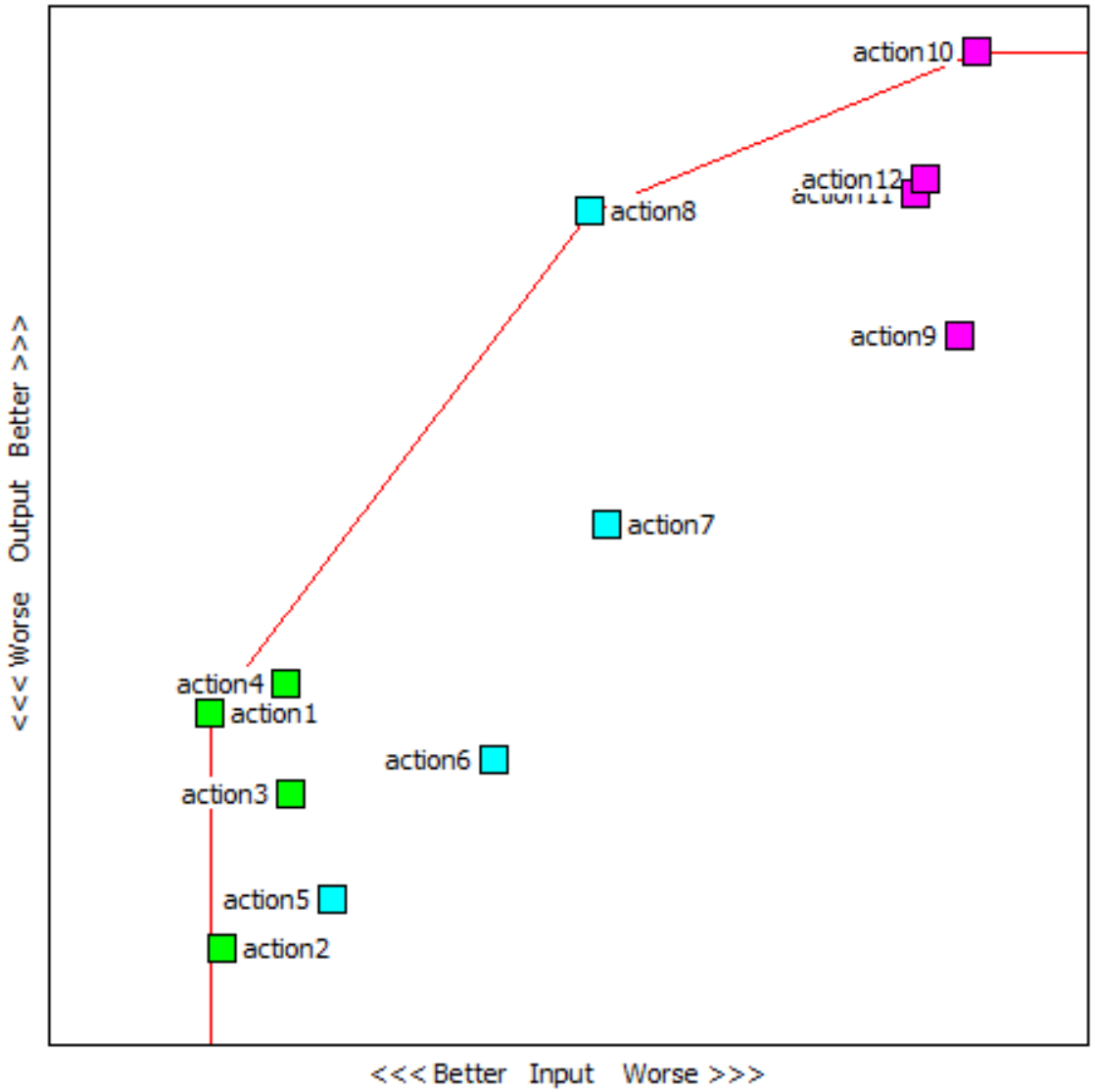

V
Zoom: 100%
Output 1
action11
action1
action8
action7
Input 31
action5
action4
action12
action3
action2
U
action9
Output 2
action6

Performance Aggregated Score



	Input	Output	O/I ratio	Score
action1	0,6880	-0,3636	2,0398	100,00
action2	0,6641	-0,8182	0,5413	26,54
action3	0,5344	-0,5174	1,0364	50,81
action4	0,5402	-0,3053	1,5107	74,06
action5	0,4523	-0,7227	0,5062	24,82
action6	0,1417	-0,4545	0,6355	31,15
action7	-0,0738	0,0000	0,9313	45,66
action8	-0,0411	0,6061	1,5427	75,63
action9	-0,7561	0,3636	0,7765	38,07
action10	-0,7879	0,9091	1,0678	52,35
action11	-0,6712	0,6364	0,9791	48,00

I/O Efficiency



Conclusion and Future

- Multicriteria approach to performance evaluation:
  - Preference modeling: priorities (weights), sensitivity analysis (how to improve performance),
  - Visual representations (decision aid).
- Future developments:
  - Other ways to compute an aggregated score?
  - Systematic improvement analysis?
  - …

More resources…

- Visual PROMETHEE Software:
  - **Free download** (Academic and Business Eds):
    http://visual.promethee-gaia.net
- PROMETHEE & GAIA:
  - Web site: www.promethee-gaia.net
  - Blog: blog.promethee-gaia.net
  - Forum: forum.promethee-gaia.net
  - FAQ: faq.promethee-gaia.net
  - LinkedIn group, Twitter.

Actual Numerical Example

- Actual annual data (2008) for the departments of two Brussels hospitals: (Europe Hospitals group, 716 beds)
  - St-Michel hospital
  - Ste-Elisabeth hospital
- 31 departments.
- 7 criteria:
  - Input: turnover, net profit
  - Output: space (m^2), staff, equipment

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- Dep
  - Si
- Crit
  - Cc

Performance analysis

- 6 criteria: performance ratios (output/ input):
  - Turnover/m2
  - Turnover/staff
  - Turnover/equipment
  - Result/m2
  - Result/staff
  - Result/equipment

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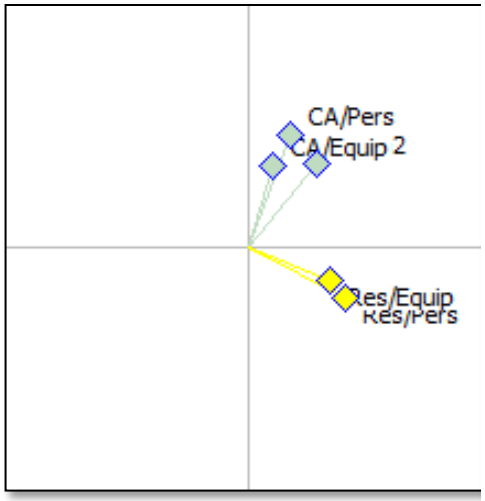

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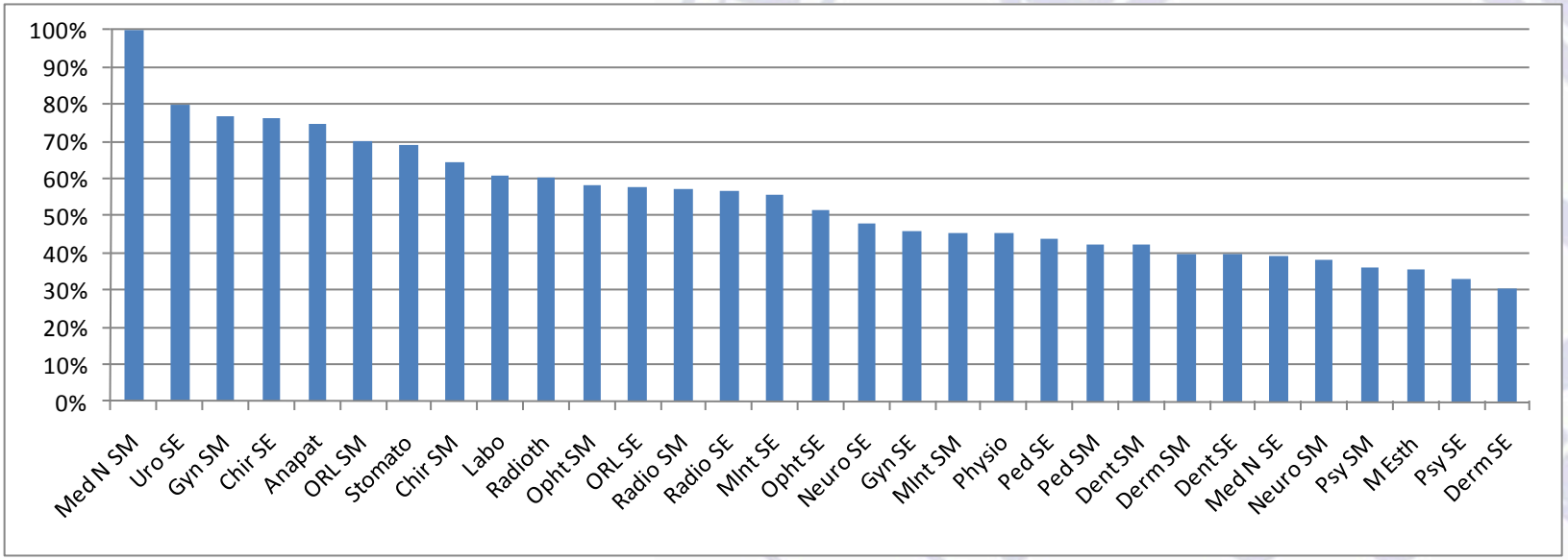
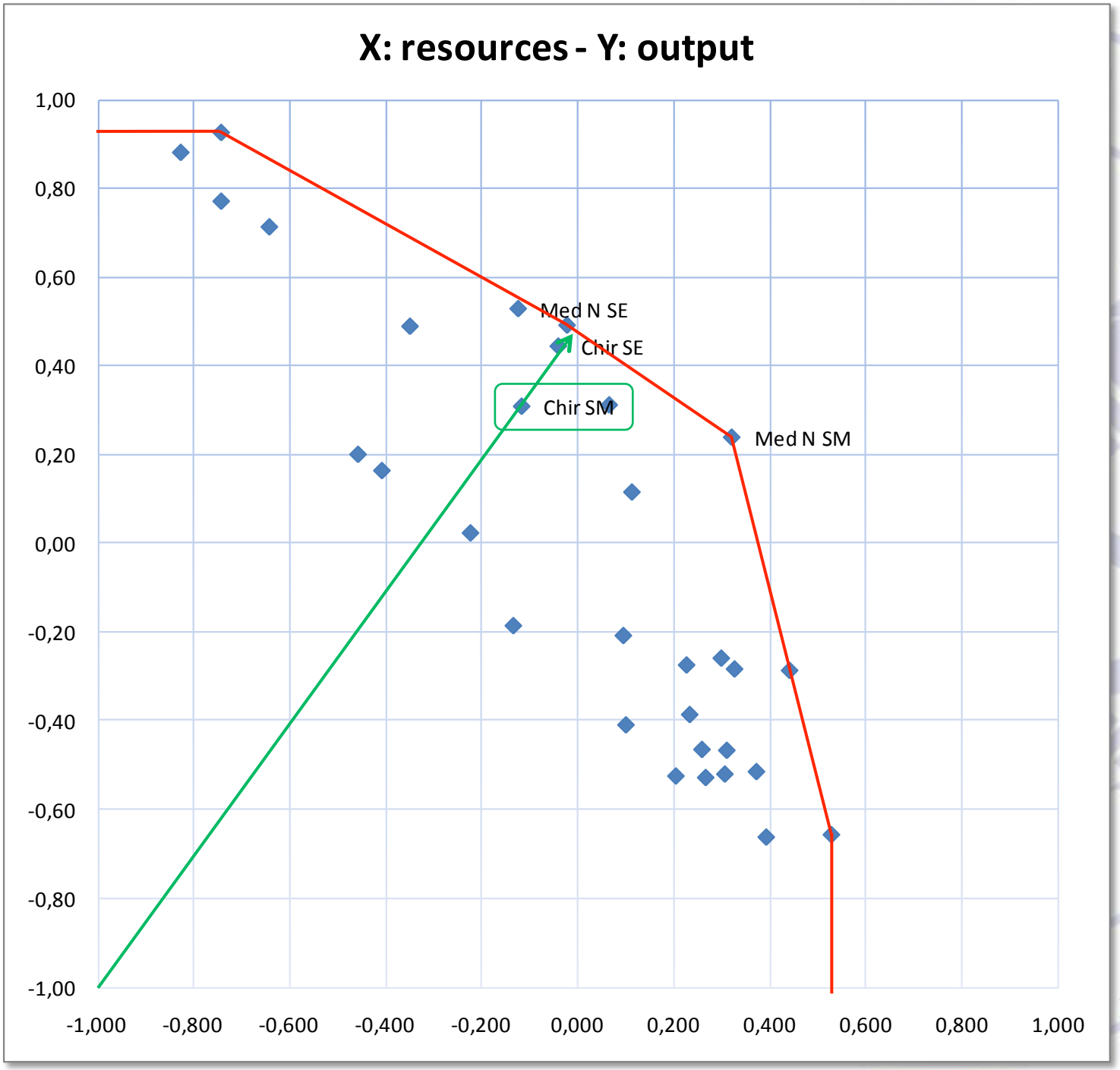
Multicriteria Performance Aggregated Score




X: resources - Y: output
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
-0,80
-1,00
-1,000
-0,800
-0,600
-0,400
-0,200
0,000
0,200
0,400
0,600
0,800
1,000
Med N SE
Chir SE
Chir SM
Med N SM