DEA-Solver-Pro Newsletter

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We now release Version 4.0 of DEA-Solver-Pro. The newcomers are the Scale Elasticity, Congestion and Assurance Region Global models. We have also updated many models in Version 3.0 so that they can cope with different returns-to-scale characteristics and orientations. Totally, DEA-Solver-Pro 4.0 has 118 models in 31 clusters, compared with 74 DEA models in 22 clusters of the previous version. The full line-up can be found at the end of this newsletter. The reinforced parts can be summarized as follows, although further details can be found in the manual Introduction 4.0.Doc.

1. The “Scale Elasticity” model evaluates the input vs. output scale elasticity under the multiple-input and multiple-output framework. This model also identifies the returns to scale of each DMU quantitatively, in contrast to the BCC model that discerns the characteristics qualitatively.
2. There are some occasions in which an increase in one or more inputs causes the worsening of one or more outputs. A typical example is the case of mining where too many miners in an underground mine may lead to “congestion” with reference to output. The “Congestion” model finds congested DMUs and points out where and how much congested resources are included in the DMUs.
3. The “Assurance Region Global” model is a variant of the AR model in that the virtual (input or output) weight of the concerned DMU is constrained to be between the designated

lower and upper bounds relative to the total virtual (input or output) weight.

4. The Radial models and the Non-oriented models are added to the “Malmquist productivity index” models. See Appendix F of the manual for further details.
5. We have reinforced many DEA models by expanding the returns to scale characteristics, i.e., GRS (General Returns to Scale).
6. The traditional Cost, Revenue and Profit efficiency models are proved to have latent shortcomings and irrationality. Hence, we have developed “New-Cost”, “New-Revenue” and “New-Profit” models as demonstrated in Appendices C, D and E of the manual.

(Followings are information on the models introduced in the previous version.)

7. The “Non-discretionary model” is a variant of the “Non-controllable model” and differs from the latter in setting non-controllable constraints. See Page 8 of the manual for detail.
8. The “Super-efficiency model” aims at discriminating between efficient DMUs, i.e., DMUs with efficiency scores unity. It will usually return scores with greater than 1 for efficient DMUs, and the larger the score the more efficient the DMU is judged to be. See Appendix A of the manual for further details of this model.

All DEA models can be classified into three types: (1) Radial, (2) Non-Radial and Oriented, and (3) Non-Radial and Non-Oriented. ‘Radial’ means that a proportionate change of input/output values is the main concern and hence it neglects the existence of slacks (input excesses and output shortfalls remaining in the model) as secondary or freely disposable, whereas ‘Non-Radial’ deals with slacks directly and does not stick to a proportionate change of input/output. ‘Oriented’ indicates the input or output orientation in evaluating efficiency, i.e., the main target of evaluation is either input reduction or output expansion. For example, input oriented models first aim to

reduce input resources to the efficient frontier as far as possible, and then to enlarge output products as the second objective. 'Non-Oriented' models deal with input reduction and output expansion at the same time.

Version 4.0 consists of 118 models in 31 clusters. They are classified into the three categories as displayed below.

Category	Cluster or Model
Radial	CCR, BCC, IRS, DRS, AR, ARG, NCN, NDSC, BND, CAT, SYS, Bilateral, Scale Elasticity, Congestion, Window, Malmquist-Radial, Adjusted Projection, FDH
Non-Radial and Oriented	SBM-Oriented, Super-efficiency-Oriented, Malmquist
Non-Radial and Non-Oriented	Cost, New-Cost, Revenue, New-Revenue, Profit, New-Profit, Ratio, SBM-Non-Oriented, Super-efficiency-Non-Oriented, Malmquist-C (V, GRS)

The following 118 models in 31 clusters are included. (Red marks are newcomers.)

No.	Cluster	Model
1	CCR	CCR-I, CCR－O
2	BCC	BCC-I, BCC-O
3	IRS	IRS-I, IRS-O
4	DRS	DRS-I, DRS-O
5	GRS	GRS-I, GRS-O
6	AR (assurance region)	AR-I-C, AR-I-V, AR-I-GRS, AR-O-C, AR-O-V, AR-O-GRS
7	ARG (assurance region global)	ARG-I-C, ARG-I-V, ARG-I-GRS, ARG-O-C, ARG-O-V, ARG-O-GRS
8	NCN (non-controllable)	NCN-I-C, NCN-I-V, NCN-O-C, NCN-O-V
9	NDSC (non-discretionary)	NDSC-I-C, NDSC-I-V, NDSC-I-GRS, NDSC-O-C, NDSC-O-V, NDSC-O-GRS
10	BND (bounded variable)	BND-I-C, BND-I-V, BND-I-GRS, BND-O-C, BND-O-V, BND-O-GRS
11	CAT (categorical variable)	CAT-I-C, CAT-I-V, CAT-O-C, CAT-O-V
12	SYS (different systems)	SYS-I-C, SYS-I-V, SYS-O-C, SYS-O-V
13	SBM-Oriented (Slacks-based Measure)	SBM-I-C, SBM-I-V, SBM-I-GRS, SBM-O-C, SBM-O-V, SBM-O-GRS
14	SBM-Non Oriented	SBM-C, SBM-V, SBM-GRS
15	Super-SBM-Oriented	Super-SBM-I-C, Super-SBM-I-V, Super-SBM-I-GRS, Super-SBM-O-C, Super-SBM-O-V, Super-SBM-O-GRS
16	Super-SBM-Non Oriented	Super-SBM-C, Super-SBM-V, Super-SBM-GRS
17	Cost	Cost-C, Cost-V, Cost-GRS
18	New-Cost	New-Cost-C, New-Cost-V, New-Cost-GRS
19	Revenue	Revenue-C, Revenue-V, Revenue-GRS

20	**New-Revenue**	**New-Revenue-C, New-Revenue-V, New-Revenue-GRS**
21	**Profit**	**Profit-C, Profit-V, Profit-GRS**
22	**New-Profit**	**New-Profit-C, New-Profit-V, New-Profit-GRS**
23	**Ratio (Revenue/Cost)**	**Ratio-C, Ratio-V**
24	**Bilateral**	**Bilateral**
25	**Window**	**Window-I-C, Window-I-V, Window-I-GRS, Window-O-C, Window-O-V, Window-O-GRS**
26	**FDH**	**FDH**
27	**Adjusted Projection**	**Adj-CCR-I, Adj-CCR-O, Adj-BCC-I, Adj-BCC-O, Adj-AR-I-C, Adj-AR-I-V, Adj-AR-O-C, Adj-AR-O-V**
28	**Malmquist-Non Radial**	**Malmquist-I-C, Malmquist-I-V, Malmquist-I-GRS, Malmquist-O-C, Malmquist-O-V, Malmquist-O-GRS, Malmquist-C, Malmquist-V, Malmquist-GRS**
29	**Malmquist-Radial**	**Malmquist-Radial-I-C, Malmquist-Radial-I-V, Malmquist-Radial-I-GRS, Malmquist-Radial-O-C, Malmquist-Radial-O-V, Malmquist-Radial-O-GRS**
30	**Scale Elasticity**	**Elasticity-I, Elasticity-O**
31	**Congestion**	**Congestion**

The meanings of the extensions -C, -V and –GRS are as follows. Every DEA model assumes a returns to scale (RTS) characteristics that is represneted by the range (L, U) of the sum of the intensity vector λ. The constant RTS (-C) corresponds to (L=0, U=infinity) and the variable RTS (-V) to (L=1, U=1), respectively. In the models with the extension GRS, you have to supply L and U from keyboard, the defaults being L=0.8 and U=1.2. The increasing RTS (IRS) corresponds to (L=1, U=infinity) and the decreasing RTS (DRS) to (L=0, U=1), respectively. It is recommended to try several sets of (L, U) in order to identify how the RTS chracteristics exerts an influence on the efficiency score.