DEA-Solver-Pro Newsletter

No. 5

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We announce that Version 4.1 is now on the market as the successor of Version 4.0 of DEA-Solver-Pro. The version 4.0 users can download the version 4.1 with no extra-charge. This time, we added Undesirable Outputs model to our repertoire. In accordance with the environmental conservation awareness in our society, undesirable outputs of productions and social activities, e.g., air pollutants and hazardous waste, have been widely recognized as societal evils. Thus, development of technologies with less undesirable outputs is an important subject of concern in every area of production. DEA usually assumes that producing more outputs relative to less input resources is a criterion of efficiency. In the presence of undesirable outputs, however, technologies with more good (desirable) outputs and less bad (undesirable) outputs relative to less input resources should be recognized as efficient. We employed and extended the Slacks-based measure (SBM) for this purpose. Further details on this subject can be found in Appendix J of the manual Introduction 4.1.Doc which is supplied with the software. We also revised the SBM and Super-SBM models so that they can deal duly with non-positive outputs, e.g., deficits or losses. Furthermore, in the Assurance Region (AR) models, weight constraints between input and output items are now allowed. Totally, DEA-Solver-Pro 4.1 has 130 models in 32 clusters, compared with 118 DEA models in 31 clusters of the previous version. The full line-up is listed at the end of this newsletter. Also many models have been enhanced in numerical accuracy. The newcomers to the version 4.0, i.e., Scale Elasticity, Congestion and Assurance Region Global models are also inherited.

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

We have also updated many models in Version 3.0 so that they can cope with different returns-to-scale characteristics and orientations. The reinforced parts can be summarized as follows, although further details can be found in the manual: Introduction to DEA-Solver-Pro 4.1.

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.

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 4.1 consists of 130 models in 32 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-SBM-Oriented, Malmquist**
Non-Radial and Non-Oriented	**Cost, New-Cost, Revenue, New-Revenue, Profit, New-Profit, Ratio, SBM-Non-Oriented, Super-SBM-Non-Oriented, Malmquist-C (V, GRS), Undesirable**

The following 130 models in 32 clusters are included. (Red marks are newcomers since Version 4.0.)

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, SBM-AR-I-C, SBM-AR-I-V, SBM-AR-O-C, SBM-AR-O-V
14	SBM-Non Oriented	SBM-C, SBM-V, SBM-GRS, SBM-AR-C, SBM-AR-V
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-NonOriented	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-NonRadial	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**
32	**Undesirable outputs**	**BadOutput-C, BadOutput-V, BadOutput-GRS, NonSeparable-C, NonSeparable-V, NonSeparable-GRS**

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.