Appendix A: Manual for DFM Solver

Introduction to DFM Solver

This is a manual for the DFM Solver. The DFM Solver was developed by Soushi Suzuki. All responsibility is attributed to Soushi Suzuki.

The DFM Solver can be downloaded via the website http://www.lst.hokkai-s-u.ac.jp/~soushi-s/DFM-Solver.html.

S. Suzuki, P. Nijkamp, *Regional Performance Measurement and Improvement*, New Frontiers in Regional Science: Asian Perspectives 9,
DOI 10.1007/978-981-10-0242-7

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Regional Performance Measurement and Improvement
-New Developments and Applications of Data Envelopment Analysis–

Springer Science+Business Media Singapore 2017

New Frontiers in Regional Science: Asian Perspectives, Vol. 9

Amsterdam Boss, The Netherlands

Download DFM-Soler

Click on its title

DFM-Solver

Then you can get access to the Excel file.

This use is free of charge. However, when you use this software and/or publish papers or articles on this DEA, you should use the following citation:

Suzuki, S., Nijkamp, P., Rietveld, P. and Pels, E. (2010) A distance friction minimization approach in data envelopment analysis: a comparative study on air-port efficiency. European Journal of Operational Research 207: 1104–1115,

as well as:

Suzuki, S., and Nijkamp, P., (2017) Regional performance measurement and improvement –new developments and applications of data envelopment analysis-, New Frontiers in Regional Science: Asian Perspective, Vol. 9. Springer Science+ Business Media Singapore.

AMS	(I)RN	(I)TS	(I)GN	(I)EN
v	3.26E-02	0	8.54E-03	3.44E-05
x	5	370000	89	2231
d^x	0.000	0.000	0.000	0.000
$x-d^x$	5.000	370000.000	89.000	2231.000
$v(x-d^x)$	0.163	0.000	0.760	0.077
Fr^x	0.027	0.000	0.578	0.006
T-value	0.933			
$\Sigma v(x-d^x)$	1.000			
ΣFrx	0.781			
%	0.0%	0.0%	0.0%	0.0%

	(O)PN	(O)AM		
u	2.19E-08	0		
y	39960400	392997		
d^y	0.000	0.000		
$y+d^y$	39960400.000	392997.000		
$u(y+d^y)$	0.875	0.000		
Fr^y	0.766	0.000		
T-value	0.933			
Σu(y+dy)	0.875			
Σfry	0.875			
%	0.0%	0.0%		

DMU	Score		V:RN	V:TS	V:GN	V:EN
AMS	0.875009423	input optimum weight	3.26E-02	0	8.54E-03	3.44E-05
			U:PN	U:AM		
		output optimum weight	2.19E-08	0		

DFM projection	d	Slack	Projection	Difference	
	d^x, d^y	s^{-**}, s^{+**}	$x-d^x, y+d^y$	dx,dy	%
(I)RN	0.000	0	5.0	0.000	0.0%
(I)TS	0.000	-234763.5575	370000.0	-234763.558	-63.4%
(I)GN	0.000	0	89.0	0.000	0.0%
(I)EN	0.000	0	2231.0	0.000	0.0%
(O)PN	0.000	0	39960400.0	0.000	0.0%
(O)AM	0.000	168893.6846	392997.0	168893.685	43.0%

i-model	o-model
0.781319	0.875009
4	2
TRUE	FALSE
TRUE	100
TRUE	
TRUE	
FALSE	
100	

Original Data	(I)RN	(I)TS	(I)GN	(I)EN
AMS	5	370,000	89	2,231
	(O)PN	(O)AM		
	39,960,400	392,997		
Projection Data	(I)RN	(I)TS	(I)GN	(I)EN
AMS	5.0	370000.0	89.0	2231.0
	(O)PN	(O)AM		
	39960400.0	392997.0		

A.1 Platform

The platform for this file is MS-Excel 2010 or later.

A.2 Data Preparation

We recommend using "DEA Solver" (Cooper, W.W., Seiford, L.M., Tone, K., (2007), Data Envelopment Analysis, A Comprehensive Text with Models, Applications References and DEA-Solver Software, Springer Science, Business Media, New York), to compute efficiency scores, optimum weights for input and output items, and slacks.

You need a preparation for all data sets as follows:

1. Input and output data sets for all decision making units (DMUs)
2. Efficiency scores for all DMUs based on the CCR-I model
3. Optimum weights for all input and output items (these data can be found in the "weight" sheet, in the computed results by DEA Solver)

A.3 Starting DFM Solver

1. After completion of all data sets at A.2, open the "DFM Solver."
2. This is an example of Amsterdam Airport Schiphol, a four-input ([Input 1] RN, number of runways; [Input 2] TS, terminal space; [Input 3] GN, number of gates; [Input 4] EN, number of employees; [Output 1] PN, number of passengers; [Output 2] AM, aircraft movements) case.
3. Enter the data as follows:

   - Cell I2: name of one DMU.
   - Cell J2: efficiency score of one DMU.
   - Cell L2 to O2: optimum weight of inputs for one DMU.

     If your case has two inputs, then you should change "Cell L2 to M2."
     You should adjust a data input cell based on your case.

   - Cell L5 to M5: optimum weight of outputs for one DMU.

     If your case has one output, then you should change "Cell L5."
     You should adjust a data input cell based on your case.

   - Cell U2 to X2: input datasets for one DMU.

     You should adjust a selection cell based on your case.

   - Cell U5 to V5: output datasets for one DMU.

You should adjust a selection cell based on your case.

- Cell D1 to E11: if your case has two inputs, then you should delete the data in "Cell D1 to E11."

  You should adjust a data input cell based on your case. If you wish to add a number of inputs, then you should copy E1–E11 and paste to F1–F11. Also you need to adjust the selection cell information in Cell B9 and B10.

- Cell C14 to C24: if your case has one output, then you should delete the data in "Cell C14 to C24."

  You should adjust a data input cell based on your case. If you wish to add a number of outputs, then you should copy C14–C24 and paste to D14–D24. Also you need to adjust the selection cell information in Cell B22 and B23.

4. Click "Solver" in Excel toolbar.
5. Click "load model" and select Cell I18 to I25 and load.

   - This program is for a four-input case. If you need to adjust a number of inputs, you should change "By Changing Cells" in the Solver Parameters dialog box. If your case have two inputs, then you should change "B4:$C $4" in "By Changing Cells" in the Solver Parameters dialog box and delete "D5 > =0" and "E5 > =0" in "Subject to the Constraints" in the Solver Parameters dialog box.

6. Click "Solve" and then compute results for Cell B4 to E4. If your case has two inputs, it computes results at Cell B4 to C4.
7. Click "load model" and select Cell J18 to J21 and load.
8. Click "Solve" and then compute results for Cell B17 to C17.

   - This program is for a two-output case. If you need to adjust a number of outputs, you should change "By Changing Cells" in the Solver Parameters dialog box. If your case has one output, then you should change "B17" in "By Changing Cells" in the Solver Parameters dialog box.

9. Cells U8 to V8 are the projected input data sets, and Cells U11 to V11 are the projected output data sets.
10. Using these projected data sets, you should recompute an efficiency score to check a result (efficiency score will be 1.000) and to confirm the existence of a slack (these data can be found in the "Slack" sheet in the computed results by DEA Solver).
11. If a slack exists, you need to add the slack data to cell K9 to K14.
12. Finally you get the DFM projection results in cells I7 to N14.