



بنیاد ملی حسابان

دبستان جمهوری
موسسه عالی آموزش و پژوهش مدیریت و برنامه ریزی

DEA-Solver Software

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Introduction

There are two types of software: non-commercial and commercial.

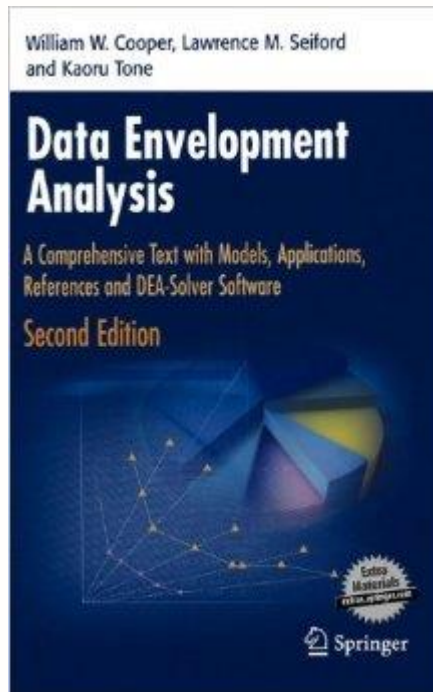
Selected non-commercial DEA software:

1. DEA-SOLVER-LV
2. DEAFrontier
3. MaxDEA
4. PIM-DEA (*Performance Improvement Management-DEA*)
5. Frontier Analyst
6. Konsi

Introduction

DEA-SOLVER was accompanied by:

Cooper, Seiford and Tone, *DATA ENVELOPMENT ANALYSIS:
A Comprehensive Text with Models, Applications, References and
DEA-Solver Software*



Introduction

- DEA-SOLVER was developed using VBA and Excel Macros in Microsoft Office.
- It is completely compatible with Excel data sheets.
- It can read a data set directly from an Excel worksheet and returns the results of computation to an Excel workbook.
- The results provide both primal (envelopment form) and dual (multiplier form) solutions as well as slacks, projections onto efficient frontiers, graphs, etc.

Versions

- There are two versions of DEA-Solver, the "*Learning Version*" (called **DEA-Solver-LV**) and the "*Professional Version*" (called **DEA-Solver-PRO**)
- DEA-Solver-LV can solve standard DEA models with up to 50 DMUs and unlimited number of inputs and outputs

Free access

DEA-SOLVER is available at <http://extras.springer.com/>

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SEARCH ISBN:

Displaying ISBN 978-0-387-45283-8



Data Envelopment Analysis

Authors: William Cooper

Publisher: Springer-Verlag

DOI: 10.1007/978-0-387-45283-8

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Notation in DEA-Solver

- DEA-Solver applies the following notation for describing DEA models:

<Model Name> - <I or O> - <C or V or GRS>

Examples: AR-I-C, CCR-I, BCC-O, FDH

Included DEA models

CCR = Charnes-Cooper-Rhodes model
BCC = Banker-Charnes-Cooper model
IRS = Increasing Returns-to-Scale model
DRS = Decreasing Returns-to-Scale model
GRS = Generalized Returns-to-Scale model
AR = Assurance Region model
ARC = Assurance Region Global model
NCN = Non-controllable variable model
NDSC = Non-discretionary variable model
BND = Bounded variable model
CAT = Categorical variable model
SYS = Different Systems model
SBM = Slacks-Based Measure model
Weighted SBM = Weighted Slacks-Based Measure model
Hybrid = Hybrid model

Cost = Cost efficiency model
New-Cost = New-Cost efficiency model
Revenue = Revenue efficiency model
New-Revenue = New-Revenue efficiency model
Profit = Profit efficiency model
New-Profit = New-Profit efficiency model
Ratio = Ratio efficiency model
Bilateral = Bilateral comparison model
FDH = Free Disposal Hull model
Window = Window Analysis
Malmquist = Malmquist model
Super-efficiency = Super-efficiency model
Scale Elasticity = Scale Elasticity model
Congestion = Congestion model
Undesirable Output = Undesirable Outputs model

Preparation of the data file

1. The first row (Row 1)

- Cell A1 = Problem Name
- Cell B1, C1, .. .= (I)/(O) +Names of I/O items.
- The ordering of (I) and (O) items is arbitrary.

2. The second row and after

3. The scope of data domain

- One blank column at right and one blank row at bottom. The data set should start from the top-left cell (A1).

▪ 4. Data sheet name

- Do not use the following names for the data sheet: "Score", "Rank", "Projection", "Weight", "WeightedData", "Slack", "RTS", "Window", "Decomposition", "Graph1" and "Graph2".

Example (Hospital Case)

Hospital	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>	<i>K</i>	<i>L</i>
Doctors	20	19	25	27	22	55	33	31	30	50	53	38
Nurses	151	131	160	168	158	255	235	206	244	268	306	284
Outpatients	100	150	160	180	94	230	220	152	190	250	260	250
Inpatients	90	50	55	72	66	90	88	80	100	100	147	120

Sample

	A	B	C	D	E	F
1	Hospital	(I)Doctor	(I)Nurse	(O)Outpatient	(O)Inpatient	
2	A	20	151	100	90	
3	B	19	131	150	50	
4	C	25	160	160	55	
5	D	27	168	180	72	
6	E	22	158	94	66	
7	F	55	255	230	90	
8	G	33	235	220	88	
9	H	31	206	152	80	
10	I	30	244	190	100	
11	J	50	268	250	100	
12	K	53	306	260	147	
13	L	38	284	250	120	
14						

The AR method

	A	B	C	D	E	F
1	Hospital	(I)Doctor	(I)Nurse	(O)Outpatient	(O)Inpatient	
2	A	20	151	100	90	
3	B	19	131	150	50	
4	C	25	160	160	55	
5	D	27	168	180	72	
6	E	22	158	94	66	
7	F	55	255	230	90	
8	G	33	235	220	88	
9	H	31	206	152	80	
10	I	30	244	190	100	
11	J	50	268	250	100	
12	K	53	306	260	147	
13	L	38	284	250	120	
14						
15	1	(I)Doctor	(I)Nurse	5		
16	0.2	(O)Outpatient	(O)Inpatient	0.5		
17						

The NCN and NDSC Models

	A	B	C	D	E	F
1	Hospital	(IN)Doctor	(I)Nurse	(O)Outpatient	(ON)Inpatient	
2	A	20	151	100	90	
3	B	19	131	150	50	
4	C	25	160	160	55	
5	D	27	168	180	72	
6	E	22	158	94	66	
7	F	55	255	230	90	
8	G	33	235	220	88	
9	H	31	206	152	80	
10	I	30	244	190	100	
11	J	50	268	250	100	
12	K	53	306	260	147	
13	L	38	284	250	120	
14						

The BND model

	A	B	C	D	E	F	G	H	I
1	Hospital	(IB)Doc.	(LB)Doc.	(UB)Doc.	(I)Nurse	(O)Output	(OB)Inpat.	(LB)Inpat.	(UB)Inpat.
2	A	20	15	22	151	100	90	80	100
3	B	19	15	23	131	150	50	45	55
4	C	25	20	25	160	160	55	50	60
5	D	27	21	27	168	180	72	70	76
6	E	22	20	25	158	94	66	60	80
7	F	55	45	56	255	230	90	80	100
8	G	33	31	36	235	220	88	80	95
9	H	31	29	33	206	152	80	70	90
10	I	30	28	31	244	190	100	90	110
11	J	50	45	50	268	250	100	90	120
12	K	53	45	54	306	260	147	130	160
13	L	38	30	40	284	250	120	110	130
14									

The CAT model

	A	B	C	D	E	F
1	Hospital	(I)Doctor	(I)Nurse	(O)Outpatient	(O)Inpatient	Cat.
2	A	20	151	100	90	1
3	B	19	131	150	50	2
4	C	25	160	160	55	2
5	D	27	168	180	72	2
6	E	22	158	94	66	1
7	F	55	255	230	90	1
8	G	33	235	220	88	2
9	H	31	206	152	80	1
10	I	30	244	190	100	1
11	J	50	268	250	100	2
12	K	53	306	260	147	2
13	L	38	284	250	120	2
14						

The Revenue model

	A	B	C	D	E	F	G	H
1	Hospital	(I)Doctor	(I)Nurse	(O)Output.	(P)Output.	(O)Inpat.	(P)Inpat.	
2	A	20	151	100	550	90	2010	
3	B	19	131	150	400	50	1800	
4	C	25	160	160	480	55	2200	
5	D	27	168	180	600	72	3500	
6	E	22	158	94	400	66	3050	
7	F	55	255	230	430	90	3900	
8	G	33	235	220	540	88	3300	
9	H	31	206	152	420	80	3500	
10	I	30	244	190	350	100	2900	
11	J	50	268	250	410	100	2600	
12	K	53	306	260	540	147	2450	
13	L	38	284	250	295	120	3000	
14								

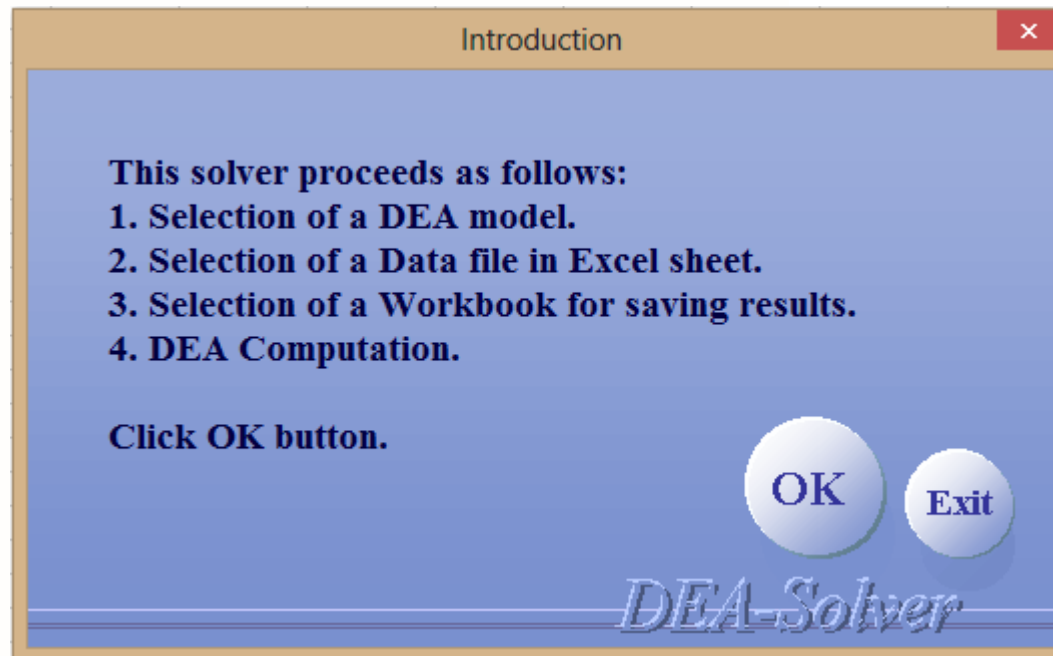
Headings summary

Heading	Description	Example	Models employed
(I)	Input	(I)Employee	All models
(O)	Output	(O)Sales	All models
(IN)	Non-controllable or Non-discretionary input	(IN)Population	NCN (Non-controllable) NDSC (Non-discretionary)
(ON)	Non-controllable or Non-discretionary output	(ON)Area	As above
(IB)	Bounded input	(IB)Doctor	BND (Bounded variable)
(OB)	Bounded output	(OB)Attendance	As above
(LB)	Lower bound of bounded variable	(LB)Doctor	As above
(UB)	Upper bound of bounded variable	(UB)Doctor	As above
(C)	Unit cost of input	(C)Manager	Cost, New-Cost, Profit, New-Profit, Ratio
(P)	Unit price of output	(P)Laptop	Revenue, New-Revenue, Profit, New-Profit, Ratio

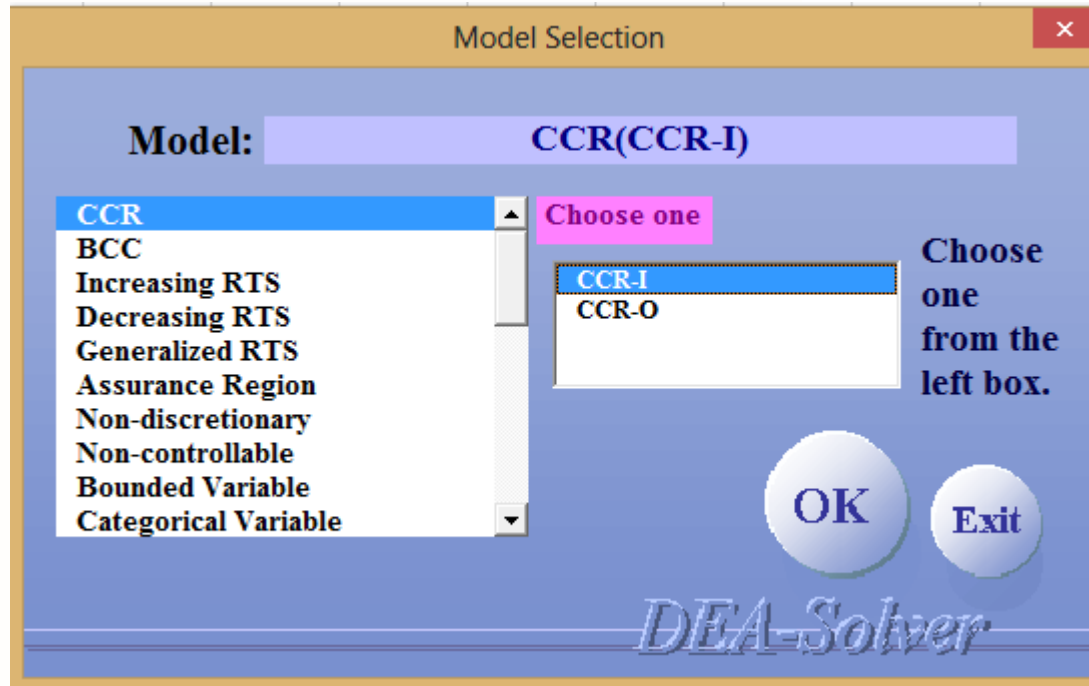
Starting DEA-SOLVER



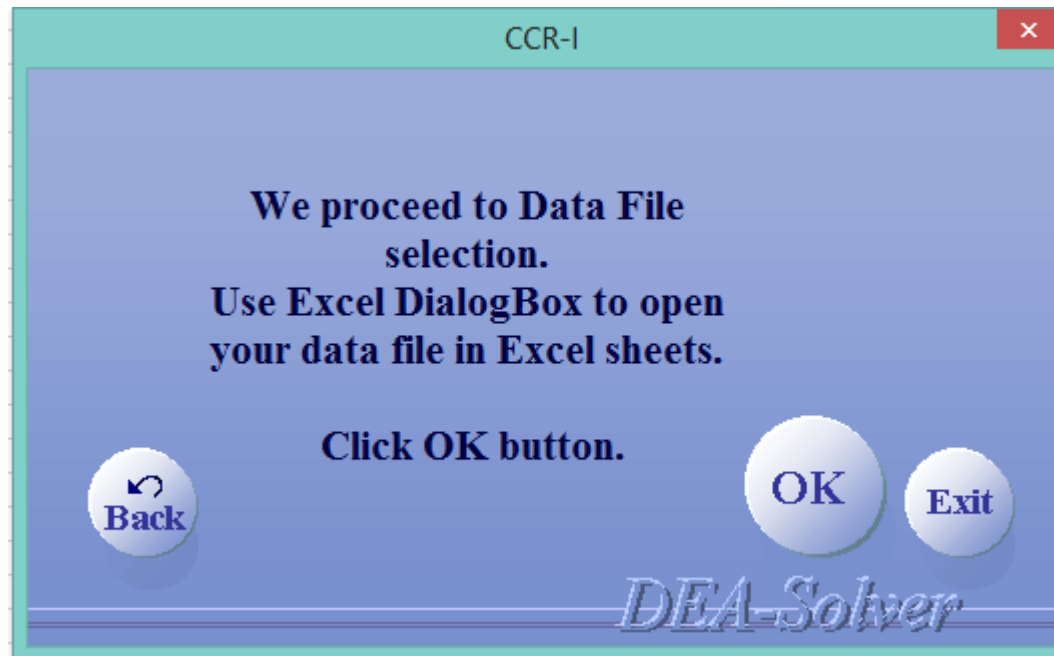
Introduction



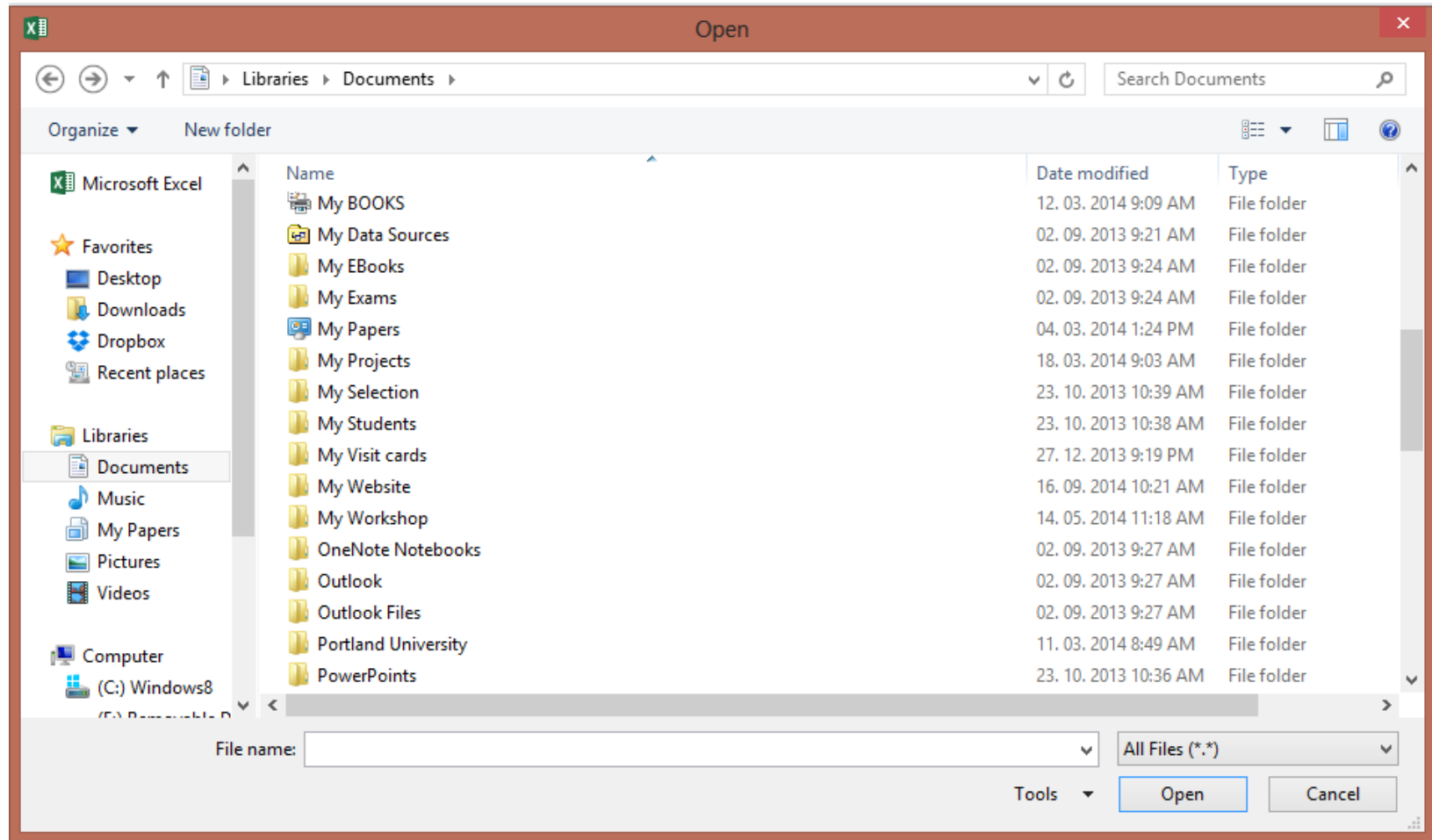
Model Selection



Information



Dialog box



Selecting the data sheet

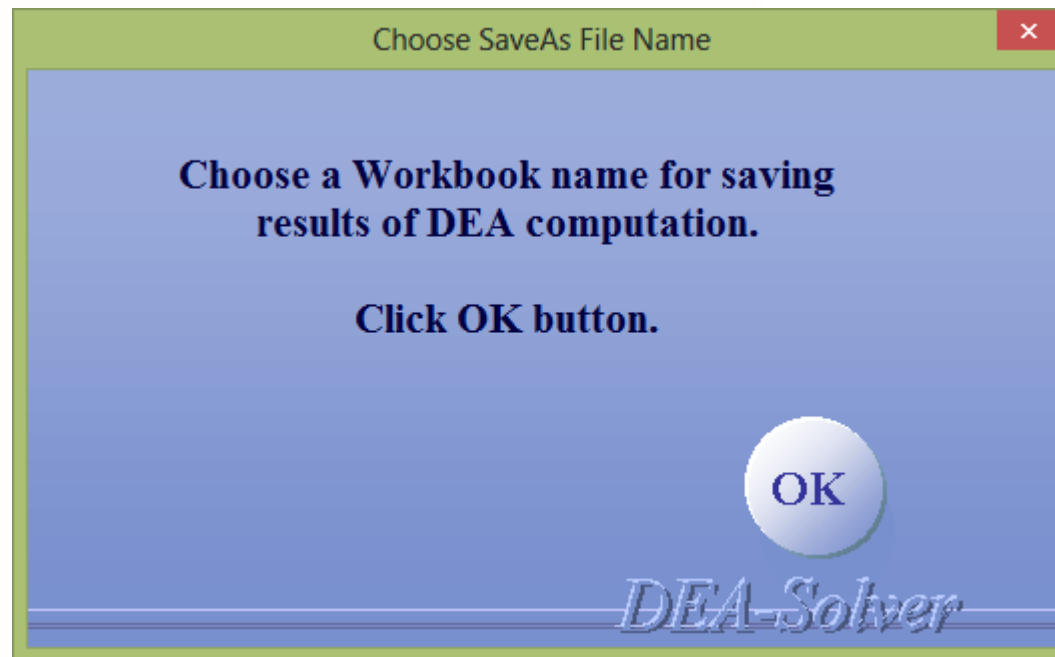
A1 | : | *Jx* | Sampme-BCC

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Sampme-B	(I)Doctor	(I)Nurse	(O)Outpati	(O)Inpatient									
2	A	20	151	100	90									
3	B	19	131	150	50									
4	C	25	160	160	55									
5	D	27	168	180	72									
6	E	22	158	94	66									
7	F	55	255	230	90									
8	G	33	235	220	88									
9	H	31	206	152	80									
10	I	30	244	190	100									
11	J	50	268	250	100									
12	K	53	306	260	147									
13	L	38	284	250	120									
14														
15														
16														
17														
18														
19														
20														
21														

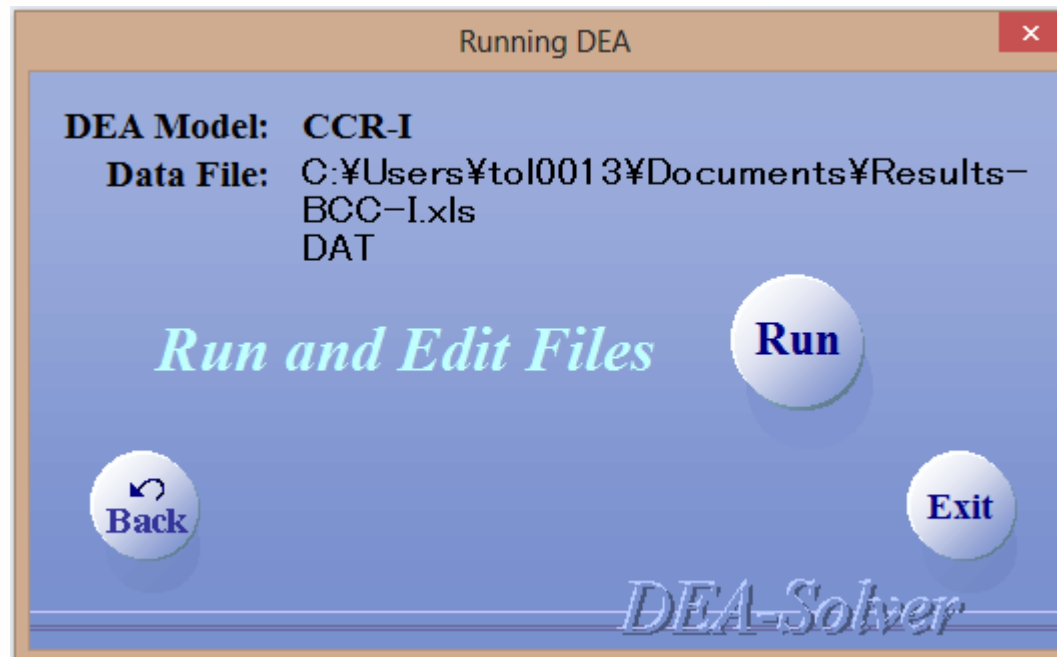
DEA Model= CCR-I

Choose your data sheet.
If the active sheet in the screen is a part of your sheet, click OK button.
Sheet Name = DAT
Otherwise click Another Sheet button.

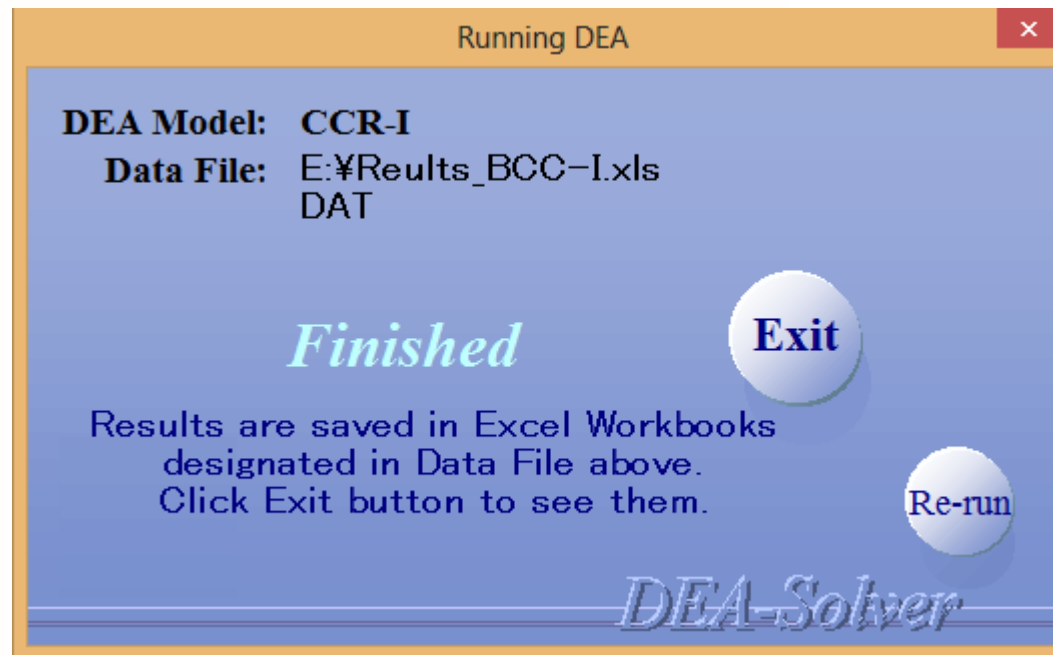
Saving the results



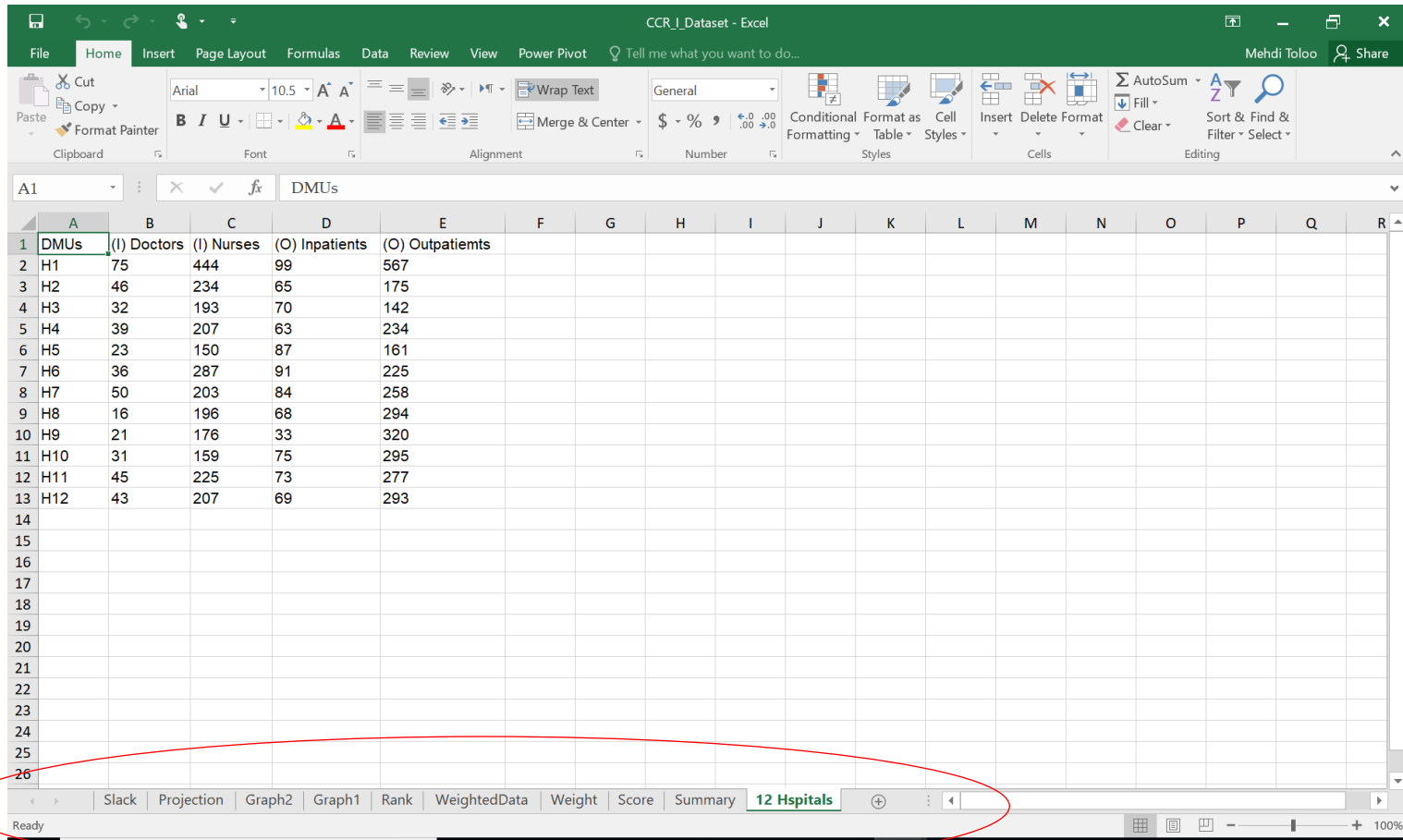
Running DEA



Running DEA



Results



CCR_I_Dataset - Excel

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A1 DMUs

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	DMUs	(I) Doctors	(I) Nurses	(O) Inpatients	(O) Outpatients													
2	H1	75	444	99	567													
3	H2	46	234	65	175													
4	H3	32	193	70	142													
5	H4	39	207	63	234													
6	H5	23	150	87	161													
7	H6	36	287	91	225													
8	H7	50	203	84	258													
9	H8	16	196	68	294													
10	H9	21	176	33	320													
11	H10	31	159	75	295													
12	H11	45	225	73	277													
13	H12	43	207	69	293													
14																		
15																		
16																		
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18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		

Slack Projection Graph2 Graph1 Rank WeightedData Weight Score Summary **12 Hospitals**

Ready

Worksheets

1. **“Summary”** shows statistics on data and a summary report of results obtained.
2. **“Score”** contains the DEA-score, reference set, λ -value for each DMU in the reference set.
3. **“Rank”** contains the ranking of DMUs in the descending order of efficiency scores.
4. **“Projection”** contains projections of each DMU onto the efficient frontier by the chosen model.
5. **“Weight”** exhibits optimal weights $v(i)$ and $u(r)$.
6. **“WeightedData”** shows the optimal weighted I/O values, $x_{ij}v(i)$ and $y_{rj}u(r)$.
7. **“Slack”** contains the input excesses s^- and output shortfalls s^+ .
8. **“RTS”** records the returns-to-scale characteristics in case of the BCC, AR-I-V and AR-O-V models.
9. **“Graph1”** exhibits the bar chart of the DEA scores.
10. **“Graph2”** plots the bar chart of the DEA scores in the ascending order.

Summary

	A	B	C	D	E	F	G	H	I	J	K
2	Workbook Name = C:\Users\Tc	Workbook Name = C:\Users\Toloo\Turin\QMDM\CCR_I_Dataset.xlsx									
3	Data File = C:\Users\Toloo\Dropbox\Toloo_PhD_Emmanuel_Italy\Turin\QMDM\Dataset.xlsx	12 Hspitals									
4	DEA model = DEA-Solver LV8.0/ CCR(CCR-I)										
5	Problem = DMUs										
6	No. of DMUs = 12										
7	Returns to Scale = Constant (0 =< Sum of Lambda < Infinity)										
8	No. of Input items = 2										
9	Input(1) = Doctors										
10	Input(2) = Nurses										
11	No. of Output items = 2										
12	Output(1) = Inpatients										
13	Output(2) = Outpatiements										
14											
15	Statistics on Input/Output Data										
16		Doctors	Nurses	Inpatients	Outpatiements						
17	Max	75	444	99	567						
18	Min	16	150	33	142						
19	Average	38.0833	223.417	73.0833	270.083						
20	SD	15.1077	74.8526	16.163	105.374						
21	Correlation										
22		Doctors	Nurses	Inpatients	Outpatiements						
23	Doctors	1	0.80548	0.52826	0.58382						
24	Nurses	0.80548	1	0.5351	0.73294						
25	Inpatients	0.52826	0.5351	1	0.22487						
26	Outpatiement	0.58382	0.73294	0.22487	1						
27											
28											
29	No. of Efficient DMUs = 4										
30	No. of Inefficient DMUs = 8										
31											
32	[CCR-I] LP started at 01-28-2018 18:55:08										
33	Finished at 01-28-2018 18:55:09										
34	Elapsed time = 1 seconds										

Score

	A	B	C	D	E	F	G	H	I	J
1										
2	Model = CCR-I		Workbook Name = C:\Users\Toloo\Turin\QMDM\CCR_I_Dataset.xlsx							
3										
4	No.	DMU	Score	Rank	Reference(Lambda)					
5	1	H1	0.6931	7	H9	0.602	H10	1.269		
6	2	H2	0.5234	12	H5	0.445	H10	0.35		
7	3	H3	0.6376	10	H5	0.736	H10	0.08		
8	4	H4	0.6363	11	H5	0.079	H8	0.017	H10	0.734
9	5	H5	1	1	H5	1				
10	6	H6	0.648	9	H5	0.757	H8	0.369		
11	7	H7	0.8095	5	H5	0.4	H10	0.657		
12	8	H8	1	1	H8	1				
13	9	H9	1	1	H9	1				
14	10	H10	1	1	H10	1				
15	11	H11	0.6793	8	H5	0.056	H10	0.908		
16	12	H12	0.7629	6	H10	0.993				
17										
18										
19		Average	0.7825							
20		Max	1							
21		Min	0.5234							
22		St Dev	0.1749							

Weights

CCR_I_Dataset - Excel

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A2 Model = CCR-I

	A	B	C	D	E	F	G	H	I	J
1										
2	Model = CCR-I									Workbook Name = C:\Users\Toloo\Turin\QMDM\CCR_I_Dataset.xlsx
3										
4	No.	DMU	Score	Rank		v(1)	v(2)		u(1)	u(2)
5	1	H1	0.6931	7		6.00E-04	0.00215		0	1.22E-03
6	2	H2	0.5234	12		0	4.27E-03		5.86E-03	8.12E-04
7	3	H3	0.6376	10		0	5.18E-03		7.11E-03	9.85E-04
8	4	H4	0.6363	11		9.91E-03	0.00296		5.38E-03	1.27E-03
9	5	H5	1	1		1.47E-02	4.41E-03		7.99E-03	1.89E-03
10	6	H6	0.648	9		0.02315	5.81E-04		7.12E-03	0
11	7	H7	0.8095	5		0	4.93E-03		6.76E-03	9.36E-04
12	8	H8	1	1		6.25E-02	0		0	3.40E-03
13	9	H9	1	1		1.20E-02	4.25E-03		2.82E-03	2.83E-03
14	10	H10	1	1		1.67E-03	5.96E-03		0	3.39E-03
15	11	H11	0.6793	8		0	4.44E-03		6.10E-03	8.45E-04
16	12	H12	0.7629	6		0	4.83E-03		0	2.60E-03
17										

Ready

Weighted Data

CCR_I_Dataset - Excel

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A1

	A	B	C	D	E	F	G	H	I	J	K
1											
2	Model = CCR-I			Workbook Name = C:\Users\Toloo\Turin\QMDM\CCR_I_Dataset.xlsx							
3											
4	No.	DMU	Score	Rank		$v(1)*Doc$	$v(2)*Nurses$		$u(1)*Inpa$	$u(2)*Outpatients$	
5	1	H1	0.6931	7		4.50E-02	0.95496		0	0.69308	
6	2	H2	0.5234	12		0	1		0.38122	0.14214	
7	3	H3	0.6376	10		0	1		0.49776	0.13984	
8	4	H4	0.6363	11		0.38634	0.61366		0.3387	0.29764	
9	5	H5	1	1		0.33879	0.66121		0.69549	0.30451	
10	6	H6	0.648	9		0.83325	0.16675		0.64799	0	
11	7	H7	0.8095	5		0	1		0.56789	0.24156	
12	8	H8	1	1		1	0		0	1	
13	9	H9	1	1		0.25182	0.74818		9.31E-02	0.90689	
14	10	H10	1	1		5.16E-02	0.94838		0	1	
15	11	H11	0.6793	8		0	1		0.44527	0.23399	
16	12	H12	0.7629	6		0	1		0	0.76291	

Graph2 Graph1 Rank WeightedData Weight Sc ...

Ready 100%

Rank

CCR_I_Dataset - Excel

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D3

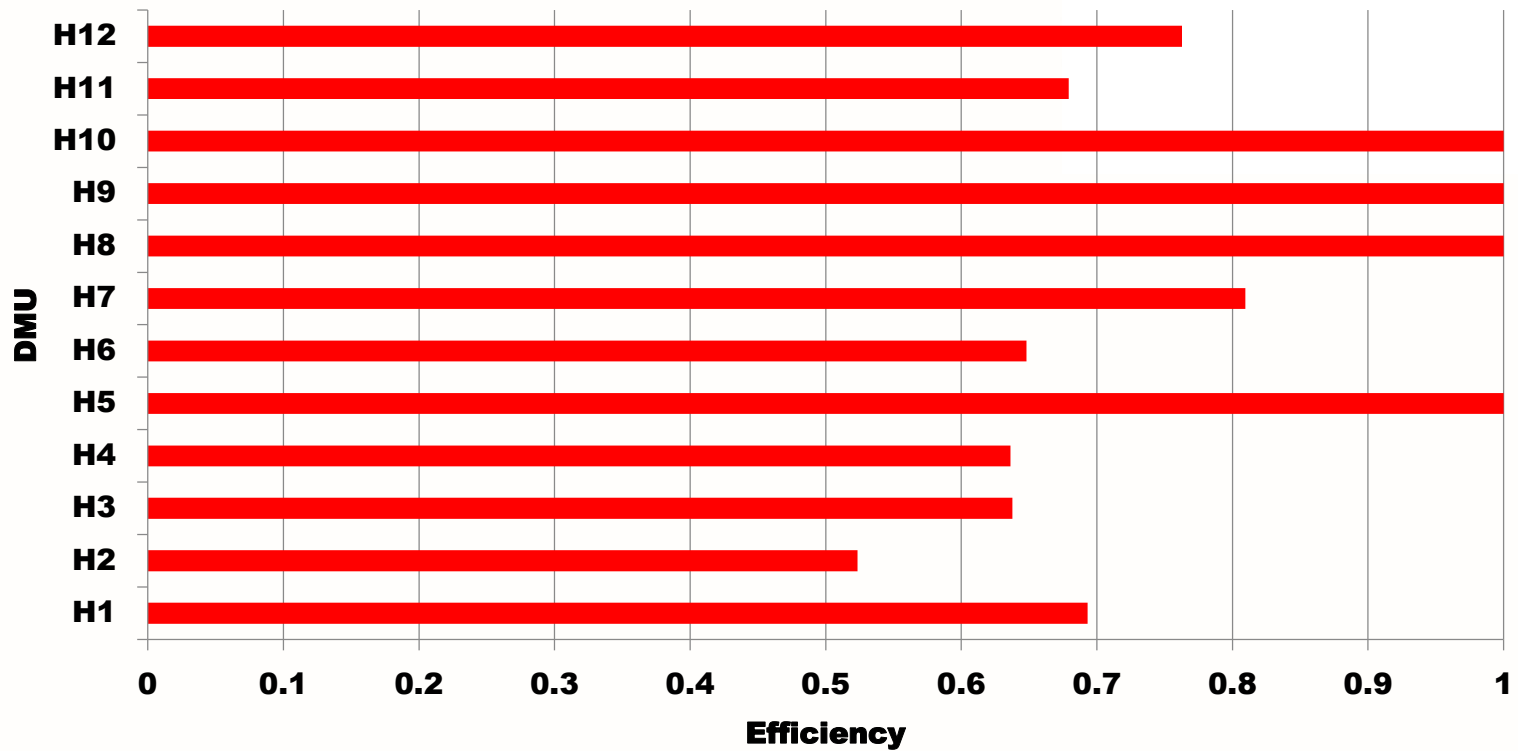
	A	B	C	D	E	F	G	H	I	J
1										
2	Model = CCR-I			Workbook Name = C:\Users\Toloo\Turin\QMDM\CCR_I_Dataset.xlsx						
3										
4	No.	DMU	Score	Rank						
5	5	H5	1	1						
6	8	H8	1	1						
7	9	H9	1	1						
8	10	H10	1	1						
9	7	H7	0.8095	5						
10	12	H12	0.7629	6						
11	1	H1	0.6931	7						
12	11	H11	0.6793	8						
13	6	H6	0.648	9						
14	3	H3	0.6376	10						
15	4	H4	0.6363	11						
16	2	H2	0.5234	12						
17										

Graph2 Graph1 Rank WeightedData Weiç ...

Ready 100%

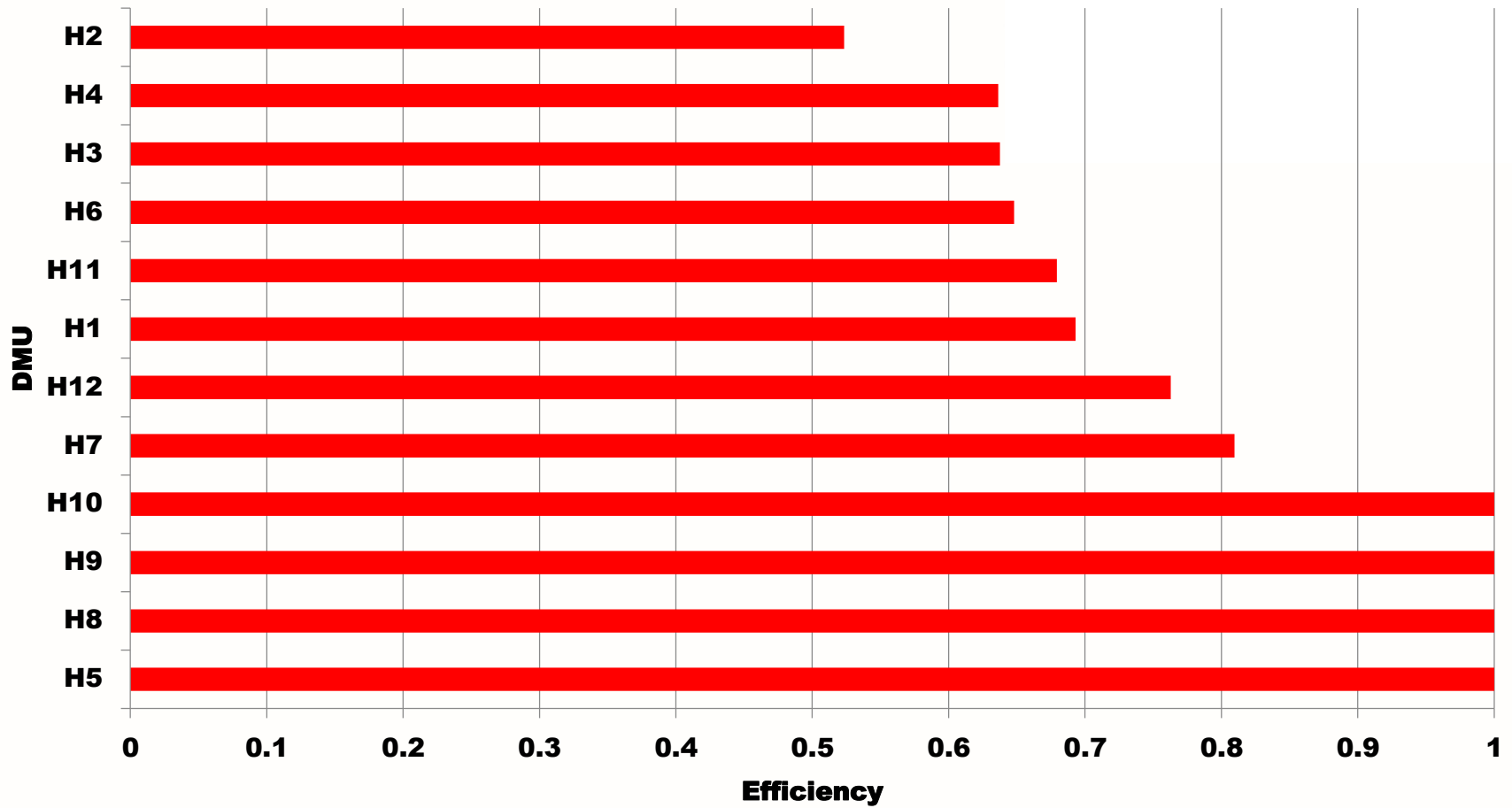
Graph 1

DMUs



Graph2

DMUs



Projection

CCR_I_Dataset - Excel

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A1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1																
2	Model = CCR-I				Workbook Name = C:\Users\Tolo\Turin\QMDM\CCR_I_Dataset.xlsx											
3					Doctors			Nurses			Inpatients			Outpatients		
4	No.	DMU	Score	Rank	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)
5	1	H1	0.6931	7	75	51.9807	-30.692	444	307.726	-30.692	99	115.039	16.201	567	567	0
6	2	H2	0.5234	12	46	21.0971	-54.137	234	122.468	-47.663	65	65	0	175	175	0
7	3	H3	0.6376	10	32	19.3969	-39.385	193	123.058	-36.239	70	70	0	142	142	0
8	4	H4	0.6363	11	39	24.8175	-36.365	207	131.724	-36.365	63	63	0	234	234	0
9	5	H5	1	1	23	23	0	150	150	0	87	87	0	161	161	0
10	6	H6	0.648	9	36	23.3276	-35.201	287	185.973	-35.201	91	91	0	225	230.484	2.437
11	7	H7	0.8095	5	50	29.5417	-40.917	203	164.319	-19.055	84	84	0	258	258	0
12	8	H8	1	1	16	16	0	196	196	0	68	68	0	294	294	0
13	9	H9	1	1	21	21	0	176	176	0	33	33	0	320	320	0
14	10	H10	1	1	31	31	0	159	159	0	75	75	0	295	295	0
15	11	H11	0.6793	8	45	29.4486	-34.559	225	152.834	-32.074	73	73	0	277	277	0
16	12	H12	0.7629	6	43	30.7898	-28.396	207	157.922	-23.709	69	74.4915	7.959	293	293	0
17																

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Thank you for attention