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Ranking and Return to Scale IDEA with Interval Data

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ABSTRACT

Modeling capabilities for the modern world, because of the complexity and the indecisive of realities, quantitative data are still insufficient and improper. Therefore it is necessary quality indicators to be taken into account when a decision is made on the performance of a DMU. The original DEA models, inputs and outputs are measured with real values. In some organizations we may face with imprecise data such as interval, ordinal and fuzzy data. In this paper BCC-CCRand CCR-BCC models are examined to determine the type of returns to scale of decision making units when data are interval. And then the ranking of these units will be discussed. Finally we apply the proposed approach to 63 Iran bank branches data.
KEYWORDS: Imprecise Data Envelopment Analysis, interval data, return to scale, ranking

1. INTRODUCTION

Data enveloping analysis (DEA) invented by Charnes, Cooper and Rhodes (1987)[2]. DEA is a method to evaluate relative efficiency decision making units based of multiple-inputs and multiple-outputs. Efficiency on a relative scale bounded is measured by a fraction of weighted outputs to weighted inputs. At DEA assumes that input-output data are accurate. Today, in many parts of organizations and companies simply cannot get accurate data because some of the problems or errors are detected. Data usually are observed the annual or in specific period and considered because data collection requires costs. However a data can be fluctuating during the time. Including imprecise and uncertain nature of the data involved in the performance evaluation and efficiency is often felt to be fluctuating. Input-output data can be placed by stochastic, interval, ordinal and fuzzy data. In this paper, we focus on the imprecise input-output data that are represented by intervals. Therefore some articles on the development of the theoretical and practical techniques of DEA with imprecise data were presented as interval data that can be noted Despotis and smirlis(2002) [3] and Kao (2006) [6] that the original data set by changing the variables, the non-linear DEA model becomes a linear programming model and accordingly, the upper bound and the lower bound performance efficiency units is defined. Jahanshahloo and Lotfi(2012) [4] proposed a method for finding all strong defining hyper planes of PPS with interval data. Jahanshahloo and Lotfi and Rezaie(2011) [5] by the interval DEA model has been formulated to obtain an efficiency interval consisting of evaluations from both the optimistic and the pessimistic viewpoints. Inuiguchi(2011) [7] extend SBM model to interval input-output data and introduce the interval DEA model with interval input-output data. Our study associated with imprecise data such as interval data are derived of Inuiguchi(2011) [7] approach. In section 2, we introduce DEA and in section 3, BCC-CCR and CCR-BCC models with interval data expands in relation to the type of units of return to scale (RTS) and show DMUs what are the types return to scale (increasing, constant, decreasing) in four different modes. Method of Anderson and Peterson (1993) [1] is shown for ranking DMUs with interval input-output data in section 4. Finally, in next section the conclusions are presented.

2-Data Envelopment Analysis

The DEA, achieve the best efficiency bound, non-priority inputs and outputs is set of decision making units. DMUs are on the efficiency bound on the highest output of levels or on the minimal input of levels. DEA can analyze the inefficient units with recognition efficiency and efficient limited units. The following model is form BCC-CCR in the nature of the input. Suppose (X_o, Y_o) activity belonging to Production Possibility Set (PPS), while the least amount of product output the value of Y_o and simultaneously, the amount input X_o reduced to ΘX_o provided that $\lambda \geq 1$, then we have:

$$\begin{aligned} \text{Min} \quad & \theta \\ s.t. \quad & \sum_{j=1}^{n} \lambda_j X_j \leq \theta X_o \\ & \sum_{j=1}^{n} \lambda_j Y_j \geq Y_o \\ & \sum_{j=1}^{n} \lambda_j \geq 1 \\ & \lambda_1, \ldots, \lambda_n \geq 0 \end{aligned} \tag{1}$$

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DEA technique is just not for calculation decision making unit of efficiency. One of the other cases we get from the DEA is ranking. Obviously, the efficiency of a DMU is more than one efficiency, the DMU is a better place. Efficiency is criteria for ranking because in this case the efficiency of all units is 1 the efficiency amount is not responsive again. Therefore we need to second criterion for its ranking namely the per unit that has the lower limit. One of the methods for ranking, is Anderson & Peterson method [1].

Model is as follows:

$$
\begin{aligned}
& Min \quad \theta \\
& \text{s.t.} \quad \sum_{\substack{j=1 \\ j\neq p}}^{n} \lambda_j X_j \le \theta X_p \\
& \qquad \sum_{\substack{j=1 \\ j\neq p}}^{n} \lambda_j X_j \ge Y_p \\
& \qquad \lambda_j \ge 0 \qquad (j=1,\ldots,n \ \& \ j \neq p)
\end{aligned} \tag{2}
$$

3-Return To Scale (RTS) decision making unit with interval data

Suppose Q_1 and Q_2 are variables within {Π,N,L,R,LR,L|R}[7]. The efficiency is computed of the model BCC-CCR and CCR-BCC in five cases Π–N, N–Π, L–L, R–R, LR–L|R for the DMUs, each with the following interpretations:

Efficiency of Π–N: It shows the worst efficiency amount and namely the worst values of the input-output interval for the under evaluation DMU and the best input-output interval for other DMUs.

Efficiency of N–Π: It shows the best of efficiency amount and namely the best values of the input-outputinterval for the under evaluation DMU and the worst value for the other DMUs.

Efficiency of L–L: It shows the worst efficiency amount use to the worst values of the input-output interval for all the DMUs.

Efficiency of R–R: It shows the best efficiency amount use to the best values of the input-output interval for all the DMUs.

Efficiency of L|R-LR: It shows evaluation efficiency maximum by comparing the worst and the best values interval for each DMU with the under evaluation DMU.

Models are as follows:

$$
\begin{aligned}
& Min \quad \theta \\
& \text{s.t.} \quad \text{if} \quad Q_1 \neq LR, \\
& \quad \begin{cases} X_i^{Q_{11}} \lambda \le \theta x_{iq}^{Q_{12}} & , i = 1,\ldots,m, \\ Y_k^{Q_{13}} \lambda \ge y_{kq}^{Q_{14}} & , k = 1,\ldots,p, \end{cases} \\
& \quad \text{if} \quad Q_1 = LR, \\
& \quad \begin{cases} X_i^{L} \lambda \le \theta x_{iq}^{L} & , X_i^{R} \lambda \le \theta x_{iq}^{R} \quad , \ i = 1,\ldots,m, \\ Y_k^{L} \lambda \ge y_{kq}^{L} & , Y_k^{R} \lambda \ge y_{kq}^{R} \quad , \ k = 1,\ldots,p, \end{cases} \\
& \quad \text{if} \quad Q_2 \neq L|R, \\
& \quad \begin{cases} X_i^{Q_{21}} \lambda z_i^{1-} \le \theta x_{iq}^{Q_{22}} z_i^{1-} & , \ i = 1,\ldots,m, \\ Y_k^{Q_{23}} \lambda z_k^{1+} \ge y_{kq}^{Q_{24}} z_k^{1+} & , \ k = 1,\ldots,p, \end{cases} \\
& \quad \text{if} \quad Q_2 = L|R, \\
& \quad \begin{cases} X_i^{L} \lambda z_i^{1-} \le \theta x_{iq}^{L} z_i^{1-} & , X_i^{R} \lambda z_i^{2-} \le \theta x_{iq}^{R} z_i^{2-} \quad , \ i = 1,\ldots,m, \\ Y_k^{L} \lambda z_k^{2+} \ge y_{kq}^{L} z_k^{2+} & , Y_k^{R} \lambda z_k^{1+} \ge y_{kq}^{R} z_k^{1+} \quad , \ k = 1,\ldots,p, \end{cases} \\
& \quad e^T \lambda \ge 1 \ , \ \lambda \ge 0 \ , \ \lambda_q = 0 \\
& \quad z_i^{1-} , z_i^{2-} , z_k^{1+} , z_k^{1+} \in \{0,1\} \qquad i = 1,2,\ldots,m \ , \ k = 1,\ldots 2, p.
\end{aligned} \tag{3}
$$

$$
\begin{aligned}
&Min \quad \theta \\
&\text{s.t.} \quad \text{if} \quad Q_1 \neq LR, \\
&\quad \begin{cases} X_i^{Q_{11}} \lambda \leq \theta x_{iq}^{Q_{12}} & , i = 1,\ldots,m, \\ Y_k^{Q_{13}} \lambda \geq y_{kq}^{Q_{14}} & , k = 1,\ldots,p, \end{cases} \\
&\quad \text{if} \quad Q_1 = LR, \\
&\quad \begin{cases} X_i^{L} \lambda \leq \theta x_{iq}^{L} & , X_i^{R} \lambda \leq \theta x_{iq}^{R} \quad , \quad i = 1,\ldots,m, \\ Y_k^{L} \lambda \geq y_{kq}^{L} & , \quad Y_k^{R} \lambda \geq y_{kq}^{R} \quad , \quad k = 1,\ldots,p, \end{cases} \\
&\quad \text{if} \quad Q_2 \neq L|R, \\
&\quad \begin{cases} X_i^{Q_{21}} \lambda z_i^{1-} \leq \theta x_{iq}^{Q_{22}} z_i^{1-} & , \quad i = 1,\ldots,m, \\ Y_k^{Q_{23}} \lambda z_k^{1+} \geq y_{kq}^{Q_{24}} z_k^{1+} & , \quad k = 1,\ldots,p, \end{cases} \\
&\quad \text{if} \quad Q_2 = L|R, \\
&\quad \begin{cases} X_i^{L} \lambda z_i^{1-} \leq \theta x_{iq}^{L} z_i^{1-} & , \quad X_i^{R} \lambda z_i^{2-} \leq \theta x_{iq}^{R} z_i^{2-} \quad , \quad i = 1,\ldots,m, \\ Y_k^{L} \lambda z_k^{2+} \geq y_{kq}^{L} z_k^{2+} & , \quad Y_k^{R} \lambda z_k^{1+} \geq y_{kq}^{R} z_k^{1+} \quad , \quad k = 1,\ldots,p, \end{cases} \\
&\quad e^T \lambda \leq 1 \quad , \quad \lambda \geq 0 \quad , \quad \lambda_q = 0 \\
&\quad z_i^{1-} \ , z_i^{2-} \ , z_k^{1+} \ , z_k^{1+} \in \{0,1\} \qquad i = 1,2,\ldots,m \quad , \quad k = 1,2,\ldots p.
\end{aligned}
\tag{4}
$$

The definition:

Models BCC-CCR and CCR-BCC with interval data are classified for to determine the type of Returns To Scale (RTS) (increasing, constant, decreasing) under the above efficiencies as follows;

$$if \ 1 = \theta_{BCC\text{-}CCR} \succ \theta_{CCR\text{-}BCC} \Leftrightarrow \text{Increasing Return To Scale (I.R.S)}$$

$$if \ \theta_{BCC\text{-}CCR} \prec \theta_{CCR\text{-}BCC} = 1 \Leftrightarrow \text{Decreasing Return To Scale (D.R.S)}$$

$$if \ \theta_{BCC\text{-}CCR} = \theta_{CCR\text{-}BCC} \Leftrightarrow \text{Constant Return To Scale (C.R.S)}$$

$$if \ \theta_{BCC\text{-}CCR} \prec 1 \ \& \ \theta_{CCR\text{-}BCC} \prec 1 \Leftrightarrow \text{DMUs are inefficient}$$

We consider models (3) & (4):

We`re divided into 4, models (3) & (4), respectively brace, also, with solve models (3) & (4) is obtained respectively $\theta \ \& \ \theta'$

Step1: If $Q_1 \neq LR$ in models (3) & (4) then solve (3-1) and (4-1).

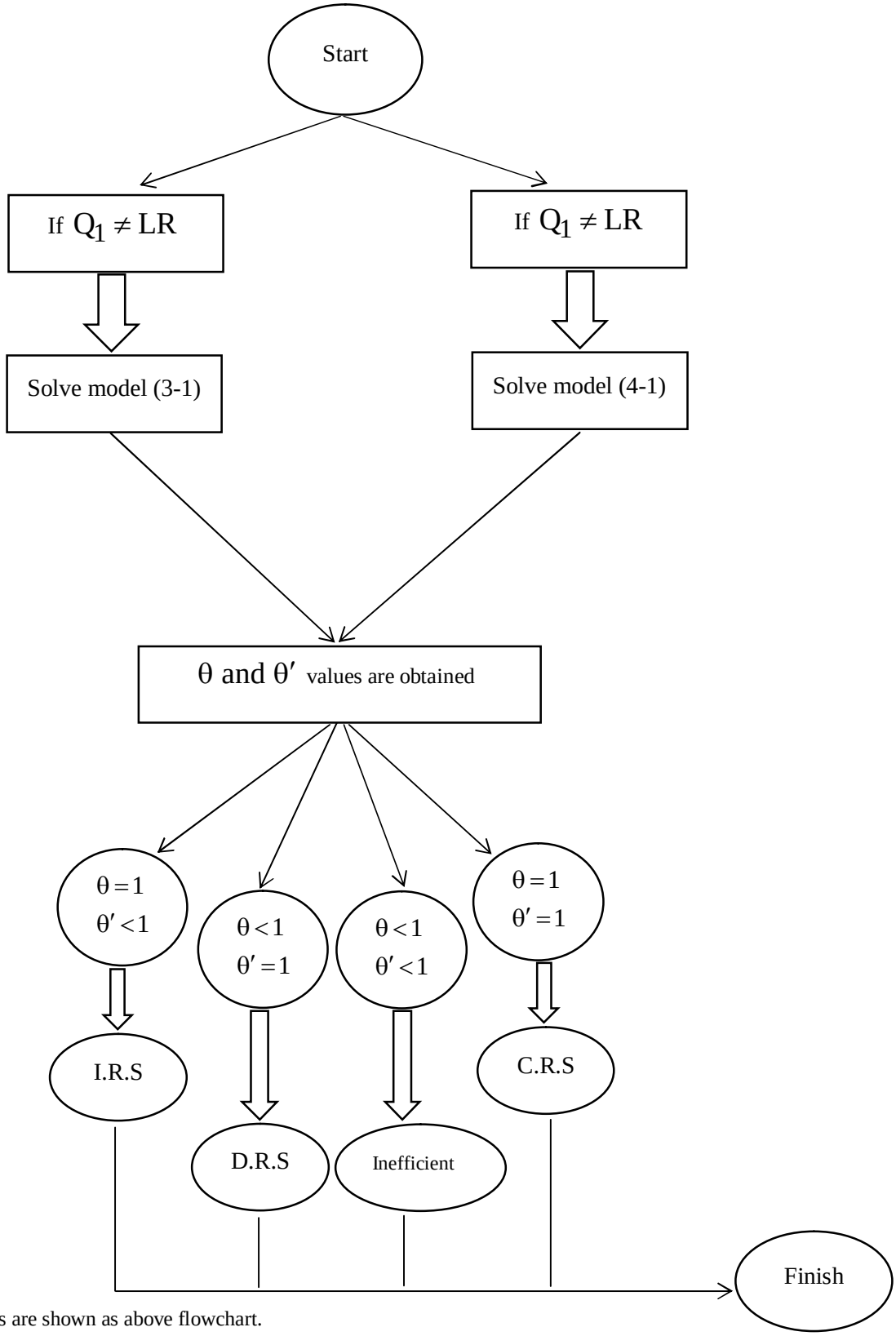
Step2: $\theta \ \& \ \theta'$ values are obtained.

Step2-1: If $\theta = 1$ and $\theta' < 1$ then I.R.S.

Step2-2: If $\theta < 1$ and $\theta' = 1$ then D.R.S.

Step2-3: If $\theta < 1$ and $\theta' < 1$ then DMUs are inefficient.

Step2-4: If $\theta = 1$ and $\theta' = 1$ then C.R.S.



Also, other modes are shown as above flowchart.

4-Ranking decision making units with interval data

The introduction of the following model parameters is like previous models. We say each DMU has a bigger Θ then it has higher rank.

$$Min \quad \theta$$

$$\text{s.t.} \quad \text{if} \quad Q_1 \neq LR,$$

$$\begin{cases} \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j X_{ij}^{Q_{11}} \leq \theta x_{iq}^{Q_{12}} & , i=1,\ldots,m, \\ \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j Y_{kj}^{Q_{13}} \geq y_{kq}^{Q_{14}} & , k=1,\ldots,p, \end{cases}$$

$$\text{if} \quad Q_1 = LR,$$

$$\begin{cases} \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j X_{ij}^{L} \leq \theta x_{iq}^{L} \quad , \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j X_{ij}^{R} \leq \theta x_{iq}^{R} \quad , \quad i=1,\ldots,m, \\ \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j Y_{kj}^{L} \geq y_{kq}^{L} \quad , \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j Y_{kj}^{R} \geq y_{kq}^{R} \quad , \quad k=1,\ldots,p, \end{cases}$$

$$\text{if} \quad Q_2 \neq L|R,$$

$$\begin{cases} \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j X_{ij}^{Q_{21}} z_i^{1-} \leq \theta x_{iq}^{Q_{22}} z_i^{1-} & , \quad i=1,\ldots,m, \\ \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j Y_{kj}^{Q_{23}} \geq y_{kq}^{Q_{24}} z_k^{1+} & , \quad k=1,\ldots,p, \end{cases} \tag{5}$$

$$\text{if} \quad Q_2 = L|R,$$

$$\begin{cases} \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j X_{ij}^{L} z_i^{1-} \leq \theta x_{iq}^{L} z_i^{1-} \quad , \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j X_{ij}^{R} z_i^{2-} \leq \theta x_{iq}^{R} z_i^{2-} \quad , \quad i=1,\ldots,m, \\ \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j Y_{kj}^{L} z_k^{2+} \geq y_{kq}^{L} z_k^{2+} \quad , \sum_{\substack{j=1 \\ j\neq q}}^{n} \lambda_j Y_{kj}^{R} z_k^{1+} \geq y_{kq}^{R} z_k^{1+} \quad , \quad k=1,\ldots,p, \end{cases}$$

$$\lambda \geq 0 \quad , \quad \lambda_q = 0$$

$$z_i^{1-} \, , z_i^{2-} \, , z_k^{1+} \, , z_k^{1+} \in \{0,1\} \qquad i=1,2,\ldots,m \quad , \quad k=1,2,\ldots p.$$

5. Examples of application

We now apply our approach to some bank branches in Iranian 9 months. There are 63 branches in this district that for a range the minimum of the lower bound and the maximum of the upper bound is. Each branch uses3 inputs to produce 5 outputs. Table 1 shows these inputs and outputs.

Table 1. Inputs and Outputs

Inputs	Outputs
Personal points	Facilities
Dividend payments	Four deposits
Outstanding claims	Dividend received
	Fees received
	Other resources

In table 2 inputs lower bounded data and in table 3 outputs lower bounded data for these DMUs are given. Also in table 4 and 5 inputs and outputsupper bounded dataof these DMUs are presented. Eke in table 6 of returns to scale of these DMUs are presented. In table 7 ranking of these DMUs are given.

Table2. Input lower bounded data for the 63 bank branches

	Input1	Input2	Input3	Input4	Input5	Input6
DMU01	24,60	16439679889,00	1075192025,00	26,07	19949611053,50	30666204135,50
DMU02	20,82	3003365402,00	570592158883,00	21,49	73173714113,00	58658216073,50
DMU03	7,63	857377173,00	652861120,00	8,17	3076385690,50	12661614357,00
DMU04	28,85	15785655833,00	5479186719,00	30,53	34213722230,00	3601834274,00
DMU05	39,60	1079854499,00	41381481457,00	40,40	2673309611,50	48311185807,00
DMU06	33,68	1849574330,00	5619666842,00	33,90	7365123125,50	6180914435,00
DMU07	10,21	440406439,00	57922720851,00	21,33	1505379093,50	38696094193,50
DMU08	25,29	77907858445,00	658789429,00	27,01	20644364162,50	3188742044,50
DMU09	14,60	3080347654,00	1463664262,00	15,34	6940115793,50	1604430269,00
DMU10	18,67	1514792987,00	637626183,00	19,63	3315194033,50	1049070235,00
DMU11	19,40	2653701671,00	4651066182,00	19,44	5960675345,00	4929365609,50
DMU12	11,00	692859739,00	6616420023,00	11,91	1711570213,00	6656666463,00
DMU13	16,70	45220370241,00	7003238838,00	18,13	9692144519,50	7194618003,50
DMU14	7,09	443393733,00	10247921620,00	7,19	917915274,00	9052523161,50
DMU15	18,12	13637323918,00	181695875,00	18,48	30362861708,00	7476541194,50
DMU16	10,34	4164536229,00	1762004802,00	10,56	9796768726,50	2048629302,00
DMU17	28,35	1817764413,00	29418150138,00	28,46	4324363800,00	29891720470,50
DMU18	14,70	3350787577,00	2596569137,00	16,54	8744782109,00	2896453091,50
DMU19	22,41	3012242405,00	5117276572,00	22,51	9465849027,00	3262801572,00
DMU20	21,36	2731392820,00	1001504589,00	21,48	6113872522,00	36637166209,50
DMU21	28,28	1613577934,00	44039927669,00	28,92	4534544292,50	54837982676,50
DMU22	49,00	3855755810,00	109332744792,00	51,01	9739459842,00	130167855090,00
DMU23	11,89	6044660027,00	76703467,00	11,94	15069294293,00	123554798,00
DMU24	34,04	2929375443,00	23631149672,00	35,21	6659366527,00	29962342938,00
DMU25	23,77	3019772612,00	5125818240,00	24,14	7485860872,00	6027457244,00
DMU26	15,39	4118634810,00	4211487064,00	15,58	79380996249,00	53490296994,50
DMU27	12,39	4755357177,00	1987717539,00	12,41	10246167885,00	2399597391,00
DMU28	19,88	2315392354,00	6587488034,00	21,24	5229369514,00	32416756110,00
DMU29	23,34	3798278529,00	7009811935,00	23,85	9811257818,00	11480824751,00
DMU30	11,21	3997277998,00	1767077410,00	11,51	9409727412,50	2175585440,50
DMU31	8,76	4043587004,00	8100000,00	9,61	9359357306,00	10702820,00
DMU32	14,27	2406427574,00	7705214515,00	15,86	5677972449,00	7845499935,00
DMU33	11,26	4880470730,00	659620478,00	11,58	14088310021,50	2402826939,50
DMU34	19,71	1840060541,00	549501719,00	21,77	4274646509,50	8392055442,00
DMU35	15,04	10190007172,00	846062645,00	15,15	22090185471,50	3180569904,00
DMU36	15,22	5014658115,00	4221286914,00	16,26	9637586974,00	4857325529,00
DMU37	19,60	2218613481,00	49261349707,00	20,08	5737171565,50	51312980577,00
DMU38	12,24	2073597678,00	833941287,00	12,32	4979144945,00	833961287,00
DMU39	24,02	7895614974,00	89930591619,00	24,46	18339153263,00	100422423059,00
DMU40	18,64	3346073172,00	1923091806,00	19,83	6528678379,00	8697433607,50
DMU41	15,22	4144979597,00	7838804281,00	15,64	10448874734,50	29266245864,50
DMU42	25,70	8589951678,00	4128166068,00	28,45	19627878698,50	10213256701,50
DMU43	9,87	1550182727,00	6497000,00	11,32	3807291748,00	72627335,50
DMU44	11,81	2375630925,00	977120794,00	11,83	5629593352,50	1199769550,00
DMU45	11,09	2268154229,00	1302815803,00	12,93	5677281657,50	1605500627,50
DMU46	13,65	1176506066,00	113660107,00	14,80	3250517443,50	158225107,00
DMU47	20,22	4247337780,00	45720575,00	20,45	2657105295,50	47289975,00
DMU48	22,32	3762811186,00	30226366562,00	22,66	65893061325,50	30264774080,00
DMU49	13,52	507016388,00	1884159729,00	15,45	1601413198,00	2088090441,00
DMU50	15,18	4013160065,00	22616499792,00	15,48	9446291769,00	14148210114,50
DMU51	23,23	2402761536,00	71894567791,00	26,27	6028145777,00	736691355432,00
DMU52	24,75	2705949589,00	2536587480,00	25,05	5986944330,00	2713485458,00
DMU53	26,35	7098533933,00	12704798972,00	27,29	17082293746,50	7867379856,00
DMU54	14,64	3539254346,00	10625060559,00	15,69	8405151197,50	10626779951,50
DMU55	10,80	2228100169,00	593129112,00	11,31	5796474966,50	864283504,50
DMU56	15,71	3027166219,00	62336613,00	16,18	7229203565,00	308749523,00
DMU57	23,32	1059001206,00	29013817453,00	24,45	2488799405,00	31008073427,50
DMU58	18,12	16382123053,00	8931147124,00	19,37	36310514015,00	21453906035,00
DMU59	16,35	1436347902,00	1117715114,00	17,84	3893568157,00	1161631261,50
DMU60	19,82	3309248149,00	5108392613,00	19,92	7794912961,50	6254439480,00
DMU61	18,65	1429547814,00	4635310340,00	19,32	3439722923,00	4856934069,50
DMU62	17,42	1926501547,00	964545057,00	17,99	4636895262,50	1391400489,50
DMU63	13,66	1648980952,00	1569514892,00	13,90	513934447715,00	4471198594,00

Table 3. Output lower bounded data for the 63 bank branches

	Output1	Output2	Output3	Output4	Output5	Output6	Output7	Output8	Output9	Output10
DMU01	262835496869,00	162663193653,00	1711476663,00	372770254,00	4437956681,00	290377927742,00	204312304926,00	9723120945	597269549,00	6000388092,00
DMU02	36245687083,00	351303031308,00	1798197495,00	105289075,00	605997546,00	39566635016	412196164501,00	1798197495,00	349382329,00	748661678,5
DMU03	166456369015,00	202084089596,00	1564260339,00	412481662,00	1077435486,00	185016698610,00	218398287033,00	8068083503	835464983,5	1179233224
DMU04	95012651709,00	474179427226,00	1371828181,00	114029594,00	354317736,00	96455435792	5000165528493,00	3552683680	158250620,00	527570514,5
DMU05	456942026653,00	260493825330,00	938728705,00	371197294,00	1525920256,00	464628334849,00	263553979257,00	6933404367,00	627693171,5	1558485348,00
DMU06	59891779593,00	99568089184,00	1652470829,00	268955984,00	321303633,00	66161072742,00	100096129483,00	4415216021,00	425320824,5	611294253,5
DMU07	470392376136,00	61317387269,00	8826968554,00	403070609,00	1886549146,00	2641248618502,00	76106744992,00	25356903643	1671274174	2321317058,00
DMU08	154813492741,00	244697219323,00	108555979,00	131144872,00	446425586,00	163457870722,00	285028511181,00	2579322858	149857641,5	447563041,00
DMU09	43250654868,00	151021249994,00	877227383,00	238097657,00	1706341205,00	47229778880	159756467576,00	3159970234,00	300127578,00	1744509271,00
DMU10	41320658651,00	116176624457,00	393892223,00	447430299,00	4651092047,00	41373707167	116281956823,00	969112455,5	417986442,00	5019317971
DMU11	124076844928,00	158070300215,00	106230277,00	157000258,00	662266151,00	124737559387,00	123914118012,00	4724976375,00	196117241,00	799704123,00
DMU12	34435138790,00	95619488709,00	222412704,00	142717069,00	1258691492,00	36347550304	116858992910,00	1239941956	193244047,00	1395589876,00
DMU13	66481448881,00	154984956704,00	43543526,00	658499774,00	5118991586,00	67579476342,00	155776101620,00	1529113047	897606701,00	5541465799,00
DMU14	48222861010,00	88231931093,00	94344658,00	63470933,00	488822951,00	4973035293	106250972325,00	400162714,5	103920627,00	587800125,5

DMU15	54041851854,00	342659742183,00	51780822,00	202160078,00	333255600,00	61543428820	360342124333,00	1457593749,00	236519761,5	690505600,00
DMU16	58016010742,00	243477288376,00	116631053,00	52028917,00	65400000,00	62199111972	140925021669,00	1601330959,00	191763530,5	122071500,00
DMU17	91447862004,00	94476632951,00	83694792,00	151070598,00	1513513708,00	96359994423	143972220655,00	2721251116	234788481,00	1521422305
DMU18	95654174476,00	141019094947,00	298878649,00	208311887,00	1473186018,00	102466768843,00	156748958587,00	3297645243	314898982,5	1773057578
DMU19	175319856561,00	193316421502,00	110653144,00	107784741,00	150892157,00	188061901247,00	241048645468,00	2533983415	156225027,5	214463278,5
DMU20	61713860245,00	106462838287,00	489106686,00	36720316,00	251210828,00	90328252110	115238023620,00	1507410149	437152385,5	304760732,00
DMU21	684093310313,00	145889160178,00	3231914137,00	161177923,00	4117820301,00	719557605554,00	1,66599E+11	14191195956	446009418,00	2289584586
DMU22	314380507503,00	211396597388,00	1870188570,00	44899731,00	94900000,00	315620792244,00	255329620163,00	9022386470	178240285,00	351515022,00
DMU23	69698531776,00	196021880999,00	179401506,00	588947969,00	4545498931,00	69716233369	213648059780,00	2329554382	803182193,5	5133749892
DMU24	40338653914,00	171713593785,00	805610215,00	121628925,00	1387990879,00	41222007847,00	197122228861,00	1902216551,00	252379681,5	1565548083,00
DMU25	57838183554,00	122590054592,00	35053334,00	861448334,00	4906492365,00	58854384610	133180592936,00	2010422643,00	1009930249	5815731284
DMU26	39105190687,00	128621246849,00	229748485,00	37272652,00	600879547,00	21321188314,00	135446979190,00	1288076503	80301008,00	1005531266
DMU27	18875959723,00	177487394171,00	49406164,00	145945738,00	386277389,00	20547303043,00	181387099843,00	434073305,00	86269247,5	597890305,00
DMU28	70999022027,00	124668142202,00	3439472416,00	72423145,00	785724924,00	89131664534	62990501573,00	4522895816,00	158994885,5	881742474,00
DMU29	180123866365,00	211277400309,00	866930994,00	1285237082,00	9785196395,00	188912167241,00	232567875977,00	5169819718,00	1773075345	10672851655,00
DMU30	46764393055,00	185200964978,00	3148861140,00	61022481,00	985668834,00	49328124546	190421830107,00	3281795243	131762530,00	1055985243
DMU31	72604301042,00	171139026323,00	89757536,00	1715761956,00	11887047848,00	76999818729	190856649480,00	3333891321	2367384493	17811231110
DMU32	30544577405,00	107432828954,00	53397515,00	246225637,00	1643415889,00	3209690289	112199925456,00	2490274509,00	309965537,5	1655680658
DMU33	22170625841,00	216011647295,00	489570566,00	123022842,00	673097188,00	123421276954,00	225165713717,00	6929923867,00	223031161,00	769908561,00
DMU34	118528963913,00	123019615370,00	95461562,00	103639657,00	552911971,00	120265736088,00	133785232921,00	1117682932	150230260,00	767596278,00
DMU35	30430531758,00	341454742624,00	1141765223,00	389665968,00	6280476641,00	32456758440,00	362807295710,00	708413245,5	1054462867	8892842098,00
DMU36	59112029730,00	226412674111,00	2825474164,00	583595886,00	5058385812,00	76512922690	257888261690,00	3111386420,00	857037148,5	5201818692
DMU37	17363078851,00	173624739976,00	140409944,00	686406470,00	6648743710,00	21389625426	86907705088	883909696,00	1078360868,00	7683309592,00
DMU38	29003506994,00	102079600929,00	59786630,00	184710394,00	5906652478,00	29676473115	102085238045,00	901224229,00	429403865,00	6671006274,00
DMU39	21477328355,00	257590730630,00	6657740996,00	19429290,00	171894190,00	2,41184E+11	260595447436,00	8660603606,00	32676235,5	244943057,00
DMU40	84550030226	163526938328,00	1005794040,00	32819019,00	199177750,00	84550030226	175720347878,00	3865637061	55865542,5	284244950,00
DMU41	180001746968,00	177298225506,00	1341269163,00	273294797,00	373024272,00	182188419612,00	190017782755,00	11731285197	1037068972,00	5829351067
DMU42	69055544067,00	365717640562,00	797296507,00	123374182,00	1170188064,00	93517988781	411845230419,00	2582128916,00	237268703,5	1997785491
DMU43	73354970586,00	159053020605,00	690082265,00	3708577726,00	32739239356,00	74607110859,00	171066690956,00	2203364564,00	5410165412,00	35061388478,00
DMU44	8813326349,00	127808864295,00	185738528,00	42889873,00	218377936,00	9750765773	128332414311,00	555763434,5	60363850,5	220636388,00
DMU45	32761012870,00	122426625814,00	33886892,00	1442668226,00	9565947456,00	32960832329,00	130992172319,00	1536511163	1751953802	9946566424,00
DMU46	109623670583,00	90165292473,00	341082816,00	148064189,00	3385982800,00	114300814156,00	90984689026,50	2340310738,00	548159231,00	3434770238
DMU47	86214504329,00	162665309419,00	225789500,00	105603480,00	1138403100,00	88677863702,50	91508326248	2529040512,00	183512106,5	9290257475,00
DMU48	114140132033,00	207865353199,00	989375641,00	1065083104,00	11519843193,00	121685523841,00	237626599071,00	5397166937	2503277826	16774146956,00
DMU49	50268876504,00	59732101506,00	298776054,00	33117786,00	253671094,00	27695942033,00	71463838286	3191308930,00	59526902,00	289283816,5
DMU50	27038599671,00	141722478764,00	76215617,00	154055276,00	1611121713,00	27455404830,00	145551348222,00	556243560,00	207553229,00	1686054816,00
DMU51	119944756433,00	117349241628,00	503249248,00	343893424,00	6215246210,00	122245918134,00	117821861568,00	37089637705,00	792596868,5	6401487632,00
DMU52	20692169064,00	110212554772,00	258652448,00	136084081,00	1526067213,00	61983734419,00	112662127427,00	1147820230,00	215124492,00	1551017031
DMU53	243321673991,00	230312832038,00	2128192362,00	57084996,00	160889432,00	271426915208,00	230844077820,00	14236398459,00	68151781,00	231682058,5
DMU54	16661898604,00	127006805603,00	125044226,00	135711047,00	84974500,00	17640142997,00	128828194080,00	420408638,00	147636347,00	111485750,00
DMU55	14567444719,00	115086158604,00	156338664,00	50221761,00	538966000,00	17581997583,00	131560358181,00	423293763,5	73099008,00	601217532,00
DMU56	45522741172,00	101347789134,00	5700000,00	33075741,00	22534000,00	46734336574,50	106468051695,00	1375579496,00	42658616,00	35034000,00
DMU57	87258659447,00	132002961103,00	154303138332,00	2637719879,00	300660833,00	2627988376,00	88043896581,00	143153049717,00	5170883010	2879665250,00
DMU58	51130953531,00	329022759004,00	1099198222,00	31341752,00	92556187,00	47160276794,50	365550321267,00	2609142185,00	44969461,5	113737787,00
DMU59	32232028684,00	92610778902,00	47970480,00	62022860,00	33828000,00	322240852963,00	117682927703,00	747712549,00	81988133,5	33828000,00
DMU60	65858515953,00	157058007225,00	116438857,00	44558930,00	118234300,00	71673310821,50	164563392964,00	1316587391,00	69115015,00	153083964,5
DMU61	36162674392,00	93321251290,00	148906957,00	46300590,00	40624636,00	36780367357,50	102535670648,00	1119323203,00	69902886,5	124424325,00
DMU62	49259700134,00	100111373644,00	102687063906,00	363780467,00	121306602,00	835010330,00	49549850994,00	101399218775,00	1445625559,00	854060655,5
DMU63	113027863796,00	85649252290,00	343642911,00	228314247,00	2556924375,00	116343846467,00	108825226711,00	3958980222,00	394389368,00	2875855375,00

Table 4. Input upper bounded data for the 63 bank branches

	Input1	Input2	Input3	Input4	Input5	Input6
DMU01	27,53	23459542218,00	60257216246,00	26,065	19949611054	30666204136
DMU02	22,16	11631377424,00	60257216264,00	21,49	73173714113,00	58658216074
DMU03	8,7	5295394208,00	25257942594,00	8,165	3076385691	12661614357,00
DMU04	32,2	52641788627,00	17264481829,00	30,525	34213722230,00	3601834274,00
DMU05	41,19	4266764724,00	55240890157,00	40,395	2673309612	48311185807,00
DMU06	34,12	6880671921,00	6742162028,00	33,9	7365123126	6180914435,00
DMU07	21,56	2570351748,00	194694967536,00	21,33	1505379094	38696094194
DMU08	28,72	334979424480,00	5558694660,00	27,005	20644364163	3188742045
DMU09	16,08	10799883933,00	1745196276,00	15,34	6940115794	1604430269,00
DMU10	20,59	5115595080,00	1460514287,00	19,63	3315194034	1049070235,00
DMU11	19,48	9267649019,00	5207665037,00	19,44	5960675345,00	4929365610
DMU12	12,81	2730280687,00	6696912903,00	11,905	1711570213,00	6656666463,00
DMU13	19,55	14863918798,00	7385997169,00	18,125	9692144520	7194618004
DMU14	7,28	1392436815,00	7857124703,00	7,185	917915274,00	9052523162
DMU15	18,84	47088399498,00	14771386514,00	18,48	30362861708,00	7476541195
DMU16	10,77	15429001224,00	2335253802,00	10,555	9796768727	2048629302,00
DMU17	28,57	6830963187,00	30365290803,00	28,46	4324363800,00	29891720471
DMU18	18,38	14138776641,00	3196337046,00	16,54	8744782109,00	2896453092
DMU19	22,6	15919455649,00	6008326572,00	22,505	9465849027,00	3262801572,00
DMU20	21,6	9496352224,00	72272827830,00	21,48	6113872522,00	36637166210
DMU21	29,56	7455510651,00	65636037684,00	28,92	4534544293	54837982677
DMU22	53,01	15623163874,00	151002965388,00	51,005	9739459842,00	130167855090,00
DMU23	11,98	24093928559,00	170406129,00	11,935	15069294293,00	123554798,00
DMU24	36,37	10689357611,00	36293536204,00	35,205	6659366527,00	29962342938,00
DMU25	24,51	11951949132,00	6929096248,00	24,14	7485860872,00	6027457244,00
DMU26	15,77	154643357688,00	6486572325,00	15,58	79380996249,00	5349029695
DMU27	12,43	15736978593,00	2811477243,00	12,41	10246167885,00	2399597391,00
DMU28	22,59	8143346683,00	58246024186,00	21,235	5229369514,00	32416756110,00
DMU29	24,36	15824237107,00	15951837567,00	23,85	9811257818,00	11480824751,00
DMU30	11,86	14822176827,00	2584093471,00	11,51	9409727413	2175585441
DMU31	10,46	14675127608,00	13305640,00	9,61	9359357306,00	10702820,00
DMU32	17,45	8949517324,00	7985785355,00	15,86	5677972449,00	7845499935,00
DMU33	11,9	23296149313,00	4146033401,00	11,58	14088310022	2402826940
DMU34	23,82	6709232478,00	11234609165,00	21,765	4274646510	8392055442,00
DMU35	15,26	33990363771,00	5515077163,00	15,15	22090185472	3180569904,00
DMU36	17,29	14260515833,00	5493364144,00	16,255	9637586974,00	4857325529,00
DMU37	20,56	9255729650,00	53364611447,00	20,08	573717565,5	51312980577,00
DMU38	12,4	7884692212,00	833981287,00	12,32	4979144945,00	833961287,00
DMU39	24,9	28902691552,00	110914254499,00	24,46	18339153263,00	100422423059,00
DMU40	21,01	12723283586,00	15471775409,00	19,825	6528678379,00	8697433608
DMU41	16,05	16752769872,00	50693687448,00	15,635	10448874735	29266245865
DMU42	31,2	30665805719,00	162983473335,00	28,45	19627878699	10213256702
DMU43	12,76	6064400769,00	80307671,00	11,315	3807291748,00	72627335,5
DMU44	11,85	8883555780,00	1422418306,00	11,83	5629593353	1199769550,00
DMU45	14,77	9086409086,00	1908185452,00	12,93	5677281658	1605500628
DMU46	15,94	5324528821,00	202790107,00	14,795	3250517444	158225107,00
DMU47	20,67	1066872811,00	48859375,00	20,445	2657105296	47289975,00
DMU48	22,99	128023311465,00	30303181614,00	22,655	65893061326	30264774080,00
DMU49	17,37	2695810008,00	2292021153,00	15,445	1601413198,00	2088090441,00
DMU50	15,77	14879423473,00	26034720437,00	15,475	9446291769,00	14148210115
DMU51	29,31	9653530018,00	75443703073,00	26,27	6028145777,00	736691355432,00
DMU52	25,34	9267939071,00	2890383436,00	25,045	5986944330,00	2713485458,00
DMU53	28,22	27066053560,00	3029960740,00	27,285	17082293747	7867379856,00
DMU54	16,74	13271048049,00	10628499344,00	15,69	8405151198	10626779952
DMU55	11,82	9364849764,00	1135437897,00	11,31	5796474967	864283504,5
DMU56	16,64	1143124911,00	555162433,00	16,175	7229203565,00	308749523,00
DMU57	25,57	391859764,00	33002329402,00	24,445	2488799405,00	31008073428
DMU58	20,61	56238904977,00	33976664946,00	19,635	36310514015,00	21453906035,00
DMU59	19,33	6350788412,00	1205547409,00	17,84	3893568157,00	1161631262
DMU60	20,02	12280577774,00	7400486347,00	19,92	7794912962	6254439480,00
DMU61	19,99	5449898032,00	5078557799,00	19,32	3439722923,00	4856934070
DMU62	18,55	7347288978,00	1818255922,00	17,985	4636895263	1391400490
DMU63	14,13	6980727039,00	7372882296,00	13,895	51393444715,00	4471198594,00

Table 5. Output upper bounded data for the 63 bank branches

	Output1	Output2	Output3	Output4	Output5	Output6	Output7	Output8	Output9	Output10
DMU01	317920358075,00	245961416200,00	17734765226,00	821768844,00	7562819503,00	290377927742,00	204312304926,00	9723120945	597269549,00	6000388092,00
DMU02	42887582948,00	473089297695,00	1798197495,00	593475583,00	891325811,00	39566635016	412196164501,00	1798197495,00	349382329,00	748661678,5
DMU03	203577028206,00	234712484471,00	14571906666,00	1258448305,00	1281030961,00	185016698610,00	218398287033,00	8068083503	835464983,5	1179233224
DMU04	97898219874,00	526151629740,00	5733539178,00	202471846,00	700823293,00	96455435792	5000165528493,00	3552683680	158250720,00	527570514,5
DMU05	47231464304,00	266614133185,00	12928080029,00	884189049,00	1591050440,00	464628334849,00	263553979257,00	6933404367,00	627693171,5	1558485348,00
DMU06	72430365891,00	100624169782,00	7177961213,00	581685665,00	901284874,00	66161072742,00	100096129483,00	4415216021,00	425320824,5	611294253,5
DMU07	578573475738,00	90896102715,00	41886838731,00	2939477738,00	2756084970,00	2641248618502,00	76106744992,00	25356903643	1671274174	2321317058,00
DMU08	17202248704,00	325359803040,00	5050089736,00	168570411,00	448700496,00	163457870722,00	285028511181,00	25793222858	149857641,5	447563041,00
DMU09	51208902891,00	168491685158,00	5442713085,00	362157499,00	1782677337,00	47229778880	159756467576,00	3159970234,00	300127578,00	1744509271,00
DMU10	41426755682,00	116387289189,00	1544332688,00	982542585,00	5387543894,00	41373707167	116281956823,00	969112455,5	417986442,00	5019317971
DMU11	125398273846,00	247757935809,00	9343722473,00	235234224,00	937142095,00	124737559387,00	123914118012,00	4724976375,00	196117241,00	799704123,00
DMU12	382599611817,00	138098497112,00	2257471287,00	243771025,00	1532488260,00	36347550304	116858992910,00	1239941956	193244047,00	1395589876,00
DMU13	68677503803,00	156567246537,00	3014682567,00	1136713628,00	5963940012,00	67579476342,00	155776101620,00	1529113047	897606701,00	5541465799,00
DMU14	51237844835,00	124270013557,00	705980771,00	144370321,00	686777300,00	49730352923	106250972325,00	400162714,5	103920627,00	587800125,5
DMU15	69045005785,00	37802450648,00	2863406676,00	270879445,00	1047755600,00	61543428820	360342124333,00	1457593749,00	236519761,5	690505600,00
DMU16	66382213201,00	383727549263,00	3086030865,00	3314498144,00	178743000,00	62199111972	140925021669,00	1601330959,00	191763530,5	1221330959,00
DMU17	101272126841,00	96733904180,00	535880439,00	318506364,00	1529330901,00	96359994423	14397220655,00	2721251116	234788481,00	1521422305
DMU18	109279363210,00	172478822228,00	6296418361,00	421486078,00	2072929137,00	102466768843,00	156748958587,00	3297645243	314898982,5	1773057578
DMU19	200803945934,00	288780869434,00	4957313685,00	204665314,00	278034400,00	188061901247,00	241048645468,00	2533983415	156225027,5	214463278,5
DMU20	118942643974,00	124013208954,00	2525713611,00	83758455,00	358310636,00	90328252110	115238023620,00	1507410149	437152385,5	304760732,00
DMU21	755021902795,00	187308357227,00	25150477774,00	730840913,00	4613488701,00	719557605554,00	1,66599E+11	14191195956	446009418,00	2289584586
DMU22	316861076986,00	299262642938,00	16174584369,00	311580839,00	608130044,00	315620792244,00	255329620163,00	9022386470	178240285,00	351515022,00
DMU23	69733934961,00	231274238562,00	4479707257,00	1017416418,00	5722000852,00	69716233369	213648059780,00	2329554382	803182193,5	5133749892
DMU24	42105361780,00	222530863937,00	299882287,00	383130438,00	1743105287,00	41222007847,00	197122228861,00	1902216551,00	252379681,5	1565548083,00
DMU25	59870585665,00	143771131281,00	3985791952,00	1158412163,00	6724970202,00	58854384610	133180592936,00	2010422643,00	1009930249	5815731284
DMU26	42637185941,00	142272711532,00	2346404520,00	123329364,00	1410182984,00	21321188314,00	135446979190,00	1288076503	80301008,00	1005531266
DMU27	222186463363,00	185286805516,00	818740446,00	26592757,00	809503221,00	20547303043,00	181387099843,00	434073305,00	86269247,5	597890305,00
DMU28	107264307040,00	131286094472,00	5606319216,00	245566626,00	977760024,00	89131664534	62990501573,00	4522895816,00	158994885,5	881742474,00
DMU29	197700468117,00	253858351645,00	9472708442,00	2260913607,00	11560506915,00	188912167241,00	232567875977,00	5169819718,00	1773075345	10672851655,00
DMU30	51891856036,00	195642659236,00	3414729345,00	202502579,00	1126301651,00	49328124546	190421830107,00	3281795243	131762530,00	1055985243
DMU31	81395336415,00	210574272638,00	5770725105,00	3019007029,00	23735414371,00	76999818729	190856649480,00	3333891321	2367384493	17811231110
DMU32	33649228360,00	116967021959,00	4927151503,00	373705438,00	166794542,00	32096902883	112199925456,00	2490274509,00	309965537,5	1655680658
DMU33	224671928067,00	234319780140,00	13370277168,00	323039480,00	866719934,00	123421276954,00	225165713717,00	6929923867,00	223031161,00	769908561,00
DMU34	122002508264,00	144550850472,00	2139904301,00	196820863,00	982280585,00	120265736088,00	133785232921,00	1117682932	150230260,00	767596278,00
DMU35	34482985122,00	384159848796,00	2750611268,00	1719259765,00	11505207555,00	32456758440,00	362807295710,00	708413245,5	1054462867	8892842098,00
DMU36	93913815649,00	289363849269,00	3397298676,00	1130478411,00	5345251571,00	76512922690	257888261690,00	3111386420,00	85737148,5	5201818692
DMU37	25416172000,00	190167670199,00	1627409448,00	1470315266,00	8717875474,00	21389625426	86907705088	883909696,00	1078360868,00	7683309592,00
DMU38	30349439235,00	102090875161,00	1742661828,00	674097336,00	7435360070,00	29676473115	102085238045,00	901224229,00	429403865,00	6671006274,00
DMU39	241190569346,00	263600164242,00	10663466216,00	51923181,00	317991924,00	24193948851	260595447436,00	8660603606,00	32676235,5	244943057,00
DMU40	88534009833,00	187913757428,00	6725480081,00	78912066,00	369312150,00	84550030226	175720347878,00	3865637061	55865542,5	284244950,00

DMU41	88534009833,00	187913757428,00	6725480081,00	78912066,00	369312150,00	84550030226	175720347878,00	3865637061	55865542,5	284244950,00
DMU42	184375092256,00	202737340004,00	22121301230,00	1800843047,00	11285677861,00	182188419612,00	190017782755,00	11731285197	1037068972,00	5829351067
DMU43	117980433494,00	457972820277,00	4366961325,00	351163225,00	2825382917,00	93517988781	411845230419,00	2582128916,00	237268703,5	1997785491
DMU44	75859251132,00	183080361308,00	3716646863,00	7111753098,00	37383537600,00	74607110859,00	171066690956,00	2203364564,00	5410165412,00	35061388478,00
DMU45	10688205196,00	128855964328,00	925788341,00	77837828,00	222894840,00	9750765773	128332414311,00	555763434,5	60363850,5	220636388,00
DMU46	33160651788,00	139557718824,00	3039135433,00	2061239377,00	10327185392,00	32960832329,00	130992172319,00	1536511163	1751953802	9946566424,00
DMU47	11897795729,00	91804085580,00	4339538660,00	948254273,00	3483557675,00	11430081456,00	90984689027	2340310738,00	548159231,00	3434770238
DMU48	91141223076,00	203051343076,00	48322915224,00	261420733,00	17442111850,00	88677863703	91508326248	2529040512,00	183512106,5	9290257475,00
DMU49	129230915649,00	267387844944,00	9804958232,00	3941472547,00	22028450719,00	121685523841,00	237626599071,00	5397166937	2503277826	16774146956,00
DMU50	54889195301,00	83195575065,00	6083841806,00	85936018,00	324896539,00	27695942033,00	71463838286	3191308930,00	59526902,00	289283816,5
DMU51	27872209989,00	149380217681,00	1036271503,00	261051182,00	1760987919,00	27455404830,00	145551348222,00	556243560,00	207553229,00	1686054816,00
DMU52	124547079835,00	118294481509,00	6914678293,00	1241300313,00	6587729054,00	122245918134,00	117821861568,00	37089637705,00	792596868,5	6401487632,00
DMU53	103275299774,00	115111700082,00	2036988012,00	294164903,00	1575966848,00	61983734419,00	112662127427,00	1147820230,00	215124492,00	1551017031
DMU54	299532156425,00	231375323603,00	26344604556,00	79218566,00	302474685,00	271426915208,00	230844077820,00	14236398459,00	68151781,00	231682058,5
DMU55	18618387390,00	130649582558,00	715773050,00	213561647,00	137997000,00	17640142997,00	128828194080,00	420408638,00	147636347,00	111485750,00
DMU56	20596550447,00	148034557759,00	690248863,00	95976255,00	663469064,00	17581997583,00	131560358181,00	423293763,5	73099008,00	601217532,00
DMU57	47945931977,00	111588314257,00	2745458992,00	52241491,00	47534000,00	46734336575	106468051695,00	1375579496,00	42658616,00	35034000,00
DMU58	88829133715,00	154303138332,00	7704046140,00	525627178,00	3131342124,00	88043896581,00	143153049717,00	5170883010	413144005,5	2879665250,00
DMU59	97189600058,00	402077883530,00	4119086148,00	58597171,00	134919387,00	47160276795	365550321267,00	2609142185,00	44969461,5	113737787,00
DMU60	32249677242,00	142755076504,00	1447454618,00	101953407,00	33828000,00	32240852963,00	117682927703,00	747712549,00	81988133,5	33828000,00
DMU61	77488105690,00	172068778703,00	2516735925,00	93671100,00	187933629,00	71673310822	164563392964,00	1316587391,00	69115015,00	153083964,5
DMU62	37398060323,00	111750090006,00	2089739449,00	93505183,00	208224014,00	36780367358	102535670648,00	11193232203,00	69902886,5	124424325,00
DMU63	49840001854,00	102687063906,00	2527470651,00	275179206,00	873110981,00	49549850994,00	101399218775,00	1445625559,00	198242904,00	854060655,5

Table6. Returns to scale of these DMUs

DMUs			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S		DMUs			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU01	Pi	N	<1	<1	inefficient		DMU04	Pi	N	1	1	C.R.S
DMU01	N	Pi	1	1	C.R.S		DMU04	N	Pi	1	1	C.R.S
DMU01	L	L	<1	1	D.R.S		DMU04	L	L	1	1	C.R.S
DMU01	R	R	<1	<1	inefficient		DMU04	R	R	1	1	C.R.S
DMU01	LR	L|R	<1	1	D.R.S		DMU04	LR	L|R	1	1	C.R.S
DMU02	Pi	N	<1	<1	inefficient		DMU05	Pi	N	1	1	C.R.S
DMU02	N	Pi	1	1	C.R.S		DMU05	N	Pi	1	1	C.R.S
DMU02	L	L	<1	1	D.R.S		DMU05	L	L	<1	<1	inefficient
DMU02	R	R	<1	1	D.R.S		DMU05	R	R	1	1	C.R.S
DMU02	LR	L|R	<1	1	D.R.S		DMU05	LR	L|R	1	1	C.R.S
DMU03	Pi	N	1	1	C.R.S		DMU06	Pi	N	<1	<1	inefficient
DMU03	N	Pi	1	1	C.R.S		DMU06	N	Pi	<1	<1	inefficient
DMU03	L	L	1	1	C.R.S		DMU06	L	L	<1	<1	inefficient
DMU03	R	R	1	1	C.R.S		DMU06	R	R	<1	<1	inefficient
DMU03	LR	L|R	1	1	C.R.S		DMU06	LR	L|R	<1	<1	inefficient

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU07	Pi	N	1	1	C.R.S
DMU07	N	Pi	1	1	C.R.S
DMU07	L	L	1	1	C.R.S
DMU07	R	R	1	1	C.R.S
DMU07	LR	L|R	1	1	C.R.S
DMU08	Pi	N	<1	<1	inefficient
DMU08	N	Pi	1	1	C.R.S
DMU08	L	L	1	1	C.R.S
DMU08	R	R	<1	<1	inefficient
DMU08	LR	L|R	1	1	C.R.S
DMU09	Pi	N	<1	<1	inefficient
DMU09	N	Pi	1	1	C.R.S
DMU09	L	L	<1	<1	inefficient
DMU09	R	R	<1	<1	inefficient
DMU09	LR	L|R	<1	<1	inefficient
DMU10	Pi	N	<1	<1	inefficient
DMU10	N	Pi	1	1	C.R.S
DMU10	L	L	<1	<1	inefficient
DMU10	R	R	<1	<1	inefficient
DMU10	LR	L|R	<1	<1	inefficient
DMU11	Pi	N	<1	<1	inefficient
DMU11	N	Pi	1	1	C.R.S
DMU11	L	L	<1	<1	inefficient
DMU11	R	R	<1	<1	inefficient
DMU11	LR	L|R	<1	1	D.R.S
DMU12	Pi	N	<1	<1	inefficient
DMU12	N	Pi	1	1	C.R.S
DMU12	L	L	1	1	C.R.S
DMU12	R	R	<1	<1	inefficient
DMU12	LR	L|R	1	1	C.R.S
DMU13	Pi	N	<1	<1	inefficient
DMU13	N	Pi	<1	<1	inefficient
DMU13	L	L	<1	<1	inefficient
DMU13	R	R	<1	<1	inefficient
DMU13	LR	L|R	<1	<1	inefficient
DMU14	Pi	N	1	1	C.R.S
DMU14	N	Pi	1	1	C.R.S
DMU14	L	L	1	1	C.R.S
DMU14	R	R	1	1	C.R.S
DMU14	LR	L|R	1	1	C.R.S

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU15	Pi	N	<1	<1	inefficient
DMU15	N	Pi	1	1	C.R.S
DMU15	L	L	<1	1	D.R.S
DMU15	R	R	<1	<1	inefficient
DMU15	LR	L|R	1	1	C.R.S
DMU16	Pi	N	1	1	C.R.S
DMU16	N	Pi	1	1	C.R.S
DMU16	L	L	1	1	C.R.S
DMU16	R	R	1	1	C.R.S
DMU16	LR	L|R	1	1	C.R.S
DMU17	Pi	N	<1	<1	inefficient
DMU17	N	Pi	<1	<1	inefficient
DMU17	L	L	<1	<1	inefficient
DMU17	R	R	<1	<1	inefficient
DMU17	LR	L|R	<1	<1	inefficient
DMU18	Pi	N	<1	<1	inefficient
DMU18	N	Pi	1	1	C.R.S
DMU18	L	L	<1	<1	inefficient
DMU18	R	R	<1	<1	inefficient
DMU18	LR	L|R	<1	<1	inefficient
DMU19	Pi	N	<1	<1	inefficient
DMU19	N	Pi	1	1	C.R.S
DMU19	L	L	<1	1	D.R.S
DMU19	R	R	<1	1	D.R.S
DMU19	LR	L|R	1	1	C.R.S
DMU20	Pi	N	<1	<1	inefficient
DMU20	N	Pi	1	1	C.R.S
DMU20	L	L	<1	<1	inefficient
DMU20	R	R	<1	<1	inefficient
DMU20	LR	L|R	<1	<1	inefficient
DMU21	N	Pi	<1	1	D.R.S
DMU21	L	L	1	1	C.R.S
DMU21	R	R	<1	1	D.R.S
DMU21	LR	L|R	1	1	C.R.S
DMU21	Pi	N	1	1	C.R.S
DMU22	N	Pi	<1	<1	inefficient
DMU22	L	L	<1	1	D.R.S
DMU22	R	R	<1	<1	inefficient
DMU22	LR	L|R	<1	<1	inefficient
DMU22	Pi	N	<1	1	D.R.S

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU23	Pi	N	1	<1	I.R.S
DMU23	N	Pi	1	1	C.R.S
DMU23	L	L	<1	1	D.R.S
DMU23	R	R	<1	1	D.R.S
DMU23	LR	L|R	<1	1	D.R.S
DMU24	Pi	N	<1	<1	inefficient
DMU24	N	Pi	<1	1	D.R.S
DMU24	L	L	<1	<1	inefficient
DMU24	R	R	<1	<1	inefficient
DMU24	LR	L|R	<1	<1	inefficient
DMU25	Pi	N	<1	<1	inefficient
DMU25	N	Pi	<1	<1	inefficient
DMU25	L	L	<1	<1	inefficient
DMU25	R	R	<1	<1	inefficient
DMU25	LR	L|R	<1	<1	inefficient
DMU26	Pi	N	<1	<1	inefficient
DMU26	N	Pi	<1	<1	inefficient
DMU26	L	L	<1	<1	inefficient
DMU26	R	R	<1	<1	inefficient
DMU26	LR	L|R	<1	<1	inefficient
DMU27	Pi	N	<1	<1	inefficient
DMU27	N	Pi	1	1	C.R.S
DMU27	L	L	1	1	C.R.S
DMU27	R	R	<1	<1	inefficient
DMU27	LR	L|R	1	1	C.R.S
DMU28	Pi	N	<1	<1	inefficient
DMU28	N	Pi	<1	<1	inefficient
DMU28	L	L	<1	<1	inefficient
DMU28	R	R	<1	<1	inefficient
DMU28	LR	L|R	<1	<1	inefficient
DMU29	Pi	N	<1	<1	inefficient
DMU29	N	Pi	1	1	C.R.S
DMU29	L	L	<1	<1	inefficient
DMU29	R	R	<1	<1	inefficient
DMU29	LR	L|R	<1	<1	inefficient
DMU30	Pi	N	<1	<1	inefficient
DMU30	N	Pi	1	1	C.R.S
DMU30	L	L	<1	<1	inefficient
DMU30	R	R	<1	<1	inefficient
DMU30	LR	L|R	<1	<1	inefficient

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU31	Pi	N	<1	1	D.R.S
DMU31	N	Pi	1	1	C.R.S
DMU31	L	L	1	1	C.R.S
DMU31	R	R	1	1	C.R.S
DMU31	LR	L|R	1	1	C.R.S
DMU32	Pi	N	<1	<1	inefficient
DMU32	N	Pi	<1	<1	inefficient
DMU32	L	L	<1	<1	inefficient
DMU32	R	R	<1	<1	inefficient
DMU32	LR	L|R	<1	<1	inefficient
DMU33	Pi	N	1	<1	R.T.S
DMU33	N	Pi	1	1	C.R.S
DMU33	L	L	1	1	C.R.S
DMU33	R	R	1	1	C.R.S
DMU33	LR	L|R	1	1	C.R.S
DMU34	Pi	N	<1	<1	inefficient
DMU34	N	Pi	1	1	C.R.S
DMU34	L	L	<1	<1	inefficient
DMU34	R	R	<1	<1	inefficient
DMU34	LR	L|R	<1	<1	inefficient
DMU35	Pi	N	<1	<1	inefficient
DMU35	N	Pi	1	1	C.R.S
DMU35	L	L	<1	1	D.R.S
DMU35	R	R	1	1	C.R.S
DMU35	LR	L|R	1	1	C.R.S
DMU36	Pi	N	<1	<1	inefficient
DMU36	N	Pi	1	1	C.R.S
DMu36	L	L	<1	<1	inefficient
DMU36	R	R	<1	<1	inefficient
DMU36	LR	L|R	<1	<1	inefficient
DMU37	Pi	N	1	1	C.R.S
DMU37	N	Pi	1	1	C.R.S
DMU37	L	L	<1	<1	inefficient
DMU37	R	R	1	1	C.R.S
DMU37	LR	L|R	1	1	C.R.S
DMU38	Pi	N	<1	<1	inefficient
DMU38	N	Pi	1	<1	I.R.S
DMU38	L	L	<1	<1	inefficient
DMU38	R	R	<1	<1	inefficient
DMU38	LR	L|R	<1	<1	inefficient

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU39	Pi	N	<1	<1	inefficient
DMU39	N	Pi	<1	1	D.R.S
DMU39	L	L	<1	<1	inefficient
DMU39	R	R	<1	<1	inefficient
DMU39	LR	L|R	<1	<1	inefficient
DMU40	Pi	N	<1	<1	inefficient
DMU40	N	Pi	1	1	C.R.S
DMU40	L	L	<1	<1	inefficient
DMU40	R	R	<1	<1	inefficient
DMU40	LR	L|R	<1	<1	inefficient
DMU41	Pi	N	<1	<1	inefficient
DMU41	N	Pi	1	1	C.R.S
DMU41	L	L	<1	1	D.R.S
DMU41	R	R	<1	<1	inefficient
DMU41	LR	L|R	<1	1	D.R.S
DMU42	Pi	N	<1	<1	inefficient
DMU42	N	Pi	1	1	C.R.S
DMU42	L	L	<1	1	D.R.S
DMU42	R	R	<1	1	D.R.S
DMU42	LR	L|R	<1	1	D.R.S
DMU43	Pi	N	1	1	C.R.S
DMU43	N	Pi	1	1	C.R.S
DMU43	L	L	1	1	C.R.S
DMU43	R	R	1	1	C.R.S
DMU43	LR	L|R	1	1	C.R.S
DMU44	Pi	N	<1	<1	inefficient
DMU44	N	Pi	1	1	C.R.S
DMU44	L	L	<1	<1	inefficient
DMU44	R	R	<1	<1	inefficient
DMU44	LR	L|R	<1	<1	inefficient
DMU45	Pi	N	<1	<1	inefficient
DMU45	N	Pi	1	1	C.R.S
DMU45	L	L	<1	<1	inefficient
DMU45	R	R	<1	<1	inefficient
DMU45	LR	L|R	<1	<1	inefficient

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU46	Pi	N	1	1	C.R.S
DMU46	N	Pi	1	1	C.R.S
DMU46	L	L	1	1	C.R.S
DMU46	R	R	1	1	C.R.S
DMU46	LR	L|R	1	1	C.R.S
DMU47	Pi	N	1	1	C.R.S
DMU47	N	Pi	1	1	C.R.S
DMU47	L	L	1	1	C.R.S
DMU47	R	R	1	1	C.R.S
DMU47	LR	L|R	1	1	C.R.S
DMU48	Pi	N	<1	<1	inefficient
DMU48	N	Pi	1	1	C.R.S
DMU48	L	L	<1	1	D.R.S
DMU48	R	R	<1	<1	inefficient
DMU48	LR	L|R	<1	1	D.R.S
DMU49	Pi	N	1	<1	I.R.S
DMU49	N	Pi	1	1	C.R.S
DMU49	L	L	1	1	C.R.S
DMU49	R	R	1	<1	I.R.S
DMU49	LR	L|R	1	1	C.R.S
DMU50	Pi	N	<1	<1	inefficient
DMU50	N	Pi	<1	<1	inefficient
DMU50	L	L	<1	<1	inefficient
DMU50	R	R	<1	<1	inefficient
DMU50	LR	L|R	<1	<1	inefficient
DMU51	Pi	N	1	1	C.R.S
DMU51	N	Pi	<1	1	D.R.S
DMU51	L	L	1	1	C.R.S
DMU51	R	R	<1	<1	inefficient
DMU51	LR	L|R	1	1	C.R.S
DMU52	Pi	N	<1	<1	inefficient
DMU52	N	Pi	<1	1	D.R.S
DMU52	L	L	<1	<1	inefficient
DMU52	R	R	<1	<1	inefficient
DMU52	LR	L|R	<1	<1	inefficient

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU53	Pi	N	<1	1	D.R.S
DMU53	N	Pi	1	1	C.R.S
DMU53	L	L	<1	1	D.R.S
DMU53	R	R	1	1	C.R.S
DMU53	LR	L|R	1	1	C.R.S
DMU54	Pi	N	<1	<1	inefficient
DMU54	N	Pi	<1	<1	inefficient
DMU54	L	L	<1	<1	inefficient
DMU54	R	R	<1	<1	inefficient
DMU54	LR	L|R	<1	<1	inefficient
DMU55	Pi	N	<1	<1	inefficient
DMU55	N	Pi	1	1	C.R.S
DMU55	L	L	<1	<1	inefficient
DMU55	R	R	<1	<1	inefficient
DMU55	LR	L|R	<1	<1	inefficient
DMU56	Pi	N	1	<1	I.R.S
DMU56	N	Pi	1	1	C.R.S
DMU56	L	L	<1	<1	inefficient
DMU56	R	R	1	1	C.R.S
DMU56	LR	L|R	1	1	C.R.S
DMU57	Pi	N	1	1	C.R.S
DMU57	N	Pi	1	1	C.R.S
DMU57	L	L	<1	<1	inefficient
DMU57	R	R	1	1	C.R.S
DMU57	LR	L|R	1	1	C.R.S

			$\theta^*_{model(3)}$	$\theta^*_{model(4)}$	R.T.S
DMU58	Pi	N	<1	<1	inefficient
DMU58	N	Pi	1	1	C.R.S
DMU58	L	L	<1	<1	inefficient
DMU58	R	R	<1	<1	inefficient
DMU58	LR	L|R	<1	<1	inefficient
DMU59	Pi	N	1	1	C.R.S
DMU59	N	Pi	1	1	C.R.S
DMU59	L	L	<1	<1	inefficient
DMU59	R	R	1	1	C.R.S
DMU59	LR	L|R	1	1	C.R.S
DMU60	Pi	N	<1	<1	inefficient
DMU60	N	Pi	<1	<1	inefficient
DMU60	L	L	<1	<1	inefficient
DMU60	R	R	<1	<1	inefficient
DMU60	LR	L|R	<1	<1	inefficient
DMU61	Pi	N	<1	<1	inefficient
DMU61	N	Pi	<1	<1	inefficient
DMU61	L	L	1	1	C.R.S
DMU61	R	R	<1	<1	inefficient
DMU61	LR	L|R	1	1	C.R.S
DMU62	Pi	N	1	1	C.R.S
DMU62	N	Pi	1	<1	I.R.S
DMU62	L	L	<1	<1	inefficient
DMU62	R	R	1	1	C.R.S
DMU62	LR	L|R	1	1	C.R.S
DMU63	Pi	N	<1	<1	inefficient
DMU63	N	Pi	1	1	C.R.S
DMU63	L	L	<1	<1	inefficient
DMU63	R	R	<1	<1	inefficient
DMU63	LR	L|R	<1	<1	inefficient

Table7. Ranking of these DMUs

Π-N	$\theta^*_{model(5)}$	Π-N	$\theta^*_{model(5)}$	N-Π	$\theta^*_{model(5)}$	N-Π	$\theta^*_{model(5)}$
DMU20	1	DMU35	41	DMU13	1	DMU08	41
DMU26	2	DMU41	42	DMU17	2	DMU51	42
DMU28	3	DMU56	43	DMU62	3	DMU27	43
DMU25	4	DMU19	44	DMU50	4	DMU22	44
DMU54	5	DMU49	45	DMU54	5	DMU29	45
DMU50	6	DMU33	46	DMU06	6	DMU36	46
DMU24	7	DMU05	47	DMU61	7	DMU11	47
DMU52	8	DMU16	48	DMU25	8	DMU53	48
DMU22	9	DMU51	49	DMU32	9	DMU35	49
DMU32	10	DMU21	50	DMU28	10	DMU12	50
DMU13	11	DMU14	51	DMU60	11	DMU19	51
DMU17	12	DMU53	52	DMU26	12	DMU48	52
DMU60	13	DMU03	53	DMU38	13	DMU42	53
DMU61	14	DMU43	54	DMU59	14	DMU20	54
DMU06	15	DMU37	55	DMU52	15	DMU03	55
DMU39	16	DMU59	56	DMU39	16	DMU16	56
DMU48	17	DMU46	57	DMU44	17	DMU04	57
DMU34	18	DMU57	58	DMU09	18	DMU43	58
DMU38	19	DMU47	59	DMU24	19	DMU33	59
DMU40	20	DMU04	60	DMU18	20	DMU23	60
DMU63	21	DMU07	61	DMU56	21	DMU07	61
DMU27	22	DMU31	62	DMU55	22	DMU47	62
DMU55	23	DMU62	63	DMU10	23	DMU31	63
DMU45	24			DMU45	24		
DMU42	25			DMU49	25		
DMU29	26			DMU37	26		
DMU02	27			DMU40	27		
DMU58	28			DMU30	28		
DMU08	29			DMU01	29		
DMU44	30			DMU46	30		
DMU18	31			DMU02	31		
DMU15	32			DMU63	32		
DMU10	33			DMU41	33		
DMU36	34			DMU58	34		
DMU11	35			DMU21	35		
DMU01	36			DMU57	36		
DMU30	37			DMU15	37		
DMU09	38			DMU14	38		
DMU12	39			DMU05	39		
DMU23	40			DMU34	40		

L-L	$\theta^*_{model(5)}$	L-L	$\theta^*_{model(5)}$	R-R	$\theta^*_{model(5)}$	R-R	$\theta^*_{model(5)}$
DMU17	1	DMU48	41	DMU20	1	DMU15	41
DMU26	2	DMU46	42	DMU28	2	DMU56	42
DMU54	3	DMU42	43	DMU17	3	DMU42	43
DMU28	4	DMU49	44	DMU25	4	DMU33	44
DMU50	5	DMU19	45	DMU26	5	DMU16	45
DMU20	6	DMU41	46	DMU22	6	DMU19	46
DMU25	7	DMU14	47	DMU52	7	DMU14	47
DMU13	8	DMU53	48	DMU50	8	DMU57	48
DMU32	9	DMU61	49	DMU24	9	DMU05	49
DMU56	10	DMU21	50	DMU06	10	DMU35	50
DMU24	11	DMU23	51	DMU32	11	DMU03	51
DMU52	12	DMU08	52	DMU54	12	DMU21	52
DMU60	13	DMU43	53	DMU51	13	DMU37	53
DMU37	14	DMU12	54	DMU13	14	DMU23	54
DMU62	15	DMU35	55	DMU61	15	DMU43	55
DMU38	16	DMU33	56	DMU40	16	DMU53	56
DMU06	17	DMU05	57	DMU60	17	DMU46	57
DMU40	18	DMU51	58	DMU48	18	DMU59	58
DMU39	19	DMU04	59	DMU01	19	DMU04	59
DMU44	20	DMU16	60	DMU38	20	DMU47	60
DMU45	21	DMU07	61	DMU39	21	DMU07	61
DMU18	22	DMU31	62	DMU45	22	DMU31	62
DMU55	23	DMU47	63	DMU34	23	DMU62	63
DMU57	24			DMU55	24		
DMU34	25			DMU10	25		
DMU10	26			DMU41	26		
DMU36	27			DMU18	27		
DMU09	28			DMU08	28		
DMU01	29			DMU27	29		
DMU02	30			DMU44	30		
DMU30	31			DMU09	31		
DMU29	32			DMU58	32		
DMU59	33			DMU02	33		
DMU58	34			DMU30	34		
DMU63	35			DMU11	35		
DMU11	36			DMU29	36		
DMU05	37			DMU12	37		
DMU22	38			DMU63	38		
DMU27	39			DMU49	39		
DMU15	40			DMU36	40		

LR-L | R	$\theta^*_{model(5)}$	LR-L | R	$\theta^*_{model(5)}$
DMU20	1	DMU19	41
DMU28	2	DMU08	42
DMU25	3	DMU61	43
DMU17	4	DMU35	44
DMU50	5	DMU37	45
DMU54	6	DMU12	46
DMU26	7	DMU21	47
DMU32	8	DMU16	48
DMU52	9	DMU03	49
DMU24	10	DMU33	50
DMU13	11	DMU23	51
DMU40	12	DMU51	52
DMU60	13	DMU04	53
DMU38	14	DMU15	54
DMU06	15	DMU59	55
DMU45	16	DMU46	56
DMU55	17	DMU07	57
DMU44	18	DMU62	58
DMU39	19	DMU53	59
DMU18	20	DMU31	60
DMU01	21	DMU57	61
DMU09	22	DMU43	62
DMU10	23	DMU47	63
DMU02	24		
DMU29	25		
DMU34	26		
DMU30	27		
DMU58	28		
DMU36	29		
DMU22	30		
DMU56	31		
DMU11	32		
DMU63	33		
DMU27	34		
DMU48	35		
DMU42	36		
DMU05	37		
DMU41	38		
DMU14	39		
DMU49	40		

Regarding table 6, it can be seen that branches 1, 2, 3, 4, 5 and 7 are N-Π efficient namely the best value of the input-output interval for the under evaluation DMU and the worst values for the other DMUs. According to the definition given type of return to scale of them is C.R.S. It is also seen that branches 1, 2, 6, 8, 9 and 10 are Π-N efficient namely the worst value of the input-output interval for the under evaluation DMU and the best values for the other DMUs and according to the definition are inefficient. Among the branches in L-L, branches 12, 15, 19, 21and 23 L-L efficient and type of return to scale of them is D.R.S. And finally, branches 23, 33, 49 and 56 are Π-N efficient and type of return to scale of them is I.R.S. As for table 7, it can be seen that branches 20 in state Π-N, R-R and LR-L | Rhas the best rank. Branch number 17 in state L-L has the best rank and also branch number 13 in state N-Π has the best rank.

5-CONCLUSION

In this paper, we exhibit a new method for determine type of return to scale DMUs under different efficiencies with interval data. Also we rank DMUs with input-output values interval by using method A.P. Finally, we applied the suggested approach from 63 branches bank in Iran.

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