Measuring Performance, Estimating Most Productive Scale Size, and Benchmarking of Hospitals Using DEA Approach: A Case Study in Iran

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Abstract

Background and Objectives: The goal of current study is to evaluate the performance of hospitals and their departments. This manuscript aimed at estimation of the most productive scale size (MPSS), returns to scale (RTS), and benchmarking for inefficient hospitals and their departments.

Methods: The radial and non-radial data envelopment analysis (DEA) approaches under variable returns to scale (VRS) assumption are applied for performance assessment of hospitals. Also, the MPSS model in DEA is employed to identify hospital with optimal scale size. Furthermore, the benchmarking for inefficient decision making units (DMUs) is introduced using the slack based measure (SBM) model.

Results: In this manuscript, the DEA approaches are implemented at macro and micro levels in health care. At macro level, the performance of 15 Iranian hospitals is assessed and at micro level, the performance of 15 departments of one hospital is evaluated. It should be noted that the number of staff, the number of beds, location & infrastructures, and equipment & facilities were considered as the input variables and number of patients and number of surgeries were selected as output variables. According to the results, six hospitals at macro level and seven hospital departments at micro level were efficient. As a result, these hospitals and departments can be considered as a benchmark for other DMUs. Notably, only four hospitals at macro level and four hospital departments at micro level have the most productive scale size.

Conclusions: The current study presents a functional pattern to managers at macro and micro levels in health care systems to better planning for capacity development and resource saving.

Keywords: Hospital Performance Evaluation, Data Envelopment Analysis (DEA), Health Care, Most Productive Scale Size (MPSS), Returns to Scale (RTS).

1. Introduction

Hospital is one of the most important parts in the health care network and the major share of health care from gross domestic product (GDP) is spent in hospitals. In other words, hospitals as one of the most important and largest providers of health care services, play a crucial role in health economics. Therefore, measuring the performance and productivity of hospitals is mandatory.

Data envelopment analysis (DEA) is one of the applicable tools that can be applied to evaluate the performance of hospitals.[1-3] DEA is one of the most effective and powerful methods widely used in many real-world applications.[4-9] The initial idea of DEA approach was raised by Farrell[10] and then developed by Charnes et al.[11] and Banker et al.[12] under constant returns to scale (CRS) and variable returns to scale (VRS) assumptions, respectively.[13] It should be noted that so far, DEA has been applied in many studies to assess the performance of Iranian hospitals.[14-16] Table 1 summarizes the studies that applied DEA approach for performance assessment of hospitals and health care centers in Iran:

Table 1: The Application of DEA in Iranian Hospitals and Health Care Centers: A Literature Review

		DEA Approach																		Application			
Year	**Research**	CCR	BCC	SBM	MPSS	RTS	MPI	WDEA	Congestion	SEDEA	CEDEA	CSWDEA	MGDEA	CDDEA	CGDEA	CCDEA	FDEA	RDEA	BIRDEA	Hospitals	Health Care Centers	Identical Departments	Different Departments
2007	Hajialiafzali et al.[17]		●							●										●			
2008	Hatam[18]	●																		●			
2010	Hatam et al.[19]	●	●			●	●													●			
2010	Jandaghi et al.[20]	●	●																	●			
2011	Ketabi[21]	●								●												●	
2011	Shahhoseini et al.[22]	●	●																	●			
2012	Ebrahimnejad[23]																●			●			
2012	Ghotbuee et al.[24]	●																			●		
2012	Khani et al.[25]	●																		●			
2012	Marnani et al.[26]		●																	●			

Year	Research	DEA Approach																		Application			
		CCR	BCC	SBM	MPSS	RTS	MPI	WDEA	Congestion	SEDEA	CEDEA	CSWDEA	MGDEA	CDDEA	CGDEA	CCDEA	FDEA	RDEA	BIRDEA	Hospitals	Health Care Centers	Identical Departments	Different Departments
2012	Sheikhzadeh et al.[27]	●	●			●														●			
2013	Yusefzadeh et al.[28]	●	●			●														●			
2014	Kalantary & Azar[29]																	●		●			
2014	Lotfi et al.[30]	●	●			●	●													●			
2014	Mehrtak et al.[31]	●	●			●														●			
2014	Torabipour et al.[32]	●	●			●	●													●			
2015	Haji Sami et al.[33]																	●				●	
2015	Jahangoshai Rezaee & Karimdadi[34]												●							●			
2015	Kheirollahi et al.[35]								●							●				●			
2015	Rezapour et al.[36]	●	●			●														●			
2016	Kakeman et al.[37]	●	●			●														●			
2016	Kalhor et al.[38]	●	●			●														●			
2016	Nabilou et al.[39]	●	●			●														●			
2016	Rabbani et al.[40]																		●	●			
2016	Rezaei et al.[41]	●	●			●														●			
2017	Abadi et al.[42]											●								●			
2017	Ameryoun et al.[43]											●								●			
2017	Farzianpour et al.[44]	●	●			●														●			
2017	Kakemam et al.[45]		●																	●			
2017	Kheirollahi et al.[46]								●								●			●			
2017	Mirmozaffari & Alinezhad[47]	●	●								●									●			
2017	Mirmozaffari & Alinezhad[48]	●	●					●												●			
2017	Raei et al.[49]						●													●			
2017	Shafaghat et al.[50]	●								●										●			
2018	Alinezhad & Mirmozaffari[51]						●													●			

Year	Research	DEA Approach																		Application			
		CCR	BCC	SBM	MPSS	RTS	MPI	WDEA	Congestion	SEDEA	CEDEA	CSWDEA	MGDEA	CDDEA	CGDEA	CCDEA	FDEA	RDEA	BIRDEA	Hospitals	Health Care Centers	Identical Departments	Different Departments
2018	Bahrami et al.[52]	●	●			●																●	
2018	Hadipour et al.[53]	●								●											●		
2018	Jahangoshai Rezaee et al.[54]												●							●			
2018	Ketabi et al.[55]	●								●												●	
2018	Kiani et al.[56]	●	●			●														●			
2018	Omrani et al.[57]														●					●			
2018	Pirani et al.[58]	●	●			●														●			
2019	Hatefi & Haeri[59]																●			●			
2019	Jahangoshai Rezaee et al.[60]													●						●			
2019	**Our Work**		●	●	●	●														●			●

As it can be seen in Table 1, in the current research, the radial and non-radial DEA methods as well as the most productive scale size (MPSS) model are applied in Iranian health care system for performance assessment of hospital and their departments. Moreover, the input and output-oriented slack based measure (SBM) models are employed for identifying input-excess, output-shortfall, and reference-set for inefficient decision making units (DMUs). In other words, the main purpose of this research is to explore causes of inefficiency of hospital and their departments by applying different DEA models. In fact, this study is an applied research in Iran's health care systems that can be used to provide more services or to improve the quality of hospital services by managing the available resources.

The rest of this paper is organized as follows: The background of radial and non-radial DEA models under both input and output orientations are explained in Section 2. The approach for estimation of MPSS is proposed in Section 3. Then, the proposed DEA approaches of the current study are implemented for a real case study of Iranian hospitals and the results are evaluated in Section 4. Finally, managerial insights and conclusions of study as well as some directions for future research are given in Section 5.

2. Data Envelopment Analysis (DEA)

In this section, the background of DEA models based on radial and non-radial approaches are introduced. Assume that there are n homogenous DMUs that each $DMU_j\ (j=1,\dots,n)$ uses m inputs $x_{ij}\ (i=1,\dots,m)$ to produce s outputs $y_{rj}\ (r=1,\dots,s)$ and k is the index of DMU under evaluation.

2.1. Radial Approach

In radial approach, DEA calculates the maximum proportional reduction in all inputs under input orientation (increment in all outputs under output orientation) to increase the efficiency of DMU under evaluation. It should be noted that the BCC model is a popular radial DEA model under variable returns to scale.[12] The input and output-oriented BCC models are presented as Models (1) and (2), respectively:

$$
\begin{aligned}
& Min \quad \theta && (1)\\
& s.t. \quad \sum_{j=1}^{n}\lambda_j x_{ij} \le \theta x_{ik}, \quad i=1,\dots,m\\
& \qquad \sum_{j=1}^{n}\lambda_j y_{rj} \ge y_{rk}, \quad r=1,\dots,s\\
& \qquad \sum_{j=1}^{n}\lambda_j = 1\\
& \qquad \lambda_j \ge 0, \quad j=1,\dots,n
\end{aligned}
$$

$$
\begin{aligned}
& Max \quad \varphi && (2)\\
& s.t. \quad \sum_{j=1}^{n}\lambda_j x_{ij} \le x_{ik}, \quad i=1,\dots,m\\
& \qquad \sum_{j=1}^{n}\lambda_j y_{rj} \ge \varphi y_{rk}, \quad r=1,\dots,s\\
& \qquad \sum_{j=1}^{n}\lambda_j = 1\\
& \qquad \lambda_j \ge 0, \quad j=1,\dots,n
\end{aligned}
$$

Note that in output-oriented BCC model presented in Model (2), the efficiency of DMU under investigation is calculated by $1/\varphi^*$.

2.2. Non-Radial Approach

In non-radial approach in contrast with radial approach, DEA model reduces inputs under input orientation (increases outputs under output orientation) non-proportionally. In other words, non-radial DEA model consider the input excesses and the output shortfalls using slack variables.[61] The input and output-oriented SBM models are introduced as Models (3) and (4), respectively:

$$
\begin{aligned}
Min \quad & \xi = 1 - \frac{1}{m}\sum_{i=1}^{m}\frac{s_i}{x_{ik}} \\
s.t. \quad & \sum_{j=1}^{n}\lambda_j x_{ij} + s_i = x_{ik}, \quad i = 1,\dots,m \\
& \sum_{j=1}^{n}\lambda_j y_{rj} \geq y_{rk}, \quad r = 1,\dots,s \\
& \sum_{j=1}^{n}\lambda_j = 1 \\
& s_i \geq 0, \quad i = 1,\dots,m \\
& \lambda_j \geq 0, \quad j = 1,\dots,n
\end{aligned}
\tag{3}
$$

$$
\begin{aligned}
Max \quad & \gamma = 1 + \frac{1}{s}\sum_{r=1}^{s}\frac{t_r}{y_{rk}} \\
s.t. \quad & \sum_{j=1}^{n}\lambda_j x_{ij} \leq x_{ik}, \quad i = 1,\dots,m \\
& \sum_{j=1}^{n}\lambda_j y_{rj} - t_r = y_{rk}, \quad r = 1,\dots,s \\
& \sum_{j=1}^{n}\lambda_j = 1 \\
& t_r \geq 0, \quad r = 1,\dots,s \\
& \lambda_j \geq 0, \quad j = 1,\dots,n
\end{aligned}
\tag{4}
$$

It should be noted that the s_i and the t_r, respectively, represent the amount of i^{th} input surplus and r^{th} output shortages. Also, the efficiency of DMU under evaluation based on output-oriented SBM model that presented in Model (4), is calculated by $1/\gamma^*$.

3. Estimating Most Productive Scale Size (MPSS)

The type of returns to scale for each DMUs under VRS production possibility set (PPS) is a very important issue.[62] Because, the type of RTS presents the direction of rescaling needed for improving the efficiency.

If the RTS of DMU is an increasing returns to scale (IRS), the expansion of the DMU under investigation will be suggested. And if the RTS of DMU is a decreasing returns to scale (DRS), contraction of DMU will be suggested. Finally, if the RTS of DMU is CRS, it is believed that the DMU under investigation operates as the most productive scale size (MPSS). The concept of MPSS has been introduced by Banker[63] for the first time. Cooper et al.[64] presented Model (5) for estimating MPSS:

$$
\begin{aligned}
&Max \quad \Delta = \frac{\Phi}{\Theta} && (5)\\
&s.t. \quad \sum_{j=1}^{n} \lambda_j x_{ij} - \Theta x_{ik} \le 0, \quad i = 1,\dots,m \\
&\qquad \sum_{j=1}^{n} \lambda_j y_{rj} - \Phi y_{rk} \ge 0, \quad r = 1,\dots,s \\
&\qquad \sum_{j=1}^{n} \lambda_j = 1 \\
&\qquad \Theta, \Phi \ge 0 \\
&\qquad \lambda_j \ge 0, \quad j = 1,\dots,n
\end{aligned}
$$

It should be stated that the DMU under evaluation is the MPSS, if and only if in the fractional objective function $\Delta^* = 1$.[65]

4. Real Case Studies and Numerical Results

In this section, the implementation of DEA approach using real-world data at macro level (hospitals) and micro level (departments of hospital) from Iranian health care system are presented. Based on literature review[66], and expert opinions, inputs and outputs of DEA approach are selected. The input variables include the number of staff (doctors, nurses, and ancillary personnels), the number of beds, location & infrastructures, and equipment & facilities. Also, the output variables include number of patients and number of surgeries.

4.1. The Macro Level: Hospital

As previously discussed, the goal at macro level is to assess the performance of hospitals. To reach this goal, 15 Iranian hospitals are selected and data from these hospitals are gathered. Summary of real-world data for inputs and outputs variables of these hospitals are presented in Table 2.

Table 2: Data Set for 15 Hospitals in Iran

Hospital Code	Inputs				Outputs	
	Number of Staff	Number of Beds	Score of Location & Infrastructures	Score of Equipment & Facilities	Number of Patients	Number of Surgeries
H01	356	120	72	56	58734	1867
H02	878	452	94	92	420434	19321
H03	333	141	66	60	76489	3218
H04	399	285	68	75	146468	3080
H05	362	122	62	58	142352	555
H06	186	76	45	52	48854	1800
H07	315	125	59	47	78278	4223
H08	175	94	35	53	97932	1155
H09	223	89	66	47	108205	1752
H10	76	20	35	24	60628	85
H11	100	24	45	34	78954	432
H12	212	78	46	39	96451	2185
H13	95	30	33	35	46196	630
H14	320	175	58	78	136582	5837
H15	107	73	43	37	85139	2062

Then, after collecting data, the radial and non-radial models under input and output orientation are run and MPSS and RTS for each hospital are estimated. The results of performance appraisal of hospitals are illustrated in Table 3.

Table 3: The Results of Hospitals Evaluation

Hospital Code	MPSS			RTS			Radial		Non-Radial	
	Δ^*	Yes	No	DRS	CRS	IRS	θ^*	$\frac{1}{\varphi^*}$	ξ^*	$\frac{1}{\gamma^*}$
H01	2.54		●			●	0.56	0.40	0.51	0.39
H02	1.00	●			●		1.00	1.00	1.00	1.00
H03	1.84		●			●	0.65	0.57	0.63	0.50
H04	1.49		●			●	0.68	0.69	0.59	0.47
H05	1.16		●		●		0.86	0.91	0.79	0.21
H06	1.73		●			●	0.82	0.67	0.76	0.54
H07	1.27		●		●		0.89	0.87	0.83	0.63
H08	1.03		●			●	1.00	1.00	1.00	1.00
H09	1.32		●		●		0.78	0.83	0.75	0.65
H10	1.00	●			●		1.00	1.00	1.00	1.00
H11	1.00	●			●		1.00	1.00	1.00	1.00
H12	1.19		●			●	0.88	0.85	0.83	0.82
H13	1.41		●			●	1.00	1.00	1.00	1.00
H14	1.19		●			●	0.91	0.86	0.83	0.81
H15	1.00	●			●		1.00	1.00	1.00	1.00

As seen in Table 3, 4 hospitals including H02, H10, H11, and H15 are the MPSS. In addition to these hospitals, H08 and H13 are also efficient. Finally, by applying input and output-oriented SBM models, input-excess, output-shortfall, and reference-set for 9 inefficient hospitals are proposed in Table 4:

Table 4: The Benchmarking for Hospitals

Hospital Code	Input-Oriented					Output-Oriented		
	Input-Excess				Reference-Set	Output-Shortfall		Reference-Set
	s_1	s_2	s_3	s_4		t_1	t_2	
H01	205.70	59.98	31.53	25.70	H02, H10	96813.64	2801.79	H02, H11
H02	0.00	0.00	0.00	0.00	H02	0.00	0.00	H02
H03	126.38	50.64	21.39	24.92	H02, H10	95813.50	2377.58	H02, H11
H04	131.66	161.94	18.92	34.78	H02, H10	65656.91	5518.48	H02, H15
H05	103.84	3.88	13.60	18.55	H02, H10	14791.35	4202.05	H02, H11
H06	83.11	10.02	3.06	16.72	H10, H15	62145.78	820.57	H02, H10, H11
H07	66.48	12.07	11.31	8.37	H02, H10	80159.69	654.07	H02, H10, H11
H08	0.00	0.00	0.00	0.00	H08	0.00	0.00	H08
H09	56.36	28.34	16.80	8.03	H02, H11	22609.28	1548.66	H02, H11
H10	0.00	0.00	0.00	0.00	H10	0.00	0.00	H10
H11	0.00	0.00	0.00	0.00	H11	0.00	0.00	H11
H12	48.45	10.84	4.56	7.58	H02, H10	17367.40	537.61	H02, H10, H11
H13	0.00	0.00	0.00	0.00	H13	0.00	0.00	H13
H14	44.36	19.10	3.84	28.97	H02, H15	41000.70	905.60	H02, H11, H15
H15	0.00	0.00	0.00	0.00	H15	0.00	0.00	H15

It is worth mentioning that the type of input and output variables is integer and the values that presented in Table 4, should be approximated to the nearest integer value.

4.2. The Micro Level: Hospital Departments

In this subsection, the performance of hospital departments as a micro level is evaluated. For this purpose, 15 departments of hospitals including intensive care unit (ICU), intensive care unit-open heart (ICU-OH), neonatal intensive care unit (NICU), coronary care unit (CCU), post coronary care unit (Post CCU), very important person (VIP), kidney transplant, head and neck surgery, neurology and physical medicine, internal, orthopedics and urology, general surgery, heart, pregnancy and maternity, and pediatric, are considered.

Then, data from these departments were gathered and the summary of real-world data are introduced in Table 5:

Table 5: Data Set for 15 Departments of a Hospital in Iran

Department Code	Inputs				Outputs	
	Number of Staff	Number of Beds	Score of Location & Infrastructures	Score of Equipment & Facilities	Number of Patients	Number of Surgeries
D01	31	26	82	63	2128	207
D02	21	11	67	48	656	138
D03	19	18	58	52	1024	12
D04	22	26	67	69	2714	472
D05	11	12	48	58	771	161
D06	14	29	63	39	1208	725
D07	15	27	64	48	725	518
D08	25	50	88	93	4313	3255
D09	30	38	70	59	1955	46
D10	25	34	64	73	1771	92
D11	54	78	88	96	5486	2921
D12	30	62	84	47	4669	1967
D13	37	60	93	94	4439	1794
D14	15	16	34	29	2887	92
D15	18	18	39	59	1116	115

Now, by employing the DEA models that were proposed in Models (1) to (4), the efficiency score for each department are calculated. Additionally, type of RTS for each department as well as MPSS are estimated. The results of performance assessment of hospitals are shown in Table 6:

Table 6: The Results of Evaluating the Hospital Departments

Department Code	MPSS			RTS			Radial		Non-Radial	
	Δ^*	Yes	No	DRS	CRS	IRS	θ^*	$\frac{1}{\varphi^*}$	ξ^*	$\frac{1}{\gamma^*}$
D01	2.01		●			●	0.59	0.65	0.52	0.27
D02	2.38		●			●	1.00	1.00	1.00	1.00
D03	3.17		●			●	0.78	0.34	0.71	0.04
D04	1.42		●			●	0.74	0.82	0.66	0.57
D05	2.22		●			●	1.00	1.00	1.00	1.00
D06	1.93		●			●	1.00	1.00	1.00	1.00
D07	3.23		●			●	0.89	0.60	0.85	0.46
D08	1.00	●			●		1.00	1.00	1.00	1.00
D09	2.95		●			●	0.50	0.51	0.47	0.05
D10	2.71		●			●	0.57	0.49	0.50	0.09
D11	1.00	●			●		1.00	1.00	1.00	1.00
D12	1.00	●			●		1.00	1.00	1.00	1.00
D13	1.32		●		●		0.88	0.93	0.76	0.71
D14	1.00	●			●		1.00	1.00	1.00	1.00
D15	2.63		●			●	0.89	0.39	0.78	0.38

According to Table 6, 4 departments including D08, D10, D11, and D14 are the MPSS. In addition to these departments, D02, D05, and D06 are also efficient. Like the previous subsection, using input and output-oriented SBM models, input-excess, output-shortfall, and reference-set for 8 inefficient departments are measured. The results of benchmarking for inefficient departments are shown in Table 7:

Table 7: The Benchmarking for a Hospital Departments

Department Code	Input-Oriented					Output-Oriented		
	Input-Excess				Reference-Set	Output-Shortfall		Reference-Set
	s_1	s_2	s_3	s_4		t_1	t_2	
D01	15.64	8.76	46.04	31.67	D08, D14	98.71	1088.33	D02, D08, D14
D02	0.00	0.00	0.00	0.00	D02	0.00	0.00	D02
D03	4.00	2.00	24.00	23.00	D14	717.35	565.97	D02, D05, D08
D04	5.80	5.92	26.51	32.31	D08, D14	0.00	700.10	D02, D08, D14
D05	0.00	0.00	0.00	0.00	D05	0.00	0.00	D05
D06	0.00	0.00	0.00	0.00	D06	0.00	0.00	D06
D07	0.00	7.93	18.63	1.57	D05, D08, D14	1624.15	38.28	D05, D08, D14
D08	0.00	0.00	0.00	0.00	D08	0.00	0.00	D08
D09	15.00	22.00	36.00	30.00	D14	1830.20	1692.61	D08, D12, D14
D10	10.00	18.00	30.00	44.00	D14	1735.80	1705.13	D05, D08, D14
D11	0.00	0.00	0.00	0.00	D11	0.00	0.00	D11
D12	0.00	0.00	0.00	0.00	D12	0.00	0.00	D12
D13	9.02	4.05	14.87	47.26	D08, D12, D14	292.71	1339.98	D08, D11, D12
D14	0.00	0.00	0.00	0.00	D14	0.00	0.00	D14
D15	2.93	1.75	4.61	29.53	D08, D14	1680.33	202.58	D05, D08, D14

As seen in Table 7, the results introduce a functional pattern for managers in health care systems to better planning for capacity development and resource saving. Since in most cases, it is easier for hospital managers to reduce inputs such as the number of staff than to increase outputs such as the number of patients. Consequently, the input-oriented model is recommended.

5. Managerial Insights, Conclusions, and Future Research Directions

Performance appraisal of hospitals is one of the major concerns of managers. The reason for this is the identification of hospitals with a desirable performance as a benchmark for inefficient hospitals. Undoubtedly, DEA is one of the most powerful approaches that can be applied to performance assessment, ranking and benchmarking in health care. In this research, the radial and non-radial DEA models including BCC and SBM are implemented for a real case study in Iran to assess the performance of hospitals and their departments. Also, the most productive scale size and returns to scale are estimated for hospitals and their departments. Finally, input-excess, output-shortfall, and reference-set for each of inefficient DMUs are proposed. For the future studies, hybrid and novel multiple criteria decision making (MCDM) approaches can be employed for performance appraisal of hospitals.[67-69] Also, in cases where the number of hospitals is considerable, clustering or grouping approach can be applied to categorize hospitals in different groups so that in each group, there are at least one benchmark hospital and other related hospitals. Moreover, uncertain DEA models such as fuzzy DEA, stochastic DEA, and robust DEA can be applied for performance measurement of hospitals in the presence of data uncertainty and ambiguity.[70-74]

Abbreviations

DEA: data envelopment analysis, **DMU:** decision making unit, **MPSS:** most productive scale size, **SBM:** slack based measure, **RTS:** returns to scale, **CRS:** constant returns to scale, **VRS:** variable returns to scale, **IRS:** increasing returns to scale, **DRS:** decreasing returns to scale, **GDP:** gross domestic product, **ICU:** intensive care unit, **ICU-OH:** intensive care unit-open heart, **NICU:** neonatal intensive care unit, **CCU:** coronary care unit, **Post CCU:** post coronary care unit, **VIP:** very important person, **MPI:** Malmquist productivity index, **PPS:** production possibility set. **CCR:** Charnes Cooper Rhodes, **BCC:** Banker Charnes Cooper, **WDEA:** window data envelopment analysis, **SEDEA:** super efficiency data envelopment analysis, **CEDEA:** cross efficiency data envelopment analysis, **CSWDEA:** common set of weights data envelopment analysis, **MGDEA:** multi group data envelopment analysis, **CDDEA:** context dependent data envelopment analysis, **CGDEA:** cooperative game data envelopment analysis, **CCDEA:** chance constrained data envelopment analysis, **FDEA:** fuzzy data envelopment analysis, **RDEA:** robust data envelopment analysis, **BIRDEA:** bootstrap interval robust data envelopment analysis, **MCDM:** multiple criteria decision making.

Competing Interests

The authors declare no competing interests.

Authors' Contributions

Pejman Peykani: Investigation, Conceptualization, Methodology, Literature Review, Data Curation, Software, Validation, Writing - Original Draft. **Emran Mohammadi:** Supervision, Formal Analysis, Investigation, Methodology, Validation, Writing - Review & Editing. **Fatemeh Sadat Seyed Esmaeili:** Investigation, Methodology, Literature Review, Writing - Review & Editing.

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