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PERFORMANCE EVALUATION OF EDUCATIONAL INSTITUTIONS IN IRAQ USING INTEGRATING (DEA- EWM-WSM) APPROACH

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Abstract:

This study focuses on assessing the performance of educational institutions in Iraq using new efficient technique. The presented approach consists of three stages: first, (DEA) is employed to identify efficient and inefficient decision-making units, in the second stage, the entropy weights method (EWM) is applied to determine the relative importance of the input and output of the decision-making units, and in the third stage, weighted sum model (WSM) is used to rank the efficient decision making units. Also, the study suggest that inefficient units can improve their efficiencies by learning from the strategic that adopted by these efficient decision making units**.**

Keywords: Performance Evaluation**,** educational institutions

1.INTRODUCTION

Today, the world is facing technical and information challenges that have had repercussions on institutions in general and institutions of higher education (university) in particular. These educational institutions are witnessing an expansion in the use of modern methods in evaluating the performance of all the inputs of the administrative and educational process with the aim of evaluating their institutional performance, which will have an impact. To provide educational services in a more efficient, distinguished and high quality manner and contribute to achieving its objectives. The impact of these challenges was reflected on the universities and their strategies, so that they were viewed with a changing view, and the universities started working on finding academic leaders to direct them towards the growth and progress of society, and to monitor the performance of all staff members, administrators and students, and to use modern, unconventional methods in evaluating their performance in order to achieve their goals. Universities are a source for preparing and rehabilitating human competencies to face technical, information, knowledge, cultural and scientific developments, and to provide them with the capabilities that make them able to lead society now and in the future. Moreover, performance evaluation with modern approaches has proven to be applied and successful in many universities, working to achieve high rates of efficiency, increase its ability to face competition and its distinction, improve its organizational effectiveness and ability to achieve the quality of the educational process, and achieve the satisfaction of its beneficiaries. On the other hand, data envelopment analysis DEA has recently used to measure the relative efficiency of the decision making units based on their input and output. This model is a nonparametric linear programming approach with input orientation or output orientation. for new mathematical formulation and application we refer for example [1],[2],[3],[4],[5],[6],[7].

In this work, we present new approach to calculate the efficiency of MCDM problems, the presented approach consists of three stages based on DEA, EWM, and WSM.

2. THE METHODOLOGY OF THE STUDY

The methodology of this study can be describe as follows:

2.1 Problem of the Study

The study aims to evaluate the performance of educational institutions in Iraq and provide a new efficient multi-criteria decision-making technique for this purpose. The problem of the study is to determine the efficient and inefficient DMUs in educational institutions in Iraq and to rank the efficient units based on their performance. The study also aims to suggest strategies for the inefficient decision-making units to improve their performance.

2.2 Aim of the Study

The aim of the study is to evaluate the performance of educational institutions in Iraq using a new efficient MCDM technique. The study also aims to determine the efficient and inefficient DMUs, determine the relative importance of the input and output of the decision-making units, and rank the efficient DMUs. Moreover, the study aims to suggest strategies for the inefficient decision-making units to improve their performance

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2.3 Importance of the Study

The study is significant because it provides a new efficient multi-criteria decision-making technique for evaluating the performance of educational institutions in Iraq. The study can help decision-makers in educational institutions to identify the efficient and inefficient decision-making units and develop strategies to improve their performance. Moreover, the study can contribute to the literature on performance evaluation of educational institutions in developing countries. The study can also serve as a reference for researchers and practitioners in the field of education management and policy.

3. DEA models

The most well-known DEA model was proposed by Charmes, Cooper, and Rhodes which is knowns as CCR model. There are two types of CCR model, the input-oriented CCR (CCR.I) and the output- oriented CCR (CCR.O). These two models are described as in [1],[2],[8],[9]as follows

$$\text{Max } z_j = \sum_{r=1}^{s} U_r Y_{rj}$$

s.t:

$$\sum_{i=1}^{m} V_i X_{ij} = 1$$

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ij} \leq 0 \, , j = 1,2, \dots, n.$$

i=1,2,…, m r=1,2,…,s $V_i, U_r \geq 0$.

$$\text{Min } z_j = \sum_{i=1}^{m} V_i X_{ij}$$

s.t.

$$\sum_{r=1}^{s} U_r Y_{rj} = 1$$

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ij} \leq 0 \, , j = 1,2, \dots, n.$$

i=1,2,…, m r=1,2,…,s $V_i, U_r \geq 0$.

4. EWM method

The computational procedure of EWM is described as in [10],[11],[12] as follows:

1-Constract the decision matrix as follows:

$$\text{DT} = \begin{bmatrix} q_{11} & q_{12} & -- & q_{1j} & -- & q_{1m} \\ q_{21} & q_{22} & -- & q_{2j} & -- & q_{2m} \\ -- & -- & -- & -- & -- & -- \\ q_{i1} & q_{i2} & -- & q_{ij} & -- & q_{im} \\ -- & -- & -- & -- & -- & -- \\ q_{n1} & q_{n2} & -- & q_{ni} & -- & q_{nm} \end{bmatrix} \quad (1)$$

$$NDM_{ij} = \frac{q_{ij}}{Maxq_{ij}} \quad (Beneficial) \quad (2)$$

$$NDM_{ij} = \frac{Minq_{ij}}{q_{ij}} \quad (Non-beneficial) \quad (3)$$

$$Pr_{ij} = \frac{NDM_{ij}}{\sum_{i=1}^{n} NDM_{ij}} \quad (4)$$

$$En_j = -Y \sum_{i=1}^{n} Pr_{ij} \log_e(Pr_{ij}) \quad (5)$$

Where $Y = \frac{1}{\log_e(n)}$ is a stable expression, n belongs to no. of experiments and value of En_j lies between zero and one.

4- Divergence and entropy weights are calculated as:

$$Div_i = |1 - En_i| \quad (6)$$

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$$Ew_j = \frac{Div_j}{\sum_{j=1}^{m} Div_j} \quad (7)$$

5. WSM approach

This algorithm can be described as in [13],[14],[15] as follows:
Step 1: Construct the decision matrix X as follows:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & & x_{2n} \\ \vdots & \ddots & & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (8)$$

Step 2: Based on the matrix in step1, we establish the normalized decision matrix R as:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & & r_{2n} \\ \vdots & \ddots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \quad (9)$$

$$r_{ij} = \frac{x_{ij}}{x_{ij}^{max}} \quad (10)$$

For non-beneficial attribute:

$$r_{ij} = \frac{x_{ij}^{min}}{x_{ij}} \quad (11)$$

Step 3: The weighted normalized decision matrix R′ is constricted as:

$$R' = \begin{bmatrix} w_1 * r_{11} & w_2 * r_{12} & \cdots & w_n * r_{1n} \\ w_1 * r_{21} & w_2 * r_{22} & & w_{n^*} \ r_{2n} \\ \vdots & \ddots & & \vdots \\ w_1 * r_{m1} & w_2 * r_{m2} & & \end{bmatrix}; \sum_{j=1}^{n} wj = 1 \quad (12)$$

Step 4: The score S_j^{WSM} of each alternative is calculated as:

$$S_i^w SM = \sum_{j=1}^{n} w_j r_{ij}; i = 1, 2, 3, \ldots\ldots, m \quad (13)$$

Step 5: The best alternative BA^{WSM} is calculated using the following formula:

$$BA^{WSM} = \max S_i^{WSM}; i = 1, 2, 3, \ldots\ldots, m \quad (14)$$

6. NEW INTEGRATING (DEA-EWM-WSM) APPROACH

This approach is used to measure the efficiency of the decision making units using the following three stages:
Stage1: using DEA models, the relative efficiency calculated and the efficient and inefficient decision making units are determined.
Stage 2: the weights of the efficient decision making units are calculated using EWM.
Stage 3: WSM is used to rank the efficient decision making units.

7. CASE STUDY

To show a new approach, we will consider the data that was presented by [16]. This data consists of three inputs and two inputs for measuring the relative efficiency of Mustansiriya University colleges as in Table 1

Table 1: Input and Output Data[16]

Name of College	Input			Output	
	Number of Lecturers	Number of Employees	Number of Student Present	Number of Graduate Students	Number of Published Research
Medicine	207	249	866	137	37
Dentistry	127	158	598	92	12
pharmacy	116	200	594	101	25
Engineering	356	377	1340	374	21
Sciences	431	285	2425	449	88

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Administration and Economics	168	204	3310	594	19
Education	336	181	4770	681	46
Basic Education	354	219	7813	1182	92
Physical Education and Sports Sciences	48	83	344	90	1
Literature	270	174	6191	848	28
Law	40	83	1394	357	7
Political Science	48	71	660	123	22

Now we calculate the efficiency based on our new approach as follows:
Stage 1: the relative efficiency is calculated using DEA as in [1] as follows:

Table 2: Efficiency of DMUs as in [1]

Name of College	Efficiency
Medicine	1
Dentistry	0.69
Pharmacy	1
Engineering	1
Sciences	1
Administration and Economics	0.74
Education	0.83
Basic Education	1
Physical Education and Sports Sciences	0.98
Literature	0.91
Law	1
Political Science	1

Stage 2: For the input and output of the efficient decision making units, we calculate the weights using EWM as follows:

Table 3: Entropy Weights for Input and Output

Input and Output	Input			Output	
	Number of Lecturers	Number of Employees	Number of Student Present	Number of Graduate Students	Number of Published Research
Entropy Weights	0.17557	0.08552	0.31229	0.23434	0.19228

Stage 3: the performance score for the efficient DMUs using WSM is calculated as in Table 4 as follows:

Table 4: WSM Efficiency Scores

Name of College	WSM Efficiency	Ranking
Medicine	0.37	6
pharmacy	0.47	3
Engineering	0.29	7
Sciences	0.38	5
Basic Education	0.49	2
Law	0.46	4
Political Science	0.58	1

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8. CONCLUSIONS

1-The new efficient multi-criteria decision-making technique presented in this study is effective for evaluating the performance of educational institutions in Iraq.
2-Data envelopment analysis (DEA) is a useful method for identifying efficient and inefficient decision-making units in educational institutions.
3-The entropy weights method (EWM) is an effective method for determining the relative importance of the input and output of the decision-making units.
4-The weighted sum model (WSM) is a useful method for ranking the efficient decision-making units.
5-The study identified the efficient and inefficient decision-making units in educational institutions in Iraq and provided strategies for the inefficient units to improve their performance.
6-The study contributes to the literature on performance evaluation of educational institutions in developing countries.
7-The study can serve as a reference for researchers and practitioners in the field of education management and policy.
8-The study highlights the importance of using efficient multi-criteria decision-making techniques for evaluating the performance of educational institutions.

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