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Measuring Relative Efficiency of Physical Education Departments in Tehran using Data Envelopment Analysis

Sara Haseli Mofrad*

M.Sc Student of Sport Managemrnt, Department of Sport Management, Faculty of Sport Sciences, Alzahra University, Tehran, Iran

Maryam Mokhtari Dinani

Assistant Professor of Sport Managemrnt, Department of Sport Management, Faculty of Sport Sciences, Alzahra University, Tehran, Iran

Abbas Rezaei Pandari

Ph.D. Graduated of Industrial Management, Department of Management and Economy, Faculty of Management and Economic, Tarbiat Modares University, Tehran, Iran

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Abstract

Background: Despite significant advances in the design of performance appraisal frameworks and systems in recent years, many organizations still rely on traditional metrics. **Purpose:** The present study aimed to measure the relative efficiency of physical education departments in Tehran through a data envelopment analysis approach. **Method:** In this research, in addition to identifying and determining the input and output indices of regions, an appropriate model of data envelopment analysis was presented to evaluate their performance, as well as ranking efficient and inefficient regions and units and providing solutions to improve inefficient regions. Input indicators of this study were the ratio of student to physical education teacher, the budget of physical education department, the number and surface area of sports halls at the disposal of the department, and output indicators included the number of sports competitions held by the department, provincial and national trophies won in competitions as well as national and international athlete students of each region. Finally, DEA method was used to design a performance assessment model for physical education departments in different regions. After designing the research model and collecting the data, BCC, CCR and Anderson-Peterson output- and input-oriented models were analyzed using DEA-SOLVER LV software. **Results:** The results of data analysis showed that 11 out of 19 regions under study in 2017 were efficient and 8 were inefficient. **Conclusion:** It is necessary that the degree of changes needed to make efficient the inefficient units be determined by modeling the efficient departments.

***Keywords**:* Performance Appraisal, Data Envelopment Analysis, Physical Education Departments

* **Author’s e-mail:** sara.haseli1365@gmail.com, m.mokhtaridinani@alzahra.ac.ir **(Corresponding Author)**; a.rezaei.p@modares.ac.ir

INTRODUCTION

Education has a special status as the center of growth and development of society, and it is always on the path of development of children and adolescents in society and plays an important role in the training system of societies. Sports in general and education in particular are considered two overlapping and influential social systems in the development of children and adolescents. Having systematic programs based on expert opinion can lead to the development and expansion of sports in the education system (Gafari, Ehsani, & Momeni, 2009).

As an effective force in social and economic development, sports has direct and indirect effects and plays an essential role in the economy and politics of countries. Sport performance is a phenomenon related to management analysis, and for better performance and excellence in its management, sports should be viewed as a system and its key elements regarded as an integrated system (Safari & Ahmadirad, 2018).

Performance assessment provides an appropriate ground for motivating and facilitating organizational goals, which can measure the relationship between organizational sources and the amount of work done as well as the achievement level of organizational goals. Moreover, assessment leads to proper feedback from individuals and organizational units and their informing of their weak and strong points that paves the way for their improvement and promotion (Abbasi & Kashani, 2010).

According to Byars and Rue (2008), performance refers to the practice degree of tasks complementing an employee's job (Byars, & Rue, 2008). Assessment is the act of finding the value of something and the assessor is the one who determines the value of everything. Performance appraisal is also the process by which employees are formally evaluated at regular intervals (Dehkhoda, 2006). Performance appraisal is expressed in terms of how to use resources and facilities in the form of performance indicators. If we consider performance as input to output ratio in the simplest definition, the performance appraisal system actually measures the effectiveness of management decisions regarding the optimal use of resources and facilities (Rahimi, 2006).

Given that several variables affect the performance of each unit under assessment, efficiency has also different types such as technical, allocation and economic (Torkashvand & Mostafaei, 2004), which further complicates the performance appraisal problem (Sheykhzade & Bahramzade, 2008).

Efficiency assessment of a unit requires comparison of its outputs with its inputs, which is done in various ways, including determining the efficiency of a decision-making unit by dividing the amount of outputs (or by weight of outputs) by the amount of inputs (or by weight of inputs) or the definition of efficient and inefficient unit, in which case a unit is inefficient compared to other units whenever a unit or linear combination of some units cannot produce their current output value with less input value or cannot achieve higher output value with the same input value (Askari & Charkhkar, 2015). In its general sense, efficiency means the degree and quality of achieving the desired set of goals (Farrel, 1957). Therefore, the producers will be efficient if they can achieve all their production goals. Farrell suggested that the efficiency of a firm consists of three components:

1. Technical efficiency, which shows the ability of a firm to obtain the maximum product using a certain amount of input and a specific level of technology (Hosseini & Soori, 2007). In other words, the ability of a firm to produce certain outputs by minimizing the set of inputs.

2. Allocation efficiency (price efficiency), which reveals the ability of a firm to use optimal ratios of inputs according to their prices (Hosseini & Soori, 2007). The purpose of this type of efficiency is to minimize costs or maximize revenue, which is measured on the assumption that the firm or organization is already technically efficient.

3. Economic efficiency (cost), which is the product of technical and allocation efficiencies, is obtained according to Farrell's definition. If a firm is fully efficient both technically and professionally, it is economically efficient. Farrell suggested that when calculating technical efficiency, it is more appropriate to compare the performance of a firm with that of the best firms in that industry.

Improving any organization requires measuring the organization's performance, as well as planning and goal setting to improve it. Despite significant advances in the design of performance appraisal frameworks and systems in recent years, many organizations still rely on traditional criteria in this regard (Mohammadi, Mirghafoori, Mirfakhredini, 2009). The method and approach of this assessment can play a main role in its results and outcomes. The current methods of assessment in physical education departments are associated with defects and problems that lead to their inefficiency. Qualitative, personal and intuitive assessments, not determining appropriate parameters for assessment, lack of relative and comparative assessments, not providing a reference or efficient unit as a model for improving the performance to managers with low assessment scores are among these problems. Therefore, it is necessary to introduce novel assessment methods and use them to assess the performance of physical education departments and thereby detect appropriate models to assess the performance of individuals and departments to be used after naturalization.

The discussion of measuring efficiency and performance using scientific methods in industry and factories has been further studied (Heidarinejad, 2003); however, in recent years, service organizations have also paid serious attention to the issue of measuring the efficiency of the organization in organizations such as health centers (Alexander, Busch, & Stringer, 2003), training centers (McMillan & Chan, 2006), libraries (Hammond, 2003), banks (Soteriou & Stavrinides, 2000), etc. Given the importance of efficiency in advancing societies and its place among other sciences, comprehensive study of efficiency, especially the analysis of its mathematical dimensions is inevitable as a criterion for measuring performance. Therefore, calculating the efficiency, assessment and ranking of all branches and subdivisions of a service or industry is an important task and it is necessary to evaluate their performance at least once a year based on scientific principles (Daneshvar, 2006). Physical education departments are no exception to this rule and it is necessary to evaluate them annually and distinguish efficient units from inefficient ones. Physical education departments start their activities with financial, human and physical resources as the inputs of organization and provide various services based on the description of assigned tasks. But the question is that given the resources allocated, to what extent these departments have been able to use the resources to provide sports services to students. In order to be aware of the desirability of the activities of these bodies, an evaluation system is needed to appraise this desirability to determine the extent to which the facilities and resources available in the departments are used efficiently. For this purpose, new techniques for performance assessment are used today (Adabi Firouzjah, Mozafari, Hadavi, 2014).

The limited number of studies in the field of performance appraisal of physical education departments using data envelopment analysis (DEA) as well as review of existing methods of performance assessment in organizations indicates that these methods are typically experimental and involve a series of quantitative and qualitative indicators that are not comparable due to lack of standards and heterogeneity of their results in different managements. In this research, data envelopment analysis (DEA) technique has been used to eliminate this weakness and present an assessment model. Existence of a modern and standard system for correct performance appraisal and addressing the concerns of physical education authorities about the performance assessment systems are all issues that have encouraged this research.

LITERATURE REVIEW

Regarding the most important domestic research conducted in this respect, Soleimani & Ashraf (2018) in their study, which used the same approach to assess the efficiency of volleyball teams in provinces, indicated that 17 and 19 delegations were generally efficient in 2012 and 2013, respectively. According to the results of this study, managerial and operational inefficiency has been the most important factor of weakness in the overall efficiency of volleyball delegations of provinces over the mentioned period. In another similar study conducted by Amirtash, Safania, and Skandari (2018) in which six metrics (i.e. human resource management, organizational structure, finance, innovation, management, organizational culture) and 37 indicators were used, the results showed that among the efficient federations, wrestling, taekwondo and soccer are models and important references for the performance of other federations, respectively.

This is while in the study of Safania, Hosseini & Mohamad Alipour, Mohamad Gafaar (2015) who assessed the performance of the associations under the auspices of Iranian Federation of Sports Associations, it was concluded that three sports are efficient and five inefficient. The results of Anderson-Peterson model rankings also indicated that rugby, baseball, softball, and sepak takraw ranked first to third, respectively. According to the results of this study, inefficient associations have the potential to increase output by maintaining inputs at the existing level (without increasing inputs), and they will be efficient if they increase their outputs by an average of one fold the existing outputs.

In the study of Goharrostami, Molaeinejad & Ramezaninejad (2019), which was performed to analyze the performance dimensions of General Directorate of Sports and Youth of Gilan Province based on a balanced scorecard model with 4 factors, 12 dimensions and 55 indicators, the results showed that there was a significant correlation between the dimensions of internal processes and customer with sports outcomes, as well as between financial dimensions with internal processes, growth and learning dimensions with internal processes. Furthermore, the highest correlation was observed between the dimensions of growth and learning with internal processes, followed by financial and customer dimension with sports results.

In the research by Forouzan (2016), which was conducted to develop a model for assessing the performance of swimming pools, the results showed that in pool performance assessment, the equipment and facilities, customers, health, HR, financial resources, management, architecture, security and safety ranked first to eighth, respectively (Forouzan, 2016).

Moreover, regarding the most important overseas studies in the field of sports, Radovanovich et al. (2014) in a two-stage research using data envelopment analysis (DEA) and modern language association (MLA) techniques, the efficiency of 26 players of National Basketball Association (NBA) was predicted. For this purpose, machine learning algorithms were used. The results of data envelopment analysis are defined as input for embedded learning algorithms and thus the form of performance boundary function is calculated with high reliability. In this study, linear regression, neural networks and support vector machines (SVM) were used to predict the performance boundary. The findings showed that neural networks could predict productivity with an error rate of <1% and linear regression predicted it with <2% error.

PURPOSE OF THE STUDY

In Iran, data envelopment analysis has been used in the assessment of service organizations (Kasaei & Khabazi, 2000), manufacturing companies (Azar & Motmeni, 2004), executive agencies (Alirezaei &

Jafari, 2000), and banks (Alirezaei & Alizad, 2000). Despite the existence of different techniques for assessing the efficiency, strengths and weaknesses of each of them, in this research, we have tried to determine the efficient and inefficient units using DEA. In this research, data envelopment analysis is a set of mathematical planning models, which relatively assesses the physical education units in 19 education regions of Tehran with an input-output viewpoint. Measuring the efficiency of physical education departments will be of great help in improving performance as well as developing this sector in education. The results of this study will be an effective step to identify efficient and inefficient physical education departments to consider productivity promotion programs for inefficient departments in Tehran Province. Therefore, the main goal of this study is to measure the relative efficiency of 19 physical education departments of Tehran using a DEA approach. Also, the specific objectives of this research are to identify and determine the criteria and indicators of performance assessment, as well as identifying and determining the criteria and output indicators of performance appraisal, specifying the appropriate model of data envelopment analysis to evaluate performance, detect and identify efficient and inefficient departments. Ranking of regions based on the level of their efficiency as well as determining and identifying strategies for making efficient the inefficient regions in 19 physical education departments in Tehran.

METHOD

Research Method

In terms of thematic scope, the present study is in the field of sports management research. The time span of this research includes the years 2017-18. In terms of spatial scope, the present research involves the physical education departments of 19 education departments of Tehran. This applied research is descriptive-analytical and it was conducted by field method.

Statistical population, Sample and Sampling Method

The statistical population of the present study includes the physical education departments of 19 regions of Tehran. Due to the limited number of units, sampling was not relevant and the units were selected as a census of all regions and all the documents were examined.

In this study, descriptive and inferential statistics and DEA were used for data analysis. Data envelopment analysis is a mathematical and non-parametric programming technique that measures the relative efficiency of a group of decision-making units. In other words, DEA is a mathematical programming approach for measuring the relative performance of organizational units that have different inputs and outputs where it is difficult to compare and measure efficiency (Fortuna, 2000). DEA is a powerful method to calculate the efficiency of decision making units (DMU), which was developed in 1978 by Charnes, Cooper and Rudes (Mehregan, 2004). In this way, the efficiency of DMUs is calculated using programming models, so that multiple inputs and outputs are defined for the existing sets and their values for each DMU is calculated. Afterward, DEA model form the efficiency boundary by creating a comparison space. Each DMU on the boundary is known as an efficient DMU and each one under the boundary is an inefficient unit, and the degree of its inefficiency is calculated based on the distance to the boundary. DEA calculates the capacity of management for optimal use of available facilities in the form of efficiency score. In this technique, the units using the highest capacity of their resources are recognized as efficient units and metrics for measuring other units (Rasool Roeisi, 2005, Emami Meibodi, 2000).

In the first stage, to prepare research tools (checklists), assessment indicators were determined by reviewing field studies as well as studying the articles and previous research background, and a number of indicators were considered to assess the performance of physical education departments. Then, the indicators were divided into input and output. At this stage, based on the main resources of the organization, three categories of human, financial and material resources (equipment) are defined. Out of these indicators, important ones remained in all three categories of organizational resources that were effective in assessing the performance of physical education departments in Tehran, and the rest were removed. The efficiency and productivity of a unit are a function of the level of inputs and outputs produced by them. Finally, the following indicators were considered as inputs and outputs of data envelopment analysis method.

Inputs

1. Ratio of student to physical education teacher: This input is related to the number of students per physical education teacher in 2017-18 academic year.
2. The budget of physical education sector: This input was considered as a definite number, and the budget allocated to each of the departments for 2017-18 is expressed per million Tomans.
3. Number of sports halls at the disposal of department: This input is the surface area of the hall and rented sports spaces or those owned by the department over 2017-18 (in terms of square meters).

Outputs:

1. Number of sports competitions held by Physical Education Department of each region: This output is related to the number of competitions in team and individual sports held in 2017-18 academic year.
2. Number of provincial and national awards: This output relates to all trophies obtained at provincial and national levels and in all levels of education (first and second grade elementary school, first and second grade secondary school) by both girls and boys in 2017-18 academic year.
3. Number of national and international athlete students: This output is related to the number of male and female athlete students in each region who work at the national and international level in 2017-18 academic years.

The next step is the choice of three models for data envelopment analysis, namely Charnes, Cooper, Rhodes (CCR), Banker, Charnes, Cooper (BCC) and Anderson-Peterson to measure their effectiveness. In the model design phase, DEA-SOLVER LV software was used to analyze the data. Finally, DEA method was employed to design a performance assessment model for the physical education departments of different regions. The research tool is a checklist, which was used to obtain the data needed to implement the model from decision-making units. The validity of the questionnaire is also approved by professors and sports management experts.

RESULTS

We used five main models in data envelopment analysis method to calculate the efficiency of physical education departments of the province: a) Input-oriented CCR model; b) Output-oriented CCR model; c) Input-oriented BCC model; d) Output-oriented BCC model, e) Anderson and Peterson ranking model (Anderson, 1993).

Table 1: General analysis of research data

	Number of provincial and national awards	Number of sports matches held by physical education department of each region	Number of sports halls at disposal of the department	Physical education sector budget	Student to physical education teacher ratio
Maximum	48	42	38529	850	1054.35
Minimum	2	11	1071	35	473.39
Mean	15.47	20.58	10519.82	344.53	703.79
SD	12.49	8.30	10345.05	226.54	162.07

According to the results of Table 1, the maximum, minimum, mean and average values of inputs and outputs can be determined. For example, the maximum value of the first input (ratio of student to physical education teacher) is 1054.35 people, which is related to region 4, and the minimum value is 473.39 ratio, which is related to region 8. The maximum amount of the second input (budget) is 850,000,000 Tomans, which is related to region 1 and the minimum of budget is 35,000,000 Tomans from region 9. The maximum and minimum value of the third input (surface area and dimensions of sports halls at the disposal of the department) is 38,529 and 1071 square meters that is related to region 13 and 12, respectively.

The maximum value of the first input (number of sports competitions held by Department of Physical Education in each region) is 42 competitions, which is related to region 4, and the minimum value is 11 competitions from region 16. The maximum and minimum value of the second output (number of awards) was 48 and 2 from region 5 and 10, respectively. The maximum value of third output (number of national and international athlete students) is 110 in region 5 and the minimum value of it is in region 10 and 12 with 0 athletes.

After determining the variables that are used in the model, the type of model, including output- and input-oriented and return to scale, both constant and variable, is discussed. The models assessing the efficiency of units can use two different approaches: 1) Decreasing the number of inputs without changing the number of outputs (input-oriented approach); 2) Increasing the number of outputs without changing the number of inputs (output-oriented approach). The choice of any of the above viewpoints depends on the desire as well as the degree of control of the manager over each of the inputs or outputs. If the manager has no control over the outputs and their level is already known and constant, then the manager will decrease the level of inputs and the model will become input-oriented. If the manager has no control over the inputs and their value is already known and constant, the manager's viewpoint is to increase the level of outputs and the model is presented as output-oriented. Return to scale can also be constant or variable. Constant return to scale mean that an increase in input value leads to an increase of output by the same proportion; however, in variable return to scale, the increase of output is higher or lower than the increase in input ratio (Momeni, 2014). Constant return to scale models are more restrictive than variable return to scale ones because the former involves a lower number of efficient models and its efficiency value decreases, too (Mehregan, 2004).

To select the appropriate model to assess the performance of regional physical education departments, first efficiency scores for all departments were calculated using input and output oriented CCR and BCC models. Comparing the implementation results of these models shows that the efficiency scores in the input- and output-oriented CCR models are not different. CCR model considers the possibility of production assuming that return to scale is constant. Therefore, the efficiency boundary in its multiplicative model is drawn as a straight line from the center of coordinates. However, there is some difference between the scores of CCR with BCC model.

In BCC model, which assumes that the return to the scale is variable, the efficiency boundary is convex, so if the conditions of the departments are not really consistent with return to constant scale, more units are indicated as efficient, and this difference in results shows that the assumption of constant return to scale does not apply to regional departments and that the CCR model cannot be used. Considering that the outputs are more controllable and manageable than inputs in physical education departments, BCC-O results can be obviously achieved by keeping the inputs constant and increasing the outputs proportionate to the efficiency factor of that unit to reach efficiency equal to 1. Therefore, the proposed model for this research is output-oriented for BCC model. The BCC model even provides the status of return to scale of each efficient unit.

Results of output-oriented BCC model (BCC-O)

According to the results obtained in BCC-O model, out of 19 physical education departments examined, 11 units are efficient, and more departments have been recognized as highly efficient (efficiency equal to 1) than CCR-O model. Efficiency equal to 1 in the model (100%) means that these departments have provided the desired outputs according to their input sources and are therefore known as reference sets with which the rest of the departments should be compared to reach full efficiency.

After these eleven units that have the highest efficiency, region 17 with 0.99% and region 14 with 0.47% have the highest and lowest efficiency, respectively, and the efficiency of other regional offices is between that of region 17 and 14.

In Table 2, the reference set is presented in addition to the efficiency score of each region; the reference set is a collection of regional departments that an inefficient unit can emulate to reach the efficiency limit. For example, to be efficient, region 14 that has 47% efficiency must determine the amount of its inputs by modeling regions 3 (0.141), 5 (0.141), 8 (0.544), 18 (0.174) . In other words, the input value of region 14 to be efficient is obtained as follows:

Region 14 Input= (Input 3 × 0.141) + (Input 5 × 0.141) + (Input 8 × 0.544) + (Input 18 × 0.174)

Table 2: Results of BCC-O model together with reference set

DMU	**Reference set**	**Score**
Region 2	Region 2 (1)	1
Region 3	Region 3 (1)	1
Region 4	Region 4 (1)	1
Region 5	Region 5 (1)	1
Region8	Region 8 (1)	1
Region 9	Region 9 (1)	1
Region 12	Region 12 (1)	1
Region 13	Region 13 (1)	1
Region 15	Region 15 (1)	1
Region 18	Region 18 (1)	1
Region 17	Region 17 (1)	0.99
Region 11	(0.683) 18 ,(0.316) 9	0.88
Region 6	(0.107) 18 ,(0.339) 9 ,(0.509) 5 ,(0.044) 3	0.85
Region 1	(0.713) 8 ,(0.077) 5 ,(0.21) 4	0.79
Region 10	(0.296) 18 ,(0.704) 9	0.66
Region 16	(0.178) 18 ,(0.578) 9 ,(0.244) 5	0.64
Region 7	(0.039) 18 ,(0.474) 9 ,(0.103) 5 ,(0.383) 2	0.52
Region 19	(0.497) 18 ,(0.346) 9 ,(0.07) 5 ,(0.088) 2	0.51
Region 14	(0.174) 18 ,(0.544) 8 ,(0.141) 5 ,(0.141) 3	0.47

Table 3: Results of BCC-O model of input overflow and output defect

DMU	Input overflow			Output defect			Score
	Student to physical education teacher ratio	Physical education sector budget	Surface area of available sports halls	National and international athlete	Provincial and national trophies	Competitions held by physical education departments of each region	
Region 2	0	0	0	0	0	0	1
Region 3	0	0	0	0	0	0	1
Region 4	0	0	0	0	0	0	1
Region 5	0	0	0	0	0	0	1
Region 8	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	1
Region 12	0	0	0	0	0	0	1
Region 13	0	0	4.63	0	0	0.007	1
Region 15	0	0	5.12	0	0	0.002	1
Region 18	0	0	0	0	0	0	1
Region 17	0	0.001	0	0	0	0.003	0.99
Region 11	0	399.40	0	11.51	1.67	0	0.88
Region 6	0	259.60	0	63.65	0	0	0.85
Region 1	0	344.48	1556.42	0	16.06	0	0.79
Region 10	80.41	0	2702.92	39.60	6.17	0	0.66
Region 16	0	0	2108.80	51.48	0	4.041	0.64
Region 7	0	0	193.96	30.45	0	0	0.52
Region 19	0	0	13463.76	28.05	0	0	0.51
Region 14	0	0	3224.50	0	0.368	0	0.47

According to the results of Table 3 from BCC-O model, input overflows and output defects indicate how much the outputs must change to keep inefficient units efficient because the model is output oriented. For example, unit 1, which is inefficient, should have 16.06 increase in its first output (i.e. competitions) by keeping the inputs constant and using the data of output deficit table and thereby achieve technical efficiency (poor efficiency); and if it wants to be a unit with strong performance, it must use the table of input overflows with 34% reduction in the second input (budget) as well as 15% reduction in the third input (sports hall) to achieve strong efficiency.

Anderson-Peterson model results

This is a model to measure efficiency that has input- and output-oriented approaches similar to BCC and CCR models. As can be seen in Table 2, a number of physical education departments have achieved score 1 of efficiency, all of which have become efficient. Now, if we want to rank all 19 regions, there is no doubt that all the regions that have received an efficiency score of 1 are in the first priority. The question, however, is whether we are able to categorize and prioritize those who have achieved an efficiency score of 1. The answer is yes. Anderson-Peterson model provides a way to rank efficient units. Here, too, the size of the numbers is the criterion for ranking the units.

Table 4: Ranking Anderson-Peterson BCC-O model

DMU	Reference set	Score
Region 5	(0.10103505) 13+ (0.56957194) 9+ (0.31942408) 6+ (9.96E-03) 2	3.10
Region 2	(0.61038622) 9+ (0.38960378) 5	1.70
Region 18	(0.22E-03) 15+ (0.14762326) 8+ (4.93E-04)5	1.63
Region 4	(0.58202568) 3+ (0.41797432) 2	1.26
Region 3	(0.44013781) 9+ (0.55986219) 4	1.19
Region 13	(0.11722773) 15+ (0.60640546) 8 + (0.2763568) 5	1.06
Region 17	Region 17 (1)	1
Region 15	Region 15 (1)	1
Region 12	Region 12 (1)	1
Region 8	Region 8 (1)	1
Region 9	Region 9 (1)	1
Region 6	(0.68330996) 18+ (0.31617892) 9+ (5.01E-04) 3	0.88
Region 11	(0.10738889) 18+ (0.33926779) 9+ (0.50912197) 5+ (4.42E-02) 3	0.85
Region 1	(0.71279346) 8+(7.72E-02) 5+ (0.2100223) 4	0.79
Region 10	(0.296) 18+ (0.704) 9	0.66
Region 16	(0.17770201) 18+ (0.57820662) 9+ (0.24408136) 5	0.64
Region 7	(3.93E-02) 18+ (0.47442162) 9+ (0.10276948) 5+ (0.38345975) 2	0.52
Region 19	(0.49657684) 18+ (0.34562845) 9+ (0.06971284) 5+ (0.08807187) 2	0.51
Region 14	(0.17352252) 18+ (0.54403638) 8+ (0.14146588) 5+ (0.14097521) 3	0.47

According to the results obtained from Anderson-Peterson model (BCC-O), region 5 has the highest efficiency (3.10%) and region 14 the lowest efficiency (0.47%) and the efficiency of other departments ranges between that of region 5 and 14.

DISCUSSION

In recent years, we have witnessed a wide range of DEA techniques to assess the performance of different types of units in various areas of activity, in several contexts and in different countries. One reason for this fact is that data envelopment analysis has the potential to be used in cases where there is resistance toward the use of other approaches due to the complexity of relationship between non-homogenous inputs and outputs. Examples include the maintenance activities of US Air Force, British and Welsh police forces, as well as operations of bank branches in Cyprus and Canada. DEA has also opened up new horizons for assessing the effectiveness of activities that have already been analyzed with other techniques. The source of many inefficiencies in efficient and profitable companies has been identified in the past through data envelopment analysis (Kooper, Siford, Ten, 2008).

The implementation results of BCC model with an output-oriented approach show that out of a total of 19 regions under study in 2017, 11 departments have an efficiency of 1 and >1.

Six regions of 2, 3, 4, 5, 13 and 18 had >1 efficiency, and the highest efficiency among these regions was related to region 5 with (3.10) score of percent efficiency and the lowest was related to region 13 with (1.06) score of percent efficiency. Five regions of 17, 15, 12 and 9 have an efficiency of 1, and eight regions of 11, 6, 1, 10, 16, 7, 14 and 19 have <1 efficiency, with region 11 having (0.88) score of percent efficiency, with the highest and lowest scores related to region 11 and 14 with (0.88) and (0.48) score of percent efficiency, respectively. Efficient and inefficient regions are listed in full detail in Table 2.

If we want to talk about the research results in a more practical way, we consider Table 2 of BCC-O model output. The eleven departments that are recognized as efficient are all highly efficient. In other words, in addition to technical efficiency, these units also benefit from allocation efficiency and do not have any inadequacies in their inputs and outputs compared to other units. As an example, we refer to department of region

11 with (0.88) efficiency. In this Table, it is indicated that the reference units for this unit are regions 18 and 9 with the following coefficients: 9 (0.316), 18 (0.683). That is, if we intend to bring the region 11 department to the boundary of technical efficiency, we can achieve efficiency equal to 1 without changing its inputs and only by dividing its outputs by 88%. These results are applicable to BCC-O model. Obviously, if the control of the organization's management is applied over the inputs, BCC-I results can be reached by holding the outputs constant and reducing the inputs proportionate to the efficiency coefficient of that unit to reach efficiency equal to 1.

When it comes to technical efficiency, only one unit is on the boundary of efficiency, but each unit may also have mixed inefficiency (i.e. reduction of inputs by the amount of calculated input overflow), which, after using the results in Table 3, the unit reaches the efficiency equal to 1. Through the results of Tables 4 and 5, the degree of inadequacy of units in allocating resources and outputs has been determined. In order for region 11 department to achieve strong efficiency equal to 1, we should divide the amount of inputs by the score calculated for that unit, followed by eliminating mixed inefficiency.

Anderson-Peterson model also deals with complete ranking of units. These scores in their linear normalized form along with the results of input-oriented and output-oriented BCC models were used in the final scoring of research units.

Therefore, the degree of changes needed to make inefficient units efficient can be determined by modeling efficient regional departments. For example, in (BCC-O) table, in addition to the efficiency score of each region, its reference set is also presented, which is a collection of regional departments the inefficient unit can emulate to reach the efficiency boundary. To answer this question, according to the reference set for each efficient department, the weight related to each reference department, the weight of reference department, the amount of defect in output, the desired amount of inputs have been calculated for each inefficient unit, which is shown in Table 3. As can be seen, the departments that were on the boundary of high efficiency will continue to be efficient with the existing value. The departments on the boundary of poor efficiency must increase their output deficit, and inefficient departments must emulate efficient ones to increase their outputs to become an efficient department.

For example, physical education department in region 2 is a highly efficient department that does not need to increase any of its outputs because in all three outputs, the current status and the optimal status it can emulate are equal, and it should not change its outputs by any percentage. However, region 1 department with an efficiency of 0.79% and a rank of 14 is on poor efficiency boundary, and to be able to improve its status, it must increase output deficit. For example, in the current situation, region 1 has held 23 competitions in schools for the first output, and to reach the desired and optimal situation, it must increase the number of competitions to 23.05, i.e. by 26.3%. Also, for the second output, which is the number of provincial and national trophies, the current status of the department is 4 trophies, and in order for the department to reach the desired and ideal situation, it must have an increase of 21.1 in this output, namely an increase of about 42%. Finally, in its third output, which is the number of national athlete students, the current situation is 12.01, which should increase the number to 15.1, i.e. by 26.3%.

CONCLUSIONS

In the end, it can also be concluded that most physical education departments have properly used the inputs and do not need to increase the amount of their outputs and inputs. However, a number of regional departments must have a percentage of increase in output so that the department can go beyond the boundaries of poor efficiency and reach the desired situation. It should be noted that these values are a result of solving the research model. What managers need to keep in mind is that like many other techniques, DEA offers a number of quantitative solutions to improve the situation. DEA can even express achievable outputs in terms based on mathematical analysis; however, in practice, about 20-40% of the desired improvements are easily achievable, 20-40% demand more effort, and the rest are not achievable (Wu, Yang, Liang, 2006).

All departments discussed in this study can achieve efficiency, which is the common goal of all organizations, by following the routine of decreasing their inputs and increasing their outputs. The goals of the program that are achieved in this way have all the desirable features of the program, including measurability, specificity, etc., and are also applicable. Benchmarking is another advantage of this technique. The results of the research indicate a positive and strong relationship between benchmarking and business performance. A review of the literature over the past ten years reveals that DEA is the most common benchmarking tool (Ketabi, Emami, 2013) and that education departments can use it to identify efficient units and receive guidelines for performance improvements from reference units. Finally, based on the findings of the study, the following suggestions can help executives and researchers in the field of practice and opinion.

In line with this research, the data envelopment analysis technique introduces an optimal modeling reference for each decision-making unit, and each inefficient unit can follow one or more reference units to improve performance. Subsidiary education departments are encouraged to consider their optimal input and output values based on BCC-O table in their goal-setting. In addition to the need for valid and reliable indicators, this requires a strong, efficient and up-to-date monitoring system providing the necessary mechanisms for continuous promotion and improvement of all units. Moreover, according to the final research model, if output-oriented BCC model is used, most departments are efficient and properly use the indicators. Therefore, it is suggested that inefficient departments change the amount of their inputs and outputs by the same determined degree to achieve full efficiency, as well as planning and modeling efficient physical education departments and using reference examples in order to direct their status towards full efficiency. Besides, according to the ranking used in final research model, which is the output-oriented BCC model, region 5 has the highest ranking with (3.10) percent efficiency. Moreover, according to the majority of models used in the research, region 5 has high efficiency and score, which seems to be a function of special conditions such as the existence of active and strong sectors and manpower as well as the high level of facilities, financial and physical resources in this region relative to other regions. Accordingly, it is suggested that the various programs of this region in pursuing the physical education goals and the mode it interacts with its human resources should be reviewed by other regional departments to be modeled for progress and efficiency. Moreover, according to the final research model, if the output-oriented BCC model is used, by dividing the amount of outputs in the calculated score for that unit and then eliminating the mixed inefficiency, efficiency equal to 1 can be attained. In contrast, the difference of input-oriented BCC model is that the amount of outputs remains unchanged and only the amount of inputs is reduced.

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