Australian Journal of Basic and Applied Sciences, 5(10): 829-837, 2011
ISSN 1991-8178

Measuring the Performance of Sport Associations in Attracting Individuals to Sports Using Data Envelopment Analysis
A Case Study in the Yazd City (Iran) in 2008

[1]Seyed Heydar Mirfakhr-al-Dini, [2]Abd-al-Nabi Khatibi Aghda

[1]Assistant professor, Yazd University.
[2]B.A. in Industrial Management, Yazd University.

Abstract: Today, for organizations to survive the socio-economical competition and achieve sustainable improvement, it is necessary to acquire the information about the performance, strategies of competitors, technological as well as procedural changes. Organizations may design a unique system for measuring their performance in order to come to the best decisions in due time. Using a new approach, this study aims at evaluating the performance of sport associations. In this paper, the performance of 15 sport associations is analyzed using the data envelopment analysis (DEA) and taking into account the following variables: duration of associations' activity in Yazd, the budget allocated, the number of coaches as the model input and the number of athletes as the output. The results show an average performance of 54% for total associations and the variation range varies between 4.2% to 100%. 40 percents have 100% efficiency and the efficiency for the rest of the associations is below 50%. Therefore it was shown that the wrestling association had the best and the bowling & billiard association had the worst efficiency rates. Furthermore, by ranking the efficient associations, it became possible to investigate ways to increase the efficiency of inefficient associations based on reference associations.

Key words: measurement, efficiency, sport association, data envelopment analysis, DEA.

INTRODUCTION

Performance measurement should be an integral part of any organization. Choosing the right strategies to improve the organization's performance is a necessity in measuring the performance of organizations. In this paper, different variables and norms are used to examine and measure the performance of an organization. Due to its importance in performance measurement, efficiency index has always drawn the attention of scholars and researchers and, different strategies have been proposed for analyzing it. Data envelopment analysis (from now on DEA) is a reliable method in measuring the relative efficiency of similar organizations based on inputs and outputs (Gabriel villa *et al*, 2004) (Charnes *et al* 1978). In this method, using mathematical planning models a margin including the best relative efficiencies is defined and this margin provides a criterion for studying performance improvement strategies in other organizations. By using no output functions, DEA makes no presupposition about the institutions under study. Sport, as an important factor in socio-political improvements, has various direct and indirect economical and political impacts on countries and sporting performance is a management-related activity (Chadwick,2009). Therefore, to have a better sport performance as well as an effective management, we need to take sport and elements related to it as an integrative system and make use of comparative approaches abroad (W. B. 1997). Due to the importance and the role of sport organizations in each society and the importance of efficiency as a measurement index of performance and the reliability of DEA in measuring the efficiency of organizations, this paper takes a systematic perspective to sport organizations in Yazd province and analyzes the efficiency of sport associations in 2008 using DEA model and finally gives further suggestions in line with improving the performance of sport associations.

2. Theoretical Framework:
2.1 The Concept of Efficiency:

Efficiency is defined as the maximum quantity of output attainable from given inputs. It is the relation between observed and optimal values of outputs from a given level of inputs. A firm is operating efficiently if it maximizes output with a given level of inputs and that is considered as "technically efficient". (White and Ozcan, 1996).

2.2 Measuring Efficiency:

There are different methods for measuring efficiency. These methods, classified into parametric and non-parametric methods, are discussed below:

a. Parametric Method:

Corresponding Author: Seyed Heydar Mirfakhr-al-Dini, Assistant professor, Yazd University.
E-mial: sh.mirfakhr@gmail.com

In this method, a particular form (such as the KAB or Douglas functions) is taken into account for the production function and then unknown parameters are calculated using typical methods used in statistics and economics. In the end, the efficiency for each agency is measured using the resulting function (Daraio *et al* ,2007).

b. Non-parametric Method:

This method is based on a series of optimized mathematics used for calculating the relative efficiency (Daraio *et al*, 2007). The term relative above is very important, because the measured efficiency is the result of comparing agencies with each other. Therefore, its value may change if some cases are omitted or added to the survey. In this method there's no need to select the function form and no limit to the number of outputs. One of the non-parametric methods is data envelopment analysis used in this study. (Farrell ,1957).

2.3 Data Envelopment Analysis (DEA):

Farrel (1957) first introduced the term "DEA" to describe what is a mathematical programming approach for the construction of production frontiers and the Measurement of efficiency relative to the constructed frontier. The model for analyzing the performance of similar organizations in a competitive environment using mathematic planning models was introduced in 1978 by Charnes, Cooper, and Rhodes (CCR; Charnes *et al* 1978). This model is based on efficiency to a fixed scale and is known as CCR. Afterwards, in 1984, the model was developed to efficiency on a variable scale (BCC) by Banker, Khosla (Banker, Khosla ,1984). DEA models, measure the capability of decision making units in transforming input to output. This capability is called efficiency (Tat Keh, Chu 2003). More specifically, these models, first measure the production feasibility using linear planning methods regarding the conditions of the units under investigation, then the result determines, the production feasibility limit called the efficiency limit. In the end, units are analyzed based on their distance from the limit and the strategies for improving the efficiency are examined accordingly (Alirezaee *et al*, 2007).

2.4 Background:

A considerable amount of research is conducted on measuring efficiency in sport organizations as a method for measuring their performance (some of these researches are shown in Table 1).

3. Methodology:

In this mathematical-analytical study we have used literature and interviews to analyze the data. First, the information related to the study was gathered by reviewing the related literature. The data was further examined by the experts in the field. In the end, the variables were detected and the data for this study were gathered from the Iran Physical Education Organization (IPEO) and were analyzed by software DEA Master.

3.1 Research Model:

There are different methods for measuring the efficiency of organizations one of which is data envelopment analysis (DEA). DEA is categorized into two groups:

a. Input- oriented models decrease the input through stabilizing the output.

Output- oriented models increase the output through stabilizing the input.(Joe Zhu,2003)

Since the ratio of efficiency to the measure is unstable (variable returns to scale VRS), output- oriented BCC models are used to measure the efficiency of sport associations. It is formulated below:

$$\text{MAX} = \sum_{i=1}^{m} v_i x_{ij} + u_0$$

s.t:

$$\sum_{r=1}^{s} u_r y_r = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} + u_0 \leq 0 \; j = 1 \dots n$$

$$u_r \geq \varepsilon \quad r = 1, \dots, s$$

$$v_i \geq \varepsilon \quad i = 1, \dots, m$$

free in sign

Output- oriented BCC model

(Jie Wu *et al*, 2009)

Table 1: Research on measuring efficiency.

article	Method	Units (DMU_S)	input	Output
Barros (2003)	DEA model	19 learning activity in sportive organization during 1999-2001	Number of coaches, managers, manager's income, physical facilities	Number of participants, number of courses, number of certificates
Barros and Leach (2006a)	DEA-CCR&BCC model	Football Clubs of Champion's League, UK	Players, income, the club's facilities, total passes	Number of spectators, score, income
Barros and Leach (2006b)	Arbitrary border model	Football Clubs of Champion's League, UK	Administrative expenditure	Number of spectators, scores
Barros and Leach (2007)	Technical efficiency	Football Clubs of Champion's League, UK	Administrative expenditure	Number of spectators, score, income
Barros and Santos (2003)	Assembly DEA model	18 learning activity in sportive organization during 1999-2001	Number of coaches, managers, manager's income, physical facilities	Number of participants, number of courses, number of certificates
Carlos Pestana Barros (2008)	Arbitrary border model	Football Clubs of Champion's League, UK	Cost matrix	Percentage of won games
Dawson *et al*. (2000)	Arbitrary border model	A selected number of Football teams, UK, 1992-1998	Player's age, experience in league, total, past experience of the team, past experience of the league, the position of players in the field	Percentage of won games
Fizel and D'Itri (1996)	DEA-CCR model	Basketball teams	The player's ability, the rival's capabilities	Winners (percent)
Fizel and D'Itri (1997)	DEA & regression model	147 College Basketball teams 1984-1991	The player's ability, the rival's capabilities	Winners (percent)
Haas (2003a)	DEA-CCR&BCC model	12 U.S Football Clubs in 2000	player and coach's income, the time spent in the club	Number of spectators, score
Haas (2003b)	DEA-CCR&BCC model	20 Champion's League Clubs during 2000-2001	Total income, incentives given to coaches, city population	Number of spectators, score
Hoefler and Payne (2006)	Arbitrary-border production model	National Confederation of Basketball Clubs	Defended shoots, chances, total passes, missed balls, services (percent)	Number of winners
Marcos P. Estellita Lins (2003)	DEA-CCR & BCC model	Countries in 2000 Olympic	Net domestic production, population of the country	Number of gold, silver, bronze medals.
Jie Wu *et al* (2009)	DEA model	Countries in 2004 Olympic	Net domestic production, population of the country	Number of gold, silver, bronze medals.
Porter and Scully (1982)	DEA-CCR model	Baseball Champion League teams 1961-1980	Number of shots defended and hit	Percentage of won games
Scully (1994)	Arbitrary border model	41 basketball teams	Number of shots defended and hit	Percentage of won games

3.2 Outputs & Inputs:

Choosing the right input/output variables is an important step in measuring the organizational performance. As mentioned in, selecting wrong variables might devaluate the results. In this paper, we indicated the initial variables based on the literature review, then, analyzed and discussed them with experts in the field. In the end, these variables were selected:

Input Variables:

1.The number of coaches in the sport association
2.Annual budget allocated to the sport association
3.The duration of a sport association

Output Variables:

1.The number of (male & female) athletes in the association

3.3 Sample and Population:

The population includes 46 sport associations in the Yazd city. Since none of the associations provided the required data, and as suggested by experts and authorities, 15 associations were taken as the sample. These include: 1. Badminton, 2. Boxing, 3. Bowling & billiard, 4. Tennis, 5. Basketball, 6. Cycling, 7. Fighting sports, 8. Swimming, 9. Football, 10. Karate, 11. Wrestling, 12. The deaf sports 13. Biking and driving, 14. Volleyball, 15. Handball.

4. Research Questions:

Research questions are:

1. What is the relative efficiency of each association in 2008?
2. What is the relative efficiency of men's associations in 2008?
3. What is the relative efficiency of women's associations in 2008?
4. What is the ranking of each association in 2008?
5. What is the ranking of men association in 2008?
6. What is the ranking of women association in 2008?

5. Data Collection:

The data for this study was collected from Iran Physical Education Organization (IPEO) and sport associations. Since categorized as classified information, the data shown in the table below are changed with a constant ratio.

Table 2: Research data.

	Input				output	
Sport association	budget	duration	No. of Coach (men)	No. of Coach (women)	No. of athletes (men)	No. of athletes (women)
Badminton	66.04	32	4	4	151	535
Basketball	95.13	40	12	4	409	242
Boxing	132.38	11	7	0	61	0
Bowling & billiard	26.7	7	5	3	28	0
Tennis	75	31	6	1	96	18
Cycling	900.37	30	6	1	160	39
Fighting sports	81.36	29	180	100	690	259
swimming	48.24	40	50	67	776	852
Football	524.66	35	50	15	12964	293
Karate	194.99	29	50	50	3176	1293
Wrestling	90.08	35	17	0	1318	0
The deaf sports	123	23	5	3	30	20
Volleyball	964.38	35	43	30	1045	2582
Handball	637.4	20	20	8	257	218
Biking	55	7	3	0	104	0

6. Findings and Results:

6.1 Descriptive Findings:

The data was arranged from great to small using SPSS (table 3). The results show that the volleyball association has the highest number of women athletes, and the football association the highest men athletes, the highest number of coaches in fighting associations (men &women), the highest budget allocated to the volleyball association and the most experienced (duration) is the swimming association.

Table 3: Ranking associations according to research variables.

rank	No. of athletes (women)	No. of athletes (men)	No. of coach (women)	No. of coach (men)	duration	budget
1	Volleyball	Football	Fighting sports	Fighting sports	swimming	volleyball
2	Karate	Karate	Swimming	Swimming	Basketball	Cycling
3	Swimming	Wrestling	Karate	Karate	Football	Handball
4	Badminton	Volleyball	Volleyball	Football	Volleyball	Football
5	Football	Swimming	Football	Volleyball	Wrestling	Karate
6	Fighting sports	Fighting sports	Handball	Handball	Badminton	Boxing
7	Basketball	Basketball	Basketball	Wrestling	Tennis	The deaf sports
8	Handball	Handball	Badminton	Basketball	Cycling	Basketball
9	Cycling	Cycling	The deaf	Boxing	Fighting sports	Wrestling
10	The deaf	Badminton	Bowling & billiard	Cycling	Karate	Fighting sports
11	Tennis	Biking & driving	Cycling	Tennis	The deaf	Tennis
12	Biking & driving	Tennis	Tennis	The deaf	Handball	Badminton
13	Boxing	Boxing	Wrestling	Bowling & billiard	Boxing	Biking & driving
14	Bowling & billiard	The deaf	Biking & driving	Badminton	Bowling & billiard	swimming
15	Wrestling	Bowling & billiard	Boxing	Biking & driving	Biking & driving	Bowling & billiard

6.2 Measuring Efficiency:

Data envelopment analysis (Output- oriented) was used to measure the efficiency of sport associations.

6.2.1 Measuring the efficiency of all Associations:

In this model, the number of coaches, sports background, budget allocated are considered as the input variables and the number of athletes as the output variable. Efficient and Inefficient associations are indicated according to findings of the output (table 4). As you can see from the table, badminton, football, karate, wrestling, volleyball and swimming associations are considered as efficient and the rest as inefficient.

6.2.2 Measuring the Efficiency of Women's Associations:

In this model, the number of female coaches, sports background, budget allocated are considered as the input variables and the number of female athletes as the output variable. Efficient and inefficient associations are indicated according to findings of the output (table 4). As you can see from the table, badminton, karate, swimming, volleyball associations are considered as efficient and the rest as inefficient.

6.2.3 Measuring the Eefficiency of Men's Associations:

In this model, the number of male coaches, sports background, budget allocated are considered as the input variables and the number of male athletes as the output variable. Efficient and inefficient associations are indicated according to findings of the output (table 4). As it can be seen in the table, the football and swimming associations are considered as efficient and the rest as inefficient.

Table 4: The output of DMUs measured by data envelopment analysis

The efficiency of all associations				The efficiency of women's associations				The efficiency of men's associations			
	DMU	Rank	Efficiency		DMU	Rank	Efficiency		DMU	Rank	Efficiency
Efficient units	Badminton	1	100 %	Efficient units	Badminton	1	100 %	Efficient units	football	1	100 %
	Swimming		100 %		Swimming		100 %		Swimming		100 %
	football		100 %		karate		100 %	Inefficient units	karate	2	88.2 %
	karate		100 %		volleyball		100 %		wrestling	3	57.1 %
	wrestling		100 %	Inefficient units	football	2	99.4 %		biking	4	44.7%
	volleyball		100 %		basketball	3	62.6 %		Fighting sports	5	42.6 %
Inefficient units	basketball	2	49.9 %		Fighting sports	4	37.7 %		Badminton	6	40 %
	biking	3	44.7%		handball	5	28.6 %		basketball	7	26.6 %
	Fighting sports	4	41.6 %		Cycling	6	25.6 %		volleyball	8	14.8 %
	cycling	5	32.2 %		Tennis	7	14.5 %		cycling	9	10.3 %
	handball	6	30.6 %		The deaf	8	5.1 %		Tennis	10	6.2 %
	Tennis	7	16.7 %1		boxing	9	0		handball	11	5 %
	boxing	8	14.7 %		Bowling & billiard		0		Bowling & billiard	12	4.1 %
	The deaf	9	5.7 %		wrestling		0		boxing	13	3.4 %
	Bowling & billiard	10	4.2 %		biking		0		The deaf	14	2.2 %

6.3 Ranking Efficient Associations:

Taking into account the fact that efficient associations are different, we can rank them further. There are different methods for ranking efficient associations one of which is the Anderson & Peterson's method.

Anderson & Peterson's (AP) method:

Anderson and Peterson proposed a model for ranking efficient organizations in 1993 which allows us to determine the most efficient associations. In this method, the score attributed to the efficient associations might exceed 1. The output using AP model is shown in table 5:

$$\text{MAX } w_p = \sum_{r=1}^{s} u_r y_{rp}$$

St:

$$\sum_{i=1}^{k} v_i x_{ip} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{k} v_i x_{ij} \le 0 \qquad j=1,\ldots,n_3\ j \neq p$$

$$u_r \ge 0 \qquad r=1,\ldots,s$$

$$v_j \ge 0 \qquad i=1,\ldots,k$$

Anderson & Peterson model

Table 5: Ranking DMUs using DEA and AP

The efficiency of all associations				The efficiency of women's associations				The efficiency of men's associations			
	DMU	Rank	Efficiency		DMU	rank	Efficiency		DMU	rank	Efficiency
Efficient units	Badminton	1	773.8 %	Efficient units	Badminton	1	250.3 %	Efficient units	football	1	401 %
	Swimming	2	667.2 %		Swimming	2	197 %		Swimming	2	133.6 %
	football	3	272.2 %		Karate	3	178.8 %	Inefficient units	karate	3	88.2 %
	karate	4	250.3 %		Volleyball	4	141.1 %		wrestling	4	57.1 %
	wrestling	5	232 %	Inefficient units	Football	5	99.4 %		biking	5	44.7%
	volleyball	6	164.8 %		Basketball	6	62.6 %		Fighting sports	6	42.6 %
Inefficient units	basketball	7	49.9 %		Fighting sports	7	37.7 %		Badminton	7	40 %
	biking	8	44.7%		handball	8	28.6 %		basketball	8	26.6 %
	Fighting sports	9	41.6 %		Cycling	9	25.6 %		volleyball	9	14.8 %
	cycling	10	32.2 %		Tennis	10	14.5 %		cycling	10	10.3 %
	handball	11	30.6 %		The deaf	11	5.1 %		Tennis	11	6.2 %
	Tennis	12	16.7 %1		Boxing	12	0		handball	12	5 %
	boxing	13	14.7 %		Bowling & billiard		0		Bowling & billiard	13	4.1 %
	The deaf	14	5.7 %		Wrestling		0		boxing	14	3.4 %
	Bowling & billiard	15	4.2 %		Biking		0		The deaf	15	2.3 %

6.4 Optimizing Inefficient Associations:

6.4.1 Reference Units:

An advantage of DEA is detecting a (virtual) model unit to change inefficient units into efficient units. Using this model a paradigm is proposed. This paradigm might be used by inefficient units to match and modify their input/ output according to the model unit and get closer to the paradigm. The estimated weights of the model units for inefficient units shows the relative importance of each efficient unit for the inefficient ones (table 7). Table 6 illustrates the model associations for inefficient associations, and table 7 shows the weight of each efficient association (in the form of the Reference Units) for the inefficient one. For example, table 6 shows that reference units for basketball association are badminton, football and wrestling. And as seen in the table 7, the weight of badminton association is more than other models, therefore it could be regarded as the most important model for modifying the input and output variables for the basketball association.

Table 6: Reference Units for Inefficient units

biking	handball	The deaf	fighting	Cycling	tennis	bowling	boxing	basketball	Inefficient units
wrestling	Badminton Football volleyball	Badminton Football wrestling	Swimming Football Karate	Badminton Football wrestling	Badminton Football wrestling	football	wrestling	Badminton Football wrestling	Reference Units

Table 7: The weight of Reference Units for Inefficient units

	badminton	basketball	boxing	Bowling & billiard	tennis	Cycling	fight	Swimming	football	karate	wrestling	The deaf	volleyball	handball	biking
badminton	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
basketball	0,891	0	0	0	0	0	0	0	0,029	0	0,233	0	0	0	0
boxing	0	0	0	0	0	0	0	0	0	0	0,314	0	0	0	0
Bowling & billiard	0	0	0	0	0	0	0	0	0,051	0	0	0	0	0	0
Tennis	0,193	0	0	0	0	0	0	0	0,015	0	0,263	0	0	0	0
Cycling	0,222	0	0	0	0	0	0	0	0,007	0	0,279	0	0	0	0
Fight	0	0	0	0	0	0	0	0,615	0,077	0,058	0	0	0	0	0
swimming	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Football	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Karate	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Wrestling	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
The deaf	0,641	0	0	0	0	0	0	0	0,029	0	0,042	0	0	0	0
volleyball	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Handball	0,362	0	0	0	0	0	0	0	0,045	0	0	0	0,196	0	0
Biking	0	0	0	0	0	0	0	0	0	0	0,176	0	0	0	0

6.4.2 Determining the Suggested Values for Inefficient Units:

Table 8 shows the suggested values for modifying inefficient associations with regard to the model associations.

The basketball association, for example, to be efficient enough must increase its female athletes to 468 and male athletes to 820.

Table 8: Suggested values for improving the efficiency of all inefficient associations.

	Female athletes		Male athletes	
	present value	Suggested value	present value	Suggested value
Basketball	242	486	409	820
boxing	0	0	61	415
Bowling & billiard	0	15	28	660
tennis	18	108	96	574
cycling	39	122	160	497
fighting	259	623	690	1659
The deaf	20	352	30	528
handball	218	713	257	841
biking	0	0	104	233

7. Conclusion:

This study investigated the performance of sport associations and teams using a new approach. The efficiency of 15 sport associations was analyzed using data envelopment analysis (DEA). The average efficiency for all associations was 54% and the variation range was from 4.2% to 100%. 40 percent of associations had 100% efficiency and the rest below were 50%. Moreover, the wrestling association indicated the best rates and the bowling and billiard associations the worst. In addition, ranking the efficient associations, we examined approaches to improve the efficiency of inefficient associations based on reference associations. Average total efficiency for female athletes was 44.9% with a variation ration of 0 to 100%. The volleyball association ranked as the best association and boxing, bowling & billiard, wrestling and biking associations as the worst female associations. Average efficiency for male associations was 34.26% and the variation ratio was between 2.3 to 100%. The football and the deaf associations ranked as the best and worst male associations, respectively.

A comparison of tables 1 & 2 with 3 & 4 shows the reason behind the efficiency of those associations. For example:

Women boxing, wrestling and biking associations have zero efficiency. Analyzing table 1, we can conclude that one of the reasons for this is the lack of female coaches in these fields. Therefore, for improving the efficiency of these associations, we need to take approaches supporting an increase in female coaches in the field.

Bowling & billiard association ranked as the lowest. The reasons might be: it being a new field, low budgets allocated, having few male coaches and no female ones. Not having any female coaches and it being a new field is the more significant factors. Based on these findings, it is suggested that the authorities train female coaches and spread this new field among the people.

Moreover, using factors affecting the efficient associations and using the findings in table 5, we can take proper strategies to change inefficient associations into efficient ones.

For example, the male football association has the highest efficiency, and analyzing the tables proves that the large number of coaches and its vast experience are the effective factors, however, regarding the fact that our model is output-based; the high efficiency of coaches in the field is the main reason.

It is suggested that the administrative strategies of the football association be examined and proper models be devised for training coaches with high efficiency so as to help improve the inefficient associations.

On the whole, these reasons are the main reasons behind high/low efficiency of associations:

1. (male, female) Coaches' productivity: the number of (male, female) athletes in relation to the number of (male, female) coaches.
2. Time productivity: the number of (male, female) athletes for a year of activity in the province.
3. Economic resources productivity: the number of (male, female) athletes for a fiscal year.

Analyzing the productivity and investigating the administrative strategies undertaken by each association, we can recognize the weaknesses and strengths of associations and suggest some administrative strategies:

Suggestions:

1. Increasing the output of inefficient groups based on table 8.
2. Designing a comprehensive system for analyzing the performance of sport associations.
3. Designing a program for recording and reporting, and collecting data and information from associations as a major instrument for gathering input for performance measurement.
4. Analyzing sport associations from the management, procedure, training system, evaluation points of view, etc. to design an administrative program for non-efficient associations. The rankings also could be used to allocate resources and develop proper policies to improve development indices in the associations and fill the gap between these associations and those of the leading countries.

5. Investigating the cause and effects of inefficient associations.
6. We can make use of effective decision making models to find and specify the organizations having positive/negative impacts.
7. It is further suggested that we could examine and modify the efficiency process of associations during different periods to fill in the gap between them and the leading countries.

8. Limitations of the Study:

1. Place and time limitation: this study only includes the sport associations of the Yazd province in 2008.
2. We had limited access to information on associations.

REFERENCES

Alirezaee, M.R., M. Afsharian, 2007. Model Improvement for Computational difficulties of DEA Technique in the Present of Special DMU's, Applied Mathematics and Computations, 186: 1600-1611.

Banker, R.D. and I.D. Khosla, 1984. Economics of operations management: A research perspective. Journal of Operation Management, 12: 423-425.

Barros, C.P., 2003. Incentive regulation and efficiency in sports organizational training activities. Sport Management Review, 6(1): 33-52.

Barros, C.P., A. Santos, 2003. Productivity in sports organizational training activities: a DEA study. European Journal of Sport Management Quarterly, 1: 46-65.

Barros, C.P., S. Leach, 2006a. Performance evaluation of the English Premier League with data envelopment analysis. Applied Economics, 38(12): 1449-1458.

Barros, C.P., S. Leach, 2006b. Analysing the performance of the English F.A. Premier League with an econometric frontier model. Journal of Sport Economics, 7(4): 391-407.

Barros, C.P., S. Leach, 2007. Technical efficiency in the English Football Association Premier League. Applied Economics Letters, 14(10): 731-741.

Carlos Pestana Barros, Pedro Garcia-del-Barrio, 2008. Efficiency measurement of the English football Premier League with a random frontier model, Economic Modelling, 25: 994-1002.

Chadwick Simon, 2009. From outside lane to inside track: sport management research in the twenty-first century, Management Decision, 47(1): 191-203.

Charnes, A., W.W. Cooper and E. Rhodes, 1978. Measuring the efficiency of decision-making units. European Journal of Operations Research, 2: 429-444.

Daraio, C., L. Simar, 2007. Advanced robust and nonparametric methods in efficiency analysis ,methodology and application, springer, ISBN: 978-0-387-35155-1.

Dawson, P., S. Dobson, B. Gerrard, 2000. Stochastic frontier and the temporal structure of managerial efficiency in English soccer. Journal of Sports Economics, 1: 341-362.

Farrel, M.J., 1957. The measurement of productive efficiency. Journal of the Royal Statistical Society, Series A, 120: 253-290.

Farrell, M.J., 1957. The measurement of productive efficiency. Journal of the Royal Statis-tical Society A 120: 253-281.

Fizel, J.L., M.P. D'Itri, 1996. Estimating managerial efficiency: the case of college basketball coaches. Journal of Sport Management, 10: 435-445.

Fizel, J.L., M.P. D'Itri, 1997. Managerial efficiency, managerial succession and organizational performance. Managerial and Decision Economics, 18: 308-295.

Gabriel Villa, Sebastián Lozano, 2004. Constant sum of outputs dea model for olympic games target setting, 4 th International Symposium of DEA,5 th -6 th September 2004 , Aston Business School, Aston University,UK.

Haas, D.J., 2003a. Technical efficiency in the Major League Soccer. Journal of Sport Economics, 4(3): 203-215.

Haas, D.J., 2003B. Productive efficiency of English football teams — a data envelopment approach. Managerial and Decision Economics, 24: 403-410.

Hoefler, R.A., J.E. Payne, 2006. Efficiency in the National Basketball Association: a stochastic frontier approach with panel data. Managerial and Decision Economics, 27(4): 279-285.

Jie Wu,Liang Liang, Yao Chen, 2009. DEA game cross-efficiency approach to Olympic rankings, Omega, 37: 909-918.

Joe, Zhu, 2003. Quantitative models for performance evaluation and benchmarking: data envelopment analysis with spreadsheets and dea excel solver,ISOR,ISBN:1-4020-7082-9.

Lyle John, W.B., 1997. Managing excellence in sports performance, Career Development International l2/7: 314-32.

Marcos P. Estellita Lins, Eliane G. Gomes, Jo~aao Carlos C.B. Soares de Mello Adelino Josee R. Soares de Mello, 2003. Olympic ranking based on a zero sum gains DEA model, European Journal of Operational Research, 148: 312-322.

Porter, P., G.W. Scully, 1982. Measuring managerial efficiency: the case of baseball. Southern Economic Journal, 48: 642-650.

Scully, G.W., 1994. Managerial efficiency and survivability in professional team sports. Managerial and Decision Economics, 15: 403-411.

Tat Keh Hean, Chu Singfat, 2003. Retail productivity and scale economies at the firm level: a DEA approach, Omega, 31(2): 75-82.

White, K.R. and Y.A. Ozcan, 1996. Church ownership and hospital efficiency. Hospital Health Services Administration, 41(3): 297-310.