نموذج قياس الكفاءه لبرامج الدراسات العليا وبرامج الدراسات الاوليه بأستخدام تحليل مغلف البيانات

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المستخلص

قياس كفاءة برنامجي الدراسات العليا والدراسات الاوليه هي واحدة من العناصر الأساسية في العملية التعليمية. في هذه الدراسه , كليات جامعة بغداد وبيانات العام الدراسي (2011-2012) اختيرت لقياس الكفاءة النسبية لبرنامجي الدراسات العليا و والدراسات الاوليه من حيث المدخلات والمخرجات الخاصة بهم. والطريقة المعنية لإجراء تحليل هذه البيانات هي تحليل مغلف البيانات (DEA). كما ان تأثير أعضاء هيئة التدريس على عدد الطلاب الملتحقين والخريجين في برامج الدراسات العليا والدراسات الاوليه هي المحور الرئيسي لهذه الدراسة.

المصطلحات الرئيسية للبحث/ تحليل مغلف البيانات, الكفاءه, تقييم الاداء, برنامج الدراسات العليا, برنامج الدراسات الاوليه, المدخلات, المخرجات.

مجلة العلوم
الاقتصادية والإدارية
المجلد 20
العدد 78
لسنة 2014
الصفحات 1- 16

1. Introduction

Improving the quality of higher education institutions is in line with the national agenda towards making Iraqi higher education as a preferred center of higher education. Higher education is important to produce future leaders equipped with knowledge and skills (Zoghbi et al., 2013). Abdulkareem and Oyeniran, (2011) stated that higher education includes undergraduate, diplomas and postgraduate. Recently, issues in higher education regarding graduate performance, staff performance and institution performance often studied. For example, Martin (2003) applied DEA methodology for assessing the performance of Zaragoza University's departments (Spain). The indicators that were included in the study concerned both the teaching and the research activity of the departments. The results thereof revealed those departments that are more efficiently carrying out these activities. In addition, Taylor and Harris (2004) measuring the relative efficiency between 1994 and 1997 among South African universities. While, Castano and Cabanda in 2007 evaluated the efficiency and productivity growth of state universities and colleges in Philippines. They used two of DEA models which are the output-orientated DEA-Malmquist index and secondly, the DEA multi-stage model (input reduction).The period covered is five years from 1999-2003 for (59) DMUs and three educational outputs and three inputs.

The issue of quality in education has been discussed from a perspective of quality assurance, quality improvement , quality management and quality measurement. The main point of all these debates is to achieve a quality education system that can provide the students with an appropriate preparation for working life , social life and private life. There is always a need to improve the quality of education . in order to make amendments or further development, the education institutions have to have a picture of the present situation regarding the quality of the education that they are offering (Jalaliyoon & Taherdoost, 2012).

Measuring the quality of a program is one of the essential elements in educational process. Performance in education sector is a means to improve the programs offered by the institutions in achieving their stated objectives (Azma, 2010).) . Besides that program evaluation assesses the organization's educational quality the efficiency of its training methods and identifies aspects of the curriculum that can be improved through modification.

Thus Baghdad university have been chosen as a case study whereby it can provide all the relevant data and information of inputs and outputs for DEA model. Where each university is liable to hire its academic staff and to control student's admission based on the allocation given by the ministry of higher education.

The scope of this study is to measure the relative efficiency of postgraduate and undergraduates programs in colleges of Baghdad University. The measurement result of each college program involved can be used to determine the performance of the overall colleges programs offered by the institution. The focus of this research is to develop a quantitative measurement model based on output, inputs and impact evaluation by using multi-criteria methods called Data Envelopment Analysis (DEA) (Charnes et al., 1978; Charnes et al., 1994).

Therefore, colleges are the Decision Making Units (*DMUs*) that transform inputs into output. Academic staff is chosen as an input to see their effect on the students' performance and to get a better picture of the effect. The superiority of the academic staff is categorized by professor (Prof.), associate professor (Asso. Prof.), lecturer (Lec.) and assistant lecturer (Assi. Lec.) (in numbers) are the inputs to produce the output which is the number of enrolled and alumni (undergraduates and postgraduate students).

2. Performance Measurement

Performance measurement is a compilation of report about efficiency , quality and effectiveness of government programs in order to improve its performance in terms of service provided (Azma, 2010; Zoghbi, et al., 2013). While according to Mawita (2000) performance measurement is the individual or group final output to achieve stated goal and objectives .Goal and objectives can be achieved when institutions utilize their limited resources to fulfil the stated objectives. Furthermore, in order to survive in the challenging world organizations that provide services need to measure their performance whether they fulfil their customers need or not (Mostafa, 2009).

Joumady and Ris (2005) have evaluated the performance of 209 higher education institutes in eight European countries and by using three evaluating models divided them to three groups. The higher education institutes of Britain, Netherlands and Australia have been the institutes with a good performance, French and Germany mediocre and Spain, Finland and Italy weak. The study (Johnes and Yu,2008) has concentrated on efficiency of universities in the production of research only. However any study of efficiency should include a detail analysis of all possible factors which might affect performance. Aside from research, teaching is another activity that affects the university performance. According to Zoghb et al., (2013) university focusses on teaching, research, and producing expert in different fields. Teaching is the part where institutions produced expertise in each field. There are two types of staff in university academic and non- academic or administrative staff. It is already known that academic staff is the key to change and improve learner to achieve better results in their academic and employability (Castano, & Cabanda, 2011)while administrative staff did not involve in teaching activity (Zoghbi,et al., 2013). Academic staff such lecturers and superior lectures play vital role in determining the statues value and performance of a university as a home of superior education institution. It is compulsory for a superior education institution to be equipped with superior lectures that possessed vast or adequate experience after years of teaching along with better and higher qualification. There are five categories of lecturers which are professor, associate professor, senior lecturer, lecturer and assistant lecturer or tutor (Ehrenberg, 2004;Wilkinson & Ishak, 2005).

3. Efficiency Measurement

Efficiency according to Sengupta (2000), there is no wastage of resources in the production process. Efficiency is measured according to the organizations objective such as minimization the costs and maximazation profit. Charnes et al.(1994) said that efficiency obtained from program inputs into preferred programs outputs to measure the performance. Also, efficiency can be achieved by comparing the programs relatively, and relative efficiency means that comparing between homogenous programs that have the same function and give the same service or product.

Efficiency in higher education institution context is complex and often controversial task. According to Jalaliyoon and Taherdoost, (2012) applying concepts such as efficiency to university performance measurement will inevitably involve the use of surrogate measures. Therefore, a clear understanding of the conceptual difference in assessing either university processes or outputs is important.

4. Input and Output

***DMUs* are the subjects that are responsible for utilizing input(s) to produce output(s). Thus, input and output are the main components in efficiency measurement of *DMUs* (Coelli et al., 2005). In the context of measuring efficiency of programs, Charnes et al.,(1994) said that the programs are responsible in utilizing input to produce output. To ensure meaningful efficiency scores, the number of colleges (*DMUs*) must be large enough relative to the number of input and output variables. A rule of thumb is provided by Banker, Charnes and Cooper (1984) as** $\left[r+i \leq \frac{n}{3}\right]$, **where** r **is the number of output variables,** i **the number of input variables, and *n* the number of *DMUs*. In this research, the number of input and output variables is *(2+2)* for the postgraduate programs and (*4+2)* for undergraduate programs, which is less than one-third of the number of *DMUs* (*n=24*).**

A new mission in this research involves taking two categories of lecturers as inputs, which are professor *(Prof.)* and associate professor *(Asso.Prof.*) to the post graduate programs. Due to the academic staffs who teach in the postgraduate programs are not includes the lectures with Master degree. So lecturers and assistant lecturers are excluded from the assessment of postgraduate programs. On the other hand, to measure the efficiency of undergraduate programs we added the assistance lecture *(Assi.Lec.)* and lecturer *(Lec.)* to the inputs.

The output is the number of enrolled (*EUS* and *EPS*) and alumni (*AUS* and *APS*) (undergraduates and postgraduate students). It is important to note that all data entered into a linear optimization method such as DEA must first meet certain characteristics or requirements. For example, all of the values must be positive and no values can be zero or missing. In addition, if any of these values or issues exists, then the results of the DEA model would be unreliable (Ramanathan, 2003).

Table (1): Inputs and Outputs

Colleges of Baghdad University (DMUs)	Postgraduate Programs				Undergraduate Programs					
	Inputs		Outputs		Inputs				Outputs	
	Prof.	Asso. Prof.	EPS	APS	Prof.	Asso. Prof.	Lec.	Assi. Lec.	EUS	AUS
Medicine	34	67	165	74	34	67	117	31	261	242
Al-Kindi Medicine	9	37	12	3	9	37	57	27	90	53
Dentistry	38	57	148	47	38	57	96	79	174	230
Pharmacy	4	27	71	69	4	27	40	48	177	172
Nursing	12	16	47	29	12	16	20	30	162	112
Engineering	34	82	247	130	34	82	137	183	608	570
Al-Khwarizmi Engineering	3	10	15	5	3	10	38	68	80	87
Agriculture	77	109	179	102	77	109	149	182	429	493
Veterinary	14	82	135	103	14	82	94	108	118	74
Science	52	144	294	101	52	144	215	279	702	424
Science for women	12	22	165	50	12	22	64	77	363	212
Administration, Business & Economy	26	70	259	100	26	70	100	95	719	891
Education - Ibn Rushd	41	92	338	166	41	92	119	103	596	707
Education - Ibn Al-Haytham	45	122	60	117	45	122	213	192	355	627
Education for Women	52	88	157	52	52	88	114	93	762	526
Arts	44	51	260	130	44	51	99	78	794	565
Languages	16	41	27	16	16	41	139	82	762	470
Information	5	27	47	44	5	27	43	26	192	390
Law	2	12	35	3	2	12	22	12	242	293
Political Science	9	20	79	45	9	20	36	22	249	218
Physical Education	51	56	44	40	51	56	54	35	330	310
Physical Education for Women	11	16	20	10	11	16	18	15	128	149
Fine Arts	40	77	105	54	40	77	108	60	311	277
Islamic Studies	3	43	86	79	3	43	41	36	324	233

Table (1) shows the collected variables of inputs and outputs for each postgraduate and undergraduate programs in colleges of Baghdad university. The source of this data is from the Statistic department of the Iraqi Ministry of Higher Education.

5. Data Envelopment Analysis (DEA)

The term DEA (Data Envelopment Analysis) was introduced in the first time by Rhodes (1978) in his report "A Data Envelopment Analysis Approach to Evaluation of the Program Follow through Experiment in U.S. Public School Education,", and appeared in Charnes, Cooper and Rhodes' subsequent paper (1979). Data Envelopment Analysis is a linear programming -based technique for measuring the performance efficiency of organizational units which are termed Decision-Making Units (*DMUs*).

In DEA, the organization under study is called a *DMU* (Decision Making Unit). The term 'Decision Making Unit' (*DMU*) was used for the first time in the CCR model proposed in Charnes, Cooper and Rhodes (1978). Decision-making units can include manufacturing units, departments of big organizations such as universities, schools, bank branches, hospitals, power plants, police stations, tax offices, prisons, and defines bases, a set of firms or even practicing individuals such as medical practitioners.

DEA is a linear programming technique aims to measure how efficiently a *DMU* uses the resources available to generate a set of outputs (Charnes et al. ,1978). DEA is a powerful technique which successfully applied to measure the performance efficiency of all these kinds of *DMUs* (Abbott & Doucouliagos, 2003, Ramanathan 2003) and these applications provide evidences of the strengths of DEA. Most of these *DMUs* are non-profit organizations for instance education, where the measurement of performance efficiency is difficult (Castano & Cabanda ,2011). Note that the efficiency of commercial organizations can be assessed easily by their yearly profits, or their stock market indices.

DEA likes all other methods has its strengths and limitations the main strength of DEA is its objectivity, i.e., DEA provides efficiency ratings based on numerical data, and not by using subjective opinions of people such as AHP . DEA is certainly a very valuable evaluation tool that makes the maximum possible objective use of the available data. Secondly DEA can handle multiple input and multiple outputs, and they can be measured in very different units. Thirdly unlike statistical methods of performance analysis (including statistical regression analysis, statistical testing , Stochastic frontier analysis (Ramanathan, 2003.;Zoghbi et al., 2013), DEA is non-parametric in the sense that it does not require an assumption of a functional form relating inputs to outputs .

The main advantages of using DEA technique is the possibility of identify the required improvement in (Inputs, outputs) and identify the reference set of non-efficient DMUs, and this is happening by dropping all the unit incompetent on the efficiency curve border and then can determine the levels of reduction in input or the increase in output to achieve the full efficiency.

DEA has been increasingly used to estimate efficiency in education. This is primarily because the field is composed of multiple inputs and outputs, facilitating DEA frontier estimation. In addition, the non-necessity of the production function does not cause model misspecification errors in estimation.

6. DEA model

There are many DEA models that can be used to measure the efficiency such as Banker-Charnes –Cooper (BCC) model, Additive model, Charnes-Cooper –Rhodes (CCR). But this research, focuses on CCR model developed by Charnes et al.,(1978) and BCC model developed by Banker et al., (1984). Due to the fact that in a university environment, it is easier to control the inputs rather than the outputs, the DEA input oriented model is used to compute the efficiency of these departments. CCR assumes Constant Return to Scale (CRS) and BCC assumes Variable Return to Scale (VRS). The indicated optimization, then, assigns the evaluated DMU the most favourable weighting that the constraints allow (Banker et al., 1984; Charnes, et al., 1994).

Efficiency can be defined as weighted sum of outputs over weighted sum of inputs as shown in equation:

$$E_0(u,v) = \frac{\sum_r u_r y_{r0}}{\sum_i v_i x_{i0}} \quad (1)$$

Using the inputs and outputs of this research, the equation will be applied for both postgraduate and undergraduate programs as follows:

$$E_p(u,v) = \frac{u_1(EPS) + u_2(APS)}{v_1(Prof.) + v_2(Asso.Prof.)} \quad (2)$$

And

$$E_u(u,v) = \frac{u_1(EUS) + u_2(AUS)}{v_1(Prof.) + v_2(Asso.Prof.) + v_3(Lec.) + v_4(Assi.Lec.)} \quad (3)$$

Where

Ep **: Relative efficiency of the postgraduate programs.**

Eu **: Relative efficiency of the undergraduate programs.**

EPS **: No. of enrolled postgraduate student.**

EUS **: No. of enrolled undergraduate student.**

APS **: No. of alumni postgraduate student.**

AUS **: No. of alumni undergraduate student.**

$Prof.$ **: No. of professor**

$Asso.Prof.$ **: No. of associate professor.**

$Lec.$ **: No. of lecture.**

$Assi.Lec.$ **: No. of assistance lecture.**

u_r **: Weight given to output,** $r = 1,2$

v_i **: Weight given to input,** $i = 1,2$ **for postgraduate programs and**

$i = 1,2,3,4$ **for undergraduate programs.**

$$\min [\varepsilon\theta - \varepsilon\left(\sum_{i} s_i^- + \right] \sum_{r} s_r^+\Big) \qquad \textbf{(4)}$$

s.t.

$$\sum_{j=1}^{24} x_{ij}\lambda_j + s_i^- = \theta x_{io}$$

$$\sum_{j=1}^{24} y_{rj}\lambda_j - s_r^+ = y_{ro}$$

$$\lambda_j \geq 0, \qquad j = 1,2,\ldots,24$$

For BCC model, the constraint $\sum_{j=1}^{24}\lambda_j = 1$ **is added to the above model.**

s_i^- **and** s_r^+ **: are slack variables used to convert the inequalities to equivalent equations and** ε **> 0 is an Archimedean element defined to be smaller than any positive real number.**

λ_j **: is the vector of intensity factors that defines the hypothetical *DMU* to which *DMUjo* is compared.**

θ **:is the radial (input reducing) measure of technical efficiency.**

The efficiency of a decision making unit is measured relative to all other *DMUs* under the restriction that all *DMUs* lie on or below the efficient frontier, measures of relative efficiency are obtained.

7. Computer Programs used in Measuring the Relative Efficiency

The current market situation and technology had provided numerous and various efficient software to determine the relative efficiency score of programs. For example DEA-Solver, Linear Interactive Discrete Optimizer *(LINDO)*, Microsoft Office Excel, Statistical Package for the Social Sciences *(SPSS)* and Frontier Analyst. DEA- Solver software is used in this research to measure the technical efficiency of the programs based on both CCR and BCC input oriented models.

8. Results and Discussion

8.1 CCR Results for Postgraduate and Undergraduate Programs

Table (2) shows the efficiency, the reference set(s) (benchmarks) for each DMU in addition to the rank of each faculty. Of the 24 postgraduate programs, only Pharmacy, Science for women, Arts and Islamic Studies colleges are efficient. Languages and Al-Kindi Medicine postgraduates programs have the least score (0.16 and 0.08), which could be attributed to the relatively high input of training resources.

We can also observe from Table 2 that all inefficient *DMUs* have (reference sets) benchmarks. These *DMUs* are asked to learn how to transform their inputs to outputs. In other words, inefficient colleges should adopt their benchmarks' policies and techniques in the production process.

For example, as shown in Table (2), for the inefficient colleges Medicine, Engineering, Education - IbnRushd, Languages, Political Science and Physical Education for Women, the reference sets are Pharmacy, Science for women and Arts. Therefore, for the inefficient colleges to become efficient, they can learn best practices from the efficient ones. Further, it is observed that *DMU 4* and *DMU 11* (Pharmacy and Science for women) are the most recurring benchmark. It was referenced 15 times, indicating that there are 15 colleges which could learn from (*DMU 4* and *DMU11*) best practices and thus become efficient. The same can be said about the other recurring benchmarks like *DMUs* 16 and 24 which are referenced 13 and 6 times respectively.

In other words, 20 inefficient colleges can improve their efficiencies by learning from the methods and techniques adopted by these *DMUs*.

Table (2): CCR Results and Reference Sets.

No	Colleges of Baghdad University (*DMUs*)	Postgraduate Programs			Undergraduate Programs		
		Efficiency Score	Rank	Reference Set	Efficiency Score	Rank	Reference Set
1	Medicine	0.45	13	4,11,16	0.42	14	19
2	Al-Kindi Medicine	0.08	24	11,24	0.17	23	19
3	Dentistry	0.36	17	11,16	0.18	22	19
4	Pharmacy	1.00	1	4	0.40	16	19
5	Nursing	0.71	8	4,16	0.74	6	19
6	Engineering	0.64	10	4,11,16	0.40	15	19
7	Al-Khwarizmi Engineering	0.32	18	11,24	0.40	17	19
8	Agriculture	0.37	16	4,16	0.26	20	19
9	Veterinary	0.55	12	4,11,24	0.11	24	19
10	Science	0.38	14	11,24	0.30	18	19
11	Science for women	1.00	1	11	0.82	4	19
12	Administration, Business & Economy	0.67	9	4,11,24	0.67	8	19
13	Education - Ibn Rushd	0.74	7	4,11,16	0.46	13	19
14	Education - Ibn Al-Haytham	0.38	15	4	0.22	21	19
15	Education for Women	0.25	21	4,11	0.61	11	19
16	Arts	1.00	1	16	0.77	5	19
17	Languages	0.16	23	4,11,16	0.92	2	19
18	Information	0.64	11	4,16	0.68	7	19
19	Law	0.93	5	11,24	1.00	1	19
20	Political Science	0.90	6	4,11,16	0.63	10	19
21	Physical Education	0.28	20	4,16	0.56	12	19
22	Physical Education for Women	0.25	22	4,11,16	0.65	9	19
23	Fine Arts	0.28	19	4,11	0.26	19	19
24	Islamic Studies	1.00	1	24	0.89	3	19

Meanwhile, the CCR input oriented results of undergraduate programs indicate that only the college of Law is efficient out of 24 colleges. In addition, the colleges of Languages, Islamic Studies and Science for Women have the highest score of efficiency with (0.92, 0.89 and 0.82) respectively while the college of Veterinary has the least score of efficiency (0.11). From these results, we can observe that all undergraduate programs in Baghdad university colleges are inefficient which could be attributed to the fact that they have relatively large inputs in terms of resources compared with the relatively low outputs (enrolled and alumni students) .

8.2 BCC Results for Postgraduate and Undergraduate Programs

In order to have more insights into the applicable model, BCC efficiencies were calculated and shown in Table(3). It is noted that BCC yields more efficient colleges than CCR. The efficient postgraduate programs in BCC model are nine (Pharmacy, Nursing, Al-Khwarizmi Engineering, Science for women, Administration, Business & Economy, Education – IbnRushd, Arts, Law, Political Science and Islamic Studies) whereas in CCR, only four colleges are efficient.

Further, it is observed that Pharmacy, Al-Khwarizmi Engineering and Political Science, is the most recurring benchmark. It was referenced seven times while Science for women was referenced six times, Education - IbnRushd five times, Arts four times and Islamic Studies two times while the colleges of Administration, Business & Economy and the colleges of Law appear as a reference set for a single time. In other words, 15 inefficient colleges can improve their efficiencies by learning from the methods and techniques adopted by these nine efficient *DMUs*.

In addition, we note that the college of Nursing appears with score (1) and in the same time has Al-Khwarizmi Engineering and Political Science as a reference sets . This case lead us to the definition of efficiency that*" DMU0 is efficient if satisfies* ($\theta = 1$) *and has no slack* ($s^{\dagger}- = s^{\dagger}+ = 0$) *, otherwise it is inefficient*" . Table (4) illustrate the score and the slack variables of all *DMUs* and it is easy to note that all efficient colleges have efficiency score one with all slack variables equal zero. While, the college of Nursing satisfy the first condition of definition ($\theta = 1$) with . In this case, we said that the college of Nursing has a weak efficiency.

Also Table (3) shows the results of undergraduate programs by using BCC input oriented model, where eight colleges (i.e. Al-Khwarizmi Engineering, Administration, Business & Economy, Arts, Languages, Information, Law, Physical Education for Women and Islamic Studies) are efficient out of 24 colleges. In addition, the colleges of Nursing, Science for Women and Education for Women have the highest score of efficiency with (0.96, 0.85 and 0.83) respectively.

Table (3): BCC results and reference sets.

No	Colleges of Baghdad University (*DMUs*)	Postgraduate Programs			Undergraduate Programs		
		Efficiency Score	Rank	Reference Set	Efficiency Score	Rank	Reference Set
1	Medicine	0.48	17	4,11,13,16	0.46	18	16,19
2	Al-Kindi Medicine	0.29	23	7,19	0.44	19	19
3	Dentistry	0.37	18	7,11,20	0.22	24	19,22
4	Pharmacy	1.00	1	4	0.55	16	19,22
5	Nursing	1.00	1	7,20	0.96	9	19,22
6	Engineering	0.83	12	4,11,13,16	0.61	15	12,16,19
7	Al-Khwarizmi Engineering	1.00	1	7	1.00	1	7
8	Agriculture	0.37	19	4,11	0.35	21	12,16,19
9	Veterinary	0.96	11	13,24	0.23	23	19,22
10	Science	0.63	15	12,13	0.46	17	12,17,24
11	Science for women	1.00	1	11	0.85	10	17,19
12	Administration, Business & Economy	1.00	1	12	1.00	1	12
13	Education - Ibn Rushd	1.00	1	13	0.69	12	12,16,19
14	Education - Ibn Al-Haytham	0.49	16	4,13,24	0.36	20	12,19
15	Education for Women	0.26	24	4,11,16	0.83	11	16,19
16	Arts	1.00	1	16	1.00	1	16
17	Languages	0.31	21	7,20	1.00	1	17
18	Information	0.75	13	4,7,20	1.00	1	18
19	Law	1.00	1	19	1.00	1	19
20	Political Science	1.00	1	20	0.64	14	16,19
21	Physical Education	0.33	20	7,20	0.64	13	16,19
22	Physical Education for Women	0.70	14	7,20	1.00	1	22
23	Fine Arts	0.30	22	4,11	0.34	22	16,19
24	Islamic Studies	1.00	1	24	1.00	1	24

On the other hand, the college of Dentistry and Veterinary have the least score of efficiency (0.22 & 0.23). Further, it is observed that the colleges of Al-Khwarizmi Engineering and Information are not appearing as reference sets of all inefficient colleges. In other words, inefficient colleges cannot learn from the methods and techniques adopted by these two efficient *DMUs*.

From these results, we can observed that 16 undergraduate programs in Baghdad university colleges are inefficient which could be attributed to the fact that they have relatively large inputs in terms of resources compared with the relatively low outputs (enrolled and alumni students).

Table (4):BCC Efficiency and Slacks for Postgraduate Programs

No	Colleges of Baghdad University (*DMUs*)	Postgraduate Programs				
		Efficiency Score	S_1^-	S_2^-	S_1^+	S_2^+
1	Medicine	0.48	0	0	0	0
2	Al-Kindi Medicine	0.29	0	0	10.64	1.24
3	Dentistry	0.37	2.89	0	0	0
4	Pharmacy	1.00	0	0	0	0
5	Nursing	1.00	5.4	0	6.4	0
6	Engineering	0.83	0	0	0	0
7	Al-Khwarizmi Engineering	1.00	0	0	0	0
8	Agriculture	0.37	1.90	0	0	0
9	Veterinary	0.96	0	22.45	20.52	0
10	Science	0.63	0	10.66	0	28.24
11	Science for women	1.00	0	0	0	0
12	Administration, Business & Economy	1.00	0	0	0	0
13	Education - Ibn Rushd	1.00	0	0	0	0
14	Education - Ibn Al-Haytham	0.49	0	0	142.38	0
15	Education for Women	0.26	1.92	0	0	0
16	Arts	1.00	0	0	0	0
17	Languages	0.31	0.33	0	5.6	0
18	Information	0.75	0	0	2.97	0
19	Law	1.00	0	0	0	0
20	Political Science	1.00	0	0	0	0
21	Physical Education	0.33	8.83	0	27	0
22	Physical Education for Women	0.70	3.98	0	3	0
23	Fine Arts	0.30	3.38	0	0	0
24	Islamic Studies	1.00	0	0	0	0

9. Conclusions

This research used the input minimizing Data Envelopment Analysis approach to measure the technical efficiency of postgraduate and undergraduate programs of Baghdad university colleges. The *DMUs* of the research are 24 colleges for each program and the study covered the period (2011-2012). Due to the importance of the academic staff as a backbone in the teaching process, we used the number of academic staffs as input variables to measure the efficiency in accepting students and alumni students in postgraduate and undergraduate programs in 24 colleges. In other words the efficient colleges are the ones that used their resources to an optimum level to increase their outputs.

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Efficiency Measurement Model for Postgraduate Programs and Undergraduate Programs by Using Data Envelopment Analysis

Abstract

Measuring the efficiency of postgraduate and undergraduate programs is one of the essential elements in educational process. In this study, colleges of Baghdad University and data for the academic year (2011-2012) have been chosen to measure the relative efficiencies of postgraduate and undergraduate programs in terms of their inputs and outputs. A relevant method to conduct the analysis of this data is Data Envelopment Analysis (DEA). The effect of academic staff to the number of enrolled and alumni students to the postgraduate and undergraduate programs are the main focus of the study.

Keywords: Data Envelopment Analysis, Efficiency, Performance Assessment, Postgraduate Program, Undergraduate Program, Inputs, Outputs.