THE EFFICIENCY OF COLLEGES: USING DEA - A NON-PARAMETRIC APPROACH

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ABSTRACT

This paper shows the application of Data Envelopment Analysis (DEA) to measure the efficiency of 20 colleges of Prince Sattam bin Abdulaziz University (PSAU). The input variables used in this study are the enrolled students and the teaching staff. The output variables are number of graduates and number of researches. In this study, the Basic Radial Models (Multiplier Forms) output oriented with Constant Returns to scale (CRS), Variable Returns to scale (VRS), Increasing Returns to scale (IRS) and Decreasing Returns to scale (DRS) are used to estimate the efficiency of colleges.

The DEA tool assists the academics and administrators to identify the inefficient measures and take the actions for improvement.

Key words: Data Envelopment Analysis, Academic Colleges, Relative Efficiency, PSAU.


1. INTRODUCTION

The diversified approaches have been used to estimate the performance of colleges. DEA is a most common well-known tool for measuring the efficiencies of schools, hospitals, and universities etc. DEA is established by Charnes, Cooper and Rhodes to evaluate the efficiencies of nonprofit and public sector organizations.


2. GENERAL DEA MODEL

Suppose that there are ‘n’ Decision making units (DMUs), each with ‘m’ inputs and ‘s’ outputs, the efficiency of $DMU_r$ is achieved by solving the following model developed by A. Charnes, W. W. Cooper, and E. L. Rhodes (1978).

$$\text{max } w_r = \frac{\sum_{k=1}^{s} v_k y_{kr}}{\sum_{j=1}^{m} u_j x_{jr}}$$

s.t. \[ \frac{\sum_{k=1}^{s} v_k y_{ki}}{\sum_{j=1}^{m} u_j x_{ji}} \leq 1 \quad ; \forall \ i; \ i = 1,2,3, ... , n \]

and \( v_k, \ u_j \geq 0 \quad ; \forall \ k, j \)

Where;

\( y_{ki} = \text{quantity of output 'k' formed by } DMU_i \)
\( x_{ji} = \text{quantity of input j consumed by } DMU_i \)
\( v_k = \text{weight given to output k,} \)
\( u_j = \text{weight given to input j.} \)

The aforementioned fractional program can be converted to a linear program as given below.

$$\text{max } w_r = \sum_{k=1}^{s} v_k y_{kr}$$

s.t., \( \sum_{j=1}^{m} u_j x_{jr} = 1 \)

\( \sum_{k=1}^{s} v_k y_{ki} - \sum_{j=1}^{m} u_j x_{ji} \leq 0 \quad ; \forall \ i \)

and \( v_k, \ u_j \geq 0 \quad ; \forall \ k, j \)

If \( w_r = 1 \), then \( DMU_r \) is efficient relative to other units. If \( w_r < 1 \), then the DMU is inefficient.

Later, the BCC model developed by Banker, R.D., Charnes, A., Cooper, W.W. (1984) modified the original CCR linear programming by adding a convexity constraint.

3. DATA

The sample used in this study covers twenty colleges of the university. The data for this study was collected for the year 2014-2015 and was obtained from University Statistics Department. In this research, we used DEA Online Software (DEAOS) to calculate the efficiency scores of all colleges based on Basic Radial Models (Multiplier Forms) Output Oriented like CRS, VRS, IRS and DRS.
4. RESULTS AND DISCUSSION
The data given in Table-1 is known as Descriptive Statistics.

Table 1 Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Total Students enrolled</th>
<th>Total teaching staff</th>
<th>Total graduates</th>
<th>Total researches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>164</td>
<td>12</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Maximum</td>
<td>4177</td>
<td>232</td>
<td>525</td>
<td>35</td>
</tr>
<tr>
<td>Mean</td>
<td>1319</td>
<td>104</td>
<td>173</td>
<td>11</td>
</tr>
<tr>
<td>Standard Derivation</td>
<td>1134</td>
<td>57</td>
<td>157</td>
<td>10</td>
</tr>
</tbody>
</table>

The efficiency scores has been obtained by different colleges in each model given in the following table 2.

Table 2 Efficiency Score of the Colleges

<table>
<thead>
<tr>
<th>DMUs</th>
<th>Colleges</th>
<th>Basic Radial Models (Multiplier Forms) Output Oriented</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CRS</td>
<td>VRS</td>
</tr>
<tr>
<td>1</td>
<td>College of Education, Al kharj</td>
<td>0.92</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>College of Business Administration, Al kharj</td>
<td>0.68</td>
<td>0.69</td>
</tr>
<tr>
<td>3</td>
<td>College of Science &amp; Humanities, Al kharj</td>
<td>0.85</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Community College, Al kharj</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>College of Applied Medical Science, Al kharj</td>
<td>0.56</td>
<td>0.61</td>
</tr>
<tr>
<td>6</td>
<td>College of Pharmacy</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>College of Engineering &amp; Computer Science, Al kharj</td>
<td>0.85</td>
<td>0.86</td>
</tr>
<tr>
<td>8</td>
<td>College of Engineering, Al kharj</td>
<td>0.78</td>
<td>0.79</td>
</tr>
<tr>
<td>9</td>
<td>Medical College</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Dental College</td>
<td>0.87</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>College of Education, Al Delam</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>College of Science &amp; Humanities, Huta</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>College of Business Administration, Huta</td>
<td>0.4</td>
<td>0.48</td>
</tr>
<tr>
<td>14</td>
<td>College of Science &amp; Humanities, Aflaj</td>
<td>0.95</td>
<td>0.99</td>
</tr>
<tr>
<td>15</td>
<td>Community College, Aflaj</td>
<td>0.43</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>College of Science &amp; Humanities, Al Sulel</td>
<td>0.64</td>
<td>0.65</td>
</tr>
<tr>
<td>17</td>
<td>College of education, Wadi Al Dawasir</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>College of Arts and Science, Wadi Al Dawasir</td>
<td>0.61</td>
<td>0.7</td>
</tr>
<tr>
<td>19</td>
<td>College of Engineering, Wadi Al Dawasir</td>
<td>0.28</td>
<td>0.33</td>
</tr>
<tr>
<td>20</td>
<td>College of Applied Medical Science, Wadi Al Dawasir</td>
<td>0.43</td>
<td>1</td>
</tr>
</tbody>
</table>

The colleges that achieved coefficient scores equal to 1 were regarded as efficient ones. The Model CRS results showed that out of 20 colleges only 7 colleges were identified as efficient. It means they are efficient in utilizing their resources to produce all the defined outputs. The average efficiency score for model CRS is 0.76 which is the lowest score among the four...
models. In model VRS, the efficiency scores of 11 colleges are equal to 1. The average efficiency score for this model is 0.85.

In model IRS, as a result, 9 colleges were identified as efficient. The average efficiency score is 0.83. In model DRS, the average efficiency score was 0.78. The result showed 8 colleges were efficient.

Finally, 6 colleges obtained an efficiency score of 1 in all models of analysis. These 6 colleges were consistently efficient regardless of the model chosen. This means that these 6 colleges utilized resources in the best possible manner in all models.

Overall, among all four models, model VRS obtained the highest average efficiency score (0.85) while model CRS obtained the lowest average (0.76). DMU 5, DMU 13 and DMU 19 were very low in all models. This indicates they are relatively far from the efficient boundary.

5. CONCLUSION
This paper examines the efficiency of 20 Colleges of Prince Sattam bin Abdulaziz University for the academic year 2014-2015. The results showed that only 6 colleges are fully efficient in term of CRS, VRS, IRS and DRS models while 11 colleges are found to be efficient in term of only VRS model which shows that more than fifty percent colleges are efficient. This means that the colleges are efficient in utilizing their resources to produce all the defined outputs as compared to their peers. Since some colleges are inefficient, it is required from Prince Sattam bin Abdulaziz University Administration to must focus more attention on them and develop strategies to minimize their inefficiencies.

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REFERENCES
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