Application of DEA on English Writing Learning Performance

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1. Introduction

1. MOE in Taiwan, system of performance evaluation for academic institutions
2. Each institution, self-evaluations concerning teachers' research results and student's learning performance
3. Avoid low student enrollment, high graduate unemployment, credential inflation, and even closure
4. This research focuses on student's learning performance
5. Evaluation method: data envelopment analysis (DEA)
6. Objective: explore the key indicators contributing to the learning performance of English freshmen writing courses

2. Literature review

1. Data envelopment analysis (DEA) used by various studies to analyze students' learning performance
2. Ahn et al. (1989): efficiency of US universities during 1981-1985
3. Glass et al. (1998): efficiency of UK universities during 1989–1992
4. Madden et al. (1997): performance of economics departments in Australian universities
5. Fu and Huang (2009): a survey of college graduates in 2003; an output-oriented BCC type of DEA model

2. Literature review

1. McGowan and Graham (2009): factors contributing to improved teaching at Brigham Young University
2. 4 factors leading to improvement: active learning, interactions, clear expectations, faculty preparation
3. Clinton and Kohlmeyer (2005): effect of group quizzes on accounting students' performance and motivation to learn
4. Students in group-condition give the instructor a higher rating, have greater motivation to learn

3. Methodology

1. Data envelopment analysis (DEA) model: a quantitative method with both multiple inputs and multiple outputs to measure the performance of DMUs
2. Decision making units (DMUs) or evaluated units

- Freshmen students of one department of a university in Taiwan from the academic year 2004 to 2006
- Following the same training program of English writing for one semester
- 50 classes selected, named from D1 to D50

3. Methodology

3. Charnes-Cooper-Rhodes (CCR) model:

- Converted the concept of multiple inputs and multiple outputs into single virtual input and output by linear combination
- Estimates the efficiency frontier by the ratio of two linear combinations and measured the relative efficiency of each DMU

3. Methodology

4. Banker-Charnes-Cooper (BCC) model:

- Suppose scale variant
- Overall technical efficiency (CCR score) includes pure technical efficiency (BCC score) and scale efficiency
- Pure technical efficiency: whether the preparation of teaching contents and teaching skills (input items) are sufficiently presented during the courses
- scale efficiency inferior to 1 means most teachers prepare more teaching contents, but students cannot assimilate or appreciate 100% of the teaching contents or even are not aware of them

4. Choice of inputs and outputs

1. Input dimension:
- I1. The preparation of teaching contents
- I2. The teaching skill
2. Output dimension:
- O1. The fair grading
- O2. The students' learning performance

5. Efficiency analysis

1. Output orientation: evaluates the maximum output performance needed under the current input resources
2. Minimizing input items to obtain an efficiency value equal to 1 can mislead educators

- Reduces the preparation of teaching contents, give higher grades to students: leads to the decline of students' professional knowledge
- Discourages hard-working teachers from making tremendous efforts to better prepare their courses

5. Efficiency analysis

1. Efficient DMUs: CCR score (overall technical efficiency value) or BCC score (pure technical efficiency value) = 1
2. Inefficient DMUs: CCR score or BCC score < 1
3. D23 (ranked 50) has the lowest overall technical efficiency of 0.906 (10.3% effort to do in fair grading and students' learning performance)
4. Solution: announce grading criteria clearly and early helps students prepare for exams; increases the value of O2, enhances students' learning performance

5. Efficiency analysis

Under the output oriented CCR model

DMU name	CCR	Rank	Refs	Peers	Room for improvement (%)			
					O1	O2	I1	I2
D6	1.000	1	14	0	0	0	0	0
D22	1.000	1	30	0	0	0	0	0
D37	1.000	1	42	0	0	0	0	0
D41	1.000	1	30	0	0	0	0	0
D49	1.000	1	3	0	0	0	0	0
…	…	…	…	…	…	…	…	…
D3	0.968	20	0	2	3.3	3.3	-3.9	0
D21	0.967	22	0	2	3.4	3.4	0	-2.4
D4	0.967	22	0	2	3.4	9.3	0	0
D40	0.966	24	0	3	3.5	3.5	0	0
D1	0.965	25	0	2	3.6	5.6	0	0
Average	0.982				1.92	2.25		

5. Efficiency analysis

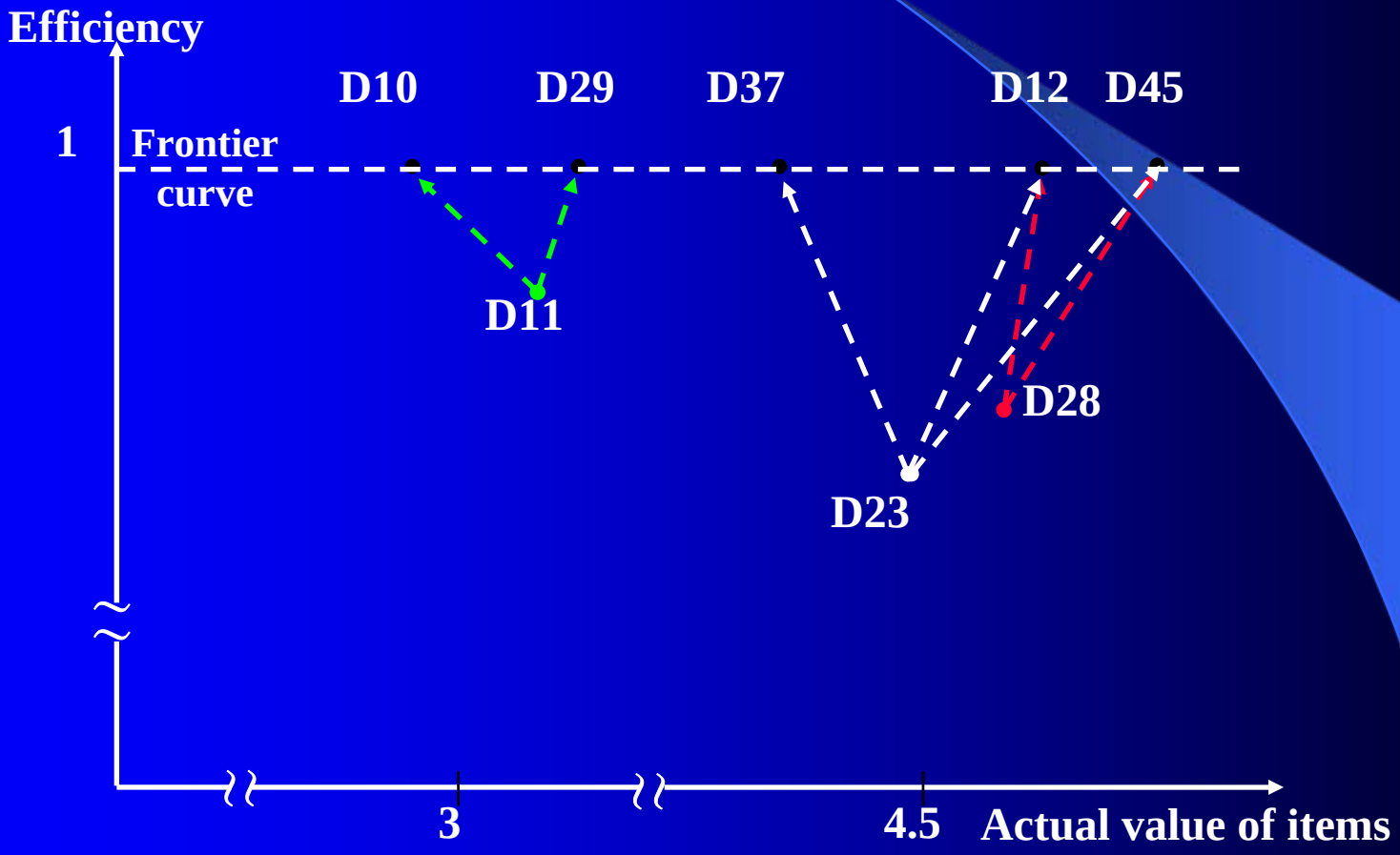
Under the output oriented CCR model

DMU name	CCR	Rank	Refs	Peers	Room for improvement (%)			
					O1	O2	I1	I2
D17	0.963	26	0	1	3.8	6.4	0	-0.5
D30	0.963	26	0	1	3.8	4.1	0	-0.9
D15	0.961	28	0	3	4	4	0	0
D44	0.953	29	0	3	4.9	4.9	0	0
D47	0.953	29	0	3	5	5	0	0
…	…	…	…	…	…	…	…	…
D33	0.932	46	0	3	7.3	7.3	0	0
D8	0.926	47	0	3	8	8	0	0
D13	0.913	48	0	2	9.5	11.8	0	0
D14	0.912	49	0	3	9.6	9.6	0	0
D23	0.906	50	0	3	10.3	10.3	0	0
Average	0.941				6.24	6.96		

5. Efficiency analysis

1. Refs: the number of times efficient DMUs are referred by the inefficient DMUs
2. Peers: the number of times inefficient DMUs refer to other efficient DMUs
3. Room for improvement: how much improvement is needed for the DMUs and what items are concerned
4. Only 5 DMUs are efficient
5. Some DMUs: negative value. Ex. D3, I1: -3.9%. Teaching contents is too much for students to assimilate, should be reduced and clearer

5. Efficiency analysis



5. Efficiency analysis

1. DEA includes the process of measuring performance using specific indicators (I1, I2, and O1, O2) resulting in quantitative values compared with others
2. Model measures the relative efficiency of each DMU
3. Inefficient DMUs refer to outstanding DMUs in their range and are not always compared with the ones with the highest range of actual values
4. Therefore, even the DMUs with lower actual values of input and output items may obtain relative efficiency values equal to 1

6. Conclusion

1. DEA evaluation method widely applied in various industries, proved to be reliable
2. Encourage inefficient DMUs to compare themselves with efficient DMUs in their range and make improvement little by little
3. Risk of taking evaluations too seriously and strictly: objective, to motivate, not discourage
4. Ryan et al. (1980): 38% of professors admitted making their courses easier in response to student evaluation
5. This evaluation approach of learning performance can be employed to the fields

7. References

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