

Efficiency Analysis of University Colleges Using a Two-Stage Non-Cooperative DEA Model

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Abstract :

The paper used an analytical technique that relates overall efficiency to the performance of individual phases, allowing for the accurate identification of inefficiencies. For the variables under consideration, the initial stage inputs include the number of faculty members and enrolled students. The framing rate was considered an intermediate variable. The future stage's outcomes were specified as the number of graduates and graduate expectations, using data from 2020/2021. The two-stage data envelopment study was carried out in a non-cooperative model, with a variable return to scale model chosen as the best strategy for decision-making units of various sizes. The findings show that more than 87.5% of the hypothetical decision-making units were inefficient. Unit (H) was recognized as the sole one that achieved complete efficiency (Efficiency = 1). The study indicates that improving research and educational quality delivers better results than just reducing inputs.

Keywords : two stage data envelopment analysis, Non-Cooperative model, Colleges, output oriented, University of Blida 1.

JEL Classification Codes: C61, I23

Introduction:

In 1961, there were 1,317 Algerian students enrolled in higher education institutions, including the University of Algiers and its annexes at Oran and Constantine. At the start of 2010/11, the number of students enrolled, fifty years after independence, surpassed 1,200,000 spread over many university campuses located in the 48 districts known as "Wilayates" or districts. (Bouchikhi & Zine, 2017). Algeria's higher education industry has undergone two major policy modifications since its independence. The most recent of these, the introduction of the three-cycle degree higher education framework known as the "LMD System" (License, Bachelor, Master, and Doctorate), has been in force since 2004/2005. "Massification" was a fundamental component of both reforms, driven in part by the demographic realities of a huge youth population, but also by specific policy decisions made by the government. The implementation of massification policies in Algeria resulted in a trend that prioritized number over quality.

The recent appearance of the COVID-19 epidemic has heightened the issues that higher education is currently facing. These new problems have put HEIs under unprecedented pressure, challenging their adaptability and resilience.(Ahmad & Nana Khurizan, 2024) The rise in the number of educational institutions in recent years, combined with the introduction of new educational technologies, increased university autonomy and openness to local communities and society as a whole, has raised concerns about the performance of higher education institutions (HEIs). Performance metrics in the public sector have frequently been criticized for being weak and unsuitable for analyzing efficiency.(Avkiran, 2001) For example, Cave et al. (1991) defined a performance indicator like "degree results" as a quality-adjusted measure of production. This metric exemplifies the uncertainty seen in education performance indicators, as high degree results may be owing to strong entry qualifications rather than teaching effectiveness. Even the value added productivity indicator, presented as an input- and quality-adjusted output measure, depends on differences in qualifications that cannot be assessed in monetary terms. (Castano & Cabanda, 2011) Despite the complexity, assessing how well resources designated for education—particularly higher education—are being used is crucial to comprehending the administration's actual state and establishing goals that reflect the reality of the nation's educational productivity.(Gori et al., 2025) therefore this study used a data envelopment analysis based on network model.

DEA Several techniques can be utilized to measure the efficiency of higher education institutions. One of the most prevalent approaches is using Data Envelopment Analysis (DEA), which is a non-parametric technique for comparing the relative efficiency of decision-making units (DMUs) with multiple inputs and outputs.in addition, The NDEA methodology is an extension of the traditional DEA approach that evaluates the efficiency of interconnected units or sub-technologies in a network. Essentially, the aim of NDEA is to pinpoint the most efficient units or sub- technologies within the network and provide valuable insights. that can be used to enhance the overall efficiency of the network(Dogan, 2023) Conventional DEA models approach the DMU as a black box, ignoring its intrinsic structure.(Azizi & Matin, 2010),(Kashim et al., 2018). In many real-world circumstances, to evaluate the internal structure, many academics have begun to look into two-stage network structures or processes in which a series of intermediate measures connect the two phases.(Fang, 2020). As such, this essay will concentrate on the topic of efficiency evaluation, delving deeply into the methodology and procedures for assessing and improving higher education efficiency.

Despite the quantitative expansion and qualitative shifts in higher education institutions, such as increased number, adoption of modern educational technologies, and increased autonomy and societal openness, their performance continues to face methodological challenges in measurement and evaluation. These challenges have been exacerbated by the COVID-19 pandemic, which has put institutions under unprecedented pressure and exposed the limitations of traditional competency assessment models, which are viewed as a black box that ignores the institution's internal structure and intermediary processes. These challenges necessitate academics seeking solutions by examining the efficiency and performance of these institutions in order to maximize resource utilization and produce high-quality educational results. Multi-stage data envelope analysis is one of the most often utilized methodologies for assessing educational institutions' efficiency. From this standpoint, we pose the following problems: How efficient are the colleges of the University of Blida in using their human inputs to achieve effective outputs using two-stage data envelope analysis?

Study hypotheses:

1. The colleges of the University of Blida 1 are efficient in using their human resources.
2. There exists a disparity in the efficiency scores among the various colleges at Blida University.

This research aims to achieve the following objectives:

1. Measuring colleges efficiency at the University of Blida 1 using a two-stage data envelope analysis approach in a non-cooperative structure.
2. Identify high-performing and underperforming colleges to inform improvement plans.
3. Offer helpful suggestions to raise college-level productivity.

The structure of this paper is organized as follows. The Section 1 presents the introduction. Section 2 describes the methodological procedures. Section 3 presents the results of the study. Section 4 discusses and analyses the results identified. Finally, the last Section 5 conclusion.

I. Literature review:

The efficiency of universities with a networked production process is an important component of educational performance measurement. However, most previous research use traditional Data Envelopment Analysis (DEA), which ignores the network nature of the production process in universities. Among the studies that used network models, we mention: (Dogan, 2023) This study uses a two-stage Network Data Envelopment Analysis (NDEA) with shared inputs model to evaluate the overall teaching and research efficiencies of Turkish research universities. According to the findings, just six out of 23 research universities are efficient, and some universities with lower world rankings outperform others with better rankings. On the other hand, there was no substantial variation in efficiency levels across regions with high and poor socioeconomic development. The study also assesses the impact of various priority scenarios on efficiency and the optimal distribution of shared inputs among sub-processes. It also encourages the use of multi-stage NDEA with shared inputs models rather than standard DEA for reliable efficiency assessment in education.

(Esfandiari et al., 2017) The unpredictability surrounding the input data is one of the most significant problems with DEA. It is nearly hard to manage the uncertainty using conventional techniques when all of the input data are unknown. This work proposes two robust DEA models for measuring the performance of two-stage processes utilizing centralized game theory and Stackelberg (leader-follower) techniques. Efficiency scores for DMUs with discrete uncertain output and input parameter data are computed using the developed models. The techniques make use of likely events and are founded on a strong optimization strategy created by Mulvey in 1995. A real-world data collection pertaining to 20 bank branches in the State of East Virginia is used to test the two suggested robust models.

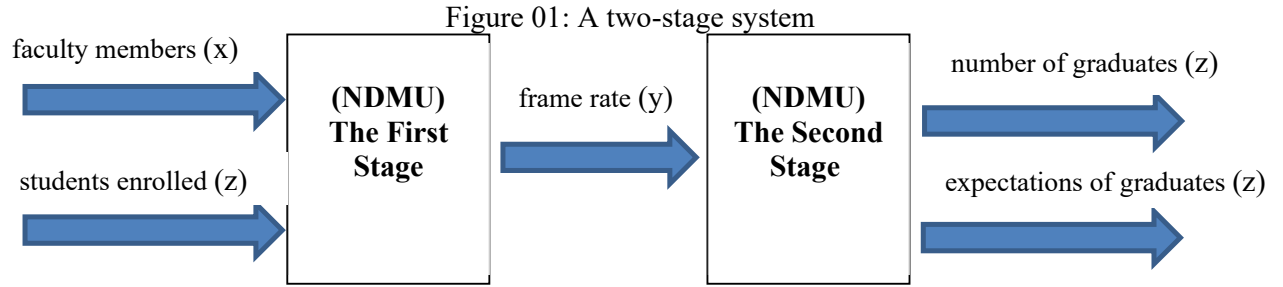
(Song et al., 2022) Decision preferences are critical in determining decision-making efficiency. This work quantifies decision-making preferences for desirable and unpleasant outputs and develops a two-stage cooperative/noncooperative game DEA model to evaluate the efficiency of China's regional industrial system between 2011 and 2015. The findings show that in a noncooperative game environment, optimal output preference weights improve evaluations, whereas ratio-based preference weights reduce efficiency deviations caused by input proportions. Furthermore, the study reveals that low pollution control efficiency has a primary impact on the industrial system's efficiency, consistent with the "Cannikin Law," while significant disparities exist between overall and substage efficiencies under cooperative game conditions, highlighting regional industrial development imbalance.

Measuring university success has always been challenging since they are complicated, interdependent systems. Traditional research has long relied on oversimplified models that view the institution as a closed box with simply inputs and outputs, while disregarding critical internal dynamics. However, recent research has begun to embrace a more realistic picture using network models that depict how resources flow between various university departments such as teaching, research, and community service. These models have evolved to become more sophisticated; some were built to deal with the lack of precise data, while others employed game theory notions. However, the majority of these

research focused on universities in educationally advanced nations, leaving a considerable gap in understanding the performance of universities in situations comparable to Algeria in terms of problems and resources. As a result, this study provides a unique perspective through a model that accurately reflects the reality of Algerian universities - a model that recognizes the complicated internal structure, analyses connections between university departments, and comprehends how efficiency develops over time. This technique not only assesses competency, but it also provides a thorough diagnosis that identifies specific strengths and weaknesses, as well as how the distribution of limited resources may be adjusted to get the greatest outcomes in our unique educational environment.

II. Methodology:

The internal structure of the DMU is disregarded in traditional DEA models, which assume the DMUs as black boxes. A two-stage model was used, with the first stage's outputs serving as the second stage's inputs. The number of faculty members and students enrolled in accordance with the graduation structure were the inputs for the first stage. The frame rate was one of the intermediate factors. the number of graduates by the college and the expectations of graduates by faculty members were the end outputs. where the second stage uses all of the first stage's outputs as inputs.



Source: prepared by authors

Assume that Y_k^* of the intermediate product had been created by the effective Stage 1 Sub-DMU at DMU k . If the Stage 2 Sub-DMU at DMU k had been efficient, it would have generated Z_k^{**} of the output. Consequently, an efficient DMU k would have generated output level Z_k^{**} utilizing an input level X_k , and the organizational inverse efficiency of DMU k under an output orientation is calculated as follows: (Sexton & Lewis, 2003)

$$\theta_k = \frac{1}{E_k}$$

The data was taken from the Blida University Statistics website for the 2020–2021 academic year, and the DMUs represented each of the university's colleges.

To meet the study objectives of quantifying the efficiency of the faculties at the University of Blida, the two-stage data envelope was analyzed within a non-cooperative structure, with the first stage acting as the leader and the second as the follower. The model is sequential with variable return to scale as the ideal strategy for varied sizes of decision-making units. (Cooper et al., 2007; Ruggiero, 2004). The Stackelberg model (leader and follower) was chosen because of the hierarchical and temporal processes inherent in the academic process. The first stage represents the role of the leader through fundamental structural decisions that establish the ceiling of accessible alternatives. The second stage, which takes on the role of the follower, symbolizes the pinnacle of institutional performance, illustrating the causal relationship between input investment and output quality while also allowing for detailed identification of areas of strength and weaknesses. As well as, The

orientation of the outputs was adopted to achieve the goal of university institutions to maximize the performance of academic outputs.

Thus, to solve the Two-Stage DEA Model for DMU k using both an output orientation and variable returns to scale in each stage and for the overall organization, we formulate and solve three DEA problems. For $d = 1, \dots, D$, we let

X_{di} = Level of input i consumed by DMU d , for $i = 1, \dots, I$,

Y_{dp} = Level of intermediate product p produced and consumed by DMU d , for $p = 1, \dots, P$,

Z_{dr} = Level of output r produced by DMU d for $r = 1, \dots, R$,

λ_{dk} = Weight placed on the Stage 1 Sub-DMU at DMU d by the Stage 1 Sub-DMU at DMU k ,

μ_{dk} = Weight placed on the Stage 2 Sub-DMU at DMU d by the Stage 2 Sub-DMU at DMU k ,

π_{dk} = Weight placed on the Stage 2 Sub-DMU at DMU d by the Stage 2 Sub-DMU at DMU k in evaluating the organizational efficiency of DMU k .

For the Stage 1 Sub-DMU at DMU k , we solve: (Sexton & Lewis, 2003)

$$\text{Max} \theta_{1k}$$

$$\sum_{d=1}^D \lambda_{dk} X_{di} \leq x_{ki}; i = 1, \dots, I$$

$$\sum_{d=1}^D \lambda_{dk} Y_{dp} - \theta_{1k} Y_{kp}; p = 1, \dots, P$$

$$\sum_{d=1}^D \lambda_{dk} = 1$$

$$\lambda_{dk} \geq 0 \quad d = 1, \dots, D$$

$$\theta_{1k} \geq 0$$

and for the Stage 2 Sub-DMU at DMU k , we solve

$$\text{Max} \theta_{2k}$$

$$\sum_{d=1}^D \mu_{dk} Y_{dp} \leq Y_{kp}; p = 1, \dots, P$$

$$\sum_{d=1}^D \mu_{dk} Z_{dr} - \theta_{2k} Z_{kr}; r = 1, \dots, R$$

$$\sum_{d=1}^D \mu_{dk} = 1$$

$$\mu_{dk} \geq 0 \quad d = 1, \dots, D$$

$$\theta_{2k} \geq 0$$

where the overall efficiency of two-stage process was defined as the product of the efficiencies of two individual stages it is calculated as follow:

$$\text{Overall Efficiency} = \theta_{1k} * \theta_{2k}$$

Game-theoretic approaches originate from the work of (Liang, 2006), who measured the performance of two-member supply chains (such manufacturer-retailer supply chains) using the DEA approach. The ideas of the Stackelberg game, also known as the manufacturer-retailer or leader-follower game, are included into their approach. (Liang, 2008) Additionally, the leader-follower, or Stackelberg, game was used to study the non-cooperative game strategy for the two-stage procedures. The study employed the non-cooperative paradigm, which has been utilized in several studies and provides precise results by measuring the effectiveness of each stage independently. (Kao, 2008; Tone & Tsutsui, 2009; Zhou, 2008), where studies confirmed the efficiency of the non-cooperative model in educational institutions.

III. Results:

The inputs and outputs Data

Table 01: Decision making units

The following table lists the decision-making units (DMUs) of Blida 1 University, which include its faculties and institutes.

No	code	DMUs
1	A	Faculty of Technology
2	B	Faculty of Sciences
3	C	Faculty of Natural and Life Sciences
4	D	Medical School
5	E	Institute of Architecture and Urban Planning
6	F	Institute of Aeronautics and Space Studies
7	G	Institute of Veterinary Sciences
8	H	Institute of Applied Science and Technology

Source : <https://ar.univ-blida.dz/charge-de-la-pedagogie/statistique/>

Results:

Table 03: Spearman correlation test

	x1	x2	Y	Z1	Z1
x1	1				
x2	0.819535	1			
Y	0.632909	0.943015	1		
Z1	-0.06892	-0.44328	-0.4828	1	
Z1	0.561732	0.92413	0.985541	-0.50744	1

Source: R Programming language outcomes

The dataset for all 08 colleges at the University of Blida 1 contains the descriptive statistics of the year (2020–2021), which are all reported in Table 1.

First, we conducted the Spearman correlation test. The coefficients are shown in Table 3. The results demonstrate a positive correlation between inputs and outputs on the one hand. On the other side, there is a negative correlation between the first stage variables and the number of graduates. Essentially, this indicates that even when we invest more resources in things like adding teachers and enrolling more students, we do not see an increase in graduation rates. As a result, there is this strange circumstance in which adding more does not result in a larger output. This raises questions regarding the efficiency and quality of the educational process.

Table 04: Pure technical efficiency result.

Output-orientation 1st stage as the leader Decentralized model (Stackelberg game approach)					
No	code	DMUs	Eff 1	Eff 2	Overall eff
1	A	Faculty of Technology	2.416667	1	2.416667
2	B	Faculty of Sciences	1.083333	2.47532	2.681595842
3	C	Faculty of Natural and Life Sciences	3.333333	1	3.333333
4	D	Medical School	1.666667	2.352027	3.920045784
5	E	Institute of Architecture and Urban Planning	1.083333	6.619313	7.17092021
6	F	Institute of Aeronautics and Space Studies	1.25	5.463736	6.82967
7	G	Institute of Veterinary Sciences	1	13.330491	13.330491
8	H	Institute of Applied Science and Technology	1	1	1

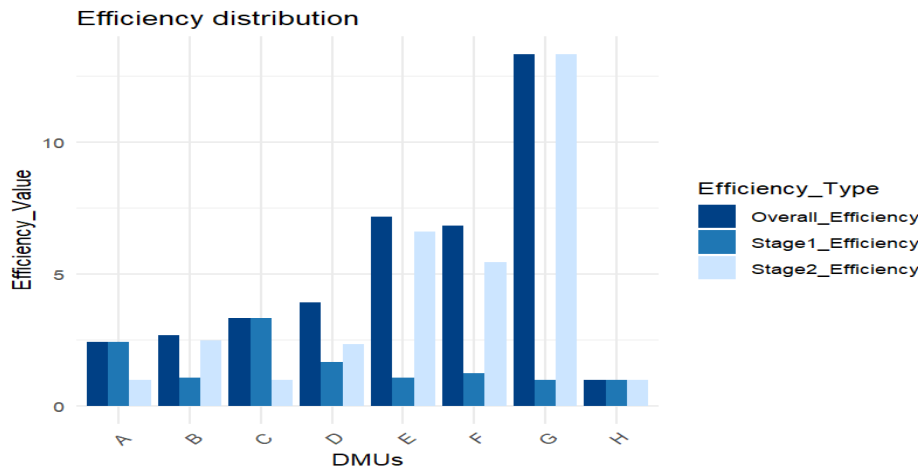
Source: R Programming language outcomes.

The efficiency of the system as a whole and each of its subsystems is demonstrated by the evaluation findings shown above. More than 87.5% of decision-making units (DMUs) experience inefficiencies in many stages, as shown in Figure 2, suggesting that problems are pervasive at the system level. We used a decentralized, output-oriented Stackelberg game model, with the first stage serving as the leader and the second stage as the follower, to gain a deeper understanding of the reasons behind these performance disparities amongst colleges and institutes.

The findings show that different units have different sources of inefficiency. Inefficiency is primarily concentrated in the first stage in departments like the Faculty of Technology and the Faculty of Natural and Life Sciences, suggesting a flaw in the process of transforming primary resources into intermediate outputs. The Faculty of Science, the Institute of Architecture and Urban Planning, the Institute of Aviation and Space Studies, and the Institute of Veterinary Science in particular, on the other hand, exhibit relative efficiency in the first stage but suffer from noticeable inefficiency in the second stage, which reflects difficulties in transforming intermediate outputs into final results. The Faculty of Medicine is a singular example of inefficiency in both phases, exposing systemic issues that impact the process as a whole.

The Institute of Applied Sciences and Technology is an exception to these challenges, emerging as the only fully efficient unit and setting a benchmark for best practices in this context. Overall, the application of the Stackelberg model emphasizes the need for differentiated solutions tailored to the source of inefficiency, whether it is leadership (in the first stage) or subordinate (in the second stage), in order to improve the overall performance of the system.

Figure 02: efficiency of each stage.



Source: R Programming language outcomes

08Table 05: Optimal multipliers

N o	cod e	DMUs							
			\$v.s1	\$v.s1	\$p	\$u.s2	\$u.s2	1\$w.s	\$w.s2
1	A	Faculty of Technology	0.0000	0	0	0.0003692762	0.0000000000	0	1
2	B	Faculty of Sciences	0.0000	0	0	0.0009140768	0.0000000000	0	2.47532
3	C	Faculty of Natural and Life Sciences	0.0000	0	0	0.0000000000	0.0004022526	0	1
4	D	Medical School	0.000000	0	0	0.0001506077	0.0008097381	0	2.352027

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5	E	Institute of Architecture and Urban Planning	0.0000 0	0	0	0.000 42385 56	0.0022 788471	0	6.619313
6	F	Institute of Aeronautics and Space Studies	0.0000 0	0	0	0.000 00000 00	0.0021 978022	0	5.463736
7	G	Institute of Veterinary Sciences	0.0000 0	0	0	0.000 85359 36	0.0045 893210	0	13.33049 1
8	H	Institute of Applied Science and Technology	12.816 26 0	0	15359.6 7	0.012 34567 90	0.0000 000000	280.304 1	- 356.2016 46

Source: R Programming language outcomes

There was a noticeable difference in performance efficiency between the university's faculties, according to the analysis of the complications of the ideal model. The table demonstrates that most faculties (A through G) had extremely low input and output weight values, indicating their relative inefficiency in using resources and achieving desired results.

The Institute of Applied Sciences and Technology (H), on the other hand, is a notable example, with notably high values in the variables \$v.s1, \$p, and \$w.s1. Since it serves as the analysis's benchmark, its exceptional achievement of full efficiency (efficiency = 1) establishes it as a benchmark for comparison and the identification of performance gaps in other units.

Certain secondary complications, like $w.s=2-356.201646$, show negative values, which are mathematically interpreted as an expression of the model's balance condition and represent the discrepancy between the resources and outputs that are actually used in some stages and the ideal quantities that are assumed.

These findings indicate that while institute (H) has reached optimal efficiency, faculties A through G are functioning below their marginal efficiency level. This suggests that by redistributing inputs and boosting output productivity, utilizing the reference model embodied by the institute (H), there is considerable opportunity to improve performance in inefficient colleges. Additionally, the extracted weights offer useful analytical insights that can be utilized to identify strengths and weaknesses at the college level and to direct administrative and academic policies towards a more effective use of resources, ultimately improving system performance.

IV. Discussion

Efficiency disparities across the faculties under investigation were evident in the outcomes of the two-stage data envelope analysis model's practical application. The majority (from A to G) performed below par, demonstrating an inability to transform the resources at hand into worthwhile results. This outcome validates the study's primary goal of measuring relative efficiency within a non-cooperative structure. It also validates the model's sensitivity and analytical correctness by clearly distinguishing between decision-making units (DMUs).

The Faculty of Applied Sciences and Technology (H) is a benchmark for the other faculties since the results demonstrate that it is a fully efficient unit (efficiency = 1). This accomplishes the study's second goal, which is to determine which models are most and least effective for directing improvement initiatives. The existence of such "efficient frontier units" is theoretically consistent with findings from the envelope analysis literature, such as the study by Dogan (2023), which discovered that only a small percentage of research universities attain full efficiency, supporting the theory that unequal efficiency distribution is a typical occurrence in higher education institutions. Regarding the third goal, which is to determine the elements that have the biggest impact on efficiency, the analysis of optimal multipliers (double multipliers) showed that enhancing outputs like *us2* and *ws1*—which could be indicative of teaching or qualitative research outputs—has a bigger effect on increasing efficiency than merely cutting inputs. The results of a study by Song et al. (2022) are supported by this conclusion. It allows for a more comprehensive conversation about institutional finance and investment objectives, which ought to move away from the "resource" rationale and towards the "value-added" logic.

In terms of methodology, the study makes a significant practical addition by employing a sophisticated mathematical model that determines relative efficiency and pinpoints the variables that affect it—an analytical component that is frequently disregarded in conventional research. The study does, however, have a number of methodological shortcomings, chief among them being its reliance on cross-sectional data that represents performance during a particular time frame (2020–2021), which restricts the capacity to examine the temporal evolution of efficiency. Additionally, focusing on a single university and using a particular set of quantitative inputs and outputs may leave out qualitative elements like beneficiary satisfaction or the caliber of the learning environment, which would lessen the results' comprehensiveness.

Thus, extending future research to incorporate qualitative indicators, longitudinal data, and comparisons across other universities will enhance our theoretical and practical understanding of academic institution efficiency. These findings have obvious policy implications as well; they highlight the necessity of developing improvement programs that are specific to the first or second stage of the shortage and of adopting strategies that enhance high-impact outputs rather than concentrating solely on rationalizing spending.

V. Conclusion

The results of this study highlight the necessity of applying an output-oriented, two-stage non-cooperative DEA model to quantitatively and impartially assess university colleges' efficiency. There was a clear difference in the level of competence between the colleges, according to the investigation, and the College of Applied Science and Technology stood out for attaining maximum efficiency and acting as a benchmark to assist the other institutions in raising their performance. Over 87.5% of the hypothetical DMUs are inefficient throughout the system.

The study's goals of assessing institutional performance and guiding university policies towards the best use of resources were both aided by the identification of the most significant

efficiency determinants through the analysis of optimal multipliers. The results are a significant step towards a better understanding of the effectiveness of higher education and set the stage for the best future, despite certain limitations brought on by a lack of data and the study's time frame.

The scientific contribution of the study is the application of an analytical approach that ties overall efficiency to sub-stage performance, allowing for an accurate diagnosis of the sources of inefficiency. The study also provides decision-makers with useful tools by identifying important efficiency determinants using optimal multiplier analysis, which revealed that boosting outputs has a bigger influence on increasing efficiency than rationalizing inputs. Based on the findings, we can make the following recommendations:

- Creating tailored improvement programs for each unit based on their specific inadequacies (first or second stage).
- Create an institutional conversation to share best practices across faculties, based on the efficient unit model.

R Programing Language script

```
install.packages("DJL")

library(DJL)

x <- data.frame(x1 = c(305,267,173,398,107,79,78,6), x2 =
c(8347,3703,7063,6542,1629,1180,996,297))

y <- data.frame(z1 = c(1/29,1/13,1/40,1/20,1/13,1/15,1/12,1/43))

z<- data.frame(z1 =c(2708,1094,2251,1102,370,375,193,81), z2 =
c(2401,880,2486,1030,370,455,182,70))

result <-dm.network.dea(xdata.s1= x , zdata.s1=NULL,zdata= y, xdata.s2=NULL, zdata.s2=z,
rts="vrs", orientation="o", type="nc", leader="1st", ss=10^-4, o=NULL)

print(result)

result <-dm.network.dea(xdata.s1= x , zdata.s1=NULL,zdata= y, xdata.s2=NULL, zdata.s2=z,
rts="crs", orientation="o", type="nc", leader="1st", ss=10^-4, o=NULL)

print(result)

install.packages("ggplot2")

install.packages("tidyr")

install.packages("dplyr")

library(ggplot2)

library(tidyr)

library(dplyr)

library(readxl)

data <- read_excel("C:/Users/M ..... H/Desktop /datta.xlsx")

View(data)
```

```

ggplot(datta, aes(x = DMUs, y = Efficiency_Value, fill = Efficiency_Type)) +
  geom_bar(stat = "identity", position = position_dodge()) +
  scale_fill_manual(values = c(
    "Stage1_Efficiency" = "#1f77b4",
    "Stage2_Efficiency" = "#cce5ff",
    "Overall_Efficiency" = "#004085"
  )) +
  theme_minimal() +
  labs(
    title = "Efficiency distribution",
    x = "DMUs",
    y = "Efficiency_Value",
    fill = "Efficiency_Type"
  ) +
  theme(axis.text.x = element_text(angle = 8, hjust = 1))

```

rts	Returns to scale assumption "crs" Constant RTS (default) "vrs" Variable RTS "irs" Increasing RTS "drs" Decreasing RTS
orientation	Orientation of the measurement "i" Input-orientation (default) "o" Output-orientation
type	Solution method "nc" Decentralized model (Stackelberg game approach) (default) "co" Centralized model (cooperative game approach)
leader	Preemptive priority for Decentralized model "1st" 1st stage as the leader (default) "2nd" 2nd stage as the leader
ss	Step size for heuristic search 10^{-4} (default)
o	DMU index to operate. NULL (default) will operate for all

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