# An Approach to the Efficiency of a Set of Hotel Units per Municipality in Mainland Portugal

António Maria de Calheiros e Menezes Ferreira de Almeida

Instituto Superior Técnico, Lisboa, Portugal

October 2023

**Abstract:** The main objective of this research is to analyze the efficiency of all hotels belonging to 86 municipalities in mainland Portugal during the years 2019, 2020 and 2021. This topic arose because the Portuguese economy dependency on the Tourism sector is increasing year by year.
A general and current perspective on tourism is given, both at a global and national level. This study was carried out using the DEA (Data Envelopment Analysis) methodology, and two models were developed to assess the efficiency of the DMUs, one with an input orientation and the other with an output orientation. The variables used in both models were the number of establishments, the number of rooms, the total capacity (measured in number of beds) and the staff employed as inputs, while the total number of overnight stays and the total revenue variable were used as outputs. After running the models and analyzing them, a ranking was made for the most efficient municipalities.
The conclusions suggest that of the 86 municipalities analyzed there are only 6 with maximum efficiency: Lamego, Lisboa, Alter do Chão, Albufeira, Lagoa and Vila Real de Santo António. It should be noted that half of the efficient municipalities belong to the Algarve region.

**Keywords:** Tourism, DEA, Efficiency, Hotels, Portuguese Municipalities, Hospitality

## 1 Introduction

### 1.1 Background and Motivation

Tourism has been growing year after year and is increasingly playing a fundamental and highly relevant role in the world economy. However, there have been some notable downturns in recent decades related to some crises. These crises were overcome quickly and even surprisingly, demonstrating, in an equivocal way, the power of this sector of the economy. According to the World Tourism Organization (UNWTO), in 2019, the pre-pandemic year, world tourism closed with 1500 million international tourist arrivals, 4% more than in the previous year, following the growth trend it has shown in the previous 10 years (UNWTO, 2023).

In Portugal, the beginning of the 21st century has been somewhat turbulent and characterized by some political and financial instability. However, tourism has followed an upward trend, growing year by year until today, with only a drop in 2009 according to data from the Instituto Nacional de Estatística (INE). However, when it comes to events with a high international profile, the first decade of this century was positively marked by the organization of the EURO 2004 football tournament. On the other hand, the banking crisis of 2008 was a negative milestone for the tourism sector and consequently for the national economy. In particular, the tourism sector experienced explosive growth, having adopted decisive measures to safeguard its own future, as well as that of the Portuguese nation as a whole. Tourism has become the main sector of the Portuguese economy, and this exponential growth is largely due to the way the country has been able to incorporate the latest trends in the travel and tourism sector. By taking advantage of its unique climate, excellent cuisine, rich cultural and historical heritage and combining it with an innovative approach, Portugal has managed to attract an increasing number of visitors - up to a record 42.6 million overnight stays in 2020 (INE).

That said, Portugal is a top tourist destination and the tourism sector plays the most significant role in the country's economy, this research study aims to evaluate the efficiency of hotel units. The aim is to provide hotel managers with a solid basis for making informed decisions on how to optimize their resources and improve the quality of services offered to tourists visiting the country.

To achieve this, this work uses the methodology known as Data Envelopment Analysis (DEA)

### 1.2 Objectives

Efficiency is now an essential tool for any business, and the hotel industry is no exception. In order to ensure greater profitability and competitiveness, hotel units should and must be run as efficiently as possible. In this context, efficiency can be defined as obtaining the best results using as few resources as possible. The main objective of this work is to analyze the efficiency of hotel units located by municipality in mainland Portugal. In order to evaluate and analyze this efficiency, some variables considered relevant to the model will be chosen beforehand and then the Data Envelopment Analysis (DEA) methodology will be applied.

Which variables and elements influence the efficiency of hotel units, which municipalities are the most efficient in terms of hotel units, whether they are located in the east or west of Portugal, whether they have more or fewer beds, occupancy rates, whether workers with higher salaries are synonymous with greater efficiency, what good practices have been identified and how they can be applied in order to improve the efficiency of less efficient units, are some of the questions that this work aims to answer.

## 2 Tourism and the hotel industry

### 2.1 World tourism

Tourism is recognized as a strong engine of economic growth, which creates a strong impact on the development of a country or place (Tang & Tan, 2013), which means that tourism as a sector has transformed the world economy in recent decades, as it has established itself as one of the most relevant and fast-growing industries in the world (Gross, 2018).

According to Leiper (1979), the word tourism emerged after a time when the English upper class sent young people on extensive tours of continental Europe to complete their studies. Nowadays, according to the World Tourism Organization (WTO), tourism "is a social, cultural and economic phenomenon that involves people traveling to countries or places outside their usual environment, for personal or professional purposes.
According to the UNWTO (2020), in 2019 export revenues generated by tourism increased to 1.7 trillion US dollars, which once again demonstrates the global strength of this sector for both growth and economic development. This represents around 7% of total world exports. Tourism also accounted for around 10.4% of global GDP, and directly employed 330 million people worldwide (World Travel & Tourism Council, n.d).

Between 2013 and 2019, world tourism grew steadily, with an average annual increase of around 4% (UNWTO, 2020). However, as previously mentioned, in 2020 the sector was severely affected by the COVID-19 pandemic, which forced the closure of borders and the adoption of security measures around the world. These restrictive measures taken by countries have made tourism almost impractical, which obviously led to a significant drop.

To conclude, world tourism is a key industry for the global economy, which has been growing exponentially in recent decades. However, the COVID-19 pandemic has had a profound and lasting impact on the sector, with a sharp drop in the number of international tourists and a significant reduction in the revenue generated by tourism worldwide. However, the signs of recovery are clear, demonstrating the strength of this sector, which year after year tries to reinvent itself by showing a great facility for innovation and development.

### 2.2 National Tourism

Tourism in Portugal plays a fundamental role, not only in the growth of the national economy, but also in the social and environmental development of Portuguese regions (Oliveira, 2014). In recent years, tourism in Portugal has consolidated its position as one of the main sectors of the national economy.

Between 2010 and 2019, the number of arrivals continued to rise, with the sharpest increase in 2015. However, in the years that followed, there was a sharp drop, just like in the rest of the world, due to the pandemic crisis.

According to the Instituto Nacional de Estatistica (INE), in 2019, the pre-pandemic year, the country saw the arrival of 24.6 million non-resident tourists, corresponding to an increase of 7.9% compared to the previous year. In the same year there were 29.5 million guests in all tourist accommodation, which provided 77.8 million overnight stays, an increase of 7.4% and 4.3% (respectively) compared to 2018. Tourism also accounted for 11.8% of national GDP and generated around 400,000 jobs (UNWTO, 2020).

In 2022, the evolution was notable, and it is possible to already see similar figures to 2019. In terms of overnight stays and guests, there was a reduction of just -0.9% and -2.3% respectively,

while the value of tourist receipts increased by 15.4%. There were also around 26.5 million guests, an increase of 83.3% on the previous year, of which 15.3 million were foreigners, which translates into an increase of 158.5%. In terms of overnight stays, there were 46.6 million overnight stays by foreigners and 22.9 million overnight stays by nationals, giving a total of 69.5 million tourists (Turismo de Portugal, 2023).

World tourism continues to grow, driven by the search for unique experiences and diverse destinations. On Portuguese soil, natural beauty, cultural heritage and hospitality have attracted people from all over the world, solidifying the country as an important tourist center. As has been said, Portugal is ultra-dependent on tourism and hospitality in its economy. This sector employs thousands of people all over the world. However, it is imperative to recognize that the hospitality industry has faced significant challenges, such as seasonal fluctuations and the impact of unexpected events, such as the COVID-19 pandemic.

## 3 State-of-art

### 3.1 Efficiency vs. Productivity

Both the concepts of efficiency and productivity are extremely important for the study of various sectors, markets and economies in general. However, as efficiency is a key point in this study, it is essential to clarify the difference between the concepts of efficiency and productivity.

Efficiency, also known as the frontier function, was defined by Niavis and Tsiopas (2019), in the context of hospitality, as the ability of destinations to exploit hotel capacity, labour and attractions in order to maximize demand for those destinations.

Lovell et al. (1993) came up with a more exact definition, in which efficiency is described as the comparison between the observed values and
According to Porcelli (2009), producers are efficient if they produce as much as possible according to the inputs applied and if they manage to produce the output at the lowest possible cost. However, efficiency is only one part of overall performance, since a complete analysis also involves measuring effectiveness, among others.

### 3.2 Different types of efficiency testing methodologies

There are various methods for testing the efficiency and performance of different systems or processes. Before more sophisticated models emerged, the use of indexes and ratios helped to understand whether a certain process or system was efficient.

Parametric methods allow the quantification of error but present the additional challenge of determining the appropriate specification for the desired behavior (Coelli et al., 1998) (Marques & Silva, 2006), two of the most widely used methods are stochastic frontiers (SFA) and regression models (OLS or COLS). On the other hand, data envelopment analysis (DEA) and numerical indices are widely used methods that are considered to be non-parametric.

The SFA is a parametric model, i.e. it assumes a functional form for the relationship between the independent and dependent variables, i.e. it has a fixed number of parameters to be estimated. The SFA is an econometric regression that aims to predict the behavior of a quantitative variable (dependent variable) from one or more relevant variables (independent variables). The SFA model takes on a specific functional form, but simultaneously estimates the parameters and the margins of error of the forecasts.

DEA, on the other hand, is a non-parametric model, which means that it makes no assumptions about the functional form of the relationship between the variables. Instead, the model uses the data itself to estimate the relationship. DEA is used to evaluate the efficiency of a set of units by comparing them with each other. It will consider the inputs and outputs in order to estimate the efficiency index for each unit.

### 3.3 DEA Methodology

The DEA (Data Envelopment Analysis) methodology was developed by Charnes, Cooper and Rhodes, based on the work of Michael Farrel (Farrell, 1957). This approach uses linear programming methods to approximate a non-parametric piecewise frontier from collected data and thus measure the relative efficiency of observations from a set of outputs and inputs (Rodríguez et al, 2021).

The DEA approach makes it possible to analyze the best combinations of inputs and outputs, considering the performance of the observations (DMUs - Decision Making Units). Based on these combinations, it is possible to establish a borderline and identify the levels of inefficiency of the relative observations, as well as identifying opportunities to mitigate these deficiencies, when compared to the observations (DMUs) considered efficient. It is worth noting that, since the evaluation is based exclusively on the full

sample of observations under analysis, technical efficiency measures the relative efficiency of the decision units, and not absolute efficiency (Cullinane et al., 2004).

This methodology is used to evaluate homogeneous units. In this study, DEA will be applied to evaluate the efficiency of hotels by municipality in mainland Portugal.

**3.4 Literature review**

Manasakis et al. (2013) compared the efficiency of independent hotels and branded hotels in Crete, Greece, using DEA analysis. They concluded that independent hotels were more efficient, with inefficiency related to the configuration of inputs/outputs.

Ashrafi et al. (2013) analyzed the efficiency of the hotel industry in Singapore, considering historical events, using a year-based approach with DEA. They identified less efficient years due to events like September 11 and the financial crisis.

Rebelo et al. (2013) assessed the efficiency of hotels in different regions of Portugal between 2006 and 2008, using DEA analysis. They found an improvement in the productivity of the Portuguese hotel sector, except in the island region, with 30 companies achieving maximum efficiency.

Benito et al. (2014) examined the efficiency of tourism in 17 Spanish regions between 2002 and 2010 using DEA. They discovered that inefficiency was generally related to pure technical inefficiency and that political and openness factors explained differences in efficiency.

Luo et al. (2014) evaluated Chinese cities with hotels between 2001 and 2011 using DEA and the Malmquist index. They found that inefficiency was generally due to pure technical inefficiency and identified that political hierarchy, degree of openness, and tourism dependence explained differences in city efficiency.

Xavier and Moutinho (2014) aimed to enhance the performance of decision units in Pestana Group's hotel units. They used DEA and the Malmquist Index to evaluate efficiency and found that more efficient hotel units used resources better and had higher productivity.

Fernández and Becerra (2015) analyzed efficiency factors in Spanish hotels with different chain scales using DEA. They found a strong relationship between quality and efficiency, with larger hotels and resorts being more efficient.

Parte-Esteban and Alberca-Oliver (2015) examined the determinants of efficiency in the Spanish hotel sector from 2001 to 2010, focusing on regional and business factors. They used DEA and Tobit regression.

Oliveira et al. (2015) studied the efficiency of 4 and 5-star hotels in the Algarve from 2005 to 2007 using DEA, with models involving monetary and quantitative variables. They found differences related to management, seasonality, and the institutional and contextual environment.

Ohe and Peypoch (2016) evaluated the efficiency of Japanese ryokans in 9 regions from 2005 to 2012 using DEA. They concluded that larger ryokans were relatively more efficient and provided management recommendations for smaller ryokans.

Oukil et al. (2016) assessed the efficiency of 58 hotels in Oman using a two-phase DEA approach. They found that most hotels were technically inefficient, with efficient hotels mainly located in the capital, Muscat.

Karakitsiou et al. (2018) analyzed efficiency in the hotel and restaurant sector in 13 regions of Greece from 2002 to 2013 using DEA. They emphasized the need to balance inputs and outputs to improve efficiency in Greek regions.

Sellers-Rubio and Casado-Díaz (2018) evaluated the efficiency of the hotel industry in 17 Spanish regions from 2008 to 2016 using a two-phase DEA and double-bootstrap approach. They observed high hotel industry inefficiency and the significant impact of environmental variables.

Niavis and Tsiotas (2019) compared the performance of Mediterranean coastal destinations in 37 regions from 7 different countries using DEA. They highlighted the crucial role of considering exogenous factors for better tourism monitoring.

Lado-Sestayo and Fernández-Castro (2019) examined the impact of location on hotel efficiency in 97 Spanish tourist destinations across 17 regions using a 4-phase DEA approach. They confirmed the usefulness of the proposed model and the importance of considering variables related to the tourist destination.

Sáez-Fernández et al. (2020) analyzed efficiency in the hotel industry in the Balearic Islands, Spain, and the effect of seasonality with DEA. Hotels open year-round were more efficient.

Pavković et al. (2021) studied efficiency in the tourism sector in 23 European countries in 2017 using DEA. They observed variations in efficiency, with some countries needing measures to improve.

Rodríguez et al. (2021) assessed the efficiency of the hotel industry in the Canary Islands, Spain, in 2010 and 2015, using DEA and different approaches. They concluded that hotels in tourist municipalities were more efficient.

## 4 CASE STUDY

### 4.1 Sample and used variables

The sample collected, the input and output variables and the models used are also described in this chapter. In total, data from hotels in 86 regions of Portugal is analyzed for the years 2019, 2020 and 2021, which makes a total of 258 observations.

Approximately 50% of these municipalities are situated along the Portuguese coast, with the northern and central regions each accounting for about 33.7% of the municipalities, and the southern region (Lisbon, Alentejo, and Algarve) representing roughly 32.5%. It's noteworthy that additional municipalities were not analyzed due to data limitations.

This study focuses on evaluating the efficiency of hotels across various municipalities in Portugal. To select the appropriate variables for this assessment, it was considered their common usage in similar studies and data availability. The chosen inputs include the number of establishments, rooms, capacity, and personnel within each municipality. Meanwhile, the selected outputs consist of the number of overnight stays and the total revenue generated.

These variables hold a critical role in the comprehensive evaluation of hotel efficiency within each municipality, providing valuable insights into the diversity and extent of the services offered to visitors.

The study's findings will shed light on the comparative performance of hotels and contribute to a better understanding of their operational effectiveness in different regions of Portugal.

The limited number of inputs and outputs in this study is influenced by Banker et al. (1989) recommendation, which suggests a rule based on the number of DMUs (Decision Making Units). According to this rule, the total number of inputs and outputs should not exceed one-third of the observations. In this research, there are a total of 86 observations and 6 variables (both inputs and outputs), ensuring compliance with the rule, since 6 is less than 86/3.

## 5 Models

The scope of this research is to analyze the efficiency of hotel establishments by municipality in mainland Portugal. To accurately assess efficiency, the Data Envelopment Analysis (DEA) methodology was employed using Stata SE software. Two models were used, both analyzed with Variable Returns to Scale (VRS).

### 5.1 Input-Oriented Model

In input-oriented models, the primary focus is on inputs. The main goal of this model is to minimize inputs while maintaining outputs. In practical terms, within the context of this research, it aims to minimize available resources such as the number of establishments, rooms, capacity, and staff, while keeping the same number of overnight stays and total revenue.

In summary, an input-oriented model is a valuable tool for evaluating and improving the efficient use of resources in hotel establishments. It not only identifies inefficiencies but also controls costs, leading to better management decisions and more effective resource allocation.

### 5.2 Output-Oriented Model

In output-oriented models, the emphasis is on output variables. The objective in this model is to maximize outputs while considering available inputs. In the context of this research, it seeks to maximize the total number of overnight stays and total revenue for a fixed number of establishments, rooms, beds, and staff.

In summary, an output-oriented model assesses performance with a focus on achieved results, facilitating comparison with other establishments, goal fulfillment, growth strategies, and continuous improvement. This model is particularly valuable when the priority is to maximize production or achieve specific outcomes.

## 6 Results

### 6.1 Efficiency input orientation model

The following table shows the parameters obtained for all the data. Since there are 86 observations evaluated over a 3-year period, the total number of DMUs is 258. The table shows

data for the Global, Technical and Scale efficiency measures.

*Table 1 - Statistical Parameters Input-oriented model*

| Parameters | Efficiency measures | | |
|---|---|---|---|
| | Global | Technic | Scale |
| Mean | 60,7% | 69,3% | 87,8% |
| Stan.dev | 21,6% | 21,6% | 14,6% |
| Minimum | 13,4% | 23,3% | 25,8% |
| Efficient units | 28 | 48 | 28 |
| Numer of DMU's | 258 | 258 | 258 |

It is possible to draw the following conclusions:

- The average overall efficiency is 60.7%, indicating a low number of efficient municipalities, only 28 (approximately 10.9% of the population).
- Regarding technical efficiency, 81.4% of municipalities were considered inefficient, with only 48 deemed efficient.
- Despite a high average scale efficiency of 87.8%, only 28 municipalities were considered efficient, representing 9.7% of the observations.

Further analysis reveals that 28 municipalities are efficient in overall efficiency, with Lamego, Albufeira, Lagoa, and Vila Real de Santo António achieving a 100% efficiency rate. Notably, three of the four 100% efficient municipalities are in the southern region of Portugal, specifically in the Algarve.

In terms of technical efficiency, out of 48 DMUs, 27 were consistently technically efficient. These municipalities are Trofa, Lamego, Penedono, Vila Nova de Paiva, Lisboa, Alter do Chão, Albufeira, Lagoa, and Vila Real de Santo António. The average technical efficiency of 67.5% suggests that municipalities achieved the same level of outputs while reducing input consumption by 22.5%.

Concerning scale efficiency, the overall average is 87.8%, indicating room for improving the ratio of total outputs to total inputs by around 12.2%. The behavior of DMUs with respect to scale, reveals that 151 DMUs exhibited increasing returns to scale (IRS), 82 showed decreasing returns to scale (DRS), and 25 had constant returns to scale (CRS).

Approximately 58.5% of DMUs (151 units) had IRS, implying they could improve efficiency by increasing inputs. The 82 DMUs with DRS would experience less significant output increases with input growth.

Regarding peer references, technically efficient DMUs serve as reference units to transform inefficient DMUs into virtually efficient ones. This analysis is conducted individually for each year and for each type of model (input and output). Notably, only Lamego, Penedono, Vila Nova de Paiva, Alter do Chão, Albufeira, Lagoa, and Vila Real de Santo António were used as references throughout the three years. Castelo Branco (61), Montijo (42), and Fundão (59) were the most commonly used references in 2019, 2020, and 2021, respectively.

Several DMUs had five references over the three years of analysis, with Caminha (2019) using Penedono (0.2101), Castelo Branco (0.5861), Sintra (0.0075), Aljezur (0.066), and Lagoa (0.0087) as peers. While Lisbon achieved 100% technical efficiency in 2021, it was not a reference for any inefficient DMU in that year. Trofa, despite having 100% technical efficiency in all years, used Vila Nova de Paiva and Torres Novas as references in 2020.

### 6.2 Output Orientation Model

*Table 2 - Statistical Parameters output-oriented model*

| Parameters | Efficiency measures | | |
|---|---|---|---|
| | Global | Technic | Scale |
| Mean | 60,4% | 67,1% | 90,6% |
| Stan.dev | 21,5% | 22,9% | 10,3% |
| Minimum | 13,4% | 13,5% | 56,3% |
| Efficient units | 25 | 41 | 31 |
| Numer of DMU's | 258 | 258 | 258 |

In terms of Global efficiency, the average is 60.4%, with only 25 municipalities considered efficient, representing 9.7% of the total population. Regarding Technical efficiency, the average is 67.1%, with 41 municipalities considered efficient, accounting for 15.9% of the total population. Finally, Scale efficiency has an average of 90.6%, with 31 efficient municipalities, which amounts to 12% of all observations.

The analysis reveals that for Global efficiency, there are 25 efficient DMUs. Of these, only Lamego, Albufeira, Lagoa, and Vila Real de Santo António achieved 100% Global efficiency over the three years. Like in the input-oriented model, three of the four municipalities with 100% Global efficiency overall years are in the southern region of Portugal.

Moving on to Technical efficiency, there are 41 observations with a maximum scale, corresponding to 100%. Among these, Lamego, Lisboa, Alter do Chão, Albufeira, Lagoa, and Vila Real de Santo António maintained 100% Technical efficiency throughout the analysis

period, while the other 217 DMUs were technically inefficient.

The 67.1% average for technical efficiency indicates that the municipalities reduced input consumption by 32.9% while maintaining the same level of outputs.

Lastly, only around 12% of DMUs were considered efficient in terms of Scale efficiency, accounting for a total of 31 efficient DMUs. The average for this indicator was 90.6%, revealing potential to improve the ratio of total outputs to total inputs by about 9.4%.

Regarding the behavior of DMUs in relation to scale, 145 DMUs experienced increasing variable returns to scale, 82 DMUs had decreasing returns, and only 31 had constant variable returns to scale.

These comparisons help identify improvement opportunities and benchmarking, enabling the evaluated unit to adjust its performance based on the practices of its reference peers. This is essential for enhancing efficiency and management across various organizations and sectors.

Lamego, Lisbon, Albufeira, Lagoa, and Vila Real de Santo António were the only DMUs used as references over the three years. In contrast to previous patterns, these four municipalities are the only ones with 100% efficiency, which explains their consistent use as references. Lamego, Lisbon, Albufeira, Lagoa, and Vila Real de Santo António had frequencies of 3, 21, 7, 2, and 39, respectively, for the year 2019, 11, 10, 10, 39, and 14 for 2020, and 14, 1, 23, 7, and 10 for 2021. It's worth noting that despite these municipalities being the only ones repeating over three years, none of them had the highest frequency. In 2019, Castelo Branco had the highest frequency of 70, Montijo had 68 in 2020, and Fundão was used as a reference 68 times in 2021.

Several DMUs had four references over the three years of analysis, the highest number observed. No efficient DMU had no references, with the lowest corresponding to Lisbon in 2021. Some DMUs, such as Braga in 2019, Trofa in 2019, Felgueiras in 2020 and 2021, Penedono in 2019, Ovar in 2020, Torres Novas in 2020, Grândola in 2021, Moura in 2021, and Alter do Chão in 2021, achieved 100% Technical efficiency but still had peer references, suggesting room for improvement.

### 6.3 Comparison of Model Results and Municipal Ranking

#### Global Efficiency Comparison

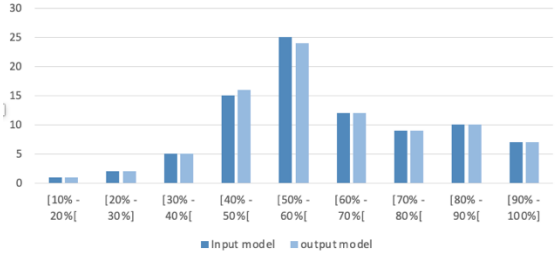


*Figure 1 - Results of the CRS efficiency*

Figure 1 displays the distribution of global efficiency percentages obtained by municipalities in both input-oriented and output-oriented models. The distribution of municipalities is quite similar between the two models in most intervals, except for a slight difference in the 40% to 50% and 50% to 60%. The 50% to 60% interval contains the most municipalities in both models, with 25 municipalities for the input-oriented model and 24 for the output-oriented model. Lamego, Albufeira, Lagoa, and Vila Real de Santo António achieved maximum Global efficiency (100%) in both models over the three analyzed years. The average Global efficiency was 60.7% for the input-oriented model and 60.4% for the output-oriented model.

#### Technical Efficiency Comparison

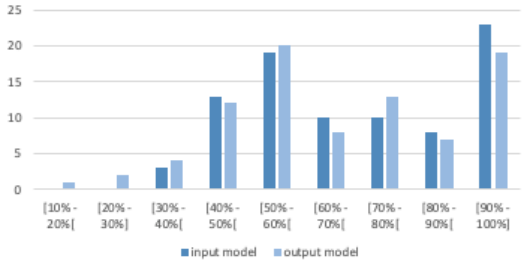


*Figure 2 - Results of the VRS Efficiency models*

Figure 2 compares both models in terms of technical efficiency, reflecting the average values for each municipality between 2019 and 2021. The distribution in this graph is less uniform than the previous one. In the input-oriented model, the 90% to 100% interval includes the most municipalities (23). In the output-oriented model, most municipalities fall into the 50% to 60% interval (20), although there is only one less municipality in the 90% to 100% interval (19). In the input-oriented model, Trofa, Lamego, Penedono, Vila Nova de Paiva, Lisboa, Alter do Chão, Albufeira, Lagoa, and Vila Real de Santo António achieved 100% Technical efficiency over the three years, while in the output-oriented model, the municipalities that reached the maximum technical efficiency were Lamego, Lisboa, Alter do Chão, Albufeira, Lagoa, and Vila

Real de Santo António. The average technical efficiency was 69.3% in the first model and 67.1% in the second model.

**Variable Returns to Scale Comparison**

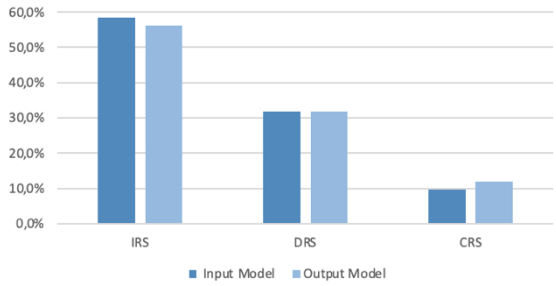


*Figure 3 - Results of the Scaling Behaviour*

In Figure 3, the subsequent graph compares the results of variable returns to scale in both models. For decreasing returns to scale, both models share the same value of 31.8%. The input-oriented model has about 58.5% of its DMUs with increasing returns to scale, while the output-oriented model has 56.2%. Finally, the DMUs with constant returns to scale in the input-oriented and output-oriented models are 9.7% and 12%, respectively.

**Comparison of Peer References**

The peer references sets in the output-oriented model are less diversified due to having fewer technically efficient DMUs in this model compared to the input-oriented model. Moreover, the first model has a higher number of municipalities used as references.

**Ranking of Portuguese Municipalities**

The ranking of municipalities in terms of efficiency can be achieved through various methods. For the purpose of this work, the employed method was the one proposed by Aristovnik (2013), which considers only the technical efficiency of DMUs.

The final ranking is determined by calculating the geometric mean of the technical efficiency results for each DMU over the three years. Some municipalities shared the first place in the ranking over the three years, including Lamego, Lisboa, Alter do Chão, Albufeira, Lagoa, and Vila Real de Santo António.

The municipalities considered 100% efficient were Lamego, Lisboa, Alter do Chão, Albufeira, Lagoa, and Vila Real de Santo António. This outcome is not surprising, as these municipalities had a technical efficiency of 100% throughout the analyzed period.

**7 Conclusions**

This study focused on evaluating the efficiency of hotel establishments in 86 mainland Portuguese municipalities over the years 2019, 2020, and 2021. Employing Data Envelopment Analysis (DEA), the research assessed both input and output-oriented models to understand efficiency across these regions. The study unveiled several key findings and implications.

**Inefficiency Prevalence**: The findings indicate that the majority of municipalities demonstrated inefficiency in managing their hotel establishments. This implies that there is considerable room for improvement in the way they utilize their resources. It's essential for these municipalities to focus on enhancing their operational efficiency to better serve their respective regions.

**The Impact of COVID-19**: The global pandemic had a significant impact on various sectors, and the hotel industry was no exception. The study's results reflect the turbulence and fluctuations in the industry, with occupancy rates and revenues varying significantly due to the pandemic's disruptive effects.

**Optimizing Resources**: The analysis of Variable Returns to Scale suggests that many municipalities have the potential to optimize their resources further. This is a positive finding, as it indicates that improvements can be made to increase the overall efficiency of the hotel sector. Efficient resource allocation and management can lead to better service quality and financial performance.

**Leading Efficient Municipalities**: Six municipalities, including Lamego, Lisboa, Alter do Chão, Albufeira, Lagoa, and Vila Real de Santo António, demonstrated an impressive 100% efficiency. These regions have excelled in managing their resources to deliver high-quality services to their visitors consistently.

This analysis serves as a useful benchmark for less efficient regions, highlighting the need for better resource utilization. It's crucial for less efficient municipalities to learn from their more efficient counterparts and implement strategies to enhance their operational efficiency. Addressing limitations such as data availability, the impact of outliers, and the methodology's sensitivity is essential for improving the accuracy and reliability of future research in this area.

**Future Research Directions**: Future research can expand on these findings in several ways. Firstly, researchers could explore the efficiency of

hotel establishments in specific tourism regions and assess the unique dynamics and challenges faced by each.

Secondly, conducting a more detailed analysis of how external events impact the operational efficiency of hotel establishments would be valuable. This could involve examining how different regions adapted to the same challenges.

Thirdly, extending the analysis over a more extended time frame by including additional years of data would allow for a more comprehensive understanding of long-term trends and seasonal variations in the efficiency of hotel establishments.

These future research directions have the potential to deepen our understanding of the efficiency of hotel establishments and contribute to the formulation of more effective management strategies within the hotel industry, ultimately benefiting the regions and the broader economy.

## References


Ashrafi, A. R., Seow, H., Lee, L. S., & Lee, C. T. (2013). The efficiency of the hotel industry in Singapore. Tourism Management, 37, 31–34. https://doi.org/10.1016/j.tourman.2012.12.003

Banker, R., Charnes, A., Cooper, W., Swarts, J., & Thomas, D. (1989). An introduction to data envelopment analysis with some of its models and their uses. Research in Government and Nonprofit Accounting, 5, 125-163.

Benito, B., Solana, J. C., & López, P. (2014). Determinants of Spanish Regions' Tourism Performance: A Two-Stage, Double-Bootstrap Data Envelopment Analysis. Tourism Economics, 20(5), 987–1012. https://doi.org/10.5367/te.2013.0327

Coelli, T., Rao, P. & Battese, G. (1998). An introduction to efficiency and productivity analysis. Boston: Kluver Academic Publishers.

Cooper, W., Seiford, L. e Zhu, J. (2006). Handbook on Data Envelopment Analysis - International Series in Operations Research & Management Science. Springer, Second Edition.

Cullinane, K., Song, D., Ji, P., & Wang, T. (2004). An Application of DEA Windows Analysis to Container Port Production Efficiency. *Review of Network Economics*, *3*(2). https://doi.org/10.2202/1446-9022.1050

Farrell, M. J. (1957). The measurement of productive efficiency. Journal of the royal statistical society: series A (General), 120(3), 253-281.

Fernández, M. H., & Becerra, R. G. (2015). An Analysis of Spanish Hotel Efficiency. Cornell Hospitality Quarterly, 56(3), 248–257. https://doi.org/10.1177/1938965513509877

Gross, M. (2018). Global tourism's growing footprint, Current Biology, 28(17), R963-R965. https://doi.org/10.1016/j.cub.2018.08.049.

INE (2020). Estatísticas do Turismo 2019.

Karakitsiou, A., Kourgiantakis, M., Mavrommati, A., & Migdalas, A. (2020). Regional efficiency evaluation by input-oriented data envelopment analysis of hotel and restaurant sector. Operational Research, 20(4), 2041–2058. https://doi.org/10.1007/s12351-018-0406-1

Lado-Sestayo, R., & Fernández-Castro, Á. S. (2019). The impact of tourist destination on hotel efficiency: A data envelopment analysis approach. European Journal of Operational Research, 272(2), 674–686. https://doi.org/10.1016/j.ejor.2018.06.043

Ledesma Rodríguez, F. J., Lorenzo Alegría, R. M., & Martín Rivero, R. (2021). A study of hotel sector efficiency in the Canary Islands. Journal of Tourism Analysis: Revista De Análisis Turístico (JTA), 28(1). https://doi.org/10.53596/jta.v28i1.374

Leiper, N. (1979). The framework of tourism. Annals of Tourism Research, 6(4), 390-407. https://doi.org/10.1016/0160-7383(79)90003-3

Lovell, C., Fried, H. e Schmidt, S. (1993). The Measurement of Productive Efficiency: Techniques and Applications. Oxford University Press.

Luo, H., Yang, Y., & Law, R. (2014). How to achieve a high efficiency level of the hotel industry? International Journal of Contemporary Hospitality Management, 26(8), 1140–1161. https://doi.org/10.1108/ijchm-01-2013-0050

Manasakis, C., Apostolakis, A., & G, D. (2013). Using data envelopment analysis to measure hotel efficiency in Crete. International Journal of Contemporary Hospitality Management, 25(4), 510–535. https://doi.org/10.1108/09596111311322907

Marques, R. C., & Silva, D. (2006). Inferência estatística dos estimadores de eficiência obtidos com a técnica fronteira não paramétrica de DEA: uma metodologia de Bootstrap. Investigação Operacional, 26(1), 89-110.

Niavis, S., & Tsiotas, D. (2019). Assessing the tourism performance of the Mediterranean coastal destinations: A combined efficiency and effectiveness approach. Journal of Destination Marketing and Management, 14,

100379. https://doi.org/10.1016/j.jdmm.2019.100379

Niavis, S., & Tsiotas, D. (2019). Assessing the tourism performance of the Mediterranean coastal destinations: A combined efficiency and effectiveness approach. Journal of Destination Marketing and Management, 14, 100379. https://doi.org/10.1016/j.jdmm.2019.100379

Ohe, Y., & Peypoch, N. (2016). Efficiency analysis of Japanese Ryokans. Tourism Economics, 22(6), 1261–1273. https://doi.org/10.1177/1354816616670505

Oliveira, E. (2014). The tourism potential of northern Portugal and its relevance for a regional branding strategy. Advances in Hospitality and Tourism Research (AHTR), 2(2), 54–78. https://www.researchgate.net/publication/269986232_Original_article__The_Tourism_Potential_of_Northern_Portugal_and_Its_Relevance_for_a_Regional_Branding_Strategy

Oliveira, R. C. L. F., Pedro, M. I., & Marques, R. C. (2015). Avaliação da Eficiência das Empresas Hoteleiras do Algarve pela Metodologia Análise de Envoltória de Dados (DEA). Revista Brasileira De Gestão De Negócios, 788–805. https://doi.org/10.7819/rbgn.v17i54.1375

Oukil, A., Channouf, N., Al-Zaidi, A.: Performance evaluation of the hotel industry in an emerging tourism destination: the case of Oman. J. Hosp. Tour. Manag. 29, 60–68 (2016). https://doi.org/10.1016/j.jhtm.2016.05.003

Parte-Esteban, L., & Alberca-Oliver, P. (2015). Determinants of technical efficiency in the Spanish hotel industry: regional and corporate performance factors. Current Issues in Tourism, 18(4), 391–411. https://doi.org/10.1080/13683500.2013.800029

Pavković, V., Jević, G., Jević, J., Nguyen, P., & Sava, C. (2021). DETERMINING EFFICIENCY OF TOURISM SECTOR IN CERTAIN EUROPEAN COUNTRIES AND REGIONS BY APPLYING DEA ANALYSIS. *Journal of Process Management. New Technologies*, 9(3–4), 49–61. https://doi.org/10.5937/jpmnt9-34122

Pereira Oliveira, R. S. L., Craveiro Pedro, M. I., & da Cunha Marques, R. D. R. (2015). Avaliação da eficiência das empresas hoteleiras do algarve pela metodologia análise de envoltória de dados (DEA). *Revista Brasileira de Gestao de Negocios*, *17*(54), 788–805. https://doi.org/10.7819/rbgn.v17i54.1375

Porcelli, F. (2009). Measurement of Technical Efficiency. A brief survey on parametric and non-parametric techniques. University of Warwick, 11(527), 1-27

Rebelo, S., Matias, F., & Carrasco, P. (2013). Aplicação da metodologia DEA na análise da eficiência do setor hoteleiro português: uma análise aplicada às regiões portuguesas. Tourism & Management Studies, 9(2), 21-28.

Sáez-Fernández, F. J., Jiménez-Hernández, I., & Ostos-Rey, M. del S. (2020). Seasonality and efficiency of the hotel industry in the balearic islands: Implications for economic and environmental sustainability. Sustainability, 12(9). DOI: 10.3390/su12093506.

Sellers-Rubio, R., & Casado-Díaz, A. B. (2018). Analyzing hotel efficiency from a regional perspective: The role of environmental determinants. International Journal of Hospitality Management, 75, 75–85. https://doi.org/10.1016/j.ijhm.2018.03.015

Tang, C. F., & Tan, E. C. (2013). How stable is the tourism-led growth hypothesis in Malaysia? Evidence from disaggregated tourism markets. Tourism Management, 37, 52-57. https://doi.org/10.1016/j.tourman.2012.12.014

Turismo de Portugal (2023). Visão Geral https://www.turismodeportugal.pt/pt/Turismo_Portugal/visao_geral/Paginas/default.aspx

UNWTO (2020). World Tourism Barometer. World Tourism Organization.

UNWTO. (2023). Global and regional tourism performance. World Tourism Organization. https://www.unwto.org/tourism-data/global-and-regional-tourism-performance

Vincent, A. (1968). La mesure de la productivité. Revue Économique, 20 (3), 546-548

Xavier, J. M., & Moutinho, V. M. F. (2014). Avaliação de desempenho com a técnica de DEA e Índice Malmquist na hotelaria: o caso do Grupo Pestana. Revista Turismo & Desenvolvimento, 4(21/22), 239-250.