

# **An empirical analysis of Lisbon hotel room rates determinants**

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## **Abstract**

This study investigates the impact of several characteristics and attributes of hotels on room rates in one of the most visited cities in Europe. The research allows to compare, in a transparent way, findings of previous studies and promotes added value using for the first time the Hedonic Price Model (HPM) in the hospitality industry in Lisbon, Portugal. Although hotel room price determinants have already been studied, in this study it was introduced physical variables and location variables all together, as well as it was added the variables relating to certain services offered.

A significant impact on hotel prices by official stars and OTAs punctuation has been confirmed. In line with previous studies, an additional star and belonging to a chain allow the hotel to increase the price. In addition, other attributes, such as the distance of the hotel from the airport and the centre, have impact on hotel prices. The evidence that the existence of a spa and a pool influences hotel prices will support stakeholders in investment and management decision.

**Keywords:** Hedonic price model, hotels, Lisbon, pricing, room rates.

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## **1. Introduction**

The Portuguese hotel industry is divided into several types of accommodation, with traditional hospitality representing 30%. In 2017, hotels represent 74% of traditional hospitality offer and 22% of total tourist accommodation offer (INE, 2018).

This study analyses Lisbon, the capital city of Portugal. Regarding the tourism accommodation in the Metropolitan Region of Lisbon, 35% are hotels, in Lisbon city, specifically, there are 194 hotels (RNET, 2018). Lisbon is considered one of the leading business tourism destinations, not only within Portugal but also West Europe; in the Metropolitan Area of Lisbon, 70.3% of the hotel guests are foreigners. Lisbon is ranked 15<sup>th</sup> in the list of the most visited cities in Europe (AHRESP, 2018).

The paper studies the effect on prices of the different characteristics and attributes of hotels in the city tourism segment. In the last few years, the Hedonic Price Model (HPM) has been gradually applied to hospitality research (Latinopoulos, 2018; Pawlicz and Napierała, 2017; Soler and Gemar, 2018; Soler et al., 2019), so it was used to analyse the price effect of the various characteristics that compose a multi-attribute product. There are several advantages to using HPM, and Soler et al. (2019) recommend its use to enable results to be compared with several studies already performed.

This research intends to contribute to the existing literature on the impact of a different set of characteristics and attributes in the hotel room rates. In several studies (Latinopoulos, 2018; Machado, 2019; Pawlicz and Napierała, 2017; Soler and Gemar, 2018; Soler et al., 2019) a great deal of explanatory variables has been analysed, but sometimes separately. For Portugal, Machado (2019) analysed the influence of some hotel features and the performance evaluation tools in the hotel room rates.

As innovator aspects, this study was applied to Lisbon and for the first time a set of characteristics and attributes of several studies were analysed together: hotel size; official classification (number of stars) and OTAs' classification system; location; member of hotel chain; and services offered by the hotel.

Considering previous studies, a dataset based on the premise of a customer who seeks to book a standard double room with breakfast for one-night stay for two guests in Lisbon, during an important event at the lowest possible rate, was created. Information about address, official star, number of beds, number of rooms and the location by geographical coordinates within this region was collected. New attributes were studied and information

about number of restaurants, pool, spa and meeting rooms existence was also collected. In line with Pawlicz and Napierała (2017) and Thompson (2005), datasets for price and explanatory variables provided by OTAs were chosen according their availability and reliability, because they reflect real transaction prices. This research is valuable for the hotel manager as it will provide which attributes to take into account when pricing, which may solve certain daily problems.

## **2. Literature Review**

### **2.1 Hotel attributes**

Many studies have been conducted about hotel attributes, including aspects such as location, price, cleanliness, number of stars, brand name and reputation, security, quality standard of services, hotel and room design, complementary services, comfort, employee sympathy; the reasons given were, on the one hand, understanding consumer behaviour and adapting the offer and, on the other hand, to manage them in the right way and to maximize the profitability.

According to several studies, the location of a hotel unit is one of the most important attributes in the choice of accommodation and in the degree of customer satisfaction, both by guests who travel for leisure (Atkinson, 1988; Barsky and Labagh, 1992; Clow et al., 1995; Knutson, 1988) and for the business segment (Dolnicar, 2002; Mccleary et al., 1993).

The quality of the hotel is also very important for consumer decision (Heikka and Mustak, 2017) and to facilitate the perception of quality many countries have adopted a classification system that is often represented by stars, which is the case in Portugal. Thus, consumers are able to associate a level of services with each star that a given hotel has. Dolnicar (2002), for example, mentions in the conclusions of his study that the hotel category influences the evaluation of attributes and quality in general. Danziger et al. (2006) refer that sometimes the stars and the brand implicitly contain information about the assets of the hotel. So, in their study the stars classification is the most important attribute for the decision maker.

In addition to the stars, consumers are increasingly paying attention to the ratings obtained on the digital platforms of travel agencies (Abrate and Viglia, 2016).

Consecutively, the brand and reputation of a hotel unit have a positive effect on consumer's attitude when selecting a hotel unit (Dubé and Renaghan, 1999; Kwun and Oh, 2007).

### **2.2 Price management**

In the literature review about attributes, several authors mention the importance of price in the decision of the consumers, as in the case of Ananth et al. (1992), Barsky and Labagh (1992), and Yavas and Babakus (2005). Based on Rabbani et al. (2018), a pricing strategy has been crucial to attract more consumers and maximize profit.

For the hotel industry, there is a rigid and permanent management where the price varies from reservation to reservation when revenue management is used; from the customer's point of view, the price has an important influence on the decision that cannot be analysed in the same way as the remaining attributes (Lockyer, 2005). In fact, the effect of price/rate in the selection of a hotel is complex because it depends on many other factors, like the reason for the travel, the budget, the location (Lockyer, 2005).

Hoteliers need to constantly analyse their pricing. Price is a flexible variable that can be adapted, in the case of hotels, to the seasons (high season, low season), to the regimes (bed and breakfast, full board, half board and all inclusive), and to contracted services (Espinet et al., 2003). Price is also a variable that must predict and contemplate fluctuations in the specific demand of the hotel industry, considering overbooking, no-shows and cancellations (Bardi, 2003; Schwartz, 2006).

Revenue management appears at the end of seventies, early eighties with the development of airline industry in the USA and establishes a new goal for this kind of companies, where hospitality is included: the aim became to maximize revenue for a given capacity instead of only maximizing the occupancy rate (Legohérel et al., 2013). Revenue management brought new useful tools for pricing strategy (Ogbeide, 2014).

In fact, Guillet and Mohammed (2015) identified seven activities involved in the revenue management process: business analysis, pricing strategy, demand modelling and forecasting, inventory and price optimization, setting booking controls, distribution channel management and performance analysis and evaluation.

Legohérel et al. (2013) state that revenue management implies four steps: database analysis (history booking, actual booking, history of no-shows, capacity and prices, events calendar); forecasting (demand forecasting, cancellations and no-shows); revenue optimization (allocation model and overbooking model) and performance monitoring. This approach implies that hotel managers can, for example, close the room inventory when they reach a high number of early room reservations, to be sold later at a higher price/rate, or to sell the more expensive rooms (Abrate and Viglia, 2016).

Due to the above, pricing decision is very important to the hospitality industry as it directly influences hotel revenue. This can be studied from demand-side and supply-side (Chen and Rothschild, 2010). According to Espinet et al. (2003) this kind of study is important for the new investment decisions in hospitality. The hoteliers should know what a hotel should offer to fix higher prices or the contrary.

In this study an HPM was applied, as it is in certain studies which analyse the influence of variables in price determination.

### **2.3 Hedonic price model**

The HPM was introduced in 1928 by Wagh's study about agricultural products, as was noted by Agmapisarn (2014). This model can be applied to several products or services, as housing markets (Osland, 2013), tourism enterprises (Rigall-I-Torrent and Fluvia, 2011), restaurant menu pricing (Yim et al., 2014). HPM is the most used in hotel studies (Chen and Rothschild, 2010; Yim et al., 2014), because of the heterogeneity of hotel products and services, thus there are a lot of factors to take into account. According to Rosen (1974), goods can be considered as a set of characteristics and this is differentiated in price. In this case neither demand nor supply is considered, but a hedonic function is estimated through econometric procedures. Based on Williams (2014), HPM models enable a more accurate approach, for example this model overcomes ordinary least square regression.

This model intends to find out the characteristics that are implicit in prices. It is important to figure out the factors that influence room rates. In the HPM function, the hotel room rate is a variable which depends on a set of characteristics (Agmapisarn, 2014; Hamilton, 2007). Espinet et al. (2003) call the characteristics 'attributes', and they affirm that the attributes consist of services and characteristics. Abrate and Viglia (2016) classified the

attributes as tangible, reputational and contextual. Then, in this model it is assumed that consumers have knowledge about the attributes of each hotel (Fleischer, 2012).

HPM has been used in several studies (Abrate and Viglia, 2016; Agmapisarn, 2014; Andersson, 2010; Chen and Rothschild, 2010; Espinet et al., 2003; Fleischer, 2012; Hamilton, 2007; Herrmann and Herrmann, 2014; Latinopoulos, 2018; Pawlicz and Napierała, 2017; Peña et al., 2016; Soler and Gemar, 2018; Soler et al., 2019; Thrane, 2007; Williams, 2014; Yim et al., 2014;). HPM has been applied in several destinations with an internal spatial homogeneity, then the findings of this model are only true for the region on study. Certain data can be taken but should not simply be extrapolated as each region has its own characteristics. Nevertheless, similarities may exist in determinants of hotel rates in regions with analogous characteristics (Soler et al., 2019).

Zhang et al. (2011a) refer that hotel characteristics should be divided into physical characteristics and area characteristics. So, they applied a new model designated by geographically weighted regression.

HPM presents some advantages as its use of recent information (Fleischer, 2012), market prices use and the utilization of actual data (Zhang et al., 2011a). Recently HPM has been applied to the Algarve, and it is referred that researchers should carry out hedonic studies in other regions to realize the pricing through hedonic literature (Soler et al., 2019). As it is intended a comparison of the results among several studies and following the advice of Soler et al (2019), it was used the HPM, but it was also considered location variables, explained below.

## **2.4 Explanatory variables**

The influence of certain variables on the price/rate determination was studied in the present research: number of rooms, number of stars in the official classification system, number of stars in the OTA classification system, location, member of a hotel chain and services offered by the hotel. Regarding the location, the study proposes to understand the effect of the distance from the hotel to the city centre, the distance from the hotel to the nearest competitor, the distance from the hotel to the airport, and whether the hotel is located in the CBD (central business district) of Lisbon in rates determination.

### *Hotel size*

In prior empirical studies, hotel size was measured by the number of rooms. According to Hung et al. (2010) and Zhang et al. (2011a) this is one of the main attributes of hotel room rate. Machado (2019) and Pawlicz and Napierała (2017) confirmed a positive impact of number of rooms on room rates. Espinet et al. (2003) conducted a study where a different sample was used. In hotels that belong to the sun and beach segment, prices of different years were used. It was found that the size of hotel influences the price – the bigger the hotel, the lower the price. In Thrane's (2007) study, a positive effect of hotel size was evidenced in rates, but only for double rooms. In fact, single rooms were not affected and the price for a double room was a little more expensive in the bigger hotels. On the other hand, Soler and Gemar (2018) verified a negative effect of hotel size in prices and referred three possible reasons: the economies of scale that bigger hotels can achieve; the preference of smaller hotels by clients and the difficulty, mainly in low season, to maintain high occupancy rates, which may lead to reduced rates.

### *Number of stars*

For consumers, the price has a different level of importance, depending on the category of the hotel (Dolnicar, 2002); for example, Knutson (1988) showed that the price has a

more important role in the luxury segment. In several studies, official stars have a positive impact on room rates (Espinet et al., 2003; Israeli, 2002; Machado, 2019; Pawlicz and Napierała, 2017; Soler et al., 2019; Zhang et al., 2011a). Likewise, Castro et al. (2016) and Machado (2019) concluded that the number of stars positively influences prices and that this influence increases with the number of stars. The consumer rating, in the study of Castro et al. (2016), is the second variable that has a positive effect on prices which is in accordance with Andersson (2010). In the Algarve study is second most significant variable (Soler et al., 2019).

In some studies, a positive influence on hotel prices is detected mainly in the higher categories, but between the hotels with 2 and 3 stars, there were no significant differences (Espinet et al., 2003). Similarly, Andersson (2010) concluded that star rating has a significant influence on hotel rates, as the 5-star hotels obtain better feedback from consumers when they have very high rates. Soler and Gemar (2018:128) concluded that “the most important in determining the price of hotel rooms in Malaga is hotel category”. Israeli (2002) corroborates the same idea, the star rating system explains some of the price variation.

Differently, Coenders et al. (2003) concluded that the stars have a positive effect on peak price level, but only for the 3-star hotels; they suggested that the 4-star clients are not as sensitive to price, so hoteliers do not need to reduce them during low season. It is important to note that this study was applied to beach hotels and there were no 5-star hotels.

In turn, Herrmann and Herrmann (2014) tested the influence of a large event on the hotel rates. During Oktoberfest, they concluded that in general, prices were much higher, but the main influence was from star category and event proximity, in terms of location.

Despite the importance of official star rating, Fernández and Bedia (2004) concluded that this is not the best system to measure quality. Other authors also note that the star classification is not really an attribute because it represents a set of attributes and this system is not used in all countries (Thrane, 2007).

#### *OTAs' classification system*

In addition to official stars, previous studies used data sources based on OTAs or on online meta-search booking engines. Despite this, the debate over which OTA dataset is most appropriate to explain real price differences remains current. Therefore, in accordance with Pawlicz and Napierała (2017), this study used three different OTAs to verify whether they offer an identical consistency of data.

OTAs' classification has different and complementary aims when compared with official classification. The OTAs' classification reveals authenticity (World Tourism Organization, 2014) and it is connected with the expectations of the guests (Blomberg-Nygard and Anderson, 2015). With the development of the OTAs' tools and other online travellers' communities like TripAdvisor, OTAs' classification and reputation are now more important than official star classification (Abrate and Viglia, 2016). The same conclusion can be drawn from Soler and Gemar (2018). The results of Yang et al.'s (2016:47) study highlighted “online quality-signalling factors, hotel class, availability of free breakfast, the presence of a fitness centre and a swimming pool” as having an influence on prices. In their study, they also tested the relationship between the variables and showed that “price pressure related to inaccessibility is mitigated when a hotel has a well-established, positive reputation in the form of positive user ratings on popular travel websites or is affiliated with a chain.” Nevertheless, it is noted that it is complicated to

verify the authenticity and objectivity of this classification (Blomberg-Nygaard and Anderson, 2015). Pawlicz and Napierała (2017) found a significant correlation between both classifications, so the OTA classification has a significant positive impact on room rates.

#### *Location*

Location is considered a significant explanatory variable for the room rates (Espinet et al., 2003; Machado, 2019; Santos, 2016; Zhang et al., 2011a). Zhang et al. (2011b) found out that location was one of the most important attributes having influence on price rates, as well as Machado (2019), who refers that the price depends on the geographical location of the hotel. In the same way, Espinet et al. (2003) confirm that the proximity to the beach, as well as the city where the hotel is located, increases the price.

Andersson (2010) validated the influence of the distance to CBD and the distance to transport (metropolitan and a main road) in the rates of the hotels. Bull (1994) and Shoval (2006) also confirmed the influence of being located in the city centre on prices. Castro et al. (2016) also proved that the distance to the city centre has a positive impact on the rates of Lisbon hotels. Other studies which used the variable of distance from the international airport, did not find a significant relationship with rates (Balaguer and Pernías, 2012; Soler and Gemar, 2018). Agmapisarn (2014) found out that room rates were higher if the room had larger space and was located closer to the city centre and closer to the station. The latter situation is corroborated by Thrane (2007). Pawlicz and Napierała (2017) also showed that in the city centre, the prices were higher than in other locations. Curiously in the study of Chen and Rothschild (2010) rates are higher in the hotels further from the centre than those hotels in the city centre. In the same way, in Espinet et al.'s (2003) research, the city centre has no significant effect on hotel prices, but this is probably because the segment analysed in this study were beach hotels; in this case the distance to the beach is more relevant.

Szegedi and Korom (2010) refer to the absence of universal indicators to measure competition. Then the identification of competitors is unclear for the hoteliers (Mohammed et al., 2014). The Balaguer and Pernías (2012) study concluded that a greater density of competitors denotes a lower difference in the prices. Abrate and Viglia (2016) stated that price determination is influenced by price level of closest competitors, except for 5-star category hotels because, in this case, they need to maintain a certain price level in order to maintain their image. According to Machado (2019), hotels under a greater level of competitiveness determine a higher price.

In this study four location attributes are tested: distance from the hotel to the city centre, distance from the hotel to the airport, location in relation to the CBD of Lisbon and distance from the hotel to the nearest competitor.

#### *Member of a hotel chain*

The perceived quality of a brand influences the hospitality and restaurant performance (Kim and Kim, 2005). Brands offer some competitive advantages, such as higher customer loyalty, higher endurance through crises, higher profit margins, less sensibility from customer to prices and extension opportunities (Keller, 2001, referred in Kim and Kim, 2005). Peña et al. (2016) also verified that customers are willing to pay a higher price for a hotel belonging to a chain.

In a study developed in Israel, Danziger et al. (2006) concluded that the star rating was the most important attribute in price decision, the second one was the brand, but only when star information was not available. This conclusion is very important for this

country since the classification system with stars was abolished in 1995. Agmapisarn (2014) also found that room rates were higher if the hotel belongs to a chain.

Thrane (2007) found out that single rooms were more expensive when associated with a chain, and double rooms were not affected. Silva (2015) concluded that prices of chain hotels are positively influenced by the effect of multimarket contact and differentiation.

#### *Services offered by the hotel*

According to Abrate and Viglia (2016), the tangible attributes with some relevance in the price are Spa and wellness centre, room dimension, presence of balcony, presence of a congress centre and free internet. Chen and Rothschild (2010) found that the service variables that influence the rates are: availability of TV, conference facilities, room size, bar, internet, fitness facilities. Andersson (2010) considered that hotel facilities such as swimming pool and fitness centre influence the rates. All these services imply an increase in the rate. For Thrane (2007), the services that positively influence the hotel rates are hairdryer, mini-bar and free-parking. Soler et al. (2019) considered a huge set of services: air conditioning, airport transportation, bar/lounge, beach, business services, casino, concierge, fitness centre, free breakfast, free parking, free Wi-fi, golf course, internet, kitchenette, meeting room, non-smoking hotel, pets allowed, pool, reduced mobility rooms, restaurant, room service, spa, suites, wheelchair access. The interpretation differs depending on the variable.

Agmapisarn (2014) corroborates the fact that customer's perception influences room rates, so there is difference in prices according service quality.

### **3. Methodology**

The objective of this research is to measure the impact of endogenous and exogenous variables and attributes of hotels on room rates, and therefore contributing to a thorough knowledge.

Price is a unique variable as it has a direct relationship with the company's positioning, business value and market share. Pricing should be consistent with the entire product concept and mix and correspond to marketing decisions. For these reasons, a thorough knowledge of the market is crucial to determine the optimal price and relevant price variations. On the other hand, the value attributed by consumers, benefits and advantages: quality of service, accessibility, image, complementary services, environment are decisive for pricing strategies. Therefore, in pricing, it is determinant to consider the set of whole variables. Then, beyond the perception of the price by consumers, all the exogenous variables must be included, and should be considered by revenue managers (RM) (Legohérel et al., 2013).

The methodology used in this article closely follows the one used in a study carried out in Warsaw (Pawlicz and Napierała, 2017), but with certain new variables.

The sample that was used consisted of 179 hotels operating in Lisbon, Portugal, in 2018. This data was obtained through SIGTUR (Sistema de Informação Geográfica – Turismo de Portugal). In this database it was possible to gather the following information: address, official star, number of beds, number of rooms, the location by geographical coordinates, number of restaurants, pool existence, spa existence, meeting rooms existence. The variable, number of stars in the OTA classification system, was collected from OTAs in internet which is the guest rating (1 to 10 except expedia that was 1 to 5). Then the data was collected in the site of each OTA, which translates into the score posted for each

hotel that conveys guests' opinion. This information was obtained on 26th of June on booking.com, on 27th of June on hotels.com and on 28th of June on expedia.com (Table 2). Thus 3 variables were created, one for each OTA.

Other information was obtained through the hotel sites, such as the chain that the hotel belongs to. Hotels distance from the airport, the CBD and to the nearest competitor were obtained through GPS Visualizer. The distances were calculated by great circle distance between two points. This calculator finds the distance between two pairs of coordinates with a very high degree of precision. Firstly, data of 194 hotels was obtained. 15 hotels had to be removed from sample for two reasons: some of them were not operating in 2018; for others there was no price information available at the level of the OTAs. The prices were collected from 3 major OTAs in internet and organized by stars (Table 1).

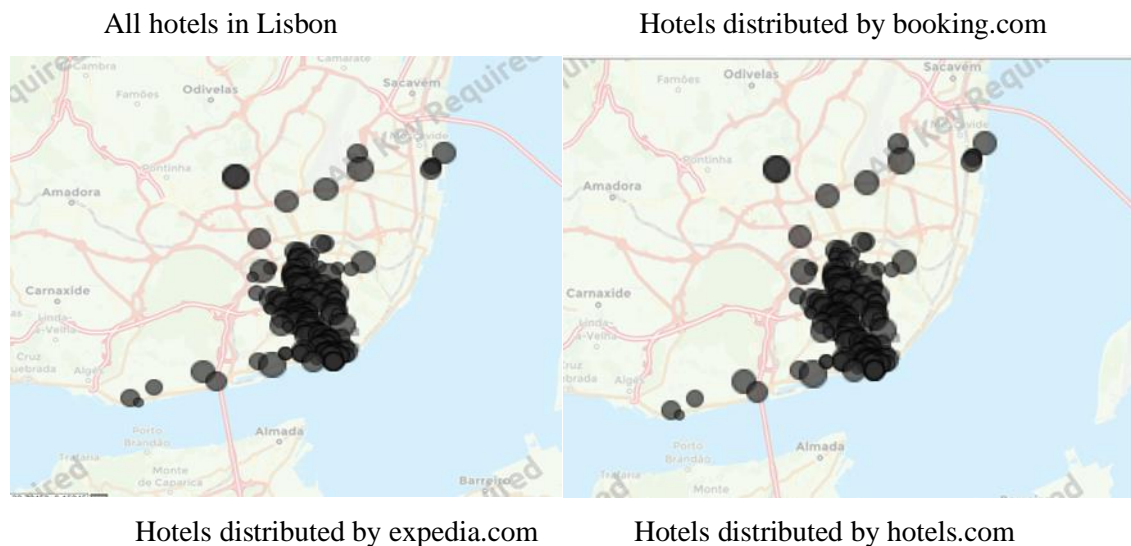
**Table 1 – Study sample**

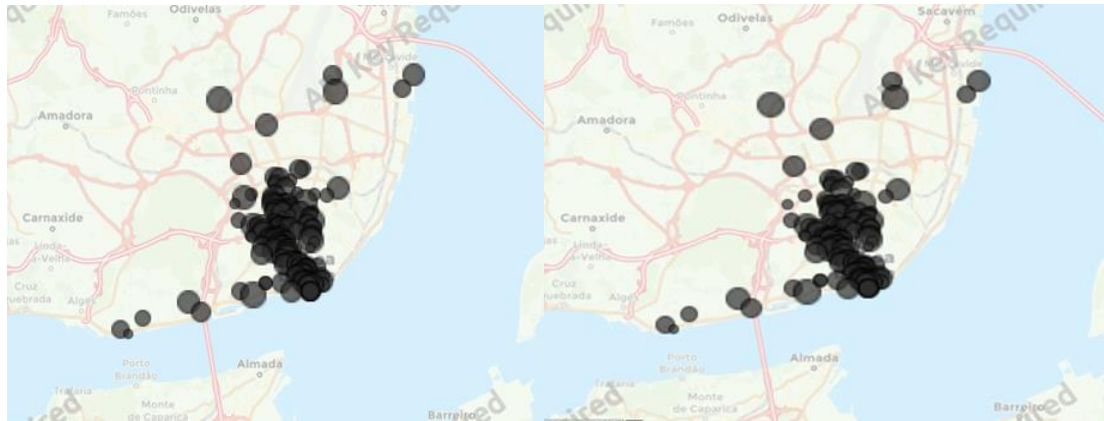
Stars	All	Booking	Expedia	Hotels
1	7	7	2	2
2	20	19	15	16
3	47	47	36	41
4	76	74	69	71
5	29	28	25	28
<b>Total</b>	<b>179</b>	<b>175</b>	<b>147</b>	<b>158</b>

An analysis of hotel room rates in Lisbon was conducted using data from three OTAs: booking.com, expedia.com, and hotels.com.

Through the figure 1 it is possible to observe the distribution of the hotels in Lisbon, as well as the hotels that are traded into the different OTAs. The distribution is similar.

**Figure 1 - Location of sampled hotels in Lisbon**





These OTAs are the most popular in the world according to Alexa (2018); Pawlicz and Napierała (2017) and Pinto (2016). The use of the internet is a suitable method to gather data (Agmapisarn, 2014). OTAs have been used in several studies (Agmapisarn, 2014; Chen and Rothschild, 2010; Machado 2019; Pawlicz and Napierała, 2017; Soler and Gemar, 2018), which allows the option of collecting information about guest rating from OTAs. To standardize the comparisons, price as an explanatory variable was defined as the best available rate for a double room with breakfast for a one-night stay for two guests, similarly to what was done by Pawlicz and Napierała (2017) and Chen and Rothschild (2010). This study focused on prices with VAT and the lowest possible rate was chosen that was found on 26th of June on booking.com, on 27<sup>th</sup> of June on hotels.com and on 28<sup>th</sup> of June on expedia.com for a stay between 5<sup>th</sup> and 6<sup>th</sup> of November. Dates were chosen in high season due the event Websummit in Lisbon, following the methodology of Agmapisarn (2014) who collected the prices in high season.

The room rates (ROOMRATEBOOK, ROOMRATEEXPEDIA, ROOMRATEHOTEL) were considered as dependent variables. During the process these variables were transformed in logarithm rate (LOGRATEBOOK, LOGRATEEXPEDIA, LOGRATEHOTEL), due the linearity issue. The selection of the hotel characteristics as independent variables (predictors) was based on Agmapisarn (2014) and Pawlicz and Napierała (2017). According to Pawlicz and Napierała (2017), the predictors chosen were: ROOMNUMB (number of rooms), STAROFFICE (number of stars in the official classification system), STAROTA (number of stars in the OTA classification system), DISTCENT (distance from the hotel to the city centre), DISTCOMP (distance from the hotel to the nearest competitor), DISTNODE (distance from the hotel to the airport), DUMMCENT (hotel is located in the central district of Lisbon), DUMMCHAIN (hotel is associated with a chain). Agreeing with Abrate and Viglia (2016) and Agmapisarn (2014) that services influence room rates, it was added: DUMMSPA (hotel has spa), DUMMPOOL (hotel has Pool), DUMMMEET (hotel has meeting rooms) and RESTNUMB (number of restaurants in the hotel) (Table 2).

The CBD was delineated based on Murphy (2007), who defined it as a central region with distinctive characteristics, for example, concentration of tall buildings, offices, retail stores. The land values there are higher than any other part of the city. After consulting INE (Instituto Nacional de Estatística) to find out the region with higher prices per m<sup>2</sup> statistics, it was concluded that the CBD of Lisbon is Santo António and Misericórdia. Then a dummy variable was created (DUMMCENT) for whether a hotel belongs to the CBD. The central point considered to measure the distance of the hotels to the centre was Praça D.Pedro IV – Rossio.

In terms of studying competitors, the ideal would be to come up with several subgroups of competitors, but the definition of these subgroups has not yet been well tested (Mohammed et al., 2014), so instead, the nearest hotel was considered.

**Table 2 – Descriptive statistics for the research variables**

Variable	Definition	Available booking.com n= 175		Available expedia.com n= 147		Available hotels.com n= 158	
		Mean	SD	Mean	SD	Mean	SD
ROOMRATE	Room rate in EURO	182.29	101.55	187.14	96.70	189.33	102.21
ROOMNUMB	Number of rooms	104.7	89.14	108.99	95.53	109.75	95.14
STAROFFICE	Number of stars official classification system (1,2,3,4,5)	3.55	1.02	3.68	0.92	3.68	0.93
STAROTA	Number of stars OTA classification system (1 to 10) except expedia (1 to 5)	8.37	0.69	4,24	0.42	8.47	0.83
DISTCENT	Distance from the hotel to city centre (kilometres)	2.19	2.90	2,17	3.04	2.15	2.94
DISTCOMP	Distance from the hotel to nearest competitor (kilometres)	0.21	0.31	0.2	0,28	0.2	0.28
DISTNODE	Distance from the hotel to airport (kilometres)	6.08	2.75	6.18	2.92	6.27	3.21
DUMMCENT**	Hotel is located in CBD of Lisbon (yes=1, no=0)	0.33	0.47	0.31	0.47	0.33	0.47
DUMMCHAIN**	Hotel's association with a chain (yes=1; no=0)	0.57	0.45	0.58	0.5	0.6	0.49
DUMMSPA	Hotel has spa (yes=1; no=0)	0.15	0.36	0.16	0.369	0.17	0.378
DUMMPPOOL	Hotel has Pool (yes=1; no=0)	0.10	0.31	0.12	0.325	0.12	0.326
DUMMMEET	Hotel has meeting rooms (yes=1; no=0)	0.54	0.50	0.54	0.50	0.56	0.498
RESTNUMB	Number of restaurants	1.22	1.00	1.28	1.024	1.30	1.019

\*With available information on booking.com, on expedia.com or on hotels.com.

\*\*Indicates a binary variable; the mean value refers to the proportion of the data where the attribute of interest is present.

According to literature review, HPM use recent data, as well as the market prices in use, then HPM was considered an appropriate methodology to reach these objectives.

Using the variable dependent RATE, it did not verify the linearity, so the variable price was transformed in ln variable: LOGRATEBOOK, LOGRATEEXPEDIA and LOGRATEHOTEL. Thus, a log-linear regression was employed, or a semi-logarithmic regression, according to Agmapisarn (2014) and Pawlicz and Napierała (2017). The hedonic model is applicable to diverse functional forms (Fleischer, 2012).

$$\ln(\text{ROOMRATE}) = f(\text{ROOMNUMB}, \text{STAROFFICE}, \text{DISTCENT}, \text{DISTCOMP}, \text{DISTNODE}, \text{DUMMCENT}, \text{DUMMCHAIN}, \text{DUMMSPA}, \text{DUMMPOOL}, \text{DUMMMEET}, \text{RESTNUMB})$$

$$\ln(\text{ROOMRATE}) = f(\text{ROOMNUMB}, \text{STAROTA}, \text{DISTCENT}, \text{DISTCOMP}, \text{DISTNODE}, \text{DUMMCENT}, \text{DUMMCHAIN}, \text{DUMMSPA}, \text{DUMMPOOL}, \text{DUMMMEET}, \text{RESTNUMB})$$

Considering the correlation between STAROFFICE and STAROTA, the idea of Pawlicz and Napierała (2017) was followed. Six different hedonic price regressions were elaborated. LOGBOOKOFFI, LOGEXPEDIAOFFI and LOGHOTELOFFI, which included STAROFFICE and the regressions LOGBOOKOTA, LOGEXPEDIAOTA and LOGHOTELOTA, which included STAROTA with different scores for each OTA.

The interpretation of the coefficients of the predictor variables was done according to Halvorsen and Palmquist (1980). For a continuous variable, the coefficient multiplied by 100 is equal to the percentage effect on the dependent variable. For a dummy variable, the relative effect on the dependent variable Y is  $g = \exp(\text{coefficient}) - 1$ , and for a percentage it is necessary to multiply by 100. This interpretation will be used for the following variables: DUMMCENT, DUMMCHAIN, DUMMSPA, DUMMPOOL, DUMMMEET.

Finally, after the estimation of the regression, all misspecification problems were diagnosed in a classical regression in line with Agmapisarn (2014) and Pestana and Gageiro (2003). Given that some outliers were found and that an outlier can distort the statistical estimates results, a new regression was estimated without outliers.

#### 4. Empirical Results

Considering the problem of independence among the predictors, the correlations between all pairs of predictor variables were analysed according to Pestana and Gageiro (2003). The highest correlation (over 0.5) that was found through Spearman's Rho involves the pair STAROFFICE and STAROTA.

Whereas for the correlation coefficients, the variables of star ratings were expected to be the most important determinants of hotel room rates. Then to reinforce the use of six models, the Kruskal-Wallis test was used to verify whether the distribution of STAROTA was the same among the groups of the hotels determined by the STAROFFICE. It was found out a different distribution. This test was chosen because STAROFFICE is a qualitative variable and STAROTA is a quantitative variable. Comparing the mean of STAROTA, it is possible to find out that when the star rating is 1, the STAROTA is less than when the STAROFFICE is 5. STAROTA follows the STAROFFICE score.

Therefore, it was decided to follow Pawlicz and Napierała (2017) and not put STAROFFICE and STAROTA in the same model. Then six different hedonic price regressions were elaborated, as was noted in the methodology section.

The 6 log-linear regressions were estimated under an ordinary least square (OLS). Observing the results, it can be concluded that the most significant predictors of hotel room rates are the STAROFFICE and STAROTA. In all six regressions, these predictors have a significance level of less than 0.01. These predictors are followed by DISTNODE, DUMMCHAIN, if the six models were considered. Moreover, there are some predictors that are significant only in some models, for example, DUMMSPA, DUMMPOOL and DISTCENT. Finally, there is a set of variables that, in an isolated way, are not significant, for instance: DISTCOMP, DUMMCENT, DUMMMEET, RESTNUMB. R-squared of the six models is over 0.5, but the LOGBOOKOFFI is the best one. The F test validates the general model, values in a range of 10.401 to 18.716, and in this case leads to rejection of the nullity of the coefficients of the independent variables of the six models.

According to STAROFFICE, an additional star implies a price increase within the range of 33.8% to 35.3%. However, when considering STAROTA, the range changes to 30.8% to 62.7%. This huge difference is due to the punctuation scale of expedia.com, which is of 1 to 5. On the other hand, for booking.com and hotel.com the punctuation is from 1 to 10. An increase in the distance of the hotel to the airport implies an increase in price of 2% to 4%. If the hotel belongs to a chain, the price will increase inside a range of 13.6% to 28.8%. If the services are referred, it was verified that the existence of a spa decreases the rate inside a range of 12.7% to 20.38%, but the existence of a pool increases the rate inside a range of 20.44% to 34.99%. Regarding the distance of the hotel to the centre it was found that nearness to the centre increases the rates in a range of 1.9% to 3.5%.

After the estimation of the regression, all misspecification problems were diagnosed in a classical regression along the lines of Agmapisarn (2014) and Pestana and Gageiro (2003): independence among predictor variables, linearity, heteroscedasticity, autocorrelation, normality and multicollinearity. The independence among predictor variables and linearity were analysed before the estimation of the model. At this moment it is necessary to verify four issues to validate the model.

Heteroscedasticity occurs when the error variance differs transversely between the cases, which implies a miss of efficiency. In Pestana and Gageiro (2003) graphs were used that analyse the variance regression studentized residual versus regression standardized predicted value and standardized residual versus unstandardized predicted value. The residuals maintain a constant approach amplitude with respect to the zero-horizontal axis, with neither increasing nor decreasing trends, so the homoscedasticity hypothesis is not rejected.

Regarding autocorrelation, this was checked through a Durbin-Watson test (Table 3 and 4). This test studies the existence of autocorrelation among the residuals. When the values are close to 2, it means that they are not autocorrelated (Pestana and Gageiro, 2003). In all these models, the Durbin-Watson is close to 2, so there is not autocorrelation.

**Table 3 - Log-linear regression with STAROFFICE**

	<b>LOGBOOKOFFI</b>	<b>LOGEXPEDIAOFFI</b>	<b>LOGHOTELOFFI</b>
Constant	3.687***	3.704***	3.714***
ROOMNUMB	0.000	0.000	0.000
STAROFFICE	0.348***	0.339***	0.377***
DISTCENT	-0.024**	-0.019	-0.013
DISTCOMP	-0.017	0.022	-0.028
DISTNODE	0.035***	0.034**	0.019**
DUMMCENT	0.024	0.002	0.018
DUMMCHAIN	0.143**	0.171***	0.142**
DUMMSPA	-0.192**	-0.151	-0.134

DUMMPOOL	0.143	0.107	0.080
DUMMMEET	-0.061	-0.101	-0.025
RESTNUMB	-0.041	-0.014	-0.064**
R <sup>2</sup>	0.591	0.513	0.576
F(ANOVA)	20.993***	12.744***	17.268***
Durbin-Watson	2.018	1.889	1.955

Notes: \*p<0.1 \*\*p<0.05 \*\*\*p<0.01

**Table 4 - Log-linear regression with STAROTA**

	<b>LOGBOOKOTA</b>	<b>LOGEXPEDIAOTA</b>	<b>LOGHOTELOTA</b>
Constant	2.184***	2.116***	2.261***
ROOMNUMB	0.001	0.000	0.001
STAROTA	0.296***	0.613***	0.306***
DISTCENT	-0.022*	-0.033**	-0.021*
DISTCOMP	-0.022	0.092	0.028
DISTNODE	0.038***	0.042***	0.025**
DUMMCENT	-0.025	0.055	0.09
DUMMCHAIN	0.267***	0.181***	0.132**
DUMMSPA	-0.12	-0.141	-0.145
DUMMPOOL	0.213*	0.164	0.302**
DUMMMEET	0.053	0.045	-0.022
RESTNUMB	-0.008	-0.004	-0.026
R <sup>2</sup>	0.456	0.500	0.46
F(ANOVA)	11.950***	11.639***	11.236***
Durbin-Watson	1.653	1.682	1.754

Notes: \*p<0.1 \*\*p<0.05 \*\*\*p<0.01

Normality was checked through a K-S (Kolmogorov-Smirnov) test. In the six models the significance level is higher than 0.1, showing normality. Therefore, the central limit theorem can be applied as it was in Agmapisarn (2014), which has 141 units. In this study there are more than 141 units, so the shape sampling distribution is normal.

Multicollinearity is often an issue in these kinds of models (Chen and Rothschild, 2010). According to Pestana and Gageiro (2003), multicollinearity can be tested through VIF (variance inflation factor) and Tolerance statistic. The closer the VIF is to zero, the smaller is the level of multicollinearity. The value limit is 10 (Agmapisarn, 2014; Pawlicz and Napierała, 2017; Pestana and Gageiro, 2003). It was observed that the VIF values for all predictor variables are below 10. Considering the Tolerance statistic, the closer to 1, the smaller the multicollinearity, and the closer to zero, the larger the multicollinearity. The value limit is 0.10 (Agmapisarn, 2014; Pawlicz and Napierała, 2017; Pestana and Gageiro, 2003). Multicollinearity was not found, as tolerance values are bigger than 0.10.

After analysing all the problems indicated, the outliers were also analysed. According to Agmapisarn (2014) and Pestana and Gageiro (2003), outliers can distort the statistic estimates. For each model the residuals were analysed and standardized and it is considered that there is an outlier when the value is bigger than 3. All the outliers found were removed and a new regression was estimated (Table 3 and Table 4). This increases the accuracy and reduces the errors.

The new estimated regressions demonstrate slight improvements at the global level. There are improvements in some statistics, for example R<sup>2</sup> increased, which means a higher percentage of the price variation is explained by the independent variables. For instance, the regression LOGHOTELOFFI went from 49.4% to 57.6%. In this moment, 57.6% of the variance of LOGROOMRATE is explained by the predictor variables.

Observing the independent variables on their own some oscillations can be found. According to STAROFFICE, an additional star implies a price increase within the range of 33.9% to 37.7%. However, considering STAROTA the range change to 29.6% to 61.3%. An increase in the distance of the hotel to the airport implies an increase on price of 1.9% to 4.2%. Regarding the distance of the hotel to the centre it was figured out that the nearness to the centre increases the rates in a range of 1.3% to 9%. If the hotel belongs to a chain, the price will increase (14.11% to 30.6%). In what concerns about services it was verified that an existence of spa decreases the rate (11.3% to 17.45%), but the existence of a pool increases the rate (8.33% to 35.26%).

## **5. Conclusions and Discussion**

The unique contributions of this study are related to the fact that this paper obtains findings about the impact of endogenous and exogenous variables and attributes of hotels on room rates what is crucial for revenue managers decision process which can not only be based on demand oscillations.

On the other hand, this research is the first in Lisbon and certain characteristics of this city are highlighted which must be kept in mind by the hoteliers and investors. This study also represents an important contribution for investment decision in new hotels in Lisbon City.

The most significant predictor variable of room rates of Lisbon hotels is the official star. A hotel with 5 stars has a room rate larger than other ones. The same happens with the punctuation of OTAs. This position confirms the conclusions of previous studies: Espinet et al. (2003), Israeli (2002), Machado (2019), Pawlicz and Napierała (2017) and Zhang et al. (2011a).

The fact of a hotel belonging to chain increases the price by about 22%. The same price increase was shown in the study of Agmapisarn (2014) and Peña et al. (2016).

Room rates of hotels with a pool are about 22% higher than those in hotels without pool. Moreover, room rates of hotels with a spa are about 15% lower than those in hotels without such facility.

In relation to the location, the further away the hotel is from the airport and the closer it is to the centre of Lisbon the more room rates increase. This situation corroborates with Agmapisarn (2014) and Pawlicz and Napierała (2017), who found a high price in relation to the proximity to the city centre. However, this contradicts Chen and Rothschild (2010), who found that the price decreases with the proximity to the centre.

This study, the first in Lisbon, generates practical implications to hoteliers, creating tools to manage the price in the right way and to maximize profitability.

Official stars allow RM to set a price level. Despite the pressure that can be felt due to high competition, official stars cannot be overlooked in the pricing decision process. On the other hand, this information can be very important when RM are identifying their set of competitors.

Price is a strategic variable but also a crucial operational variable. Indeed, the results show that the punctuation of OTAs is a high determinant of room rates. It means that satisfaction of clients gives to RM a margin to increase the prices and the profit. This study gives also a quantitative measure that can be useful for RM as price fluctuation is very thin. Then, the importance of online consumers' reviews show that it is necessary to

work harder on service quality because it is one of the most important aspect for customer decision and satisfaction (Zhang et al., 2011b) and must be carefully analysed to identify the operational aspects that can be improved.

Belonging a chain increase room rates and in the same way of official stars, RM must resist to the pressure to low the prices because customers are less sensitive to prices, since brand gives a better-quality perception as it was identified in literature review.

Regarding services, having a pool in a hotel increase room rates, however, surprisingly, a spa decreases the room rates. This kind of information can also be very useful for RM since the can manage the price considering the most valued services.

Finally, the location, being close to Lisbon city centre increases room rates and greater distance of the hotel to the airport implies an increase in the room rates. If the first result was expected, the second one can be interesting for RM. It can be explained by the fact that Lisbon airport is situated in the city and not in periphery as most of other European capitals.

Concerning theoretical implications are reflected in this research. All models estimated both by other authors and in this study were based on the same methodology (semi-logarithmic regression) and produce similar results for star rating as leverage of hotel room rates. On the other hand, findings allow comparisons with studies in other cities with similar characteristics.

This research has limitations that could be addressed in the future, for example, some other variables influence can be tested, such as the view of the room (Fleischer, 2012; Latinopoulos, 2018), coastal landscape (Hamilton, 2007).

In addition, the type of segment analysed (Espinet et al., 2003), and the period during which prices are analysed (Chen and Rothschild, 2010) have shown differences in results. The season can also have influence on the results (Soler and Gemar, 2018).

The number of competitors may have also influenced the result, so it can be interesting to include this factor in this kind of study (Abrate and Viglia, 2016; Balaguer and Pernías, 2012).

Despite the importance of these attributes in price determination, other aspects like booking day or booking margin are also very important (Soler and Gemar, 2018), which can be related to the importance of revenue management (Guillet and Mohammed, 2015).

Other models should be applied to corroborate the conclusions achieved on this study.

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