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Bangkok four-star hotels' Average Daily Rate (ADR) prediction model

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ABSTRACT

This research aims to propose a prediction model for the Average Daily Rate (ADR) for Bangkok four-star hotels. The model was developed using the hedonic price model, which was calculated from 158 four-star hotels in Bangkok. The variables in the model were derived from a literature review and suggested by an expert panel. Factor Analysis was adopted to merge the highly correlated variables. The best-fit model is a log-linear form with a .576 Adjusted R^2 value. The top five most sensitive variables are (1) staff performance score from Agoda's review, (2) location score from Agoda's review, (3) room standard score from Agoda's review, (4) fitness availability (presence or absence), and (5) the number of hotel outlets. The model was verified by a paired-sample t-test from 30 hotels with similar criteria. From the analysis, the observed ADRs were not significantly different from the predicted ADRs at the .05 significance level (p-value = .849). Furthermore, Theil's U statistic was .578, which could suggest that the model has high accuracy. In summary, this model can give useful information to investors or developers in the decision-making process for hotel investment, hotel renovation, hotel room pricing, and rechecking the ADRs of operating hotels.

Introduction

Bangkok is Thailand's capital and one of the world's main travel destinations. According to Tripadvisor.com (2015), there are several interesting places in Bangkok, for example, (1) the Temple of the Emerald Buddha (Wat Phra Kaew), (2) the Temple of the Reclining Buddha (Wat Pho), (3) the Temple of Dawn (Wat Arun), (4) the Chao Phraya River, (5) Siam Paragon, (6) MBK Center, and (7) Central World Plaza. The revenue of hotels in Bangkok accounted for about 22.02 and 29.96% of the total hotel revenue in 2012 and 2013, respectively, and it is the biggest portion from all regions (National Statistical Office, 2012, 2013). In addition, information from the 2012 to 2014 Annual Registration Statements (56-1 Forms) of four Thai listed hospitality companies on the Stock Exchange of Thailand showed that the room revenue ratios were more than 50% of the total revenues, as shown in Table 1. This information shows the importance of room revenue in the hotel business. Moreover, according to the survey by Thailand's National Statistical Office in 2012, 62.79% of

Table 1. Room revenues of hospitality listed companies.

Company	Ratio of room revenue		
	Year 2012 (%)	Year 2013 (%)	Year 2014 (%)
DusitThani Plc. (2015)	54.32	55.00	52.16
Grand Asset Hotels and Property Plc. (2015)	66.43	66.43	64.47
Royal Orchid Hotel (Thailand) Plc. (2015)	59.67	60.09	57.12
Shangri-La Hotel Plc. (2015)	55.41	55.05	52.67

the Bangkok hotels' revenue came from their room revenues. The room revenues are directly relevant to the hotels' values when they are appraised by the income approach, which is the most widely adopted approach for hotel value appraisal among the three main ones (cost approach, sales comparison approach, and income approach) because the hotels' value is reflected in their future net cash flow (Raleigh & Roginsky, 1999). Moreover, Average Daily Rate (ADR) is also one of the required inputs for the ARRY valuation technique which Jefferies (2010) proposed as a valuation model for twenty-first century valuers.

"Four-star hotels" is an important sector of the hotel business in Bangkok. According to www.agoda.com, the numbers of four-star and five-star hotels in December 2014 were 259 and 84, respectively. These data revealed that four-star hotels were the main types of high-end hotels in Bangkok. Therefore, this research focuses on proposing an ADR prediction model for four-star hotels in Bangkok.

After reviewing several previous ADR prediction models, the researchers found that the independent variables, which have effects on the ADR, as proposed for each model, were different. For example, the research of Chen and Rothschild (2010) in Taipei found that hotel brands affected the ADR, but this variable was not mentioned in the research of Zhang, Ye, and Law (2011), which was done in New York. This suggests that previous research done in other locations may not apply to four-star hotels in Bangkok.

From this, the research questions of "what are the significant determinants of the hotels' ADRs?" and "how do they impact on the ADRs of four-star hotels in Bangkok?" arose. Therefore, the research objective is to propose an ADR prediction model that is optimized to four-star hotels in Bangkok. This model could give useful information to investors or developers in the decision-making process for hotel investment, hotel renovation, hotel room pricing, and rechecking the ADRs of operating hotels.

Literature review

Hotel value appraisal methods

As mentioned in the introduction, the income approach is the most widely adopted approach in hotel value appraisal. The following presents brief details of each method (International Association of Assessing Officers, 2013): (1) the income approach is based on the concept that the current value is the present value of all future benefits to be derived through income production by the asset over the remainder of its economic life. The income approach uses the capitalization rate to convert the anticipated benefits of the ownership of the property into an estimate of its present value. (2) The cost approach is based on the principle of substitution that a rational and informed purchaser would pay no more for a property than the cost of the building is an acceptable

substitute for the utility. The cost approach seeks to determine the replacement cost of an establishment less depreciation plus land value. (3) The sale comparison approach estimates a property's value (or some other characteristic, such as its depreciation) by referring to comparable sales. It should be noted that the ADR is relevant only when a hotel's value is appraised by the income approach.

Previous research

A number of research studies proposed ADR prediction models using a hedonic price model for several regions around the world. The dependent variable in all these models is the ADR, but the independent variables differ depending on the location, timing, and type of the hotel. It follows that these independent variables cannot be directly applied to the prediction of the ADR of four-star hotels in Bangkok. For example, White and Mulligan (2002) studied 584 hotels in four states in the United States of America (Arizona, Colorado, New Mexico, and Utah) and proposed linear form models. There were four significant determinants in the models: (1) hotel's brand, (2) average room size, (3) CBD location, and (4) location in relations to travel destinations. In Israel, Israeli (2002) found three significant determinants from 215 hotels, and linear form models were proposed. Moreover, Monty and Skidmore (2003) studied 15 bed-and-breakfasts in Wisconsin, USA, and found the best-fit models in a natural log-linear form with three significant determinants: (1) location attributes, (2) increasing price during weekends, and (3) increasing price during travel seasons. In 2007, Thrane (2007) collected data from 74 hotels in Oslo, Norway, and reported the best-fit models in a log-linear form. Moreover, it was found that the room rates were affected by some physical attributes: the availability of a minibar, hair dryer, room service, and free parking. However, the hotels' brands and distance from the city center were also significant. In Italy, Abrate, Capriello, and Fraquelli (2011) studied 140 hotels in Turin and found that the best-fit model was a natural log-linear form with two significant determinants: (1) star rating and (2) hotel facilities.

In Asia, Chen and Rothschild (2010) collected data from 73 hotels in Taipei and proposed log-linear models. There were four significant determinants in their research: (1) hotel's brand, (2) average room size, (3) hotel facilities, and (4) CBD location. Andersson (2010) collected data from 69 hotels in Singapore and a natural log-linear model was proposed. The significant determinants were classified into three groups: (1) hotel's attributes, (2) customers' satisfaction, and (3) location's attributes. A summary of the previous work and their determinants are shown in Tables 2 and 3, respectively.

From Table 2, it can be seen that most of the previous works proposed models in the log-linear form with Adjusted R^2 ranges between .311 and .892. In addition, Table 3 shows seven determinants, classified into three groups, of rating, physical attributes, and location attributes, as mentioned in the previous section.

Furthermore, a number of research works related to the hotel industry display an application of the hedonic price method. Even though these research studies are not very accurate for predicting the revenues of four-star hotels in Bangkok directly, their determinants, forms of best-fit models, and the range of accepted Adjusted R^2 values provide the necessary information to perform this research. For example, Thrane (2005) analyzed the prices of package tour accommodation to the Canary Islands offered in the catalogs of four Norwegian tour operators. Data were collected from 252 packages. Four determinants were found from

Table 2. Summary of Previous Research.

Researchers	Regions	Sample Size	Best Model	Adjusted R^2/R^2
[1] Israeli (2002)	Israel	215 hotels	Linear	.620–.820
[2] White and Mulligan (2002)	Arizona, Colorado, New Mexico and Utah (USA)	584 hotels	Linear	.570–.583
[3] Monty and Skidmore (2003)	Wisconsin, USA	15 bed-and-breakfasts	Natural log-linear	.605–.714
[4] Thrane (2007)	Oslo, Norway	74 hotels	Log-linear	.703–.705
[5] Andersson (2010)	Singapore	69 hotels	Log-linear	.892
[6] Chen and Rothschild (2010)	Taipei	73 hotels	Log-linear	.681–.703
[7] Zhang et al. (2011)	New York, USA	243 hotels	Log-linear	.311–.686
[8] Abrate et al. (2011)	Turin, Italy	140 hotels	Log-linear	.7804
[9] Thrane (2005)	Canary Islands, Spain	252 tour packages	Log-linear	.684
[10] Roubi and Littlejohn (2004)	United Kingdom	211 hotels	Log-linear	.794

Table 3. Determinants found in previous research.

Group	Independent variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Rating	1. Star rating	X							X	X	
	2. Hotel's brand	X	X				X				
Physical attributes	3. Number of rooms	X									X
	4. Average room size		X		X		X				
	5. Hotel facilities				X	X	X	X	X	X	X
Location attributes	6. CBD		X	X	X	X	X				
	7. Distance from travel destinations to hotel		X								
	8. Overall location									X	X

the research results: tour operator attributes, destination attributes, hotel star rating, and package attributes. However, some variables were found to have no significant effect on the package prices: namely, swimming pools for children, sport facilities, age of hotel, and 24-h reception. In addition, this research concluded that a hotel's star rating is strongly affected by the package prices. From another perspective, Roubi and Littlejohn (2004) studied the determinants of hotel transaction values in the United Kingdom. Data were collected from 211 hotels from 1996 to 2002 and seven determinants, sorted by their levels of effects on the values, were identified as the number of rooms, local economic conditions during the year, details of recreation facilities, meeting and banquet facilities, affiliation with major hotel chain, number of food and beverage outlets, and location attributes. It should be noted that most of the previous research studies did not use the vacancy rate as a determinant. This might be due to the fact that the vacancy rate is dependent on the ADR, and the main objective of this research was to analyze the ADR from the hotel's physical attributes.

Methodology and data

Average Daily Rate

According to Raleigh and Roginsky (1999), the ADR is an important indicator for evaluating sales performance in the hotel business. It is calculated for a specific period, such as daily, weekly, monthly, quarterly, or yearly. The unit of the ADR in this work is in Baht (Thailand's currency, which was at an average of 32.574 Baht per 1 US Dollar during September and December 2014 (Bank of Thailand, 2016)) per room per night. The ADR can be calculated by the formula shown in Equation 1 (Raleigh & Roginsky, 1999):

$$ADR = \frac{\text{Room revenue}}{\text{Rooms occupied}} \qquad (1)$$

The hedonic price model is an implicit price prediction model of each product's attribute when using a Multiple Regression Analysis. The dependent variable is the price of the goods and the independent variables are the attributes of the goods (Rosen, 1974).

There are four common model types, which have been generally used in the previous research studies (Abrate et al., 2011; Chen & Rothschild, 2010; Israeli, 2002; White & Mulligan, 2002; Zhang et al., 2011):

(1) Linear–linear form.
(2) Log-linear form, in which the dependent variable was transformed by taking the logarithm.
(3) Linear-log form, in which the independent variables were transformed by taking the logarithm.
(4) Log–log form, in which the dependent variable and the independent variables were transformed by taking the logarithm.

There are several statistical criteria for best-fit model selection. For Multiple Regression Analysis, a multicollinearity problem will occur when any pair of independent variables has a correlation of more than .75 (Prasith-rathsint & Sukkasem, 1993). In addition, the variance inflation factor (VIF) is an effective multicollinearity investigation tool, in which the value of each selected independent variable should not be more than 10 (Panichwong, 2002; Prasith-rathsint & Sukkasem, 1993; Wanitbancha, 2003). Moreover, AIC (Akaike Information Criteria) and BIC (Bayesiaan Information Criteria) should be adopted to select the best-fit model. The model with the lowest value for the AIC or BIC is the most appropriate model (Akaike, 1973; Sawa, 1978). In summary, there are six statistical criteria to determine the best-fit models, as presented in Table 4.

Furthermore, the Stepwise Regression Method was applied to select independent variables for the model. The variable with the highest correlation coefficient was first inserted into the model, and then the variable with the next highest coefficient was the next one to be inserted. The process was repeated until all independent variables (or determinants) were inserted into the model. The acquired model will show the significant determinants of the hotels' ADRs and how they impact on the ADRs of four-star hotels in Bangkok.

Finally, the adopted model was tested with a paired-sample *t*-test and Theil's U Test with the data from 30 hotels, which had not been used in the Multiple Regression Analysis process. The paired-sample *t*-tests compared the means of the observed ADRs and the means of the ADRs calculated from the model at the .05 significance level to verify the

Table 4. Statistical criteria for best-fit model selection.

Statistical criteria	Condition	Statistic meaning
Sig. value of independent variables	All variables have t-test significance values of no less than .05	All variables in the model are significant
Adjusted R^2	As high as possible	The higher the value is, the closer the data are to the expectations of the regression model
AIC (Akaike Information Criteria)	As low as possible	The lowest value shows the most appropriate model
BIC (Bayesian Information Criteria)	As low as possible	The lowest value shows the most appropriate model
VIF	Not more than 10	No multicollinearity of the independent variables
Residual	(1) Residuals are normally distributed (2) Residual's mean is equal to zero (3) There is no heteroscedasticity problem (4) No relationship between each residual(Durbin-Watson statistic value is between 1.50 and 2.50)	All conditions of the residuals from the Multiple Regression Analysis are satisfied

Independent Variables	Dependent Variable	Result
1. Rating Group 2. Physical Attribute Group 3. Location Attribute Group	Average Daily Rate (ADR)	ADR Prediction Model for Four-Star Hotels in Bangkok

Figure 1. Research framework.

accuracy of the model, while Theil's U Test gives a value between 0 and 1 when the model is accurate, and a value of more than one signifies that the model is inaccurate. The lower the value from the test, the more accurately the model can predict the dependent variable (Makridakis, Wheelwright, & McGee, 1983).

The research framework is presented in Figure 1 to establish the hypothesis that each independent variable (rating variables, physical attribute variables, and location attribute variables) has an effect on the dependent variable or the ADR of four-star hotels in Bangkok.

Data

Independent variables were divided into three groups: (1) rating, signified by an "R" in front of the variables' names, (2) physical attributes, signified by a "P", and (3) location attributes, signified by an "L". All variables were reviewed and screened by 13 experts, who were high-level managers in the hotel business with more than five years' experience, before the researchers began to collect the required data, which came from various hotel types and ratings. The experts' details are provided in Appendix 1.

After all the variables had been reviewed and screened by the experts, 17 variables were accepted by more than 80% of the experts. These were retained for the analysis process. They can be classified into dummy variables and scale variables. Dummy variables would be "0" if the hotel did not have the attribute and would be "1" if hotel did have the attribute. Furthermore, all dummy variables had to be standardized before performing the Multiple Regression Analysis. The details of the independent variables of the prediction model are presented in Table 5.

Table 5. Independent variables for ADR prediction model.

No.	Construct	Variable name	Description	Measurement
1	Rating	R_Brand	Hotel's international brand (yes or no)	Dummy
2	Physical attributes	P_NoRm	Number of rooms	Scale
3		P_Rmsize	Average room size (square meters)	Scale
4		P_Outlet	Number of hotel outlets	Scale
5		P_Pool	Swimming pool (present or absent)	Dummy
6		P_Fitness	Fitness room (present or absent)	Dummy
7		P_Spa	Spa (present or absent)	Dummy
8		P_Recrea	Other recreation facilities, such as tennisor squash courts, etc. (present or absent)	Dummy
9		P_Rs	Room service (present or absent)	Dummy
10		P_Meet	Meeting rooms (present or absent)	Dummy
11		P_Internet	Free internet in room (present or absent)	Dummy
12		P_Staff	Staff performance score from Agoda's review	Scale
13		P_Room	Room standard score from Agoda's review	Scale
14	Location attributes	L_CBD	CBD location (yes or no)	Dummy
15		L_BMRT	Distance from hotel to Bangkok mass rapid transit (km)	Scale
16		L_Airport	Distance from hotel to airport (km)	Scale
17		L_Ovw	Location score from Agoda's review	Scale

In Table 5, three variables were acquired from Agoda customers' opinions: staff performance score, room standard score, and location score. These data are reliable because they are reviewed by the customers who have stayed in the hotels and the data are promptly shown on the website.

To prevent multicollinearity problems, the correlation values of all independent variables were tested. It was found that one pair of variables, P_Room (room standard score from the Agoda's review) and L_Ovw (location score from the Agoda's review), had a correlation value of .942, which was more than .750, as suggested by Prasith-rathsint and Sukkasem (1993). To prevent omitted variable problems in the analysis, Factor Analysis was the method selected to solve this concern (Prasith-rathsint & Sukkasem, 1993). Therefore, these two variables were merged into one variable. The component score of P_Room and L_Ovw was .507, and the new variable's name was P_RmLo. It should be noted that the predicted ADR will be less reliable if one of them is excluded from the tests. After merging the correlated variables, the final number of independent variables became 16.

Source of data

In 2012, the Thai Hotel Association rated 56 hotels in Bangkok using the Ministry of Tourism and Sports' criteria into 21 five-star hotels, 24 four-star hotels, and 11 three-star hotels (Thai Hotel Association, 2012). However, the number of hotels was not enough to perform Multiple Regression Analysis, which requires at least five samples per independent variable, as suggested by Bartlett, Kotrlik, and Higgins (2001). Therefore, the hotel star ratings from Agoda (www.agoda.com), the most popular hotel reservation website in Thailand according to www.alexa.com (2014), which provided 158 sample hotels located around Bangkok, especially in business areas, such as Sukhumvit, Silom, Sathorn, and Ratchadapisek, as shown in Figure 2, were used in this research.
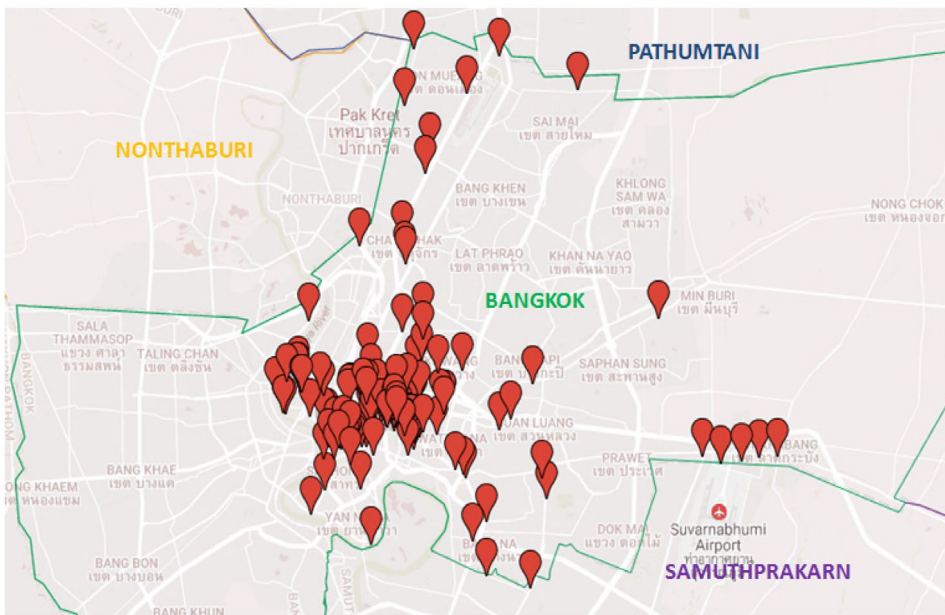
Figure 2. Locations of samples.

The comparison between the hotel ratings from the Thai Hotel Association (2012) and Agoda showed that 54 from 56 hotels (about 96.42%) received the same ratings. This confirms the reliability of these two sources of data.

The variables in the physical and location attribute constructs were collected from the 158 four-star hotels' public information. The hotels' ADRs were also calculated from the estimated full year room revenues of the hotels, which were collected from their room prices provided on www.agoda.com, which are lower than the price from the hotel's website according to its best-price guarantee (www.agoda.com, 2016), and they were recorded during September and December 2014. For example, the estimated rooms occupied per year for Hotel A, which has 63 rooms classified into four types, is 22,995 room - nights (365 days × 63 rooms). In addition, its room revenue can be calculated from the weighted average of rooms by type in each month to control for the effect of room rate fluctuation because the room rate will vary by season; e.g. from May to October is low season and from November to April is high season, as in the example in Table 6.

The ADR calculated from the example above is 3486 Baht/room/night. However, it should be noted that the room occupancy rate may have an effect on both the denomination and the divisor of Equation 1, and this information seems to be confidential in each hotel. However, if we assume that the occupancy rates of all types of rooms are the same, we can neglect the occupancy rate in the calculation. It should also be noted that all data were collected during a as short a period as possible, i.e. during September and December 2014, for the sake of relevance and comparability. However, the political crisis in Thailand that started in early 2014 may have had an effect on the overall hotel business in Bangkok.

After collecting the data, it was found that P_Rs (room service presence or absence) should be removed from the analysis because only 3.72% of the samples do not provide such facilities. This implies that this variable has a low effect on the hotels' ADR. Therefore,

Table 6. Example of estimated room revenue calculation.

Month	Number of operated days	Room price (Baht/night)			
		Type 1	Type 2	Type 3	Type 4
January	31	3929	4724	5629	6797
February	28	3929	4724	5629	6797
March	31	3929	4724	5629	6797
April	30	1964	2391	2846	3415
May	31	1964	2391	2846	3415
June	30	1964	2391	2846	3415
July	31	1964	2391	2846	3415
August	31	1964	2391	2846	3415
September	30	1964	2391	2846	3415
October	31	1964	2391	2846	3415
November	30	3929	4724	5629	6797
December	31	3929	4724	5629	6797
Estimated revenue per one room (Baht)		1,013,575	1,224,998	1,459,023	1,757,157
No. of rooms		32	10	5	16
Estimated room revenue (Baht)		32,434,400	12,249,980	7,295,115	28,114,512
			80,094,007 (all types)		

Table 7. Adjusted R^2, AIC, and BIC values of each model.

Model form	Adjusted R^2	AIC	BIC
Linear-linear	.554	2058	2048
Log-linear	.576	2044	2030
Linear-log	.406	2102	2094
Log-log	.492	2096	2084

the final number of independent variables was 15, and the ratio between the sample size to the number of independent variables becomes 158 to 15, or 10.533.

Finally, the researchers presented the research results to 13 hotel business experts (see Appendix 1 for details) to acquire their opinions on the research results. The reasons for this step were to verify the research results and to acquire the experts' perspectives, which make the research results more accurate and practical.

Results

From the analysis, the log-linear model with seven significant independent variables at the 95 percent confidence level was selected because it had the highest Adjusted R^2 value of .576 and the lowest AIC and BIC values of 2044 and 2030, respectively. The Adjusted R^2, AIC, and BIC values of all the models are presented in Table 7. In addition, all the statistical criteria mentioned in Table 4 are satisfied. The details of the descriptive statistics of the log-linear model are shown in Table 8.

The acquired model complied with the other statistical values for the Multiple Regression Analysis, presented in Table 4, and the results are shown in Table 9. The scatter plot between the residuals and the predicted ADRs from the model shows that the data are freely dispersed, as presented in Figure 3. This indicates that the predicted ADRs do not depend on the residuals, and the model does not have a heteroscedasticity problem.

In Figure 3, it should be noted that there are three outliers, which are classified into two groups. The first group consists of two outliers with high residual values, as their observed

Table 8. Test statistics of log-linear model.

Variables	Coefficient	Standard error	t-Statistic	Sig.	Collinearity statistic: VIF
Constant	2.241	.108	20.730	.000	
P_RmLo	.063	.014	4.546	.000	1.430
P_Rmsize	.003	.000	7.291	.000	1.152
P_Staff	.051	.011	4.595	.000	1.396
P_Outlet	.017	.005	3.788	.000	1.146
P_Fitness	.024	.008	2.879	.005	1.160
R_Brand	.017	.008	2.166	.032	1.110
L_Airport	.003	.002	2.038	.043	1.123

Table 9. Other test statistics for log-linear model.

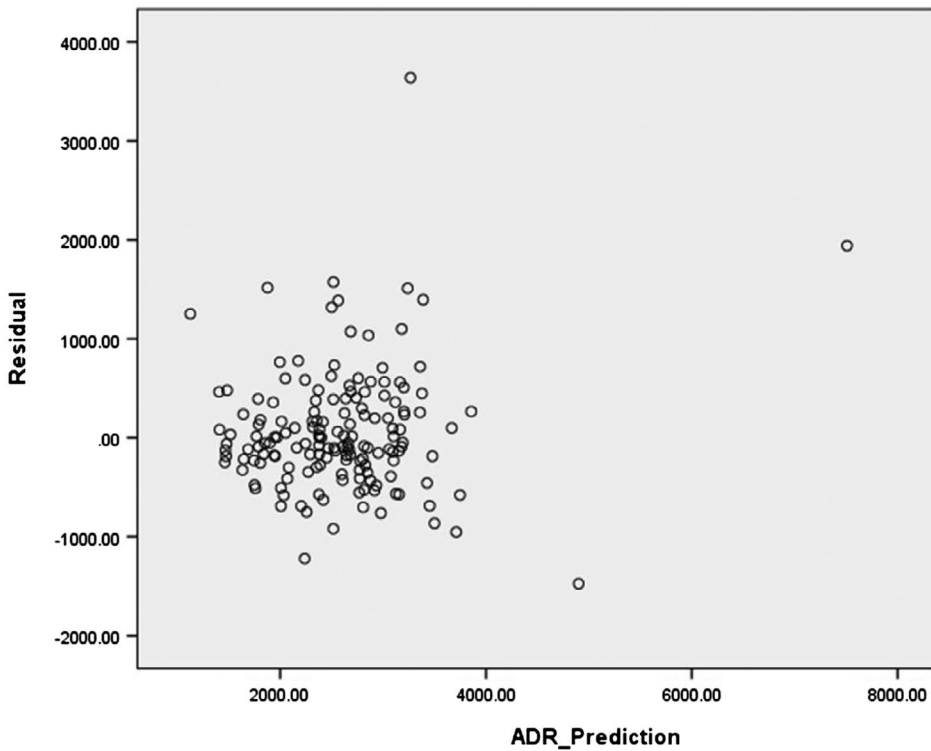| Statistic test	Value
Adjusted R^2	.576
VIF of all variables (less than 10)	Yes
Residual analysis	
1. Normally distributed	Yes
2. Mean is equal to zero	Yes
3. Does not have heteroscedasticity problem	Yes
4. No relationship between each residual (Durbin-Watson statistic value is between 1.50 and 2.50)	2.246
Number of independent variables	7

Figure 3. Residual scatter plot.

ADRs are much higher than the calculated ADRs. Their observed ADRs are higher than the average by 162 and 258%. Therefore, the calculated ADRs of these hotels from the proposed model are less than the observed ADR by about 52 and 20%. As the second hotel's room size is bigger than the average by 365%, its calculated ADR is higher and its residual lower than those of the first hotel. On the other hand, the second group consists of one outlier with a low residual, as the observed ADR is much less than the calculated ADR. Its room size is bigger than the average by 189% while the observed ADR is higher than average by only 30%. Therefore, the calculated ADR of this hotel from the proposed model is higher than the observed ADR by 43%. However, the maximum Cook's Distance of residual was .485 which is less than 1.000. This means the mentioned outliers are acceptable (Panichwong, 2002).

Finally, the acquired equation is presented as Equation 2. The values of all the dummy variables have to be replaced by the standardized value, as presented in Table 10, while the scale variables can be replaced with the real values of each hotel.

$$\log(ADR) = .063(P\_RmLo) + .051(P\_Staff) + .024(P\_Fitness) + .017(P\_Outlet)$$
$$+ .017(R\_Brand) + .003(L\_Airport) + .003(P\_Rmsize) + 2.241 \tag{2}$$

where P_RmLo = .507(L_Ovw) + .507(P_Room).

The best-fit model is a log-linear form that is similar to several former studies; i.e. Thrane (2007), Andersson (2010), Chen and Rothschild (2010), Zhang et al. (2011), Abrate et al. (2011), Thrane (2005), and Roubi and Littlejohn (2004). However, this form of the model seems to be difficult to use in the analysis of the changes in the ADR when some independent variables are altered because the ADR will be changed in a nonlinear form. Therefore, a sensitivity analysis table is necessary to analyze the effect of the independent variable change on the ADR, as shown by the example in Table 11.

In Table 11, which shows an example of the analysis of the price sensitivity of a hotel to its room size and staff performance as the variables of interest, the other variables are fixed within a determined condition (with 9.00 location overview score from the Agoda's review, 8.60 hotel room standard score, a fitness center, one outlet, no international brand, and distance of 19.60 km to the airport). The predicted ADRs of the four-star Bangkok hotel varies between 2322 and 2840 Baht/room/night, depending on the room size (with a range between 40.93 and 48.93 square meters) and staff performance score from the Agoda's review (with a range between 7.10 and 7.90). Moreover, the tested variables can be changed to other variables that are more relevant.

Model accuracy test

The paired-samples t-test between the observed ADRs and the predicted ADRs from the log-linear model for 30 random hotels, which were not used in the model development process with the Multiple Regression Analysis, gained a .849 p-value at the .05 significance

Table 10. Standardized value of dummy variables.

No.	Variable	Description	Value for yes	Value for no
1	P_Fitness	Fitness room (present or absent)	1.192	−.833
2	R_Brand	Hotel's international brand (yes or no)	.369	−2.696

Table 11. Example of sensitivity analysis.

		Staff performance score from Agoda's review				
Predicted ADR 2608.62 Baht/room/night		7.10	7.30	7.50	7.70	7.90
Room Size (sq.m)	40.93	2432.25	2490.44	2550.01	2611.01	2673.46
	41.93	2450.79	2509.41	2569.44	2630.90	2693.83
	42.93	2469.46	2528.53	2589.01	2650.95	2714.36
	43.93	2488.27	2547.80	2608.74	2671.14	2735.04
	44.93	2507.23	2567.21	2628.62	2691.50	2755.88
	45.93	2526.34	2586.77	2648.65	2712.00	2776.88
	46.93	2545.59	2606.48	2668.83	2732.67	2798.03
	47.93	2564.98	2626.34	2689.16	2753.49	2819.35
	48.93	2584.52	2646.35	2709.65	2774.47	2840.83

level. The result shows that the observed ADRs and the predicted ADRs from the proposed model are not significantly different. In addition, the result from Theil's U Test between the observed ADRs and the predicted ADRs from the same data-sets, as mentioned above, gained a .578 Theil's U, which is less than 1.00 and shows that the proposed model has acceptable accuracy. After presenting the results to the hotel business experts (see Appendix 1), they agreed with the results and that the prediction model could be applied to the hotel business in Bangkok, especially for customers who booked the hotel via an online travel agent (OTA) channel.

Discussion

There are some interesting issues from the comparison between the research results and the results of previous studies. First, a hotel's international brand had less of an effect on the ADR of the four-star hotels in Bangkok than presented in Israeli (2002), White and Mulligan (2002), and Chen and Rothschild (2010). Regarding this topic, the experts suggested that the main reason is that the data for this research were collected mainly from an online travel agency (www.agoda.com), where the customers, especially Thai customers, can check the hotels' facilities and locations for themselves and rely less on the brand of the hotel. The customers who use this channel when booking hotels seem to focus more on the hotel comforts. Furthermore, the top three variables' factor loadings were the Agoda's review scores, which were reviewed by the hotel customers. This finding showed the importance of the hotels' staff performance (P_Staff), room facilities (P_Room), and locations (L_Ovw). The acquired data demonstrated that the location scores of hotels in Bangkok have spatial patterns. Although, it was found that the location scores from Agoda's review do not depend on CBD and mass rapid transit with correlation values of .178 and −.196, respectively; the hotels with highest location scores were found along the Chao Phraya River in Rattanakosin Island, a cultural destination area in Bangkok. It is possible that the location scores of hotels in Bangkok have are related to cultural destinations. Focusing on the raw data from the 158 sample hotels, it was found that the coefficients of the variable P_Staff were more than those of P_Room and L_Ovw for about 19% of the hotels. This implies that the room facilities and location overview of each four-star hotel in Bangkok are not very different. On the other hand, the hotels' staff services are more varied. This can explain why P_Staff has a higher effect on the ADR than P_Room and L_Ovw. The staff performance or service quality determinant is revealed for the first time as they have never

been mentioned in previous studies. In addition, this finding emphasizes the importance of the hotels' locations and room facilities, which were mentioned in previous research throughout this decade by White and Mulligan (2002), Monty and Skidmore (2003), Thrane (2007), Andersson (2010), Chen and Rothschild (2010), Zhang et al. (2011), and Abrate et al. (2011). Moreover, location is an important determinant for other types of hotel. Studies about the price of beachfront resort accommodation by Hamilton (2007) in coastal districts of Schleswig-Holstein in Germany and Rigall-I-Torrent and Fluvia (2011) in Catalonia in Spain found the location to have a high level of importance. However, in some situations, the location is not of a high enough level of an effect to determine the real estate price, such as in house prices in Perth, as proposed by Costello and Elkins (2000). The details of the coefficients of all variables are presented in Table 12.

Conclusion

It was found that a log-linear multiple regression model with eight determinants was the best model for the prediction of the ADRs of Bangkok's four-star hotels at the 95% confidence level with a .576 Adjusted R^2 value, while the four highest effect determinants were the Agoda's review score, staff performance, location, and room standard. The determinants with the lowest effect were fitness center availability (presence or absence), number of hotel outlets, hotel's international brand (yes or no), distance from hotel to airport (km), and average room size (square meters). The research findings can give very useful information to investors or hotel entrepreneurs in understanding the customers' satisfaction with each component of the hotel. These pieces of information can support them in making effective decisions for their key business operations, such as project feasibility studies, setting the room rates, and hotel renovation for higher room rates with an acceptable ADR or, finding the optimal balance between room price and hotel quality. As shown by Hartman (1989), there can be an increase in hotel operating profit by improving the occupancy rate. These applications can lead to a successful hotel business. As most of the determinants from this research results are related to other studies conducted in the past decade, academia can benefit from this research. Moreover, the newly revealed determinant, which is the staff performance or service, should be further considered and expounded upon in future. In addition, this research also revealed the ADR prediction model that was applicable to Bangkok's four-star hotels as one usable source of information for further research, on which interested researchers can perform further studies in other locations or with other hotel ratings or, separately study each room type in the hotels.

Finally, six limitations should be noted. First, the results were obtained only from Bangkok four-star hotels, for which the majority of room revenue is generated from the OTA channel. This is because the data were collected from www.agoda.com. Based on the experts' opinions, the behavior of customers who use OTAs to investigate and book hotels is different from that of general customers in several ways, as discussed above. Second, this research focused mainly on the revenue perspective. However, some independent variables

Table 12. Coefficients of variable P_Staff, P_Room, and L_Ovw.

Variable	Standard deviation (SD)	Mean	Coefficient of variation (SD/mean)
P_Staff	.807	7.897	.102
P_Room	.667	8.020	.083
L_Ovw	.657	8.030	.082

that lead to changes in the ADR could also cause increases in the investment or operating costs to entrepreneurs. Therefore, hotel entrepreneurs, as well as other research users, should understand this concern when applying the results of this research to acquire a comprehensive perspective. Third, the ADR of each hotel was calculated without the effect of the occupancy rate, as mentioned in the Source of Data section, because this seems to be confidential information for each hotel. Fourth, the currency exchange rate, which may impact hotels' income, was not included in this research because the data were collected in one period, and therefore cannot include the currency exchange rate as an independent variable. Fifth, the acquired ADR from the proposed model seems to be an average ADR of all types of rooms in the hotel as it gives useful overall information for hotel management purposes. Academia may add room type as a determinant in the model in further studies. Finally, all the research data were collected from a specific time period, i.e. from September to December 2014, and it may have been affected by some seasonal or special events, e.g. the political crisis in Thailand, which could impact the acquired data of the hotels' ADRs.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1

Table A1. Experts' details.

No.	Roles	Organizations	Number of hotels worked in
1	Management in Sales and Marketing Department	Listed Company in Hotel Business	1 Five-Star Bangkok Hotel 1 Three-Star Provincial City Hotel 2 Five-Star Resorts 1 Three-Star Resort
2	Management in Finance Department	Listed Company in Hotel Business	1 Four-Star Bangkok Hotel 2 Five-Star Bangkok Hotels 1 Three-Star Provincial City Hotel 3 Four-Star Provincial City Hotels 1 Five-Star Provincial City Hotel 1 Three-Star Resort 10 Four-Star Resorts 7 Five-Star Resorts
3	Management in Business Development Department	Listed Company in Hotel Business	4 Three-Star Bangkok Hotels 2 Four-Star Bangkok Hotels 2 Five-Star Bangkok Hotels 5 Three-Star Provincial City Hotels 1 Four-Star Provincial City Hotel 2 Five-Star Resorts
4	President	Sales and Marketing Consultant in Hotel Business	1 Three-Star Bangkok Hotel 1 Three-Star Resort 2 Four-Star Resorts
5	Management in Finance Department	Listed Company in Hotel Business	1 Five-Star Bangkok Hotel 1 Three-Star Provincial City Hotel 1 Three-Star Resort 2 Five-Star Resorts
6	Management in Operations Department	Company in Hotel Business	2 Five-Star Bangkok Hotels 2 Four-Star Provincial City Hotels 1 Four-Star Resort
7	Management in Finance Department	Listed Company in Hotel Business	1 Four-Star Bangkok Hotel 1 Five-Star Bangkok Hotel 3 Four-Star Provincial City Hotels 2 Five-Star Provincial City Hotels 4 Five-Star Resorts
8	Management in Marketing Department	Listed Company in Hotel Business	1 Four-Star Bangkok Hotel 2 Three-Star Provincial City Hotels 1 Five-Star Resort
9	Hotel Owner	Stand Alone Hotel	1 Three-Star Bangkok Hotel 1 Three-Star Resort
10	Hotel Owner	Stand Alone Hotel	1 Four-Star Provincial City Hotel
11	Hotel Owner	Stand Alone Hotel	1 Three-Star Resort
12	General Manager	Stand Alone Hotel	1 Four-Star Resort
13	Hotel Owner	Stand Alone Hotel	1 Five-Star Resort