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Classification of Lodging Facilities Using Questionnaire Data on Revenue Management

Emi Iwanade[1] and Kohei Otake[2]

[1]Graduate School of Information and Telecommunication Engineering, Tokai University, 2-3-23,Takanawa, Minato-ku, Tokyo 108-8619, Japan
[2]School of Information and Telecommunication Engineering, Tokai University, 2-3-23, Takanawa, Minato-ku, Tokyo 108-8619, Japan

ABSTRACT

The COVID-19 epidemic has drastically changed our way of life.Especially in Japan, the lodging industry was hit hard by the trend toward self-restraint in travel. The purpose of this study is to typify and understand the characteristics of lodging facilities by focusing on their revenue management methods. Specifically, we use a questionnaire of employees involved in decision-making regarding the facility. First, we performed principal component analysis on 13 question items related to current profit management among all questionnaire items. From the result, we summarized the questionnaire items into 6 principal components. Moreover, we interpreted each principal component using the principal component loadings. Next, we performed cluster analysis using the principal component scores obtained by principal component analysis. We calculated the average principal component score for each cluster and named and discussed each cluster with reference to the calculated value. This study allowed us to develop a classification of facilities based on their revenue management methods. From these results, several findings were obtained that can be used in the operation of lodging facilities.

Keywords: Revenue management, Hotel industry, Principal component analysis, Cluster analysis, Questionnaire

INTRODUCTION

In recent years, the COVID-19 has been spreading worldwide. The increase in the number of infected patients associated with the COVID-19 epidemic posed serious problems for the medical community. In addition, it is also affecting industries outside of healthcare. According to the survey on the impact of the COVID-19 on corporate performance conducted in Japan by Teikoku Databank Corporation, the lodging industry experienced the largest decline in sales, with an average growth rate of -28.5%, compared to other industries[1].

In addition, according to a survey conducted by the Japan Tourism Agency for hotels and inns nationwide, the number of overnight guests decreased significantly by -44.3% overall between 2019 and 2020[2]. A further breakdown shows that the number of Japanese guests decreased by 35.2% from

the previous year, while the number of foreign guests decreased by 82.4%, indicating that the number of foreign guests has decreased. Under these circumstances, the room occupancy rate remained at 34.3%. Resort Trust, the highest revenue company in the Japanese hotel industry, had a net profit of 7.1 billion yen in 2019. However, in 2020, the company reported a net loss of 10.2 billion yen, a significant negative figure even for a major company[3].

In order to overcome this situation, there is a renewed focus on "Revenue Management" in the hotel industry. "Revenue Management" refers to a management method in which prices of products and services fluctuate in response to customer demand. Many companies have adopted this system, including the airline Solaseed Air and APA Hotel of the major hotel company. On the other hand, it is seen as a problem in terms of customer satisfaction in terms of price inequality due to fluctuating rates, and so on. Aoki et al[4] conducted an interview survey on "Revenue Management" in times of shrinking demand based on the impact of the COVID-19 and its countermeasures. They examined the state of "Revenue Management" in each of the target hotel companies based on the previous literature and interviews. Through the result of the analysis, they found that many hotels are reducing fixed costs to survive in the face of rapidly declining customer numbers, but that "Revenue Management" is more profit-oriented than revenue-oriented. Furthermore, it was shown that the cost management is increasingly linked to the cost management focusing on fixed costs. In addition, Yoshioka[5] shows that companies operating in the lodging industry can improve labour productivity by utilizing revenue management.

In recent times, there has been a gradual increase in the number of people traveling within Japan due to revised guidelines. In a survey conducted by J.D. Power on "COVID-19 Disaster, Post COVID-19 Travel," 58% of respondents in 2021 answered they plan to take a trip involving an overnight stay for business or personal purposes within the next six months[6]. Moreover, the national government is taking steps to provide stronger support for regional tourism in Japan. This is a project called the National Travel Subsidy Program, in which the national government provides financial support to each prefecture that is eligible for subsidies as part of its support for regional tourism projects to create demand. This program started on October 11, 2022. This is the government's way of encouraging people to travel, and they have high expectations for the lodging business in the future. In fact, the number of overnight stays from September to October 2022 is on an increasing trend, with a particularly large increase in resort hotels[7]. On December 13, 2022, the Ministry of Tourism announced the implementation of the national travel support program after the new year, and it is expected that the travel industry will regain its pre-pandemic the COVID-19 status.

Thus, travel awareness in Japan is returning to pre-pandemic levels, and the government is encouraging people to travel. Therefore, we believe that the lodging industry including hotels needs to review its management policies based on the situation before the COVID-19 epidemic.

In this study, we categorize and characterize lodging facilities according to their revenue management methods with the aim of obtaining knowledge that can be used after COVID-19.

DATASETS

In this study, we used the questionnaire data from the "Analysis of Revenue Management Practices in Japanese Lodging Industry" (Table 1). It was sent to managers of lodging facilities in Japan[8]. The questionnaire consists of 9 questions, each of which can be answered Free answer, as a single answer, or on a 5-point scale. It was conducted on July 31, 2017, and a total of 242 responses were used, with missing values removed. Hereafter, it will be referred to as the facility questionnaire data.

Consolidation of Survey Items

First, we performed Principal Component Analysis(PCA) to aggregate several questionnaire items and to understand the relationships among the questionnaire items to categorize lodging facilities based on their revenue management methods. PCA is a method of multivariate analysis that focuses on correlations among variables and synthesizes variables called principal components that well represent the overall variability[9].

We conducted PCA using a question about "Rooms Division Revenue Management Policy". Here, we excluded three items about employees' understanding of revenue management methods. In this study, we use up to the sixth principal component whose cumulative contribution from the first principal component is closest to 80%. The question items and the principal component loadings for each principal component are shown in Table 2.

Next, each principal component is interpreted based on the principal component loadings. We named the first principal component "Focusing on Constancy" because of the high value of item 8 and the large low values of items 1 and 3, indicating a tendency not to engage in price fluctuations. We named the second principal component "Focusing on Demand Forecasting" because items 8, 11, and 13 are high values, and items related to

Table 1. Summary of response questions for facility survey data.

Detail	Number of questions	Format
Respondent Attributes	5	Free Answer Single Answer
Percentage of Sales from Direct Online Sales	1	Single Answer
Business Environment	9	5-point scale
Revenue Management Methods in the Rooms Department	1	Single Answer
Revenue Manager Authority	1	Single Answer
Rooms Division Revenue Management Policy	16	5-point scale
Point Program Introduction or not	1	Single Answer
How to use the Points Program	9	5-point scale
Reputation Management Policy	8	5-point scale
Competitive ComparisonsPerformance Comparison	6	5-point scale

Table 2. Principal component loadings for each survey item.

Items	PC1	PC2	PC3	PC4	PC5	PC6
1) You frequently change the selling price of rooms depending on how many of its own rooms are filled.	−0.37	−0.16	−0.02	0.19	0.03	0.10
2) You frequently open and close sales plans depending on how many of its own rooms are filled.	−0.29	−0.12	−0.03	−0.09	−0.73	−0.08
3) You frequently change the selling price of rooms based on competitors' prices.	−0.38	−0.26	−0.02	−0.13	0.13	−0.05
4) You frequently open and close sales plans based on competitors' prices.	−0.32	−0.24	−0.01	−0.37	−0.27	−0.09
5) You are trying to attract a wide range of customer segments by setting a wide range of room prices.	−0.25	−0.02	−0.13	0.60	0.14	0.04
6) You are attempting to capture last-minute demand by drastically reducing room prices immediately before the date of the stay.	−0.19	−0.29	0.45	−0.01	0.14	0.61
7) You are not aware of the prices of competing lodging facilities, and are more concerned with maintaining its own ideal price range.	−0.26	0.03	−0.07	0.53	−0.13	−0.34
8) You are not aware of the prices of competing lodging facilities and is more concerned with maintaining its own ideal price range.	0.20	0.44	0.10	0.12	−0.47	0.31
9) You prioritize increasing occupancy rates over other factors in revenue management.	0.07	0.02	0.85	0.14	−0.06	−0.40
10) You frequently update demand forecasts.	−0.30	0.26	0.14	0.06	0.01	0.28
11) You place a high priority on accurately forecasting demand.	−0.28	0.41	0.05	−0.10	0.04	0.17
12) You perform a detailed analysis of the market and competitors prior to making pricing decisions.	−0.28	0.32	0.09	−0.32	0.30	−0.35
13) You perform a detailed analysis of the difference between the demand forecast and the results (actual demand) after the fact.	−0.27	0.47	−0.06	−0.09	0.06	0.00

demand forecasting are concentrated in this component. We named the third principal component "Focusing on Room Occupancy" because items 6 and 9 were higher in value, indicating that items related to room occupancy were concentrated in this component. We named the fourth principal component "Focusing on Customer Demand" because items 5 and 7 have high values, indicating that the items tend to emphasize the need from customers in setting room rates. The fifth principal component, item 12 was high and item 2 was very low. We named the fifth principal component "Focusing on Competitors," because we believe that the items that determine the company's movement are concentrated in the items that are determined by competitors. We named the sixth principal component "Focusing on Company Policy" because item 8 had a high value, and we considered that it was not influenced by demand or competitors.

Classification of Lodging Facilities

Next, we performed cluster analysis using the principal component scores of all lodging facilities obtained by principal component analysis. We used

k-means++, an extended version of the k-means method[10], to perform the cluster analysis. We performed the elbow method to determine the number of clusters. In this study, we set the number of clusters to 8. To interpret the clusters, we calculated the mean of the principal component scores of the lodging facilities to each cluster(Table 3). We interpreted the clusters based on their characteristics by looking at which principal component scores are higher or lower for each cluster.

We named cluster 1 "Company-oriented Cluster" because it emphasizes the company's own policy and does not use demand forecasting. 22 lodging facilities belong to this cluster, many of which are located in tourist destinations. We named cluster 2 "Balanced Cluster" because it sets room rates by incorporating various factors. 52 lodging facilities belong to this cluster, the largest number of lodging facilities compared to the other clusters. The results of the questionnaire regarding the business environment of the lodging facilities belonging to this cluster shows that they have less confidence in the future demand forecast than the other clusters. We named cluster 3 "Stable Cluster" because it does not change its room rates. 36 lodging facilities belong to this cluster. Although this cluster does not perform much revenue management, it is not as trustworthy in forecasting future demand as facilities in the "Balanced Cluster". We named cluster 4 "Demand-prioritizing Cluster" because it tends to change its room rates according to demand forecasts and occupancy rates, although it has a base room rate setting. 12 lodging facilities belong to this cluster, most of which are business hotels. The results of the questionnaire survey on the business environment of lodging facilities belonging to this cluster show that they are fully occupied for more days than the other clusters. We named cluster 5 "Market Trend Priority Cluster" because it has a wide range of room rates while keeping an eye on competitors. 24 lodging facilities belong to this cluster, many of which shows that price competition with other lodging facilities is intense in their business environment. We named cluster 6 "Customer Needs-prioritizing Cluster" because it determines room rates according to demand forecasts and market conditions. 42 lodging facilities belong to this cluster. we found that a larger percentage of respondents reported a greater disparity between busy and quiet occupancy rates than the lodging establishments in the other clusters with respect to the business environment. We named cluster 7 "Internal Factor-first Cluster"

Table 3. Mean of principal component scores for facilities belonging to each cluster.

Cluster Number	constancy	demand forecasting	demand forecasting	customer demand	competitors	company policy
1	−1.08	−1.34	−0.19	−0.23	−0.16	0.23
2	0.86	−0.92	0.15	0.23	−0.11	−0.14
3	3.29	−0.52	−0.29	−0.14	0.15	−0.04
4	2.62	2.72	1.24	−0.64	−0.12	−0.26
5	−0.79	0.56	−0.34	1.07	1.28	0.20
6	−0.06	1.20	−0.36	0.05	−0.55	0.05
7	−2.36	−0.43	1.19	−0.57	0.03	0.37
8	−3.21	0.47	−0.77	−0.20	−0.13	−0.44

because it is considered to place importance on its own situation at the time, as it sets room rates based on the occupancy rate. 29 lodging facilities belong to this cluster. We found that this cluster has many lodging facilities in a relatively low price range. We named cluster 8 "Forecast-first Cluster" because it actively incorporates demand forecasting without setting a fixed price. 25 lodging facilities belong to this cluster, and many of them are in the higher price range, such as city hotels. We also found that more lodging facilities responded to our business environment questionnaire by indicating that they place more importance on high-priced customers than the other clusters.

DISCUSSION

Based on the results of the analysis, we discuss each cluster with a focus on revenue management.

"Company-oriented Cluster" is a lodging facility located in a sightseeing resort, and it may not use demand forecasting because a certain number of customers use the facility even without price fluctuation.

"Balanced Cluster" includes lodging facilities that use revenue management in their room rate setting, but we believe that there is no need to use revenue management or that the method used is not suitable for this purpose. There are various methods used for revenue management, such as room occupancy rates and important forecasts. However, we believe that the effect of revenue management is less effective than in other clusters because fluctuations in room rates may give a sense of distrust depending on the purpose of customers' use of lodging facilities.

Based on the results of the "Stable Cluster," we speculate that this cluster may have other priorities than incorporating demand forecasting into room rate setting. Specifically, we believe that this cluster has an operational policy that focuses on facility services rather than revenue management. The lodging facilities in this cluster are mid- to high-price range lodging facilities with high customer evaluations, so they emphasize service in order to maintain their image.

In the "Demand-prioritizing Cluster," most of the lodging facilities belonging to this cluster are business hotels, which have been widely developed in Japan. These nationwide hotels are operated by a single company, which is considered to set room rates mechanically. Therefore, it is assumed that they are categorized in this cluster because they can combine various methods for revenue management.

"Market Trend Priority Cluster" refers to the room rates of competitors, but as a result, it leads to a competitive trend. Since customer demand differs among competing lodging facilities, it is necessary for lodging facilities in this cluster to conduct revenue management on their own.

In the "Customer Needs-prioritizing Cluster," only market demand is incorporated into revenue management, resulting in a disparity between busy and off-peak periods. This suggests that it is important to reflect the occupancy rate of the company in revenue management, rather than relying solely on market demand.

On the other hand, "Internal Factor-first Cluster" emphasizes occupancy rates, and there is little disparity between the busy and off-peak periods. For lodging facilities that need to generate a certain level of revenue, it is considered to be a good idea to use occupancy rates in revenue management efforts.

"Forecast-first Cluster" includes many high prices range facilities such as city hotels. Since these facilities can spend more money on facility operation due to their high cost per guest, they can incorporate AI. Many of the facilities in this cluster also have chatbots on their homepages, suggesting that they use AI tools for purposes other than demand forecasting.

After understanding the characteristics of all clusters, we discuss what we have found out about revenue management. First, occupancy rates are the most important factor to consider when incorporating revenue management. Demand forecasting is based on the market, and it is difficult to take into account the facility conditions at any given time. In fact, the "Internal Factor-first Cluster" is considered to be more stable than the "Customer Needs-prioritizing Cluster," with no disparity between busy and off-peak periods. Another point is that the use of demand forecasting in revenue management is suitable for lodging facilities such as business hotels that target business travelers. There is no on-season or off-season for them, and room occupancy rates do not vary greatly from those of lodging facilities in tourist areas. Therefore, it is important to be able to forecast demand, and we believe that demand forecasting is appropriate for lodging facilities with a large number of them.

CONCLUSION

In this study, we conducted a typology of facilities based on their revenue management methods using questionnaire data. Specifically, we performed principal component analysis using it of 13 selected items to aggregate the questionnaire items. We selected up to the sixth principal component based on the proportion of variance, and aggregated the 13 questionnaire items into 6. Next, we performed a cluster analysis using the principal component scores obtained by principal component analysis. Through the result of cluster analysis, we categorized all 242 lodging facilities into eight clusters. Our categorization of facilities based on revenue management showed that each facility's price range is characterized by its operational policies, such as its active use of demand forecasting. It was also revealed that there are differences in the methods to be used and facility operation methods depending on the target group of the lodging facility and the image of the lodging facility by customers. The classification results obtained from this study can be used to conduct a more detailed analysis of similar and competing lodging facilities.

In the future works, we will work on feature comparisons using natural language processing analysis of text data submitted by customers. In particular, we will use customer review data for each facility to clarify in what areas, such as service and meals, customers rate each cluster highly.

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