Journal of Systems Thinking in Practice
JSTINP, *QUARTERLY*
Homepage: jstinp.um.ac.ir
Online ISSN: 2821-1669, Print ISSN: 2980-9460
Research Article
DOI: 10.22067/JSTINP.2023.81465.1051
JSTINP 2023; Vol. 2, No. 2

Analyzing and Prioritizing Customers' Quality Requirements by Combining k-means, Kano Model and Fuzzy AHP

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How to cite this article

Sibevei, A., Gholamian Ghouzhdi, S., 2023. Analyzing and Prioritizing Customers' Quality Requirements by Combining k-means, Kano Model and Fuzzy AHP. *Journal of Systems Thinking in Practice, 2*(2), pp.93-114. doi: 10.22067/JSTINP.2023.81465.1051.
URL: https://jstinp.um.ac.ir/article_43992.html.

ABSTRACT

Customer satisfaction is the main condition for competing in the global market. In the international market, customer requirements or needs have been turned into a primary concern for organizations. Also, numerous studies have shown that customer satisfaction has a positive effect on organizations' profitability. In order to attract and retain customers, it is essential to identify and classify their requirements and predict them for organizations. Ideally, every organization should fully understand each of its customers, which is impossible in practice, so this study has used the market segmentation technique to identify customer needs. After the market segmentation, appropriate services should be provided for each segment to achieve customer satisfaction. One of the powerful techniques in this field is the Kano model. Investing in the motivational needs of customers and obtaining their satisfaction requires identifying the most important motivational needs. Therefore, in this study, the combinations of the K-means, Kano, and fuzzy analytic hierarchy process (FAHP) methods are used.

Keywords

Quality requirement, Kano model, K-means, Fuzzy AHP.

Article history

Received: 2023-03-05
Revised: 2023-06-19
Accepted: 2023-06-24
Published (Online): 2023-06-27

Number of Figures: 3 **Number of Tables: 9** **Number of Pages: 22** **Number of References: 56**

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1. Introduction

Delivering high-quality services to customers is the key success factor in service industries. Monitoring and improving services' quality should be grown by increasing competition for efficiency improvement and business volume. In manufacturing and service industries, quality improvement is an essential factor affecting customer satisfaction and purchase intention (Meesala and Paul, 2016). In the international market, customer requirements or needs have become a primary concern for organizations. To survive in this situation, companies can no longer rely solely on high-volume and low-cost production. Instead, to maintain competitive advantage, they make an effort to meet customers' needs and achieve customer satisfaction. Companies deal with a big challenge to satisfy the variety of customers' requests. Therefore, identification and meeting customers' needs are fundamental factors in designing and developing a product or service and maintaining the market position (McKay et al., 2001). To satisfy customer demands, it is necessary to understand the service quality required by customers and provide them with services based on such requirements (Huang et al., 2015). Providing high-quality services for customers and satisfying them is a primary and major challenge to the management of hotels in the modern hospitality industry (Kuo et al., 2016). One of the techniques to improve customer service quality while measuring customer satisfaction is the Kano model (Kano et al.,1984). The significant difference between the Kano model compared with other quality models, namely the importance-performance analysis (Martilla and James, 1977), technical and functional quality model (Gronroos, 1984), or service quality gap model (Servqual) (Zeithaml et al., 1990) is that it regards the influence of attribute performance on the overall level of customer satisfaction as nonlinear and asymmetric. Besides, it allows a complex perspective on separate attributes and their contribution to customer satisfaction.

Considering the above-mentioned points, it is vital to identify the customers' needs and satisfy them. On the other hand, because of different demographic characteristics, customers will express different preferences for service characteristics (Lai and Wu, 2011). And this is because hotels' guests include people from different cultures that probably have different needs and values (Liu and Shih, 2005). Therefore, ideally, every organization should know each of its customers thoroughly which is not possible in practice. Market segmentation allows similar customers to be included in one market segment, so managing and understanding these segments is much easier than identifying individual customers' needs (Shahin et al., 2021). The k-means method can be used for market segmentation as one of the clustering methods (Wu, 2006).

After market segmentation, it is possible to identify the needs of different groups of customers in different market segments by the Kano model to provide services compatible with each customer's needs. All customers' quality requirements are not of equal importance because of design constraints, time, budget, and so on in a competitive environment (Fung et al., 2003). Therefore, customers' quality requirements are prioritized in attractive categories. Given the facilities and limitations of the organization, more facilities were provided for high-priority customers' quality requirements in attractive categories. The hierarchical analysis process can be used to prioritize the quality requirements of different customers. Therefore, the main purpose of this study is to provide a combined model of clustering, Kano, and FAHP methods for recommending customer-based services.

The rest of this paper is organized as follows: In the second section, related studies are presented and the paper's contributions have been provided. In the third section, the proposed research methodology, including the clustering method, Kano model, and FAHP, is described concisely. In the fourth section, the application of the proposed model in a four-star hotel in the tourist city of Mashhad is explained. Finally, the conclusion and future research are stated.

2. Literature review

2.1. Customer satisfaction

Many studies have been done on the topic of customer satisfaction. Customer satisfaction is the customer's evaluation of the goods and services, whether they meet their needs and expectations or not (Schiffman et al., 2010; Levens, 2012; Kotler & Armstrong, 2012). Satisfaction levels may vary depending on whether consumers rate a feature as a minimum requirement or value-added (Gregory and Parsa, 2013). Topfer (1996) believes that customer satisfaction does not depend on the type of organization's business activity or its market position but depends on the organization's ability to provide the expected quality of a customer.

2.2. Quality of service

Service quality is a complex concept. It is difficult for consumers to evaluate the quality of services before consumption, during, and after it considering various attributes and characteristics of rendered services (Bougoure & Neun,2010). Service quality is considered as a key factor in customer satisfaction. There is extensive literature on the relationship between service quality and customer satisfaction (Gregory and Parsa, 2013; Gunarathne, 2014). According to Parasuraman et al. (1988), customer' judgment is defined as the superior nature of a service compared with similar services which consider its salient advantages. Ong (1998)

defined service quality as the overall quality levels of consumption assessed by customers' subjective judgments.

2.3. Studies related to customer satisfaction and service quality

The literature review for writing the current paper was centered on customer satisfaction and service quality, which have been done with different methods, specifically in service industries. Several studies have used the Servqual model as a measurement tool for service quality. For example, Akbaba (2006) has used the Servqual model in the hotel industry to measure the service quality of a hotel in Turkey. Stefano et al. (2013) evaluated the service quality of a large hotel through the fuzzy Servqual and fuzzy AHP.

For many years, customer satisfaction had been focused on a one-dimensional structure. It means that the higher quality of a product is received by a customer, the greater customer satisfaction will be gained and vice versa. In comparison, kano's two-dimensional quality model states that all quality components are not the same. (Kano et al.,1984). In other words, customers do not necessarily treat all attributes equally, and sometimes adding an attribute to a product can cause them dissatisfaction (Gregory and Parsa, 2013). Some papers applied the Kano model to consider customers' satisfaction and their needs in hotels. Yang et al. (2009) also applied the Kano model in hotels. Using this model, they examined the frequency of using service items to propose a strategic pricing model. The application of the proposed model is demonstrated in a case studying a 5-star hotel in Taiwan. Lee and Chen (2006) used the Kano model to measure service quality in hot spring hotels in Taiwan. They assessed that customers with different attributes, such as demographics and travel modes, had various views about service quality. Ban and Mester (2014) tested a two-dimensional quality model, proposed by Noriaki Kano, in an actual situation of four hotels from Oradea. Their research illustrated the degree of global satisfaction of the surveyed clients and categorized quality attributes into the three main areas (plus one) suggested by Kano. Zobnina and Rozhkov (2018) conducted a study to test the Kano model for identifying satisfaction drivers, developing segmentation, and customer profiling in service segments.

The Kano model also can be used in service organizations to perceive customers' needs and define new requirements for improving their services. Most of the time the Kano model is integrated with other tools. For example, some studies have used a combination of Kano and AHP or ANP methods. Momani et al. (2014) provided a systematic approach for determining and prioritizing the healthcare quality attributes that affect patients' satisfaction using FAHP

and the Kano model. Alroaia and Ardekani (2012) Represented a combination algorithm of AHP and Kano to prioritize influential factors on customer needs in e-banking. Also, several studies have used the combination of Kano and quality function deployment(QFD). Tan and Shen (2000) suggested a method to integrate the results of the Kano model into the QFD. Then, they proposed an approximate conversion function to adjust the ratio of improvement to any customer need in the QFD. Chaudha et al. (2011) also proposed a new method for integrating the results of the Kano model into the QFD and represented a new formula for the improvement ratio. Chang and Chen (2011) used a combination of the Kano model and QFD to explore customers' contacts with brands in a business hotel based on customers' perspectives and service providers. Kuo et al. (2016) also integrated the Kano model and QFD in a hotel in Taiwan to rank attributes and suggest technical attributes. Bayraktaroğlu and Özgen (2008) used the Kano and AHP models to recognize, categorize and weigh user requirements for library services; then, employ QFD to identify visible marketing strategies.

Identifying customer needs and satisfying them is of utmost importance. On the other hand, because customers have different demographic characteristics, they will have different preferences for service characteristics (Lai and Wu, 2011). Therefore, some researchers used clustering methods to analyze customers' quality requirements. Dursan and Caber (2016) used RFM (Recency, Frequency, and Monetary) analysis and clustering in three Hotels in Turkey. According to its results, RFM effectively clusters the group, and hotel managers can generate new strategies for improving their abilities in customer relationship management (CRM). Some papers applied a combined model of the Kano and Cluster analysis. Rezaeian et al. (2016) identified customers' requirements in Nyazco online shopping. They clustered these customers using two k-means algorithms and a fuzzy kano model to provide product features based on each customer's needs. Chang et al. (2009) proposed an approach to training artificial neural networks to group users into different clusters. Then, they applied the well-established Kano method to extract users' implicit needs in different clusters. Huang et al. (2015) used cluster analysis to effectively segment customer characteristics into the maintenance and repair of motor vehicles and then applied the Kano model, which is different from the traditional measurement of customer preference. Table 1 presents a comprehensive overview of previous studies that has focused on analyzing customers' quality requirements.

Table 1. Literature summary

Author	Methodology	Study subject	Context
Akbaba (2006)	Servqual	Service quality	Hotel industry
Grobelna & Marciszewska (2013)	Servqual	Service Quality	Hotel Sector
Alroaia & Ardekani (2012)	AHP and Kano	Customer needs	E-banking
Ban & Mester (2014)	Kano two dimensional	Touristic services	Hotels' clients
Bayraktaroglu and ozgen (2007)	Kano model, AHP & QFD	Customer requirements	Library services
Chang & et al., (2016)	Data mining methods	Tourist loyalty	Hotel
Chang & Chen (2011)	Kano model and QFD	Brand contacts	Hotel business
Dominici & Palumbo (2013)	Kano model	customer satisfaction	Hotels
He et al., (2017)	fuzzy Kano's model	Customer Requirements	Manufacturer
Gupta & Srivastava (2012)	Customer satisfaction	Customer satisfaction	Hotel industry
Kuo et al.,(2015)	Kano and QFD	Service Quality	Hotel
Chen et al., (2018)	Kano Model and QFD	Service Quality	Restaurants

2.4. Conclusions of literature and research contributions

Previous studies have demonstrated that the Kano model can be used for categorizing attributes in terms of consumer preferences because of eliminating the Servqual shortcomings in the Linear relationship assumption between an attribute performance and customer satisfaction. On the other hand, clustering allows companies to behave differently in various market segments (Golsefid et al., 2007). Therefore, the present research has used a combined model of the Kano and K-means to study the quality requirements of provided services for hotel customers. In the next step, FAHP was used to prioritize elements of quality requirements. The literature review shows that no studies have used motivational needs prioritization. Therefore, managers can make the right decision to invest in motivational needs based on the results of priorities. Overall, investing in the most important motivational needs can result in customer satisfaction and profitability. In contrast, most previous studies have used the QFD, FAHP, or AHP methods to develop the Kano model. For example, Gupta and Srivastava (2012), Chang and Chen (2011), and Kuo et al. (2015) have used the Kano model combined with the QFD. Alroaia and Ardekani (2012), Wongrukmit and Thawesaengskulthai (2014), and Momani et al. (2014) have used the Kano model combined with AHP, or FAHP. Also, the literature review had not used the combined model of k-means and the Kano to study the satisfaction and needs of customers in the field of hotel service and hospitality. However, the combination of the Kano and clustering methods has been used out of hotel services and hospitality in the studies of Mozafari et al. (2016), Rezaeian et al. (2016), Abdolahi et al. (2017), Huang et al. (2015), and Chang et al. (2009). Therefore, the mentioned points have distinguished the present study from others due to using a combined model of k-means, kano, and FAHP methods in the hospitality industry and hotel services.

3. Research methodology

In this study, to assist top hotel managers in categorizing customers' requirements and improving their planning according to what they want, the K-means and Kano models were used. First, hotel clients were clustered using the K-means method. In the next stage, after interviewing with the managers and experts, 15 qualitative requirements were identified; then, they were used in the framework of the Kano questionnaire. According to the Cochran formula, 168 questionnaires were distributed among customers. After the fulfillment and collection of questionnaires, the Kano analysis was done to extract customers' preferences. In the final step, the FAHP method was used to prioritize customers' requirements in the quality categories derived from the Kano. The steps of the proposed method in this paper are presented in Figure 1.

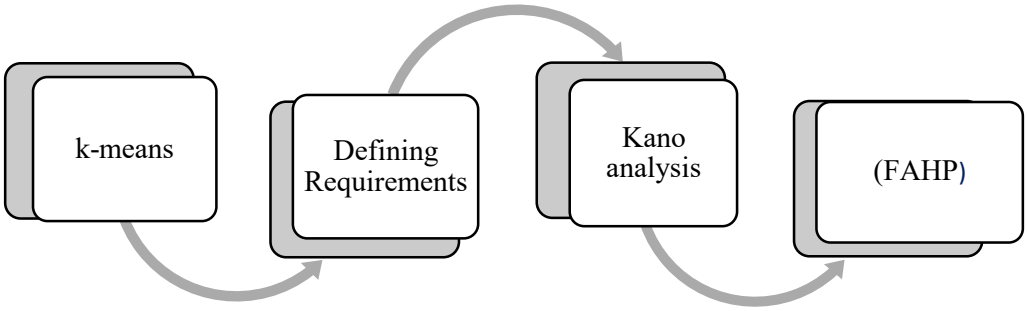

Figure 1. Research steps

3.1. K-means algorithm

Due to the significant volume of data, that must be analyzed, data mining tools have been increasingly used in recent years. It can be stated that two essential tasks of data mining are classification and clustering. One of the most known algorithms being used in clustering is the K-means algorithm applied in this paper. The K-means algorithm is used to cluster customers of hotels to perform a more accurate examination of customer requirements; so that customers' needs are checked in each cluster to improve customer satisfaction and loyalty. The K-means algorithm has been described below.

The K-means is one of the most used clustering algorithms, which partitions data into the K-clusters (MacQueen, 1967). It starts partitioning by randomly selecting k samples from the input data set as initial centroids. Then, clusters are formed repeatedly by measuring the distances of all samples in the input space. Compared with the other clustering algorithms, K-means does not require a huge number of parameters, and by using some heuristic approaches, it becomes computationally efficient (Güngör & Özmen, 2017). The steps of the K-means algorithm are defined as the following (Larose and Larose, 2014):

- Step 1: Ask the decision-maker how many clusters (k) the data set should be divided into.
- Step 2: Assign k records randomly as the initial cluster of central locations.
- Step 3: For each record, find the closest cluster center.
- Step 4: For each k cluster, find the cluster centroid, and update its central location to the centroid's new value.
- Step 5: Repeat steps 3 to 5 until the convergence or termination phase.

3.2. The Kano model

One of the most accepted tools for recognizing and categorizing customers' needs is the Kano model proposed by Dr. Kano (Kano, 1984). Kano is a two-dimensional quality model that applies functional and dysfunctional questionnaires. It also applies a 5×5 evaluation table, as a guidance tool, and is applicable to be utilized in a lot of research and case studies (Lee and Huang, 2009). In this research, the Kano model has been implemented in each k-means cluster for a more accurate survey of customer requirements.

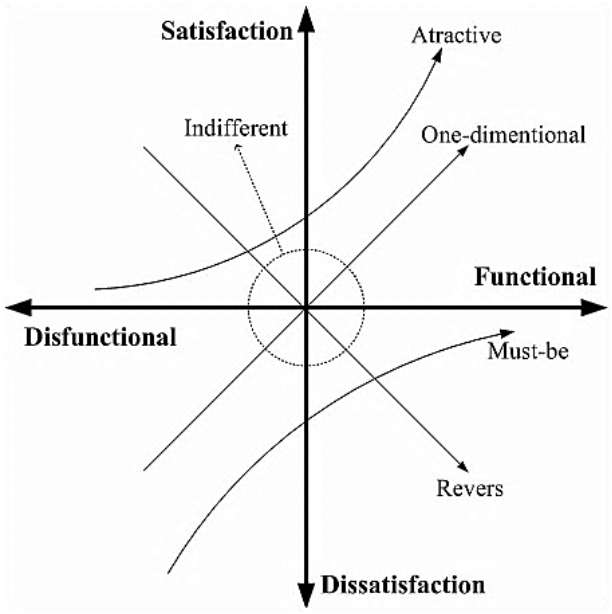

Figure 2. Kano model dimensions

Thus, the Kano model defines the relationship between the implementation and non-implementation of customers' requirements in a product/service. According to its impact on customer satisfaction, it provides five categories of products/services namely, One-dimensional, Attractive, Indifferent, Questionable, and Reverse (Rashid et al., 2010). The Kano model dimensions are represented in Figure 2.

The first dimension of the model, the vertical axis in Figure 2, measures customer satisfaction, and its horizontal axis measures their requirements function. Five categories of the Kano model are defined as follows.

- *Attractive category*: Implementing an attractive requirement in a product/service leads to higher customer satisfaction, but its absence does not lead to customer dissatisfaction.
- *One-dimensional category*: Embedding a one-dimensional requirement in a product/service increases customer satisfaction, and its absence leads to customer dissatisfaction.
- *Must-be category*: The absence of a mandatory requirement leads to customer dissatisfaction, but its presence does not increase customer satisfaction.
- *Indifferent category*: Whether an indifferent requirement is embedded or not in a product/service, neither leads to satisfaction nor dissatisfaction.
- *Reverse category*: Implementing a reverse requirement in a product/service results in customer dissatisfaction. In contrast, its absence leads to customer satisfaction (Rashid et al., 2010).

The Kano questionnaire is provided to realize the feelings of potential customers about the presence or absence of a requirement in a product/service compared with its alternatives. It is possible to achieve this purpose by asking two functional and dysfunctional questions for each requirement. After collecting the questionnaires, an overall attitude toward categorizing customers' requirements is concluded through Table 2 (Lee and Huang, 2009).

Table 2. Kano evaluation

Dysfunctional						
Dislike	**Live-with**	**Neutral**	**Must-be**	**Like**		
O	A	A	A	Q	Like	
M	I	I	I	R	Must-be	
M	I	I	I	R	Neutral	Functional
M	I	I	I	R	Live-with	
R	R	R	R	R	Dislike	

A=Attractive, I=Indifferent, M=Must-be, O=One-dimensional, Q=Questionable, and R=Reverse

According to the mentioned points, 168 questionnaires were distributed among customers in a four-star hotel in Mashhad. The questionnaire includes 15 questions about customers' requirements, which are presented in Table 6. As a result, the Kano model classifies the customers' requirements into five categories. The implementation of the Kano model in each cluster shows how the presence or absence of a requirement in a product/service affects customer satisfaction in a cluster.

3.3. Fuzzy analytical hierarchy process (FAHP)

In the conventional method of AHP, decision-makers are asked to compare two criteria with the Crisp numerical values to indicate their preferences. Moreover, it is supposed that decision-

makers are confident about their preferences, which is not always true. To reduce the effects of uncertainty and vagueness in decision-making, the FAHP approach is used in which the Fuzzy set theory and its operations are integrated with the conventional AHP. The FAHP is designed so that decision-makers can express their uncertain judgments and preferences through linguistic values rather than the Crisp ones used in the conventional AHP. These linguistic values are transformed into fuzzy membership functions representing fuzziness and uncertainty. The steps of the fuzzy AHP technique using Chang's method are presented as follows:

Step 1-Prioritizing criteria, sub-criteria, and options

In this paper, the FAHP is implemented to categorize the variables into three groups Must-be, One-Dimensional, and Attractive. It should be noted that the variables of each group are already identified by the Kano method.

Step 2- Formation of paired comparison tables and responses.

Paired comparisons are made based on the spectrum presented in Table 3. Table 3 represents the linguistic values and their triangular fuzzy numbers (TFNs) (Vahidnia et al., 2009) used in the FAHP; these numbers can be changed and evaluated to fit the decision maker's fuzziness.

Table 3. Triangular fuzzy number of linguistic variables

Linguistic value	**TFNs**
Equally important	(1,1,2)
Moderately important	(2,3,4)
Important	(4,5,6)
Very Important	(6,7,8)
Absolutely important	(8,9,9)

Step 3- Calculating the incompatibility rate of paired comparisons.

In this step, the incompatibility rate of paired comparisons should be assessed. If this rate is less than 0.1, it means that the paired comparison has proper stability and consistency.

Step 4 - Merging paired comparisons.

When several respondents have answered paired comparisons, the Geometric mean method is used to merge them and obtain a merged pairwise comparison matrix.

Step 5- Calculating weights with Chang's analysis method.

First, based on Equation (1), S_i values can be obtained for each row of the fuzzy pairwise comparison matrix, Where i represents the row numbers, and j denotes the column numbers.

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} \quad (1)$$

M_{gi}^{j} is a triangular fuzzy number for the pairwise comparison matrices. The values of $\sum_{j=1}^{m} M_{gi}^{j}, \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]$ and $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1}$ can be calculated using Equations (2), (3), and (4) respectively.

$$\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j\right) \quad (2)$$

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i\right) \quad (3)$$

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right) \quad (4)$$

In the above equations, l_i, m_i and u_i are the first, second, and third components of fuzzy numbers, respectively.

STEP 6: Computing the magnitude of S_i comparison with each other.

In general, if $M_1 = (l_1, m_1, u_1)$ and $M_2 = (l_2, m_2, u_2)$ be two triangular fuzzy numbers, the magnitude of M_1 compared with M_2 can be defined as follows in Equation (5).

$$V(M_2 \geq M_1) = hgt\,(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1 = if\ \ m_2 \geq m_1 \\ 0\ if\ l_1 \geq u_2 \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}\ otherwise \end{cases} \quad (5)$$

On the other hand, the magnitude of a triangular fuzzy number from k, as another triangular fuzzy number, can be obtained through Equation (6).

$$V(M \geq M_1, M_2, \ldots, M_k) = V[(M \geq M_1)\ and\ (M \geq M_2)\ and \ldots (M \geq M_k)] = \min V(M \geq M_1) \quad i = 1,2,3,\ldots,k \quad (6)$$

STEP 7: Computing weights of the criteria and alternatives in the pair-wise comparison matrix (Equation (7)).

$$\acute{d}(A_i) = \min V(S_i \geq S_K) \quad k = 1,2,\ldots,n \quad , k \neq i \quad (7)$$

STEP 8: Calculating the final weight vector.

The weight vector calculated in the previous step must be normalized to calculate the final one.

4. Results

According to the former methods and steps, the proposed method is implemented in a four-star hotel in Mashhad, a city with numerous hotels, which makes the competition more challenging. In the following, the results of the proposed combined methods, i.e., K-means clustering and the Kano model, are described, respectively.

4.1. K-means clustering

According to the mentioned points, the Kano analysis could be improved by the clustering technique. Therefore, after data processing, the K-means clustering was used according to the demographic variables. The questionnaire includes seven demographic variables, namely gender, nationality, age, education, hotel experience, the goal of the trip, and reservation way, presented in Table 4.

Table 4. Demographic features of the questioner

Gender	Nationality	Age	Reservation way	Experience in hotel	The trip goal	Educated or not
Male	Iranian	Young	Organization	Yes	Pilgrimage	Educated
Female	Arab	Not young	Telephone or coming	No	Else	Not educated
			Agency			
			internet			

The dataset analysis is done through a data mining tool called RapidMiner. This tool can easily handle numerical and categorical data together. The tool contains a different number of algorithms for performing clustering operations. In this article, the K-means operator in RapidMiner is used to generate a cluster model.

To process it through the K-means algorithm, attributes are converted into numerical values for the accuracy of results. Through RapidMiner, can be easily achieved using a nominal-to-numerical conversion operator (Anuranjana et al., 2019).

One of the clustering challenges is the number of clusters. There are various methods to determine the k numbers. In this study, the Silhouette method is used. According to this method, the closer the score is to one, the better k is selected. Therefore, as can be seen in Table 5, by using the Orange software, the Silhouette values from different clusters were calculated, and k=5 was chosen.

Table 5. Silhouette values for selecting clusters

Number of clusters	2	3	4	5	6
Silhouette value	0.29	0.28	0.28	0.32	0.31

In terms of the frequency distribution of the demographic variables in each cluster and experts' collaboration, they are labeled in Figure 3 as follows: Cluster 1: Housemen, Cluster 2: Co-men, Cluster 3: Housewives, Cluster 4: Tourists, and Cluster 5: Co-Women.

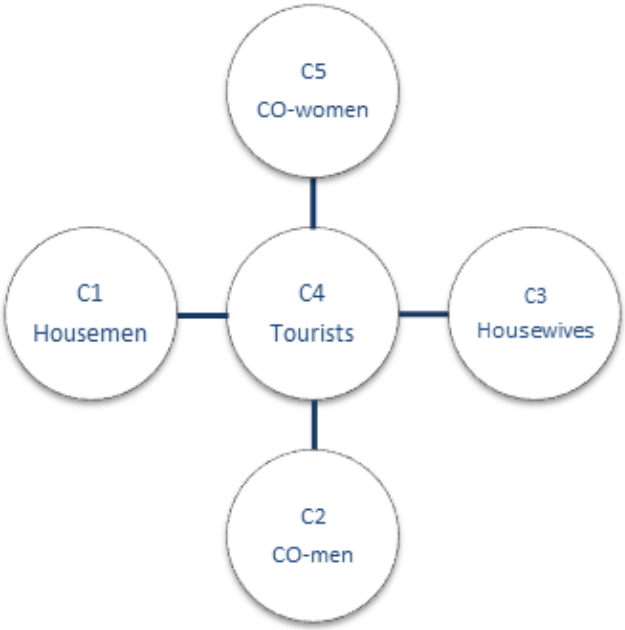

Figure 3. Five labeled clusters of the customers

4.2. The Kano analysis

In this section, the results of the Kano analysis related to customers' requirements are presented to make a more precise comparison between the results of the Kano model and the combined method. Table 6 illustrates the customer preferences. According to the Kano model analysis, the most frequent criterion is chosen as the most preferred one. For example, R7 gets a from the final category. According to Table 6, R8 and R15 are the requirements that should be avoided by the hotel manager. Also, R3, R11, and R13 should be strictly considered not to dissatisfy the customers. Number R5, i.e. providing the rental car, is the only indifferent requirement that customers do not care about; therefore, investing in this requirement might not be beneficial.

Table 6. Requirements analysis based on the Kano model

No.	Quality requirements	A	O	R	M	I	Final category
R1	Providing information about the exact time of services.	9.58	44.91	1.79	36.53	7.19	O
R2	Attractiveness of the equipment, etc.	13.02	52.07	0.59	22.48	11.84	O
R3	Cleanness of the hotel, equipment, etc.	4.14	43.20	0.00	48.52	4.14	M
R4	Sincere efforts of staff for solving guests' problems.	13.69	54.76	1.19	26.19	4.16	O
R5	Providing rental car service.	24.85	15.98	0.00	9.47	49.70	I
R6	Giving guidance book about the city.	38.32	19.76	0.60	14.37	26.94	A
R7	Providing transportation service from/to the airport/station.	34.32	26.63	0.59	16.56	21.90	A
R8	Requesting the tip	1.20	3.59	56.29	2.99	35.93	R
R9	Easy reservation.	15.98	44.97	0.00	26.03	13.02	O
R10	Quality and variety of foods and beverages.	7.69	47.93	1.18	34.91	8.29	O
R11	safe and secure accomodation in the hotel.	2.99	44.32	0.59	47.91	4.19	M
R12	Providing the Internet connection for guests.	35.12	22.03	0.00	19.05	23.81	A
R13	Providing various options of choosing rooms.	21.43	22.61	0.00	38.69	17.26	M
R14	Serving guests on the initial arrival date (welcome drinking).	28.15	33.53	1.79	23.35	13.18	O
R15	Waiting for a long time, when delivering the rooms.	3.57	11.91	70.83	7.15	6.54	R

4.2.1. The Kano analysis in clusters

The Kano analysis has been done again for each cluster. The results are shown in Table 7. Some requirements are discussed according to their clusters to gain a better insight. As shown in Table 4, the categories of R2, R4, R5, R8, and R15 are the same as the primary ones. Particularly R8 and R15, i.e., "requesting the tip" and "waiting for a long time when delivering the rooms," respectively, belong to the reverse category. It demonstrates that these two requirements annoy most people and should be considered entirely. Also, tourists are even indifferent to R5, i.e., "providing rental car service," but other requirements are not the same.

However, in other requirements, different preferences among the clusters are apparent. For example, If we look at R12, i.e., "providing the Internet connection for the guests," in Cluster 3, which is labeled as Housewives, there is an indifferent requirement. In contrast, it is considered a must-be requirement for tourists and an attractive one for other clusters, which seems reasonable. Therefore, some customers are stimulated by providing the Internet, and some others become dissatisfied when it is not provided.

Table 7. Category of requirements of the Kano model for each cluster

No.	C1	C2	C3	C4	C5	Primary category
R1	O	M	O	O	M	O
R2	O	O	O	O	O	O
R3	O	M	M	M	M	M
R4	O	O	O	O	O	O
R5	I	I	I	I	I	I
R6	A	A	I	A	A	A
R7	O	O	I	I	A	A
R8	R	R	R	R	R	R
R9	O	O	O	M	O	O
R10	O	O	O	M	M	O
R11	M	M	O	O	M	M
R12	A	A	I	M	A	A
R13	M	M	I	M	M	M
R14	O	O	O	M	M	O
R15	R	R	R	R	R	R

It is noticeable that all attractive requirements i.e., R6, R7, and R8 are indifferent to Cluster 3. This shows that these requirements are not crucial for the cluster, and the manager should seek other motivations for this group. R10, i.e., "quality and variety of foods and beverages," can be interesting for Cluster 4. It means tourists, who are mostly Arabic, think the food quality is a must-be requirement. This is the same for Cluster 5, either.

One of the exciting discoveries, found in the above table, is the number of M categories in each cluster. Cluster 4 (tourists) and Cluster 5 (co-women) have the most M categories, i.e., six out of fifteen Rs are M, but Clusters 2,3, and 1 have four, two, and one M, respectively. These points emphasize that Clusters 4 and 5 should be considered and behaved cautiously.

4.3. Prioritizing quality requirements in each category using the FAHP

The requirements of "must be" and "one-dimensional" categories must be met. If the hotel does not satisfy these requirements, it will lead to severe customer dissatisfaction. However, if the manager does not satisfy the requirements of the Attractive category, it will not lead to customer dissatisfaction. Therefore, in this phase, the FAHP is used to prioritize the quality requirements based on customers' preferences and their importance in the "Attractive category." Prioritizing and ranking the requirements in this category help the management group to improve their knowledge of investment preferences. Also, based on this prioritization, they can make critical financial decisions and future investments. According to the scores obtained from the Kano model, the Attractive category requirements include "Giving guidance book about the city (R6)," "Providing transportation services from/to the airport/station (R6)" and "Providing the Internet connection for the guests (R12)".

4.3.1. Ranking of the attractive category

By collecting experts' opinions, including hotel directors and assistants, pairwise comparisons have been made. Pairwise comparisons of triangular fuzzy number matrixes for the Attractive category are presented in Table 8. It should be noted that the inconsistency rate is less than 0.1.

Table 8. Pairwise comparison of triangle fuzzy number matrix for requirements

Attractive	R6	R7	R12
R6	(1,1,1)	(2,3,4)	(2,3,4)
R7	(0.25,0.333,0.5)	(1,1,1)	(0.5,1,1)
R12	(0.25,0.333,0.5)	(1,1,2)	(1,1,1)

Using Chang's method, S_i values are calculated for each row of the pairwise comparison matrix according to Equation 1. In the fifth column, the degree of preference is calculated based on Equations 5 to 7. In the last step, using the weight normalization of vectors obtained from the degree of preference, the final weight is calculated and entered into the last column of Table 9.

Table 9. Ranks of requirements within Attractive category by using FAHP

Kano classes	No	Quality Requirement	S_i	Crips Value	Normalized Crips Value	Rank
Attractive	**R6**	Giving guidance book about the city	(0.043,0.058,0.106)	0.057	0.280	3
	R7	Providing transportation service from/to the airport/station.	(0.036,0.075,0.122)	0.068	0.334	2
	R12	Providing theInternet connection for the guests	(0.048,0.082,0.161)	0.078	0.384	1

The fulfillment of the Attractive category requirement leads to higher customer satisfaction. In contrast, its absence does not lead to customer dissatisfaction. This category includes three requirements, as mentioned above. With the increasing growth of virtual communications, the spread of virtual networks, and the Internet, the results of the requirements ranking through the FAHP method show that providing an in-room WiFi connection for guests (R12) is the most critical customer requirement with the highest value. Then, "Providing transportation service from/to the airport/station (R7) " and "giving guidance book about the city (R6) " are ranked in descending order of importance.

5. Conclusion

With increasing competition and rapidly changing customer requirements, organizations try to categorize, predict and prioritize customer preferences. Service quality in the hospitability industry is essential for managers. As a consequence, they try to get customers' voices and categorize them. It helps them to better understand what customers want and make decisions

about financial and future investments based on the considered priority. In recent years, the Kano model has been used in several papers analyzing customers' requirements. These studies include He et al. (2015), Mattmann et al. (2016) but, most of them have often used qualitative analysis methods. In this article, by combining the Kano model and K-means, then FAHP, it is tried to improve the Kano model by analyzing the data and helping the top managers to better understand customers' requirements in a four-star hotel in Mashhad City. This combined method is used for the first time in the hotel industry. As mentioned earlier, customer satisfaction is considered one of the key goals of any organization. Satisfied customers are one of the success keys in any organization. In order to achieve organizational goals, customer satisfaction levels should be constantly improved. Therefore, the proposed method of the present research can be used in service industries, such as banks and insurance organizations to measure customers' needs and obtain their satisfaction.

The results of this study show that the combination of the two mentioned methods creates the organizational ability to differentiate between customers. It allows the hotel managers to choose their target customers through understanding the requirements and type of them in each cluster; and, take the necessary steps to satisfy their target market needs. The findings of the research show that there are differences in the types of customers' requirements and their demands for each cluster using the Kano model. The attributes of "Attractiveness of the equipment, etc" (R2) and "sincere efforts of staffing for solving guest problems" (R4) for each of the five clusters are considered one-dimensional qualities. This means that the absence of the proper presentation of these requirements leads to customer dissatisfaction. In contrast, the full and proper presentation of these requirements leads to customer satisfaction.

Also, features of "requesting the Trip guidance" (R8) and "waiting for a long time when delivering the rooms" (R15) are Reverse qualities for all five clusters. In other words, if these features are presented, customers are dissatisfied, and customers are pleased if these features are not presented. Also,"providing rental car service" (R5) for all clusters is considered the indifference quality, meaning that customers do not care whether this feature exists or not. Therefore, the manager should ignore them. Staying safe and secure in the hotel (R11) is classified into the must-be categories in the first, second, and last clusters of hotel clients. Providing the Internet connection for the guests (R12) is classified into the attractive category in the first, second, and last clusters. This is not a perceived requirement by customers. As a result, the failure to satisfy this group of qualitative requirements does not result in customer dissatisfaction. However, offering them a product or service creates a great deal of customer

excitement and satisfaction. The FAHP results also show that this requirement positioned in the attractive category has the highest priority. Therefore, if the hotel managers want to attract customers from the first, second, and fifth clusters, and to be more successful than competitors, they should have special attention to this variable.

As shown, by using clustering methods, decision-makers can better predict the requirements of each group or cluster. Thus, customers will be more satisfied because of delivering more customized services to each group. After classifying the requirements of each category, it is essential to focus on this issue due to the limited availability of resources, and prioritizing requirements in the Attractive category through the FAHP helps the management group to achieve more optimal outcomes.

In fact, by customer segmentation, hotel managers can identify the quality of customer needs using the Kano model and prioritize them in the attractive category to improve service quality.

This paper has some limitations. Firstly, we applied the proposed method only in one hotel with a sample of 168 customers. Therefore, It is recommended that future research be conducted with a larger sample size to be more generalizable. Secondly, Considering more experts other than hotel top managers can improve decision-making. Also, for future studies, integrating other data mining methods, such as Association rules, can discover more information. Comparing other clustering and classification tools would be appropriate, either. Moreover, multiple attribute decision-making methods can be used combined with the clustering method to select the most appropriate one for clustering. The results of the Kano and K-means compilation methods were analyzed to understand customer demands with the obtained priorities from the FAHP in this study. As a result, future studies can prioritize requirements in each cluster for a more accurate understanding of customer demands.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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