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Research Paper

The Service Quality of Intra-city Transportation an Online Taxi Company Based in the 22 Districts of Tehran

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Abstract

Organizations that provide intercity online taxi services are interested in clustering the community based on the car request rate to increase their service quality and examine all factors affecting this quality. Managers of online taxi systems are concerned about intercity service quality. Hence, they permanently update their knowledge of online taxi requests and their service quality. Managers became aware of service quality rates in different city districts based on their experiences, especially in Tehran, so that they decided to examine this issue. Accordingly, the purpose of this study is to examine the intercity transportation service quality of an online taxi company in 22 districts of Tehran, Iran. Using semi-structured and unstructured interviews with senior managers, the main variables were identified. The community clustering was also done using the K-means method and IBM1 Software. Results showed that the classification of senior managers of this company regarding their service qualities, as well as the experiences and platforms of similar foreign companies, could not be used as an appropriate reference to examine intercity service quality in different districts. Therefore, driver rating, driver performance, and accepted request volume were the most important issues in district clustering followed by passenger rating. However, the variables mentioned were previously ignored.

Keywords: Service Quality, Transportation, Online Taxi, 22 districts of Tehran, K-means method

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1. Introduction

Services are not limited to the transportation and banking sectors in today's world. Now, the changing structure of the service sector has improved from traditional services to instant services provided for people. Expansion of communicational infrastructures, software development within the information process, research and development, technical services, marketing, business organization, and human resource development have led to simpler and qualified services. Improved services play a vital role in employment constituting a big part of it. The advances in innovation and technology, particularly in the field of information and communication, have led to changes in guidance procedures and implementation of business activities, as well as increased efficiency [Rai, 2016]. Quality assessment concerning public transportation services is a new measure, and studies on this field have been conducted over the recent 15 years [Redman, 2013]. Both transportation operators and officials should find the most substantial features of quality that are perceived by current and potential users. However, a set of quality characteristics is not applicable to all developing cities as users have different needs and expectations among different countries and market sectors [Quattro, 1998]. Therefore, it is essential to examine and compare the quality of intra-city transportation services. Segmentation is among the fundamental components of marketing whose accurate targeting and positioning lead to increased customer value [Wedel & Kamakura, 2002]. Effective segmentation of this market is required due to increasing competition between companies [Fournier & Mayzlin, 2009]. Organizations that provide intra-city online taxi services are interested in clustering the community based on the car request rate to increase their service quality and examine all factors affecting this quality. In this research, one of the online taxi companies was selected to examine whether the activities of the company were based on providing district-oriented service quality. It should be mentioned that managers of online taxi systems are concerned about intra-city service quality; hence, they always update their knowledge of online taxi requests and their service quality. The other considerable point of such software is the rating system in which two sides of the trip (passenger and driver) rate the ride at the end of the trip. This excellent and appropriate reference gives information about service quality. However, such a rating system does not satisfy all needs of senior managers of these companies, as it does not include all factors affecting service quality such as value-added.

Managers became aware of service quality rates in different city districts based on their experiences especially in Tehran so that they decided to examine this issue. First, it was required to investigate the urban districts, particularly in Tehran. Accordingly, the clustering method was used to classify and rank districts based on the predominant organizational variables. It was aimed at obtaining an algorithm of the quality of provided services regarding significant metrics of senior managers. Consequently, managers could identify districts, implement proper strategies for each district, and separate and check the problems of districts with lower service quality. The mentioned procedure is highly effective by saving the time and costs caused by field assessment and marketing. In the past, managers in different areas of Tehran were classified according to social classes.

Therefore, districts 1-5, 6-8, 9-12, 13-16, and 17-22 were assigned to the first to fifth categories, respectively. However, the class index of the community was not an appropriate criterion for service quality because there were different request volumes in various districts of Tehran. In this research, 22 districts of Tehran were clustered based on the important indicators and variables introduced by senior managers within various interviews. The managers of the company, however, had segmented the Society based on the request volume in the past while ignoring different indicators of service quality. Online taxis have been a good alternative to compensate for the lack of public transport. This research helps managers to properly distribute taxis throughout the city, especially in busy times so that they can be easily accessible to all members of the community and minimize intercity transportation problems. Considering the current situation of the community and world, these companies can investigate and troubleshoot the service quality, change their marketing strategies, increase their profitability, and increase users' satisfaction within a short time. Accordingly, this study asks about the service quality of intercity transportation provided by an online taxi company based in the 22 districts of Tehran.

2. Literature Review Background and Previous Studies

2.1. Online Taxi

Nowadays, online transportation services are extensively available providing bikes and cars. Online taxi services, also known as ride-sharing, enable customers to reserve a car using a mobile app [Weng et al., 2017]. An online taxi mobile app provides value-added services based on cellphone technology [Kuo et al., 2009]. Go-Car, GrabCar, UberX, and MyBluebird are the most popular online taxi providers around the world. They have a lion's share of the market and are developed services in severe competition in this industry [Shilvia & Silalahi, 2017].

2.2. Service Quality

Service quality is a critical issue of e-commerce. Service quality, information quality, and system quality are included in the DeLone and McLean Success Model to evaluate successful e-commerce [DeLone & McLean, 2004]. There are two perspectives in defining service quality. The first perspective states that service quality is the comparison between customer expectations and customer perception [Caro & Garcia, 2006]. The second perspective argues that service quality is only measured by what customer perceives. Based on the first perspective, Parasuraman et al. (1998) developed the SERVQUAL scale, which was among the most influencing studies on service quality [Salameh & Hassan, 2015]. Cronin and Taylor (1992) proposed the SERVQUAL scale in their article.

In her research under the title "Measuring the quality of service for passengers on the Hellenic railways," Nathanail (2008) examined the quality of services in railways.

2.3. Service quality of transportation

Many researchers have studied the service quality of the public transportation sector from various perspectives using a variety of methods. There has been increasing use of discrete choice models based on the considered surveys for analysis of public transportation service quality since the beginning of the 21st century [Hensher et al., 2003]. These methods assume that although specific aspects of service quality may affect passenger satisfaction with a service positively or negatively, the total passenger satisfaction level is the best benchmark indicating how a person evaluates the provided service packages. The customer satisfaction survey-based models have been widely used to analyze the service quality of public transportation. Previous studies have revealed

general characteristics and methodological issues that are critical in the development and use of an appropriate method for analysis of public transportation service quality. This part of the study provides a summary of issues concerning methodology defined as cognitive judgment (thinking and judgment) that summarizes the extraordinary good or bad consequence of service, especially in comparison with other alternatives [Oliver, 2010].

2.4. Characteristics of Service Quality

A high number of characteristics have been applied to evaluate service quality. These characteristics are usually grouped as smaller units called items. Although there is no consensus on the nature of its items, service quality is a multi-item [Parasuraman et al., 1985] and hierarchical multi-level structure [Jen & Lu, 2011]. Parasuraman et al. (1988) presented a general list of characteristics and items for analysis of service quality of any kind of services. However, many researchers have criticized this general list. Most researchers agree that features named in a survey should be selected for each item [Carman et al., 1990]. However, many options are repeated regardless of their services or considered themes due to their importance. For instance, items related to transportation services include service frequency, punctuality, calmness, cleanness, safety, information availability, good intent in providing personnel services, and rent rate. Therefore, other aspects should be considered for each service besides the abovementioned options since the accepted aspects for each user highly depends on his/her social characteristics such as geographical area, social class, service type, trip reason, and transportation methods. On the other hand, data collection is simplified by reducing the number of features. Therefore, a survey on transportation service quality is the best measure used to analyze service quality. Alavi Moghadam (2019) conducted a study to assess passengers' perceptions of the quality of services provided by taxi drivers in Mashhad, Iran. The main purpose of this study was to examine the effect of the quality of received services on customer satisfaction. The data were randomly collected from passengers in taxi stations at the cross-sectional level during summer 2019. Results indicated that service quality could affect the passengers' satisfaction with taxi services. However, responsiveness had no significant effect on satisfaction. Hence, drivers are recommended to improve the service quality in the competitive market of the online taxis. The instructors of training courses are also suggested to run professional business training courses. . Nadimi et al. (2017) conducted a study entitled "Comparison and statistical analysis of service quality of ordinary and online taxis" by performing a field survey of passengers of both systems to compare the quality of services provided by them. In a study under the title "Study on users' satisfaction with intercity transportation service quality using Snapp," Noori (2017) identified dimensions of public transportation service quality, including tangible factors, reliability, interactivity, trust, and empathy. Harati and Heydarian (2016) carried out a study entitled "Effect of quality of provided services on passenger satisfaction in road transportation sector," considering the strengths and weaknesses of these services.

De Ona (2021) carried out a study entitled "Understanding the mediating role of satisfaction in public transport" indicating that the quality of services besides their specific features and general effects on the objectives or behavioral loyalty is superior to the effect of satisfaction, which has important consequences for transportation operators. Shilvia et al. (2017) carried out a study to measure the service quality of online transportation and the best service options provided by a company. De Ona (2015) used the clustering technique and decision-tree to analyze quality service in

public transport. In this research, users and different groups of passengers were identified using cluster analysis, which contributed to discovering the difference between main features, including perceived quality. Eboli and Mazzulla (2011) proposed a method to evaluate public transport service quality based on the subjective and objective measures from the passenger's points of view. The present paper is indeed in line with their studies in this field. Friman and Felleson (2009) studied the relationship between objective performance measures of public transportation services and customers' perceived satisfaction. Eboli and Mazzulla (2009) suggested a customer satisfaction index for the measurement of quality in public transportation.

2.5. Rating Driver and Rating Passenger

Passengers can give points to the driver at the end of the trip based on the level of satisfaction with the trip. This scoring method leads to the creation of an intelligent monitoring system. On the other hand, the average driver score has a direct effect on increasing the number of trips of the driver. Passengers give drivers scores from one to five points, and in the case of choosing less than 5, they must specify the reason. Drivers with an average score between four and five are given priority over the others. The drivers also indicate their level of satisfaction with a passenger using the rating options.

If a driver dissatisfied with a particular passenger, the company contacts the passenger and asks him/her questions about his/her recent trips with the Snapp service. If the driver is right, the company provides security and comfort for other drivers by not offering service to that particular customer [fa.wikipedia].

2.6. Value Added

The difference between the price of the finished product/service and the cost of the inputs involved in making it So added value is the increase in value that a business creates by undertaking the production process [Jim Riley,2019].

2.7. Drivers' Performance Index (PI) Based

Performance has a concept beyond data or output and is the sum of job-related behaviors exhibited by service providers [Griffin, 2017]. Armstrong (1994) defined performance as "achieving goals whose quantity and quality have been determined." Oxford English Dictionary defines performance as "performing, applying, doing something regular or committed" [Armstrong, 1994]. Therefore, performance can be considered as behavior, in addition to dealing with results. In this study, driver performance is based on the number of requests accepted, ie the average number of trips accepted by a driver per hour is at least 1.

2.8. Request Volume

Average car demand, per hour in an area.

2.9. Research Innovation

In previous studies, in order to obtain information, questionnaire have been designed and standardized and only their distribution and collection was done online. In this study, all data was extracted completely online from the application of the company on which the study was conducted, i.e., the main data of the study was obtained in the shortest possible time and there was no need to distribute questionnaires in the community because the customers themselves rated the trip quality after each trip they experienced.

An important point in this study was the simultaneous survey of several variables in the classification of society to assess the quality of services. That is, the survey was conducted from both perspectives of customer satisfaction and company's profit. In similar studies, the factors such as satisfaction or service quality were examined from the perspective of either the customers or the companies, and the

reviews were not conducted bilaterally, taking into account the interests of both parties.

3. Methodology

This study was conducted in 22 districts of Tehran that had a considerable influence on saving time and cost for online taxi companies. A mixed methods (qualitative and quantitative) research was performed. In the qualitative part, the main variables were designed based on the online and telephone interviews (due to COVID-19 pandemic conditions) with senior managers of one of the online taxi companies. The semi-structured and unstructured interviews were done regarding the research objective. Unstructured interviews usually take 1.5-2 hours. They are often so long that may cause a reduction in the number of eligible participants who are not willing to miss their precious work or leisure time. Short interviews do not provide efficient time for interaction and deep coverage of the subject. Unstructured interviews that take about an hour can be considered unless participants tend to spend more time [Robson, 2002].

Questions are predetermined in a semi-structured interview, and all respondents are asked similar questions. They are free to answer questions the way they want.. The guidelines of such interviews do not include details, expression method, and order. These options are brought up during the interview process [Delavar, 2005; Babbie, 2004].

Clustering is a branch of data mining and a kind of unsupervised teaching. It is the task of dividing the data into similar groups. In this method, data are clustered based on the maximization of seminaries in groups and minimization of the similarities between groups. Clustering is a common descriptive method used to determine a specified number of clusters for data description [Kaufman & Rousseeuw, 2005].

In this step, the K-means was used as a data clustering method within data mining to cluster Tehran districts. This simple method is a basic approach for many other clustering methods, such as fuzzy clustering.

It is an exclusive and flat method. Different forms have been introduced for this algorithm. However, all of them have a repetitive process tending to estimate the following options for a fixed number of clusters: obtaining some points as the centers of clusters (these points are indeed the mean of points belonging to each cluster.); attributing each data sample to a cluster so that the data has the minimum distance from the center of that cluster. In the simple form of this method, points are randomly selected regarding the number of clusters. Then, the data are assigned to the clusters based on their similarities. Accordingly, new clusters are obtained. The process is repeated, and new centers can be calculated for data by averaging them in each iteration. Afterward, the data can be attributed to new clusters. This procedure is continued until no change occurs in the data. The following function is introduced as the objective function.

According to the K-means method, the similarity between clusters is calculated based on the similarity between means of objects existing in clusters, which indicates the "center of gravity" of the cluster.

In this method, objects that indicate the mean or center of a cluster are selected randomly. Then each object with the shortest distance from the mean is attributed to clusters. In the next step, the new mean value of each cluster is measured, and the process of allocating objects to their fit clusters is continued until the function becomes convergent. Squared error measure is usually used for objective function [Guha & Rastogi, 2001].

The IBM SPSS Modeler (v.18.0) software was used for data analysis and clustering.

The calculation and formulation is as follows:

Given N samples of pattern $\{x_1, x_2, \ldots, x_N\}$, which are waiting for classifying, they are. They need to be classified to K clusters.

1) Choose any one among $\{x_1, x_2, \ldots, x_N\}$ to act as the role of first cluster focal point $z1$, for example,

We choose $z1 = x1$

2) Choose another point which is as much as possible far apart to $z1$ to be the focal point of the second cluster and calculate the distance between each sample and z_1

$$x_i - z_1 \quad , i=1,2,\ldots,N$$

if: $x_j - z_1 = \max\{ x_i - z_1 \quad ,i=1,2,..,N\}$ $j=1,2,\ldots,N$

Then choose x_j to be the focal point of the second cluster, and $z_2=x_j$

3) Calculate the distance between each sample among $\{x_1, x_2, \ldots, x_N\}$ and $\{z_1,z_2\}$ one by one.

$d_{i1}= x_j - z_1 \quad , i=1,2,\ldots,N$

$d_{i2}= x_j - z_2 \quad , i=1,2,\ldots,N$

Choose the minimum of the outcomes:

Min $(di1, di\ 2)$, $i \quad 1,2,\ldots, N$

Gather the minimums of all samples of pattern and $\{z_1, z_2\}$ Choose the maximum among the minimums to be the third cluster focal point z_3 .

If:

$\min(d_{j1}, d_{j\ 2}) =$

$\max\{\min(d_{j1}, d_{j\ 2}) , i \quad 1,2,\ldots, N\}$

$j=1,2,\ldots,N$

Then:

$$Z_3=X_j$$

4) Suppose that we have got r (r <k) cluster focal points{ z_i, i=1,2,…r }, now we need to determine the r+1th cluster focal point, namely if:

$\text{Min}\{d_{1j},d_{2j},\ldots,d_{rj}\}=\max\{\min(d1j,d2j,\ldots,drj), i=1,2,\ldots,N\}$, j=1,2,3,…,N

Then:

$$Z_{r+1}=x_j$$

5) Repeat, till r+1 = K

6) Now we have chosen K initial cluster focal point $z_11,z_21,\ldots,z_k1$ The numbers in parenthesis are serial numbers used in iterative operations to seek cluster points

7) According to the rule of minimizing distance, allocate$\{x_1, x_2, \ldots, x_N\}$ to one of the K clusters,

namely, if: $x - z\,j\,(t)$

$$\min\{ \quad x - z\,j\,(t) \quad , i=1,2,..,K\}$$

j=1,2,…,K

Then:

$$x \in s\,j\,(t)$$

The symbol t in the formula is the serial number of iterative operations, s_j stands for the j th cluster, and the cluster focal point is z_j.

8) Calculate the new vector values of each cluster focal point:

$Z_j\,(t+1)$, j=1,2,…,k

Calculate the mean vectors of samples of each cluster:

$$Z_j\,(t+1)=\frac{1}{Nj}\sum_{x\in sj(t)} x \ ,j=1,..,k$$

The symbol Nj in the formula above stands for the number of samples of the j th cluster j s . Calculate the mean vectors of samples of the K clusters respectively. Making mean vectors be new clusters can minimize cluster criterion function J j .

$$J_{\,j}=\sum_{x\in sj(t)}(x - zj(t+1))^2$$

9) If $Z_j\,(t+1)\neq Z_j\,(t)$, j=1,2,…,k, then turn back to 7. classify samples of pattern one by one again, and repeat iterative operations . if $Z_j\ (t+1)=Z_j\ (t)$ j=1,2,…,k, then the convergence of the algorithm is finished .[Li&Wu,2012].

The main variables in the clustering of districts included request volume, Average driver rating (Based on the score the customer gives to the driver), average passenger rating (Based on the score the driver gives to the customer), driver performance index based on the accepted requests, and value-added rate of the company. All variables were examined in 22 districts of Tehran. District clustering can be used to design

an accurate strategy for marketing and service quality.

This strategy can be reviewed after the conclusion by interviewing experts in service quality-based marketing strategies. The methodology steps diagram is as follows:

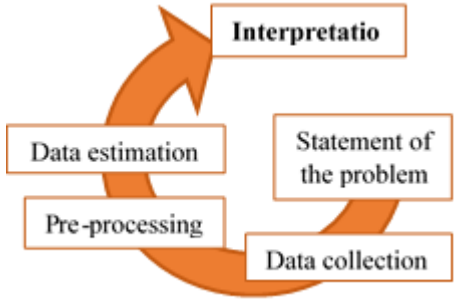

Figure 1. Methodology

Table 1. Components inserted

n	TP	RV	ARD	ARP	PI	VA
1	A	500	4.67	5	10	5
2	B	1000	4.2	4.5	11	4.99
3	C	1600	5	4.55	15	4.99
4	D	2500	4.9	4.38	20	4.99
5	E	2000	4	4.78	15	4
6	F	1600	4	4.56	10	4
7	G	3000	4.1	4	25	3
8	H	3200	4.8	4.94	26	5
9	I	1500	5	4.5	10	4
10	J	1000	3.75	4	5	3
11	K	1000	4	4.32	5	4
12	L	5000	4.22	4.5	14	4
13	M	5500	4.5	4	13	4
14	N	1000	4.56	5	5	4.5
15	O	1500	4.11	5	10	4.5
16	P	3000	3.22	4.7	15	3
17	Q	3000	3.99	4	13	3
18	R	1000	4.8	5	11	5
19	S	1000	4.9	5	13	5
20	T	2000	5	4.8	14	5
21	U	2000	4.7	5	17	5
22	V	1600	4.4	4.8	10	4

4. Case Study

According to examinations and elements considered by senior managers of the company, the following variables were obtained:

- Request Volume (RV)
- Average Rating Driver (ARD)
- Average Rating Passenger (ARP)
- Drivers' Performance Index (PI) based on the accepted requests (regarding organizational indicators)
- Value-added rate of the company (VA)

Example Calculation for Average Rating passenger(ARP) and Value Added(VA)

C1={a,b,c,d,e}=>{1,2,3,4,5}=> {(5,5),(4.5,4.99),(4.5,4.99),(4.38, 4.99),(4.78,4)}

Step1:M1= {(5+ 4.5 + 4.55 +4.38 + 4.78)/5 , (5 + 4.99 + 4.99 + 4.99 + 4)/5}={(4.642 , 4.794)}

Step2:E12 = [(5-4.6)2 +(5-4.7)2]+[(4.5-4.6)2 +(4.99-4.7)2]+[(4.5-4.6)2 +(4.99-4.7)2]+[(4.38-4.6)2 +(4.99-4.7)2]+[(4.78-4.6)2 +(4-4.7)2]= 1.4142

Step3:D(M1,a)=√(2&(5-4.6)2+(5-4.7)2) =0.5

Table 1 includes the initial data given by senior managers of the company regarding their organizational database. It should be noted that VA, ARD, and ARP equaled the range 1-5 considering the raw data of the company.

Another point is that rates of drivers and passengers were recorded in the app of the company at the end of the online trips. In addition, RV, PI and VA indices were extracted on the technical analyses and digital marketing of this company via modern software.

5. Results and Discussions

According to the conducted study, districts of Tehran were named with alphabets (i.e., district 1:a, district 2:b, and so on) as reported in the first column entitled "Tehran Province." The second column reports the average request volume (RV) of each district. The third column includes ARD, and the fourth column shows the ARP index. The fifth column reports drivers' average PI in each district, and finally, the last column indicates the VA rate of the company regarding its service quality.

It should be explained that distribution and number of drivers were considered the same in all districts. Although there are more drivers in

some districts, no bias occurs because of the normal distribution of start and endpoints (Where to live) of these individuals. In this case, there is no considerable difference between them.

Table 3 presents the data extracted from IBM (K-Means) software in which cluster 1 consists of districts A, B, C, I, N, O, R, S, T, U, and V that represent districts 1, 2, 3, 9, 14, 15, 18, 19, 20, 21, and 22 in Tehran, Iran. Therefore, managers must consider these districts together in one category with similar importance rates, which make up the largest cluster.

The second cluster includes districts G and M representing districts 7 and 13; the third cluster consists of districts 11, 10, and 17; the fourth cluster includes districts 5, 6, 12, and16; and the last cluster consists of districts D and H representing districts 4 and 8. Figure 1 depicts the percentages of clustering, largest and smallest clustering besides classification average rate.

Figure 1 shows that the first and fourth clusters are the heaviest ones. Clusters 2 and 5 have equal weight in the table of the figure (Table 2). The largest and the smallest clusters are also displayed. The IBM software outputs are shown in Table 3. Each region of the city of Tehran is represented in a cluster in alphabetical order.

The K - means algorithm presented this classification with respect to the information imported. The first cluster appears to be the heaviest one based on the data.

Table 2. Cluster Sizes

TP	RV	ARD	ARP	PI	VA	k-means
A	500	4.67	5	10	5	cluster-1
B	1000	4.2	4.5	11	4.99	cluster-1
C	1600	5	4.55	15	4.99	cluster-1
D	2500	4.9	4.38	20	4.99	cluster-5
E	2000	4	4.78	15	4	cluster-4
F	1600	4	4.56	10	4	cluster-4
G	3000	4.1	4	25	3	cluster-2
H	3200	4.8	4.94	26	5	cluster-5
I	1500	5	4.5	10	4	cluster-1
J	1000	3.75	4	5	3	cluster-3
K	1000	4	4.32	5	4	cluster-3
L	5000	4.22	4.5	14	4	cluster-4
M	5500	4.5	4	13	4	cluster-2
N	1000	4.56	5	5	4.5	cluster-1
O	1500	4.11	5	10	4.5	cluster-1
P	3000	3.22	4.7	15	3	cluster-4
Q	3000	3.99	4	13	3	cluster-3
R	1000	4.8	5	11	5	cluster-1
S	1000	4.9	5	13	5	cluster-1
T	2000	5	4.8	14	5	cluster-1
U	2000	4.7	5	17	5	cluster-1
V	1600	4.4	4.8	10	4	cluster-1

Before analyzing the data, the classification of managers was only based on experience. These data were entered into the software with very high precision. The numbers were imported with much higher precision. The managers of the company were confident of the accuracy of the presented data. Managers' predictions of data outputs were wrong. They were wrong about the classification of their community. Which data has the greatest effect on this classification? This was the question that managers asked after viewing Table 3. In the following, this question is answered in detail. The main question of managers after observing Table 3 was this:

Table 3. Software output

Size of Smallest Cluster	2 (9.1%)
Size of Largest Cluster	11 (50%)
Ratio of Size Largest Cluster to Largest Cluster	5.50

What variables are more important? How to prioritize variables? Using this algorithm, we will show managers which variable has the greatest impact, which one is more important and which one has a lower priority. The answers to these questions are shown in Figures 3 and 4. The model summary is provided to managers so that they can have a proper analysis of it.

Figure 3 shows the diagram of clustering quality, which is in the range [-1,1]; the range [0, 0.5] is average, and [0.5, 1] is acceptable.

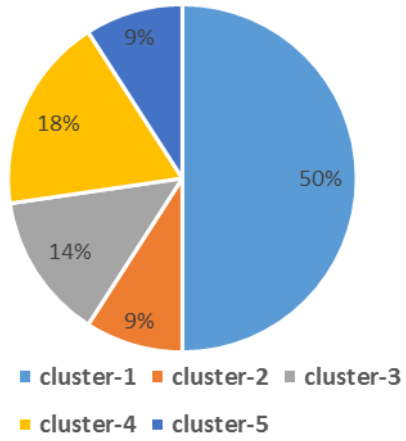

Figure 2. Cluster Sizes

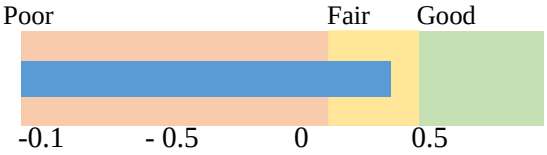

Figure 3. Cluster Quality (silhouette measure of cohesion and separation)

Table 4. Model Summary

Algorithm	K-means
Inputs	5
Cluster	5

Figure 4 illustrates the importance of components after clustering. As can be seen, ARP is at first rank followed by VA, ARD, PI, and RV, respectively.

Accordingly, it is concluded that ARP and VA play a vital role in urban service quality. Hence, these two components can be examined in further studies on the quality of service provided by online taxis using different methods.

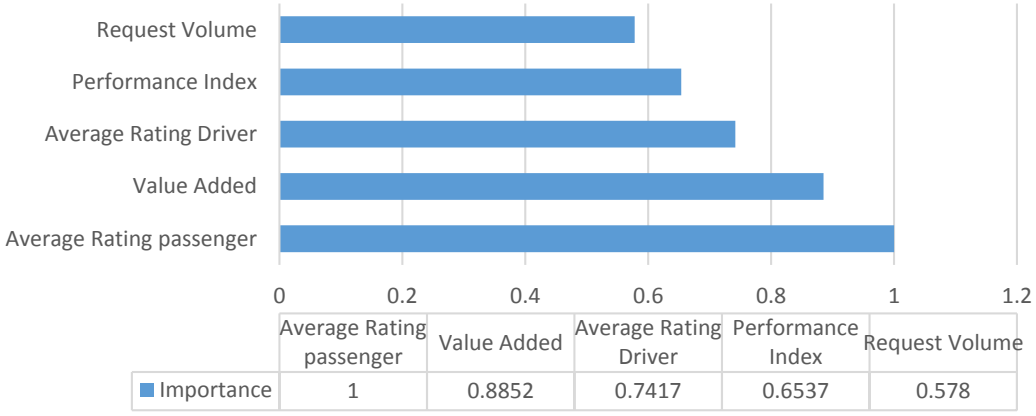

Figure 4. the importance of components after clustering

6. Conclusion

It should be mentioned that managers' experiences did not have any considerable impact on the process of community segmentation regarding service quality. Ultimately, it is a scientific and logical method that helps managers with the case. At the first phase of the study, senior managers of the studied company clustered the service quality based on the social class indicators. This clustering was done as follows: the first category included districts 1-5; the second category consisted of districts 6-8; the third category covered districts 9-12; and districts 13-16 and 17-22 were assigned to the fourth and fifth categories, respectively.

C1= {a, b, c, d, e} => {1, 2, 3, 4, 5} C3= {I, j, k, l} => {9, 10, 11, 12} C5= {q, r, s, t, u, v}

C2={f,g,h}=>{6,7,8}

C4={m,n,o,p}=>{13,14,15,16}

However, the results obtained from the K-means algorithm differed from the previous clustering:

C1={a,b,c,I,n,o,r,s,t,u,v}=>{1,2,3,9,14,15,18,19,20,21,22}

C2= {g, m} => {7, 13}

C3={j,k,q}=>{10,11,17}

C4={e,f,l,p}=>{5,6,12,16}

C5={d,h}=>{4,8}

Results showed that the first cluster included the highest portion (about 50%) of total clustering volume. Moreover, passenger rate was introduced as the most substantial variable; and value-added, driver rate, driver performance, and accepted request volume were ranked at the next positions, respectively. C5 clustering is a sample of the wrong clustering method provided by managers in comparison with the new K-Means-based clustering.

The distances of all districts (from b to v) from M1-M2 were measured, and each district was assigned to a specific cluster. Reaching a new clustering, the process continued until achieving the lowest error rate. Finally, the clustering was obtained for Tehran city.

The new clustering changed the managers' insight into the quality of service provided in

different districts of Tehran. Accordingly, they can design some specific strategies in every district. Managers can also investigate the sources of difference between districts regarding underlying organizational variables of aspects.

Prediction and zoning methods used by managers were based on the wrong beliefs without any scientific reason before this study while now they have a new perspective in this field.

The first cluster (C1) indicated that service quality is highly important in districts 1, 2, 3, 9, 14, 15, 18, 19, 20, 21, and 22. Therefore, there should be an integrated focus on these districts. The next classification includes districts 7 and 13 that can be reviewed in terms of their importance rate. The third and fourth clusters can also be analyzed similarly.

7. References

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