Revised SERVQUAL Analysis Method for the Service Quality

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Abstract: It has been used widely in the measurement of service quality by SERVQUAL since its introduction, but in the past some studies have proposed the shortcomings of its measurement method. This study proposed applying the Mahalanobis distance method to measure the gap values for dimensions. The advantage is that the variance and correlation of elements can be incorporated into the measurement to get more accurate results. Through the case study, the analysis and comparison of the results of Mahalanobis distance method and the traditional method are adopted to verify the feasibility of the new method, and more accurate results can be provided.

1. Introduction

The gap model and SERVQUAL have been applied to the measurement of service quality by various studies since Parasuraman et al. (1985) [1,2], but until 1988, a general measurement method was not designed to be widely applicable to all quality of service measurement thru the determination of expectations and perceptions of consumers in the services provided [3,4]. The measurement method to put forward a lot of controversy, hence the goal of this study proposed a new method applying the Mahalanobis distance method to measure the gap values for dimensions. The advantage of this new method is that the variance and correlation of elements are able to be incorporated into the measurement to get more accurate results. Through the case study of the outpatients in the hospital, the analysis and comparison of the results of Mahalanobis distance method and the traditional method are adopted to verify the feasibility of the new method, and more accurate results can be provided.

2. The Issue of the Method of Measuring for Dimensions by Gap

In the measurement of service quality, two different measurement variables are included in each item: customer's expectation and customer's perception after service of actual feelinge. The measured result is to compare the gap values between the two variables (Q is P minus E, where Q is the quality of service, P is the customer's perception after service; E is the customers' expectation for service).

SERVQUAL contains five dimensions consisting of a total of 22 elements, usually when researchers want to explore the quality of service for each dimension, the method is to average the gap values of all elements, such as: $Gap_{Di} = \frac{\sum_{j=1}^{m} gap_j}{m}$, where m is the element number in a dimension.

Euclidean distance is the conception of "ordinary" distance for the traditional gap measurement method. It is calculated as the distance of any two points P and Q in a certain dimension, such as $\sqrt{(p_x - q_x)^2} = |p_x - q_x|$. For the measurement of the distance between the two dimensions as $\sqrt{(p_x - q_x)^2 + (p_y - q_y)^2}$.

Although this concept of Euclidean distance is widely applied, the variance of element gap is not taken into account in the measurement of service quality. For the gap of two dimensions, if the average gap of the gap value of the interviewee is the same, but the variance is not the same, they

should actually be different. That is, only a unified measurement unit, such as a standardized measurement unit, can obtain more accurate measurement results. Secondly, the traditional gap value measurement means that the gap value is regarded as a single variable problem, so the dimension gap is taken as the average value from the gap value of elements directly. However, it should be treated as a multivariable issue will be more correct, That is, each element belongs to a different variable. Therefore, the multivariable measurement must note that the gap of each element may be a distribution pattern, which may have different variance. In addition, the elements may be not independent among them, so the traditional measurement method of gap may produce a lot of errors and hinder the obtaining of accurate results.

This study suggests using the concept of Mahalanobis distance to measure gap values. The Mahalanobis distance for element i and k in p dimension can be defined as: $MD^2_{ik} = (x_i - x_k)'S^{-1}(x_i - x_k)$, where $(x_i\text{-}x_k)$ is a vector of p ×1, $(x_i\text{-}x_k)'$ is its transpose vector, S is the covariance matrix of p × p, and S^{-1} is its inverse matrix.

In the concept of Mahalanobis distance, if the correlation relationship of the observed values x_i and x_k is 0, that is, there is no linear correlation, then S is the identity matrix with diagonal line 1, where the calculated results of Mahalanobis distance are the same as those of Euclidean distance. In order to compare the meanings and differences between these two distances, figure 1 shows the state of the two variable data forming the Euclidean space and the Mahalanobis space, respectively. It can be seen that the circle center distance of the two points of a, and b in Euclidean space is the same, however, the circle center distance of the two points in the Mahalanobis space may be different.

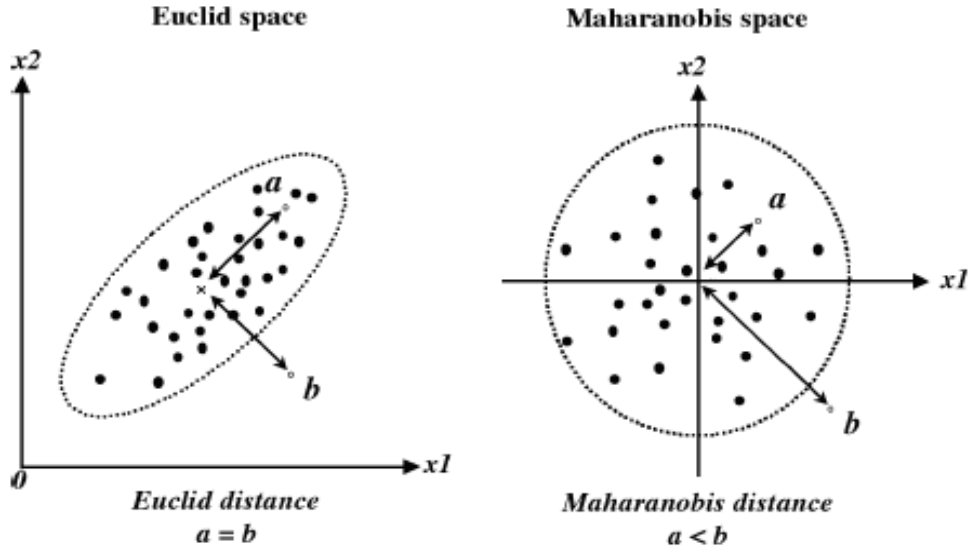

Figure 1. Euclid and Mahalanobis space

3. The advantages of the Mahalanobis distance method for the measurement of the gaps in each dimension of the SERVQUAL are as follows:

(1) The Mahalanobis distance is suitable for multivariable measurement;
(2) The correlation between elements is considered;
(3) The Mahalanobis distance has the standardizing function of elemental gap

3. Methodology

This Mahalanobis distance method treats every dimension as Mahalanobis space and treats every element as a multivariable issue. Accordingly, the measuring method for its dimension gap is as follows:

$$\text{Gap}_{Di} = \pm\sqrt{\left|(g_1, g_2, \ldots . g_m)^T S^{-1}(g_1, g_2, \ldots . g_m)\right|} \quad (1)$$

Where: Gap_{Di} is the gap of the i-th dimension from Mahalanobis distance;
g_m is the gap value of the m-th element;
$(g_1, g_2,\ldots,g_m)$ is the vector consisting of gap value of various elements;
T is the transpose vector of g_m vector;
S is the covariance matrix of element, and S^{-1} is its inverse matrix;

4. Case Study

4.1. Design of research

The case of this study selected a regional hospital in Hsinchu, Taiwan. The questionnaire was based on 22 elements of the traditional SERVQUAL5 dimension, but these elements were adjusted according to the characteristics of the hospital outpatient service. After reviewing and revising the contents and wording of these questionnaires with scholars and the relevant quality management departments of the hospital, the questionnaires were tested on a small scale to ensure that their contents were easily understood and understood by the subjects. After its feasibility and reliability were confirmed, a formal questionnaire was issued. The questionnaire was analyzed by Mahalanobis distance measurement method in the form of likert7 point scale to confirm the feasibility and reliability of the method.

4.2. Sample description

These data were collected by random sampling of patients or their families during office hours in the outpatient clinic of the hospital. At the same time focus on every responder's gender and age as far as possible to scale and fill out the questionnaire, to avoid too much on certain gender or age group. A total of 288 people were collected in the hospital, of which 16 were invalid questionnaires, with a valid questionnaire rate of 94.4%. The statistical software spss20.0 was used as an analytical tool for our data.

Of the 272 valid questionnaires, 57.72% or 157 were male and 42.28% or 115 female; 208 or 76.47% were married and 64 or 23.53% were single. Based on the highest educational background, 156 or 57.35% of the population in primary and secondary schools or below; 33 or 12.13% in senior secondary schools; 67 or 24.63% in junior college and 16 or 5.89% in master's degree and above. Under 20 years of age 18 or 6.2%; between 20 and 40 years of age 63 or 23.16%; between 41 and 60 years of age 88 or 32.35%; and over 61 years of age 103 or 37.87%.

4.3. Reliability test

In this study, cronbach's α coefficient was used as a reliability test. The measurement results obtained the overall cronbach's α coefficient value is 0.8236, and the cronbach's α coefficient value of five dimensions ranged from 0.6783 to 0.7867. The reliability of the visible data is sufficient.

4.4. The result by traditional method

The average value of each element was calculated by the traditional method of the recovered valid questionnaire, and the gap value of each element with the dimension was further obtained. As shown in table 1, the Tangibles was -0.166; the Reliability was -0.169; the Responsiveness was -0.166; the Assurance was -0.156 and the Empathy was -0.151.

Table 1. The result of traditional method

Dimensions	Mean of Perception	Mean of Expectation	Value of Gap
	0.618	0.779	-0.161
	0.607	0.795	-0.188
	0.611	0.783	-0.172
	0.635	0.779	-0.144
Tangibles			**-0.166**
	0.621	0.785	-0.164
	0.617	0.802	-0.185
	0.631	0.786	-0.155
	0.621	0.791	-0.170
	0.625	0.796	-0.171
Reliability			**-0.169**
	0.632	0.808	-0.176
	0.651	0.797	-0.146
	0.643	0.799	-0.156
	0.623	0.807	-0.184
Responsiveness			**-0.166**
	0.637	0.778	-0.141
	0.627	0.805	-0.178
	0.640	0.768	-0.128
	0.641	0.818	-0.177
Assurance			**-0.156**
	0.616	0.791	-0.175
	0.625	0.766	-0.141
	0.636	0.783	-0.147
	0.623	0.762	-0.139
	0.646	0.799	-0.153
Empathy			**-0.151**

4.5. The result by Mahalanobis distance analysis

The Mahalanobis distance method treats every dimension as Mahalanobis space and treats the gap of dimensions as a multivariable issue. According to the requirements of formula (1), the covariance matrix of each dimension is first calculated as following Fig.2:

$$S_1=\begin{vmatrix} 2.62 & 2.13 & -0.27 & 0.65 \\ 2.13 & 2.68 & 2.87 & 2.49 \\ -0.27 & 2.87 & 2.91 & 1.30 \\ 0.65 & 2.49 & 1.30 & 3.13 \end{vmatrix} \quad S_2=\begin{vmatrix} 3.11 & 3.78 & 1.38 & 2.95 & 1.97 \\ 3.78 & 2.97 & 2.51 & 2.52 & 2.32 \\ 1.38 & 2.51 & 3.02 & 1.62 & 1.43 \\ 2.95 & 2.52 & 1.62 & 3.25 & 6.14 \\ 1.97 & 2.32 & 1.43 & 6.14 & 3.56 \end{vmatrix} \quad S_3=\begin{vmatrix} 2.79 & 2.14 & 3.33 & 1.51 \\ 2.14 & 3.61 & 7.45 & 5.15 \\ 3.33 & 7.45 & 3.76 & 5.57 \\ 1.51 & 5.15 & 5.57 & 3.18 \end{vmatrix}$$

$$S_4=\begin{vmatrix} 2.96 & 1.83 & 0.99 & 1.65 \\ 1.83 & 3.30 & 3.91 & 3.67 \\ 0.99 & 3.91 & 3.34 & 5.03 \\ 1.65 & 3.67 & 5.03 & 5.60 \end{vmatrix} \quad S_5=\begin{vmatrix} 3.51 & 5.07 & 3.47 & 2.48 & 3.96 \\ 5.07 & 3.27 & 2.38 & 1.78 & 3.28 \\ 3.47 & 2.38 & 3.04 & 2.74 & 3.99 \\ 2.48 & 1.78 & 2.74 & 3.26 & 4.81 \\ 3.96 & 3.28 & 3.99 & 4.81 & 3.64 \end{vmatrix}$$

Figure 2. The covariance matrix of each dimension

Each dimension of the five dimensions of D1 to D5 (tangibles, reliability, responsiveness, assurance and empathy, respectively) can then be calculated by formula (1) as below: Gap_{D1}=0.013; Gap_{D2}=0.010; Gap_{D3}=0.007; Gap_{D4}=0.009; Gap_{D5}=0.007.

5. Discussion and Conclusion

The traditional gap measure shows that the order in which each dimension needs to be improved is: Reliability, Tangibles and Responsiveness, Assurance, and Empathy at its best. However, the results of Mahalanobis distance analysis show that the order in which each dimension needs to be improved is: Tangible, Reliability, Assurance, Responsiveness, and Empathic performance is best. By comparing the results with the two methods, it is found that the results are not different except that Empathy is the best result between two methods. There are some differences in Responsiveness but not too big. The top two are basically the same but in different order. The Reliability of the traditional gap measurement method is the first, but only the second in the Mahalanobis distance analysis method, whereas under the Mahalanobis distance analysis, the Tangibles is the first, but the second in the traditional gap measurement method. The reasons for the difference in results may be:
1. There may be correlations between elements under each dimension, not independence.
2. The variance of the gap of each element is different and there may be significant differences.

When using WERVQUAL to measure service quality, the traditional gap measurement method treats the gap of elements of dimensions as an independent relationship, does not take into account the possible correlation, and does not take into account the variance of the element gap may be different either, hence the average value is directly used as the basis for its calculation. Therefore, the concept of replacing the Euclidean distance with the Mahalanobis distance, measured by the Mahalanobis distance, proposed in this study, has the managerial significance of improving these oversimplified assumptions. The advantages include variance differences and possible correlation of elements in the overall measurement, which can yield more accurate results and provide a more correct direction for decision making.

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