Techniques

A performance index approach to managing service quality

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Keywords

Customer service, Performance, Service quality

Abstract

Measuring service performance in an appropriate way has received widespread attention due to the vital role customer service plays in gaining competitive advantages. Since performance of customer service directly correlates with customer satisfaction, measuring service performance that attempts to assess validity is a major concern for many firms. The new proposed index in this paper, the service performance index, involves observing the number of customer complaints that the firm receives. Since sample data must be collected to calculate these indices, the results may in some degree be exposed to sampling errors and even lead to incorrect conclusions. Taking sampling errors into account, the uniformly minimum variance unbiased (UMVU) estimator is used to develop a procedure in order to generate an index value that is more reliable.

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1. Introduction

Customer service involves implementing a set of activities and represents the output of a service system. The meaning of customer service varies from one firm to another. LaLonde and Zinszer (1976) pointed out that customer service could be viewed in several ways: as an activity; as an indication of performance levels; and as a philosophy of management. LaLonde *et al.* (1988) defined customer service as: "... a process for providing significant value-added benefits to the supply chain in a cost-effective way". Customer service has received widespread attention over the past years due to the demands of the global market. Managers in a wide variety of industries are placing increased emphasis on customer satisfaction to enhance customer loyalty. Price and quality are no longer enough to attract customers or maintain customer loyalty, instead, the key determining factor has been service. Customers tend to reward those companies who can provide or exceed their service expectations. Consequently, the level and quality of service a firm provides has a tremendous impact on its long-term market share and profitability.

Since resources available in a firm are limited, full engagement of some activities will inevitably be at the cost of others. Therefore, the managers will need to understand issues such as what activities customers value, how satisfied customers are, and how customers respond to the different levels of service. Ideally, an explicit relationship, either a mathematical formulation or a descriptive model, between the level of service provided and the profits generated is in the best interest of managers. In other words, planning and controlling a service system can be managed in a better shape if managers know precisely how profits (or costs) will change with the variation of service level. However, since it is unlikely to develop such a relationship in theory, thanks to an enormous number of factors involved in practice, one common way is to establish a desired level of customer service first. Once that level is established, the next step is to try to attain that level at the lowest cost to the firm.

To determine an appropriate level of customer service, a procedure has to be developed for measuring performance. The purpose of carrying out such a procedure is to

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ensure that the performance level does not deviate from the desired level. Instead of conducting statistical analysis as commonly done in the literature, the service performance index proposed in this paper uses an explicit expression that measures the number of complaints which occurred and the desired target set by the firm. By so doing, a hypothesis-testing procedure can be used to check whether the index meets the target. The main objective of using this proposed index aims to establish a theoretical basis for measuring service performance and helping managerial action.

2. Service performance index

Substantial research has been dedicated to the analysis of service performance in applications such as quality management and logistics management. Major issues associated with the analysis of service performance include:

- how the performance is defined;
- what methodologies are developed to measure the performance; and
- how the service elements are selected.

When defining performance, the research methodology employed greatly differs (see, for example, Bowersox and Closs, 1996; Chow *et al.,* 1994; Lalonde and Zinszer, 1976; Marr, 1994; Mentzer and Knoard, 1991). Methodologies and findings of the major studies relating to service performance conducted in the past are summarized in Tucker (1994). A number of emerging approaches to measuring customer service are worth mentioning, they include Data Envelopment Analysis (Charnes *et al.*, 1981; Clarke and Gourdin, 1991; Kleinsorge *et al.,* 1991) and the Taguchi method (Holcomb, 1994; Taguchi and Wu, 1980). Finally, to analyze service performance, it is important to select the proper set of elements so that customer responses can be closely monitored. To do so, one can consider the "representativeness" (Chow *et al.,* 1994) which means that the set of elements chosen will capture the dimensions of the performance.

Following the idea of representative service elements, it is assumed that there are total k service elements identified in a firm. For each service element i, $i = 1, 2, \ldots, k$, we measure its performance in terms of examining the degree of customer satisfaction which can be done by counting the number of customers who complain. Service performance alone has been put forward by many researchers as the best indicator of satisfaction (Liljander and Strandvik, 1997). Naturally, a number of factors contribute to customer satisfaction with the level of service received. Much of the literature on satisfaction focuses on the expectancy-disconfirmation paradigm as a means of identifying the process by which customers evaluate satisfaction. Recent models have been extended to include effective dimensions and emotions (Oliver, 1993). As to measure the degree of the customer satisfaction, there are two broad types of scales used in the literature, which are the single- and the multi-item scales. Many researchers have used simple single-item scales (generally having two to nine points) to reflect "very satisfied" or "very dissatisfied" responses. Recognizing the shortcomings of using single-item scales, recent studies have mainly used multi-item scales. Here, customers are not just asked to give an overall evaluation of their satisfaction with the service but are also asked to rate the key components of the service process. With this methodology, several measures of satisfaction are obtained which can be combined through averaging or factor analysis into a single measure or index. For more details concerning question scales used for measuring customer satisfaction, see Danaher and Haddrell (1996).

In this study, it is not our primary objective to investigate factors such as how to measure the severity of the complaint. Nor do we try to categorize the nature of the complaints. Instead, our main objective is to attempt to establish an index that substantially captures the essence of measuring customer satisfaction based on mathematics, because research on satisfaction has normally been very cognitive in nature (Liljander and Strandvik 1997). Moreover, Stauss and Neuhaus (1997) suggested that a customer scored, using a satisfaction index, is closely connected with various emotional, cognitive, and intentional components.

A recent paper by Chen and Yang (2000) proposed to use the ratio of the number of customers with complaints to the total number of customers encountered in a given time period to measure the degree of customer satisfaction. The ratio they defined was as follows:

$$p = \frac{\text{number of customers with complaints}}{\text{total number of customers encountered}}.$$

One of advantages of doing so is to enable us to use the Bernoulli random variable to describe the occurrence of customer complaints. For example, let random variable X equal 1 if the customer complains about service element i and 0 otherwise. If parameter p is associated with a service element i, then random variable X is a Bernoulli random variable with parameter p, i.e. $P(X = 1) = p$ and $P(X = 0) = 1 - p$.

Based on the prior research, this paper continues to study the service performance but differs from Chen and Yang's in the following way: we simply count the number of customer complaints to measure customer satisfaction. The rationale mainly founds on the use of Poisson distribution to approximate a binomial distribution. It is widely known that the Poisson distribution can be used to approximate the binomial distribution for the case where the parameter p approaches 0 and sample size n approaches infinity with np ($= \gamma$, for example) constant. In general, the approximation is good for large n and if $p < 0.1$. The larger the value of n and the smaller of p, the better the approximation. In our case, it is no doubt that n is large since there is in nature a countless number of customers. In addition, an assumption about the value of $p < 0.1$ should be fairly realistic because 10 percent of complaints could imply a serious defeat to the firm. It may be noted that in stating this way, 10 percent of complaints are not necessarily the same as 10 percent of loss in profits. Putting all this together, we assume that the number of complaints of each service element i, denoted by X_i ($i = 1, 2, \ldots k$), is a Poisson distributed random variable with mean rate λ_i. The service performance index of element i is thus defined as follows:

$$\frac{d_i - \lambda_i}{d_i}$$

$$S_{PI(i)} = \lambda, i = 1, 2, ..., k, \qquad (1)$$

where,

$\lambda_i = E(X_i)$, the mean number of complaints of service element i,

d_i is the maximal allowable number of complaints of service element i.

There are three distinct advantages to use the equation (1). First of all, it is unitless whose importance from a practical perspective has been pointed out in Kane (1986). A second advantage is that the calculation is very straightforward and easy to apply. The third advantage is that it gives the insight into the relationship between magnitude of the index value and the practical interpretation. For example, by equation (1), it is obvious that the best policy for a firm to seek is to maximize the value of $S_{PI(i)}$ as possible as it can. The reasons are twofold. On the one hand, for the situation where $\lambda_i > d_i$, which means that the number of complaints is beyond the firm's acceptance and obviously not desirable, then $S_{PI(i)}$ is less than 0. On the other hand, for a fixed value d_i where $d_i > \lambda_i$, as λ_i decreases, $S_{PI(i)}$ increases. That is, a larger value of $S_{PI(i)}$ (or a smaller value of λ_i) indicates that the service performance of element i is better. Consequently, $S_{PI(i)}$ plays an intuitive role in interpreting the excellence or inferiority of service performance. Note that the maximal value of $S_{PI(i)}$ happens to be 1, which is the most encouraging result where no single complaint takes place. In practical applications, the value of λ_i or d_i needs not to be integer.

3. Estimation of performance indices

As usually done, we need to estimate $S_{PI(i)}$ based on the sample data, because their real values are generally unknown. Though we are most concerned with the overall performance index of a firm (denoted by S_{PI}), it is imperative to estimate the service performance of each element $S_{PI(i)}$ first. Assume that $X_{i1}, X_{i2}, \ldots, X_{in}, i = 1, 2, \ldots, k$, are n sets of random variables, then the natural estimator (denoted by $\hat{S}_{PI(i)}$) of $S_{PI(i)}$ can be written as the following:

$$\hat{S}_{PI(i)} = \frac{d_i - \bar{X}_i}{d_i}, i = 1, 2, \ldots, k, \qquad (2)$$

where,

$$X_i = \frac{\sum_{j=1}^{n} X_{ij}}{n}$$

is a conventional estimator of λ_i.

It is easy to show that $\overline{X}_i$ is an unbiased estimator of λ_i. Therefore, since $E[\hat{S}_{PI(i)}] = S_{PI(i)}$ and depends merely on the complete, sufficient statistic $\overline{X}_i$, it follows that $\hat{S}_{PI(i)}$ is a *uniformly minimum variance* *unbiased* (UMVU) estimator of $S_{PI(i)}$. The variance of the estimator for $S_{PI(i)}$ can be obtained as the following:

$$Var(\hat{S}_{PIi}) = \frac{1 - S_{PI(i)}}{nd_i}, i = 1, 2, \ldots, k. \quad (3)$$

4. Procedure for testing hypothesis problem

Since the statistical properties associated with the estimators $\hat{S}_{PI(i)}$ and $\hat{S}_{PI}$ are exactly the same, for ease of reading we simply use the notation S_I to represent either $S_{PI(i)}$ or S_{PI}, and the term "service performance" to mean the performance of either a service element i or the firm.

Given a realized service performance, to determine whether it meets a preset target, consider the following hypothesis-testing problem (Kane, 1986):

$$H_0 : S_I \leq S$$

$$H_a : S_I > S$$

The above hypothesis-testing problem suggests that the service performance will meet the service target if $S_I > S$, or fail when $S_I \leq S$. Our intention is to try to reject H_0, showing that the service performance is acceptable. To do that, we will calculate the rejection probability, or the commonly called p-value, based on the *central limit theorem* to make a decision. The p-value, according to Montgomery (1996), is "the probability that the test statistic will take on a value that is at least as extreme as the observed value of the statistic when the null hypothesis H_0 is true". So, "a decision maker can draw a conclusion at any specified level of significance". Let the test statistic of S_I be denoted as $\hat{S}_I$ whose observed value equals to V_I, then

$$p - value = \mathrm{P}(\hat{S}_I > V_I | S_I \leq S)$$

$$= \mathrm{P}\left(Z > \frac{\sqrt{nd_I}\ (V_I - S)}{\sqrt{1 - S}}\right), \quad (4)$$

where,

$$Z = \frac{\sqrt{nd_I}\ (\hat{S}_I - S)}{\sqrt{1 - S}},$$

$$d_i = d_i \text{ or } dk^2.$$

According to the *central limit theorem*, the variable Z is approximately normally distributed. At this point, recall what the equation (1) implies. Apparently, if the value of S equals to 0, then the performance at least meets the target.

By the same reasoning, a larger S means that the firm demands a higher target (i.e. less number of complaints allowed). For this reason, it is normally assumed that S equals to 0.

The procedure to determine whether the service performance meets the preset target is briefly described as follows. First, we have to determine S, and choose the α-risk. Afterwards, we calculate the estimated observed value of the index from the sample, that is, $\hat{S}_I = V_I$.

Finally, by the equation (4), we compute the p-value based on V_I, and sample size n to reach the conclusion. In management's viewpoint, however, it would be of great help if the computational results are represented in some way, aided by pictures, for example, so that managers can easily reach the conclusion.

To serve this purpose, we use a table (Table I) with some designated marks to visually indicate the status of the service performance. For instance, an "*" in Table I indicates that the service performance at least meets the preset target.

With this kind of design, the firm has an option to classify various levels of performance by associating appropriate sets of p-values. For example, let p-value ≤ 0.01 represent an excellent case, $0.01 < p$-value ≤ 0.05 for being good, and p-value > 0.05 showing a poor result. Once thus done, a popular way of using symbols to represent an excellent case is to associate it with "***", highlighting it as an outstanding outcome.

In sum, the complete testing procedure is outlined below.

Table I Service performance indices

	$\hat{S}_I$ $\hat{S}_{PI(1)}$ or $\hat{S}_{PI}$)	p-value
Service element 1	$\hat{S}_{PI(1)} = V_1$	p_1
Service element 2	$\hat{S}_{PI(2)} = V_2$	p_2^{*}
Service element 3	$\hat{S}_{PI(3)} = V_3$	p_3^{***}
–	–	–
–	–	–
–	–	–
Service element k	$\hat{S}_{PI(k)} = V_k$	p_k
Overall performance of the firm	$\hat{S}_{PI} = V$	p_1

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The procedure

Step 1: Determine the value of S (normally set to 0), and the α-risk (normally set to 0.01 or 0.05).

Step 2: Determine sample size n.

Step 3: Compute $\hat{S}_I$ (assume the observed value to be V_I) based on the sample size n
Fill in the column of $\hat{S}_I$ in Table I.

Step 4: Compute p-value based on V_I and the sample size n.
Fill in the column of p-value in Table I.

Step 5: Determine whether the performance target is satisfied by checking:
If the p-value is less than α-risk, we conclude that the service performance meets the preset target; otherwise, we do not have sufficient evidence to conclude that the process meets the preset performance target.

In the example of Table I, p_2 is associated with an "*" which indicates that the service performance of element 2 at least meets the preset target, while element 1 does not. Similarly, the performance of service element 3 is excellent for being marked with "***".

5. Conclusion

Achieving high quality of customer service has become increasingly critical in the service industry and been the focus of the study by the practitioners. Managers are under tremendously increased pressure to enhance service quality by every means so that not only existing customers remain loyal but also new customers will become existing ones. From a practical perspective, how to suitably measure the service performance is important for a firm because it is the foundation to determine whether the desired target has been met. In this paper, we propose an index for measuring service performance. The index is straightforward to compute, and gives an insight into the practical interpretation of the performance. Based on the proposed index, we also develop a step-by-step procedure to deal with the hypothesis-testing problem.

Several limitations should be mentioned in this paper, however. First, the index is simply based on the number of customers with complaints in ratio to the total number of customers encountered. The underlying assumption is that every dissatisfied customer will register a complaint. This may not be an accurate assumption given that many people do not always voice their displeasures with service, but merely choose not to return to the business for further service. Further, as we pointed out in Section 2, more efforts are required to develop a model that takes measuring the severity of the complaint into account. To do so, one way is to consider adding information when customers register complaints. For example, a complaint may be a minor complaint, registered by one individual compared to several individuals complaining about a major service problem. From a manager's perspective, it is more important to know the seriousness and repetitiveness of the complaints rather than the mere number of complaints registered compared to the total number of customers.

References

Bowersox, D.J. and Closs, D.J. (1996), *Logistical Management*, McGraw-Hill, New York, NY.

Charnes, A., Cooper, W.W. and Rhodes, E. (1981), "Evaluating program and managerial efficiency: an application of data envelopment analysis to program follow through", *Management Science*, Vol. 27 No. 6, pp. 668-97.

Chen, K.S., and Yang, H.H. (2000), "A new decision-making tool: the service performance index", *International Journal of Quality and Reliability Management* (forthcoming).

Chow, G., Heaver, T.D. and Henriksson, L.E. (1994), "Logistics performance: definition and measurement", *International Journal of Physical Distribution & Logistics Measurement*, Vol. 24 No. 1, pp. 17-28.

Clarke, R.L. and Gourdin, K.N. (1991), "Measuring the efficiency of the logistics process", *Journal of Business Logistics*, Vol. 12 No. 2, pp. 17-33.

Danaher, P.J. and Haddrell, V. (1996), "A comparison of question scales used for measuring customer satisfaction", *International Journal of Service Industry Management*, Vol. 7 No. 4, pp. 4-26.

Holcomb, M.C. (1994), "Customer service measurement: a methodology for increasing customer value through utilization of the Taguchi strategy", *Journal of Business Logistics*, Vol. 15 No. 1, pp. 29-51.

Kane, V.E. (1986), "Process capability indices", *Journal of Quality Technology*, Vol. 18 No. 1, pp. 41-52.

Kleinsorge, I.K., Schary, P.B. and Tanner, R. (1991), "The shipper-carrier partnership: a new tool for performance evaluation", *Journal of Business Logistics*, Vol. 12 No. 2, pp. 35-57.

Lalonde, B.J. and Zinszer, P.H. (1976), *Customer Service: Meaning and Measurement*, National Council of Physical Distribution Management, Chicago, IL.

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Lalonde, B.J., Cooper, M.C. and Noordewier, T.G. (1988), *Customer Service: A Management Perspective*, Council of Logistics Management, Chicago, IL.

Liljander, V. and Strandvik, T. (1997), "Emotions in service satisfaction", *International Journal of Service Industry Management*, Vol. 8 No. 2, pp. 148-69.

Marr, N.E. (1994), "Do managers really know what service their customers require?", *International Journal of Physical Distribution & Logistics Management*, Vol. 24 No. 4, pp. 24-31.

Mentzer, J.T. and Knoard, B.P. (1991), "An efficient/ effectiveness approach to logistics performance analysis", *Journal of Business Logistics*, Vol. 12 No. 1, pp. 353-61.

Montgomery, D.C. (1996), *Introduction to Statistical Quality Control*, John Wiley & Sons, New York, NY.

Oliver, R.L. (1993), "Cognitive, affective and attribute bases of satisfaction response", *Journal of Consumer Research*, Vol. 20 No. 3, pp. 418-30.

Stauss, B. and Neuhaus, P. (1997), "The qualitative satisfaction model", *International Journal of Service Industry Management*, Vol. 8 No. 3, pp. 236-49.

Taguchi, G. and Wu, Y. (1980), *Introduction to Off-line Quality Control*, Central Japan Quality Control Association, Nagoya.

Tucker, F.G. (1994), "Creative customer service management", *International Journal of Physical Distribution & Logistics Measurement*, Vol. 24 No. 1, pp. 32-40.