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# Measuring Quality of Service in Retail Outlets Using Fuzzy Numbers

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**Abstract:** The measurement of quality of service in any service providing organisation has been a very complex process to deal with. Most of the attributes here are intangible; largely depend upon customers' expectations and perceptions. The quality of service may be poor, average, good, and so on depending upon the performance of the service provider. The linguistic terms like poor, average and good could be vague (fuzzy) unless various attributes of a particular service are understood precisely. In order to avoid the ambiguity of the concept associated with customers' expectations and perceptions of service quality fuzzy numbers are widely used in many complex management issues. In this paper we focus on quantifying the quality of service in retail outlets based on some specific characteristics using fuzzy numbers.

**Key words:** Quality of service; Retail outlets; linguistic terms; fuzzy numbers

## 1. INTRODUCTION

Basically speaking quality means "fitness for use (Juran, 1988)". The unprecedented competition has forced the companies to improve their quality of products and services in order to have survival in the market. A decade ago the scenario was completely different because of less competition. Just after the globalization the conditions have been drastically changed with too many competitors' existence in the market place. Had it been goods or services the quality issue is now a days has been a key attribute for satisfying the customers' requirements. The customers do not just buy the products or services rather the bundle of satisfaction within which they want many attributes of varying degrees of quality. These attributes depend upon the products to products and services to services. In almost all cases the attributes like tangibles, reliability, responsiveness, assurance and empathy play important role in customers' satisfaction level. These are called as the five basic dimensions moulding the customers' expectations and perceptions. If any one of the dimensions lacks he/she gets dissatisfied up to a certain degree. Continuation of the same leads to the distraction towards products or services over a period of time. The study by Le Boeuf (1987) explains the reasons why a customer quits certain company:

- Only 3% quit without any reason
- 5% develop other company relationship
- 9% leave for competitive reasons
- 14% dissatisfied with the products/services
- 69% quit because of indifferent attitude of the company towards customers

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Clearly the last one speaks of the story of the reliability, responsiveness, assurance and empathy which play vital roles in attracting and retaining the customers for a longer period of time. Parsuraman et al. (1988) have mentioned about these attributes which are responsible for lessening the gaps in the “service quality conceptual model (SERVQUAL)”. In this model, the expected service describes customers’ expectations about what the service firm should provide and perceived service reveals their feelings of the service they actually receive from the firm. If there is a mismatch in the expectations and perceptions then gaps are found which lead to customer dissatisfaction. In any case they referred to ten different dimensions to minimize the gaps at different levels of the model. They are as mentioned in the following figure 1.1.

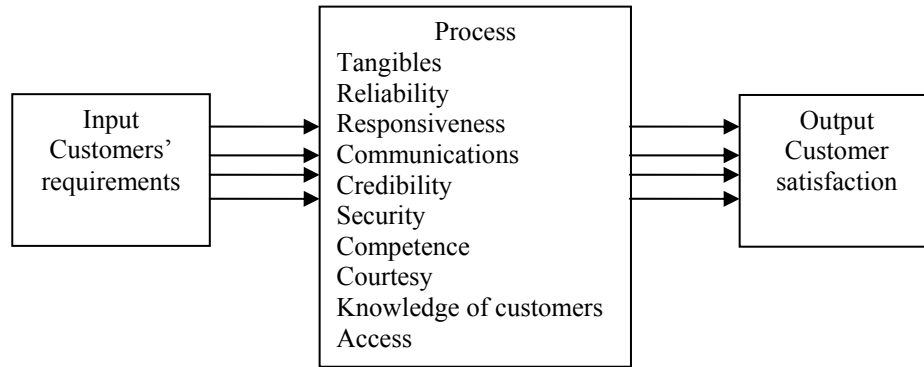


Figure 1.1

In the figure we have given a system approach of the customer satisfaction through the ten different attributes of service quality preceded by the customers’ requirements which greatly vary depending upon their income, purchasing power, standard of living, experience and above all the competitive market environment etc.

## 2. QUALITY OF SERVICE IN RETAIL OUTLETS

For evaluating quality of services in the retail industries we first need to identify the diversified service attributes that are under control of the retail personnel. The quality of services perceived by the customers in the retail outlets can be represented and measured by these attributes. To stay competitive in the market the retail outlets of the company need to offer “the best value for money”. The retailing is a process of making reach the product or services to the end users and is a sub process of the whole marketing process. Now- a- days in order to optimize the costs and profits the companies are directly coming to the retailing sector by curbing the longer supply chains. This is depicted in the given figure 1.2.

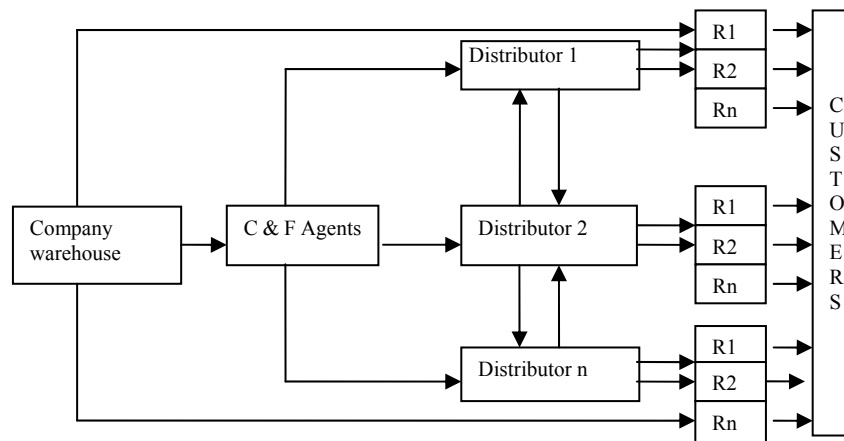


Figure 1.2

This way there is going to be a boom in the sector but giving rise to new issue of efficient retail management. The retail store management is a task of marketing department. Customers come to retail stores for getting the products or services for meeting their needs and demands. How efficiently and effectively the products or services are delivered to them is generally judged by the managers of the stores. They monitor and supervise the whole process starting from the reception to the delivery. In each and every step of the whole process the quality initiative has been imperative. The various steps of the whole process can be as hereunder;

- a) The customer enters the retail store
- b) Go to the specified counter
- c) Ask the sales man for the desired product
- d) Sales man shows the variety of the products under that category
- e) Customer looks it thoroughly
- f) Ask for discounts if any or bargain wherever required
- g) If satisfied purchase else leaves the store
- h) Searches for other stores at his/her convenience

The process repeats till he/she gets his/her desired product with a competitive price. In the whole process the high degree of reliability, responsiveness, assurance and empathy required from the sales man. So it's very important to understand the customers' needs and demands and all this can be possible by an effective communication of the sales man. If the product is a durable one then on time delivery, timeliness and the after sales service are the vital points. However the functional quality of the products/services is adjudged as what you deliver and how you deliver. In retailing sector employees do not have to do anything with the products available and so is "whats" rather to deal with "hows". The way you handle the queries and deliver is a key factor which needs to be constantly guided by the managers and modification in behavior should be brought as and when required. This way the performance of the sales persons and other employees could have been supervised and improved. Linguistically they can be rated as poor, average, good and so on as per the opinions of the customers.

### **3. LINGUISTIC TERMS**

We say regarding the various attributes of man like truthfulness, workaholicness, sincerity and dedication in many cases. Considering the word truthful; "if a person is truthful" then question comes up to what extent he/she is truthful. Whether he/she speaks truth in all cases no matter what the consequence is or some cases speaks truth and some cases speaks lie it all depends upon the situation. In this way we can see that the concept is vague if the criteria for truthfulness are not indicated precisely. So a person can be a hardcore truthful to the hardcore liar or may be partly truthful and partly liar depends upon his characteristics and personality traits. Similarly in the industrial sense the performance level of the employees is recognized as poor, average, fair, good, very good, excellent and outstanding in a seven point rating scale. If we look thoroughly that, a person who is neither fair nor good at the work can not be rated in the seven point rating scale which brings a very conflicting situation in the minds of the managers who generally go for the performance appraisal. Some may use the five point rating scale without the ratings 'fair' and 'outstanding'. These are all the words of the mouth used to measure the performance level of the employees and considered to be the linguistic terms.

### **4. HISTORY OF FUZZY LOGIC**

As discussed in the previous section that the linguistic terms like poor, average and good etc are vague terms. This vagueness has generated the fuzzy set theory which plays a vital role in all decision making process. This helps measuring the ambiguity of the concepts that are associated with human beings' judgments. During the process of the customer survey of assessing the performance of the retail stores the customers may be biased and imprecise. As per, Herrera and Herrera-Viedma (2000) the linguistic terms are easy to use for decision makers which are purely subjective and imprecise and hence for measuring this quantitatively the fuzzy set theory is becoming very popular. The fuzzy set theory was founded by Zadeh

(1965) who introduced the grades from ‘0’ to ‘1’ and the concept of graded membership. For an example if we assign the poor performing retail outlet as ‘0’ and the excellent performing retail outlet as ‘1’ then any other kind of performer will lie inside the interval [0, 1] depending upon their performance level. Zadeh (1975) and Mandami and Assilian (1975) developed fuzzy logic by introducing a concept of approximate reasoning of linguistic terms.

## 5. FUZZY NUMBERS AND FUZZY MEMBERSHIP FUNCTION

This is slightly mathematical and little bit of understanding of mathematics is required up to the intermediate level. Let ‘R’ be the set of real numbers and ‘X’ be a subset of ‘R’ is the universe of discourse of dimensions i.e.  $X = \{ \text{tangibles, reliability, responsiveness, assurance, empathy} \}$ . Defining a set of ordered pairs  $F = \{ (x, \mu_F(x)) : x \in X \}$ . Here ‘ $\mu_F(x)$ ’ is called as the membership function whose value lie between ‘0’ to ‘1’. Here we will take the dimensions on x-axis and  $\mu_F(x)$  on y-axis in the two dimensional plane in order to show them pictorially. So clearly the minimum and maximum value of the membership function is 0 and 1 respectively quite similar to the rule of probability. The greater will be the value of the membership function the greater will be the truth of the statement. For every parameter poor, average, good, very good and excellent of the elements of X we are taking a triplet  $(a_1, a_2, a_3)$  where  $a_1$ = lower value,  $a_2$  =middle value,  $a_3$ = upper value. We can also take the two values e.g. lower value and the upper value without considering the middle value but to bring e accuracy this is highly reliable. The triplet is a triangular fuzzy number and  $\mu_F(x)$  is the desired membership function of the same which is now displayed in the figure 1.3. Any value on x-axis can be both members of good as well as average performing retailing outlets which is very confusing. Hence  $a_2$  is the most likely value of the respective parameter. This indicates the fuzziness of the linguistic terms i.e. the words of the mouth generally considered for measuring the performance level of the individuals or the organizations at a large. Now let’s define the membership function of the fuzzy triplet  $(a_1, a_2, a_3)$  from the figure 1.3

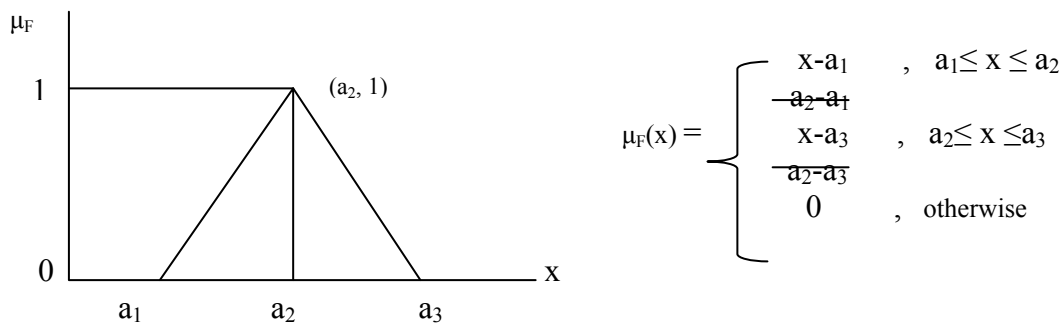
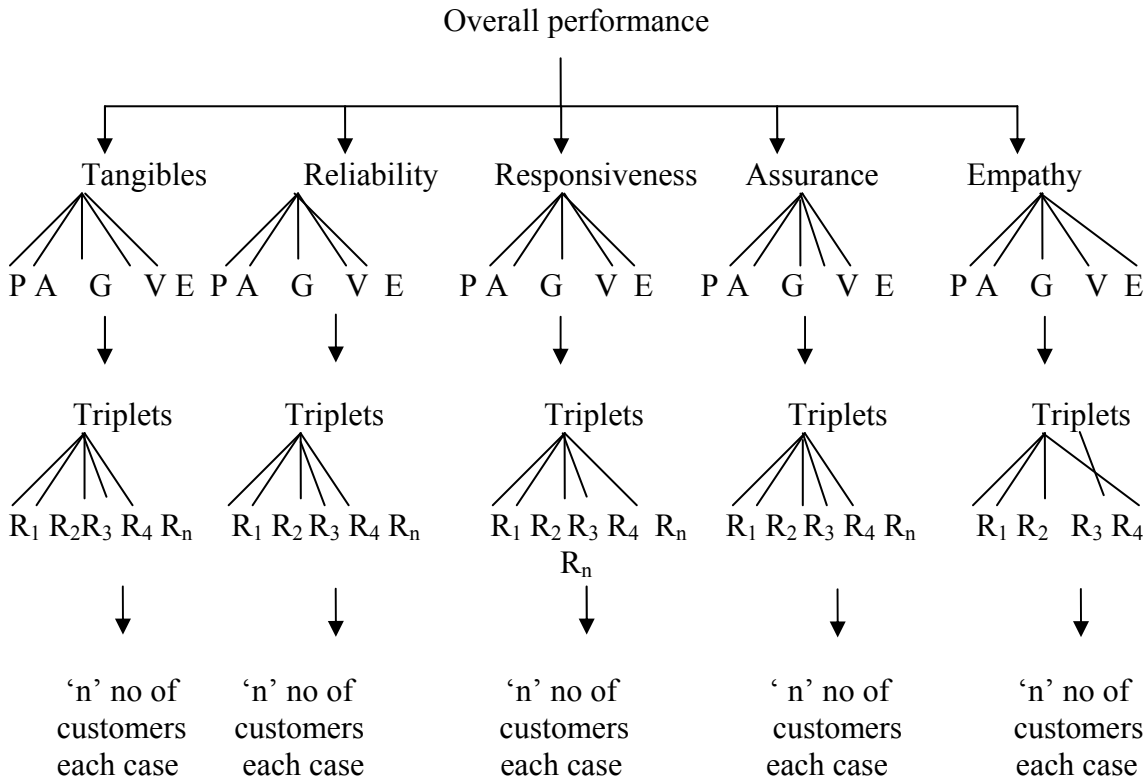


Figure 1.3

The values of the constants on the x-axis depend upon the parameters of the dimensions. Once the values are confirmed we have to verify in which side of the interval it is lying then we can put it in the membership formula given above to find out the membership value. The accuracy of the statement depends upon the membership value. Based on the five different dimensions of the service quality the value of the triplets can be fixed up to proceed further. These triplets are correlated to the nature of service. If it is healthcare industry or pharmaceutical industry then the parameters can not be taken to be poor, average etc rather it has to be excellent or outstanding because it deals with the life of the patients just like six sigma concept of 3.4 defectives in million opportunities. So clearly the values of  $a_1, a_2,$  and  $a_3$  should be taken to be close to 100.

## 6. FUZZY-LINGUISTIC FRAMEWORKS IN RETAIL OUTLETS

In the retail outlet the five basic dimensions play the major role in bringing the customer satisfaction. For every dimension there are triplets based on the customers' opinions. So if we take the set  $X = \{ \text{tangibles, reliability, responsiveness, assurance, empathy} \}$  then the five dimensions could be poor, average, good, very good, or excellent it all depends upon the retail stores' performance in dealing with the customers. Customers' opinions of the dimensions in the different outlets will be taken for finding the overall performance. This can be represented well with the help of the below given hierarchical structure where P = Poor, A = Average, G = Good, V = Very good, E = excellent and Rs' are the different retail outlets.



Since there are 'n' no of customers in all cases so there are 'n' no of different triplets for each dimension as mentioned above. In order to find the aggregated opinion of the 'n' no of customers we take the average of the triplets for each dimension by using the formula of average as used in the case of statistics i.e.,

$$F = \frac{F_1 \oplus F_2 \oplus F_3 \oplus \dots \oplus F_n}{n} \quad \text{-----} \quad (1)$$

where  $F_1, F_2, F_3, \dots, F_n$  etc are the 'n' different triplets obtained from the 'n' no of customers' opinions. They can be assigned as:  $F_i = (a_1^{(i)}, a_2^{(i)}, a_3^{(i)})$  and  $i = 1, 2, 3, \dots, n$

$\oplus$  = addition of triangular fuzzy nos term wise

n = total no of observations

The equation no (1) shows the average performance which is a refined triangular fuzzy number. To justify whether the performance of the outlet in each dimension is poor or good we need to de-fuzzify the refined the triangular fuzzy number based on "Kaufmann & Gupta's (1988)" method i.e.,:

$$V_F = \frac{a_1 + 2a_2 + a_3}{4} \quad \text{-----} \quad (2)$$

where ' $v_F$ ' is the defuzzified value of ' $F$ ' as obtained in the equation (1). In this way five different values will be found for tangibles, reliability, responsiveness, assurance, and empathy. For each different value we have to find out the respective membership value using the above fuzzy membership formula and summing up for final ranking of the outlets. If there are ' $n$ ' no of outlets every time the same process will be repeated and results can be compared to find the highest performer to the least performer. We have to remember that all the membership values will be restricted to  $[0, 1]$  but the overall value may not necessarily be within the range because it is the sum of the values obtained from the membership functions. The membership functions are different for diversified dimensions/attributes so carefulness should be given to the likes and dislikes.

## **7. WORKING RULE**

To reach at the conclusion there are some basic steps to be followed in this method.

- a) Take the desired outlets to be assessed in the service quality
- b) Assign a dimension of quality say tangibles
- c) Define the various parameters of the service quality like poor, average, good etc.
- d) Convert the parameters to the triangular fuzzy numbers based on customers' opinions of a particular dimension. So for ' $n$ ' no of customers there are ' $n$ ' no of triangular fuzzy numbers
- e) Find the aggregated group opinion by using the formula given in (1). This is the refined triangular fuzzy number
- f) To justify the aggregated group opinion for any particular dimension defuzzify it basing on the formula given in (2). Defuzzification is just a formula to get rid of the triangular fuzzy number and finding the realistic value
- g) Repeat the procedure for other dimensions too. These are the values on the x-axis
- h) Define the membership function of each dimension based on the customers' opinions or the quality experts' opinion as the case may be. Here the entire dimension varies from 0% to 100%. This depends upon problems to problems
- i) Find the fuzzy membership values of the dimensions as obtained above. These are the values on the  $\mu_F(x)$ -axis
- j) Adding all the values of  $\mu_F$ 's' to find the overall score of the service quality i.e.,  
Overall score ( $\mu$ ) =  $\mu_{\text{tangibles}}(x) + \mu_{\text{reliability}}(x) + \mu_{\text{responsiveness}}(x) + \mu_{\text{assurance}}(x) + \mu_{\text{empathy}}(x)$
- k) Repeat the same for all the outlets
- l) Based on the overall scores ( $\mu$ ) now we can rank the outlets on the basis of their performance

## **8. CONCLUSION**

Just after the era of globalization there has been a sea change in the market place irrespective of any business. The cut throat competitive environment has compelled each business firm to improve the quality of the products and services. Quality itself is not a very clear concept because it all depends upon the satisfaction level of the customers. May be the quality of a product used by a group of customers is good whereas it is not accepted by another group of customers simply rating it as poor. This is all about the customers' expectations and the perceptions of a particular product or service. Products are tangible that's why we can measure their quality in the organisation before it reaches the end users by various quality measuring instruments/ideas as invented by the quality experts. On the contrary the services are mostly intangible hence measuring the quality of it is a highly complex task. To avoid this complex situation fuzzy logic and fuzzy numbers are greatly used in many complex management issues. It basically deals with the objects that are a matter of degrees varying from '0' to '1'. The fuzzy membership function facilitates to measure the performance level of the business firms, individuals and the company as a whole with respect to the competition in the market. Here it is no deviation. We have taken some retail outlets of a particular

company for service quality measurement in different attributes. As more and more number of companies are entering this sector so the measurement of the service quality in this case has been inevitable. The reason behind this booming, in the sector is that the companies are directly reaching to the end users by cutting down the large supply chains to optimize the costs and profits. And in order to have this optimization the service quality measurement and improvement can not be neglected any more. Here we try to express the subjective judgments of the customers of service quality in quantitative terms on the basis of fuzzy membership functions. The greater the value of the membership function the greater the truth value of the statement and so is the level of the performance leading to the optimum customer satisfaction. There is a limitation of this procedure. When the number of outlets to be measured for performance and the number of dimensions or attributes are more it is difficult to calculate the fuzzy membership values and the overall scores manually. To get rid of the problem computers can be used. The procedure can be written in the form of a programme and installed in to the computers for faster and accurate calculations. This will help in saving time, minimizing human error and biasness.

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