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Using Fuzzy Approach to Assess Service Quality in One Round Survey

Li Yong
School of Information Engineering and Automation,
Kunming University of Science and Technology, Kunming, China

Abstract: The assessment of service quality is an on-going process that requires continuous monitoring to maintain high levels of service quality across a number of different service attributes with a questionnaire using crisp measures and needs at least 2 round surveys to test whether the measurement tool suggests changes in common attributes for providing the validity of a questionnaire. In a practical sense, it is more realistic to use lingual expressions to describe the desired value and the method used in different time to test the validity of a questionnaire is inconvenient. This paper discusses a fuzzy approach for assessing current perception of the service satisfaction of retailers in one round survey and uses the degree of importance of the perception of current attributes to assure its' validation. At the end, a sample of cigarette retailers' service satisfaction assessment is used to implement the proposed method.

Key words: Service satisfaction, SERVQUAL, assessment, fuzzy measures

INTRODUCTION

Increasing competition and product homogeneity in many consumer categories have enabled retailers to switch from one consumer goods manufacturer to another, forcing many manufacturers to compete for retail business as virtually faceless "vendors" (Thomassen *et al*., 2006). For those manufacturers, understanding exactly what retailers expect and want is the most crucial step in defining and delivering the high quality service. Service quality is one of common notions that a form of attitude, related to satisfaction which results from the comparison of expectations with performance. There are many measurement concepts of perceived service quality, the researches of Parasuraman *et al.* in SERVQUAL can be traced (Ladhari, 2009). The SERVQUAL model which breaks down the notion of service quality into five constructs: *Tangibles*, *Reliability*, *Responsiveness*, *Assurance* and *Empathy*. It represents service quality as the discrepancy between a customer's expectations for a service offering and the customer's perceptions of the service received which implemented with a questionnaire use Likert scales to measure respondents' attitude. Manufacturers assess the service satisfaction of retailers by determining whether there is any gap between of retailers' expectations and perceptions in the five dimensions. Since human judgments and preference are often vague and can't estimate his preference with an exact numerical value, it is more realistic to use lingual expressions to describe the desired value, e.g. "very low", "low", "fair", "high", "very high", "strongly", "somewhat" and "undecided", "satisfied", "dissatisfied", etc. (Vinodh *et al*., 2011). Due to this type of existing fuzziness in the survey process, fuzzy set theory is an appropriate method for dealing with uncertainty.

Normally, the assessment of service quality is an on-going process that requires continuous monitoring to maintain high levels of service quality across a number of different service attributes. It need at least 2 round surveys to test whether the measurement tool suggests changes in common values (attributes). This paper proposed a fuzzy method to assess the organization service quality at one round based on the author's formal research. Finally, this assessment model is tested by a case of a tobacco group in Yunnan province.

RESEARCH METHODOLOGY

In practical setting, the valid information need to be obtained in single round survey. Normally, the model of service quality gap uses expectation attributes to improve the perception of current attributes. In the same logic, by measuring the degree of importance of the perception of current attributes in the same questionnaire, the validation of the attributes can be judged. Based on the logic, the questionnaire sought the satisfaction and important level of retailers using a 7-point Likert scales. Experts were asked to evaluate different cognitive levels given each grade of candidate retailers according to subjective perceptions. Additionally, the presence of the values is defined using fuzzy membership functions and then giving the membership degree of the service type at a specified level is taken through fuzzy intersection

function. The use of a predefined parameterized S-shaped membership function is preferred (Dubois and Prade, 1997). Further, the fuzzy measures of uncertainty service satisfaction assessment are executed through fuzzy entropy. There are three major steps of this methodology as following:

Step 1: The construction of value membership function. The membership function $\mu_v(\bar{x}_i)$ generating for service satisfaction value is given in Eq. 1. Here, $\bar{x}_i$ denotes the average of all retailers' judgments for a given value i:

$$\mu_v(\bar{x}_i) = \begin{cases} 0 & \text{if } \bar{x}_i \le 5 \\ (\bar{x}_i - 5)/2 & \text{if } 5 < \bar{x}_i < 7 \\ 1 & \text{if } \bar{x}_i \ge 7 \end{cases} \quad (1)$$

For instance, if $\bar{x}_i$ is greater than 5, then it can be concluded the most of retailers think the service completely has the value i. Therefore, it can be inferred the service certainly has this value and the membership value should be 1. Thus, the membership degree shows to what extent the service presents a value represented by a particular fuzzy set.

Step 2: Fuzzy intersection functions in service satisfaction value. When the presence of the values is defined using fuzzy membership functions, the presence of service satisfaction will also have a fuzzy characteristic. To transform the membership degrees of the values to service satisfaction membership degrees, a concept derived from the intersection of fuzzy sets is used as follows

If m values are used to measure a service satisfaction at a level and n number of these values should exist to accept the existence of the service satisfaction at that level, then the m values are used to make combinations of sets with n members, thus giving the minimum membership degree within a combination and then the maximum among combinations is taken, this will give the membership degree of the service type at a specified level (Medasani *et al*., 1998; Pal, 1999):

$$\mu_{S-L}(\bar{X}) = \sup_{i_1, i_2, \cdots, i_n \in SS} \{ \bigwedge_{k=1}^{m} \mu_v(\bar{x}_{i_k}) \} \quad (2)$$

where, S-L denotes the service satisfaction level and SS indicates the service satisfaction set and $\bar{X}$ is a vector of all the average values of the retailers' satisfaction.

Step 3: The fuzzy measures of uncertainty in service satisfaction assessment. For any service, the values of a service satisfaction set belong to the set to some degree. Fuzzy entropy is the most well-known measure of fuzziness which estimates the average ambiguity in fuzzy sets in some well-defined sense (Zadeh, 1968). The measure of fuzziness for a discrete fuzzy set A is defined as a mapping H: $P_n(X) \rightarrow R^+$ quantifies the degree of fuzziness present in A in which $P_n(X)$ is the set of all fuzzy subsets of X. A measure of fuzziness should satisfy at least five well-known properties (Klir and Yuan, 1995) and a non-probabilistic entropy measure based on the membership functions of the intersection and union of the set and its complement set is used which is introduced in Shang and Pal's works (Shang and Jiang, 1997; Pal, 1999), satisfies all properties and is defined as Eq. 3:

$$H(A) = \frac{1}{n} \sum_{i=1}^{n} \frac{\mu_{A \cap A'}(\bar{x}_i)}{\mu_{A \cup A'}(\bar{x}_i)} \quad (3)$$

where, n denotes the number of values in a service satisfaction type; $\bar{x}_i$ is the average of all respondents' judgments for a given value i and $\mu_A(\bar{x}_i)$ denotes the degree of belongingness of value i to the service satisfaction set A. A' is the complement set of A.

CASE SURVEY: DATA ANALYSIS AND RESULTS

Data collection and measures: The authors implemented the questionnaire in one round based on the definition of questionnaire with 7 point Likert-types proposed in our formal research. Data was collected using an online survey system developed by authors. Anonymity was promised to protect participating retailers' privacy and business proprietary information. More one hundred responses were received. Finally, 50 responses were used for analysis in this study. About half of response cases were dropped due to incomplete answers or same answer in all questions. Three different decision levels ("Average", "High", "Very High") to identify the possible types of service satisfaction present in the organization have been defined. Table 2 gives the corresponding numbers of values for each level and type of service satisfaction. For instance, *Tangibles* consist of three values (A1-A3).While the number of "Average" level is 1 means that only one of three value sets belonging to *Tangibles*, the service satisfaction has the "Average" degree in *Tangibles*.

Table 1: Questionnaire Items

Service criteria and questions	
A:	**Tangibles**
A1:	Service personnel dress nniform and clean, bring with complete certifications
A2:	Service personnel make a clear service promise, for example, the complaint accepted 100%
A3:	There are clear service instructions and as well as others that can contribute to enhance the tangible items of the QOS and the image of the company
B:	**Reliability**
B1:	Service personnel can keep their promises
B2:	Service personnel answer retailers' questions patiently
B3:	Service personnel treatment warmly on retailers' needs
B4:	Supply allocation is fair and equitable
B5:	Retailers can be kept informed of the supplies information
B6:	Retailers has reasonable profit margins
C:	**Responsiveness**
C1:	Service personnel always provide fast service
C2:	Even they are busy, service personnel still respond retailers' requirements
C3:	Even if they can not immediately resolve question, service personnel can reply in time
C4:	Delivery accurate, timely
C5:	Retailers can be kept informed of the products and relevant market
C6:	There are telephone and other consulting and complaints channels for retailers' commnnicating with service personnel
C7:	Phone ordering is convenient and fast
C8:	Network ordering is convenient and fast
D:	**Assurance**
D1:	The attitude of service personnel is polite, warm and thoughtful during service process
D2:	Service personnel are familiar with the performance of products
D3:	Service personnel can provide effective guidance on retailers' sales
D4:	Service personnel are able to provide the necessary market support
D5:	Service personnel are positive in anti-counterfeiting and cleaning up the market
D6:	Service personnel are familiar with market
D7:	Ensuring the rational distribution of retail outlets, avoiding vicious competition among retailers
D8:	Service personnel have ability to grasp information about retailers' demands
E:	Empathy
E1:	Service personnel can know initiatively the retailers' demands at any time
E2:	Providing targeted services for the different demands of different retailers
E3:	Offering a variety of ordering ways

$\bar{x}_i$, $\bar{y}_i$: Average of responses for value i in the current option and the importance option.

$\mu_v(\bar{x}_i), \mu_v(\bar{y}_i)$: Membership degree of value i in the current option and the importance option, respectively.

Assessing suppliers' service quality for retailers: After collecting data with the questionnaire, the average of responses is used to calculate the membership degrees for each service satisfaction value using (1). The extent of the average of responses to service satisfaction values is shown in Table 3. The study set a suitable threshold of membership degree "S<0.5" by expert consensus and eliminate values having "S" less than 0.5 (Table 2). Obviously, these selected values are the most influential factors for the manufacturers' service. The authors

Tabke 2: Numbers of values for each decision level and service satisfaction

	Decision levels			
Value	No. of values	Average	High	Very high
A1-A3	3	2	3	3
B1-B6	6	3	4	5
C1-C8	8	4	5	6
D1-D8	8	4	5	6
E1-E3	3	2	3	3

Table 3: Results of the questionnaire and membership degrees of service satisfaction

Value	I	$\bar{x}_i$	$\mu_v(\bar{x}_i)$	$\bar{y}_i$	$\mu_v(\bar{y}_i)$
A1	1	6.18	0.59	5.74	0.37
A2	2	6.20	0.60	6.12	0.56
A3	3	6.16	0.58	5.68	0.34
B1	4	6.34	0.67	6.16	0.68
B2	5	6.50	0.75	6.34	0.67
B3	6	6.52	0.76	6.28	0.64
B4	7	6.28	0.64	6.54	0.77
B5	8	6.30	0.65	6.22	0.61
B6	9	6.14	0.57	6.22	0.61
C1	10	6.36	0.68	6.16	0.58
C2	11	6.34	0.67	6.10	0.55
C3	12	6.58	0.79	6.18	0.59
C4	13	6.56	0.78	6.30	0.65
C5	14	6.20	0.60	6.10	0.55
C6	15	6.30	0.65	6.04	0.52
C7	16	6.02	0.51	5.78	0.39
C8	17	6.41	0.71	6.32	0.66
D1	18	6.42	0.71	6.28	0.64
D2	19	6.32	0.66	6.06	0.53
D3	20	6.38	0.69	6.14	0.57
D4	21	6.18	0.59	6.00	0.50
D5	22	6.40	0.70	6.47	0.74
D6	23	6.36	0.68	6.24	0.62
D7	24	6.30	0.65	6.32	0.66
D8	25	6.44	0.72	6.32	0.66
E1	26	6.30	0.65	6.20	0.60
E2	27	6.30	0.65	6.02	0.51
E3	28	6.53	0.77	6.18	0.59

i: Number of value

obtained results {A2, B1, B2, B3, B4, B5, B6, C1, C2, C3, C4, C5, C6, C8, D1, D2, D3, D5, D6, D7, D8, E1, E2, E3}.

According to the results given in Table 3, B2, B3, C3, C4, C8, D1, D5, D8 and E3 are the strongest values in terms of current service satisfaction value, i.e., the retailer holds these values. The service can also be said to have A2, B1, B4, B5, C1, C2, C5, C6, D2, D3, D6, D7, E1, E2, because these values have moderately strong membership degrees (>0.6).

It can be observed that current service satisfaction values of retailers are divided into two main groups by the option important. This can be explained as those values {B1, B2, B3, B4, B5, C4, C8, D1, D5, D6, D7, D8, E1} which are both common (current) and important are service satisfaction values that have really been perceived and identified by the retailers while those values {A2, C1, C2, C3, C5, C6, D2, D3, E2, E3} which are current but not important are again service satisfaction, but indicate that they are service satisfaction values because of the

Table 4: Membership degrees and fuzzy entropy measures of service satisfaction

		Decision levels		
Service criteria	H(.)	Average	High	Very high
Tangibles	0.67	0.60	0.60	0.60
Reliability	0.50	0.67	0.65	0.64
Responsiveness	0.44	0.67	0.67	0.65
Assurance	0.46	0.68	0.68	0.66
Empathy	0.47	0.65	0.65	0.65

retailers complies with. The values {B6} not common but are important could be considered as espoused service satisfaction values and these values affect the internal forces of the retailers. And then, the values {A1, A3, C7, D4} both not common and not important could be considered as pointless service satisfaction values and these values can not affect service satisfaction for the retailers, so these values would be discarded.

Membership's roles of service satisfaction: Using Eq. 2, the membership degrees of service types at different levels which indicate the existence of each service type in the cigarette supply for retailers, are calculated as given in Table 4.

For example, the calculation of the membership degree of the service type at the average level (Service-Level (S-L): Assurance-Average) is given below:

From Table 2, n equals 4 and SS is {18,29,20,22,23,24,25}. Then:

$$\mu_{\text{Assurance-Average}}(\bar{X}) = \sup_{r_1,r_2,r_3,r_4\in\{18,19,20,22,23,24,25\}} \left\{ \bigwedge_{k=1}^{4} \mu_v(\bar{X}_{r_k}) \right\} = 0.68$$

We denote Assurance as A. Furthermore, an example calculation of the fuzzy entropy measure for A is given below:

$$H(A)\frac{1}{7}\sum_{i=1}^{7}\frac{\mu_{A\cap A^*}(\bar{X}_i)}{\mu_{A\cup A^*}(\bar{X}_i)} = 0.46$$

Using the same method, the membership degree of the service types at "High" and "Very High" level can be calculated. The "High" level and "Very High" of Assurance have the membership degree 0.68 and 0.66 respectively.

CONCLUSION

From Table 4, it can be concluded according to the decision level "High" that the product supply shows the characteristics of *Assurance*, *Responsiveness*, *Empathy*, *Reliability* and *Tangibles* from its service satisfaction values. Here, the product supply has service of *Assurance* with a membership degree of 0.68, indicating a quite strong and dominant value in D1, D2, D3, D5, D6, D7 and D8 (Table 1). If the decision level is increased to "Very High", the conclusion is same. However, *Responsiveness*, *Reliability*, *Empathy* and *Tangibles* show the same characteristics. A further measure, fuzzy entropy, that may contribute to a more consistent and accurate judgment, is considered. Table 4 shows *Tangibles* is the most uncertain value set with a fuzziness of 0.67. This service type implies high uncertainty and thus poor judgment about the value set (A2). The high uncertainty and moderate membership degree can be implied from the indecision. In this context, although *Reliability* presents the nearly second highest value at "Average", "High" and "Very High" decision levels will not be considered for the product supply. *Empathy* is the third uncertain value set with a fuzziness of 0.47 and it presents the highest value at "Average", "High" and "Very High" decision level will also mainly be considered for the product supply. The *Assurance* with a second relatively low degree of fuzziness (0.46) and the first degree of membership at all decision levels can be implied to be the most important part of the service satisfaction. Finally, the assessment concludes *Reliability*, *Responsiveness*, *Assurance* and *Empathy* form the values of service satisfaction in this one round survey.

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