

New Fuzzy ServQual Build with 3 Fuzzy Number

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Abstract: Every community in this world wants to get optimal service quality and in accordance with expectations. Therefore, it is necessary to take measurements to find out how much the level of public satisfaction with the quality of services provided by the service provider. Fuzzy servqual is a method to find out the level of service quality from data survey. Data processing is carried out by calculating the value of fuzzification, defuzzification, as well as the calculation of the GAP value between perception and expectation, this paper uses 3 types of fuzzy numbers, including shoulder fuzzy, triangle fuzzy and trapezoidal fuzzy, by using 3 types of fuzzy numbers, the GAP (the diferent value between expectations and reality) calculation results obtained will certainly be different from the GAP calculation which only uses a triangular fuzzy. The results from this research obtained are in the fuzzification step from fuzzy number improvement make gap results better with better accuracy.

Keywords: SERVQUAL, OEM, COA, FUZZY NUMBER

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1. Introduction

Professor Lotfi A. Zadeh introduced fuzzy numbers in 1965 (Goguen, 1973). A fuzzy set is a set represented by a membership function i.e. a curve that shows the mapping of data input points into their membership values (degrees of membership) that have intervals. Kusuma and sudrajad, (Kusumadewi, 2010; Sudradjat & Preda, 2007) explains the advantages of the fuzzy concept over the concept of boolean numbers.

Servqual model (Service Quality) (Wisniewski, 2001) measurement of service quality is the most widely used method, according to (Abant et al., 2020) The servqual scale is used as a data collection tool for employees and patients of university hospitals in Turkey, the sample group selected by the random sampling method, while (Dewi, 2022) analyzes and measures the quality of library services (servqual) through tangible indicators and others (Zeithaml et al., 1990). One of the benchmarks is the presence of physical library services (Hapsari et al., 2017) Service materials should be considered in community assessments. This real appearance can be felt directly before entering further service. Physical services are concerned with the attractiveness of facilities, equipment, materials used, and the appearance of employees (Fandy, 2011). This examination was inspired by several previous studies, which raised the servqual using the dimensions of tangible service, reliability, responsiveness, assurance, and empathy with almost the same method (Agustina et al., 2020; Fanani, 2022; Hapsari et al., 2021; Jonkisz et al.,

2022; Lu et al., 2020).

Further research related to user satisfaction through the method on servqual at the Public Library and Archives of the Alternative Library of the Southern Region of Yogyakarta City (Yuliana & Khusnullaili, 2020).

2. Method

Service quality is highly dependent on three things, namely systems, technology and people. The human factor holds the greatest contribution so that the quality of service is more difficult to imitate compared to product quality and price (Harinoto, 2015). The dimensions used to measure the quality of service are :

1. Reliability relates to the company's ability to deliver the promised service accurately from the first time.
2. Responsiveness, with respect to the service provider's willingness and ability to assist customers and respond promptly.
3. Assurance, with regard to the knowledge and courtesy of employees and their ability to cultivate customer confidence and confidence.
4. Empathy, means that the company understands the problems of its customers and acts in the interests of the customers, as well as providing personal attention to the customers and having comfortable operating hours.
5. Physical evidence (tangibles), with respect to the physical appearance of the company's service facilities, equipment or equipment, human resources, and

communication materials. The way or method of research contains a description of the ways in which the research is carried out, which includes the subject of the study, population and sample, data collection techniques, and data analysis techniques (Budi Harto, 2015).

3. Results and Discussion

3.1 Fuzzy ServQual

Fuzzy servqual consists of two methods, namely fuzzy and servqual, fuzzy itself is a method to describe the input space in the output space while servqual is a method to evaluate service quality, from both methods it can be concluded that fuzzy servqual is a fuzzy set. A method that provides a way to represent uncertainty and is a tool for modeling. Uncertainty is related to ambiguity, uncertainty and lack of information related to aspects of service evaluation.

3.2 Fuzzy ServQual TFN

Method of fuzzy servqual with TFN (Triangle Fuzzy Number). To make it easier for readers to understand the flow, the author creates an analysis flow in the form of a flowchart as follows:

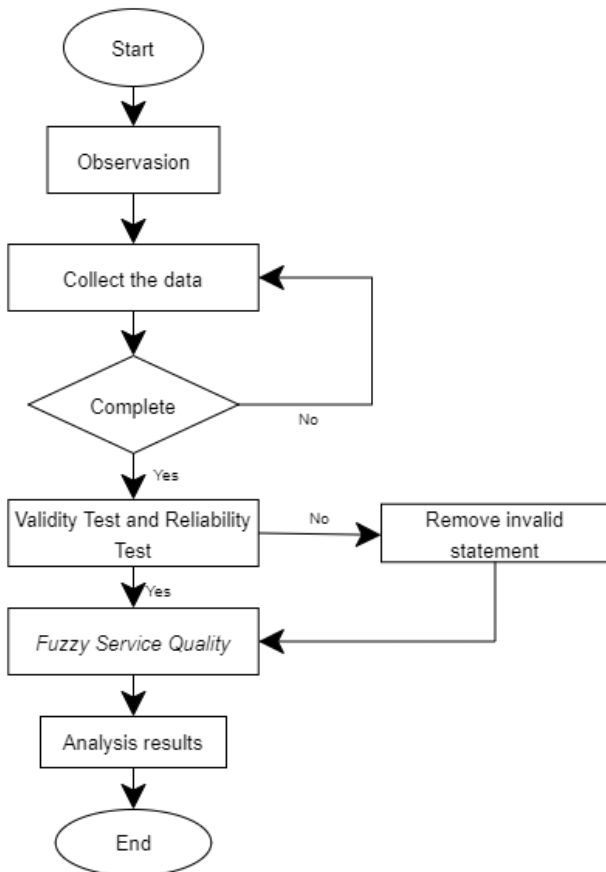


Fig 1. The flow of fuzzy servqual TFN method.

3.3 Fuzzy ServQual with 3 Fuzzy Number

The data processing process to find out the gap is carried out using the defuzzyfication process with methods such as the following:

1. Determine the value of the linguistic scale on each

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- fuzzy number;
2. Determine the value of crips on each question;
3. Fuzzyfikation of input values using the overall effectiveness measure;
4. Defuzzyfication using CoA (Center of Area);
5. Gap value (Melnyk, S.A., & Christensen, 2000; Singh et al., 2022)

Method of fuzzy servqual with 3 Fuzzy Number. To make it easier for readers to understand the flow, the author creates an analysis flow in the form of a flowchart as follows in Fig. 2. The linker scale used in the fuzzy servqual calculation can be seen in Table 1.

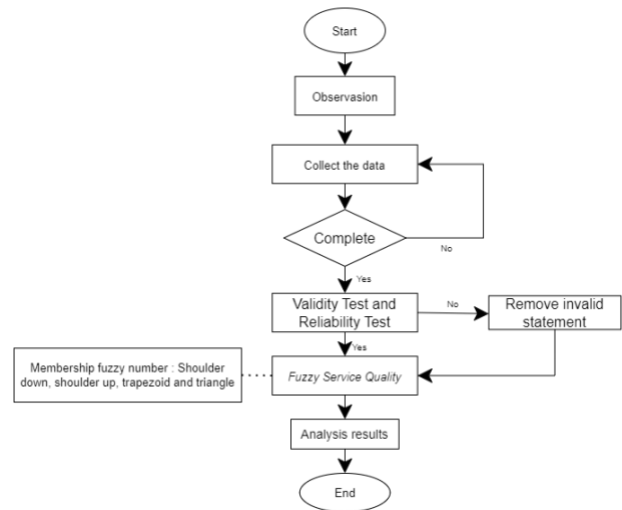


Fig 2. The flow of Fuzzy servqual 3 fuzzy number method.

Table 1.Linkert scale (source in (Purnama, 2006)).

LINGUISTIC	DOMAIN	RANGE
Very Dissatisfied (VD)	0 – 2	0,1,2
Not Satisfied (NS)	2 – 4	2,3,4
Quite Satisfied (QS)	4 – 6	4,5,6
Satisfied (S)	6 – 8	6,7,8
Very Satisfied (VS)	8 – 10	8,9,10

a. Fuzzy membership

The membership function is a curve that shows the mapping of data input points into membership values (often also called membership degrees) which have intervals between 0 and 1 (Wulandari et al., 2021).

In this servqual fuzzy calculation, it uses 3 types of fuzzy numbers, namely the right shoulder, left shoulder, triangle and trapezoid

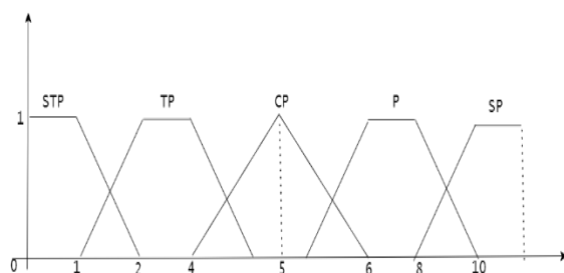


Fig 3. Fuzzy number.

After the fuzzy number is built, the next step is to look for the value on the fuzzy number

- Fuzzy number STP

$$\mu(STP)_x = \begin{cases} 1 & , x \leq 10 \\ \frac{20-x}{10} & , 10 \leq x \leq 20 \\ 0 & , x \geq 20 \end{cases} \quad (1)$$

- Fuzzy number TP

$$\mu(TP)_x = \begin{cases} 1 & , 20 \leq x \leq 40 \\ \frac{x-10}{20-10} & , 10 \leq x \leq 20 \\ \frac{50-x}{50-40} & , 40 \leq x \leq 50 \\ 0 & , x \leq 10, x \geq 50 \end{cases} \quad (2)$$

- Fuzzy number SP

$$\mu(SP)_x = \begin{cases} 1 & , X \geq 100 \\ \frac{x-80}{100-80} & , 80 \leq x \leq 100 \\ 0 & , X \leq 80 \end{cases} \quad (3)$$

- Fuzzy number CP

$$\mu(CP)_x = \begin{cases} 0 & , x \leq 40, x \geq 60 \\ \frac{x-40}{50-40} & , 40 \leq x \leq 50 \\ \frac{60-x}{60-50} & , 50 \leq x \leq 60 \end{cases} \quad (4)$$

- Fuzzy number P

$$\mu(P)_x = \begin{cases} 1 & , 60 \leq x \leq 80 \\ \frac{x-50}{60-50} & , 50 \leq x \leq 60 \\ \frac{100-x}{100-80} & , 60 \leq x \leq 80 \\ 0 & , x \leq 50, x \geq 100 \end{cases} \quad (5)$$

b. Overall effectiveness measure

At this stage fuzzification calculations are carried out to obtain the values of the lower limit (c), middle limit (a), and upper limit (b) which are the values of the Triangular Fuzzy Number (TFN). To do fuzzification can be done with the following overall effectiveness in Eq. (1, 2, and 3).

$$a = \frac{(a_{j1} + n_{j1}) + (a_{j2} + n_{j2}) + \dots + (a_{ji} + n_{ji})}{(a_{j1} + a_{j2} + \dots + a_{ji})} \quad (6)$$

$$b = \frac{(b_{j1} + n_{j1}) + (b_{j2} + n_{j2}) + \dots + (b_{ji} + n_{ji})}{(b_{j1} + b_{j2} + \dots + b_{ji})} \quad (7)$$

$$c = \frac{(c_{j1} + n_{j1}) + (c_{j2} + n_{j2}) + \dots + (c_{ji} + n_{ji})}{(c_{j1} + c_{j2} + \dots + c_{ji})} \quad (8)$$

Information: c is upper limit, b is middle limit, a is lower limit, n is number of respondents, i is criteria (1,2,3,4,5), n_{ji} is number of respondents per importance level.

c. Defuzzification

This defuzzification is carried out in order to obtain a single representative value of each indicator of the statement. The defuzzification results will then be used to calculate the gap value per statement indicator. The following is a defuzzification calculation using the Arithmetic Mean formula, namely center of area (CoA), can be calculated in Eq. (9).

$$Z_x = \frac{x \cdot a + x \cdot b}{a + b} \quad (9)$$

d. GAP

The calculation is carried out by finding the average of the statement indicators of each statement variable, can be calculated in Eq. (10).

$$Gap = P - H \quad (10)$$

5. Conclusion

Servqual with 5 dimensions such as reliability, responsiveness, assurance, empathy and tangibles can be formulated using 3 types of fuzzy numbers, namely right shoulder, left shoulder, triangle and trapezoid. The results from this research obtained are in the fuzzyfication step from fuzzy number improvement make gap results better with better accuracy.

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