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# Analysis of FAM in satisfaction of inpatient services

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**ABSTRACT**

Patients are the main object who must get the best service at a hospital, because the quality of hospital services determines the recovery of a patient and the quality of the hospital. The quality of hospital services has two components, namely the fulfillment of predetermined quality standards and the fulfillment of patient satisfaction. Hospitals must provide services that focus on patient satisfaction. Improving the quality of health services can be started by evaluating each element that plays a role in shaping patient satisfaction. The application of evaluation measures to patient care in each hospital is needed as an increase in the quality of service to patients. The analysis of the fuzzy associate memory method has the closeness of human reasoning to get solutions to various problems so that they are easy to apply and understand. Utilization of decision support system (DSS) analysis with fuzzy associate memory method can be used as an evaluation of the perception of each consumer complaint to measure the level of patient satisfaction.



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## 1. INTRODUCTION

The hospital is a place for providing health services provided by doctors [1], nurses and other health professionals. And the quality of hospital servants has two components, namely fulfillment of predetermined quality standards and fulfillment of customer satisfaction [2]. Hospitals must provide services that focus on customer satisfaction so that health services have a very important role for every visitor who comes to the hospital [3]. Improving the quality of health care services can be started by evaluating every element that plays a role in shaping patient satisfaction, so that the health care system can be improved through clinical channels, services, including patient perspectives such as some of the health services they need. The quality of this service in the end can provide several benefits, including establishing a harmonious relationship between the provision of goods and services with patients, providing a good basis for the creation of patient loyalty and forming recommendations from quality to quality that are favorable for the provision of these services. In decision support systems there are several methods used to solve a problem, one of which uses a computational method. One of the computational methods that are quite developed at this time is an intelligent system. In information technology, intelligent systems can also be used to make predictions. One of the methods in intelligent systems that can be used to make predictions is using fuzzy logic [4]. Utilization of fuzzy logic can be used as a decision support system (DSS) to determine the level of service satisfaction that is a problem by using the fuzzy associative memory (FAM) method. Decision support systems are computer-based systems that are used to make decisions in an organization, agency or company [5], [6]. So that the FAM method is one of the algorithms that have fuzzy logic so that this method can make flexible decisions [7], [8]. Fuzzy systems have the closeness of human reasoning [9], [10], so that the solutions obtained are easy to apply and understand. By utilizing the fuzzy system, it can be used as an evaluation of the perception of each consumer's complaint which can measure the level of satisfaction with the patient.

## 2. RESEARCH METHODS

### 2.1. DSS

DSS is also a computer-based information system that produces various alternative decisions that assist management in dealing with structured or unstructured problems using data or models [11], [12]. Decision support systems are usually built to support a solution to a problem or to evaluate an opportunity [13]. Decision support system is an interactive information system used to provide information, modeling, and data processing [14]. This system functions in making decisions in both semistructured and unstructured situations. Decision support systems are systems that help make decisions using data and models [15]. A system that can solve problems.

### 2.2. FAM

FAM which was first published by Bart Kosko [9], [16]. So that FAM is a fuzzy system that maps one fuzzy set to another [17], [18]. Simple FAM will map a fuzzy rule or set of pairs (Ai, Bj) that connects the fuzzy set Bj to fuzzy Ai, [19]. Thus, a FAM system can consist of several different FAM sets [14], [20].

The FAM algorithm is [8], [21]:

- Encodes input and output into a FAM matrix {(Ai, Bi) | 0 <= i <m} where m is the amount of data.
- Calculating the auto-associative fuzzy Hebbian FAM matrix with one of the two learning rules, namely with correlation-minimum encoding or with correlation product encoding.
- If the value of M has been obtained, the value of B can be found by relating the composition of A and M. We can also find the value of A by relating the composition of B and M. Composition relation can be done with max-min composition or with max-product composition .
- Perform a defuzzy process using the winner take all rule or by using the weighted average.

The four points of explanation above are illustrated in Figure 1.

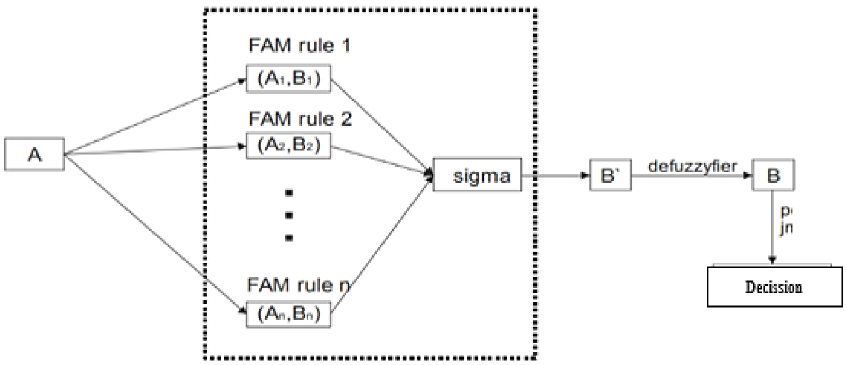


Figure 1. The FAM algorithm

## 3. ANALYSIS AND RESULT

### 3.1. Problem analysis

A patient, at the hospital provides an assessment of 5 criteria, namely service, facilities, comfort, cleanliness, rates and values given by a patient in service 50, facilities 65, comfort 67, cleanliness 70 and rate 75, then from the assessment given by the patient We can determine the level of patient satisfaction using the fuzzy Associative Memory method based on the algorithmic steps. The FAM flowchart starts from the input variable, define matrix, FAM process, defuzzyfication and displays the results, the flow can be seen in Figure 2.

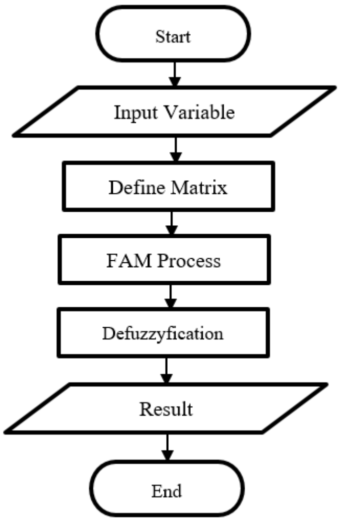


Figure 2. Flowchart FAM

– Encoding input and output into FAM matrix

Encoding fuzzy (A, B) = ((a1, a2, ... an), (b1, b2, ... bp)) to numerically form a fuzzy associative memory matrix, requires the Hebb learning rules [22], [23]. There are 2 lessons, namely correlation-minimum encoding or with correlation product encoding. The rule used is correlation product encoding (M=AToB).

Based on the patient's function in each of the fuzzy set of variables above.

a. The function of the patient for each service set (input) is as follows;

$$a1 = \mu\, Less\,(50) = (90 - 50) / (90 - 30) = 0.66$$

$$a2 = \mu\, Enough\,(50) = (90 - 50) / (90 - 60) = 1.33$$

$$a3 = \mu\, Good\,(50) = (50 - 30) / (90 - 30) = 0.33$$

This explanation is in accordance with Figure 3.

b. Patient functions in each facility set (input) are as follows:

$$a1 = \mu\, Less\,(65) = (90 - 65) / (90 - 30) = 0.41$$

$$a2 = \mu\, Enough\,(65) = (90 - 65) / (90 - 60) = 0.83$$

$$a3 = \mu\, Good\,(65) = (65 - 30) / (90 - 30) = 0.58$$

This explanation is in accordance with Figure 4.

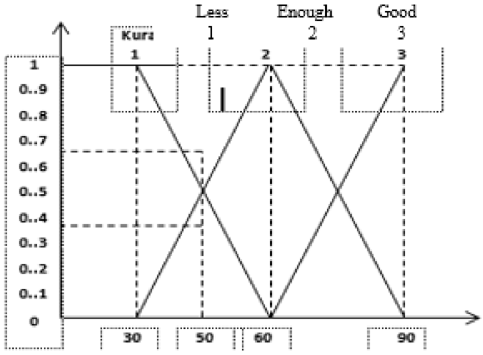


Figure 3. Function of patient care

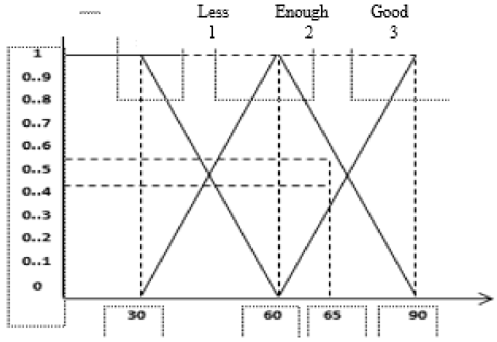


Figure 4. Functions of patient facilities

c. The patient's functions for each comfort set (input) are as follows:

$$a1 = \mu\, Less\,(67) = (90 - 67) \,/\, (90 - 30) = 0.38$$

$$a2 = \mu\, Enough\,(67) = (90 - 67) \,/\, (90 - 60) = 0.76$$

$$a3 = \mu\, Good\,(67) = (67 - 30) \,/\, (90 - 30) = 0.61$$

This explanation is in accordance with Figure 5.

d. Patient functions in each cleanliness set (input) are as follows:

$$a1 = \mu\, Less\,(70) = (90 - 70) \,/\, (90 - 30) = 0.33$$

$$a2 = \mu\, Enough\,(70) = (90 - 70) \,/\, (90 - 60) = 0.66$$

$$a3 = \mu\, Good\,(70) = (70 - 30) \,/\, (90 - 30) = 0.66$$

This explanation is in accordance with Figure 6.

e. Patient functions for each tariff set (input) are as follows:

$$a1 = \mu\, Cheap\,(75) = (90 - 75) \,/\, (90 - 30) = 0.25$$

$$a2 = \mu\, Quite\ Expensive\,(75) = (90 - 75) \,/\, (90 - 60) = 0.5$$

$$a3 = \mu\, Expensive\,(75) = (75 - 30) \,/\, (90 - 30) = 0.75$$

This explanation is in accordance with Figure 7.

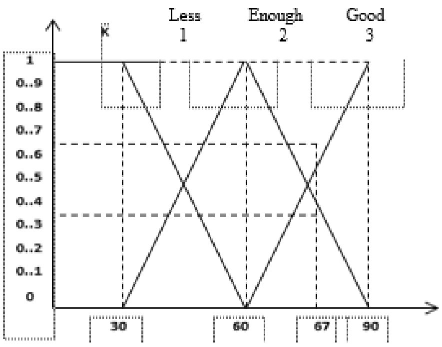


Figure 5. Functions of patient comfort

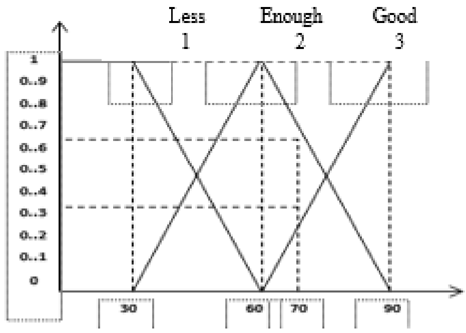


Figure 6. Graph of patient hygiene functions

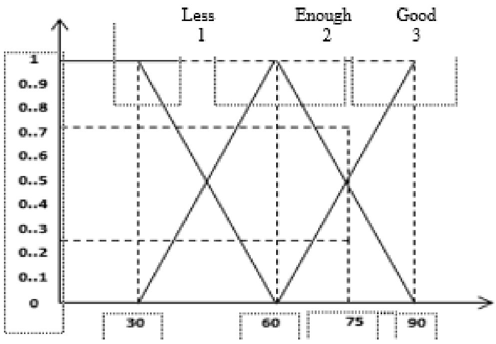


Figure 7. Graph of patient functions rates

– Calculating auto associative fuzzy hebbian FAM

From the research process, it can be seen that the value of A = (0.66, 0.58, 0.61, 0.66, 0.75) and B = (0.7, 0.6, 0.6, 0.7, 0.8) thus the M matrix based on correlation-product encoding can be seen as the following:

$$M=A^{T}{}_{O}B = \begin{bmatrix} 0.66 \\ 0.58 \\ 0.61 \\ 0.66 \\ 0.75 \end{bmatrix} (0.7,0.6,0.6,0.7,0,8)= \begin{bmatrix} 0.46 & 0.39 & 0.39 & 0.46 & 0.52 \\ 0.40 & 0.34 & 0.34 & 0.40 & 0.46 \\ 0.42 & 0.36 & 0.36 & 0.42 & 0.48 \\ 0.46 & 0.39 & 0.39 & 0.46 & 0.52 \\ 0.52 & 0.45 & 0.45 & 0.52 & 0.60 \end{bmatrix}$$

– Relation of composition A and B

If the value of the matrix M has been obtained, then the value of B can then be obtained by using the composition relation of A and M. The composition relation used is the max-product composition [24], [25]. At the max-product composition, the value of B can be obtained using the composition A o M as follows:

$$bj = max\,\{(ai * mij)\}, so\ that;$$

$$b1 = max\{(0.66 * 0.46)\ ;\ (0.58 * 0.40);\ (0.61 * 0.42)\ ;\ (0.66 * 0.46);\ (0.75 * 0.52)\}$$
$$= max\{0.30;\ 0.0.23;\ 0.25;\ 0.30;\ 0.39\} = 0.39$$

$$b2 = max\{(0.66 * 0.39)\ ;\ (0.58 * 0.34);\ (0.61 * 0.36)\ ;\ (0.66 * 0.39);\ (0.75 * 0.45)\}$$
$$= max\{0.25;\ 0.19;\ 0.21;\ 0.23;\ 0.33\} = 0.33$$

$$b3 = max\{(0.66 * 0.39)\ ;\ (0.58 * 0.34);\ (0.61 * 0.36)\ ;\ (0.66 * 0.39);\ (0.75 * 0.45)\}$$
$$= max\{0.25;\ 0.19;\ 0.21;\ 0.23;\ 0.33\} = 0.33$$

$$b4 = max\{(0.66 * 0.46)\ ;\ (0.58 * 0.40);\ (0.61 * 0.42)\ ;\ (0.66 * 0.46);\ (0.75 * 0.52)\}$$
$$= max\{0.30;\ 0.23;\ 0.25;\ 0.30{,}0;\ 0.39\} = 0.39$$

$$b5 = max\{(0.66 * 0.52)\ ;\ (0.58 * 0.46);\ (0.61 * 0.48)\ ;\ (0.66 * 0.52);\ (0.75 * 0.60)\}$$
$$= max\{0.34;\ 0.26;\ 0.29;\ 0.34;\ 0.45\} = 0.45$$

$$B = 0.39;\ 0.33;\ 0.33;\ 0.39;\ 0.45$$

– Defuzzy

In the FAM method, the defuzzyfication process is carried out in 2 ways, namely winner take all by taking the highest value of B*100% or the corresponding weighted average. So, that in the case of this study the final score to determine the level of satisfaction of the patient is b5=0.45*100%=45% (winner take all). If the weighted average is calculated in the following way, [26]:

$$B^* = \frac{(0.39*50)+(0.33*65)+(0.33*67)+(0.39*70)+(0.45*75)}{0.39+0.33+0.33+0.39+0.45} = 65.66$$

From the results above, there is a table for assessing the level of patient satisfaction as in Table 1. From the results of the calculations that have been done, the example of the case above has a defuzz value or a final score of 65.66 and if it is presented to 66%, then the case above the patient on the 3rd floor feels Quite Satisfied with the services provided by the hospital.

Table 1. Assessment of patient satisfaction level

| No | Decision | Value Parameters |
|---|---|---|
| 1 | Very dissatisfied | 0-39 |
| 2 | Unsatisfied | 40-59 |
| 3 | Quite Satisfied | 60-79 |
| 4 | Very Satisfied | 80-100 |

## 4. CONCLUSION

The research conducted has the following conclusions, the method used to determine the level of patient satisfaction with inpatient services at the hospital is to get a score on each questionnaire given to the patient, the selection of the right criteria in the analysis makes this study very accurate in determining the results, in the application of the FAM method for the selection of criteria based on the level of importance, and giving weight to the alternatives to be selected, and analytical methods can be used in different cases by providing appropriate criteria for the problem to be solved.

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