Fuzzy Analysis Determining The Criteria of Recipients for Liable Housing Using Sugeno Method

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Abstract

The house is the most important part in human life, a comfortable home will produce peace of mind and soul to carry out daily life. Currently, many rural communities have houses in poor conditions or are not suitable for occupancy, so the government provides housing assistance to be repaired to make it better and more durable. The problem that occurs is that there is no knowledge system in determining people who are entitled to housing assistance according to predetermined criteria. The purpose of this study is to help make it easier to select the right community to receive assistance in the form of a system. The settlement of this case uses the Sugeno method with the output results in the form of values 0 and 1. The variables used in this study are 4, namely family cards, identity cards, land ownership rights and house conditions, output in the form of systems in decision making.

***Keywords;*** *Uninhabitable House Assistance, Fuzzy Logic, Sugeno Method, Decision Making System.*

1. Introduction

Fuzzy logic is a problem-solving control system methodology, which is suitable to be implemented on systems, ranging from simple systems, small systems, embedded systems, PC networks, multi-channel or workstation-based data acquisition, and control systems. This methodology can be applied to hardware, software, or a combination of both. In classical logic it is stated that everything is binary, which means that it has only two possibilities, "Yes or No", "True or False", "Good or Bad", etc. Therefore, all of these can have membership values 0 or 1. However, fuzzy logic allows the membership value to be between 0 and 1. That is, it is possible for a situation to have two values "Yes and No", "True and False", "Good and Bad" simultaneously, but the value depends on the weight of the membership it has [1].

According to [2] Fuzzy logic is an appropriate way to map an input space into an output space. The reasons for using Fuzzy Logic are:

a) The concept of Fuzzy Logic is easy to understand. The mathematical concepts underlying fuzzy reasoning are very simple and easy to understand.
b) Fuzzy logic is very flexible.
c) Fuzzy logic has tolerance for inaccurate data.
d) Fuzzy logic is able to model very complex nonlinear functions.
e) Fuzzy logic can build and apply the experiences of experts directly without having to go through the training process.
f) Fuzzy logic can work with conventional control techniques.
g) Fuzzy logic is based on natural language.

The set is a collection or collection of objects that have certain properties in common. The fuzzy set is a further development of the concept of sets in mathematics. The fuzzy set is a range of values, each value has a membership degree between 0 to 1 (Charolina, 2016). According to (Maryaningsih, Siswanto, & Masterjon, 2013) on the crisp set, the
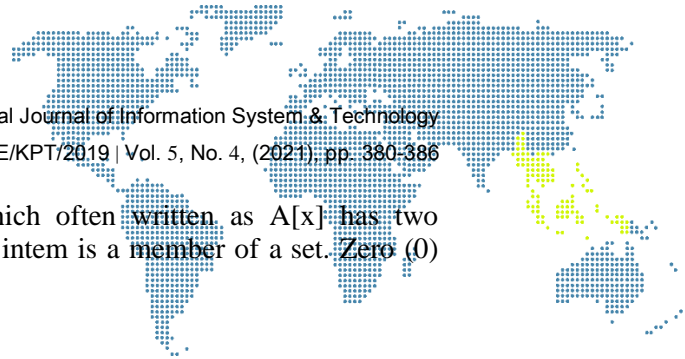
membership value of an intem x in a set A, which often written as A[x] has two possibilities, namely: One (1), which means that an intem is a member of a set. Zero (0) which means that an intem is not a member of a set.

2. Research Methodology

According to (Minarni & Aldyanto, 2016) there are 3 types of fuzzy which are included in the fuzzy inference system, namely:

a) Mamdani Method

The Mamdani Method is often known as the Max-Min Method. Formation of fuzzy sets. B. Application function Implication. C. Composition of Rules. D. Affirmation (defuzzification). In this method, confirmation is obtained by taking the center point (z*) of the fuzzy area. Generally formulated:

$$Z^* = \frac{\int_z 2\mu(z)dz}{\int_z \mu(z)dz} \qquad (1)$$

b) Sugeno Method

It is also called the TSK fuzzy inference system method introduced by Takagi, Sugeno and Kang. The output of the fuzzy inference system requires 4 stages the same as the Mamdani method, the difference is in the defuzzification stage. In this process the output is in the form of crisp numbers. Defuzification is done by finding the average value, namely:

$$Z = \frac{\sum_{r=1}^{R} \alpha r z r}{\sum_{r=1}^{R} \alpha r} \qquad (2)$$

c) Tsukamoto Method

The Tsukamoto method is an extension of monotonous reasoning. In the Tsukamoto method, every consequence of a rule in the form of If-Then must be represented by a fuzzy set with a monotonic membership function. based on the predicate. The final result is obtained using the weighted average.

$$Z = \frac{\alpha_1 z_1 + \alpha_2 z_2 + \cdots + \alpha_i z_i}{\alpha_1 + \alpha_2 + \cdots + \alpha_i} \qquad (3)$$

In order to get a good form of research, it is necessary to have a systematic process of making it, the steps for completing this research are:
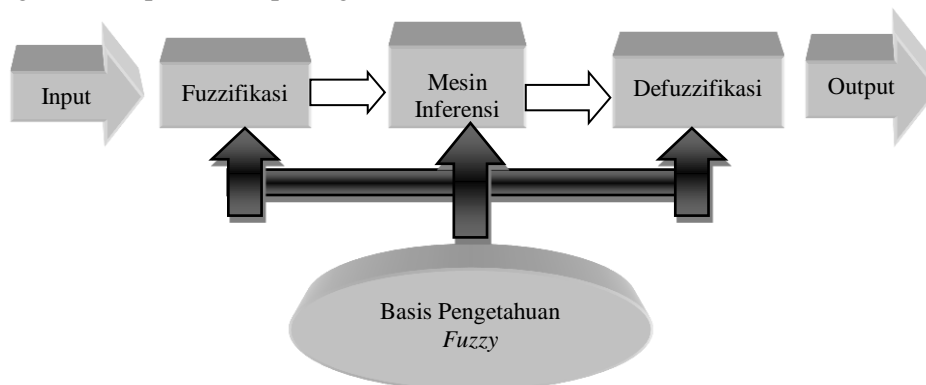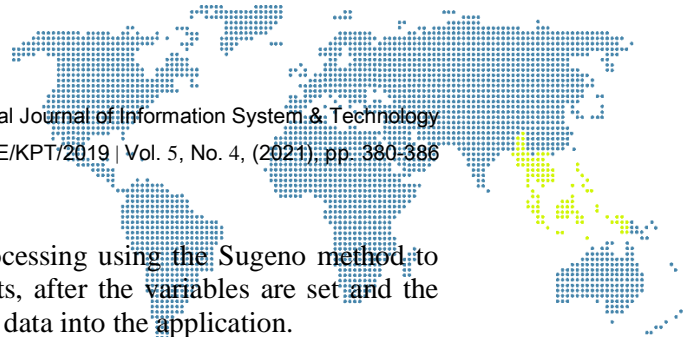

Figure 1. Fuzzy Inference System Structure

3. Results and Discussion

The Fuzzy discussion begins with data from processing using the Sugeno method to determine variables, then the formation of fuzzy sets, after the variables are set and the fuzzy sets have been formed, the next step is to enter data into the application.

Input Variables

       a) Family card;
       b) Identity Card;
       c) Land of ownership;
       d) House Eligibility.

Output Variable

       a) Decent;
       b) Considered;
       c) Not eligible.

Fuzification

In this study, there are five input variables, namely, Family Card, Identity Card, Land Ownership, and House Eligibility and as output in the form of a decision. The explanation is in table 1.

Table 1. Fuzzy Set

Fungsion	Variable Name	Universe of Conversation
Input	Family card	[0 100]
	Identity card	[0 100]
	Land Status	[0 100]
	Home Condition	[0 100]
Output	Desicion	[0 100]

The fuzzy set domain table describes the domain range used in determining the domain range in the fuzzy set in table 2.

Table 2. Domains of Fuzzy Sets

Variabel	Nama Himpunan Fuzzy	Domain
Family card	Complete	[80 100]
	in the process	[55 85]
	There is not any	[0 50]
Identity card	Available	[70 100]
	In Process	[60 80]
	There is not any	[0 70]
Land Status	Right of ownership	[80 100]
	Shared	[65 90]
	Rent	[0 70]
Home Condition	Not feasible	[65 100]
	less worthy	[45 85]
	Very Worthy	[0 45]
Desicion	Eligible/Not Eligible/Considered	0-1

The Family Card variable is divided into three membership functions, complete, in the process of making and not present. Each membership function is desired to be of type trimf and trapmf with parameters [80 90 100], [55 70 85].

$$\mu \text{ There is not any } [x] = \begin{cases} 1 & ; & x \leq 90 \\ \frac{100-x}{100-90} & ; & 90 \leq x \leq 100 \\ 0 & ; & x \geq 100 \end{cases}$$

$$\mu\text{in the process } [x] = \begin{cases} 0 & ; \quad x \leq 55 \text{atau} \geq 85 \\ \frac{x-55}{70-55} & ; \quad\quad 55 \leq x \leq 70 \\ \frac{85-x}{85-70} & ; \quad\quad 70 \leq x \leq 85 \end{cases}$$

$$\mu\text{Complete } [x] = \begin{cases} 0 & ; \quad\quad x \leq 0 \\ \frac{x-0}{25-0} & ; \quad 0 \leq x \leq 25 \\ 1 & ; \quad 25 \leq x \leq 50 \end{cases}$$

The Identity Card variable is divided into three membership functions, namely Available, in the process of making and not available. Each membership function is desired to be of type trimf and trapmf with parameters [80 90 100], [65 75 95] and [0 35 70].

$$\mu\text{ There is not any } [x] = \begin{cases} 1 & ; \quad\quad x \leq 35 \\ \frac{70-x}{70-35} & ; \quad 35 \leq x \leq 70 \\ 0 & ; \quad\quad x \geq 70 \end{cases}$$

$$\mu\text{ in the process } [x] = \begin{cases} 0 & ; \quad x \leq 450 \text{ atau} \geq 95 \\ \frac{x-65}{75-65} & ; \quad\quad 450 \leq x \leq 75 \\ \frac{90-x}{95-75} & ; \quad\quad 550 \leq x \leq 95 \end{cases}$$

$$\mu\text{Available } [x] = \begin{cases} 0 & ; \quad\quad x \leq 80 \\ \frac{x-0}{35-0} & ; \quad 0 \leq x \leq 90 \\ 1 & ; \quad 35 \leq x \leq 100 \end{cases}$$

The land status variable is divided into three membership functions, namely property rights, joint property and rent. Each membership function is desired to be of type trimf and trapmf with parameters [0 30 50], [55 65 80] and [65 80 100 100].

$$\mu\text{Rent } [x] = \begin{cases} 1 & ; \quad\quad x \leq 30 \\ \frac{50-x}{50-30} & ; \quad 40 \leq x \leq 50 \\ 0 & ; \quad\quad x \geq 50 \end{cases}$$

$$\mu\text{ Shared}[x] = \begin{cases} 0 & ; \quad x \leq 55 \text{ atau} \geq 80 \\ \frac{x-55}{65-55} & ; \quad\quad 55 \leq x \leq 65 \\ \frac{80-x}{80-65} & ; \quad\quad 65 \leq x \leq 80 \end{cases}$$

$$\mu\text{ Right of ownership } [x] = \begin{cases} 0 & ; \quad\quad x \leq 65 \\ \frac{x-65}{80-65} & ; \quad 65 \leq x \leq 80 \\ 1 & ; \quad 80 \leq x \leq 100 \end{cases}$$

The variable of house conditions is divided into three membership functions, namely latak, less feasible and not feasible. Each membership function is desired to be of type trimf and trapmf with parameters [65 80 100], [45 70 85] and [0 25 45].

$$\mu\text{ Not feasible } [x] = \begin{cases} 1 & ; \quad\quad x \leq 25 \\ \frac{45-x}{45-25} & ; \quad 25 \leq x \leq 45 \\ 0 & ; \quad\quad x \geq 45 \end{cases}$$

$$\mu\text{ less worthy}[x] = \begin{cases} 0 & ; \quad x \leq 45 \text{ atau} \geq 85 \\ \frac{x-45}{70-45} & ; \quad\quad 45 \leq x \leq 70 \\ \frac{70-x}{85-70} & ; \quad\quad 70 \leq x \leq 85 \end{cases}$$

$$\mu\text{ Very Worthy } [x] = \begin{cases} 0 & ; \quad\quad x \leq 65 \\ \frac{x-65}{85-65} & ; \quad 65 \leq x \leq 85 \\ 1 & ; \quad 85 \leq x \leq 100 \end{cases}$$

Decision variables are divided into three membership functions, namely feasible, considered, not feasible. Each membership function is desired to be of type trimf and
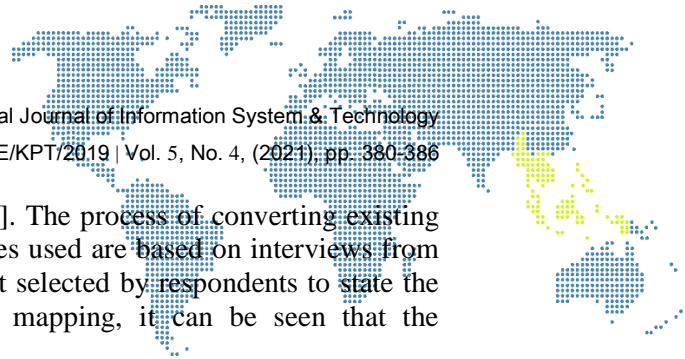
trapmf with parameters [0-0,3], [0,2-0,7] and [0,6-1]. The process of converting existing real/firm values into membership functions. The rules used are based on interviews from the maximum rules that can be formed and the most selected by respondents to state the relationship between input and output. From the mapping, it can be seen that the maximum rules are as follows:

Table 3. The Results

No Rule	Family card	Identity card	Land Status	Home Condition	Function Implication	Decision
Rule 1	Complete	Available	Rent	Not feasible	→	Right to Receive
Rule 2	In Process	Available	Rent	Not feasible	→	Right to Receive
Rule 3	There is not any	Available	Rent	Good	→	Considered
Rule 4	There is not any	In Process	Rent	Good	→	Not entitled to receive
Rule 5	There is not any	There is not any	Right of ownership	Sangat Worthy	→	Not entitled to receive
Rule 6	There is not any	There is not any	Shared	Good	→	Not entitled to receive
Rule 7	There is not any	Available	Shared	Shared	→	Not entitled to receive
Rule 8	In Process	Available	Shared	Not feasible	→	Right to Receive
Rule 9	There is not any	Available	Shared	Not feasible	→	Considered
Rule 10	Complete	Available	Shared	Not feasible	→	Considered

1) Input : Family Card = 90, Identity Card = 90, Land Status = 80, House Condition = 85. Look for the degree of membership of each variable.Family Card, consists of 3 fuzzy sets, namely Complete, In Process, and None. If it is known that the Family Card has a Value of X = 90 , then

μComplete[90] $= (x-a)/(b-a)$
$= (90-80)/(90-80)$
$= 10/10$
$= 1$

μIn Process[90] $= 0$
μThere is not any $= 0$

2) Identity Card, consists of fuzzy sets, namely Available, In Process and Not Available. If the value of the Identity Card is known x 90, then

μAvailable [90] $= (x-a)/(b-a)$
$= (90-80)/(90-80)$
$= 10/10$
$= 1$

μIn Progres[90] $= 0$
μThere is not any$[90] = 0$

3) Status of the house, consisting of fuzzy sets, namely rent, joint property and property rights. If the status of the house is known with a value of x [80], then

μShared[80] $= (x-a)/(b-a)$
$= (80-65)/(80-65)$
$= 15/15$
$= 1$

μRight of ownership[80] $= 0$
μRent $= 0$
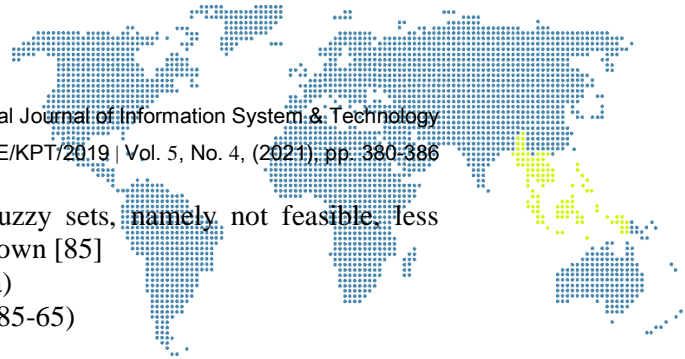
4) The condition of the house, consisting of 3 fuzzy sets, namely not feasible, less feasible and very feasible. If the value of X is known [85]

μ Not entitled to receive[85]   = (x-a)/(b-a)
                                    = (85-65)/(85-65)
                                    = 20/20
                                    = 1

μConsidered[85]   = 0
μRight to Receive [85]   = 0

5) Defuzzifikasi

$$z = \frac{(\alpha^1 * z^1) + (\alpha^2 * z^2) + (\alpha^3 * z^3) + (\alpha^4 * z^4)}{\alpha^1 + \alpha^2 + \alpha^3 + \alpha^4}$$

$$z = \frac{(1 * 1) + (1 * 1) + (1 * 1) + (1 * 1)}{\frac{1 + 1 + 1 + 1}{1 + 1 + 1 + 1}}$$

$$z = \frac{1 + 1 + 1 + 1}{1 + 1 + 1 + 1}$$

$$z = \frac{4}{4}$$

$$z = 1$$

Based on the search above, the number 1 is obtained which is at the output of the decision support system, which means the value of X is inputted into the defuzification process which produces a decent value.

4. Conclusion

Based on the results obtained from the process of finding the output value in the decision-making system, Sugeno's Fuzzy Logic can solve the problem of determining the people who are entitled to receive housing assistance in accordance with the conditions determined by the local government. get assistance, namely, Family Card, Identity Card, Land Status and House Condition, output variables, namely, eligible, considered or not feasible. With this system, it is possible to determine whether the community is eligible or not to receive housing assistance that is unfit for habitation. In addition, fuzzy Sugeno can be used as a system in decision making by considering input variables according to community conditions.

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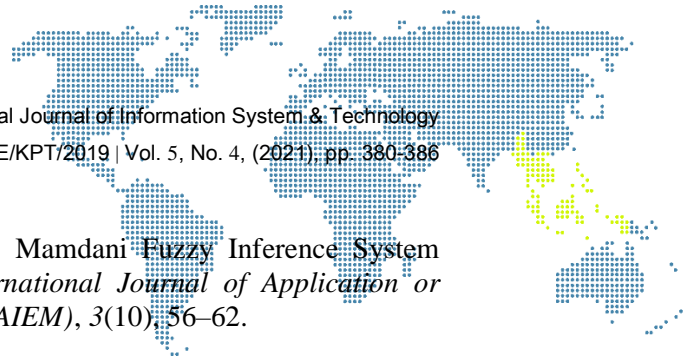
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