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# Utilization of Fuzzy Inference Marketing System for Home Purchase Based on Consumer Interest Using Sugeno Fuzzy Logic

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***Abstract***

*This study aims to determine the purchase of a house based on consumer interest in accordance with consumer criteria. By using the Sugeno method to determine the input and output variables which are a set of companies, then changing the input variables into a fuzzy set with a fuzzification process, then fuzzy processing manages the data with the minimum method. The last step is to convert the output into a set of deficits with a defuzzification process using the centroid method, so that it will get the desired results on the output variable. This study uses variables Size, Type, Design, Position and Material using mathematical constants or functions of input variables, and in the defuzzification process using the centralized mean method. The results of this study are by using the Sugeno method in fuzzy logic to determine house selection based on consumer interests, fuzzy logic can be used to assist in determining the selection of houses in Solok City and by applying the Sugeno method in fuzzy logic to be able to produce house buying decisions based on consumer interests.*

***Keywords****: House Selection, Fuzzy Logic, Sugeno method, Defuzification*

## 1. Introduction

Artificial intelligence is one part of computer science that makes machines (computers) able to do work as and as well as humans do. At the beginning of its creation, the computer only functioned as a calculating tool. But along with the times, the role of computers is increasingly dominating human life. Computers are no longer only used as calculating tools, more than that computers are expected to be empowered to do everything that humans can do [1]. Fuzzy logic is a problem-solving control system methodology, which is suitable to be implemented in 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 [2].

Fuzzy logic is an appropriate way to map an input space into an output space. The starting point of the modern concept of uncertainty is a paper made by Lofti A Zadeh (1965), in which Zadeh introduces a theory that has objects from fuzzy sets that have imprecise boundaries and membership in fuzzy sets, and not in true logical form. true) or false (false), but expressed in degrees (degrees). This concept is called Fuzziness and the theory is called Fuzzy Set Theory. Fuzziness can be defined as fuzzy logic regarding the semantics of an event, phenomenon or statement itself. Often found in statements made by someone, evaluation and decision making [3]. According to [4] Fuzzy logic is an appropriate way to map an input space into an output space. The reasons for using Fuzzy

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Logic are: The concept of Fuzzy Logic is easy to understand. The mathematical concepts underlying fuzzy reasoning are very simple and easy to understand.

1) Fuzzy logic is very flexible.
2) Fuzzy logic has tolerance for inaccurate data.
3) Fuzzy logic is able to model very complex nonlinear functions.
4) Fuzzy logic can build and apply the experiences of experts directly without having to go through the training process.
5) Fuzzy logic can work with conventional control techniques.
6) Fuzzy logic is based on natural language.

According to [5] on a crisp set (crisp), the membership value of an item x in a set A, which is often written as A[x] has two possibilities, namely:

a. One (1), which means that an item is a member of a set.
b. Zero (0) which means that an item is not a member of a set.

The fuzzy inference system will function as a controller for certain processes by using inference rules based on fuzzy logic [6]. The inference system has 4 units, namely:

1) The fuzzification unit.
2) Fuzzy logic reasoning unit.
3) Knowledge base unit consisting of:
   a) Database containing membership functions of fuzzy sets associated with the values of the linguistic variables used.
   b) The rule base contains rules in the form of fuzzy implications.
4) Defuzzification unit / defuzzification unit.

## 2. Research Methodology

Partial research design is a description of the relationship between variables, data collection, and data analysis, so that with a good design both researchers and interested parties have a clear picture of the relationship between variables in the research context and what a researcher wants to do in conducting research [7].

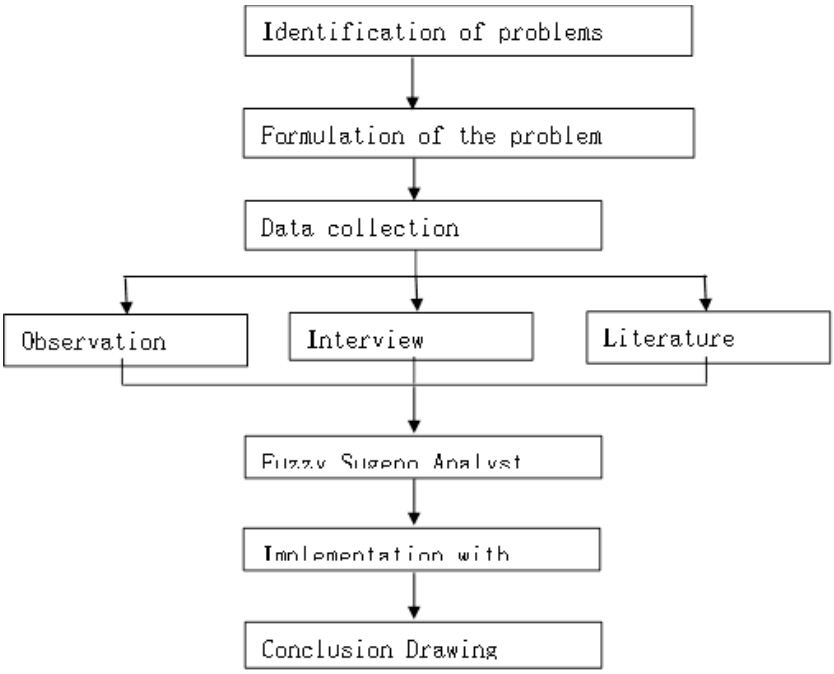


**Figure 2.** Framework

Accordance with Figure 1, the research steps to be carried out are as follows:

a) Identify the problem.
The initial step taken in this research is to identify the problem or subject matter in determining the object as the material to be studied in this study.

b) Problem Formulation.
At this stage the researcher formulates the problem which is the reason for this research. The purpose of this problem formulation is for researchers to know the specific problem so that it can be easier and more focused to solve the problem through research.

c) Data Collection.
The purpose of data collection is to obtain data related to the criteria for consumer interest in housing

d) Fuzzy Sugeno Analysis.
After all the necessary data has been collected, the author will process the data by analyzing it using Sugeno's fuzzy logic method.

e) Implementation with MATLAB.
After the researchers carried out the test manually by calculating manually, data processing was carried out with the help of MATLAB software using the facilities provided in the fuzzy toolbox to determine more precise results.

f) Withdrawal of Conclusion.
Withdrawal of results can be known after the data is obtained, identified, processed based on research design and testing which will produce output conclusions and suggestions for research

## 3. Results and Discussion

Fuzzy Inference system analysis after collecting data and grouping it, then obtained 5 input variables and 1 output variable. The input variables consist of Design, Position, Material, PRICE, and type while the output variable is to buy or not to buy. The process of solving fuzzy cases has four parts, namely fuzification, Inference Engine, Implication Function Application and Defuzification. Below is a table of fuzzy sets.

**Table 1.** Fuzzy Set

| Function | Variable Name | Universe of Conversation |
|---|---|---|
| Input | Design | [0 40] |
| | Position | [0 100] |
| | Material | [0 20] |
| | Price | [0 1000] |
| | Type | [0 100] |
| Output | Consumer Interest | [0 100] |

**Table 2.** Domains of Fuzzy Sets

| Variable | Fuzzy Set Name | Domain | Universe of Conversation |
|---|---|---|---|
| Desain | Minimalist | [60 100] | [0 0 12 19] |
| | Semi Minimalis | 50 70]] | [16 23 30] |
| | Simple | [40 60] | [27 34 40 40] |
| Posision | Hook | [70 100] | [0 0 69 84] |
| | Currently | [60 80] | [69 84 99] |
| | Small | [60 70] | [84 99 100 100] |
| Material | Very Nice | [65 100] | [0 0 1 9] |
| | Good | [60 70] | [1 9 18] |
| | Currently | [55 65] | [9 18 20 20] |

| Variable | Fuzzy Set Name | Domain | Universe of Conversation |
|---|---|---|---|
| Price | Tall | [50 100] | [55 70 100 100] |
| | Currently | [30 79] | [40 55 70] |
| | Inexpensive | [0 50] | [0 0 40 50 |
| Tipe | Big | [75 100] | [75 90 100 100] |
| | Currently | [60 90] | [60 75 90] |
| | Small | [0 75] | [0 0 60 75] |
| Decision | Buy | [60 100] | [60 70 100 100] |
| | Not Buying | [0 40] | [ 0 0 40 50] |

Design membership form:

$$\mu\text{Minimalist} = \begin{cases} 1; & x \leq 12 \\ \frac{19-x}{19-12}; & 20 \leq x \leq 19 \\ 0; & x \geq 19 \end{cases}$$

$$\mu\text{Semi Minimalis} = \begin{cases} 0; & x \leq 16 \; atau \; x \geq 30 \\ \frac{x-16}{23-16}; & 16 \leq x \leq 23 \\ \frac{30-x}{30-23}; & 23 \leq x \leq 30 \end{cases}$$

$$\mu\text{Simple} = \begin{cases} 0; & x \leq 27 \\ \frac{x-27}{34-27}; & 27 \leq x \leq 34 \\ 1; & 34 \leq x \leq 40 \end{cases}$$

On the Sesain temperature variable: fill in the range with [0 40]. The Simple fuzzy set uses the trapmf type (trapezoidal-shaped membership function) with the domain [0 0 12 19], for the Semi Minimalist fuzzy set it uses the trimf type (triangular membership function) with the domain [16 23 30], and for the Minimalist fuzzy set it uses trapmf type (trapezoidal-shaped membership function) with domain [27 34 40 40]. Trapmf and trimf are used to display fuzzy set domains in the form of trapezoidal curves and triangles are basically a combination of 2 lines (linear). Position membership form:

$$\mu\text{Small} = \begin{cases} 1; & x \leq 84 \\ \frac{84-x}{84-69}; & 69 \leq x \leq 84 \\ 0; & x \geq 84 \end{cases}$$

$$\mu\text{Currently} = \begin{cases} 0; & x \leq 69 \; atau \; x \geq 99 \\ \frac{x-69}{84-69}; & 69 \leq x \leq 84 \\ \frac{99-x}{99-84}; & 84 \leq x \leq 99 \end{cases}$$

$$\mu\text{Hook} = \begin{cases} 0; & x \leq 84 \\ \frac{x-84}{99-84}; & 84 \leq x \leq 99 \\ 1; & 84 \leq x \leq 100 \end{cases}$$

In the Position variable: fill in the range with [0 100]. The Small fuzzy set uses the trapmf type (trapezoidal-shaped membership function) with the domain [0 0 69 84], for the medium fuzzy set it uses the trimf type (triangular membership function) with the domain [69 84 99], and for the Hook fuzzy set uses the type trapmf (trapezoidal-shaped membership function) with domain [84 99 100 100]. Material membership form:

$$\mu\text{Currently} = \begin{cases} 1; & x \leq 1 \\ \frac{9-x}{9-1}; & 1 \leq x \leq 9 \\ 0; & x \geq 9 \end{cases}$$

$$\mu\text{Good} = \begin{cases} 0; & x \le 1 \; atau \; x \ge 18 \\ \frac{x-1}{9-1}; & 1 \le x \le 9 \\ \frac{18-x}{18-9}; & 9 \le x \le 18 \end{cases}$$

$$\mu\text{Very Nice} = \begin{cases} 0; & x \le 9 \\ \frac{x-9}{18-9}; & 9 \le x \le 18 \\ 1; & 18 \le x \le 20 \end{cases}$$

In the lMaterial variable: fill in the range with [0 20]. In the Medium fuzzy set using the trapmf type (trapezoidal-shaped membership function) with the domain [0 0 1 9], for the Good fuzzy set using the trimf type (triangular membership function) with the domain [1 9 18], and for the Very Good fuzzy set using trapmf type (trapezoidal-shaped membership function) with domain [9 18 20 20]. Trapmf and trimf are used to display fuzzy set domains in the form of trapezoidal curves and triangles are basically a combination of 2 lines (linear). Membership form Price:

$$\mu\text{Tall} = \begin{cases} 1; & x \le 30 \\ (50-x)/(50-30) & 30 \le x \le 50 \\ 0; & \le x50 \end{cases}$$

$$\mu\text{Currently} = \begin{cases} 0; & x \le 30 atau \; x \ge 70 \\ (x-30)/(50-30); & 30 \le x \le 50 \\ (70-x)/(70-50); & 50 \le x \le 70 \end{cases}$$

$$\mu \text{ Inexpensive} = \begin{cases} 1; & x \le 50 \\ (50-x)/(70-50) & 50 \le x \le 70 \\ 0; & \le x70 \end{cases}$$

In the Price variable: fill in the range . The High fuzzy set uses the trapmf type (trapezoidal-shaped membership function) with the domain [55 70 100 100] , the Medium fuzzy set uses the trimf type (triangular membership function) with the domain [40 55 70] , and for the Cheap fuzzy set uses the type trapmf (trapezoidal-shaped membership function) with domain[0 0 40 50. Trapmf and trimf are used to display fuzzy set domains in the form of trapezoidal curves and triangles are basically a combination of 2 lines (linear). Type set can be seen in the following equation:

$$\mu\text{Small} = \begin{cases} 1; & x \le 60 \\ (75-x)/(75-60) & 60 \le x \le 75 \\ 0; & \le x75 \end{cases}$$

$$\mu\text{Currently} = \begin{cases} 0; & x \le 30 atau \; x \ge 70 \\ (x-60)/(75-60); & 60 \le x \le 75 \\ (90-x)/(90-75); & 75 \le x \le 90 \end{cases}$$

$$\mu\text{Big} = \begin{cases} 1; & x \le 75 \\ (75-x)/(70-75) & 75 \le x \le 90 \\ 0; & \le x90 \end{cases}$$

On the Price variable: fill in the range with [0 100]. Large fuzzy sets use trapmf type (trapezoidal-shaped membership function) with domain [75 90 100 100] , for Medium fuzzy set use trimf type (triangular membership function) with domain [60 75 90] , and for Small fuzzy set use type trapmf (trapezoidal-shaped membership function) with domain [0 0 60 75]. Trapmf and trimf are used to display fuzzy set domains in the form of

trapezoidal curves and triangles are basically a combination of 2 lines (linear). The next step is to make a combination of each input and output variable rule.

**Table 3.** Rules formed in FIS

| Rule | Desain | posision | Material | Price | Type | Desicion |
|---|---|---|---|---|---|---|
| R1 | Minimalist | Hook | Very Good | Expensive | Big | Buy |
| R2 | Semi Minimalis | Hook | Very Good | Expensive | Big | Buy |
| R3 | Simple | Hook | Very Good | Expensive | Big | Buy |
| R4 | Minimalist | Currently | Very Good | Expensive | Big | Buy |
| R5 | Minimalist | Small | Very Good | Expensive | Big | Buy |
| R6 | Minimalist | Hook | Good | Expensive | Big | Buy |
| R7 | Minimalist | Currently | Currently | Expensive | Big | Buy |
| R8 | Minimalist | Small | Currently | Currently | Big | Buy |
| R9 | Minimalist | Hook | Very Good | Currently | Big | Buy |
| R10 | Minimalist | Hook | Very Good | Currently | Small | Buy |
| R11 | Minimalist | Small | Currently | Currently | Small | Not Buying |
| R12 | Minimalist | Small | Currently | Currently | Small | Not Buying |
| R13 | Minimalist | Small | Currently | Small | Small | Not Buying |
| R14 | Semi Minimalis | Currently | Currently | Currently | Small | Not Buying |
| R15 | Currently | Currently | Currently | Currently | Small | Not Buying |

In the Sugeno method, the implication function used is Max. However, before entering the implication function, the rules are determined first. In general, rules are made by experts intuitively. Rules in the form of qualitative statements written in the form of if then, so that it is easy to understand Inference.

## 4. Conclusion

Based on the research results that have been described in various stages, it can be concluded that the results of this study are:

a) In buying a house based on consumer interest there are 5 criteria that must be considered such as design, position, material, price and type so as to produce decisions for consumers.
b) The process of the Sugeno method is able to solve the problem of choosing a house based on consumer interest
c) The logic of the fuzzy inference system is able to produce output in the selection of houses based on criteria according to consumer interest
d) Mapu be used as a decision-making system in the selection of buying a house.

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