Fuzzy Implementation in The Selection of A Chieving Employees at PT. Sumber Barkah using Matlab Software

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Abstract

A company must set a high standard of discipline so that the company can develop quickly. A good company cannot be separated from the performance of employees in the form of standard rules made. With the standard, the company can see employees who excel and can be used as examples for other employees. There are 3 generated criteria such as performance, target and absence. The main purpose of this study is to provide criteria for selecting outstanding employees in a company. This study uses mamdani which uses the lowest min value and uses the AND operator to get the results. There are four things in the Mamdani fuzzy process, the first is the fuzification of the determination of the input value, the second is the application of the implication function, the third is the inference rules and the last is defuzzification. The results of this study can be used as a standard in determining outstanding employees at PT Berkah.

Keywords: Achievement Employees, Fis, Mamdani Method, Matlab Software

1. Introduction

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 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 [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:

- 1) The concept of Fuzzy Logic is easy to understand. The mathematical concepts underlying fuzzy reasoning are very simple and easy to understand.
- 2) Fuzzy logic is very flexible.
- 3) Fuzzy logic has tolerance for inappropriate data.
- 4) Fuzzy logic is able to model very complex nonlinear functions.
- 5) Fuzzy logic can build and apply the experiences of experts directly without having to go through the training process.
- 6) Fuzzy logic can work with conventional control techniques.
- 7) Fuzzy Logic is based on natural language

According to [3] there are 3 types of fuzzy which are included in the fuzzy inference system, namely:

- 1) Mamdani Method

The Mamdani Method is often known as the Max-Min Method. To get the output, the following steps are needed:

- Formation of fuzzy sets. In the Fuzzy Mamdani method, both input and output variables are divided into one or more fuzzy sets.
- Implication function application. In Fuzzy Mamdani, the implication function used is Min.
- Composition of Rules. Unlike monotonic reasoning, if the system consists of several rules, then inference is obtained from the collection and correlation between rules.
- Affirmation (defuzzification). Defuzzification is a way to obtain crisp values (crisp) from fuzzy sets. The defuzzification method used in the Mamdani method is the centroid (composite moments) method. In this method, confirmation is obtained by taking the center point (z^*) of the fuzzy area. Generally formulated:

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

- 2) 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. Defuzzification is done by finding the average value, namely:

$$Z = \frac{\sum_{r=1}^R \alpha_r z_r}{\sum_{r=1}^R \alpha_r} \quad (2)$$

- 3) The Tsukamoto Method

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

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

2. Research Methodology

The research methodology must be done systematically in order to obtain a satisfactory score. The research design serves as a direction and guide for the researcher regarding what to do at the researcher's place, what data to collect, how to analyze the data and determine what results must be achieved after completing the research process. research methods based on post-positivism philosophy are used to examine the condition of natural objects where the researcher is the key instrument. The data collection technique is carried out in a combined manner, data analysis is inductive or qualitative and the results of qualitative research emphasize meaning rather than generalization [4]. The steps for completing the research to determine outstanding employees are:

Figure 1. Fuzzy Inference System Structure

3. Results and Discussion

3.1. Fuzzy Analysis Flow

Fuzzy analysis begins with data from the Police Office to determine the 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.

Figure 2. Fuzzy Flow

3.2. Fuzzyfication

The process of converting existing real/firm values into membership functions. FIS takes the inputs and determines the degree of membership in all fuzzy sets using the membership of each fuzzy set. In fuzzy systems, membership functions play a very important role in presenting problems and producing accurate decisions. There are many membership functions that are often used, namely:

- Sigmoid Function
- Phi function
- Triangle function
- Trapezoid Function

In this study, researchers used a triangular function. In this function, there is only one x value that has a membership degree equal to 1, namely $x = b$. But the values around b have a degree of membership that drops quite sharply (away from 1). The graphic form and mathematical notation are as follows:

Figure 3. Graph of the Triangle Function 2 Fungsi

$$\begin{aligned}\text{Triangle } (x, a, b, c) &= 0, x \leq a, x \geq c \\ &= (x-a)/(b-a), a < x \leq b \\ &= -(x-c)/(c-b), b < x \leq c\end{aligned}$$

(4)

Input Performance = 80 is in Good linguistic value [40 60 80]. For good linguistic values, the degree of membership is calculated using the formula $(c-x) / (c-b)$; $b < x < c$

$$\begin{aligned}\text{Where: } x &= 80 \text{ } b = 60, c = 80 \\ \text{Kinerja [80]} &= (c - x) / (c - b) \\ &= (80 - 80) / (80 - 60) \\ &= 0\end{aligned}$$

As for the linguistic value Very Very Good [60 80 100] the degree of membership is calculated using the formula $(x-a) / (b-a)$; $a \leq x \leq b$

$$\begin{aligned}\text{Where: } x &= 80 \text{ } a = 60, b = 80 \\ \text{Performance [80]} &= (x - a) / (b - a) \\ &= (80 - 60) / (80 - 60) \\ &= 0\end{aligned}$$

Target = 75 is in the linguistic value According to Target [40 60 80]. For good linguistic values, the degree of membership is calculated using the formula $(c-x) / (c-b)$; $b \leq x \leq c$

$$\begin{aligned}\text{Where: } x &= 75, b = 60, c = 80 \\ \text{Target [75]} &= (c - x) / (c - b) \\ &= (80 - 75) / (80 - 60) \\ &= 0.25\end{aligned}$$

As for the linguistic value of Achieving the Target [60 80 100] the degree of membership is calculated using the formula $(x-a) / (b-a)$; $a < x < b$

$$\begin{aligned}\text{Where: } x &= 75 \text{ } a = 60, b = 80 \\ \text{Target [75]} &= (x - a) / (b - a) \\ &= (75 - 60) / (80 - 60) \\ &= 0.72\end{aligned}$$

Input Absent = 76 is at Active linguistic value [40 60 80]. For good linguistic values, the degree of membership is calculated using the formula $(c-x) / (c-b)$; $b < x < c$

$$\begin{aligned}\text{Where: } x &= 76 \text{ } b = 60, c = 80 \\ \text{Absent [76]} &= (c - x) / (c - b) \\ &= (80 - 76) / (80 - 60) \\ &= 0.2\end{aligned}$$

Meanwhile, for Very Active linguistic value [60 80 100] the degree of membership is calculated using the formula $(x-a) / (b-a)$; $a < x < b$

$$\begin{aligned}\text{Where: } x &= 76 \text{ } a = 60, b = 80 \\ \text{Absent [75]} &= (x - a) / (b - a) \\ &= (76 - 60) / (80 - 60) \\ &= 4.05\end{aligned}$$

From the results of fuzzification, it produces 3 fuzzy inputs, namely:

1. Performance = Good (0) and Very Good (0)
2. Target = On Target (0.25) and Achieved Target (0.75)
3. Achievement = Good (0.2 and Very Good (0.8)

The process of fuzzy analysis in improving performance begins with analyzing the variables that affect the performance itself.

3.3. Determine the variables used

There are four variables used in this study, the first input is Employee Performance, the second input The third input target is absenteeism and the output is employee achievement. These variables are shown in the table below:

Table 1. Fuzzy Set

Function	Variable Name	Universe of Conversation
Input	Performance	[0 100]
	Target	[0 100]
	Absent	[0 100]
Output	Performance	[0 100]

In this discussion the three variables are defined in a number range from 0 to 100. A score of 100 means “Very Good” with a maximum degree for Performance quality, “Excellent” with a maximum degree for Target and “Excellent” with a maximum degree for Achievement.

Table 2. Domains of Fuzzy Sets

Variabel	Fuzzy Set Name	Domain
Performance	Very Good (SB)	[60 80 100]
	Good (BG)	[40 60 80]
	Fairly Good (CB)	[20 40 60]
	Not Good (TB)	[0 20 40]
Target	On Target (ST)	[60 8 100]
	Reaching Target (MT)	[40 60 80]
	Less Achieving Target (KMT)	[20 40 60]
	Not Reaching Target (TMT)	[0 20 40]
Absent	Very Active (SA)	[60 80 100]
	Aktif (A)	[40 60 80]
	Moderately Active (CA)	[20 40 60]
	Off (TA)	[0 20 40]
Prestasi	Very good	[60 80 100]
	Good (BG)	[40 60 80]
	Not Good (KB)	[20 40 60]
	Not Good (TB)	[0 20 40]

Employee Performance Variables are divided into four membership functions which are given as Not Good, Fairly Good, Good and Very Good. Each desired membership function is of type trimf with parameters [0 20 40], [20 40 60], [40 60 80], and [60 80 100].

a) Representation of Performance Variables

To present the Performance Level variable using the graph (for fuzzy sets not Good, Fairly Good, Good and Very Good) in the image below.

Figure 4. Representation of Performance Variables

Membership function for Service variable: Fill in Range with [0 100]. In the membership function, change the name to Good (B), take the trimf type (triangular membership function) and fill in the param value with the value [40 60 80]. Trimf is used to display the fuzzy set domain in the form of a triangular curve. The triangular curve is basically a combination of 2 lines (linear).

b) Target Representation

To present the Target variable by using the graph (for the fuzzy set not achieving the target, not achieving the target, according to the target) in Figure 5 below.

Figure 5. Representation of Target Variables

Membership function for Target variable: Fill in Range with [0 100]. In the membership function, change the name to Good (B), take the trimf type (triangular membership function) and fill in the param value with the value [40 60 80]. Trimf is used to display the fuzzy set domain in the form of a triangular curve. The triangular curve is basically a combination of 2 lines (linear).

c) Representation of Absent Rate Variables

To present the Absent variable by using the graph (for fuzzy sets that are not Active, Less Active, Active, and Very Active) in Figure

Figure 6. Representation of Absent Variables

Membership function for the Absent variable: Fill in the Range with [0 100]. In the membership function, change the name to Active (A), take the type trimf (triangular membership function) and fill in the param value with the value [40 60 80]. Trimf is used to display the fuzzy set domain in the form of a triangular curve. The triangular curve is basically a combination of 2 lines (linear).

d) Representation of Achievement Level Variables

To present the Satisfaction Level variable using the graph (for fuzzy sets Not Good, Less Good, Good, Very Good) in Figure

Figure 7. Representation of Achievement Variables

Membership function for the Achievement variable: Fill in the Range with [0 100]. In the membership function, make the name Satisfactory, take the type trimf (triangular membership function) and fill in the param value with the value [40 60 80]. Trimf is used to display the fuzzy set domain in the form of a triangular curve. The triangular curve is basically a combination of 2 lines (linear). The rules used are based on the distributed questionnaires, namely 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:

- 1) [R1] IF Performance is Not Good AND Target is Not Reaching Target AND Absence is Inactive THEN Performance is Not Good
- 2) [R2] IF Performance is Not Good AND Target is Not Achieving Target AND Absence is Less Active THEN Performance is Not Good.
- 3) [R3] IF Performance is Not Good AND Target is Not Achieving Target AND Absent is Active THEN Performance is Not Good.
- 4) [R4] IF Performance is Not Good AND Target is Not Reaching Target AND Absence is Very Active THEN Achievement is Not Good
- 5) [R5] IF Performance is Not Good AND Target is Not Reaching Target AND Absence is Inactive THEN Achievement is Not Good
- 6) [R6] IF Performance is Not Good AND Target is Not Achieving Target AND Absent is Less Active THEN Performance is Not Good.
- 7) [R7] IF Performance is Not Good AND Target is Not Achieving Target AND Absent is Active THEN Performance is Not Good.

3.3. Defuzzification

This stage is also known as the affirmation stage. The input of this assertion process is a fuzzy set obtained from the composition of fuzzy rules, while the resulting output is a number in the domain of the fuzzy set. In this stage, the researcher uses the centroid method. This method is also known as Center of Area or Center of Gravity. This method is

the most important and interesting method among all methods. This method calculates the crisp value.

1) Input, that is

- Performance value, obtained a real number of 80 which is a membership of the domain of the set of fuzzy numbers Bagus [40 80] which means that the performance level variable can be said to be very good.
- Target value, obtained a real number of 75 which is a membership of the fuzzy set domain Good [60 100] which means that the target level variable is said to be on target.
- Absent value, obtained a real number of 76 which is a membership of the fuzzy set domain Good [40 80] which means that the Absent level variable is said to be Active.

2) Outputs, namely:

Employee Achievement Level obtained a real number of 75.42 which is a membership of the domain set of fuzzy numbers Satisfactory [40 80] which means that the variable level of consumer satisfaction can be said to be good, reaching 75.42.

Figure 8. Rule 1- 30

In the first, second and third columns, there are 64 plots that represent the input variables, namely Performance, Target and Absence. In the third column there are 64 plots that represent the output variable, namely Achievement. The plot in the seventeenth row in the lower right corner is the aggregated plot. From the results of the aggregation, it can be concluded that the output is good based on the entered performance, target and absent values.

4. Conclusion

The final results of the research in determining the criteria for outstanding employees are as follows:

- a. The fuzzy logic used can help the company in assessing Outstanding Employees who can be used as examples for other employees.
- b. Fuzzy logic concept is applied to PT. Blessings by using the matlab application by setting Performance, Target, and absent as input to get Employee Achievements.
- c. The results of the fuzzy logic of satisfactory employee performance help other employees to work according to the rules and improve performance so that the company can get a high turnover.

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