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Application Of Sugeno Fuzzy Logic In The Determination Of Employee Incentives

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Abstract

Suzuya superstore is one of the marketers of human needs products that have various types of products. Suzuya already has several branches in Indonesia which are located in North Sumatra, Aceh, West Sumatra, and Riau. Suzuya was founded in 1983 and currently suzuya already has more than 22 outlets, one of which is in Pematangsiantar. Suzuya superstore Pematangsiantar has employees who are divided into several teams, one of which is the cashier team. The cashier team is the spearhead of the sale of focus items, where the focus item is the flagship product of suzuya superstore Pematangsiantar. The cashier team is also responsible for the sales transaction service process at suzuya superstore Pematangsiantar. The existence of incentives can motivate the work spirit of the cashier team in increasing sales, work speed, and good transaction processing service attitude at suzuya superstore Pematangsiantar. In determining the feasibility of the cashier team receiving incentives at suzuya superstore Pematangsiantar, three variables were used, namely sales of focus items, assessment of work attitudes, and assessment of work speed. Based on the results of processing the cashier team's data using the fuzzy logic algorithm, the Sugeno method, manually and using Matlab software, there was no significant difference. So that Fuzzy Logic with the Sugeno method can be used to determine employee incentives at suzuya superstore Pematangsiantar.

Keywords: *Fuzzy logic, Sugeno method, Incentive, employees*

1. Introduction

Incentives are wages that need to be given to employees in accordance with their abilities and achievements if they reach the given target in order to create a higher sense of morale and as a means of motivation that can increase morale for each employee [1], [2]. Suzuya superstore is one of the marketers of human needs products that has various types of products for human needs. Suzuya has many branches in Indonesia including North Sumatra, Aceh, West Sumatra, and Riau. Founded in 1983, Suzuya currently has more than 22 outlets, one of which is in Pematangsiantar. Suzuya superstore Pematangsiantar has employees who are divided into several teams, one of which is the cashier team. The cashier team is the spearhead of the sale of focus items, where the focus item is the flagship product of Suzuya Superstore Pematangsiantar. The cashier team is also responsible for the sales transaction service process at the suzuya superstore Pematangsiantar. The existence of incentives can motivate the work spirit of the cashier team in increasing sales, work speed, and good transaction processing service attitudes at the suzuya superstore Pematangsiantar.

In determining the feasibility of the cashier team receiving incentives at the suzuya superstore Pematangsiantar, it is still subjective, so as to produce an objective, fast decision, and avoiding mistakes in selecting the eligibility of the cashier receiving incentive team, requires the right method to help decision makers.With this, the author uses the Sugeno method of fuzzy logic to help the management of suzuya superstore Pematangsiantar in decision making in determining the feasibility of the cashier team to get computerized incentives[3],[4]. Where fuzzy logic is a branch of artificial intelligence, which means knowledge that studies computers that imitate human intelligence[5],[6]. Sugeno is reasoning similar to Mamdani, where the consequence of the output of the system is not a fuzzy set form, but is in the form of a linear equation (constant)[7],[8]. In the process of selecting the appropriateness of the cashier team, the incentive recipient includes three parameters, namely sales of focus items, assessment of work speed, and assessment of the service attitude of the transaction process. Based on the parameters above, the data will be processed to produce a decision on the feasibility of the cashier team receiving incentives.

2. Research Methodology

Methodology is a research step carried out by researchers to obtain information and conduct investigations from the data obtained. The research method provides a design or description of the research which will include: data collection methods, research design, research location and research time. The design of this research is a series of processes that include all activities from the planning process to the implementation process. The research design was carried out using direct observation and interviews with the cashier's head to determine the results of the assessment of work speed, work attitude, and the results of the sale of the cashier team's focus items. Then the results of the observations will be carried out with experimental data using Matlab version 6.1.

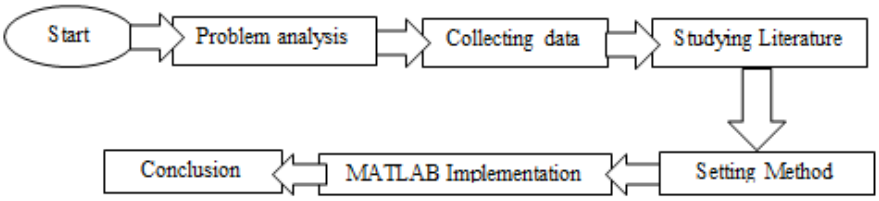

Figure 1. Research Design

The research design carried out on the application of Sugeno fuzzy logic to determine incentives is as follows: Problem Analysis is the stage of understanding the goals and needs of the research objectives, where the research objective is to find out how many sales of focus items, the results of the assessment of work speed, and work attitudes on the cashier team . Collecting data by means of observation and interviews. Studying the literature based on previous studies that will be used to obtain information in research. Establish a method for solving the problem. In this study, a fuzzy algorithm with the Sugeno method was used. MATLAB implementation to find out precise and more precise results. Making Conclusions From all stages of research that have been carried out in the form of data that has been processed by the Sugeno method[9].

2.1. Data Analysis

Data analysis is a way to process data into information so that the characteristics of the data are easy to understand and can be useful for solving problems or problems related to the research. The formula used in determining the membership function to determine incentives is as follows[10],[11]:
Ascending Linear Representation
Membership Functions:

$$\mu[x]\begin{cases} 0 & x \le a \\ (x-a)\ /(b-x) & a \le x \le b \\ 1; & x \ge \end{cases} \quad 1)$$

Descending Linear Representation\
Membership Functions:

$$\mu[x]\begin{cases} 0 & \\ (b-x)\ /(b-a) & a \le x \le b \\ 1; & x \ge b \end{cases} \quad 2)$$

Triangle Curve Representation

$$\begin{cases} 0; & x \le a \ or \ x \ge c \\ (x-a)/(b-a); & a \le x \le b \\ (c-x)/(c-b) & b \le x \le c \end{cases} \quad 3)$$

A research variable is an attribute or nature or value of another person, object or activity that has a certain variation determined by the researcher to be studied and then drawn conclusions. The research consists of input variables and output variables as follows: Working speed, Work attitude and Sales of focus items. While the output variables are cashier teams who are eligible and not eligible to get the following incentives:

Table 1. Operational Variables

Variable	Fuzzy Set Name	Domain	Keterangan
Working speed	Slow	[0 0 30 50]	Score [0-100]
	Fast	[40 50 70]	
	Very Fast	[60 80 100 100]	
Work attitude	Not Friendly	[0 0 30 50]	Score [0-100]
	Friendly	[40 50 70]	
	Very Friendly	[60 80 100 100]	
Focus item sales	Low	[0 0 30 50]	Score [0-100]
	Currently	[40 50 70]	
	High	[60 80 100 100]	
Decision	Worthy	[1]	[0-1]
	Not Worthy	[0]	

Variable Working speed is divided into 3 function sections where members are marked with Slow, Fast, and Very Fast. Each membership function is of type trimf and trapmf with parameters [0 0 30 50], [40 50 70], and [60 80 100 100]. Variable Work attitude which is divided into 3 parts of member functions with marks, namely Not Friendly, Friendly, Very Friendly. Each membership function is of type trimf and trapmf with parameters [0 0 30 50], [40 50 70], and [60 80 100 100]. Variable Focus item sales which are divided into 3 parts of member functions with marks, namely Low, medium, high. Each membership function is of type trimf and trapmf with parameters [0 0 30 50], [40 50 70], and [60 80 100 100]. Variable Decision is divided into 2 membership functions marked by the determination of the cashier team that is feasible and not feasible. Each membership function is of type trimf and trapmf with parameters [1] and [0].

2.2. Rules

After the fuzzy set and membership function are worked on, then the next step is to determine the rules used in MATLAB. This rule is used to express the relationship between input and output. Each rule is an implication. Connecting between two inputs is the AND operator and the one that does the mapping between input and output is IF-THEN.

Table 2. Fuzzy Rules

Rules	Work Rate Value	Work attitude value	Focus item sales	Implication Function	Decision
R1	Slow	Not Friendly	Low	_	Not Worthy
R2	Slow	Not Friendly	Currently	_	Not Worthy
R3	Slow	Not Friendly	High	_	Not Worthy
R4	Slow	Friendly	Low	_	Not Worthy
R5	Slow	Friendly	Currently	_	Not Worthy
R6	Slow	Friendly	High	_	Not Worthy
R7	Slow	Very Friendly	Low	_	Not Worthy
R8	Slow	Very Friendly	Currently	_	Not Worthy
R9	Slow	Very Friendly	High	_	Not Worthy
R10	Fast	Not Friendly	Low	_	Not Worthy
R11	Fast	Not Friendly	Currently	_	Not Worthy
R12	Fast	Not Friendly	High	_	Not Worthy
R13	Fast	Friendly	Low	_	Not Worthy
R14	Fast	Friendly	Currently	_	Worthy
R15	Fast	Friendly	High	_	Worthy
R16	Fast	Very Friendly	Low	_	Not Worthy
R17	Fast	Very Friendly	Currently	_	Worthy
R18	Fast	Very Friendly	High	_	Worthy
R19	Very Fast	Not Friendly	Low	_	Not Worthy
R20	Very Fast	Not Friendly	Currently	_	Not Worthy
R21	Very Fast	Not Friendly	High	_	Not Worthy
R22	Very Fast	Friendly	Low	_	Not Worthy
R23	Very Fast	Friendly	Currently	_	Worthy
R24	Very Fast	Friendly	High	_	Worthy
R25	Very Fast	Very Friendly	Low	_	Not Worthy
R26	Very Fast	Very Friendly	Currently	_	Worthy
R27	Very Fast	Very Friendly	High	_	Worthy

3. Results and Discussion

The application of Sugeno fuzzy logic to determine employee incentives using the MATLAB version 6.1 application can be seen in the following figure [12]:

1. Function Variable input value Working speed

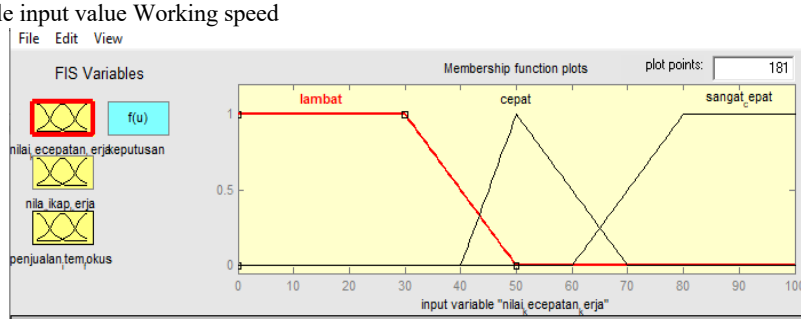

Figure 2. Variable Input Value Working speed

In Figure 2 above, the Working speed value variable input function has three forms of fuzzy sets, namely: Slow with a range value (0, 0, 30, 50), Fast with a range value (40, 50, 70), and Very Fast (60, 80, 100, 100).

$$\mu\text{Slow}\ [x]\begin{matrix}1 & ; b \le x \le c \\ \frac{(d-x)}{(d-c)} & ; c \le x \le d \\ 0 & ; x \ge d\end{matrix}\ ; x = \begin{matrix}1 & ; 0 \le x \le 30 \\ \frac{(50-x)}{(50-30)} & ; 30 \le 50 \\ 0 & ; x \ge 50\end{matrix}$$

$$\mu\text{Fast}\ [x]\begin{matrix}0\\ \frac{(x-a)}{(b-a)};\\ \frac{(c-x)}{(c-b)};\end{matrix}\begin{matrix}x \le a\ atau\ x \ge c\\ a \le x \le b\\ b \le x \le c\end{matrix};x=\begin{matrix}0\\ \frac{(x-40)}{(50-40)};\\ \frac{(70-x)}{(70-50)};\end{matrix}\begin{matrix}x \le 40\ atau\ x \ge 70\\ 40 \le x \le 50\\ 50 \le x \le 70\end{matrix}$$

$$\mu\text{Very Fast}\ [x]\begin{matrix}0\\ \frac{(x-a)}{(b-a)};\\ 1\end{matrix}\begin{matrix};\ x \le a\\ ;\ a \le x \le b\\ ;\ b \le x \le c;\end{matrix}x=\begin{matrix}0\\ \frac{(x-60)}{(80-60)};\\ 1\end{matrix}\begin{matrix};\ x \le 60\\ ;\ 60 \le x \le 70\\ ;\ 70 \le x \le 100\end{matrix}$$

2. Function Variable input value Work attitude

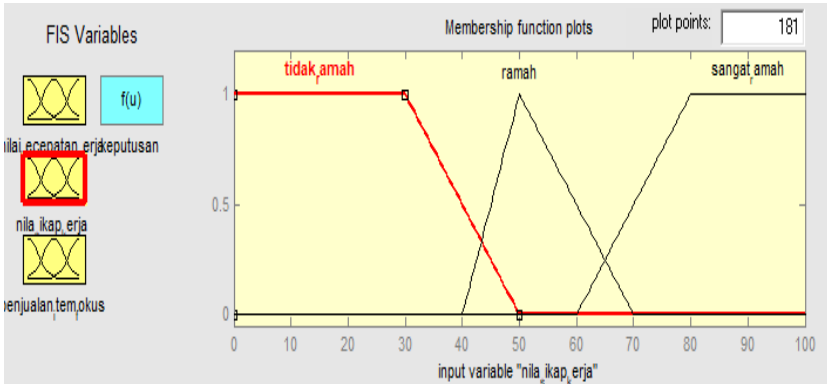

Figure 3. Variable Input Value of Work attitude

Figure 3 above is a function of the Work attitude value input variable which has three forms of fuzzy sets, namely: Not Friendly with a range value (0, 0, 30, 50), Friendly with a range value (40, 50, 70), and Very Friendly. (60, 80, 100, 100).

$$\mu\text{Not Friendly}\ [x]\begin{matrix}1\\ \frac{(d-x)}{(d-c)};\\ 0\end{matrix}\begin{matrix};\ b \le x \le c\\ ;\ c \le x \le d\\ ;\ x \ge d\end{matrix};x=\begin{matrix}1\\ \frac{(50-x)}{(50-30)};\\ 0\end{matrix}\begin{matrix};\ 0 \le x \le 30\\ ;\ 30 \le x \le 50\\ ;\ x \ge 50\end{matrix}$$

$$\mu\text{Friendly}\ [x]\begin{matrix}0\\ \frac{(x-a)}{(b-a)};\\ \frac{(c-x)}{(c-b)};\end{matrix}\begin{matrix}x \le a\ atau\ x \ge c\\ a \le x \le b\\ b \le x \le c\end{matrix};x=\begin{matrix}0\\ \frac{(x-40)}{(50-40)};\\ \frac{(70-x)}{(70-50)};\end{matrix}\begin{matrix}x \le 40\ atau\ x \ge 70\\ 40 \le x \le 50\\ 50 \le x \le 70\end{matrix}$$

$$\mu\text{Very Friendly}\ [x]\begin{matrix}0\\ \frac{(x-a)}{(b-a)};\\ 1\end{matrix}\begin{matrix};\ x \le a\\ ;\ a \le x \le b\\ ;\ b \le x \le c;\end{matrix}x=\begin{matrix}0\\ \frac{(x-60)}{(80-60)};\\ 1\end{matrix}\begin{matrix};\ x \le 60\\ ;\ 60 \le x \le 70\\ ;\ 70 \le x \le 100\end{matrix}$$

3. Function Variable input Focus item sales

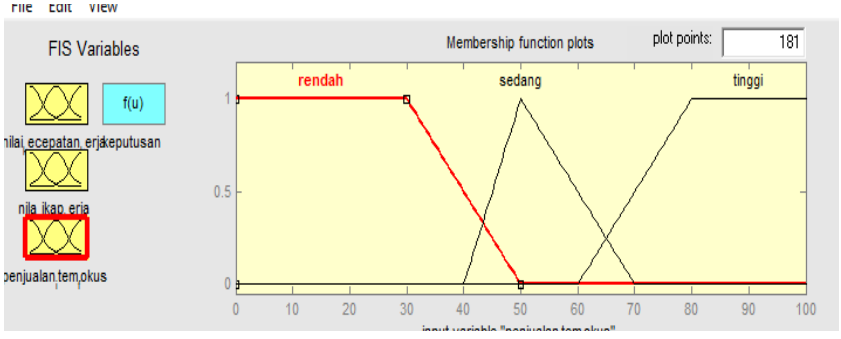

Figure 4. Variable Input Focus item sales

Figure 4 above is a function of the Work attitude value input variable which has three forms of fuzzy sets, namely: Not Friendly with a range value (0, 0, 30, 50), Friendly with a range value (40, 50, 70), and Very Friendly. (60, 80, 100, 100).

$$\mu\text{Low}\ [x]\begin{matrix}1\\ \frac{(d-x)}{(d-c)};\\ 0\end{matrix}\begin{matrix};\ b \le x \le c\\ ;\ c \le x \le d\\ ;\ x \ge d\end{matrix};x=\begin{matrix}1\\ \frac{(50-x)}{(50-30)};\\ 0\end{matrix}\begin{matrix};\ 0 \le x \le 30\\ ;\ 30 \le x \le 50\\ ;\ x \ge 50\end{matrix}$$

$$\mu\text{Currently}\ [x] \begin{matrix} 0 \\ \frac{(x-a)}{(b-a)}; \\ \frac{(c-x)}{(c-b)} \end{matrix} \begin{matrix} x \le a\ atau\ x \ge c \\ a \le x \le b \\ b \le x \le c \end{matrix}; x = \begin{matrix} 0 \\ \frac{(x-40)}{(50-40)}; \\ \frac{(70-x)}{(70-50)}; \end{matrix} \begin{matrix} x \le 40\ atau\ x \ge 70 \\ 40 \le x \le 50 \\ 50 \le x \le 70 \end{matrix}$$

$$\mu\text{High}\ [x] \begin{matrix} 0 \\ \frac{(x-a)}{(b-a)}; \\ 1 \end{matrix} \begin{matrix} x \le a \\ a \le x \le b \\ b \le x \le c \end{matrix}; x = \begin{matrix} 0 \\ \frac{(x-60)}{(80-60)}; \\ 1 \end{matrix} \begin{matrix} x \le 60 \\ 60 \le x \le 70 \\ 70 \le x \le 100 \end{matrix}$$

3.1. Data Calculation

The following is a sample of research data that will be calculated:
Sample 1 has the following data Working speed value = 65, Work attitude value = 65, Focus item sales = 52.

a. Finding the Degree of Membership in Each Variable

The Working speed value has three fuzzy sets, namely: Slow, Fast, Very Fast. The value of 65 in the Working speed variable is included in the Fast count, in this case it can be calculated for the fuzzy set value with the following equation:

$$\mu\text{Slow}\ [x] = \begin{matrix} 1 \\ \frac{(50-x)}{(50-30)}; \\ 0 \end{matrix} \begin{matrix} 0 \le x \le 30 \\ 30 \le x \le 50 \\ x \ge 50 \end{matrix}$$

$$\mu\text{Slow}\ [65] = \frac{(50-x)}{(50-30)} = \frac{(50-65)}{(50-30)} = \frac{(-15)}{(20)} = -0{,}75 = 0$$

$$\mu\text{Fast}\ [x] = \begin{matrix} 0 \\ \frac{(x-40)}{(50-40)}; \\ \frac{(70-x)}{(70-50)}; \end{matrix} \begin{matrix} x \le 40\ atau\ x \ge 70 \\ 40 \le x \le 50 \\ 50 \le x \le 70 \end{matrix}$$

$$\mu\text{Fast}\ [65] = \frac{(70-x)}{(70-50)} = \frac{(70-65)}{(70-50)} = \frac{(5)}{(20)} = 0.25$$

$$\mu\text{Very Fast}\ [x] = \begin{matrix} 0 \\ \frac{(x-60)}{(80-60)}; \\ 1 \end{matrix} \begin{matrix} x \le 60 \\ 60 \le x \le 70 \\ 70 \le x \le 100 \end{matrix}$$

$$\mu\text{Very Fast}\ [65] = \frac{(x-60)}{(80-60)} = \frac{(65-60)}{(80-60)} = \frac{(5)}{(20)} = 0.25$$

Work attitude values have three fuzzy sets, namely: Not Friendly, Friendly, Very Friendly. The value of 65 in the Work attitude variable is included in the Friendly count, in this case it can be calculated for the fuzzy set value with the following equation:

$$\mu\text{Not Friendly}\ [x] = \begin{matrix} 1 \\ \frac{(50-x)}{(50-30)}; \\ 0 \end{matrix} \begin{matrix} 0 \le x \le 30 \\ 30 \le x \le 50 \\ x \ge 50 \end{matrix}$$

$$\mu\text{Not Friendly}\ [65] = \frac{(50-x)}{(50-30)} = \frac{(50-65)}{(50-30)} = \frac{(-15)}{(20)} = -0{,}75 = 0$$

$$\mu\text{Friendly}\ [x] = \begin{matrix} 0 \\ \frac{(x-40)}{(50-40)}; \\ \frac{(70-x)}{(70-50)}; \end{matrix} \begin{matrix} x \le 40\ or\ x \ge 70 \\ 40 \le x \le 50 \\ 50 \le x \le 70 \end{matrix}$$

$$\mu\text{Friendly}\ [65] = \frac{(70-x)}{(70-50)} = \frac{(70-65)}{(70-50)} = \frac{(5)}{(20)} = 0{,}25$$

$$\mu\text{Very Friendly}\ [x] = \begin{matrix} 0 \\ \frac{(x-60)}{(80-60)}; \\ 1 \end{matrix} \begin{matrix} x \le 60 \\ 60 \le x \le 70 \\ 70 \le x \le 100 \end{matrix}$$

$$\mu\text{Very Friendly}\ [65] = \frac{(x-60)}{(80-60)} = \frac{(65-60)}{(80-60)} = \frac{(5)}{(20)} = 0{,}25$$

Focus item sales has three fuzzy sets, namely: Low, Currently, High. The value of 52 in the Work attitude variable is included in the Current count, in this case it can be calculated for the fuzzy set value with the following equation:

$$\mu\text{Low}\ [x] = \begin{cases} 1 & ; 0 \le x \le 30 \\ \frac{(50-x)}{(50-30)} & ; 30 \le x \le 50 \\ 0 & ; \quad x \ge 50 \end{cases}$$

$$\mu\text{Low}\ [52] = \frac{(50-x)}{(50-30)} = \frac{(50-52)}{(50-30)} = \frac{(-2)}{(20)} = \text{-0,1} = 0$$

$$\mu\text{Currently}\ [x] = \begin{cases} 0 & ; x \le 40\ atau\ x \ge 70 \\ \frac{(x-40)}{(50-40)} & ; \quad 40 \le x \le 50 \\ \frac{(70-x)}{(70-50)} & ; \quad 50 \le x \le 70 \end{cases}$$

$$\mu\text{Currently}\ [52] = \frac{(70-x)}{(70-50)} = \frac{(70-52)}{(70-50)} = \frac{(8)}{(20)} = 0{,}4$$

$$\mu\ \text{High}\ [x] = \begin{cases} 0 & ; \quad x \le 60 \\ \frac{(x-60)}{(80-60)} & ; \ 60 \le x \le 70 \\ 1 & ; 70 \le x \le 100 \end{cases}$$

$$\mu\text{High}\ [52] = \frac{(x-60)}{(80-60)} = \frac{(52-60)}{(80-60)} = \frac{(-8)}{(20)} = \text{-0,4} = 0$$

b. Determining the Implication Function

[R1] if (Work speed value is Slow) and (Work attitude value is Not Friendly) and (Focus item sales is Low) then (Decision is Not Worthy).

Apred1 = min(μSlow)[0]∩(μNot Friendly)[0]∩(μLow)[0]
= 0

Decision results from the set of Variables Z1 = 0.

[R2] if (Nilai Working speed is Slow) and (Nilai Work attitude is Not Friendly) and (Focus item sales is Currently) then (Decision is Not Worthy).

Apred2 = min(μSlow)[0]∩(μNot Friendly)[0]∩(μCurrently)[0.4]
= 0

Decision results from the set of Variables Z2 = 0.

[R3] if (Work speed is Slow) and (Work attitude is Not Friendly) and (Focus item sales is High) then (Decision is Not Worthy) value.

Apred3 = min(μSlow)[0]∩(μNot Friendly)[0]∩(μHigh)[0,4]
= 0

Decision results from the set of Variables Z3 = 0.

[R4] if (Work speed is Slow) and (Work attitude is Friendly) and (Focus item sales is Low) then (Decision is Not Worthy) value.

Apred4 = min(μSlow)[0]∩(μFriendly)[0,25]∩(μCurrently)[0.4]
= 0

Decision results from the set of Variables Z4 = 0.

[R5] if (Nilai Working speed is Slow) and (Nilai Work attitude is Friendly) and (Focus item sales is Currently) then (Decision is Not Worthy).

Apred5 = min(μSlow)[0]∩(μFriendly)[0,25]∩(μCurrently)[0.4]
= 0

Decision results from the set of Variables Z26 = 1.

.
.
.

[R27] if (Work speed is Very Fast) and (Work attitude is Very Friendly) and (Focus item sales is High) then (Decision is Worthy).

Apred27 = min(μVery Fast)[0,25]∩(μVery Friendly)[0,25]∩(μHigh)[0]
= 0

Decision results from the set of Variables Z27 = 1.

c. Defuzzification

The following results from the defuzzification of sample 1 data can be seen in table 3:

Table 3. Defuzzification

Rules	Ax	Zx	Ax*Zx
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0

5	0	0	0
….	…..	……	……
27	0	1	0
Σ	1		1

so $Z^* = \frac{\sum_i^n predikat\ x * zx}{\sum_i^n predikat\ x} = \frac{1}{1} = 1$

the calculation is carried out until the last amount of data and the next test will be carried out using Matlab. From the calculations done manually, the best value from each cashier team can be made based on a predetermined value range to get the best value. Manual calculations are used as a reference to compare the results of the system calculations in the next chapter. Worthy and Not Worthy of each student is determined based on a predetermined range of values. Based on the results of the Decision, there are three (3) Worthy, and two (2) Not Worthy.

3.2. Testing With Matlab

The following is the test value to get the defuzzification value which is carried out using Matlab software as shown in Figure 5 below:

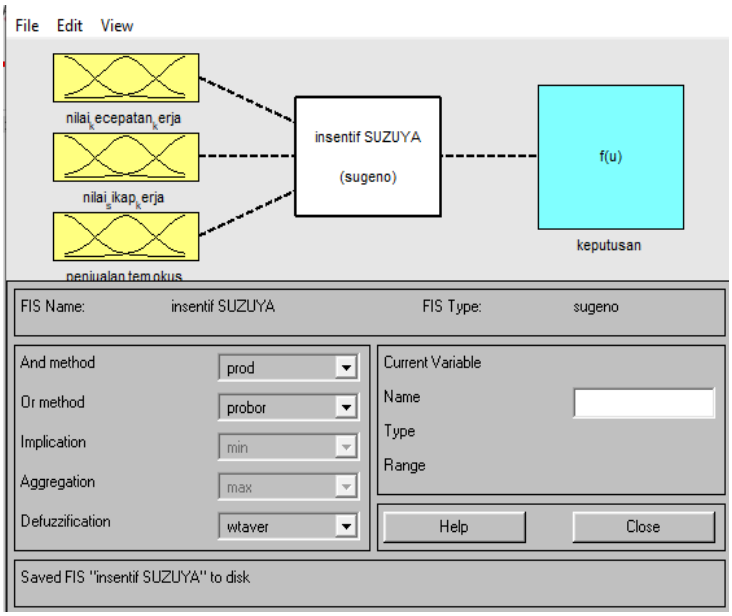

Figure 5. Matlab System Variables

The following is a display of the rules used in the MATLAB software testing as shown in Figure 6

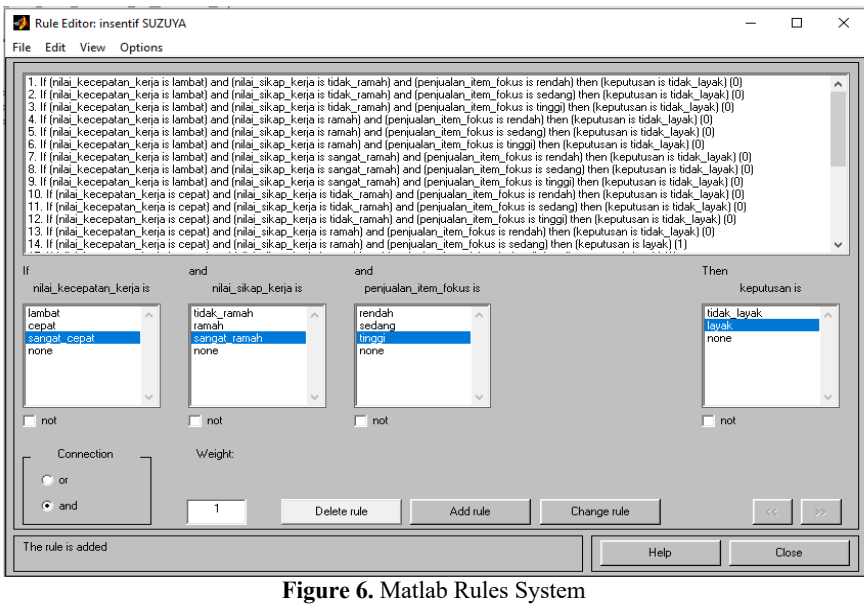

Figure 6. Matlab Rules System

The following are the results of testing sample 1 data which can be seen in Figure 7 below:

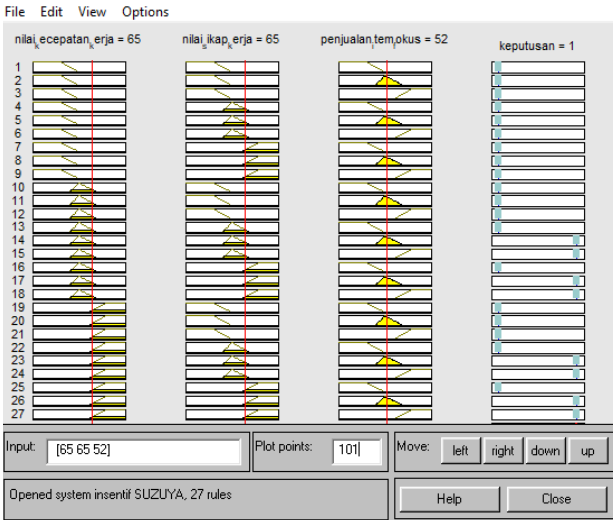

Figure 7. Matlab System Test Results

After doing calculations manually and testing with Matlab software, then comparing the two calculations. From the sample data of the cashier team that was made as a parameter, the results of the comparison can be seen from the following table 4 below:

Table 4. Comparison Results

No	Name	Manual Test Results	System Test Results	Decision
1	Data 1	1	1	Worthy
2	Data 2	0	0,5	Not Worthy
3	Data 3	1	1	Worthy
4	…….	0	0.5	Not Worthy
5	Data n	1	1	Worthy

Researchers in this test provide a range of values between 0 and 1 to get the results of Decision Worthy and Not Worthy. From the results of testing manually and systemically, it can be concluded that the results obtained are appropriate, so using Matlab software is easier and the process is faster in determining employee incentives.

4. Conclusion

Fuzzy logic with the Sugeno method can be used to determine employee incentives. In this study, three variables were used, namely, Working speed value, Work attitude value, and Focus item sales. And based on the results of the comparison of manual calculations and using Matlab software that there are no significant different results.

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References

[1] A. Hakim, "Effect of compensation, career development, work environment on job satisfaction and its impact on organizational commitments in pt Jakarta Tourisindo," *J. Crit. Rev.*, vol. 7, no. 12, pp. 538–548, 2020, doi: 10.31838/jcr.07.12.99.

[2] C. Eshun and F. Duah, "Reward as Motivation tool for Employee Performance," *Reward as Motiv. tool Empl. Perform.*, pp. 1–70, 2018.

[3] A. Yunan and M. Ali, "Study and Implementation of the Fuzzy Mamdani and Sugeno Methods in Decision Making on Selection of Outstanding Students at the South Aceh Polytechnic," *J. Inotera*, vol. 5, no. 2, pp. 152–164, 2020, doi: 10.31572/inotera.vol5.iss2.2020.id127.

[4] F. Cavallaro, "A Takagi-Sugeno fuzzy inference system for developing a sustainability index of biomass," *Sustain.*, vol. 7, no. 9, pp. 12359–12371, 2015, doi: 10.3390/su70912359.

[5] R. Ilahi, I. Widiaty, and A. Gafar Abdullah, "Fuzzy system application in education," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 434, p. 12308, Dec. 2018, doi: 10.1088/1757-899X/434/1/012308.

[6] C. González García, E. Núñez-Valdez, V. García-Díaz, C. Pelayo G-Bustelo, and J. M. Cueva-Lovelle, "A Review of Artificial Intelligence in the Internet of Things," *Int. J. Interact. Multimed. Artif. Intell.*, vol. 5, no. 4, p. 9, 2019, doi: 10.9781/ijimai.2018.03.004.

[7] F. Ariani and R. Y. Endra, "Implementation of Fuzzy Inference System with Tsukamoto Method for Study Progamme Selection," *2nd Int. Conf. Eng. Technol. Dev.*, no. Icetd, pp. 189–200, 2013.

[8] Murnawan, R. A. E. Virgana, and S. Lestari, "Comparison of Sugeno and Tsukamoto fuzzy inference system method for

determining estimated production amount," *Turkish J. Comput. Math. Educ.*, vol. 12, no. 8, pp. 1467–1476, 2021.

[9] A. M. H. Pardede *et al.*, "Decision Support System for Deciding Eligible Journals to be Published in Majalah Kedokteran Nusantara Using the Fuzzy Logic Method," in *Journal of Physics: Conference Series*, 2019, vol. 1363, no. 1, doi: 10.1088/1742-6596/1363/1/012081.

[10] M. Muhathir, "Perhitungan Metode Fuzzy Sugeno Dan Antropometri Dalam Memprediksi Status Gizi Indeks Massa Tubuh," vol. 2, Aug. 2018.

[11] L. Ayuningtias, M. Irfan, and J. Jumadi, "ANALISA PERBANDINGAN LOGIC FUZZY METODE TSUKAMOTO, SUGENO, DAN MAMDANI (STUDI KASUS : PREDIKSI JUMLAH PENDAFTAR MAHASISWA BARU FAKULTAS SAINS DAN TEKNOLOGI UNIVERSITAS ISLAM NEGERI SUNAN GUNUNG DJATI BANDUNG)," *J. Tek. Inform.*, vol. 10, Apr. 2017, doi: 10.15408/jti.v10i1.5610.

[12] A. M. H. Pardede, "SISTEM PENDUKUNG KEPUTUSAN PEMBERIAN JUMLAH SKS MENGAJAR DOSEN PADA STMIK KAPUTAMA BINJAI," *Konf. Nas. Pengemb. Teknol. Inf. dan Komun. (KeTIK 2015)*, pp. 12–19, 2015, doi: 10.31219/osf.io/xzwm3.