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Application of The Fuzzy Inference System Method to Predict The Number of Weaving Fabric Production

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Abstract*-- In this study discusses the application of fuzzy logic in solving production problems using the Tsukamoto method and the Sugeno method. The problem that is solved is how to determine the production of woven fabric when using three variables as input data, namely: stock, demand and inventory of production costs. The first step is to solve the problem of woven fabric production using the Tsukamoto method which is to determine the input variables and output variables which are firm sets, the second step is to change the input variable into a fuzzy set with the fuzzification process, then the third step is processing the fuzzy set data with the maximum method. And the last or fourth step is to change the output into a firm set with the defuzzification process with a weighted average method, so that the desired results will be obtained in the output variable. The solution to the production problem using the Sugeno method is almost the same as using the Tsukamoto method, it's just that the system output is not a fuzzy set, but rather a constant or a linear equation. The difference between the Tsukamoto Method and the Sugeno Method is in consequence. The Sugeno method uses constants or mathematical functions of the input variables. From the calculation data of the production of Mlaki Wanarejan Utara Pemalang woven fabric according to Tsukamoto's method in March 2017 using Weka's rule obtained 343 woven fabrics in meters, while using the Sugeno method obtained 371 woven fabrics in meters. While according to Tsukamoto's method in March 2017 using monotonous rules obtained 313 woven fabrics in meters, then using the Sugeno method obtained 321 woven fabrics in meters, while according to the company's production data in March 2017 produced 340 woven fabrics in meters, then from the analysis direct comparison with the original data in the company can be concluded that the method that is closest to the truth value is the production obtained by processing data using the Tsukamoto method using the Weka rules.

Keywords: Fuzzy Logic, Tsukamoto Method, Sugeno Method, Fuzzyfication, Defuzzyfication, Implication Function, Weka Rules, Monotonous Rules.

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I. INTRODUCTION

The increasingly intense competition era has caused companies engaged in industry to be more specific in determining the survival of their companies in order to survive, especially in determining the amount of production. As is the case with woven fabric companies, where the problem of determining the amount of manual production and the production of woven fabrics that depend on requests from individual buyers, this will make it difficult to determine the amount of production each month.

Inventory is important in the course of a company. If in a company has an uncontrolled amount of stock or overstock, it causes problems in the company's finances. Therefore, determining the amount of production is very necessary to maintain the stability of the number of woven fabric stocks.

To solve this problem, the company should be able to make an appropriate decision to determine how much amount will be produced in a company. So, we need a system that can handle this. In this case the researcher uses fuzzy logic or fuzzy logic.

Fuzzy logic is an appropriate way to map an input space into an output space [1]. The reason for using fuzzy logic in this research is that the concept of fuzzy logic is easy to understand, the mathematical concepts that underlie fuzzy reasoning are very simple and easy to understand, fuzzy logic is very flexible, fuzzy logic has a tolerance for data that is not precise, fuzzy logic is based on natural language. Based on fuzzy logic, a model will be generated from a system that is able to estimate the amount of production. Factors that influence in determining the amount of production with fuzzy logic include the number of stocks, the number of requests, and the inventory of production costs.

Therefore, from all the descriptions above, this final project takes the theme with the title "Application of the Fuzzy Inference System Method to Predict the Number of Woven Fabric Production". The fuzzy inference system method that will be used by researchers is the fuzzy Tsukamoto method and Sugeno fuzzy method, each rule is represented using fuzzy sets with monotonous membership functions. To determine the strict output value of crisp or results the two methods are searched using the average defuzzification weighted.

Based on the matters that have been described in the background of the problem, and in accordance with the discussion, the authors identify several existing problems: What is the fuzzy inference system rule model? How many woven fabrics will be produced using a fuzzy inference system based on the amount of stock, demand, and production costs? And Which fuzzy inference system method is suitable for calculating the amount of woven fabric production?

The objectives of this study are: To determine the rules that are in accordance with the data that the researcher took from one of the woven fabric entrepreneurs precisely in Mlaki Wanarejan Utara, Pemalang, to determine the number of predictions of woven fabric using fuzzy inference system by Tsukamoto and Sugeno methods, and to determine the method that matches the data expected in reality from one of the woven fabric entrepreneurs precisely in Mlaki Wanarejan Utara, Pemalang.

Benefits of research he benefits of the research are: Can make it easier to apply the Tsukamoto fuzzy method and Sugeno fuzzy to predict the amount of woven fabric production based on stock data, number of requests, and production costs, Provide new insights into the prediction of woven fabric production in a company using a fuzzy inference system, and Can help the process of predicting woven fabric production based on stock data, number of requests, and production costs.

II. LITERATURE REVIEW

According to Solikin [2] with the title "Fuzzy Logic Application in Optimizing the Production of Goods Using the Mamdani Method and the Sugeno Method". In this study a system that can assist in the optimization of the production of goods in certain companies is built using the Mamdani and Sugeno methods by using two variables as inputs, namely demand and supply and the results of the output in the form of the amount of goods produced in a monthly period.

According to Juliansyah [3] conducted a study entitled "Application of the Fuzzy Tsukamoto Method to Predict Palm Oil Results (Case Study: PT. Amal Tani Tanjung Putri-Bahorok Plantation)". In this study a system that can help predict the results of oil palm in the company is built by using the Tsukamoto method by using two variables as input, namely demand and supply and the results of the output in the form of the amount of palm oil production in a monthly period.

According to Laksono [4] conducted a study entitled "Supporting Systems for Deciding the Number of Tile Production Using the Tsukamoto Method". In this research, a system can be built that can help tile production in tile companies using the Tsukamoto method by using two variables as input, namely demand and supply and the results of the output in the form of tile production in a monthly period.

III. METHODOLOGY

In this research which is used as an object is a system of applying the Tsukamoto fuzzy method and Sugeno fuzzy to help woven fabric entrepreneurs in determining the amount of woven fabric production based on stock data, number of requests, and inventory of production costs.

A. Methods

The research method used in this study is adopted from [5] and modified as follows:

1) Interview

Data collection is done by using the interview method directly with the parties concerned, so that the data obtained is more accurate.

2) Literature Review

Data collection methods obtained from various books and other media such as the internet as a reference for the author in preparing the Final Project Report.

3) Observation

Data collection is done by making direct observations of one activity that is being carried out by a woven fabric cloth

company with the aim of finding and collecting data needed to make the system created by researchers.

4) Study of Literature

Data collection is carried out by studying documents relating to Fuzzy Logic in which there is production consisting of inventory, number of requests, and production costs which will then be used as a reference.

B. System Development Method

System development that will be made in the system of applying the Tsukamoto and Sugeno fuzzy methods to predict the amount of woven fabric production can be seen in Fig 1.

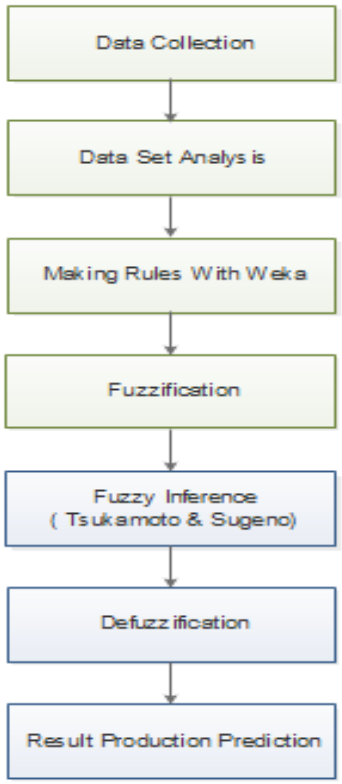


Figure 1. System Development

From Figure 1, the development of the system developed is 7 stages, where the explanation is as follows:

1) Data Collection

Data collection was carried out in Mlaki North Wanarejan Pemalang, precisely at Pemalang Islamic Boarding School. Data collection activities began from September 2014 to February 2017. Data collection was carried out by interviewing the woven fabric directly to Mrs. Nyai Diana as the owner of the woven fabric business. The data obtained are data on stock, demand, production costs, and the amount of production. The data on stock, demand, production costs, and the number of monthly production periods can be seen in Table 1.

TABLE I. DATA PRODUCTION COSTS, DEMAND, STOCK, AND AMOUNT OF PRODUCTION

Month	Year	Production Cost	Demand	Stock	Amount Of Production
September	2014	1500000	100	15	120
Oktober	2014	1200000	110	12	128
November	2014	1000000	200	50	205
Desember	2014	1100000	300	75	305
Januari	2015	1600000	400	10	410
Februari	2015	1000000	50	5	106
Maret	2015	900000	230	12	280
April	2015	1400000	124	100	180
Mei	2015	900000	450	100	465
Juni	2015	1100000	105	98	250
Juli	2015	1600000	290	230	100
Agustus	2015	1000000	50	10	100
September	2015	900000	50	15	80
Oktober	2015	1400000	75	34	116
November	2015	900000	120	100	122
Desember	2015	1200000	126	59	160
Januari	2016	7890400	220	33	224
Februari	2016	8806250	245	24	250
Maret	2016	14547925	409	65	413
April	2016	10497050	292	22	298
Mei	2016	7608600	211	32	216
Juni	2016	12082175	340	58	343
Juli	2016	7925625	215	27	225
Agustus	2016	16344400	485	64	464
September	2016	16600000	450	40	472
Oktober	2016	8806250	245	38	250
November	2016	8665350	243	26	246
Desember	2016	8348325	300	30	237
Januari	2017	10664000	242	37	248
Februari	2017	12900000	276	44	300
Maret	2007	6000000	320	60	?

It can be seen in Table 1 from September 2014 to February 2017, it can be concluded that the largest stock of woven fabric up to 230 seeds per month, and the smallest reaches 5 seeds per month. The largest demand for woven fabric reaches 485 seeds per month, and the smallest demand reaches 50 seeds per month. The largest production costs that have to be spent per month reach 16,600,000 rupiahs, and the smallest production costs reach 900,000 rupiah. The highest amount of woven fabric production is 472 seeds per month, and the smallest is 80 seeds per month. And it can be seen that the stock in March is 60, the demand is 320 and the production cost is only 6000000, then it is asked how much should be produced using the Fuzzy Inference System method using Tsukamoto and Sugeno methods ?

2) Dataset Analysis

Analysis of data sets based on data at Pemalang Islamic Boarding School that will be used for Tsukamoto and Sugeno's Fuzzy Inference System process is using stock data, demand, production costs, and the amount of production as training data before being processed with the test data to be predicted.

3) Making Rules with Weka

Making rules or rules with Weka, by generating all data of stock, demand, production costs, and the amount of production then processed by using C4.5 Algorithm to construct decision trees from the training data. The algorithm for building a decision tree is C4.5 in Weka known as J48 so that a rule classification will be formed, then the classification results are

described in the form of a decision tree which will be explained in the implementation chapter. The rules formed by Weka are If ... And ... Then ...

4) Fuzzification

Fuzzisification is the steps to create a membership function based on variables that have been determined along with the universe of discussion, the variables are stock, demand, production costs, and the amount of production, after that find the membership degree of a fuzzy set, based on predetermined linguistic values, namely little and many.

5) Fuzzy Inference System

In the Fuzzy Inference System stage, it uses the Tsukamoto and Sugeno methods to do the calculation process until the prediction of the number of woven fabric production is obtained.

6) Defuzzification

Defuzzification is the last way to get the prediction results of the woven fabric by using the following equation:

$$Z = \frac{\Sigma(\alpha * z)}{\Sigma\alpha}$$

7) Result Production Prediction

At this stage, the final stage is the result of predicting the amount of woven fabric production from the Fuzzy Inference System using Tsukamoto and Sugeno methods.

IV. CALCULATION AND IMPLEMENTATION

A. Fuzzy Inference System Calculation

The following are examples of Tsukamoto fuzzy manual calculation and Sugeno fuzzy based on stock, demand, and production costs data as shown in Table 2.

1) Fuzzy Tsukamoto Method

Case in point: Woven fabric company xxx, is a woven fabric manufacturing company, from the sample production data from September 2014 to February 2017 which is known per month, the maximum production cost is 16,600,000 rupiahs, minimum production cost is 900,000 rupiahs, maximum demand is 485 seeds , minimum demand for 50 seeds, maximum stock of 230 seeds, and minimum stock of 5 seeds, as well as a minimum production amount of 80 seeds, maximum production amount of 472 seedlings. It is known that the current production costs in March 2017 are: 6000000 rupiahs and the current demand is: 320 seeds, the current stock is 60 seeds. What is the number of woven fabrics that should be produced by woven fabric xxx in March 2017?

Completion :

In this case there are 4 variables, namely: 3 input variables, namely: stock variables, demand variables, and production costs variables while for the output there is 1 variable, namely: the amount of woven fabric production. Stock variables, demand variables, production cost variables, and variable quantities of woven fabric production have 2 linguistic values, namely many and little. With the following rules or rules, where rules or rules are made using the Weka application 3.6:

[R1] IF Stock LITTLE THEN Amount of production MANY

[R2] IF Stock Many And Production cost LITTLE And Demand LITTLE THEN Amount of production LITTLE

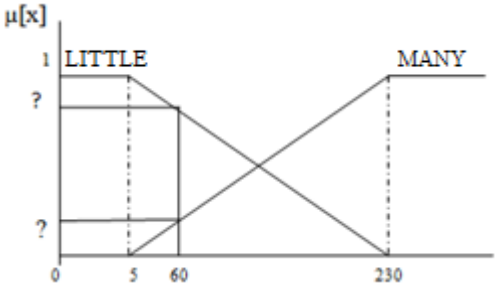
[R3] IF Stock MANY And Production cost LITTLE And Demand MANY THEN Amount of production MANY

[R4] IF Stock MANY And Production cost MANY THEN Amount of production LITTLE

Step 1

Determine the relevant variables in the process to be determined and the corresponding fuzzification function. In this case, there are 4 variables that will be modeled, namely:

a) Stock (x), consists of 2 fuzzy sets, namely LITTLE and MANY. Based on the many and little stock data from Table 1 sample data, the membership function is formulated as follows:



Woven fabric stock (Month)

$$\mu_{stock-Little[x]} \begin{cases} 1 & x \leq 5 \\ \dfrac{230-x}{225} & 5 \leq x \leq 230 \\ 0 & x \geq 230 \end{cases}$$

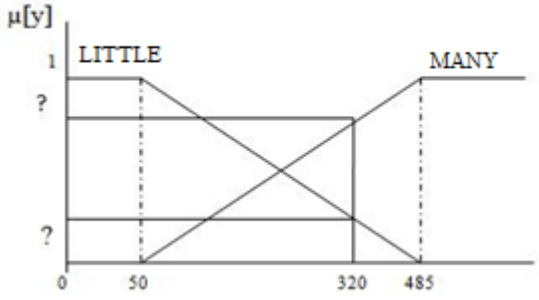
$$\mu_{stock-Many[x]} \begin{cases} 0 & x \leq 5 \\ \dfrac{x-5}{225} & 5 \leq x \leq 230 \\ 1 & x \geq 230 \end{cases}$$

If stock 60 seeds, then:

$$\mu_{stock-Little[60]} = \frac{230-60}{225} = 0.755$$

$$\mu_{stock-Many[60]} = \frac{60-5}{225} = 0.244$$

b) Demand (y), consists of 2 fuzzy sets, namely LITTLE and MANY. Based on the many and little demand data from Table 1 sample data, the membership function is formulated as follows:



Wofen fabric demand (Month)

$$\mu_{demand-Little[y]} \begin{cases} 1 & y \le 50 \\ \frac{485-y}{435} & 50 \le y \le 485 \\ 0 & y \ge 485 \end{cases}$$

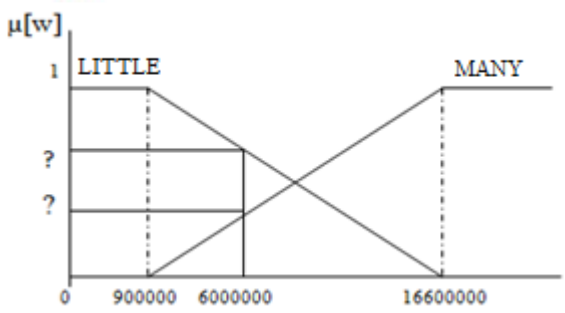
$$\mu_{demand-Many[y]} \begin{cases} 0 & y \le 50 \\ \frac{y-50}{435} & 50 \le y \le 485 \\ 1 & y \ge 485 \end{cases}$$

If demand 320 seeds, then:

$$\mu_{demand-Little[320]} = \frac{485-320}{435} = 0.379$$

$$\mu_{demand-Many[320]} = \frac{320-50}{435} = 0.621$$

c) Production cost (w), consists of 2 fuzzy sets, namely LITTLE and MANY. Based on the many and little production cost data from Table 1 sample data, the membership function is formulated as follows:



Wofen fabric production cost (Month)

$$\mu_{cost-Little[w]} \begin{cases} 1 & w \le 900000 \\ \frac{16600000-w}{15700000} & 900000 \le w \le 16600000 \\ 0 & w \ge 16600000 \end{cases}$$

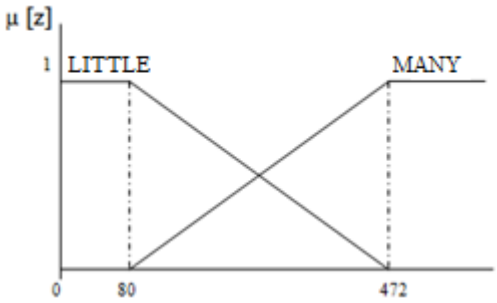
$$\mu_{cost-Many[w]} \begin{cases} 0 & w \le 900000 \\ \frac{w-900000}{15700000} & 900000 \le w \le 16600000 \\ 1 & w \ge 16600000 \end{cases}$$

If production cost 6000000 Rupiah, then:

$$\mu_{cost-Little[6000000]} = \frac{16600000-6000000}{15700000} = 0.675$$

$$\mu_{cost-Many[6000000]} = \frac{6000000-900000}{15700000} = 0.325$$

d) Amount of production (z), consists of 2 fuzzy sets, namely LITTLE and MANY. Based on the many and little amount of production data from Table 1 sample data, the membership function is formulated as follows :



Wofen fabric amount of production (Month)

$$\mu_{production-Little[z]} \begin{cases} 1 & z \le 80 \\ \frac{472-z}{392} & 80 \le z \le 472 \\ 0 & z \ge 472 \end{cases}$$

$$\mu_{production-Many[z]} \begin{cases} 0 & z \le 80 \\ \frac{z-80}{392} & 80 \le z \le 472 \\ 1 & z \ge 472 \end{cases}$$

Step 2

Application function implications. By using the MIN function in the application implication function, you can find the z value for each rule:

[R1] IF Stock LITTLE THEN Amount of production MANY

$$\alpha_{-predikat1} = \mu_{stock-Little} = (\mu_{Stock-Little}[60]) = 0.756$$

$$\mu_{Production-Many[z]} \begin{cases} 0 & z \leq 80 \\ \dfrac{z-80}{392} & , \quad 80 \leq z \leq 472 \\ 1 & z \geq 472 \end{cases}$$

$$\frac{Z1-80}{392} = 0.756$$

$$z_1 = 376.178$$

[R2] IF Stock MANY And Production cost LITTLE And Demand LITTLE THEN Amount of production LITTLE

$$\alpha_{-predikat2} = \mu_{stock-Many} \cap \mu_{cost-Little} \cap \mu_{demand-Little}$$
$$= \min(\mu_{stock-Many[60]} \cap \mu_{cost-Little}[6000000] \cap \mu_{demand-Little}[320])$$
$$= \min(0.244; 0.675; 0.379 = 0.244$$

$$\mu_{production-Little[z]} \begin{cases} 1 & z \leq 80 \\ \dfrac{472-z}{392} & , \quad 80 \leq z \leq 472 \\ 0 & z \geq 472 \end{cases}$$

$$\frac{472-z2}{392} = 0.244$$

$$z_2 = 376.178$$

[R3] IF Stock MANY And Production cost LITTLE And Demand MANY THEN Amount of production MANY

$$\alpha_{-predikat3} = \mu_{stok-Many} \cap \mu_{cost-Little} \cap \mu_{demand-Many}$$
$$= \min(\mu_{stok-Many[60]} \cap \mu_{Cost-Little}[6000000] \cap \mu_{demand-Many}[320])$$
$$= \min(0.244; 0.675; 0.621) = 0.244$$

$$\mu_{Production-Many[z]} \begin{cases} 0 & z \leq 80 \\ \dfrac{z-80}{392} & , \quad 80 \leq z \leq 472 \\ 1 & z \geq 472 \end{cases}$$

$$\frac{z3-80}{392} = 0.244$$

$$z_3 = 175.822$$

[R4] IF Stock MANY And Production cost MANY THEN Amount of production LITTLE

$$\alpha_{-predikat4} = \mu_{Stock-Many} \cap \mu_{cost-Many}$$
$$= \min(\mu_{Stock-Many[60]} \cap \mu_{cost-Many}[6000000])$$
$$= \min(0.244444444; 0.32484076)$$
$$= 0.244$$

$$\mu_{Produksi-sedikit[z]} \begin{cases} 1 & z \leq 80 \\ \dfrac{472-z}{392} & , \quad 80 \leq z \leq 472 \\ 0 & z \geq 472 \end{cases}$$

$$\frac{472-z4}{392} = 0.244$$

$$z_4 = 376.178$$

Step 3

The final results are obtained using a weighted average, namely:

$$z = \frac{\alpha_{-predikat1} * z1 + \alpha_{-predikat2} * z2 + \alpha_{-predikat3} * z3 + \alpha_{-predikat4} * z4}{\alpha_{-predikat1} + \alpha_{-predikat2} + \alpha_{-predikat3} + \alpha_{-predikat4}}$$
$$= \frac{0.756 * 376.178 + 0.244 * 376.178 + 0.244 * 175.822 + 0.244 * 376.178}{0.756 + 0.244 + 0.244 + 0.244}$$
$$z = \frac{511.111}{1.489}$$
$$= 343.284$$
$$\approx 343$$

So the total production of woven fabric that must be produced by the xxx woven fabric company is as much as 343 seeds.

2) Fuzzy Sugeno Method

Step 1

just like the above step which is about fuzzification to determine the membership set, the researcher goes straight to the rules or rules that are combined using the order 0 and order 1 where the results are in the form of a constant. Looks like the following:

[R1] IF Stock LITTLE THEN Amount of production = Demand

[R2] IF Stock MANY And Production cost LITTLE And Demand LITTLE THEN Amount of production = (Demand - Stock) + 150

[R3] IF Stock MANY And Production cost LITTLE And Demand MANY THEN Amount of production = 1.25* Demand - Stock

[R4] IF Stock MANY And Production cost MANY THEN Amount of production = Demand+200

Step 2

Application function implications. By using the MIN function in the application implication function, you can find the z value for each rule:

[R1] IF Stock LITTLE THEN Amount of production = Demand

$$\alpha_{-predikat1} = \mu_{stok-sedikit}$$
$$= (\mu_{Stok-sedikit}[60])$$
$$= 0.756$$

So that the Z_1 value = Demand

= 320

[R2] IF Stock MANY And Production cost LITTLE And Demand LITTLE THEN Amount of production = (Demand - Stock) + 150

$$\alpha_{-predikat2} = \mu_{Stock-Many} \cap \mu_{Cost-Little} \cap \mu_{demand-Many}$$
$$= \min(\mu_{Stock-Many}[60] \cap \mu_{Cost-Little}[6000000] \cap \mu_{demand-Little}[320])$$
$$= \min(0.244; 0.675; 0.379 = 0.244$$

So that the Z_2 value = (Demand – Stock) + 150

= (320 – 60) + 150

= 410

[R3] IF Stock MANY And Production cost LITTLE And Demand MANY THEN Amount of production = 1.25* Demand – Stock

$$\alpha_{-predikat3} = \mu_{Stock-Many} \cap \mu_{Cost-Little} \cap \mu_{demand-Many}$$
$$= \min(\mu_{Stock-Many}[60] \cap \mu_{Cost-Little}[6000000] \cap \mu_{demand-Many}[320])$$
$$= \min(0.244; 0.675; 0.621)$$
$$= 0.244$$

So that the Z_3 value = 1.25 * Permintaan - Stok

= 1.25 * 320 - 60

= 340

[R4] IF Stock MANY And Production cost MANY THEN Amount of production = Demand+200

$$\alpha_{-predikat4} = \mu_{Stock-Many} \cap \mu_{Cost-Many}$$
$$= \min(\mu_{Stock-Many}[60] \cap \mu_{Cost-Many}[6000000])$$
$$= \min(0.244; 0.325)$$
$$= 0.244$$

So that the Z_4 value = Permintaan + 200

= 320 + 200

= 520

Step 3

The final results are obtained using a weighted average, namely:

$$\boldsymbol{z} = \frac{\alpha_{-predikat1}*z1 + \alpha_{-predikat2}*z2 + \alpha_{-predikat3}*z3 + \alpha_{-predikat4}*z4}{\alpha_{-predikat1} + \alpha_{-predikat2} + \alpha_{-predikat3} + \alpha_{-predikat4}}$$

$$z = \frac{0.756*320 + 0.244*410 + 0.244*340 + 0.244*520}{0.756 + 0.244 + 0.244 + 0.244}$$

$$z = \frac{552.222}{1.489}$$

$$= 370.896 \approx 371$$

So the total production of woven fabric that must be produced by the xxx woven fabric company is as much as 371 seeds.

B. Weka implementation for creating rules

m The first step is to make rules or rules on Weka namely, fill all the related data on Microsoft Excel such as data on stock, demand, production costs, and the amount of production, then save the data in the format (* .csv), then call the data to . After that, select the classify menu, the test options select use training set, and on the choose button select file trees, then select J48, then click the start button, then the classification display will appear as shown in Fig 2:

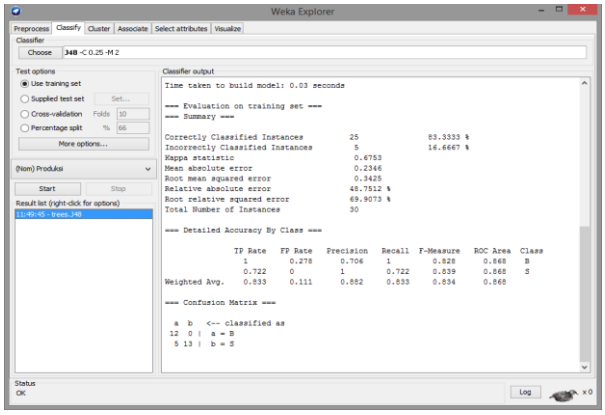


Figure 2. Clasifier Output

From Figure 2, it can be seen that the data entered is 30 correct in the classification of 25 and the wrong classification is 5. The accuracy level is 83.3333%. Next is to display the decision tree by right-clicking on the result list, then selecting visualize tree, then the image will appear as Fig 3:

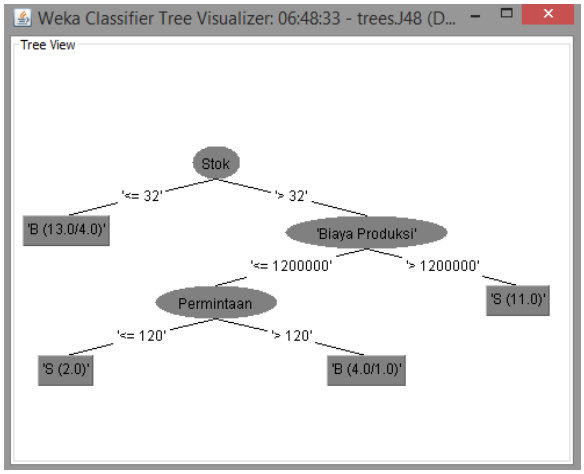


Figure 3. Decision Tree

From Figure 3, it can be concluded that what is formed from the rules of boundary data is as follows:

Stok (Stock) :

Little : $4 < \text{Stock} \leq 32$

Many : More than 32

Permintaan (Demand) :

Little : $49 < \text{Demand} \leq 120$

Many : More than 120

Biaya produksi (Production cost) :

Little : $900000 < \text{Cost} \leq 1200000$

Many : More than 1200000

So the following rules are obtained:

[R1] IF Stock LITTLE THEN Amount of production MANY

[R2] IF Stock Many And Production cost LITTLE And Demand LITTLE THEN Amount of production LITTLE

[R3] IF Stock MANY And Production cost LITTLE And Demand MANY THEN Amount of production MANY

[R4] IF Stock MANY And Production cost MANY THEN Amount of production LITTLE

To find out the differences in rules or rules that predict the results from the actual data results, then here the researcher makes rules or rules based on monotony. The following monotonous rules or rules are used:

[R1] IF demand LITTLE and stock LITTLE and cost LITTLE then amount of production LITTLE.

[R2] IF demand LITTLE and stock LITTLE and cost MANY then amount of production LITTLE.

[R3] IF demand LITTLE and stock MANY and cost LITTLE then amount of production SEDIKIT.

[R4] IF demand LITTLE and stock MANY and cost MANY then amount of production LITTLE.

[R5] IF demand MANY and stock LITTLE and cost LITTLE then amount of production MANY.

[R6] IF demand MANY and stock LITTLE and cost MANY then amount of production MANY.

[R7] IF demand MANY and stock MANY and cost LITTLE then amount of production MANY.

[R8] IF demand MANY and stock MANY and cost MANY then amount of production LITTLE.

C. Result

The result is shown in Table II and Table III:

TABLE II. RESULT OF WEKA RULES

DATA					Data real	Fuzzy	
Month	Year	Stock	Demand	Cost	production	Tsukamoto	Sugeno
Marc	2017	60	320	6000000	340	343	371

TABLE III. RESULT OF MONOTONOUS RULES

Data					Data real	Fuzzy	
Month	Year	Stock	Demand	Cost	production	Tsukamoto	Sugeno
Marc	2017	60	320	6000000	340	313	321

V. CONCLUSION AND SUGGESTION

Based on the discussion about fuzzy inference system with Tsukamoto and Sugeno methods, the following conclusions can be drawn: The rule base model in this study is a decision tree that can be used for fuzzy inference systems.

From the calculation data of the production of Mlaki Wanarejan Utara Pemalang woven fabric according to Tsukamoto's method in March 2017 using Weka's rule obtained 343 woven fabrics in meters, while using the Sugeno method obtained 371 woven fabrics in meters. Meanwhile according to Tsukamoto's method in March 2017 using monotonous rules obtained 313 woven fabrics in meters, then using the Sugeno method obtained 321 woven fabrics in meters.

So from the analysis of direct comparison with the original data in the company, it can be concluded that the method that most closely approximates the truth value is the production obtained by processing data using the Tsukamoto method using the Weka rules.

This application can be implemented in woven fabric industry institutions, with this application it is expected that woven fabric entrepreneurs can be easier and more objective in determining the appropriate and appropriate production amount based on stock, demand, and production costs. In its use it is recommended to adjust the parameters used.

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