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PREDICTION OF PRODUCT SALES RESULTS USING ADAPTIVE NEURO FUZZY INFERENCE SYSTEM (ANFIS)

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Abstract

This study aims to optimize profits and minimize losses from product sales at X Market has achieved in the future. The data used in this study were obtained directly from X Market Trade by observing and interviewing. X Market Tradingis one of the industries that produces and sells food products to be marketed in the region and outside the region. The data to be processed is the result of the sale of food products at X Market uses the adaptive neuro fuzzy inference system (ANFIS) method which is a combination of Fuzzy Logic and Artificial Neural Networks. The data used is monthly sales data from 2018 to 2020 as many as 36 data. From a total of 36 data, it will be divided into 2 types of training and test data distribution, namely 90:10 with a total of 60 epochs and a learning rate range of 0.1 – 0.9. From the research results obtained the highest accuracy of 88.55% on 90% training data and 10% test data with a learning rate of 0.6. It was concluded that the ANFIS method could be implemented in predicting the sales of tofu. By doing this research is expected to provide input to X Market in optimizing profits and minimizing losses from product sales in the future.

Keywords: *Predict, Sales, Know, Adaptive neuro fuzzy inference system (ANFIS)*

1. Introduction

Food products are a popular food among the people of Indonesia. Food products include 4 healthy 5 perfect foods that contain high protein or nutrition. Food products have a soft texture and solid form because the main raw material is soybeans. In addition, food products have low prices and are easy to obtain. almost all Indonesian people consume food products[1]. Predicting sales to produce food how much demand for the product is something that must be done to be able to optimize profits and minimize losses. X Market is one of the industries that produces and sells food products to be marketed in the region and outside the region. X Market, which is located in Pasar 1A Trading, produces food products with a large number of requests and sales. The high market demand which has an impact on the incompatibility of the supply of food products every day. Based on the data obtained that in 2018-2020 food products there is a demand for 180000-250000 food products/month while the supply is only 120000-210000 food products/month, where in 1 package contains 5 seeds of food products which are marketed at a price of Rp. 2000/package.

Fuzzy logic is one of the methods in the control system process to solve problems in accordance with the implementation of a system starting from a simple system to a more complex control system[2],[3]. One of the studies related to the prediction of food products has been conducted regarding the prediction of food products using the Sugeno technique [4],[5],[6]. The results obtained from the level of error difference (error) 0.19%, meaning that from an error rate of 100%, it has a truth value in the estimated amount of food product production, which is 99.81%. The use of the Sugeno method of fuzzy logic often has difficulty in determining the fuzzy sets and fuzzy rules used to obtain problem solutions[7]. Therefore, in this study, to predict sales of food products, it is possible to combine it with other methods in order to obtain a more optimal solution with increased accuracy. One way to improve the accuracy of the test is ANFIS.

Adaptive Neuro fuzzy inference system (ANFIS) which is a combination of artificial neural network and fuzzy inference system (Fuzzy Inference System)[8]. ANFIS is a hybrid learning (learning) intended to determine good features and reduce errors[9],[10]. The advantage of the ANFIS method is that it has the ability to learn from numerical and measurable data so that much needed mathematical modeling can be made[11],[12]. This is evidenced by several studies on ANFIS conducted regarding the prediction of sales of goods with the results of research using the ANFIS method which produces an average Mean Absolute Percentage (MAPE) of 8.73% of training and an average MAPE of testing of 13, 58%[13]. The MAPE test results are less than the error tolerance limit, which is 20%. The tolerance limit is based on the interpretation of Batey and Friedrich where MAPE < 10% is a very good estimate and 10% < MAPE < 20% is a good estimate.

2. Research Methodology

Methodology is a way of doing something by using the mind carefully to achieve a goal. While research is an activity to search, record, formulate and analyze to compile the report. In completing this research using quantitative research which demands more use of numbers. Numerical computing is an approach to solving mathematical problems using several numerical methods. In an effort to obtain the data needed in this study, a data collection method was carried out. The data collection method used in conducting this research is Library Research, which is a method of collecting data by studying literature related to the case and the method studied as reference material in obtaining information, analysis, and discussion sourced from libraries, books, proceedings or scientific journals. Another source of research data was obtained from X Market. This study uses data from the sale of food products in food products from 2018 to 2020. The variables used are demand, supply, and distribution costs and use the adaptive neuro fuzzy inference system (ANFIS) method as a solution for solving cases of predicting food product sales results. In conducting a research, the most important component is the need for research data where it will be processed so as to produce a useful goal. The following is the raw data obtained from the sale of food products at X Market in Table 1:

Table 1. Food Product Sales Results on food products 2018-2020

No.	Month	Request	Stock	Distribution Fee	Sale
1	January 2018	210.000	250.0000	656.000	7.540.000
2	February 2018	210.000	250.0000	704.000	7.700.000
3	March 2018	210.000	180.0000	675.000	7.100.000
4	April 2018	210.000	180.0000	680.000	7.000.000
5	May 2018	150.000	180.0000	660.000	7.800.000
6	June 2018	150.000	180.0000	700.000	7.550.000
7	July 2018	150.000	180.0000	630.000	6.550.000
8	August 2018	210.000	250.0000	790.000	8.994.000
9	September 2018	210.000	250.0000	860.000	8.760.000
10	October 2018	210.000	250.0000	900.000	11.500.000
11	November 2018	210.000	250.0000	925.000	1.2000.00
12	December 2018	150.000	180.0000	620.000	7.1900.00
13	January 2019	150.000	180.0000	700.000	8.540.000
14	February 2019	150.000	180.0000	511.000	6.000.000
15	March 2019	210.000	250.0000	1.119.000	15.000.000
16	April 2019	210.000	250.0000	1.020.000	12.900.000
17	May 2019	210.000	250.0000	990.000	11.525.000
18	June 2019	210.000	250.0000	800.000	9.920.000
19	July 2019	150.000	180.0000	652.000	6.000.000
20	August 2019	150.000	180.0000	650.000	8.500.000
21	September 2019	150.000	180.0000	642.000	5.000.000
22	October 2019	150.000	180.0000	680.000	7.390.000
23	November 2019	150.000	180.0000	528.000	6.590.000
24	December 2019	150.000	180.0000	677.000	7.770.000
25	January 2020	210.000	250.0000	985.000	10.459.000
26	February 2020	210.000	250.0000	854.000	9.150.000
27	March 2020	210.000	250.0000	1.003.000	11.116.000
28	April 2020	210.000	250.0000	1.260.000	10.147.000
29	May 2020	210.000	250.0000	1.021.000	10.459.000
30	June 2020	210.000	250.0000	1.171.000	9.800.000
31	July 2020	150.000	180.0000	612.000	4.500.000
32	August 2020	150.000	180.0000	799.000	7.000.000
33	September 2020	210.000	250.0000	894.000	9.000.000
34	October 2020	210.000	250.0000	798.000	10.000.000
35	November 2020	210.000	250.0000	1.160.000	15.600.000

No.	Month	Request	Stock	Distribution Fee	Sale
36	December 2020	210.000	250.0000	1.520.000	15.500.000

Based on Table 1, the data used in this study is data from the sale of food products at X Market on food products 2018 to 2020 . The adaptive neuro fuzzy inference system (ANFIS) method is a combination of Fuzzy Logic and Artificial Neural Networks. In the process of calculating the Artificial Neural Network, first the raw data is divided into 2 (two) patterns, namely training data and testing data. The initial training data (training) can be seen in Table 2 and the initial testing data (testing) in Table 3.

Table 2. Initial Data on Food Product Sales Training

No.	M/Y	X1	X2	X3	Target	Inf
1	Jan 18	210.000	250.0000	656.000	7.540.000	*Training*
2	Feb 18	210.000	250.0000	704.000	7.700.000	*Training*
3	Mar 18	210.000	180.0000	675.000	7.100.000	*Training*
4	Apr 18	210.000	180.0000	680.000	7.000.000	*Training*
5	May 18	150.000	180.0000	660.000	7.800.000	*Training*
6	Jun 18	150.000	180.0000	700.000	7.550.000	*Training*
7	Jul 18	150.000	180.0000	630.000	6.550.000	*Training*
8	Agus 18	210.000	250.0000	790.000	8.994.000	*Training*
9	Sep 18	210.000	250.0000	860.000	8.760.000	*Training*
10	Okt 18	210.000	250.0000	900.000	11.500.000	*Training*
11	Nov 18	210.000	250.0000	925.000	1.2000.00	*Training*
12	Des 18	150.000	180.0000	620.000	7.1900.00	*Training*
13	Jan 19	150.000	180.0000	700.000	8.540.000	*Training*
14	Feb 19	150.000	180.0000	511.000	6.000.000	*Training*
15	Mar 19	210.000	250.0000	1.119.000	15.000.000	*Training*
16	Apr 19	210.000	250.0000	1.020.000	12.900.000	*Training*
17	May 19	210.000	250.0000	990.000	11.525.000	*Training*
18	Jun 19	210.000	250.0000	800.000	9.920.000	*Training*
19	Jul 19	150.000	180.0000	652.000	6.000.000	*Training*
20	Agus 19	150.000	180.0000	650.000	8.500.000	*Training*
21	Sep 19	150.000	180.0000	642.000	5.000.000	*Training*
22	Okt 19	150.000	180.0000	680.000	7.390.000	*Training*
23	Nov 19	150.000	180.0000	528.000	6.590.000	*Training*
24	Des 19	150.000	180.0000	677.000	7.770.000	*Training*
25	Jan 20	210.000	250.0000	985.000	10.459.000	*Training*
26	Feb 20	210.000	250.0000	854.000	9.150.000	*Training*
27	Mar 20	210.000	250.0000	1.003.000	11.116.000	*Training*
28	Apr 20	210.000	250.0000	1.260.000	10.147.000	*Training*
29	May 20	210.000	250.0000	1.021.000	10.459.000	*Training*
30	Jun 20	210.000	250.0000	1.171.000	9.800.000	*Training*
31	Jul 20	150.000	180.0000	612.000	4.500.000	*Training*
32	Agus 20	150.000	180.0000	799.000	7.000.000	*Training*
33	Sep 20	210.000	250.0000	894.000	9.000.000	*Training*
34	Okt 20	210.000	250.0000	798.000	10.000.000	*Training*
35	Nov 20	210.000	250.0000	1.160.000	15.600.000	*Training*
36	Des 20	210.000	250.0000	1.520.000	15.500.000	*Training*

Based on table 2 above, the variables can be explained as follows:
Month/Year = Month/Food product 2018 to 2020, X1 = request data, X2 = inventory data, X3 = distribution cost data, Target = sales data

Table 3. Initial Data Testing of Food Product Sales

No.	M/ Y	X1	X2	X3	Target	Inf
1	Jan 18	210.000	250.0000	656.000	7.540.000	*Testing*
2	Feb 18	210.000	250.0000	704.000	7.700.000	*Testing*
3	Mar 18	210.000	180.0000	675.000	7.100.000	*Testing*
4	Apr 18	210.000	180.0000	680.000	7.000.000	*Testing*
5	May 18	150.000	180.0000	660.000	7.800.000	*Testing*
6	Jun 18	150.000	180.0000	700.000	7.550.000	*Testing*
7	Jul 18	150.000	180.0000	630.000	6.550.000	*Testing*
8	Agus 18	210.000	250.0000	790.000	8.994.000	*Testing*
9	Sep 18	210.000	250.0000	860.000	8.760.000	*Testing*
10	Okt 18	210.000	250.0000	900.000	11.500.000	*Testing*
11	Nov 18	210.000	250.0000	925.000	1.2000.00	*Testing*
12	Des 18	150.000	180.0000	620.000	7.1900.00	*Testing*
13	Jan 19	150.000	180.0000	700.000	8.540.000	*Testing*
14	Feb 19	150.000	180.0000	511.000	6.000.000	*Testing*
15	Mar 19	210.000	250.0000	1.119.000	15.000.000	*Testing*

No.	M/ Y	X1	X2	X3	Target	Inf
16	Apr 19	210.000	250.0000	1.020.000	12.900.000	*Testing*
17	May 19	210.000	250.0000	990.000	11.525.000	*Testing*
18	Jun 19	210.000	250.0000	800.000	9.920.000	*Testing*
19	Jul 19	150.000	180.0000	652.000	6.000.000	*Testing*
20	Agus 19	150.000	180.0000	650.000	8.500.000	*Testing*
21	Sep 19	150.000	180.0000	642.000	5.000.000	*Testing*
22	Okt 19	150.000	180.0000	680.000	7.390.000	*Testing*
23	Nov 19	150.000	180.0000	528.000	6.590.000	*Testing*
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25	Jan 20	210.000	250.0000	985.000	10.459.000	*Testing*
26	Feb 20	210.000	250.0000	854.000	9.150.000	*Testing*
27	Mar 20	210.000	250.0000	1.003.000	11.116.000	*Testing*
28	Apr 20	210.000	250.0000	1.260.000	10.147.000	*Testing*
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32	Agus 20	150.000	180.0000	799.000	7.000.000	*Testing*
33	Sep 20	210.000	250.0000	894.000	9.000.000	*Testing*
34	Okt 20	210.000	250.0000	798.000	10.000.000	*Testing*
35	Nov 20	210.000	250.0000	1.160.000	15.600.000	*Testing*
36	Des 20	210.000	250.0000	1.520.000	15.500.000	*Testing*

Based on table 2 above, the variables can be explained as follows: Month/Year = Month/Food product 2018 to 2020, X1 = request data, X2 = inventory data, X3 = distribution cost data, Target = sales data

2.1. Research Work Activity Diagram

In this study using the workflow or stages of the research process which can be described in the activity diagram shown in Figure 1

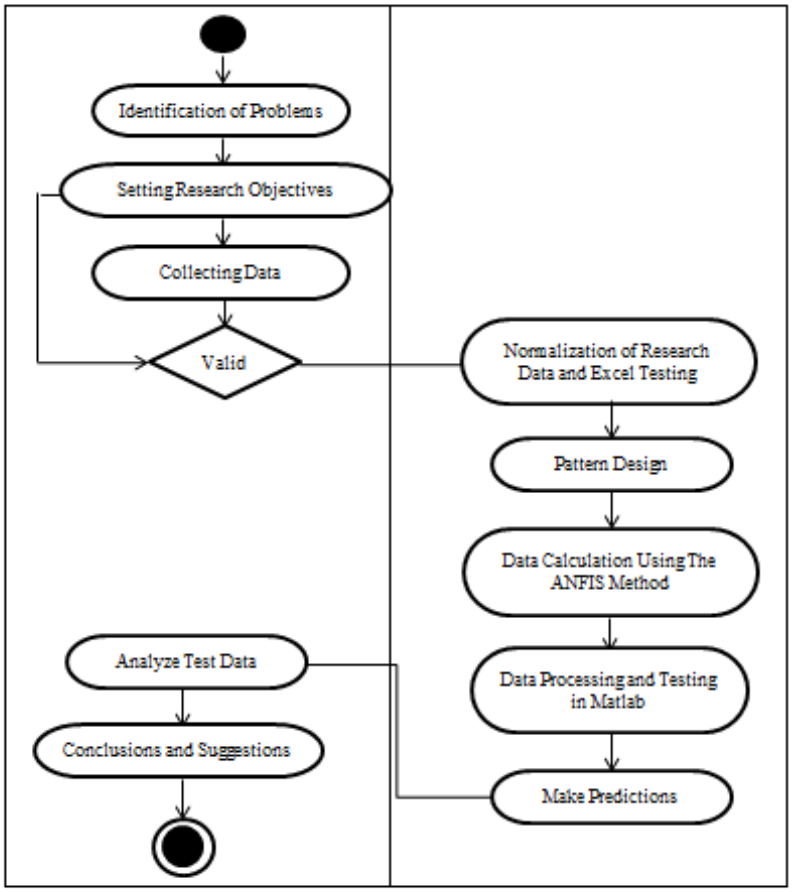

Figure 1. Research Work Activity Diagram

Figure 1. is a diagram of the research workflow activity carried out on the system used. At this stage of data collection, researchers take data that will be used as input for the fuzzy logic system. The 3 inputs obtained from the sales data are: demand, supply and distribution costs. Where the sales data is taken from samples of food product sales from 2018 to 2020. The output of the ANFIS system is to predict

the sales results of food products. At the data processing stage, the existing sales data must be processed first by using Microsoft Excel 2010 software for the data normalization calculation process in accordance with the established equation or formula. Then determine the pattern of training and testing data that will be used in the study and perform the calculation process on the data pattern using the adaptive neuro fuzzy inference system (ANFIS). Then input the training and testing data patterns into the Matlab R2011a software so that the best architectural results can be determined in Excel so as to optimize the sales profits that have been achieved and in the future.

2.2. Modeling Method

This method is used in solving cases in the research, namely the adaptive neuro fuzzy inference system (ANFIS) method. The use case diagram modeling of the ANFIS method that will be used in solving cases in this study is shown in Figure 2:

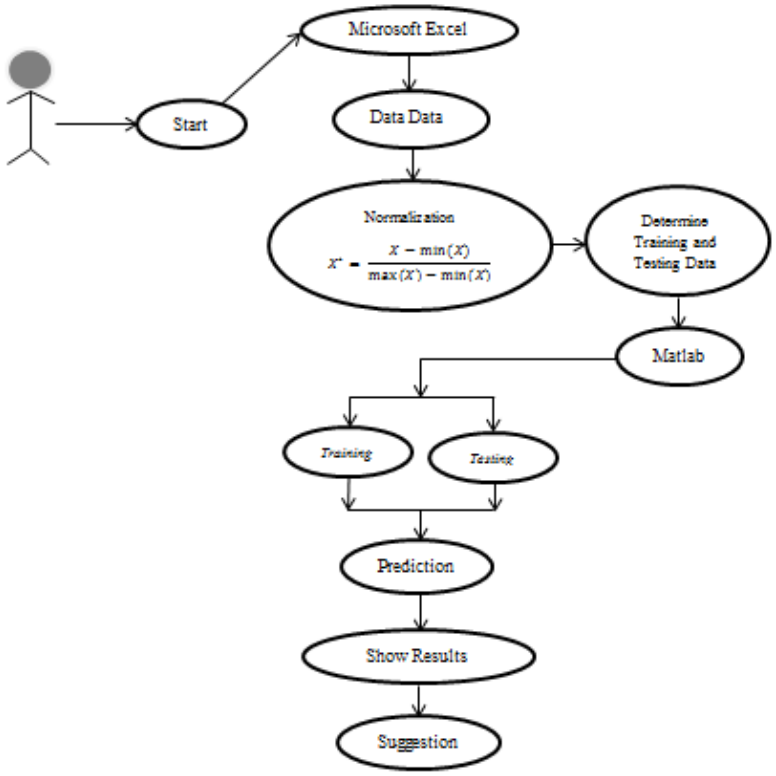

Figure 2. Use Case Diagram of ANFIS General Process

The explanation from Figure 2 about the general process of the adaptive neuro inference system (ANFIS) is as follows. The user is a user who preprocesses predictions using the adaptive neuro fuzzy inference system (ANFIS) method. The user will start the prediction process which begins by opening the Microsoft Excel 2010 software. When the Microsoft Excel 2010 software is opened, the raw data input is used for the prediction process. In this case, the data used is data from the sale of food products at X Market Tradingon food products 2018 to 2020. The next step is to normalize raw data in Microsoft Excel 2010 software according to the normalization formula that has been set, then open the Matlab R2011a software which is used as a system tool for the testing process. Then determine the pattern of training data and test data. And carry out the process of testing the training data pattern on the Matlab R2011a software. Then the process of testing the test data pattern (testing) on the Matlab R2011a software. If the output results are training data and testing data. Then the next step is to do the prediction process. After the prediction process is carried out, the process is complete.

3. Results And Discussion

In this study, the method used is the Adaptive Neuro Fuzzy Inference System (ANFIS) to predict the sales of food products at X Market Trading. The variables used in this study include demand, supply, distribution costs and the output in the form of selling food products at X Market. To implement there are steps that are carried out in the ANFIS method, namely manual calculations and adjustment of the final results with Matlab software. In the research on the prediction of food product sales using the ANFIS method, 2 input variables will be used, namely demand, supply and distribution costs and 1 output variable in the form of food product sales at X Market which is seen in table 4 below.

Table 4. ANFIS . Research Data Variables

Variable	Information
X1	Request
X2	Srock
X3	Distribution Cost
Y	Target

At this stage the data will be normalized and then divided into 2 groups, namely training data and test data. This data sharing aims to produce accurate food produced by the ANFIS method to predict sales of food products. The amount of data used in this study is from food products from 2018 to 2020. The following is table 5 of food product sales data.

Table 5. Food Product Sales Data

No	Request (X1)	Stock (X2)	Dist.Cost (X3)	Target (Y)
1	210000	250000	656000	7540
2	210000	250000	704000	7700
3	210000	180000	675000	7100
4	210000	180000	680000	7000
5	150000	180000	660000	7800
6	150000	180000	700000	7550
7	150000	180000	630000	6550
8	210000	250000	790000	8994
9	210000	250000	860000	8760
10	210000	250000	900000	11500
11	210000	250000	925000	12000
12	150000	180000	620000	7190
13	150000	180000	700000	8540
14	150000	180000	511000	6000
15	210000	250000	1119000	15000
16	210000	250000	1020000	12900
17	210000	250000	990000	11525
18	210000	250000	800000	9920
19	150000	180000	652000	6000
20	150000	180000	650000	8500
21	150000	180000	642000	5000
22	150000	180000	680000	7390
23	150000	180000	528000	6590
24	150000	180000	677000	7770
25	210000	250000	985000	10459
26	210000	250000	854000	9150
27	210000	250000	1003000	11116
28	210000	250000	1260000	10147
29	210000	250000	1021000	10459
30	210000	250000	1171000	9800
31	150000	180000	612000	4500
32	150000	180000	799000	7000
33	210000	250000	894000	9000
34	210000	250000	798000	10000
35	210000	250000	1160000	15600
36	210000	250000	1520000	15500

3.1. Data Normalization

After the data is obtained, the normalization process is carried out so that the range of the processed data is not too large, ranging between 0 and 1. The following is the calculation of the 1st data normalization based on food product sales data using the normalization formula as follows:

$$X' = \frac{X - \min(X)}{\max(X) - \min(X)}$$

$$X11 = \frac{210000-150000}{210000-150000} = 6000$$

$$X12 = \frac{250000-180000}{250000-180000} = 7000$$

$$X13 = \frac{1520000-51100}{1520000-51100} = 100900$$

$$X14 = \frac{15600-4500}{15600-4500} = 11100$$

The same steps were also carried out for the 2nd to 36th data. The following is the normalized data obtained, seen in table 6 below.

Table 6. Normalization Results

No	Request (X1)	Stock (X2)	Distr. Cost (X3)	Target (Y)
1	1	1	0.143707	0.273874
2	1	1	0.191278	0.288288
3	1	0	0.162537	0.234234
4	1	0	0.167493	0.225225
5	0	0	0.147671	0.297297
….	……	…..	……	……
36	1	1	1.000000	0.990991

3.2. Training Data and Test Data

Training data is data that will be used in the training process (training) while test data is data that will be used in the testing process (testing). The amount of data used is 36 data, training and testing data will be divided into 2 data options with the amount of training data and different test data in which the aim is to find the highest accuracy. In this training process, we will use 90:10 division by 26 training data and 10 test data. The following is a table of training data from the sale of food products that have been normalized, totaling 26 data which can be seen in table 7 below:

Table 7. Normalization Training Data

No	Request (X1)	Stock (X2)	Distr. Cost (X3)	Target (Y)
1	1	1	0.143707	0.273874
2	1	1	0.191278	0.288288
3	1	0	0.162537	0.234234
4	1	0	0.167493	0.225225
5	0	0	0.147671	0.297297
….	……	…….	……..	……..
25	1	1	0.469772	0.536847
26	1	1	0.339941	0.418919

3.3. Data Clustering Using Fuzzy C-Means (FCM) Algorithm

Before entering the ANFIS method, clustering will be carried out using the FCM algorithm to obtain the mean and standard of exchange that will be used in the ANFIS method, namely at layer 1 ANFIS.

3.3.1. Calculating Cluster Center

After forming a random matrix, the next step is to calculate the center of the cluster, where the value (⟦(μ_11)⟧ ^2 is from the 26 x 2 matrix in the first column and the X value is taken from table 4.4. The following is the calculation for the 1st data in cluster 1.

$(\mu_{11})^2 = (0.32350)^2 = 0.104649$
$(\mu_{11})^2 * X_{11} = 0.104649*1 = 0.104649$
$(\mu_{11})^2 * X_{12} = 0.104649*1 = 0.104649$
$(\mu_{11})^2 * X_{13} = 0.104649*0.143706 = 0.01504$

Similarly, the calculation for the 2nd data to the 26th data in Cluster 1, so that the center of the 1st cluster is obtained on the variable X_11 (V_11). Here is the calculation.

$$V_{11} = \frac{\sum_{i=1}^{n}(\mu_{ik})^w W_{ij})}{\sum_{i=1}^{n}(\mu_{ik})^w}$$

$$V_{11} = \frac{0.10465 + 0.00124 + 0.04410 + 0.81374 + 0.00000 + \cdots + 0.34210}{0.10465 + 0.00124 + 0.04410 + 0.81374 + 0.33722 + \cdots + 0.34210}$$

$$V_{11} = \frac{9.54109}{4.54853}$$

$$V_{11} = 0.47673$$

Thus the calculation for the 1st cluster on the variables X_12(V_12) and X_13 (V_12). The following is the calculation of the center of cluster 1 in table 8. following:

Table 8. Calculation of the 1st Cluster Center

No.	μ_{11}	Cluster			$(\mu_{11})^2$	$(\mu_{11})^2 * X_{11}$	$(\mu_{12})^2 * X_{12}$	$(\mu_{13})^2 * X_{13}$
		X_{11}	X_{12}	X_{13}				
1	0.32350	1	1	0.14371	0.10465	0.10465	0.10465	0.01504
2	0.03522	1	1	0.19128	0.00124	0.00124	0.00124	0.00024
3	0.21001	1	0	0.16254	0.04410	0.04410	0.00000	0.00000
4	0.90208	1	0	0.16749	0.81374	0.81374	0.00000	0.00000
5	0.58070	0	0	0.14767	0.33722	0.00000	0.00000	0.00000
….	…..	..	..	…..	…..	…..	……	……
26	0.58489	1	1	0.33994	0.34210	0.34210	0.34210	0.11629
	Jumlah (∑)				9.54109	4.54853	3.69068	1.62303
	Pusat Cluster					0.47673	0.38682	0.17011

3.3.2. Calculation Using ANFIS Method

Calculations Using the ANFIS Method use the new standard deviation and mean values, which values will be used in the Advanced Stage of Layer 1 ANFIS. The stop condition has been met at the 60th epoch where Epoch60= Max Epoch (=60). Consequence Parameter Value (Value in Layer 4 Advanced Stage) and Premise Parameter Value (Mean Value (cij) and Standard. Deviation (aij). Only in the Back Stage) in epoch 60 this will be used in the ANFIS testing process. The calculation results up to layer 5 are as follows:

Table 9. Calculation Results for Layer 5

Data	Layer 4		Layer-5	Dernomalisasi	Real Target
	$w_{i1}\, y_{i1}$	$Ww_{i2}\, y_{i2}$	$\sum_i \bar{w}_{i11} y_{i11}$		
27	55	0	55	9876.114965	11116
28	57	0	57	12423.19128	10147
29	55	0	55	10054.50942	10459
30	56	0	56	11541.12983	9800
31	27	0	27	6000.99108	4500
32	28	0	28	7854.311199	7000
33	54	0	54	8795.837463	9000
34	54	0	54	7844.400396	10000
35	56	0	56	11432.111	15600
36	58	0	58	15000	15500

3.4. Implementation with Matlab

Data processing using ANFIS is carried out using fuzzy logic through Matlab to predict sales of food products. The stages of the simulation process in MATLAB consist of the following training and testing data:

3.4.1. Data Input Process

The application of the Adaptive Neuro Fuzzy Inference System (ANFIS) method to input a food product sales data whose overall accuracy value is close to the predicted value of food product sales. The following is Figure 10 Food Product Sales Data Input Process

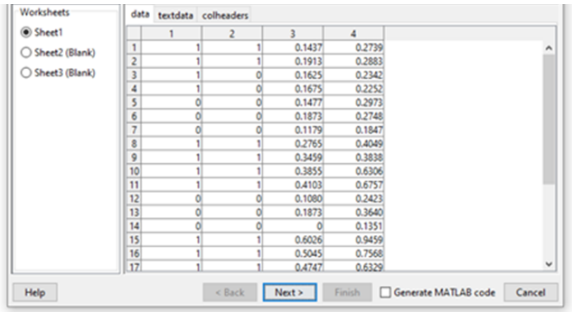

Figure 10. Sales Data Input Process

3.4.2. Data Training Stage

At the data training stage, the data is taken (loaded) from the HPAI.dat datatrain file. After the data load is complete, then generate FIS. The type of membership that will be tested in this study is the s-curve because this type is related to the increase and decrease of the surface in a non-linear manner. The model used is built using a Hybrid Algorithm with the MF output function used is constant.

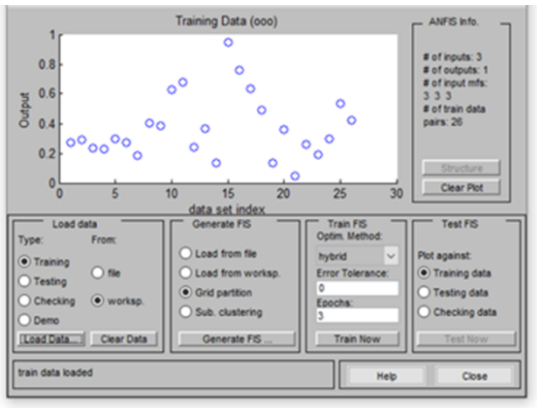

Figure 11. Generate FIS with Hybrid Method

3.4.3. Training Data with Backpropagation Method

In the data training stage, the data is taken (loaded) from the HPAI.dat datarain file. After the data load is complete, then generate FIS. The type of membership that will be tested in this study is the s-curve because this type is related to the increase and decrease of the surface in a non-linear manner. The model used is built using the Backpropagation Algorithm with the MF output function used is constant.

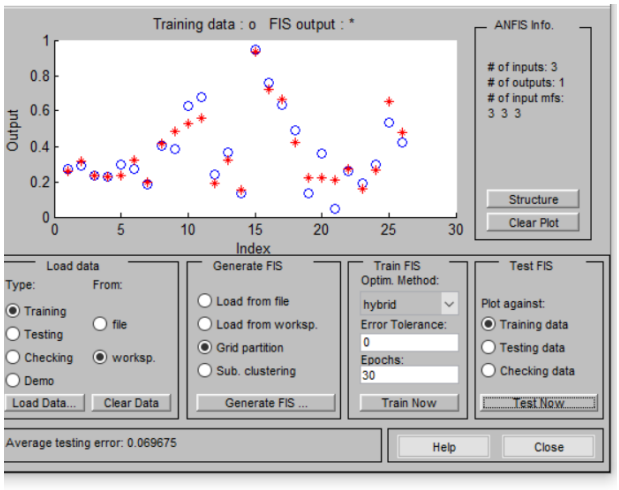

Figure 12. FIS Output Training Data with Backpropagation Method

After the training process is complete, the ANFIS Architecture formed is as follows:

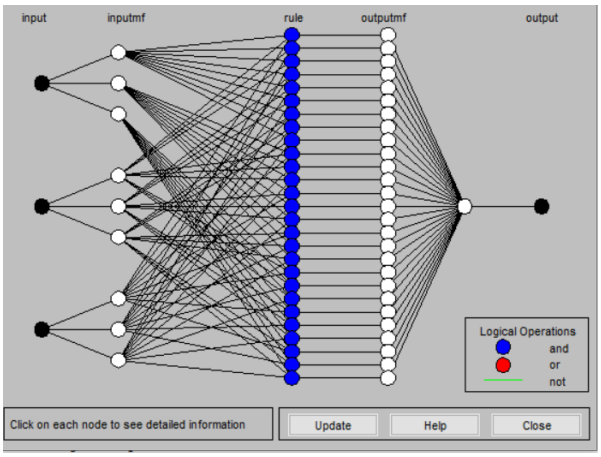

Figure 13. ANFIS Arsitektur Architecture

The results of the rule viewer testing (Training) with the hybrid method are also the most optimal, as evidenced by filling in the input data, namely demand, inventory and distribution costs, producing output, namely sales.

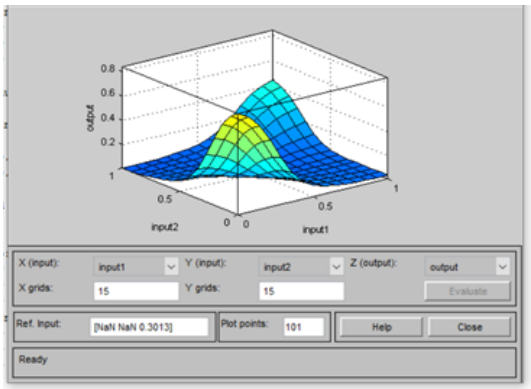

Figure 14. Surface Testing ANFIS

The testing process in Matlab Software obtained 88.55%. Based on the results of testing in Matlab and the results of manual calculations, the accuracy in predicting the sales of food products is similar to the training and testing data used.

4. Conclusion

Predicting for the Adaptive Neuro Fuzzy Inference System (ANFIS) method in the training and testing process shows that the Adaptive Neuro Fuzzy Inference System (ANFIS) method is more optimal. The parameters used in the process of forecasting sales of food products are learning rates 0.1, 0.2 0.3, 0.4, 0.5, 0.6, 0.7, 08, 09. With the number of epochs 60 and a comparison of 90% training data and 10% test data. This study produces the best accuracy in data presentation of 90% training data and 10% test data with an accuracy of 88.55% at a learning rate of 0.6.

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