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SALES PREDICTION OF *KACAMPRING* CHIPS USING ADAPTIVE NEURO FUZZY INFERENCE SYSTEM METHOD

PREDIKSI PENJUALAN KERIPIK KACAMPRING DENGAN MENGGUNAKAN METODE ADAPTIVE NEURO FUZZY INFERENCE SYSTEM

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ABSTRAK

Industri makanan dan minuman selalu menjadi sektor yang dinamis dan kompetitif. Salah satu produk yang memiliki popularitas yang tinggi adalah keripik kacampring. Kebutuhan akan keripik kacampring yang terus meningkat telah mendorong produsen untuk mencari cara untuk meningkatkan produksi dan memenuhi permintaan pasar yang terus tumbuh. Salah satu pendekatan yang efektif dalam mengelola produksi adalah dengan memanfaatkan teknologi prediksi penjualan yang dapat memberikan wawasan berharga tentang permintaan pelanggan di masa depan. Salah satu metode pemecahan masalah yang digunakan dalam penelitian adalah Adaptive Neuro Fuzzy Inference System (ANFIS). Berdasarkan pengujian sistem prediksi penjualan keripik kacampring didapat beberapa kesimpulan yaitu, dari data penjualan keripik kacampring di UMKM dapat dihasilkan sebuah data yang dapat diproses dan menghasilkan 27 rule untuk menjadi acuan dalam melakukan prediksi penjualan keripik kacampring yang akan mendatang. Pada pengujian menggunakan software Matlab R2016 bahwa proses pelatihan menggunakan MF gbellmf dengan menghasilkan tingkat akurasi 99,902%. Selain itu berdasarkan hasil perhitungan MAPE, terlihat bahwa nilai MAPE 3,96 yang berarti bahwa kemampuan model yang dibuat sangat baik dan akurat karena hasil pengujian lebih rendah dari 10%.

Kata kunci: ANFIS, Fuzzy, MAPE, penjualan, prediksi

ABSTRACT

The food and beverage industry has always been a dynamic and competitive sector. One product that enjoys high popularity is *kacampring* chips. The ever-increasing demand for *kacampring* chips has prompted producers to explore ways to boost production and meet the growing market demand. One practical approach to managing production is to utilize sales prediction technology, which can provide valuable insights into future customer demand. One of the problem-solving methods employed in this research is the Adaptive Neuro Fuzzy Inference System (ANFIS). Several conclusions were drawn based on testing the *kacampring* chip sales prediction system. Specifically, data on sales of *kacampring* chips in Micro, Small, and Medium-sized Enterprises (MSMEs) can be collected and processed to generate 27 rules that serve as a reference for predicting future sales of *kacampring* chips. During testing using Matlab R2016 software, the training process employed the MF gbellmf, resulting in an accuracy rate of 99.902%. Furthermore, based on the Mean Absolute Percentage Error (MAPE) calculations, it is evident that the MAPE value was 3.96. This indicates that the model's performance is highly commendable and accurate since the test results are less than 10%.

Keywords: ANFIS, Fuzzy, MAPE, prediction, sale, sales

INTRODUCTION

The food and beverage industry has always been a dynamic and competitive sector, and one product that enjoys immense popularity is kacampring chips. kacampring chips have become a favorite snack for people worldwide. Currently, sales of kacampring chips extend beyond city limits, and they exhibit monthly fluctuations driven by consumer demand. The higher the consumer demand, the greater the sales, which, in turn, leads to less dynamic inventory levels. This fluctuation can significantly impact profit and loss calculations.

Additionally, it can result in discrepancies between raw material procurement and actual sales, underscoring the need for a predictive system to align kacampring chip sales with supply and demand. The ever-increasing demand for kacampring chips has spurred producers to seek ways to boost production and meet the growing market demand. One effective approach to managing production involves the utilization of sales prediction technology, which offers valuable insights into future customer demand (Wahyudin, 2020).

Sales forecasting is a crucial component of business planning and supply chain management. Accurate predictions empower manufacturers to optimize their production, manage inventory efficiently, streamline distribution, and mitigate losses resulting from inventory shortages or excesses,

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ultimately reducing overall operating costs. Predicting the sales of goods is essential to maintain sales stability, and the resulting predictions serve as vital inputs for making informed decisions in business management planning (Laksmana *et al*., 2019). Sales prediction is key to enhancing competitiveness and increasing profits (Virrayyani and Sutikno, 2016). These predictions are instrumental in providing insights into future sales estimates to meet consumer demands effectively. In this context, one of the problem-solving methods employed in research is the Adaptive Neuro Fuzzy Inference System (ANFIS).

ANFIS is a method that utilizes an Artificial Neural Network to implement a Fuzzy Inference System. It combines the mechanisms of a Fuzzy Inference System within the framework of an artificial neural network architecture (Azis *et al*., 2022; Nurmawan, 2016). In statistical modeling, ANFIS finds application in classification, clustering, regression, and forecasting problems in time series analysis. The author's choice of the ANFIS method is driven by extensive research on predictions. This research underscores the advantages of the ANFIS method, particularly its ability to predict with high accuracy and minimal error values. ANFIS can effectively forecast sales by creating a model that considers various factors such as price, camera features, and others (Esmaeili *et al*., 2012). Moreover, ANFIS can optimize profits while minimizing losses in product sales (Sinaga *et al.*, 2022). Evaluation of ANFIS can be carried out using metrics like Average Forecasting Error Rate (AFER) and Mean Squared Error (MSE) (Zuhdi *et al*., 2020). This method has found applications in diverse fields, including predicting temperature distribution, diagnosing diabetes, forecasting cancer incidence, anticipating student academic performance, analyzing the growth of online commerce, and predicting machine breakdowns (Jiyun *et al.*, 2014; Zhang *et al*., 2014; Develi and Sorgucu, 2015; Kalaiselvi and Nasira, 2014; Chen and Do, 2014).

In prior research related to ANFIS, as evidenced by the work of Darmawan in 2018, the study demonstrated the achievement of the best RMSE value at 0.001965. Conversely, Maharani's research in 2018 reported an RMSE value of 0.6. This variation in RMSE values underscores the importance of accurate and reliable predictive models. With this context in mind, the present research aims to utilize ANFIS for sales prediction of kacampring butter chips, using three key input variables: demand, inventory, and distribution costs. This research output will be predictions for sales in the upcoming month, leveraging the ANFIS method to address future sales predictions for kacampring chips. The intention is that these prediction results can be shared with Micro, Small, and Medium-sized Enterprises (MSMEs), enabling them to manage their production and inventory in alignment with these forecasts. This proactive approach will aid MSMEs in optimizing their kacampring chip sales effectively.

RESEARCH AND METHODS

Data Collection Process

Source of research data obtained from UMKM Kacampring Chips in Bandung Regency. This study uses data from the sale of Kampring Chips from 2018 to 2021. The variables used are demand, supply, and distribution costs, and uses the adaptive neuro fuzzy inference system (ANFIS) method is a solution to solving cases of predicting the results of selling Kacampring chips.

Data Analysis

The input data used in this study is primary data obtained from UKM Kacampring Chips, Bandung Regency. Input data consists of demand, supply, and distribution cost data from 2018 to 2021. Furthermore, the data will be processed using the ANFIS method as an optimization to predict the results of sales of kacampring chips in the future. In addition, the data is also processed using Matlab R2016 software, which aims to find the accuracy of the data, which is then processed to obtain results as an alternative decision making. The following is the raw data obtained from the sales of UKM Kacampring Chips, Bandung Regency, in Table 1.

Based on Table 1, the data used in this study is data on sales of kacampring chips from 2018 to 2021. The ANFIS method combines Fuzzy Logic and Artificial Neural Networks. In carrying out the process of calculating an Artificial Neural Network, the raw data is first divided into 2 (two) patterns, namely training data and testing data.

Adaptive Neuro Fuzzy Inference System (ANFIS)

ANFIS combines fuzzy logic and artificial neural networks (ANN). The advantages of fuzzy logic in modeling qualitative aspects of human knowledge and decision-making processes by applying a rule basis. ANN has advantages in recognizing patterns and practicing in solving a problem without the need for mathematical modeling so that it can work based on historical data entered and can predict future events based on these data. So ANFIS can do both (Virrayyani dan Sutikno, 2016).

The ANFIS method has five stages/layers for processing actual data into future forecasting data (Saxena *et al.*, 2012; Xu *et al.*, 2020). ANFIS Layer 1 involves the process of converting crisp numbers into fuzzy logic. This layer includes membership functions and a number of nodes. This layer will produce output $O_{1,i}$=μAi(x) for each i = 1,2; and $O_{1,i}$=μBi(y) for i=1,2; where x is the i node input. Layer 2 is the product layer, where multiplication occurs between the inputs using (1). Layer 3 is the normalization layer, where each input is scaled from 0 to 1 using; (2) Layer 4 is the defuzzification layer.

Table 1. Sales result kacampring chips 2018-2021
Tabel 1. Hasil Penjualan Keripik Kacampring Tahun 2018-2021

Month	Demand	Supply	Distribution costs	Sales
January 2018	5588	8902	781925	9100
February 2018	6682	7711	741711	8437
March 2018	10765	7283	1198480	9411
April 2018	10422	9964	937039	8994
May 2018	6335	7924	841022	9563
June 2018	10038	8448	653950	9646
July 2018	10735	8323	685185	8668
August 2018	9692	9720	1076627	8648
September 2018	9859	9369	637663	9144
October 2018	6193	9789	1029463	10757
November 2018	6772	7152	968783	10974
December 2018	8502	9459	611467	8960
January 2019	10815	8024	715481	9307
February 2019	9082	7037	777375	9125
March 2019	5945	9904	695111	10301
April 2019	5954	7348	617957	10840
May 2019	8304	7432	666733	10237
June 2019	11004	7217	528818	8200
July 2019	8593	8646	1005222	10293
August 2019	5239	9091	892771	9513
September 2019	10463	8456	1134014	10648
October 2019	9920	8455	638115	8390
November 2019	11171	7269	932429	9332
December 2019	8097	9970	938137	8587
January 2020	9413	9445	701825	8058
February 2020	5456	7304	603880	8286
March 2020	9155	7841	807436	8717
April 2020	9294	9564	619360	10783
May 2020	7160	8307	657806	10786
June 2020	7858	7465	891394	10968
July 2020	5695	8257	856350	8053
August 2020	6214	9945	812503	10349
September 2020	9630	7424	718959	10410
October 2020	6740	9153	701079	10704
November 2020	10983	8695	1159333	8060
December 2020	10678	8703	953868	10436
January 2021	10633	9624	505178	10451
February 2021	11069	9589	602885	10355
March 2021	6986	7187	1087613	8067
April 2021	7810	8085	823821	8788
May 2021	11171	7269	932429	9332
June 2021	8097	9970	938137	8587
July 2021	9413	9445	701825	8058
August 2021	5456	7304	603880	8286
September 2021	9155	7841	807436	8717
October 2021	9294	9564	619360	10783
November 2021	7160	8307	657806	10786
December 2021	7858	7465	891394	10968

This layer involves the initial input values (x and y) to calculate the value of equation $px^2 + qx + r$. The p, q, r values continue to change with the number of iterations. Layer 5 is the total output layer, where all the results from the previous process are added and divided by the total number of results using (3).

$$O_{2,i} = \mu Ai\ (x)\ x\ \mu Bi\ (y) = Wi \quad \text{...................} \quad (1)$$

$$O_{3,i} = \frac{W_i}{W_1 + W_2} \quad \text{...............................} \quad (2)$$

$$O_{5,i} = \frac{\Sigma W_i}{i} \quad \text{...............................} \quad (3)$$

RESULTS AND DISCUSSION

Data Processing *Adaptive Neuro Fuzzy Inference System* (ANFIS)

In the research on the prediction of sales of kacampring chips using the ANFIS method, three input variables will be used, namely demand, supply, and distribution costs, as well as one output variable in the form of kacampring chips which can be seen in Table 2.

Table 2. Research data variables
Tabel 2. Variabel data penelitian

Variable	**Information**
X1	Permintaan
X2	Persediaan
X3	Biaya Distribusi
Y	Penjualan keripik/Target

At this stage, the data will be normalized and then divided into two groups: training data and testing data. This data sharing aims to determine the ANFIS method's resulting accuracy for predicting kacampring chip sales. The amount of data used in this study is from 2018 to 2021. After the data is obtained, a normalization process is carried out so that the range of data processed is not too extensive, ranging between 0 and 1. The following is the calculation of the first data normalization based on sales data for kacampring chips in Table 1 by using the normalization formula as follows:

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

$$X11 = \frac{5588 - 5239}{11171 - 5239} = \frac{349}{5932} = 0.06$$

$$X12 = \frac{6682 - 5239}{11171 - 5239} = \frac{1443}{5932} = 0.24$$

$$X13 = \frac{10765 - 5239}{11171 - 5239} = \frac{5526}{5932} = 0.93$$

$$X14 = \frac{10422 - 5239}{11171 - 5239} = \frac{5183}{5932} = 0.87$$

$$X15 = \frac{6355 - 5239}{11171 - 5239} = \frac{1116}{5932} = 0.18$$

The same steps were also carried out for the 6th data to the 48th data. The following is the normalized data obtained, seen in Table 3.

The steps taken in the training process in predicting the results of sales of kacampring chips start from the clustering process using the Fuzzy C-Means (FCM) algorithm to get the mean and standard deviation values that will be used in the calculation process using the ANFIS method at layer 1 Go forward and continue with layer 2 to layer five forward until it ends in the ANFIS reverse process. This training process will use a 90:10 division with 48 training data and 12 test data.

Experimental Results Using Matlab Software

Data processing using ANFIS uses fuzzy logic through Matlab to predict sales of kacampring chips in SMEs. The stages of the simulation process in Matlab consist of training and testing data as follows:

Data Input Process

Application of the ANFIS method to input data on sales of kacampring chips whose overall accuracy value is close to the predicted value of sales of kacampring chips. The following is Figure 1. Data Input Process for Sales of kacampring Chips.

Data Training Stage

Data is loaded from the HPAI.dat datarain file at the Data Training stage. After loading the data 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 was built using the Hybrid Algorithm with the constant MF output function. The following are Figure 2 and Figure 3.

Training Data with Backpropagation Method

At the training data stage, data is loaded from the datarainHPAI.dat file. After loading the data 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 was built using the Backpropagation Algorithm with the constant MF output function. At this stage, FIS is trained so that the output results from FIS will be the same as the target or close to the target data. At this stage, it can be seen the error level in ANFIS. ANFIS training results are presented in the Figure 3.

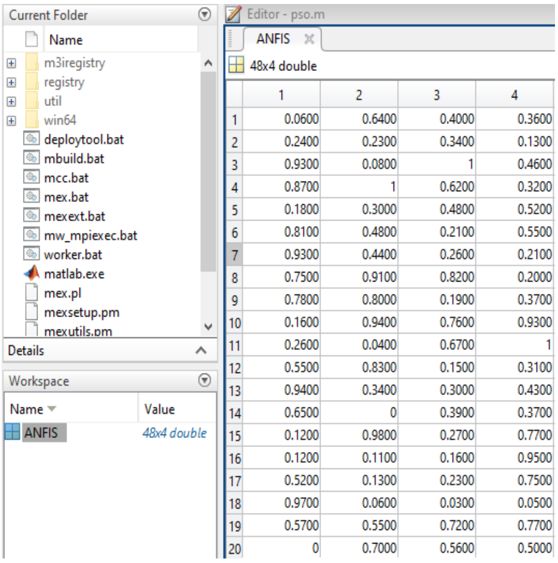

Figure 1. Data input process for sales of kacampring chips
Gambar 1. Proses input data penjualan keripik kacampring

Table 3. Data Normalization Results of Kacampring Chips
Tabel 3. Hasil Normalisasi Data Keripik Kacampring

No	Demand (X1)	Supply (X2)	Distribution Costs (X3)	Target (Y)
1	0.06	0.64	0.40	0.36
2	0.24	0.23	0.34	0.13
3	0.93	0.08	1.00	0.46
4	0.87	1.00	0.62	0.32
5	0.18	0.30	0.48	0.52
6	0.81	0.48	0.21	0.55
7	0.93	0.44	0.26	0.21
8	0.75	0.91	0.82	0.20
9	0.78	0.80	0.19	0.37
10	0.16	0.94	0.76	0.93
11	0.26	0.04	0.67	1.00
12	0.55	0.83	0.15	0.31
13	0.94	0.34	0.30	0.43
14	0.65	0.00	0.39	0.37
15	0.12	0.98	0.27	0.77
16	0.12	0.11	0.16	0.95
17	0.52	0.13	0.23	0.75
18	0.97	0.06	0.03	0.05
19	0.57	0.55	0.72	0.77
20	0.00	0.70	0.56	0.50
21	0.88	0.48	0.91	0.89
22	0.79	0.48	0.19	0.12
23	1.00	0.08	0.62	0.44
24	0.48	1.00	0.62	0.18
25	0.70	0.82	0.28	0.00
26	0.04	0.09	0.14	0.08
27	0.66	0.27	0.44	0.23
28	0.68	0.86	0.16	0.93
29	0.32	0.43	0.22	0.94
30	0.44	0.15	0.56	1.00
31	0.08	0.42	0.51	0.00
32	0.16	0.99	0.44	0.79
33	0.74	0.13	0.31	0.81
34	0.25	0.72	0.28	0.91
35	0.97	0.57	0.94	0.00
36	0.92	0.57	0.65	0.82
37	0.91	0.88	0.00	0.82
38	0.98	0.87	0.14	0.79
39	0.29	0.05	0.84	0.00
40	0.43	0.36	0.46	0.25
41	1.00	0.08	0.62	0.44
42	0.48	1.00	0.62	0.18
43	0.70	0.82	0.28	0.00
44	0.04	0.09	0.14	0.08
45	0.66	0.27	0.44	0.23
46	0.68	0.86	0.16	0.93
47	0.32	0.43	0.22	0.94
48	0.44	0.15	0.56	1.00

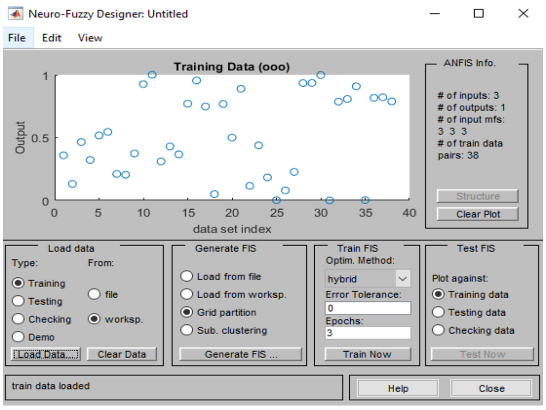

Figure 2. Load training data with a hybrid method
Gambar 2. Memuat data pelatihan dengan metode hybrid

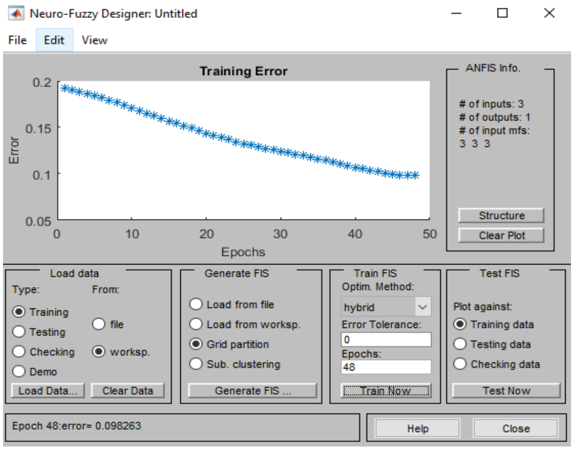

Figure 3. Load training data with backpropagation method
Gambar 3. Memuat data latih dengan metode backpropagation

In Figure 3, it can be analyzed that the training process produces the smallest error value of 0.098% at epoch 48. Even though the epoch is added, it will not affect the error value obtained because the resulting error value is already the smallest value.

In Figure 4, the type membership function settings used are gbellmf, the number of membership functions is 3 3, and the output is linear with an error value of 0.098 at epoch 48. The red dot in Figure 4 shows the results of ANFIS, and the blue dot is the actual data used in the test. Figure 4 shows a graphic comparison of actual data with ANFIS results, where ANFIS results have been able to follow sales patterns.

After the training process is complete, the formed ANFIS Architecture is as follows, using three inputs, namely demand, supply, and distribution costs and output in the form of sales. The membership functions are [3 3], and the trim function type produces 27 rules. The ANFIS architecture can be seen in Figure 5.

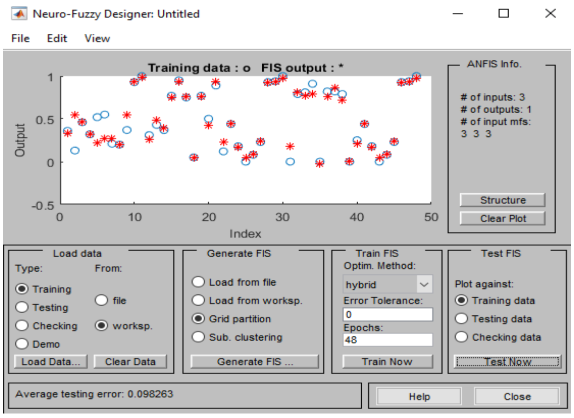

Figure 4. FIS output training data with backpropagation method
Gambar 4. Data latih keluaran FIS dengan metode backpropagation

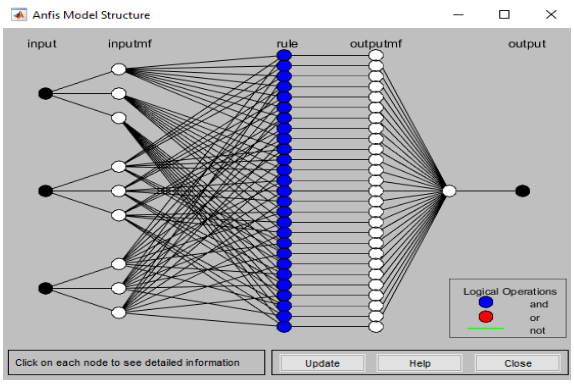

Figure 5. ANFIS Architecture
Gambar 5. Arsitektur ANFIS

Membership function and Parameters Formed From The Training Process

In Figure 6, the training input process with previously analyzed criteria and indicators is used as a variable to obtain the membership function.

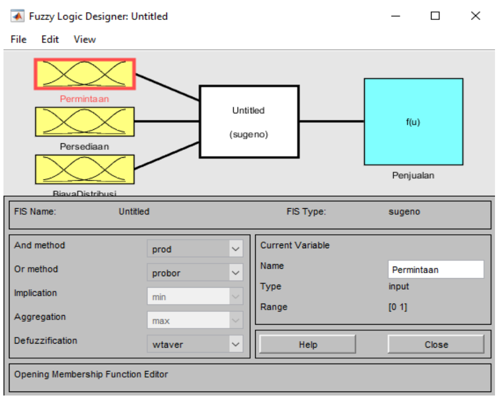

Figure 6. Process input training
Figure 6. Process input training

In Figure 7 is the MF gbellmf membership function, which will be formed as a request input variable with a range between 0 and 1. Moreover, a gbellmf type is formed with three parameters, namely Low [0.3647 1.991 0.07828], Medium [0.2344 2.014 0.3789], and High [0.2344 2.014 0.3789].

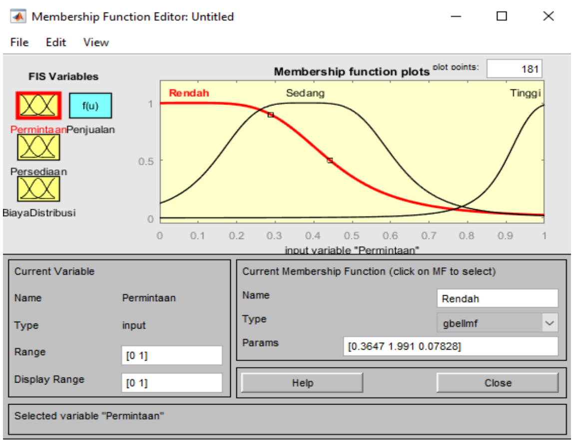

Figure 7. Membership Function Request Input
Gambar 7. Input Permintaan Fungsi Keanggotaan

In Figure 8, the MF gbellmf membership function will be formed as input variable inventory ranging between 0 and 1. Moreover, type gbellmf is formed with three parameters, namely Low [0.1168 2.01 -0.03826], Medium [0.281 2.01 0.525], and High [0.1871 1.996 1.075].

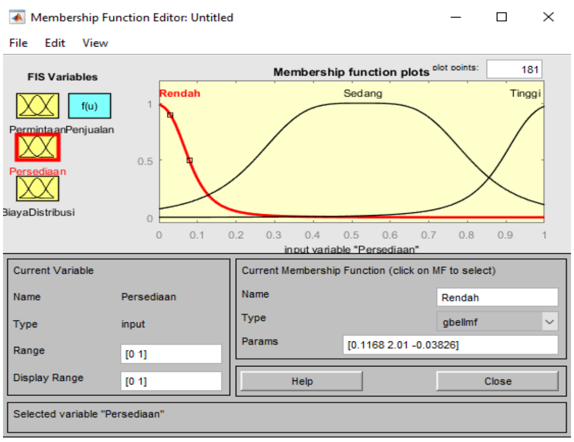

Figure 8. Membership function inventory input
gambar 8. input inventarisasi Fungsi Keanggotaan

Figure 9 shows the MF gbellmf membership function which will form the input variable of distribution costs with a range between 0 and 1. Moreover, the type gbellmf is formed with three parameters, namely Low [0.1903 2.004 -0.02556], Medium [0.1876 2.014 0.5487], and High [0.2763 1.99 1.019].

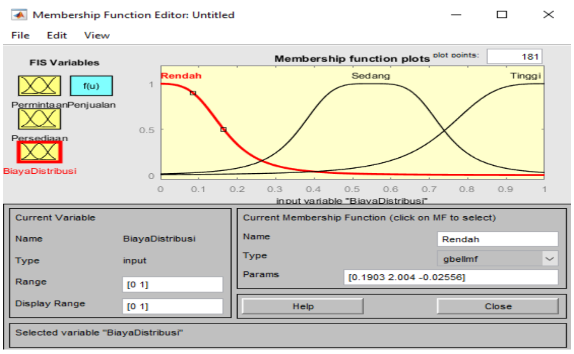

Figure 9. Membership Function distribution costs Input
Gambar 9. Fungsi Keanggotaan Distribusi Biaya Input

Figure 10 shows the MF Trimf membership function, forming an output variable between 0 and 1. Moreover, a type constant is formed.

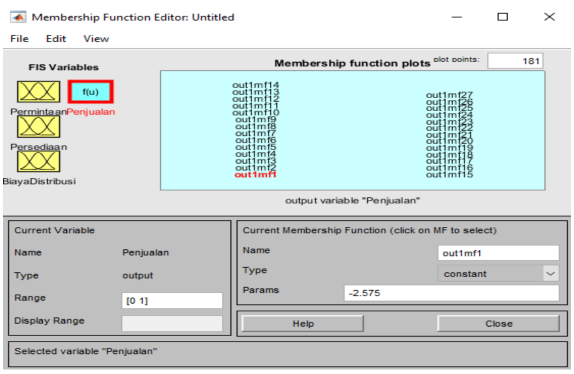

Figure 10. *Membership Function sales output* (Y)
Gambar 10. Output penjualan fungsi keanggotaan (Y)

ANFIS Simulation For Testing Data With A Hybrid Method, Then A Rule Is Formed.

In Figure 11. Each rule is an implication after the fuzzy set is formed, then the formation of fuzzy rules is carried out. The rule used is the default rule, so ANFIS automatically creates the rules. There are 27 rules in this study.

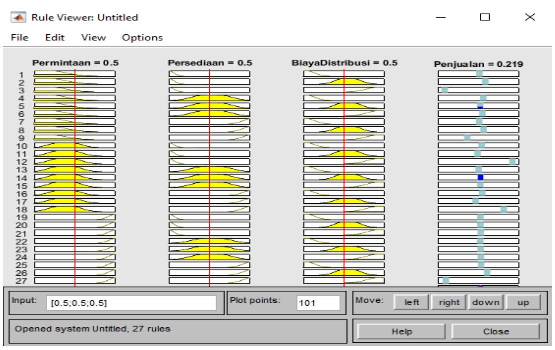

Figure 12. *Rule Viewer Training* ANFIS
Gambar 12. Pelatihan rule viewer ANFIS

The results of rule viewer testing (Training) with the hybrid method are also the most optimal, as evidenced by filling in the input data, namely demand, supply, and distribution costs, and producing output, namely sales. The following Figure 13.

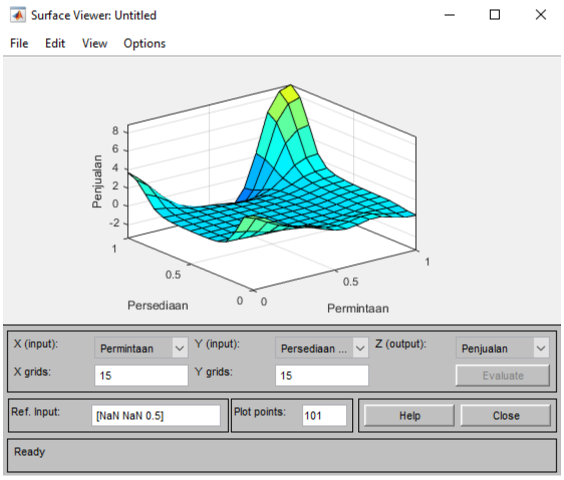

Figure 13. *Surface Testing* ANFIS
Gambar 13. Pengujian permukaan ANFIS

MAPE (Mean Absolute Percent Error)

MAPE is a calculation used to calculate the average absolute error percentage (Sukerti, 2015), with the formula (Montgomery *et al.*, 2015).

$$\text{MAPE} = \sum (|\text{ Aktual - Forecast } | / \text{ Aktual}) * 100 / n$$

The lower the MAPE value, the higher the ability of the forecasting model used is likely good. For MAPE, a range of values can be used as measurement material regarding the ability of a forecasting model. The range of values can be seen in the Table 4.

Table 4. MAPE value range
Tabel 4. Kisaran nilai MAPE

Range **MAPE**	**Significance**
< 10%	The ability of the forecasting model is very good
10-20%	The ability of the forecasting model is good
20-50%	The ability of the forecasting model is feasible
>50%	The ability of the forecasting model is bad

After the ANFIS network training is complete, FIS will be tested with new data. The output of the model is compared with the actual load, and its performance is evaluated using MAPE, which is an indicator of statistical error that is often used in evaluating forecasting studies. MAPE is one of the main criteria describing forecasting accuracy. The following is a Table 5 of MAPE calculation results from actual data and forecasting results using ANFIS.

Table 5. FIS Testing of Training Results
Tabel 5. Pengujian Hasil Pelatihan FIS

No	**Sales**	**Prediction**	**MAPE (%)**
1	9100	9000	1.10
2	8437	10200	20.90
3	9411	9430	0.20
4	8994	8920	0.82
5	9563	8840	7.56
6	9646	8690	9.91
7	8668	9430	8.79
8	8648	8650	0.02
9	9144	9920	8.49
10	10757	10800	0.40
11	10974	10500	4.32
12	8960	9850	9.93
13	9307	9500	2.07
14	9125	10400	13.97
15	10301	10300	0.01
16	10840	9430	13.01
17	10237	10200	0.36
18	8200	8240	0.49
19	10293	10400	1.04
20	9513	9650	1.44
21	10648	10500	1.39
22	8390	8380	0.12
23	9332	9280	0.56
24	8587	8580	0.08
25	8058	8150	1.14
26	8286	8830	6.57
27	8717	9140	4.85
28	10783	10100	6.33
29	10786	10800	0.13
30	10968	10200	7.00
31	8053	8210	1.95
32	10349	10300	0.47
33	10410	9720	6.63
34	10704	10400	2.84
35	8060	8260	2.48
36	10436	9970	4.47
37	10451	10200	2.40
38	10355	10600	2.37
39	8067	8260	2.39
40	8788	8400	4.42
41	9332	9280	0.56
42	8587	8580	0.08
43	8058	8150	1.14
44	8286	8830	6.57
45	8717	9140	4.85
46	10783	10100	6.33
47	10786	10800	0.13
48	10968	10200	7.00
		MAPE	3.96

Based on the table above, it can be seen that the MAPE value is 3.96, which means that the model's ability is very good and accurate because the test results are lower than 10%.

CONCLUSION AND RECOMENDATION

Conclusion

Based on testing the sales prediction system for kacampring chips using the Adaptive Neuro Fuzzy Inference System (ANFIS) method, several conclusions can be drawn, that is, from the results of data processing on the sale of kacampring chips in MSMEs, it produces 27 rules to be used as a reference in predicting future sales of kacampring chips. The data used is the period January 2018 to December 2021. The data used is 60, with 48 training data and 12 as testing data. In testing using the Matlab R2016 software, the training process uses the MF gbellmf with an accuracy rate of 99.902%. The prediction results are greatly affected by the training results carried out before the test. If the error is large at certain weights, testing some data will produce a large error and vice versa. Furthermore, based on the results of MAPE calculations, it can be seen that the MAPE value is 3.96, which means that the model's ability is very good and accurate because the test results are lower than 10%.

Recommendation

Recommend further research that involves the analysis of external factors, such as market trends, changes in consumer behavior, or significant events that have an impact on sales. Additionally, it is essential to conduct comparisons with alternative methods, such as neural networks and other machine learning models, in order to determine whether ANFIS demonstrates superior performance in predicting sales of kacampring chips.

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