Prediction Of Customers at Bank Rakyat Indonesia Using Backpropagation Algorithm

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Abstract

This study aims to see the development of the number of BRI bank customers in the following year. With this prediction, it is hoped that it can help bank bri in making policies related to customers who save more easily. The data source is obtained from Bank Rakyat Indonesia (BRI). In this study, researchers used the Backpropagation Algorithm. Backpropagation Algorithm is an algorithm that functions to reduce the error rate by adjusting the weight based on the desired output and target. The benefit of this research is to determine the increase or decrease in savings customers at the BRI bank in the following year. And artificial neural networks using the backpropogation algorithm can be applied in analyzing the increase in the number of bank bri customers by determining the best architectural model from a series of training and testing processes carried out.

Keywords: *Customer, Prediction, Algorithm, Backpropagation*

1. Introduction

Banks are financial intermediary institutions or commonly called financial intermediaries. That is, a bank institution is an institution whose activities are related to money matters. Therefore, the bank's business will always be associated with the issue of money which is the main means of facilitating the occurrence of trade. Bank activities and businesses will always be related to commodities, including transferring money, receiving and paying back money in checking accounts, discounting bills of lading, orders and other securities, buying and selling securities [1]. For example, customers at Bank Rakyat Indonesia (BRI) are always the focus of problems.

With the large number of customers of Bank Rakyat Indonesia (BRI) Serbelawan Unit, there are several problems with Bank Rakyat Indonesia (BRI) Serbelawan Unit. These problems, such as the increasing number of customers often lead to a decline in service quality[2],[3]. The increasing number of customers if it is not balanced with the quality of both human resources and science and technology will make customers disappointed with the services provided[4]. This is because the prediction of the number of customers at Bank Rakyat Indonesia (BRI) Serbelawan Unit has not been done [5],[6].

Here the author applies a method of Backpropagation which is one of the artificial intelligence methods of Artificial Neural Networks (ANN)[7],[8]. Backpropagation is a supervised learning algorithm and is usually used by perceptrons with many layers to change the weights in the hidden layer[9]. In a previous study conducted by [10] with the title Implementation of ANN in Determining the Eligibility of KUR Loan Customers at Bank Mandiri Mikro Serbelawan Using the Backpropagation Method. It is said that Backpropagation has advantages in realizing a system that is resistant to damage and consistently works well in predicting the feasibility of KUR loan customers at Bank Mandiri.

2. Research methodology

In this research framework, the author will describe the methodology and framework of the research work used in solving research problems. This research methodology is used systematically in order to get a good workflow so that it can be used as a guide for researchers in carrying out this research so that the results achieved deviate and the desired goals can be carried out properly and in accordance with the goals set.
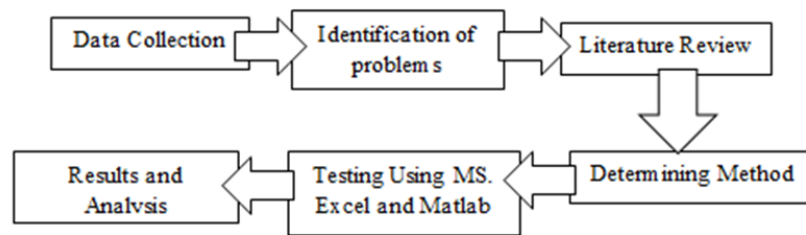
Figure 1. Research Framework

Based on the research framework in Figure 1. above, each step can be described as Data collection were obtained from data on the number of customers at the Indonesian People's Bank in the Serbelawan unit. The following is data obtained from the Serbelawan unit of the Indonesian People's Bank.

Table 1. Table of Number of Customers

NO	Month	Year				
		2016	2017	2018	2019	2020
1	January	11344	10174	10849	11720	11195
2	February	10521	10285	10957	10856	12327
3	March	11118	11407	11082	12034	12416
4	April	10789	10476	12248	13202	10442
5	May	11920	12762	10390	11347	12631
6	June	12158	11242	12502	12720	12227
7	July	10345	10506	11657	10183	11413
8	August	11455	10718	11865	12357	10423
9	September	10677	11447	10979	11579	10672
10	October	10883	12743	10190	13700	11057
11	November	11890	14457	10279	10866	11228
12	December	12298	10736	11552	10085	10516

Identification of problems at the problem identification stage, after all the data is met, the appropriate dataset is obtained for processing at the data conversion stage, which is obtained in accordance with the specified weight. Literature review is the first step in this research, this literature study was conducted to complete the basic knowledge and theories used in this research. The literature study used comes from books, journals, and seminars. Determining Method for predicting the customers of Bank Rakyat Indonesia Serbelawan units in the following year, the Backpropagation method will be used. Testing Using MS.Excel and Matlab will perform the calculation process using MS.Excel and the results of the calculations are then tested using Matlab R2011b software. Results and Analysis is carried out to determine whether testing the results of data processing is as expected.

The network used to determine the prediction of the number of customers of Bank Rakyat Indonesia (BRI) is an artificial neural network backpropagationwith feedforward learning steps. This network has several layers, namely input layer, hidden layer and output layer. The hidden layer of the artificial neural network that will be built is a backpropagation algorithm (backpropagation) with a sigmoid activation function. The activation function in the artificial neural network is used to calculate the actual value of the output in the hidden layer and calculate the actual value of the output in the output layer.

In this manual calculation only sample data is given inputas an example of proof by using 12 input variables, namely X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, X11, X12. The following steps will be carried out in using the algorithm: backpropagation by sigmoid activation function. The steps that must be taken are as follows:
  a. Initialization is the stage where the value variables will be set or defined first, for example, such as: input data value, weight, expected output value, learningrate and other data values.
  b. Activation is the process of calculating the actual value of the output in the hidden layer and calculating the actual value of the output in the output layer.
  c. WeightTraining, is the process of calculating the error gradient value at the output layer and calculating the error gradient value at the output layer.
  d. Iteration, is a stage in testing, where if the expected error still occurs, it has not been found, then it returns to the activation stage.
  e. Normalization, is a calculation process and guarantees that the attribute whose value range is smaller to give better results, the recommended attribute value range is [0,1] or [-1,+1].

3. Results And Discussion

In conducting a study, it will produce an output, to get the required results, two stages are carried out, namely the training stage and data testing. The following are the results of training and data testing.

Table 2. Architectural Training Data Accuracy 2-2-1

| No	Pattern	Target	Output	Error	SSE	Results
1	Pattern 1	0.22608	0.286	-0.05992	0.00359	1
2	Pattern 2	0.24625	0.2537	-0.00745	0.00006	1
3	Pattern 3	0.26960	0.3066	-0.03700	0.00137	1
4	Pattern 4	0.48739	0.2681	0.21929	0.04809	0
5	5 pattem	0.14035	0.3365	-0.19615	0.03847	1
6	Pattern 6	0.53484	0.3199	0.21494	0.04620	0
7	7 pattem	0.37700	0.2525	0.12450	0.01550	0
8	Pattern 8	0.41585	0.3039	0.11195	0.01253	0
9	9 pattern	0.25036	0.291	-0.04064	0.00165	1
10	10 pattern	0.10299	0.3204	-0.21741	0.04727	1
11	Pattern 11	0.11961	0.5287	-0.40909	0.16735	1
12	12 pattern	0.35739	0.3182	0.03919	0.00154	1
				Number of SEE	0.38362	50.0
				MSE	0.031968274	
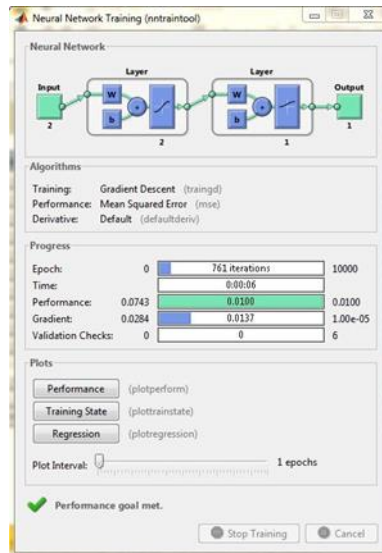
Figure 2. Backpropagation Architecture Training Using 2-2-1

Based on Figure 2, it can be seen that the network model with the 2-2-1 architecture produces 761 epochs in 00:06 seconds.
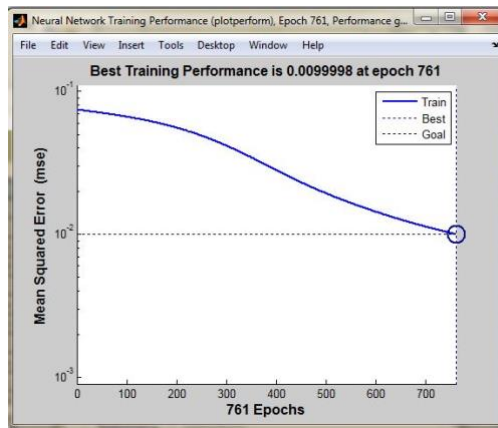

Figure 3. Best Training Performance Using 2-2-1 Arsitektur Architecture

Figure 3 shows the error goal (MSE) in this training of 0.0099998 achieved in the 761st epoch.

Based on this description, the accuracy of the 2-2-1 architectural training data can be seen in Table 2. In Table 2, it can be seen that the accuracy of the 2-2-1 architectural training data has been determined using the predetermined equation. There is a pattern of 1 to 12 which is the pattern used in the training data. Target value is obtained from the normalized training data table. The output value is obtained from the formula [a,Pf,Af,e,Perf]=sim(net,P,[],[],T) which is entered in the Matlab application from the input and target data of the training data. Error value is obtained from: Target-Output. SSE is obtained from : Error^2 (^: Power). The number of SSEs is the total of all SSEs. MSE is obtained from : the number of SSE / 12 (amount of data).

Table 3. Architectural Testing Data Accuracy 2-2-1

No	Pattern	Target	Output	Error	SSE	Results
1	Pattern 1	0.34564	0.3108	0.03484	0.00121	1
2	Pattern 2	0.59615	0.2605	0.33565	0.11266	0
3	Pattern 3	0.61585	0.3147	0.30115	0.09069	0
4	Pattern 4	0.17900	0.3143	-0.13530	0.01831	1
5	5 pattern	0.66343	0.2556	0.40783	0.16633	0
6	Pattern 6	0.57402	0.3137	0.26032	0.06777	0
7	7 pattern	0.39389	0.3091	0.08479	0.00719	0
8	Pattern 8	0.17480	0.3147	-0.13990	0.01957	1
9	9 pattern	0.22990	0.2953	-0.06540	0.00428	1
10	10 pattern	0.31510	0.3167	-0.00160	0.00000	1
11	Pattern 11	0.35295	0.3171	0.03585	0.00129	1
12	12 pattern	0.19538	0.4029	-0.20752	0.04306	1
				Number of SEE	0.53235	41.7
				MSE	0.044362902	

From the architectural model 2-2-1 in Table 4.4, it can be seen that the level of test accuracy is 41.70%. Pattern 1 to 12 is the pattern used in the test data. The target value is obtained from the normalized test data table.Output value is obtained from the formula [a,Pf,Af,Perf] = sim(net,P,[],[],T) entered in the Matlab application from the input and target test data. Error value obtained from: Target-Output. SSE is obtained from: Error^2. The number of SSEs is the total of all SSEs. MSE is obtained from: Total SSE / 12 (amount of data). The result is worth 1 (True) if the SSE value <= 0.05 is the target error of the backpropagation test. And the accuracy (%) is obtained from : Total True / 12 * 100.

In this study, the last stage to be carried out is the process of predicting the number of customers in the coming year. After obtaining the best architectural model from the Backpropagation algorithm, the prediction process will then be carried out. This stage is carried out by testing by applying the 2-4-1 architectural model using Matlab R2011 software, this model is used to determine how accurate the 2-4-1 architectural model is in obtain a desired result.

In the process of predicting the number of customers in the coming year, data processing will be carried out by conducting computerized data testing. The process is the same as training the initial data, but in the process of predicting the data testing carried out on the Matlab R2011 software using the 2-4-1 architectural model to find out how much accuracy the best architectural model is obtained. The steps taken in the prediction process are as follows:

    a.   Perform computerized calculations on input data (initial data) with different variables from the previous training.
    b.   See the results of the prediction target data output using the Matlab R2011b software by determining the parameters that have been determined.
    c.   After the results of the prediction target data output are obtained, the next step is to find the results of the prediction results as a result of the number of blanks in the coming year using the following equation.

$$\text{Prediction} = \frac{(Xn\ 0.1)\ (b)}{0.8a}$$

       Information :
       0.8 = constant value (constant)
       Xn = value obtained (data from prediction target)
       A = minimum/maximum data
    d.   After the prediction results are obtained, arrange the prediction results into new data like the previous initial data to be used as data to predict in the coming year.

In testing the data to obtain the desired prediction results using the best 2-4-1 architectural model obtained through the steps that have been taken by the author using Matlab R2011 software. The prediction results for the population for 2021 can be seen in Table 4.15. following.

Table 4. Customer Prediction in 2021

	2021 Prediction			
No	Real Data	Target	Prediction Target	Prediction
1	11195	0.34564	0.315	11016
2	12327	0.59615	0.6938	12062
3	12416	0.61585	0.6348	11899
4	10442	0.17900	0.2672	10884
5	12631	0.66343	0.6732	12005
6	12227	0.57402	0.2741	10904

7	11413	0.39389	0.5999	11803
8	10423	0.17480	0.2888	10944
9	10672	0.22990	0.269	10889
10	11057	0.31510	0.2718	10897
11	11228	0.35295	0.4712	11448
12	10516	0.19538	0.5679	11714

The explanation from the table above is:
1. Real data is obtained from the original data of the last year
2. Target data is obtained from normalized testing data
3. Prediction Target Data is obtained from the test results using Matlab R2011 Software, while the search parameters for prediction target data are as follows:
   a. *>>net=newff(minmax(PP),[4,1].{'tansig','logsig'},'trainingd');*
   b. *>> net=IW{1,1};*
   c. *>> net.b{1};*
   d. *>> net.LW{2,1};*
   e. *>> net.b{2};*
   f. *>> net.trainParam.epochs=100000;*
   g. *>> net.trainParam.goal=0.001;*
   h. *>> net.trainParam.Lr=0.01;*
   i. *>> net.trainParam.show=1000;*
   j. *>> net=train(net,PP,TT)*

After all the parameters have been inputted, the first prediction testing process with the 2-4-1 architectural model will appear. In this case, the prediction results obtained using the best architectural model obtained are the 2-4-1 model with an accuracy rate of 75% and the epoch of 597 liters in 00:06 seconds is something that is still a prediction that can be used as a reference. or not, in applying a backpropagation algorithm to predict the number of Customers. The following is the final result of the prediction conclusions that have been obtained using the backpropagation algorithm in predicting the number of customers in the next 2 years starting from 2016-2022 can be seen in Table 5.

Table 5. Data on Number of Customers (2016-2022)

No	Month	Year						
		2016	2017	2018	2019	2020	2021	2022
1	January	11344	10174	10849	11720	11195	11016	11201
2	February	10521	10285	10957	10856	12327	12062	11758
3	March	11118	11407	11082	12034	12416	11899	11671
4	April	10789	10476	12248	13202	10442	10884	11130
5	May	11920	12762	10390	11347	12631	12005	11728
6	June	12158	11242	12502	12720	12227	10904	11140
7	July	10345	10506	11657	10183	11413	11803	11620
8	August	11455	10718	11865	12357	10423	10944	11162
9	September	10677	11447	10979	11579	10672	10889	11133
10	October	10883	12743	10190	13700	11057	10897	11137
11	November	11890	14457	10279	10866	11228	11448	11431
12	December	12298	10736	11552	10085	10516	11714	11573

4. Conclusion

The use of the Backpropagation method can be used in predicting the number of prospective customers of Bank Rakyat Indonesia (BRI) Serbelawan units in the coming year which has valid data. The results obtained from the analysis of the Backpropagation and virtualization methods using the MATLAB application can be generated with valid data and produce an accuracy rate of 75.0% on the 2-4-1 architectural model. It can be concluded that the Backpropagation method can be used as a prediction method that makes it very easy to find any predictions.

Acknowledgement

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