Implementation of Artificial Neural Networks to Predict Monthly Target Receiving Section in Pt. Indako Trading Coy using Backpropagation Method

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ABSTRACT

PT. Indako Indako Trading Coy is a company engaged in the sale of motorbikes and their spare parts with 1000 employees who are given work targets every month. Through the given target, it can be predicted whether the employees will be rewarded or not. Prediction is an important tool in determining everything to be effective and efficient. During this time, many forecasting is done intuitively using statistical methods. The choice of this method depends on various aspects that affect, namely the aspect of time, data patterns, the type of system model observed, the level of forecast accuracy or the desired prediction and so on. The forecasting method used is using artificial neural networks (ANN) with the Backpropagation method, namely the algorithm, learning to reduce the error rate by adjusting the weight based on the difference in output and the desired target.

Keywords:
PT Indako Trading Coy, Prediction, Backpropagation.

1. INTRODUCTION

Prediction is an important tool in determining everything to be effective and efficient[1]. So far, many forecasting have been carried out predictably using statistical methods[2]. The choice of this method depends on various aspects that affect it, namely the aspect of time, data patterns, the type of system model being observed, the level of forecast accuracy or the desired prediction and so on[3], [4]. Therefore, a problem will arise if the observation or testing is carried out on a dynamic system that has a data pattern system with a formulation that is always changing, such as a computer sales prediction system[5], [6]. The forecasting method used is an artificial neural network (ANN) with the Backpropagation method[7]–[9].

This study aims to describe the monthly target of the Receiving section at PT. Indako Trading Coy based on the Backpropagation method on Artificial Neural Networks and describes the reasons for not achieving the monthly target[10], [11]. This type of research is descriptive qualitative research. The subject of this research is the incoming goods data in the form of Honda motorcycle spare parts. The data was collected by means of tests, observation, and documentation. Data analysis was performed by data reduction, data presentation, and drawing conclusions.

Efforts that can be made to achieve the monthly target include calculating container unloading times, calculating time for data entry of incoming goods, calculating container waiting
times, and applying appropriate correction techniques. Based on the background description above, the author raises the title Implementation of Artificial Neural Networks to Predict the Receiving Section Monthly Target at PT. Indako Trading Coy Using the Backpropagation Method.

2. RESEARCH METHOD
In this method the writer will provide an overview of the steps that include from the beginning of the study to the end of the research at PT Indako Trading Coy Medan. In the first stage, the authors do this by collecting the necessary data and materials first, and in the next stage the authors process and discuss arriving at a conclusion which in the end can be made a report to attach all activities carried out during the research.

3. RESULTS AND DISCUSSION
The following is an example of manual calculation using the Backpropagation method to classify data in the ANN pattern recognition process.

Example of Calculation of Backpropagation Method Training Manual
a. Initialize initial weight, number of epochs, Learning rate, number of hidden layer neurons. The calculation is done using the 1st training data with a stop condition based on the specified number of Epochs.

Epoch = 1000 Learning Rate = 0.9

Table 1. Employee performance index for May, first week of 2020

<table>
<thead>
<tr>
<th>Kelompok</th>
<th>Senin</th>
<th>Selasa</th>
<th>Rabu</th>
<th>Kamis</th>
<th>Jum’at</th>
<th>Sabtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karyawan</td>
<td>0.224602</td>
<td>0.227065</td>
<td>0.348039</td>
<td>0.22327</td>
<td>0.219484</td>
<td>0.30908</td>
</tr>
</tbody>
</table>

Table 2. Employee performance index for the month of May, week I, 2020

<table>
<thead>
<tr>
<th>Kelompok</th>
<th>Senin</th>
<th>Selasa</th>
<th>Rabu</th>
<th>Kamis</th>
<th>Jum’at</th>
<th>Sabtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karyawan</td>
<td>05.55</td>
<td>06.02</td>
<td>05.54</td>
<td>05.51</td>
<td>05.47</td>
<td>06.32</td>
</tr>
</tbody>
</table>

Table 3. Employee performance index for the month of May, week II, 2020

<table>
<thead>
<tr>
<th>Kelompok</th>
<th>Senin</th>
<th>Selasa</th>
<th>Rabu</th>
<th>Kamis</th>
<th>Jum’at</th>
<th>Sabtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karyawan</td>
<td>0.234892</td>
<td>0.232497</td>
<td>0.2363</td>
<td>0.232373</td>
<td>0.345594</td>
<td>0.249209</td>
</tr>
</tbody>
</table>
a. Normalization Process

Before being processed, the data is normalized first. Normalization of the data is done so that the network output matches the activation function used. Based on the explanation in Sub Chapter 2.3.3 regarding the activation function, the activation function that the researchers used in this study is the sigmoidbiner activation function and the bipolar sigmoid activation function. In backpropagation, the activation function used must meet several conditions, namely: continuous, easily differentiated and a function that does not go down. One of the functions that fulfill the three requirements so that it is often used is the binary sigmoid function which has a range (0, 1) and the bipolar has a range (-1,1). The binary sigmoid activation function is almost the same as the sigmoidbipolar function, because it is often used by the researchers are in the process of prediction (forecasting), but the sigmoid bipolar function is only suitable for use in prediction (forecasting) which uses data that is not volatile (stable) and uses a range between -1 to 1.

\[ x' = \frac{0.9(x - a)}{b - a} + 0.1 \]

Information:

- \( x' \): Data that has been transformed
- \( x \): Data to be normalized
- \( a \): Minimum data
- \( b \): Maximum data

b. Data Processing (Normalization)

The data processing that will be done is to change the teacher absenteeism index data based on the type of absenteeism coming and going, namely by making the best architectural pattern using Artificial Neural Networks with backpropogation. The following will describe the data normalization in the prediction process based on table 3 in the previous discussion.

<table>
<thead>
<tr>
<th>Data Input</th>
<th>Data Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senin</td>
<td>Selasa</td>
</tr>
<tr>
<td>Rabu</td>
<td>Kamis</td>
</tr>
<tr>
<td>Jum'at</td>
<td>Sabtu</td>
</tr>
<tr>
<td>Pola 1</td>
<td>0.224602</td>
</tr>
<tr>
<td>Pola 2</td>
<td>0.227065</td>
</tr>
<tr>
<td>Pola 3</td>
<td>0.348039</td>
</tr>
</tbody>
</table>

Explanation:

Training data for Week I - Week III is carried out using rotary rotation, meaning that each dataset has the same rights to achieve the target. The data value in pattern 1 is taken from the IPP target in week I. While the target value is taken from the IPP target for the second week of July 2020. The data value in pattern 2 is taken from the IPP target for week I to week II in July 2020. The target value in pattern 2 is taken from the IPP target for the second week of July 2020. The data value in pattern 3 is taken from the IPP target for Week I of 2020 July 2020. The target value in pattern 3 is taken from the IPP target for the second week of July 2020. And so on until all values have been rolled. The maximum value \( b \) of the dataset is 06.02 while the minimum value \( a \) is 0.348039. The binary sigmoid function will get the following normalization data:

\[ x' = \frac{0.9(0.224602 - 0.348039)}{0.62 - 0.348039} + 0.1 \]

Then you will get the results of Normalization pattern 1 for Week I.080414. And so on for all data, normalized using the same function.
Table 6. Results of Training Data Normalization Week I - Week III

<table>
<thead>
<tr>
<th>Data</th>
<th>Senin</th>
<th>Selasa</th>
<th>Rabu</th>
<th>Kamis</th>
<th>Jum’at</th>
<th>Sabtu</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pola 1</td>
<td>0.080414</td>
<td>0.080804</td>
<td>0.1</td>
<td>0.080195</td>
<td>0.079601</td>
<td>0.093818</td>
<td>0.917489</td>
</tr>
<tr>
<td>Pola 2</td>
<td>0.080804</td>
<td>0.1</td>
<td>0.080195</td>
<td>0.079601</td>
<td>0.093818</td>
<td>0.917489</td>
<td>1</td>
</tr>
<tr>
<td>Pola 3</td>
<td>0.1</td>
<td>0.080202</td>
<td>0.079601</td>
<td>0.093818</td>
<td>0.917489</td>
<td>1</td>
<td>0.923836</td>
</tr>
</tbody>
</table>

Explanation:
The dataset value is in table 4.9. is the result of normalization based on table 4.8. by using the binary sigmoid function.

Table 7. Initial Data of Attendance Testing Week I to Week III Using Rotation Rotation

<table>
<thead>
<tr>
<th>Data</th>
<th>Juli</th>
<th>Agustus</th>
<th>September</th>
<th>Oktober</th>
<th>November</th>
<th>Desember</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pola 4</td>
<td>0.22327</td>
<td>0.219484</td>
<td>0.30908</td>
<td>05.50</td>
<td>06.02</td>
<td>05.54</td>
<td>05.51</td>
</tr>
<tr>
<td>Pola 5</td>
<td>0.219484</td>
<td>0.30908</td>
<td>05.50</td>
<td>06.02</td>
<td>05.54</td>
<td>05.51</td>
<td>05.47</td>
</tr>
<tr>
<td>Pola 6</td>
<td>0.30908</td>
<td>05.50</td>
<td>06.02</td>
<td>05.54</td>
<td>05.51</td>
<td>05.47</td>
<td>06.32</td>
</tr>
</tbody>
</table>

Explanation:
Testing data for week I - week III is carried out using rotary rotation, meaning that each dataset has the same rights to achieve the target. The data value in pattern 4 is taken from the 2020 IPP target. Meanwhile, the target value is taken from the IPP target in July 2020, in pattern 5 is taken from the IPP target for 2020 in July 1st week and 2nd week as well as the dataset for July 2020. The target value in pattern 2 is taken from the IPP target for the second week of July 2020. The data value in pattern 6 is taken from the IPP target week II of 2020 in July Third week of 2020. The target value in pattern 3 is taken from the IPP sector in July 2020. And so on until all values have been rotated. The maximum value (b) of the dataset is 06.32. While the minimum value (a) is 0.30908. By using the binary sigmoid function, the following normalization data will be obtained:

$$x' = \frac{0.9(0.22327-0.30908)}{0.632-0.30908} + 0.1$$

Then you will get the results of Normalization pattern 7 for the month of July 0.34597. And so on for all data, normalized using the same function.

Table 8. Results of Testing Data Normalization in 2020

<table>
<thead>
<tr>
<th>Data</th>
<th>Senin</th>
<th>Selasa</th>
<th>Rabu</th>
<th>Kamis</th>
<th>Jum’at</th>
<th>Sabtu</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pola 4</td>
<td>0.087152</td>
<td>0.086585015</td>
<td>0</td>
<td>21.03</td>
<td>0.955082</td>
<td>0.883213</td>
<td>0.878721</td>
</tr>
<tr>
<td>Pola 5</td>
<td>0.086585</td>
<td>0</td>
<td>21.03</td>
<td>0.955082</td>
<td>0.883213</td>
<td>0.878721</td>
<td>0.872732</td>
</tr>
<tr>
<td>Pola 6</td>
<td>0</td>
<td>21.03</td>
<td>0.955081751</td>
<td>0.883213</td>
<td>0.878721</td>
<td>0.872732</td>
<td>1</td>
</tr>
</tbody>
</table>

Network Training

In this step, the learning rate of network work will be observed with parameters of the level of accuracy, learning time, MSE during the training process and the length of iteration time (Epoch). The main objective of this step is to obtain an optimal level of learning rate accuracy. By using the best network architecture in training, it will be observed the learning rate of network performance. The architecture used for training is 3 patterns. These 3 architectural patterns use a Learning rate of 0.1, target error (goal) of 0.01 and the maximum epoch is 1000 iterations and to produce the lowest error using trainsgd.

In training architecture 1 uses input layers of 6 neurons, hidden layers of 3 neurons and output layer of 1 neuron. In training architecture 1 this results in training with an epoch of 5308 iterations, time 00.32, MSE 0.009999 and an accuracy rate of 58%. In the training architecture 2 uses an input layer of 3 neurons, a hidden layer of 6 neurons and an output layer of 1 neuron. In training 2 this results in training with an epoch of 821 iterations, time 00.05, MSE 0.009982 and an accuracy rate of 67%. In training architecture 3 uses layers input 6 neurons, 6 neurons hidden layer and 1 neuron output layer. In training 3 this results in training with an epoch of 4999 iterations, time 00.31, MSE 0.009996 and an accuracy rate of 67%. In training architecture 4 uses 6 input layers, neurons, the hidden layer is 33 neurons and the output layer is 1 neuron. In training 4 this resulted in training...
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with an epoch of 961 iterations, time 00.06, MSE 0.009975 and an accuracy rate of 67%. In
training architecture 5 uses 6 neurons as input layers, 34 neurons hidden layer and 1 neuron output
layer. In training 5 this resulted in training with an epoch of 1491 iterations, time 00.09, MSE
0.009996 and an accuracy rate of 67%.

4. CONCLUSION

Application of Artificial Neural Networks on target prediction at PT. Indako Trading Coy
Medan using the Backpropagation Algorithm can provide a level of accuracy that matches the data
needs. The results of the decisions given by the system are given by the system in the form of
reports that are easy to obtain. This ANN application is only a tool that relies heavily on data input
by a programmer so that this Artificial Neural Network application must always be developed.
Based on the results of application design using the Backpropagation Algorithm method, the
application can display the results of the satisfaction level criteria of the employees of PT. Indako
Trading Coy Medan.

REFERENCES


Smoothing Pada Studi Kasus Memprediksi Kuantiti Penjualan Produk Farmasidi Apotek,”


PESAWAT TANPA AWAK,” J. Ilm. Rekayasa Pertan. dan Biosist., 2019, doi:
10.29303/jrpbb.v7i2.139.

Mandiri, 2016.

10.24176/simet.v7i2.788.

CUARA HUJAN METODE FAST FOURIER TRANSFORMATION (FFT),
AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) DAN ARTIFICIAL


Memprediksi Jumlah Mahasiswa baru di PTS Surabaya (Studi Kasus Universitas Wijaya