Forecasting Paint Products Using Artificial Neural Network Algorithm

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Abstract. The purpose of this research is to make it easier to determine a target which is initially done manually, and the process is done so many stages that require a lot of time. The forecasting process using revenue data exclude from discount or promo, and others type data for setting a target of revenue sales. Artificial Neural Network algorithm was a research method to get a good prediction. Hopes this research can study the company and can grow better with greater income going forward with the help of artificial neural algorithms in determining an income target to be the correct prediction. This research for calculating data and used three-month transaction data pattern to get a revenue target. The conclusion from this research has histogram, training, and testing to node 4 with 6.672403 value and node 5 with 0.9987362 value. That last node is making predictive material data and used as a multiplier for more value to be the revenue target.

1. Introduction
Forecasting in this research predicts to determine the target revenue in a company. From that research explained about ANN is a method for a comparison of values and also analyzes a series. The ANN results and functions themselves show a function model for future assessments. The ANN method is also a problem solving for statistics, strength, and also a single or multidimensional timing. ANN is a method for rows of data with multidimensional time [1].

PT HIJ is a company in manufacture product in Bandung, Indonesia. That is the product is painted to build house or maintenance house or object like a Football floor, Basket Ball floor, etc. The company has a desire to maintain product quality by conducting quality control of the entire process and production results. The process is carried out through the synergy of some experienced experts, the latest technology machines, and quality raw materials. To provide good quality, determine a target in selling, it is also a good idea to provide better achievements in turnover, so this research can be study aimed at determining a sales revenue target. The problem with the company is about target revenue to be valid and use of the artificial neural network algorithm is forecasting for conditions results that are expected to solve one of the problems that exist in paint production the company to determine a revenue target by getting forecast results for sales optimization that are expected to improve optimization in determining a target selling in all regions in Indonesia. Sometimes this is a problem in work reality for final executing a revenue target because it is a false prediction if calculation with the manual process. This forecasting process using revenue data exclude from discount or promo, and others type data for setting a target of revenue in selling. Hopes from this research can study the company and can grow better with greater income going forward with the help of artificial neural algorithms in determining an income target to be the correct prediction. This Research is have found these indices to be useful for revenue target to HIJ company. This process is useful to execute with this mining or time-series data with research method artificial neural network algorithm to forecast the revenue target company. The ANN has plus and minus if the show on the process, begin from the input, hidden and output with used. This research from this artificial neural network method also can give big size data set and had node 4 and node five from this research. This research had a complicated process to know all the characteristics data sets with artificial neural network unwise. This research had 3-month transaction data set to be single data sets; this data can compare with method artificial neural network algorithms when applied to the create a new revenue.

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target at different time scales with the pattern 3-month transaction and other various prediction scenarios strategy in this method — the goal of this research to comparative study and for forecasting future selling to HIJ company. Section 2 about method reviews target revenue in sales, r studio application for calculating and method. Section 3 is a result and discussion research the method artificial neural network algorithm. Section 4 presents the conclusions. In this forecasting paint products using the artificial neural network is a requirement to give revenue target for the company to be a success. Many methods like technical analysis, time series analysis, and statistical analysis, etc. There are all used to attempt to predict the revenue target in the share on selling paints, but none of these methods are proved as a consistently acceptable prediction tool. So, in this paper, a model is proposed for recognizing the success target on the paints selling.

Set training with the first sample dataset of the sample and provide a training dataset into the sub training set and sub validation set to generate ANN [2]. ANN and simulate the prediction results in this study using a normalized sub training dataset as well as sub validation to train ANN, this ANN uses two layers, one hidden layer, and one output layer. The number of unit models can be hidden by using fold crossing validation to select the ANN architecture and the least error taken randomly and the original training dataset randomized into the same subsample size. Subsamples are retained as data validation for model testing, and remaining subsamples are used as sub training data and are repeated five times for cross-validation. After determining the best ANN, include the testing value from set to ANN to produce the value as a result of forecasting. ANN is used for the average prediction as to the final estimation result which is then compared with the actual value of the testing dataset [3].

ELM is a learning algorithm for advanced feed ANN training. Unlike BPNN as well as RBFNN, ELM internal parameters are not iterative but are set to random values and uniformly distributed to simplify output with hidden units.

1) Back Propagation Neural Network
   The BPNN model is an ANN-based algorithm for classification and prediction [4][5][6].

2) Radial Basis Function Neural Network
   RBFNN is an ANN with a radial base function for the activation function. Network radial basic functions (RBF) have an input layer, hidden layers with non-linear RBF activation functions and linear output layers [7][8][9].

3) The Extreme Learning Machine
   ELM was originally for a single, neural forward feed network and then expanded into an advanced feed network in general. [10][11].

2. Method
   In the method of artificial neural networks, there were several stages, namely as follows:

2.1. Three Month Transaction Data
   The table below was a 3-month transaction data that was made in a repetitive pattern, and the data became a sample for calculations in the method of artificial neural network algorithms. The table below had three fields, namely output, transaction3month, and rank. The output itself had data 0 and 1 which means that it was the contents of the output field. Transaction 3 month was the value of the transaction that has been owned by the process that has been done in the company. The last was the rank field was the position of the amount of the transaction 3 month value.
   The data Table 1 shows an example of data to analyze the calculations that occur using neural network algorithms method.
Table 1. Three Month Transaction Data

| output | transaction3month | rank |
|--------|-------------------|------|
| 0      | 1234268142        | 2    |
| 1      | 1557217235        | 1    |
| 1      | 514520000         | 3    |
| 1      | 100145100         | 6    |
| 0      | 200003010         | 4    |
| 1      | 150003010         | 5    |

From the data used as shown in Table 2 is the initial capital to run the neural network algorithm method itself. Each field itself is in accordance with the previous exposure with the "int" data type which will produce the numbers needed for the final result in forecasting.

Table 2. Frame Data Type

| Field Names     | Type Data |
|-----------------|-----------|
| Output          | int       |
| transaction3month| int      |
| Rank            | int       |

3. Result and Discussion

In this finding and discussion are the results of the methods outlined in the previous chapter which explain the research method.

3.1. Histogram Transaction Default

The figure below is a histogram of transaction default data that is patterned with transactions for three months before using formula. If seen in more detail, the histogram illustrates from the figure described the highest ranking position in default with the amount of transaction held in the transaction field.

The histogram bottom explains that the frequency point starts from 0.0 to 3.0. with data ranging from 0 (0.0e + 00) to 2,000,000,000 (2.0e + 09) and produces histogram levels like the figure. The following is a 3monthtransaction image histogram on Figure 1:

![Histogram of data$transaction3month](image-url)
3.2. Transaction Histogram Set

The below is a histogram of a transaction after setting with formula code on the R Studio that is patterned with transactions for three months. If seen in more detail the histogram illustrates from the table described above with the highest ranking position with the amount of transaction held in the transaction field. The formation of the histogram below it is helped with the following formula code:

\[
data$\text{transaction3month} <- (data$\text{transaction3month} - \min(data$\text{transaction3month})) / (\max(data$\text{transaction3month}) - \min(data$\text{transaction3month}))\]

(1)

The following is a 3month transaction image histogram data on Figure 2, and the histogram below explains that the frequency point starts from 0.0 to 3.0. With data ranging from what was (0.0e + 00) to be 0.0 and (2.0e + 09) to be 1.0 the data changes from default to the following histogram with the formula on (3).

![Histogram of data$transaction3month](image)

**Figure 2.** Histogram Transaction 3 Month Set

3.3. Artificial Neural Network Output

This process is a process where the methods of artificial neural network algorithms react to a predetermined value either from the value of a 3-month transaction field that has a transaction pattern and also a rank field according to the significant level of the transaction.

The following on figure 3 are the ANN outputs. On figure 3 below shows two input one is hidden and one output from the plot (n). Keep in mind, the layers are more hidden, the process becomes very slow, and sometimes your computer cannot process it so the message "Out of Memory" appears. The value of the results of this artificial neural network algorithm method is a valued transaction with a value of 2.70308, rank -1.28289, hidden 2.57404. Among the values above, it produces two nodes and the fifth node. The fourth node with blue has a value of 0.68559, and the fifth node has a value of 4.37774. The error value is 0.008031 and steps 42. ANN-based algorithm for classification and prediction...
illustrated as shown in Figure 3 like a BPNN because have stages of the input layer, hidden layer, and output layer [4-6].

Figure 3. Artificial Neural Network Output

3.4. Training Data
In the results of the training, this data produces stimuli called neurons, had result net and also in head training have output to the main point, and that output can combine to create forecasting. outputs which can be seen with the following the table. RBF has an input layer, hidden layers with non-linear RBF activation functions and linear output layers and can have a result like on table 3 for neuron output [7][8][9].

On the Table 3 is output from $neurons [[1]]. Neurons that receive input data which are rank 2, 3 and 4 with the output results as shown bottom.

| Table 3. First Neuron Output |
|-----------------------------|
| Transaction3month | rank |  |
| 2                | 1 | 1.0000000 | 0.0 |
| 3                | 1 | 0.2843887 | 0.4 |
| 4                | 1 | 0.0000000 | 1.0 |

On the Table 4 is output from $neurons [[2]]. Neurons that receive input data which are rank 2, 3 and 4 with the output as shown below in the second layer of neurons.

| Table 4. Second Neuron Output |
|-------------------------------|
| [1.] | [2.] |
| 2 | 1 | 0.9673485 |
| 3 | 1 | 0.7193336 |
| 4 | 1 | 0.3549613 |

On Table 5 is output $net result. Net Result output symbolizes the result of the calculation of X being the value of Y.

| Table 5. Net Result Output |
|-----------------------------|
| [1.] |
| 2 | 0.9989602 |
On Table 6 is head training output. It can be concluded that in the head training table 1 result is taken with the 2nd rank position.

| Table 6. Head Training |
|------------------------|
| output | transaction3month | rank |
| 2       | 1                  | 1     |

3.5. Node 4

Node is an individual part of a larger data structure that blocks from each input and forms into a predetermined node, why this is called node four because in this node produces a value that has been determined with a particular formula to produce a value of forecasting.

\[
in4 \leftarrow 0.68559 + (2.70308*1)+(-1.28289*1)\\[1] 2.10578 \\
\]

\[
out4 \leftarrow 1/(1+exp(-in4))\\[1] 0.8914637 \\
\]

3.6. Node 5

In node 5 is continued from node 4, from that individual part of a larger data structure that blocks from node 4 and continues to be a new node in node 5.

\[
in5 \leftarrow 4.37774 + (2.57404*out4)\\[1] 6.672403 \\
\]

\[
out5 \leftarrow 1/(1+exp(-in5))\\[1] 0.9987362 \\
\]

Value from node 5 is 0.9987362, and this value proves from net result output but much noisy data and data not the same, but this value approaches each other. When this research used can combine with a target for forecasting data and weather forecast data can be used or not. For calculation of targets with aggregate results than this fifth node can be seen among others. Below are the results of this research in table 7:

| Table 7. Research Result |
|---------------------------|
| Target * Node 5 Result   | Comparison |
| 1234268142 * 0.9987362 = 1235829984 | 1234268142 - 1235829984 = 1561842 |

Table 7 is the research result output. Target * node 5 taken from a neuron and becomes a node 4 then 5, the results are calculated with the specified target, so it looks like the picture above. The difference from the comparison above produces a comparison worth 1561842.

4. Conclusion

The results of this research result from forecasting revenue target with the ANN algorithm can have 0.9987362. That data last result from node 5 and research result from this ANN have an advantage that is robust with noisy data and disadvantage that are less interpretable than other models such as decision trees and usually need longer training times.
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