BANKING PRICE FORECASTING APPLICATION USING NEURAL NETWORK TIME SERIES METHOD

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ABSTRACT

In the capital market is a meeting place for investors to make an offer with demand for securities as a means of business funding or as a means for companies to get funds. One of the assets to invest in the capital market is stocks. In terms of business aspects, stock investment has good growth but this does not apply to all stock sectors. Because in fact the development of capital markets in Indonesia turned out to be ups and downs. It can cause changes in demand and supply that will affect investor psychology in predicting stock prices. This stock price forecasting system will be created using the Neural Network Time Series method. Using historical data as a reference in the neural network training process can be used as a basis for predicting bank stock prices the next day. In the tests that have been carried out using the application forecasting stock prices of state banks using the neural network time series method with the backpropagation algorithm, the average accuracy rate of the State Savings Bank (BTN) is 97.32%, Bank Negara Indonesia (BNI) 98.25%, Bank Mandiri 97.68% %, and at Bank Rakyat Indonesia (BRI) 98.59%.

Keywords: *Stock, Backpropagation, Neural Network Time Series, Forecasting*

1. INTRODUCTION

The capital market is a meeting place between supply and demand for securities as a means of business funding or as a means for companies to get funds from the public investors (investors). One of the assets to invest in the capital market is stocks. Changes that occur in stock prices are determined by the demand and supply that occurs in a stock. To be able to get periodic share price information, of course it is not enough just to rely on current stock price information. Therefore it is necessary to know the stock price information from the past. In order to create a model that illustrates how the nature of stock price information at this time to be predicted / predicted. Forecasting about stock prices will be very useful for investors to be able to see how the prospect of a company's stock investment in the future and predictions in anticipation of the rise and fall of stock prices. Neural networks can be applied to the field of prediction. Neural Networks do not require a mathematical model but data from problems to be solved. Past data are assumed to be like function values that explain the structure of past data or historical data as a reference.

Therefore, Neural Network Time Series is very appropriate to solve the problem of stock price predictions which are expected to help investors and capital market players in investing in shares on the Indonesia Stock Exchange.

2. THEORETICAL BASIS

2.1 Stock

Shares are securities that show the ownership portion of a company. Buying a share means having ownership rights over the company and being entitled to company profits in the form of dividends, at the end of the company's accounting period.

2.2 Forecasting

Forecasting is a conjecture or estimate regarding the occurrence of an event or incident in the future. According to [1] in forecasting, accurate calculations are needed so that accurate forecasting is needed. According to [1], forecasting techniques are divided into two, namely:

a. Qualitative forecasting methods that combine factors such as intuition, decision making, emotions, personal experience.
b. Quantitative forecasting methods are forecasting that uses one or more mathematical models with past data and cause and effect variables to predict demand.

Basically quantitative forecasting methods are divided into two, namely:

1. Time series model
   In this model, a variable is predicted based on the value of the variable itself in the previous period.
2. Causal model (explanatory)
   In this model, a variable is predicted based on the value of one or more other influential variables.

2.3 Neural Network

Neural Network itself is included in the category of soft computing which actually adopts the ability of the human brain that is able to provide stimulation / stimulation, process, and provide output. Output is obtained from variations in stimulation and processes that occur in the human brain. neural network is one of the artificial representations and the human brain that always tries to simulate the learning process in the human brain. The term artificial here is used because this neural network is implemented using a computer program that is able to complete a number of calculation processes during the learning process. [2]

2.4 Backpropagation Algorithm

Backpropagation algorithm or commonly called back propagation algorithm is one part of the Neural Network. Backpropagation is a supervised learning method, which means it has targets to look for. The hallmark of backpropagation itself is that it can minimize errors in the output generated by the network. In the backpropagation method, multilayer networks are usually used. The backpropagation method consists of two stages: forward propagation and backward propagation. There are two stages in using the backpropagation algorithm, namely:

1. Learning or training stage, where at this stage in the backpropagation neural network is given a number of training data and targets.
2. The testing phase or use, testing and use is carried out after backpropagation has finished learning.

According to [3] consists of two stages, feedforward and backward (backpropagation) of the error. For details, the following details can be explained:

- Step 0
  Weighing initialization (randomly given a small value)
- Step 1
  Repeat steps 2 through 9 until the final iteration conditions are met
- Step 2
  For each pair of training data (training data) do steps 3 to 8
- Step 3
  Each input unit (xi = 1, ... n) receives the input signal xi and the signal is transmitted to the next unit units (hidden layer units).
- Step 4
  Each unit in the hidden layer is multiplied by the weigher and added up and added to the bias
  $z\_in_j = v_{oj} + \sum_{i=1}^{n} x_i \, v_{ij}$ ……....(2.1)
  Then calculated according to the activating function used:
  $z_j = f(z\_in_j)$ ……..……(2.2)
  If the sigmoid function is used, the form of the function is:
  $z_j = \frac{1}{1+exp^{(-z\_in_j)}}$ ……(2.3)

The output signal from the activating function is sent to all output layer units.

- Step 5

Each unit of output ($y_k, k = 1,2,3, \ldots \ldots m$) is multiplied by the weigher and added up and added with the bias:

$y_{k\_}in_k = w_{0k} + \sum_{j=1}^{p} z_j w_{jk}$ ……..…(2.4)

Then it is recalculated according to the sigmoid function:

$y_k \frac{1}{1+exp^{(-y\_in_k)}}$……..……..…(2.5)

- Step 6

Each unit of output ($y_k, k\ 1, \ldots m$) receives a target pattern according to the input pattern during training and calculates the error:

$\delta_k = (t_k - y_k) f'(y\_in_k)$ ……...…(2.6)

Because $f' y\_in_k = y_k$ uses the sigmoid function, then:

$f' y\_in_k = f\ (y\_in_k)(1 - y\_in_k))$

$= y_k(1 - y_k)$ ……....…(2.7)

Calculate the weighing fixes then to fix (wk_j).

$\Delta w_{kj} = \alpha . \delta_k . z_j$ ……...…… (2.8)

Calculate correction corrections:

$\Delta w_{0k}\ \alpha . \delta_k$…….……..…(2.9)

and use the delta value $(\delta_k$) on the previous unit layer.

- Step 7

Each weigher that connects units to the output layer with units to the hidden layer (z_j , j=1,…p) multiplied by delta (δ_k) and added as input to the next layer units.

$\delta_{inj} = \sum_{k=1}^{m} \delta_k w_{jk}$……...…(2.10)

Next multiplied by the derivative of the activating function to calculate the error.

$\delta_k = \delta\_in_j f'(y - in_j)$…….……(2.11)

The next step is calculating the weigher (used to fix).

$\Delta v_{ij} \alpha . \delta_j . x_i$……...…(2.12)

Then calculate the refractive bias (to correct v_{0j})

$\Delta v_{0j} = \alpha . \delta_j$……..…(2.13)

Next correct the weighing and bias.

- Step 8

Each unit output $(y_{k\ ,} k = 1, \ldots m)$ correcting the bias and weighing (j = 0, ….p),

$w_{jk}\ (baru) = w_{jk}(lama) + \Delta w_{jk}$...(2.14)

Each hidden unit $(z_{j\ ,} k = 1, \ldots p)$ corrects the bias and weight (k = 0, …n)

$v_{jk}(baru) = v_{jk}(lama) + \Delta v_{jk}$. …(2.15)

- Step 8

  Test the stop condition (end iteration).

  • List of Notations

  x^n = The n[th] training input pattern $(x_1, x_2, x_3, \dots \dots x_n)$

  t^k = The target pattern of output from the training

  x_i = I-unit in the entry layer

  z_in_j = Output for the unit z_j

  z_j = Activation value of the z_inj unit

  y_in_k = Output for the unit y_k

  y_k = The active value of the unit y_in_k

  w_{kj} = Weighing value of z_{ij} to unit y_k

  Δw_{kj} = The difference between w_{kj} (t) and w_{kj} (t+1)

  v_{0j} = Weighing value of the unit x_i to unit z_j

  Δv_{ij} = The difference between v_{ij} (t) and v_{ij} (t + 1)

  δ_k = Weighing control factor at the output layer

  δ_j = The controlling factor of the weighing value on the hidden layer

  α = Training rate constant (learning rate) 0 < a < 1

2.5 Root Mean Square Error (RMSE)

Root Mean Square Error is an alternative method for evaluating forecasting techniques used to measure the accuracy of a model's forecast results. According to [4] one measure of error in forecasting is the mean square root value or Root Mean Square Error (RMSE).

$$RMSE = \sqrt{\frac{(T-Y)^2}{n}} \quad \text{.....(2.16)}$$

Where:

T = target data

Y = predictive data

n = amount of data

2.6 Normalizing and Denormalizing Data

- Data Normalization

  Normalization of data is very necessary when the data is too large or too small so that users have difficulty in understanding the information in question. The data normalization formula is as follows,

  $$X' = \frac{X-b}{(a-b)} \quad \text{.....(2.17)}$$

  Where:

  X' = normalized data

  X = real data / initial data

  a = maximum value of real data

b = minimum value of real data

- Data Normalization
  Denormalization can provide or return data. The denormalization formula is as follows,
  $F' = (X.SD) + b$……...…2.18)

  Where:

  F' = denormalized data

  X' = predictive data

  b = minimum value of real data

  SD = standard deviation (maximum value - minimum value)

2.7 Average Accuracy

In the fields of science, the engineering industry, and statistics, the accuracy of a measurement system is the level of proximity of a quantity measurement to its true value. The accuracy value indicates the closeness of the results to the actual value determined by the standard method.

$$G = \frac{\text{Total Accuracy Value}}{n} \text{……(2.19)}$$

Where:

G = total accuracy value

n = amount of data

3. SYSTEM ANALYSIS AND DESIGN

Based on the preliminary description above, this study aims to make "Application of Bank Share Price Forecasting Using the Neural Network Time Series Method". With this information system, users can obtain information on government bank stock price data in Indonesia. Users can also predict stock prices for the next day.

3.1 System Flowchart

A system flowchart is a graphical depiction of the steps and sequences of procedures of a program. The following is an overview of the system flowchart that will be created.

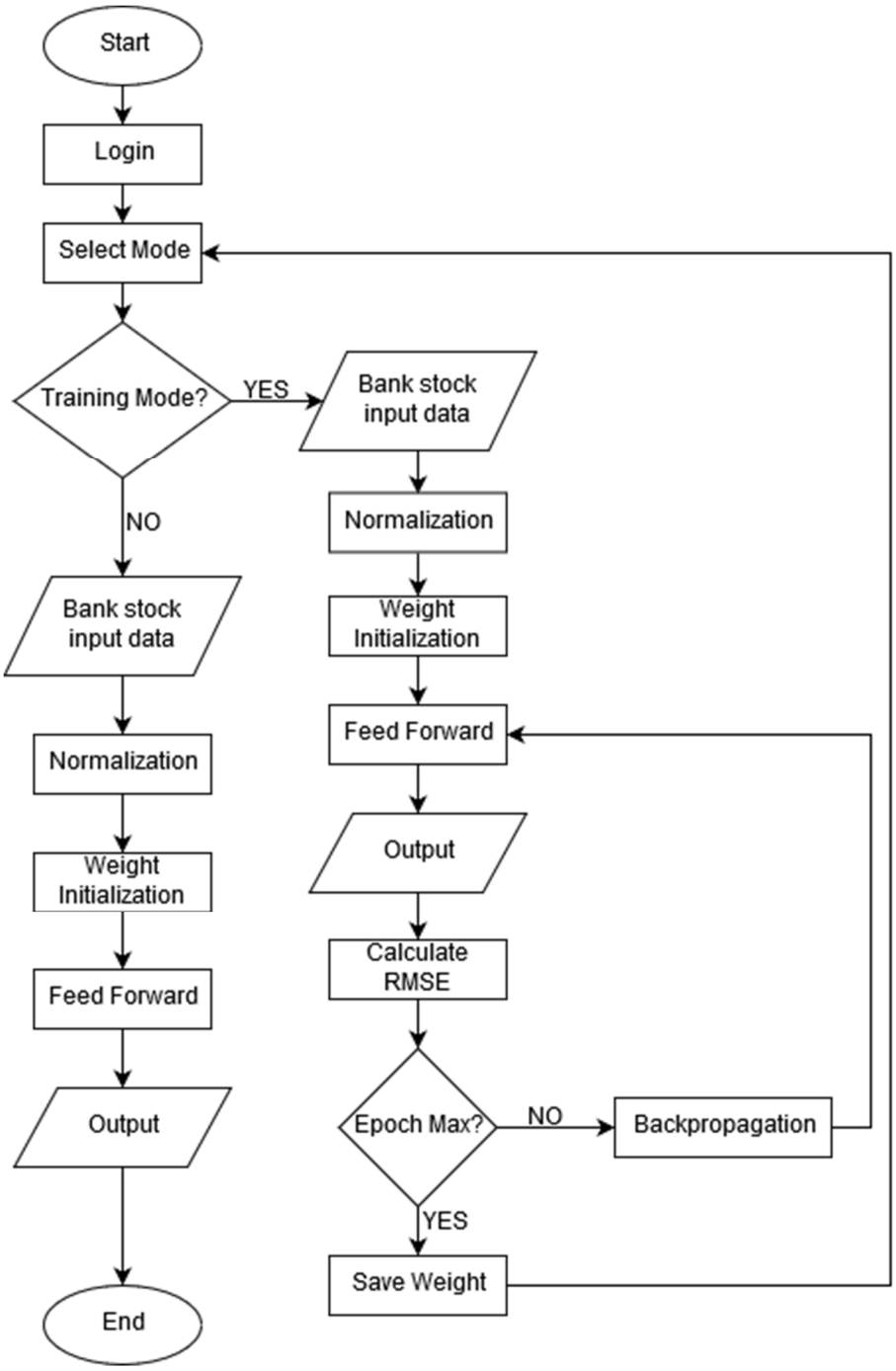

Figure 3.1. System flowchart

4. TESTING AND RESULTS

4.1 Test result

The following are the test results of the Bank's Stock Price Forecasting Application Using the Neural Network Time Series Method. In the testing process that is conducted using data close to bank stock prices obtained from the Yahoo Finance site with a daily period of 5 days for training data and 1 day for target data conducted for 5 times at each bank and with a maximum iteration number of 1000 repetitions. The data will be processed first with the stages in data normalization before the calculation process is carried out with the Neural Network Time Series. There are 4

banks to be tested, namely: the National Savings Bank (BTN), Bank Negara Indonesia (BNI), Bank Mandiri, and Bank Rakyat Indonesia (BRI).

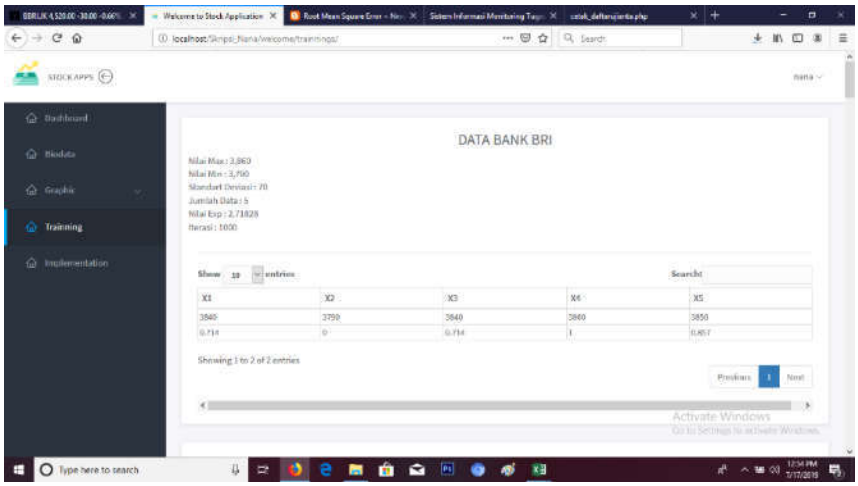

Figure 4.1 Test Results from a Government Bank.

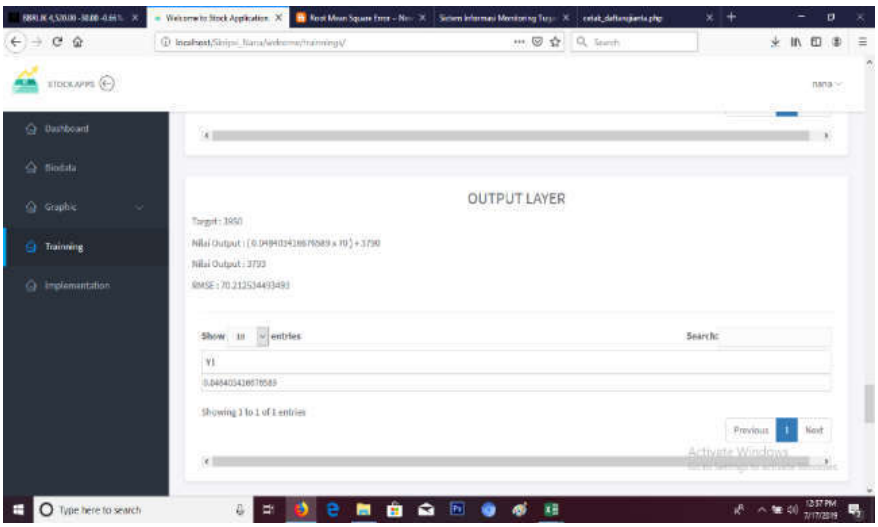

Figure 4.2 Test Results Calculation on the Output layer

4.2 Analysis of Testing Results

The results of trials conducted at each state bank in Indonesia for 5 trials by taking the closing price data for 5 days for training data and for the following days used as target data and with a maximum iteration number of 1000 repetitions. The data will be processed first with the stages in data normalization before the calculation process is carried out with the Neural Network Time Series. After the process of calculating the results of the forecasting data will be denormalized and will be displayed on the graph, after measuring the accuracy level at each bank it will produce an average level of accuracy as follows,

Table 4.3 Average Accuracy of Each Bank

No.	Bank	Test	Accuracy
1	Bank Tabungan Negara	5 times	97.32%
2	Bank Negara Indonesia	5 times	98.25%

3	Bank Mandiri	5 times	97.68%
4	Bank Rakyat Indonesia	5 kali	98.59%

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the test results, it can be concluded several things as follows:

1. Determine the value of prediction or forecasting using data close to the previous stock price can be used as input data that will affect the output value, namely the close of stock prices on the next day.
2. In the tests that have been carried out using the forecasting application of the stock prices of government banks using the Neural Network time series method after 5 tests, the average accuracy rate of the State Savings Bank (BTN) is 97.32%, Bank Negara Indonesia (BNI) 98.25%, Bank Mandiri 97.68%, and at Bank Rakyat Indonesia (BRI) 98.59%.

5.2 Recommendations

Suggestions are needed as further research development. These suggestions include:

1. It is expected that the system can be further developed to be able to predict close share prices for a longer period of time.
2. For further research more developed training algorithm variations in order to obtain optimal results with shorter training time.
3. Better weight initialization because the weight value affects the output, especially in the test data.

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