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# High Accuracy in Forex Predictions Using the Neural Network Method Based on Particle Swarm Optimization

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**Abstract.** In forex trading, trader has to predict the risk in forex transaction and how to gain or increase the profits based on analysis. The purpose of this study is to predict the value of the USD against the IDR by comparing the neural network method with the neural network method based on Particle Swarm Optimization (PSO) to find out which level of accuracy is higher. This method was chosen by the author after reading several previous studies using PSO-based Neural Networks showing a higher level of accuracy compared to using Neural Networks without PSO-based. From the results of the study it was found that predictions using Neural Networks strengthened with PSO resulted in very high accuracy.

## 1. Introduction

According to KBBI Foreign exchange (Forex) is a market place that specialized in foreign exchange trading. In foreign exchange business that needs to be considered is exchange rate. Currency exchange rates are often unstable to make the business of forex as a business with a big risk but also as a business with a big advantage anyway. Therefore, appropriate predictions are needed to minimize risk and increase profits.[1]. Foreign exchange trading develops in the international market due to the difference in the currency exchange rates between countries arising from the supply and demand.[2] Predicting a currency exchange rate can be done with a technique of computational intelligence or data mining techniques with artificial neural network[3]. Data mining techniques can predict the pattern, knowing the characteristics, and create a grouping to generate information about the relationship between variables[4]. One of the data mining methods that can accurately predict for timeseries forecasting is Neural Network, neural network is a method that leads itself well to time series prediction [5]. The purpose of prediction using the neural network method is to predict future currency price movements to facilitate foreign exchange business in making decision.

There is some previous research on foreign exchange predictions using neural network methods such as Comparing ANN Based Models with ARIMA for Prediction of Forex Rates with writers Joarder Kamruzzaman and Ruhul A Sarker comparing two models namely Artificial Neural Networks (ANN) and ARIMA to predict the forex exchange rate, the results gained from the research model Artificial Neural Networks (ANN) are superior and thorough in predicting



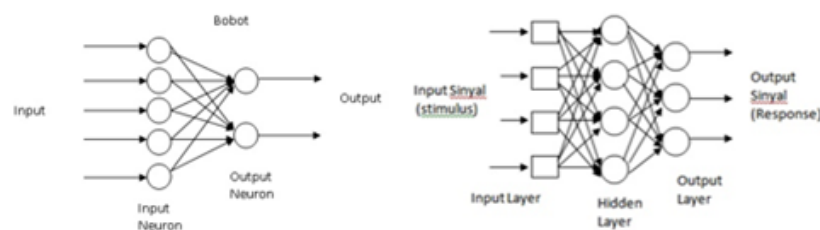
Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

value When measured at three performance metrics [6] Research with the title of Artificial Neural Network Model for Forecasting Foreign Exchange Rate by Adewole Adetunji Philip, etc to provide conclusions on the price of irregular stocks the Neural Network models can solve problems with systems that Complex and incompleteness of data. Research has been conducted from 2003 to 2005 with 800 pieces of data. Using back propagation on the ANNFM network compares predictive data with real use of MSE calculations and SDEV is obtained by the results of 81.2% prediction accuracy compared to HMF (Hidden Markov Forecasting Model) which is only 69.9%.[7]. The research conducted by Nijolė Maknickienė and Algirdas Maknickas titled Application of Neural Network For Forecasting of Exchange Rates Trading concluded that predictions with Neural networks could be likened With expert predictions like human predictions[8]. Research with the title Application of Back propagation Artificial Neural Networks for Gbp / Usd Currency Estimates in Forex Trading conducted by Hendra William et al, GBP / USD currency predictions. The analysis results obtained from the system show that in testing the training data, the activation function of Tansig-Logig is the best activation function with an average accuracy rate of 98.74%. In testing the netw24 test data is the best network due to the accuracy level of 99.21% and can make exact forecasts 4 times, and at the forecast price of closing GBP / USD, netw14 is the best network with an accuracy level of 99.98%.[9]. The application of PSO to the Neural Network method makes the test results more accurate, in accordance with the conclusions of Amr M. Ibrahim's Study entitled Particle Swarm Optimization trained recurrent neural network for voltage instability prediction, this study present the performance of neural network based on PSO training algorithm is compared with neural network based on backpropagation training algorithm to predict the voltage instability. Based on the result, the application of PSO in training recurrent neural network gives higher performance than using backpropagation[10]. The study entitled Particle swarm optimization and its application to seismic inversion of igneous rocks by Yang Haijun et.all, in the igneous rock inversion system is done by 2 methods, namely probabilistic neural network and igneous rock inversion based on PSO, where the inversion based on the PSO method has better result.[11] The other study entitled Particle swarm optimization based on back propagation network forecasting exchange rates, it was found that the optimal input layer neurons for BPN that rely on PSO will provide the optimal solution and achieves the best performance forecasting.[12] Based on some research that has been done, we make a forex prediction test using Neural Network and Neural Network based on Particle Swarm Optimization (PSO) to find out which level of accuracy is higher.

## 2. Methods

### 2.1. Artificial Neural Network

Artificial Neural Network (ANN) is a system that is like the biological nerve performance in the process of an information.



**Figure 1.** Simple Artificial Neural Network.

Hidden Layer is a layer between input neurons and output neurons that serves as a performance improvement. The hidden layer functions as an encoder / replicator / identity map to match and remember patterns.

## 2.2. Particle Swarm Optimization (PSO))

PSO is developed so that a particle sends information to other particles in a group. Then the memory of each particle stores what has been passed, if the path that has never been traversed does not get results then the path will be abandoned. The basic structure governing PSO is the speed equation and its position, which is as follows:

$$V_t = V_{(t-1)} + c_1 r_1 (P_{(t-1)} - X_{(t-1)}) + c_2 r_2 (G_{(t-1)} - X_{(t-1)}) \quad (1)$$

$$X_t = X_{(t-1)} + V_t \quad (2)$$

$V_t$  and  $X_t$  represent the current speed and particle position parameters.  $V_{t-1}$  and  $X_{t-1}$  are the velocity and position of the previous particle and  $w$  is the weight. Constants  $C_1$  and  $C_2$  are social constants.  $P_{t-1}$  represents the best previous position of the particles and  $G_{t-1}$  is the previous best position of the whole herd. The algorithm steps consist of: 1: Each particle is initialized by setting a random position and speed value. 2: the value of each particle depending on the nature of the problem is calculated by entering position parameters. A higher or lower fitness value that represents the shortest distance from the optimal solution. 3: The best fitness value is obtained from comparing fitness values in groups. The best fitness value depends on the nature and purpose of the problem. The term G-best represents the position parameter that produces the best fitness value for the whole group. 4: G-best value is replaced by the present value if the particle Fitness value is greater than the G-best value, conversely if the G-best value is greater than the previous particle is checked. The best P-best value is personally updated using the value parameter. 5: The previous G-best value will be reconsidered then used in the velocity equation if the particle fitness value is lower than the previous fitness value. This is a complementary function for the same loop process for all particles. 6: When all particles have the same solution, the algorithm cannot optimize further. This condition is considered as a final condition

## 3. Result and Discussion

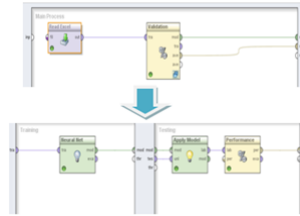
### 3.1. Neural Network

Data of exchange rate used is data set taken from link <https://www.investing.com/currencies/usd-idr-historical-data> is real data from foreign exchange (Forex) USD price Movement for 1 year (01 January – 31 December 2019) as many as 261 Record, with attributes consisting of: date, Price, open, high and low.

**Table 1.** Data Set price movement USD/IDR.

Date	Price	Open	High	Low
Dec 31, 2019	13.882,50	13.922,50	13.922,50	13.862,50
Nov 29, 2019	14.105,00	14.090,00	14.120,00	14.090,00
Oct 31, 2019	14.037,00	13.995,00	14.045,00	13.985,00
Sep 30, 2019	14.195,00	14.155,00	14.195,00	14.155,00
Aug 30, 2019	14.185,00	14.220,00	14.245,00	14.185,00
Jul 31, 2019	14.017,00	14.015,00	14.031,00	14.005,00
Jun 28, 2019	14.127,50	14.132,50	14.147,50	14.097,50
Mar 29, 2019	14.240,00	14.245,00	14.250,00	14.220,00
Feb 28, 2019	14.065,00	14.030,00	14.083,00	14.030,00
Jan 31, 2019	13.972,50	14.132,50	14.132,50	13.957,50

From 261 records that have been obtained, the authors divide into 2 pieces of data consisting of training data and data testing. The data training amounted to 222 records while data testing amounted to 39 records. Based on the distribution of data is tested using cross validation in the Rapid Miner application with the following results:



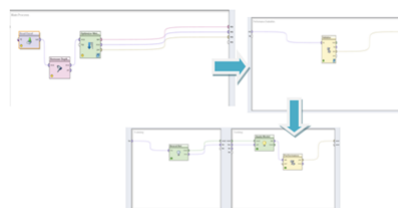
**Figure 2.** Neural network cross validation testing

accuracy: 90.00% +/- 12.25% (mlkrc: 89.74%)			
	true 0.0	true 1.0	class precision
pred 0.0	13	2	86.57%
pred 1.0	2	22	91.67%
class recall	86.57%	91.67%	

**Figure 3.** the accuracy result of neural network

### 3.2. Neural Network based on PSO

Based on previous data set testing using neural network method, we get 90% accuracy result which is the result of good value accuracy. To optimize the value of accuracy, then this research is done optimization using PSO. Here are the results of neural network method testing based on particle swarm optimizing:



**Figure 4.** neural network validation based PSO test

accuracy: 100.00% +/- 0.00% (mlkrc: 100.00%)			
	true 0.0	true 1.0	class precision
pred 0.0	15	0	100.00%
pred 1.0	0	24	100.00%
class recall	100.00%	100.00%	

**Figure 5.** result of PSO-based neural network accuracy

In Figure 5 above, it is obtained that the accuracy of the Neural Network-based PSO method has a perfect accuracy value of 100%.

#### 4. Conclusion

Research results show that this study uses the Neural Network method to look for accuracy values with foreign currency log data. The single method used is the Neural Network with the results of an accuracy value of 90%. The accuracy value of the Neural Network method has good performance. However, to get a higher accuracy value, it is necessary to use a Particle Swarm Optimizing (PSO) based Neural Network to raise the value of a higher variable, which is an accuracy value of 100%, which is said to be perfect with the variables contained in the log of foreign currencies. Foreign exchange rate forecasting is not only interesting for traders but also for international companies which want to decrease exchange exposure. So, for further research it's expected to be able to use many data sets foreign currency with improved method.

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