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Designing Perceptron Three-Layered Neural Network for Predicting Dollar-Franc Currency Pair in International Exchange Market

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Abstract

International financial markets like exchange market are among the most dynamic markets in the capital markets available in which investing needs enough knowledge and experience. So we decided to invent a system so that it can forecast trend created in exchange market. There are a lot of wide transactional strategies for buy and selling of exchange symbols which here we used science of artificial neural network in this article. Final results of the predictions and percent of Mean square error of the network is calculated after defining neural network and training by Matlab software. Training of desired neural network is achieved by 2010 price data in order to mean square error decrease to 2.15e-6 and at comparison against newest of research show proper improvement.

Keywords: FOREX; Mean square error; Perceptron neural network; Hidden layer.

1. Introduction.

International financial market was divided into several important Sections like stock market, CFD market, BOND market, Currency market and commodity market but between these sections, currency market is significant sector because it has biggest cash flow between them which called FOREX. Turnover of currency exchange market is thirtyfold turnover of American stock markets and has 3 trillion dollar daily cash flow. Therefore we diverted our attention into full potential currency exchange market until invent profitable trading system.

Jingtao Yao and Chew Lim Tam presentation data of time series and technical indicator as input for neural network in case study because they would to predict probable motions in price's future. Their results show that if the ranges of data are not very extensive, their neural network can better forecast

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to future's price of dollar- franc [1]. Shuo Yao, Michel Pasquier and Chai Quek conduct their currency's portfolio via fuzzy neural network to optimize and improvement share's revenue. Buy and sell signal published separable for each share and combination of signals with moving average published buy or sell orders finally [2]. In one recent study, using a combination of time series and genetic algorithms were attain to design a system which it used for predicting of dollar-yen and euro-dollar in exchange market that result expressed mean square error decrease to 1.17e-5 [3]. In other research, a model was proposed to predict the price of various currencies by fuzzy inference system. Mean square error of this model is 6.15e-4 [4]. In other systems, a model was proposed to predict euro-dollar rates which using of genetic algorithm and proprietary indicator to generate profitable strategies to trade futures contracts on foreign exchange market. The value of MSE for this model is 1.27e-5 [5].
In this article, we are designed three layers neural network to can predict dollar – franc future's price with the highest yield by means of 2010 price's data.

2. Introduction to global currency market

Global currency market or FOREX is the interbank which primary and obsolete performer is banks but speculators, Financial Managers, investing companies, credit institutions and end-users can trades through the brokers in the FOREX market. Indeed exchange market is purchase a currency and sells other in the over counter place that currency trades as pair.

3. Benefit of electronic business in the currency market

A) Liberation from the shackles of time: Forex market is active 24 hours over five days a week. Everyone can to engage trading in this market at any time.
B) Liberation from constraint of place: Wherever internet is available can be attributed to the action in FOREX market. The availability of wireless Internet service can be traded even in the Park and even the possibility of trading and analysis on cell phone exist in countries where they provide mobile phone Internet service.
C) Equal opportunity for all traders in the world: While a doctor or lawyer or any other expert in the various countries involved discrimination in income and other employment opportunity to multiple, a FOREX trader, in Bangladesh, Japan, London, or Iran have equal opportunity with others and does not suffer from any discrimination. This feature, especially for residents of countries with low income and high discrimination in employment is considerable.

4. Types of trading strategies

For trading in exchange market that the buying and selling common currencies against other, requires very high knowledge and experience. Using these experiences can be invented special kind of trading strategy that has necessary profitability.
Trading strategies are usually based on two general types:

a) Strategy based on Technical Analyses
b) Strategy based on Fundamental Analyses

Developed trading ideas based on market technical behavior analyses behavior of price on the desired symbol and given that we are attempting to buy or sell without have considerable the market fundamental foundation but in trading strategies based on fundamental analysis, has shifted our attention to the general terms and market's basic and its analysis, we predict a currency medium-term trends such as unemployment rates, GDP rates.

5. Perceptron Neural Network

Perceptron neural network is capable of simulating the behavior of a nonlinear system with a very small error percentage so that the computational behavior of it comes from human brain. Neural networks are abstruse, flexible and self educated modeling that they can be used to prediction and patterns recognizing. Different models of neural networks are proposed to predict. Most used and most popular type of neural network is multi-layer Perceptron. Multi-layer Perceptron network has several layers and

nodes. The first layer is input layer that receives initial information (In this article, previous data). The last layer is output layer that represents the final answer. Input and output layers by one or more intermediate layers are connected together called the hidden layer. Nodes in adjacent layers usually by one-sided vectors are connected from the lowest layer to higher layer. During the learning process of neural networks, knowledge and training can be learned by the network and in the vectors and nodes are stored as weights and bias.

Inputs of neural network are values of past observations of data for time series and outputs of neural network are the future values of data and each input patterns is composed of the window with fixed length. For example, to predict a time series using a neural network with P input and one output can be written relation (1).

$$y_{t+1} = f(y_t, y_{t-1}, \cdots, y_{t-p}) \quad (1)$$

So that y_t is observation in moment t. In this case, if each neural network used instead of function f, we will have an autoregressive model. Now suppose, N previous observation of $y_1, y_2, \cdots, y_N$ were as neural network training data sets and we want to do anticipate after stage. Suppose, we have neural network with P input and one output. Thereupon we will have $N - P$ training pattern. The first training pattern is formed from $y_1, y_2, \cdots, y_{p+1}$ as input and y_{p+2} as output. Similarly, the latest training model uses $y_N, y_{N-1}, \cdots, y_{N-P+1}, y_{N-P}$ as desired output. The purpose of training the neural network is finding the weights in order to minimize the prediction error. We use Mean square error as a criterion for error prediction which can be writing it according to relation (2).

$$SSE = \sum_{i=p+1}^{N} (y_i - a_i)^2 \quad (2)$$

Where a_i is response of network corresponding with desired output y_i [6].

5.1. Developed a neural network system for forecasting

Determine the number of input nodes to hidden nodes has a greater impact on network performance. Hence the number of input nodes is the most important aspects for design of neural networks. Indeed, so long as the prediction system is based on past data, Determine the number of input nodes has a great impact on system errors for forecast. We have chosen dollar- Franc currency pair with 4H time frame for forecasting. We will use 2010 price data during 12 month for training and 2011 price date for testing.

5.2. Preparing the data

The data preparation is a critical step and success's key in using of neural network. Using new data with larger sample size leads to more efficient of prediction model. Next important topic is classifying of data. There is no certain rules relation to classification of data but their division must be away to prevented over fitting of data. We also divided the data in two parts: training and testing, which their ratios are respectively 50% and 50% [7].

5.3. The hidden layer

Existence of hidden layers and their nodes provides the possibility of using non-linear model. On the other hand, they expose data complicating communications. Neural network without hidden layer is similar to linear statistical models. In general, networks with few hidden nodes have not sufficient ability to learning and modeling but the other networks with many hidden nodes can make the data over fitting trouble. There are no special rules for determining the number of nodes or middle layer neurons and should it be determined based on try and error method. In this research, we consider the number of middle layer nodes are ten that have been achieved through try and error of dollar-franc 2010 price data.

5.4. Transfer functions

Other important criteria for neural network design are selecting of transfer function for each layer. Here, we selected Logsig transfer function for second and third layer and Linear transfer functions for fourth layer.

5.5. Training algorithm

Learning is a process through the free parameters of neural network adapted by a stimulating continuous process in the environment where it is located in the network [8]. Type of learning or the learning algorithm is determined by the way which the changing of parameters performs in it. In this research, we use gradient descent back propagation with adaptive learning rate method for learning.

6. The Important parameter of network

Neural network designed with the following parameters:

I. There are 14 neurons in the middle layer and one neuron in outer layer.
II. Linear transfer functions in fourth layer
III. Logsig transfer function in second and third layer.
IV. The number of epochs is 1000 for network learning.

The network is trained by MATLAB software which is displayed in Figure 1.

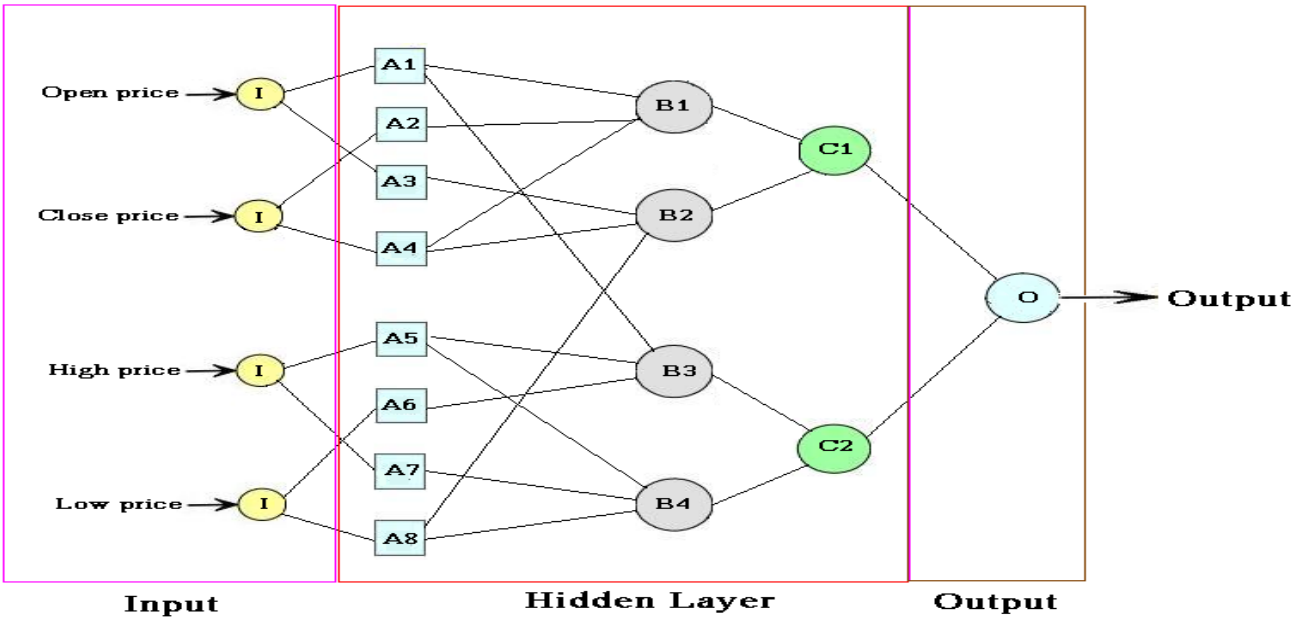

Figure 1: Overview of neural networks

V. The epochs, time of network learning and performance are respectively 1000 iterations, 10 seconds.

7. Conclusion

The purpose of designing this trading system is forecasting the future rate of dollar-franc currency pair accurately. Therefore we use the mean of square error (MSE) to measure the accuracy of artificial neural network. After creating and training neural network which their details are shown in Figure 1, we arrive into simulation stage. At this stage trained neural network analyses by the different data (2011 price

data of dollar-franc) ones again and we compare the resulting output with real data. This compare are shown in figure 2.

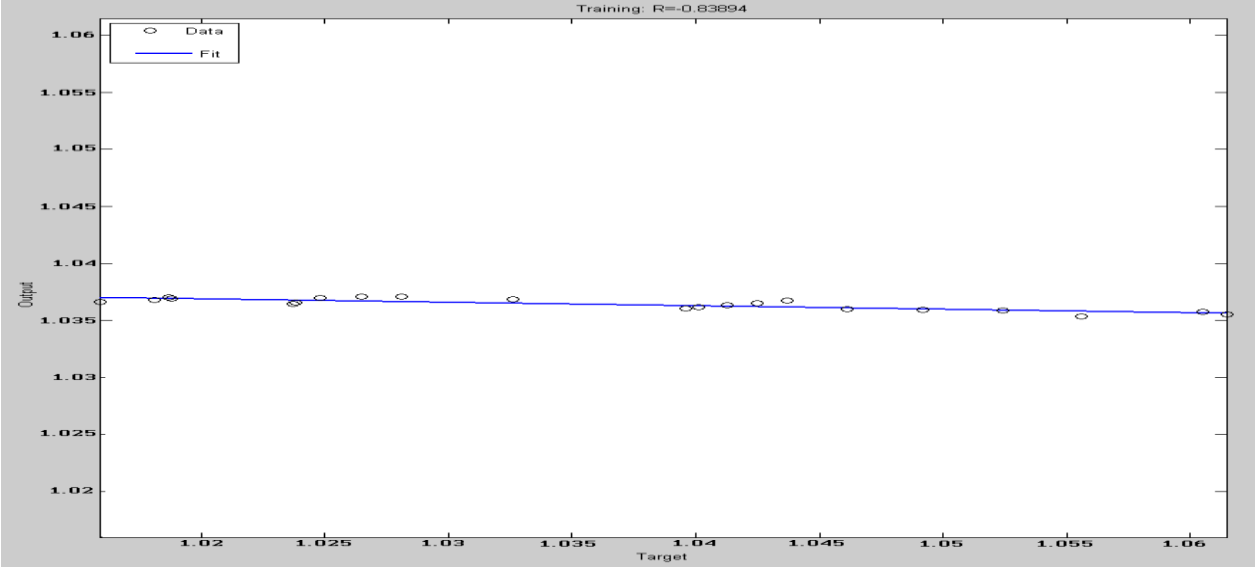

Figure 2: the comparison between Output of neural networks and actual price data in 2011

It should be mentioned that the number of iterations for training the neural network has a significant effect on trading system accuracy. Figure 3 show the mean square error in terms of number of iterations.

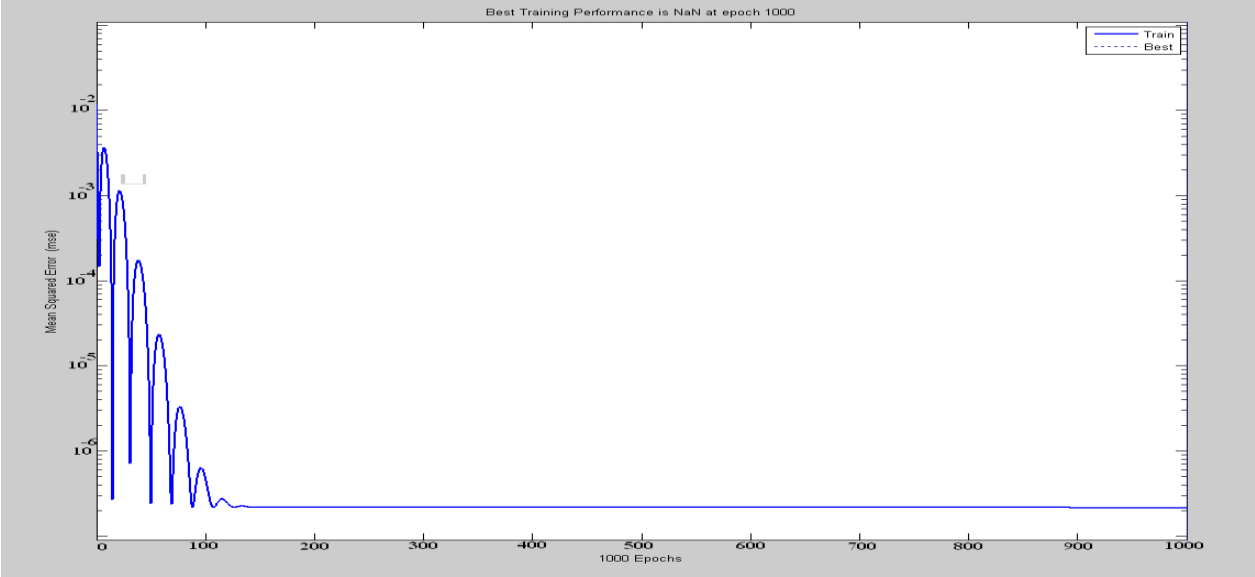

Figure 3: the values of mean square error according to number of iterations

It can be seen that after approximately 100 iterations, the system error will converge towards a constant number. This means that increasing the number of iterations, cannot be reduced the system error and so the network has lost its sensitivity to the number of iterations. Repeat with 1000 iterations, the mean square error of network converge into 2.15e-6. In Figure 4, the value of gradient changes depending on the iterations rate is displayed. After approximately 200 iterations, the gradient lost its sensitivity and after 1000 iterations, converges into 0.000437.

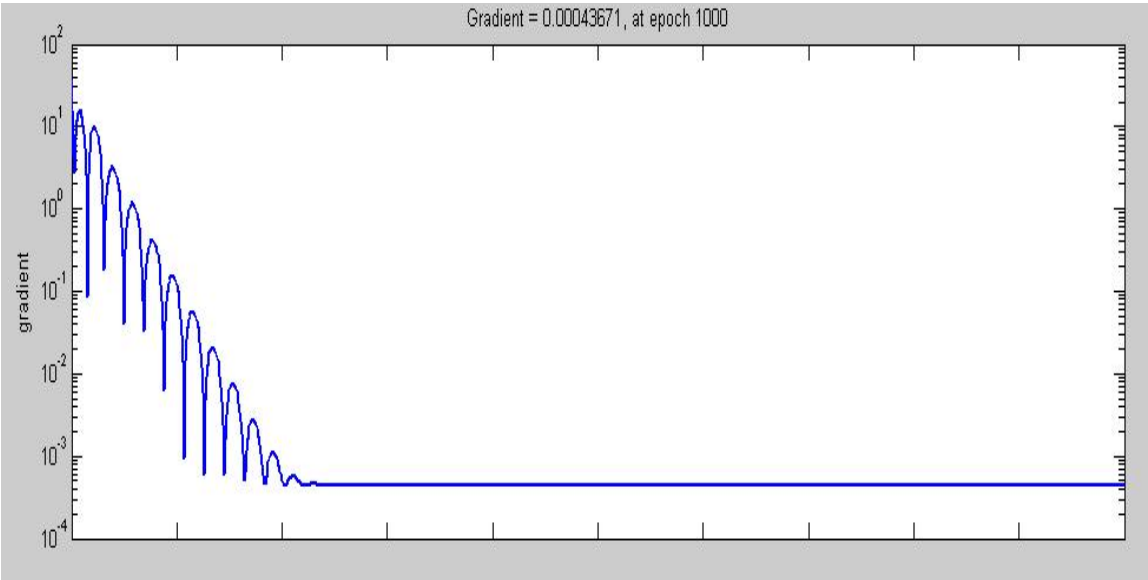

Figure 4: the value of gradient changes according to number of iterations

8. Pluralization

In this paper, a model for predicting the price of dollar-franc 4H time frame for 2011 presented. In developing the model, many parameters are involved, including the number of input nodes, type of transfer functions and the number of middle layers. Using the try and error method, individual important parameters of network were selected that make more efficient the system predicting. Other methods, such as prior rate, the simple average and weighted average are the conventional method to predict the international financial market. There are a comparison between traditional methods and neural network method in table 1. It Can be seen that the proposed neural network more efficient and more accurate than the other traditional methods for forecasting in international financial markets. Also the prediction based on desired neural network shows higher accuracy and significant progress with respect to other neural network.

Table 1: comparison between traditional and neural network method with desired neural network for prediction

Type of prediction	Number of input data	MSE	Error Percentage	Percentage of trend correct diagnosis
prior rate	1	0.02416	33%	65%
Simple average	120	0.00568	26%	62%
Weighted average	120	0.000785	12.1%	71%
Yaghubi's combined fuzzy model	2	1.17e-5	6.3%	68%
Abraham's neural network	2	6.15e-4	8.6%	66%
Bicz's genetic model	6	1.13e-5	6.2%	72%
The proposed neural network	4	2.15 e-6	6.1%	74%

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