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Forecasting Stock Price in Tehran's Stock Market Using Evolutionary Strategies

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Abstract
This study aimed to forecast stock prices and daily stock returns of food products manufacturers, accepted in Tehran Stock Exchange, Using evolutionary strategies. The study was divided into two models. First, the time series of 14 variables related to price prediction, for a period of 5 years (2009 till 2013), was extracted to predict stock price. Then, the price for 19 statistical companies was calculated using evolutionary strategy and back propagation algorithm (Algorithm LM). In the used network, the sigmoid function and linear function were used in the middle layer. In order to find the best algorithm for three companies with low, medium, and high observations, their error square's mean root and coefficient of determination were calculated. After finding the best model to predict stock prices, the RMSE value was matched with R^2 and RMSE values of the accumulated moving average distribution (ARIMA).
In the second model, the (R / S) analysis of random and non-random time series was used to predict daily stock returns. The logarithmic functions relating to all companies were extracted. They along with six other variables were used as inputs in the forward multilayer neural network with back propagation error algorithm (Algorithm LM). In order to find the best algorithm used in the research, the quasi-Newton algorithm and LM algorithm were compared according to the RMSE value for all companies. The results of predicting stock price showed that forecasting stock prices is possible using neural networks, the best algorithm to predict the stock price is the 1-1-10-16 algorithm, and an increase in middle layer does not provide satisfactory results. The comparison of the RMSE value and coefficient of determination R^2 in both neural network and ARIMA network showed the excellence of neural network. These results were obtained in predicting daily stock returns. First, neural networks have the ability to forecast daily stock returns with appropriate error. Second, the time series of daily stock returns of companies is not a random process and has memory. Third, LM algorithm is considerably better than quasi-Newton algorithm.

Key words: Artificial Neural Network, Forecasting Daily Stock Returns, Forecasting Stock Price, ARIMA Model, Linear and Nonlinear Time Series, Multilayer Neural Networks, Back Propagation Error Network

Introduction

Since the objective of any investment is to defer consumption in order to consume more and better in future, people invest to obtain greater wealth and benefits. Today, prediction has been considered as one of the most important branches of science in economic and business fields and has been developed rapidly. Facing with a multitude of influencing variables, the economic and business managers are always looking for a mechanism that will assist them in making decisions (Adel Azar, 2006). For this reason, most governments and central banks in many countries consider the current state and conduct long-term and short-term forecasts in their decision making and policy making. The prediction of stock price and stock return is one of the most important predictions that the researchers in the field of economy and trade look for it. They are constantly optimizing these predictions. The Tehran Stock Exchange began to work again after the Iran-Iraq war with the First Development Plan in 1990. The intersection of Stock Exchange reactivation and beginning of First Development Plan, privatization and construction were the main topics of it, caused the stock market boom very soon (Sinai et al., 2009). Today, nearly 22 years have passed since the reactivation of Stock Exchange and listed companies have increased dramatically. Many legal and natural persons are active in this market. So, it can be said many of the legal and natural persons are always looking to purchase a stock with low price and sell it with high price. This is consistent with the issue of price prediction. The prediction of stock prices and stock returns is possible using various techniques and methods. Today, however, prediction is conducted using linear and nonlinear time series, as the most common methods for forecasting prices. In the past two decades, it has attracted the attention of many researchers (Kriege, 2007).

The prediction of macroeconomic variables has special importance in the science of economics. Several models have been developed to predict future values of variables to help economic policy makers in appropriate fiscal and monetary policy makings (Moshiri, 2010). For this reason, most governments and central banks in many countries consider the current state and conduct long-term and short-term forecasts of Key economic variables in their decision making and policy making. On the other hand, the financial markets are growing and changes in these markets can greatly impact the entire global economy. The unpredictable events such as attack on the strategic and important countries and reported financial frauds in American corporate have created severe confusion and uncertainty among the investors about the performance of financial markets in different regions of the world (Namazi, 2011). As a result, the confidence of investors to these markets has been reduced and many negative problems in the world economy have been created. This clearly shows the strong relationship between uncertainty in financial markets and investors' confidence. However, many articles have investigated the relationship between price volatility and financial information (Schwert, 2010).

This study aims to identify the best model for predicting stock prices and daily stock returns using past data. Using these models, we want to get the best results in predicting daily stock prices and returns for companies listed in Tehran Stock Exchange. In general, the applied objectives of this study are as follows:

1. Determining the ability of neural networks in forecasting stock prices and daily stock returns and comparison of linear prediction methods;
2. Assisting future researchers in evaluating and predicting stock value;

3. Providing a reliable method for predicting stock prices and daily returns by a neural network;
4. Provide a reliable method for predicting stock prices by ARIMA with lowest error rate.

Methodology

This is an applied survey research. Because of the low number of food companies listed on the Stock Exchange, the population consisted of all food companies listed on the Stock Exchange which had the following features:

- Their fiscal year end was March.
- They were not financial and investment companies.
- Their information was available.
- They were regularly active since 2009 onwards in the Stock Exchange.
- Their stock had been traded frequently.

Due to limited number of companies in the population, all the companies producing food and beverages (except sugar) and had the features were selected as sample and were analyzed. In this study, we have benefited from library research to gather primary sources. The primary sources are the information which are related to the basic foundations and literature and define the concepts of research and research framework. This information is obtained through the library. The information in this study included Stock Exchange database, reputable local and foreign books, and valid internal and external papers. The secondary sources include the web sites related to the central bank and Stock Exchange which the financial information about food and beverage companies has been extracted from them. The financial information of Stock Exchange was provided from two software including Rahavard Novin 3 and financial data of companies listed on the Stock Exchange, First Edition.

In analyzing data by using neural networks to predict price, first data were normalized by 4Cast software that runs in Excel software. Then, price was predicted using Levenberg Marquardt (LM) algorithm. Changing the number of intermediate layers, the calculated and actual values were investigated. Then, the error value and calculated values were measured for three companies with low, medium, and high number of observations. Using the network (1, 2, and 3) of ARIMA, the stock price of the companies was predicted. In this test, the RMSE, MAE, MAP, and tile index were measured. After using the RMSE values and coefficient of determination R^2, the performance of two neural networks and ARIMA was investigated. The Eviews software was used to measure the amount calculated in ARIM network.

To calculate the return of studied companies, first their logarithmic values, original Hurst function, and disrupted Hurst function were calculated using Kaotixl software which is applicable in Excel. Then, the daily stock returns of firms with low, medium, and high observations were predicted. Finally, the RMSE values were compared in the algorithm using quasi-Newton algorithm and LM algorithm.

Findings

Because the information of studied companies is not same completely, the number of observations for each company is different. The following table shows the number of observations in each company.

Table 1: the number of observations in the studied companies

No.	Names of companies	Number of observation	No.	Names of companies	Number of observation
1	Pegah in Western Azerbaijan	176	11	Margarine	677
2	Yek O Yek	270	12	Sanaati Naab	370
3	Behnoush	290	13	Noosh of Mazandaran	418
4	Behshahr	385	14	Paak	542
5	Khorak Dam Pars	604	15	Peghah of Esfahan	590
6	Glucosan	154	16	Pyazar	375
7	Georgi	146	17	Pegah of Khorasan	318
8	Holding Of Behshahr	725	18	Pars Minoo	305
9	Kimyadaroo	725	19	Salemin	94
10	Shahd Iran	613			

The primary hypothesis of the study was whether the prediction is achieved by a neural network?

For this purpose, the test carried out on three types of observations was selected: Gorji Company for low observation, Peghah Esfahan Company for medium observation, and Yek O Yek Company for high observation.

It can be concluded that the1-1-10-16 network is more suitable for prediction. The values of RMSE and MSE and R^2 of 1 -1- 10- 16 network give results much better than the other models. However, the time series were predicted using the (1, 2, 1) ARIMA network. The ARIMA function gave the best results for the prediction of prices in the selected sample.

The results show that the prediction is also possible through ARMIA network and the calculated values of the test are acceptable. It can be concluded that the neural networks perform better than ARIMA networks in predicting stock prices. Then, the logarithmic returns of companies were predicted. The results for all companies showed that prediction of daily stock returns is possible through neural networks. Using quasi-Newton and LM algorithms in learning functions, it was concluded that LM learning algorithm has better results in predicting neural networks.

Conclusion

To provide a neural network model for stock prices, the necessity of normalizing data to improve the performance of the model was evaluated. Then, the sigmoid function in the middle layer was selected for conducting the model. Changing the number of nodes in the middle layer, the results were compared using error back-propagation algorithm. The first finding of

this study is to understand the complexity of mechanisms and price changes in food and beverage companies in Tehran Stock Exchange. Both the neural network and ARIMA model have relative position in recent model in predicting the stock price. In this study, the neural networks had a better estimate than ARIMA models. In general, the results of this research can be stated as follows:

- The behavior of time series in daily returns of companies is not a random process. But rather it is a non-random behavior process. The results of R / S analysis indicate the presence of memory in these time series.
- The daily returns time series of each studied company is a non-random process. However, it has too many complexities. It gives acceptable results when neural networks are used to forecast returns.
- LM algorithm gives better results than the Quasi- Newton algorithm.

Recommendations for future studies:

- Predicting stock prices using a synthetic model of artificial neural networks
- Predicting daily stock returns by the Hopfield neural network models
- Stock price prediction by considering all fundamental and technical variables affecting the stock price
- Daily stock prices and stock returns forecast using neural network (Data from 10 last year)
- Predicting daily stock prices and returns using combined and momentum gradient algorithms.

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