

# FORECASTING OF EARNINGS PER SHARE FOR ACCEPTED FIRMS IN TEHRAN'S STOCK EXCHANGE BY UTILIZING THE GENETIC ALGORITHM OF ARTIFICIAL NEURAL NETWORK

**Mohammad Sarchami**

Department of Accounting, Hajiabad branch, Islamic Azad University, Hajiabad, Iran  
mohammadsarchami@yahoo.com  
m.sarchami@iauha.ac.ir

**Mohammad Hossein Nekouei**

Department of Management, Sirjan branch, Islamic Azad University, Sirjan, Iran

## ABSTRACT

Forecasting the Earnings per Share for Investments is Particularly Important because it is considered an Important Factor in Share assessment methods and a Fundamental Factor in making Investment decisions. In Order to Forecast earnings per share using an Artificial Neural Network, 61 Firms were selected in eight Financial Years From the Beginning of 2000 to the End of 2007 along With 9 Variables (8 Input Variables and 1 Output Variable), yielding 4392 (9 x 8 x 61) data points. The Research Hypothesis is that a Neural Network with a genetic algorithm can forecast earnings per share. In order to Test the Hypothesis, MATLAB Software was used to determine the Mean Square Error and Mean Absolute Error. The researchers' hypothesis is supported.

## KEYWORDS

Earnings per Share, Artificial Neural Network, Genetic Algorithm.

## 1. INTRODUCTION

Financial reports are among the most important products of accounting systems because one of their major purposes is providing necessary information to evaluate an economic institution's performance and profitability. A necessary condition for achieving, this purpose is measuring and representing information in a way that makes it possible to evaluate previous performance and to be effective in measuring the profitability and forecasting of the institution's future activities. Forecasting Earnings per Share has a special importance in investments, because it is a big factor in share evaluation and in most cases is the basic factor in share investment decisions. One way to help investors is to find new patterns for forecasting earnings. When these forecasts appear close to reality, decisions based on the forecasting will be more correct [1].

Recently, artificial neural networks have had an important role in many fields of research. By copying the human brain, neural networks can discover relationships among the variables, no matter how complicated and non-linear they are. One important application of this method is to forecast and estimate decision-making in financial markets. Decision-makers use such networks to maximize efficiency and to minimize the risk of investing in ambiguous conditions [2].

Various statistical methods have been used in primitive studies in this field, but the present research focuses on creation and application of artificial intelligence and mechanical learning methods to test the strength of per share earnings forecasting, by applying such a network with a genetic educational algorithm to firms in the stock exchange of Iran.

## **2. LITERATURE REVIEW**

From 1988 to 1995, on the whole, 213 scientific activities were performed in the field of neural networks in commercial areas. Of these activities, 54 were in the financial field while 2 were in forecasting and time series analysis [3].

Cao and Parry (2009) investigated the models for forecasting earnings per share using neural networks (comparing error backward propagation and genetic algorithms) in 283 firms in different industries. They used a neural network with 7 input variables. The results reveal that the genetic algorithm makes a more accurate forecast of earnings than the error backward propagation algorithm.

Zhang et al. (2004) studied models of per share earnings forecasting using neural networks (a comparative analysis of alternative methods) with four kinds of models in 283 firms: one-variable linear models, multi-variable linear models, a one-variable neural network and a multi-variable neural network. This research shows that neural network methods provide more accuracy in forecasting than linear forecasting models.

Callen et al. (1996) studied neural network forecasting using three months of accounting earnings in 296 firms whose shares were exchanged in the New York stock exchange and concluded that when paying attention to this matter, three-month earnings are financial, seasonal, and non-linear, and that Brown-Rozeff and Griffin-Watts' time series models have better forecasting results than neural networks.

Sinaei et al. (2005) investigated index forecasting in the Tehran stock exchange by means of artificial neural networks. From the neural network designed with data from different intervals of the index, the 3-layer neural network 3-15-1, with an input of three intervals of the index and 299 epochs of training, is the best network model ( $MSE = 5710$  and  $R^2 = 0.999$ ) for forecasting the stock exchange index.

Mahdavi and Behmanesh (2005) investigated the forecasting of the stock prices of investment firms using artificial neural networks. The results of their investigation showed that if a neural network is trained properly, it will be able to identify the relation between the variables and will be effective in forecasting stock prices of investment firms with the least error (0.044).

## **3. GENETIC ALGORITHM**

The main idea of a genetic algorithm is to transfer inheritable specifications by gens. A genetic algorithm is a probable research method based on a simulation of natural and biological evolution. Genetic algorithms act on a population of potential answers by using the principle of the survival of the first to produce estimations that are better than estimations (chromosome). The concepts of neural network learning with a genetic algorithm are as follows:

**Coding:** in this paper, the coding uses a basis of 10 to 2 or a binary code. Another method is decimal coding.

**Chromosome:** A chromosome is defined as a series of bits which are a coded form of a feasible answer for a considered problem. If binary coding is used, every bit accepts either a 0 or 1 measure.

**Population:** A population is defined as a set of chains and chromosomes. One of the specifications of a genetic algorithm is that instead of concentrating on one point in a research area, it works on a

population of feasible points. So an algorithm has a population of chains in every stage that is considered to have properties that are better than the previous population.

Suitability function: As in neural networks, one criterion of environment is elimination or survival of a person in next generation. The, suitability measure is a measurement scale for retaining or deleting a chromosome from the population of the next generation in a genetic algorithm.

The suitability of an answer in a genetic algorithm is estimated by a scale that is derived from suitability functions or objective functions. The more suitable an answer is, the higher the amount of suitability.

The suitability function in this research is as follows:

$$\min E = \sum_{j=1}^n (O_i - \widehat{O}_i)^2 + C \sqrt{\frac{\sum_{j=1}^n (O_i - \widehat{O}_i)^2}{N}}$$

Where N is the number of education data points,

O is the network output,

O<sub>i</sub> is a favorite output,

And C is the number of non-zero scales of network [4].

Proliferation: In the proliferation stage, the chains which have more suitability are selected with more possibility for production of the next generation. This stage of selecting chromosomes is the most important and sensitive stage in a genetic algorithm.

Operation: As children inherit their features from their parents in nature, in a genetic algorithm some operators are applied in individual or paired form to produce new members of the selected population in the proliferation stage.

Condition for ending an algorithm: The conditions for ending an algorithm can be determined by the conditions of the problem or conditions like the time for executing the algorithm, the number of stages for producing a generation. Also not changing the best answer for a specific number of stages for producing a generation can be used as a condition for ending the algorithm. If conditions for ending the algorithm are not provided, the population is used as the primary population for the next stage.

#### 4. HYPOTHESIS

- An artificial neural network with a genetic algorithm is able to forecast per share earnings

#### 5. STATISTICAL COMMUNITY AND SAMPLE

The statistical community for this present study were all accepted firms in the Tehran stock exchange that were active in the stock market from the beginning of the year 2000 to 2007. Information from informing firms' software and stock exchange services in the beginning of the year 2000 showed that the number of active firms in the Tehran stock exchange was 300 firms. These firms were in the stock exchange based on their activities in one of the existing 31 industries in the Tehran stock exchange. The method for choosing a suitable statistical sample to be an appropriate representative for the statistical community at hand was the omitting method. Seven

criteria were considered and if a company met all criteria, it was chosen as one of the typical firms. The criteria are as follows:

1. The firm’s financial period should be finished at the end of financial years because the stability of typical firms should be observed based on the end of their financial year.
2. The firm should not be an investment firm or a member of finance dealing industries, holdings and banks because their activities depend on other firms’ activity or it is separate from other firms; therefore, the accuracy of earnings forecasting in these firms is different from the forecasting framework in other firms.
3. The firm’s financial statements should be continuously presented. Firms whose trades have been completely prevented during the research period were deleted from the sample.
4. The firms should be profitable. Firms experiencing a loss were deleted from the sample as a result of their stability and the issue of per share earnings forecasting.
5. The firm should be productive or commercial. Service firms were deleted from the sample, because one of the data sets is net sale in calculating labor force efficiency (net sale / number of employee) and service firms are without sale.
6. The number of the firm’s employees must be listed in the explanatory notes. Because one of the data sets involved in the calculation of labor force efficiency (net sale / number of employee) requires the number of employees.
7. The firm should not be a member of a firm group because groups are the result of combination and division, and the forecasting of per share earnings can be influenced.

After applying all the aforementioned criteria, our observations totaled 488 firm-years and included 14 different industries.

**Table 1: The distribution of firms in the statistical sample within various industries**

Industry	Type of Industry	Accepted number in stock exchange up to the end of 2007	Numbers of Eligible for sample membership
1	Mining	11	3
2	Types of food and drink products	51	6
3	Transportation, storekeeping and communications	3	1
4	Vehicle and parts manufacturing	31	8
5	Manufacture of radio, television and communication sets	7	1
6	Manufacture of metal products	18	1
7	Other nonmetal inorganic products	64	17
8	Basic metals	29	2
9	Machinery and equipment	33	1
10	Machinery and electrical devices	13	1
11	Textiles	27	1
12	Optical and medical measurement tools	2	1
13	Chemical materials	65	17
14	Nuclear fuel, coke and oil products	6	1
Total		360	61

## 6. INPUT & OUTPUT VARIABLES

Predicting variables (independent):

1. Relation of Rial value of inventory to number of common shares.
2. Relation of commercial received accounts to number of common shares.
3. Relation of non-commercial received accounts to number of common shares.
4. Relation of capital expenditure (increase in cost of tangible fixed assets during the financial year) to number of common shares.
5. Relation of gross earnings to number of common shares.
6. Relation of administrative expenses and sales to number of common shares.
7. Effective tax rate.
8. Labor force productivity logarithm [4].

Predicted variable (dependent)

1. Earnings per share

## 7. EXPLANATION OF TESTS OF THE HYPOTHESIS

The artificial network model has been designed in a multilayer perceptron with sigmoid transfer function and a genetic educational algorithm with 8 input layers and 1 output layer. First, the data were entered in Excel, and after doing the necessary calculations and finding the most and the lowest value, values were normalized according to the following formula:

$\frac{\text{The lowest value} - \text{All value}}{\text{The most value} - \text{The lowest value}}$

The most value - The lowest value

After normalization, the data were put between 0 and 1, that is, sigmoid dimension function. Figure 1 status of shows the network training using the genetic algorithm:

Figure 1: Situation of training network using a genetic algorithm

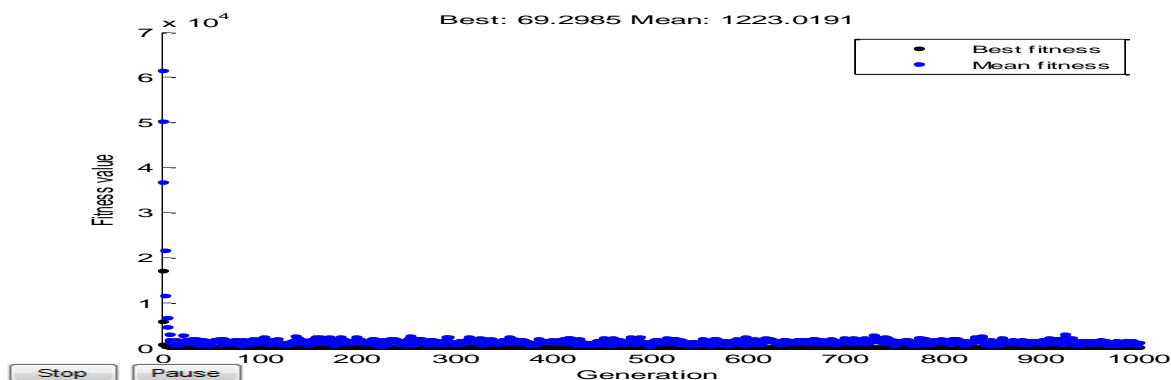
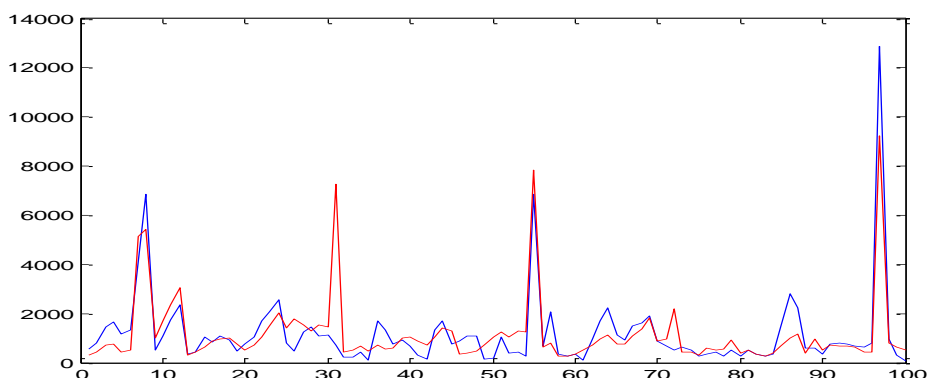


Figure 2: The state of training data and forecasting data movement in the artificial neural network with genetic algorithm



**Table 2: Mean square error and mean absolute error in earnings per share forecasting using the artificial neural network with a genetic algorithm**

Description	MSE	MAE
Forecasting of per share earnings in 1387 using the artificial neural network with genetic algorithm (GA)	$2.7 \times 10^{-3}$	$2.7 \times 10^{-3}$

As showed in Table 2. The mean square error in forecasting of earnings per share is calculated by taken from artificial neural network with a genetic algorithm  $1.3 \times 10^{-3}$  and the mean absolute error in forecasting the earnings per share is taken by artificial neural network with genetic algorithm  $2.7 \times 10^{-3}$ . The low mean square error and mean absolute error show that the, artificial neural network with a genetic algorithm is able to forecast earnings per share.

## 8. CONCLUSION

One hypothesis was tested: 1- An artificial neural network with a genetic algorithm is able to forecast per share earnings. For testing the hypothesis, MATLAB software for calculating mean square error and mean absolute error was used. Mean square error in forecasting of earnings per share is taken by artificial neural network with genetic algorithm  $1.3 \times 10^{-3}$  and also, mean absolute error in forecasting of earnings per share is taken by artificial neural network with genetic algorithm  $2.7 \times 10^{-3}$ . The results show that artificial neural network with genetic algorithm is able to forecasting of earnings per share.

## 9. RECOMMENDATION

- 1) As shown in Table 2 the artificial neural network with a genetic algorithm is able to forecast earnings per share. Therefore, managers, investors, employees, shareholders, creditors and other interested persons can obtain future earnings and the position of the company.
- 2) In most countries, including Iran, despite the power of neural networks for financial forecasting, this method is used little in firms. One reason is unfamiliarity with neural network. Thus, more research should be performed and more education provided in the financial sector in the future.

## REFERENCES

- Mashayekh, S., & Shahrokhi, S. (2007). Investigation into the Precision of Earnings Forecasting by Managers and Other Influential Factors. *J. Account. Audit. Investig.*, 50(14), 65-82.
- Kuvayev, L. (1996). Prediction of Financial Markets with Neural Networks. Seminar in Capital Markets. *Review Paper*, 1.
- Wong, B., Bodnovich, T., & Selvi, Y. (1995). Neural Network Applications in Business: A Review and Analysis of the Literature (1988-1995). *Decis. Support Syst.*, 19(4), 301-320.
- Cao, Q., & Parry, M. (2009). Neural Network Earnings per Share Forecasting Models: A Comparison of Backward Propagation and the Genetic Algorithm. *Decis. Support Syst.*, 47, 32-41.
- Zhang, W., Cao, Q., & Schniederjans, M.J. (2004). Neural Network Earnings per Share Forecasting Models: A Comparative Analysis of Alternative Methods. *Decis. Sci.*, 35(2), 205-237.

Callen, J.L., Kwan, P., & Yuan, Y. (1996). Neural Network Forecasting of Quarterly Accounting Earnings. *Int. J. Forecast.*, 475-482.

Sinaei, H., Mortazavi, S., & Teymoriasl, Y. (2005). Index Forecasting of Tehran Stock Exchange by Means of Artificial Neural Networks. *J. Account. Auditing Investig.*, 41(12), 59-83.

Mahdavi, G.H., & Behmanesh, M.R. (2005). The Forecasting of Stock Price of Investment Firms by Using Artificial Neural Networks. *J. Econom. Res.* 19(4), 211-233.