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Full Length Research Paper

Forecasting stock price using artificial neural networks: A multi-layer perception model - Iranian evidence

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In recent years, steel manufacturers have been playing a great role in economic growth, bringing about large amounts of stock exchange transactions in this industry. In the current study, we try to design a model to forecast stock price of steel industry, using artificial neural networks. To design the model, we used a three-layer network (five neurons in input layer, twelve neurons in the middle layer and one neuron in output layer), a sigmoid transfer function, 7% Alpha, 2% Etta and Windows Neural Network (WNN) software. The input variables of the network include net assets, P/E ratio, dividend per share (DPS), earning per share (EPS), amount of stock transactions, and stock price network output of companies being studied. The results from designed model show that if an artificial neural network is taught correctly, it can recognize the relationship between variables and it can help to forecast the stock price of steel industry with minimum error (35% in this research). Investors can forecast the stock price of steel manufacturing companies using these inputs variables and WNN software.

Key words: Forecast, artificial neural networks, stock price forecasting, Tehran stock exchange.

INTRODUCTION

The future belongs to those who do their best to plan for it. A successful business-person, investor, institute or organization should have the necessary plans by forecasting the future situation. Nowadays, because of the importance of forecasting, different fields of human sciences try to work on this subject, like forecasting atmosphere situation, economic situation of communities, the earnings and expenditures of an institution, a country's budget and, in this research, the forecast of steel industries' stock price.

Nowadays, the greatest amount of capital is exchanged throughout the stock exchange all over the world. National economies are influenced by stock performance. Stock is assumed as an investing accessible instrument for both master investors and the public. Stock is influenced not only by macroeconomic parameters but also by lots of other factors; unknown factors and a great number of them results in lack of trust in investment.

It is clear that lack of trust is not desirable, but it is an inevitable event for investors who choose the stock market for investment. Investors try to decrease this lack of trust; from this point of view, stock exchange forecasting is a good instrument for decreasing this lack of trust.

Investors have always been in the need of stock investment strategies that are going to create profit in a non-distant future. As defined above and denoted by various researchers like Avmarov (2002), the stock market has an important characteristic: uncertainty. This uncertainty has to be eliminated (or at least minimized) to predict the near future and to make profit.

Theory of investment in stock exchange

The investment theory introduces parameter that should be considered when investing in the market. There have always been two investment theories in stock exchange:

1) Basic analysis
2) Golden dream

Using these two theories we learn how a market is

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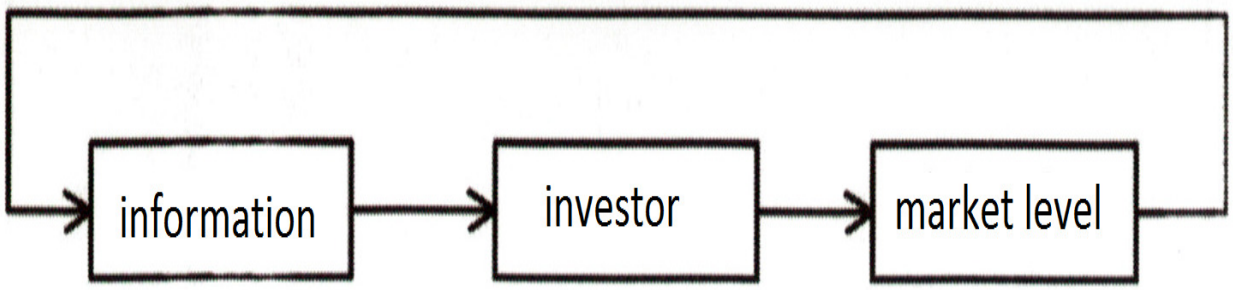

Figure 1. Investment process.

formed and how an investor thinks and acts. Following these thoughts and reactions we can determine the place of investment and finally the market level. Investors always try to find ways of determining the future of market and stock to earn a profit. During the investment process, the investor considers the existing information, chooses a stock and makes investment. Figure 1 shows the investment process in capital market.

Based on the first theory, market is formed from reactions between investments; these reactions are based on real information from the company's existing at the market. Company's real information is gathered by the analysis of the existing situation and the perspectives follow it and market is formed based on rational viewpoints. Based on the second theory, market is a result of investors who consider they should buy with the price of 20 units today and sell with the price of 30 units tomorrow. According to this theory, the real information of the company is not important at all and market is a product of mind exchange between the investors.

THEORETICAL ISSUES ON STOCK PRICE

Technical analysis model (Chartists)

At the beginning of the 20th century when stock price behavior was studied scientifically, many financial experts used some models to forecast the stock price and make decisions following the price and its net trend. This group is known as Chartists. Drawing the stock price behavior graph, investigating its fluctuations, identifying its long-term behavioral sensitivity and forecasting the future of stock were the main goals of this doctrine.

Chartists believe that it is not possible to evaluate the inherent value of stock and the history is always repeating. They say that prices in the past reflect the prices in the future, so studying price history can help us to determine the price behavior in future. As a result, we can forecast the future trend of stock price by examining its past trend. They use some diagrams and curves and believe that we can never identify factors that influence supply and demand, because they are too many. The best way to study stock behavior and produce a model to identify future changes is to investigate time series of price and the information related to stock transactions (Botshekan, 1999; Afshari, 2005).

Random walk hypothesis

The theorists of this hypothesis believe that price changes are not related to each other and there is no relationship between sequential movements of prices. So, price changes are like a set of random numbers that cannot be forecasted using prices in the past. Although this method was known since 1930s, emerging hypothesis of effective market made it more important.

This hypothesis was first suggested by Working, and then completed by Kendall (1953). After lots of researches in American and British companies he said that his selected study set has some confusing movements and a number from a scattered set is taken randomly each week and is added to current price to give the next week price. Later on, Kendall's random model was completed by Niederhoffer and Osborne (1966) and resulted in a model named Fair Play which was a completed form of Random Walk and insisted on random nature of stock prices. They studied some numbers from stock prices and learned that these prices are like some extra thin physical particles. He also found out that price change variance in long time intervals increases with square root numbers of time duration. This increase means that price change logarithms are related to each other (Pan Heping and Yearwood, 2005).

Fama's (1970) efficient market hypothesis added a new part to Random search model and the basic model of a market based on random walk was formed. In his doctoral essay, Fama introduced effective capital market and said that in an effective market, nobody can get to an unusual profit, using the information. He classified this effective capital market into three levels where each level price reflects the related information. These levels contain weak, semi-weak and strong forms. Observing weak form of effective hypothesis shows that there is no relationship between prices; and future prices do not report any thing and we cannot expect future prices studying past price. Statisticians introduce this result as

"Random walk". This random nature means that past prices do not have any value in relation to the forecast of future prices (Botshekan, 1999).

In semi-strong state, all published and popular information show their effect on prices. These popular information contain not only the past prices but also some information about the future , company's performance and its co-ordinations in the industry; and in case of any new information about the company , industry or the whole economy, price adjustment takes place and affects the way of price forming by the power of market in a reasonable way. In strong state, all the related information is reflected by stock exchange; stock price contains all the historical and confidential information and, the internal control systems do not allow confidential information to exist. It is believed that in this state the stock price contains Random Walk trend and price changes in two different days are distributed individually and separately. And the changes since *t* day till *t+1* day are not influenced by price change in *t* to *t+1* day (Botshekan, 1999). The results form 1960s' researches on the behavior of stock price show that stock price follows the random search hypothesis generally and if the stock exchange market is effective, prices will reflect all existing information and price always approximates to inherent value of stock. So by random arrival of new information, the reaction of prices is fast and the change of stock price in market is also random. The foundation of Effective Market hypothesis and fast reaction of prices to new information is something new (Botshekan, 1999).

FOUNDATION ANALYSIS MODEL

This group (fundamental analysts) believes that each share contains its own inherent value and determination of inherent value needs some fundamental study about foundation and the whole economics. They believe that the stock price does not have any special trend and we cannot forecast the future price by studying the history of stock price (Afshari, 2005).

Each country has its special form related to the structure of capital market and introduced models are not generalized. Researches show that the market has a weak performance and prices depend on each other in a short term and they are independent in long term.

Foundation analysis pays attention to inherent value of stock and the stock exchange value is determined by scientific tools like statistics, economy evaluation, financial management and others. These models consider financial statement, company's dividend background, management policy, sales growth, company's profitability trend and the institution's ability of increasing the profit and net value of assets and many other factors to determine the stock value. They compare the inherent value with current stock price and introduce guidance for financial decision making. Because there is no agreement among these indoctrinated scientists, they can be divided into two groups. One group named "complete capital market" believes in the policy of profit in the market. The second group named "incomplete capital markets" believes that this policy influences the stock price (Botshekan, 1999).

Nonlinear searching opinion and neural network

After the crisis of October 19th in 1987 in stock market, there was an increasing attention towards nonlinear relationship and especially irregular movements in the market. According to this group's hypothesis, dynamics of the market and irregular behaviors that seem random were considered because these movements and dynamics would result in bigger and more complicated moves. Additionally, there can be an intermediate variable in determining the relationship between X and Y, that Y=F(x) should be considered. So, we cannot prove their relationship by limited action. As a result, the behavior of stock price is a function time factor and also based on market foundation, it makes possible to forecast the stock price in the framework of random processes. In this regard, because of some non linear complicated relationship within different variables, the ability of regression models increased due to their time – consuming nature; and neural networks should be used. In this method, market simulation is done faster and the ability of decision making is improved.

Recently, neural network has become a popular tool in forecasting and simulation field. Because these models can identify the sample widely, they can be used to forecast, especially because neural networks are parts of non-parametric relationships. In 1988, Holbert White introduced the function of neural networks in economic forecasts, for the first time, and in this study the value of neural networks in forecasting nonlinear models was considered and the code of stock market was revealed using this technique. This is because it was believed that there are some orders in historical prices of capital assets which can be found by computer (Botshekan, 1999). In the capability of forecast and Effective Market hypothesis from 1965, in financial field, there has been a hypothesis about the effectiveness of the capital market. These researches were done to test the hypothesis that: Does the stock market act reasonably in gathering and processing the input information? Furthermore, is the information reflected in the stock price immediately and without any bias?

Reasonably, investors used all information related to determination of value and pricing of stock. For sure, when determining the price of stock we should consider the costs of processing information and also transaction logically; and according to Effective Market hypothesis, each stock price current value is estimated till its cash flow is a risk factor. Regarding these information,

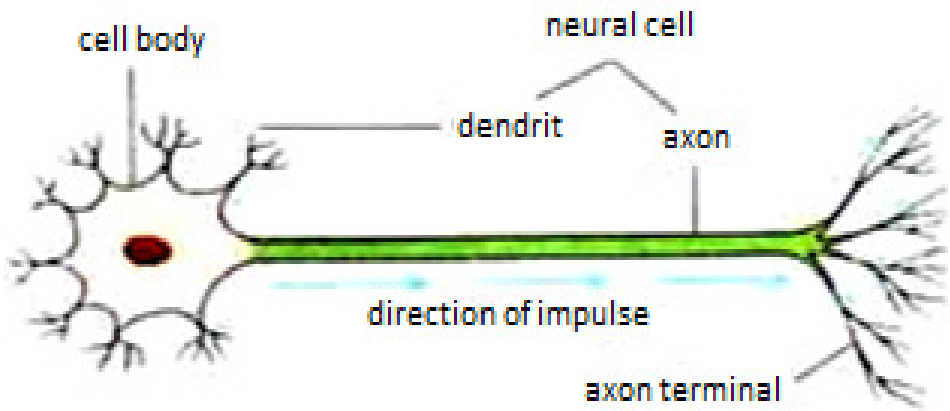

Figure 2. Natural nueral model.

effective market hypothesis mentions that the competition among investors to gain profit by forecasting leads to the fact that current price of stock is a non-biased forecast about its inherent value and is not related to these information. This hypothesis does say that all the investors act reasonably or each of them has an access to every part of information, but it is believed that all the information has reflection in stock price.

INTRODUCING ARTIFICIAL NEURAL NETWORKS

An artificial neural network is ideal for processing information inspired by bio-neural system which does his job like a brain. In an artificial neural network the goal is to make a structure like biological structure of human's brain and neural network to let it have the ability of learning, generalizing and decision making.

Today, the increasing power of brain has resulted in increased use of artificial neural networks. These networks are formed to understand the complicated system of human brain and it is developing every day. These networks follow the function of human brain, they make artificial neurons and put them in a parallel way. They create some educational algorithms and give suitable models and examples, so that their ability to process information increase and can act differently from other intellectual statistic methods and learn new processes to be able to give the best results in new and unidentified conditions. Now, because of their preferences compared to other models, they are being used all over the world and in many scientific fields.

Artificial neural networks do not need mathematic models. These networks experience like human and then generate their experience. These networks- in contrast with regressive models that concentrate just on the amounts of a variable in the past and cannot identify input information suitably- can consider the examples and models as input information and understand new conditions and parameters with the help of their hidden education. They can change intellectually and improve results. These networks can choose the best parameters from among a mass of input information which are received in different ways and can do the best forecast. This is why stock forecasts like stock price forecast, earning per share, financial situation of company and stock index are easily feasible through these models.

Although the function of artificial neural network forecast is not known completely in Iran financial market, these networks are used to settle lots of issues like approximation, estimation, identifying models, classifying and clustering and in a wide variety of practical function industries (Botshekan, 1999).

Biological neuron model of neural networks

Interest in artificial neural networks and researches started when brain was introduced as a dynamic system with parallel structure and a processing which was different from prevailing processors. In the 19th century, William James presented some interesting ideas about the physiology and structure of brain consisting of neurons and the mechanism of parallel process in brain. Brain is an information processing system with a parallel structure which contains 100 trillion (10^{11}) neurons related to each other with the whole number of 10^{16} relations.

Neurons are the simplest structure unit of neural system. Tissues named "nerves" are a set of neurons that transfer information or messages from one part of body to another. Even the easiest daily tasks like blinking are done through the coordination among these neurons. Figure 2 is a schematic model of neuron cell.

As we can see, each neural cell (neuron) consists of three basic parts:

1. Dendrites
2. Cell body containing nucleus and other protecting parts
3. Axon.

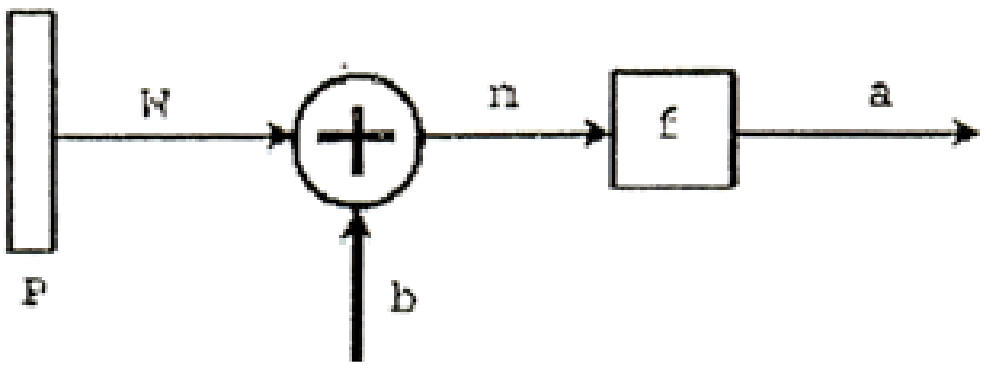

Figure 3. Artificial neuron model.

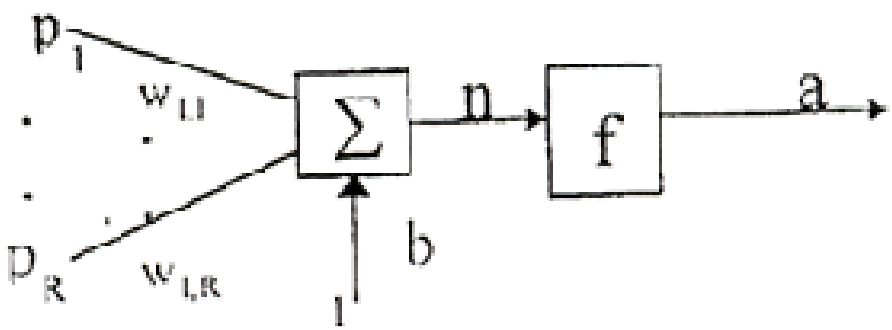

Figure 4. Multi – input model of a neuron.

Dendrites are a mass of strings related to a cellular material that receives neural messages from outside. Actually dendrites are the small outgrowths around cellular body which enter the neural signals into cellular material. Axon is the individual and long outgrowth that transfers the neural signals of cellular material to the other neurons. Axons are divided into several branches at the end and these branches are in contact with dendrites of other neurons and transfer the signals. The contact point of one neuron's axons with dendrites of other neuron is called "synopsis". Neural messages from dendrites to cell body and then axon.

So, in general, we can say that input route of "*dendrite"* and its output route "*axon"* and the connection among neurons is called "*synapse*". An artificial neuron is formed of three parts like biologic neuron: *input* part of neuron, *output* part and finally *middle* part of neuron. Input art works as superseding of dendrites, output part works as superseding of axons and middle part works as cellular material. The two input and output parts like dentists and axons are in contact with outside the world but the middle part like cellular material does not have any relation or contact with the outside world.

Artificial neuron model of neural network

Figure 3 shows the structure of a neuron with one input. Scales of p and a are in order of input and output. Figure 4 shows an artificial neuron with R inputs. Inputs contain p1, p2,…,Pr that in order, are multiplied in weights of W1,1, W1,2 ,…, W1,R and are added to bias amount to get the amount of n.

$$n = \sum wp + b$$
$$n = W1,1\ P1 + W1,2\ P2 + \ldots + W1,R\ PR + b$$

To simplify the model in multi-input neurons, we can implement the weight and input quantities to neuron as a matrix that the equation for calculating n is revised as below, where *W* as weight matrix and *P* as input matrix are represented.

$$n = wp + b$$

After calculating *n* we pass it through transfer function (*f*) to obtain (a) as the neuron output. As is shown in equation of calculating *a*, *n* is transformed through transfer function (*f*) to *a* output. So we should pay attention to transfer functions and their types.

$$a = f\ (wp + b)$$

n net input is calculated through this equation:

$$n=\sum_{i=1}^{p} pi\ w1,i + b = W P + T$$

that : P =[p1,p2,…,pR] and W= [W1,i ,…, W1.R]

and f inally it will be as below:

a= f (WP + b)

In-advance multi-layer perceptron neural network

Neural in-advance network of nodes is located in sequential layers with one way relationship. When an input sample is implemented to the network, the first layer calculates its output quantity and gives it to the next layer. The next layer receives them as an input and transfers its output quantities to the next layer. Each node transfers signals to the next layer. Multi-layer perceptron network is component of this kind of network.

Generally, feed-forward multi-layer perceptron neural network has the following characteristics:

1. This network includes three layers named input, middle (hidden) and output layers. There is no limitation for the number of hidden layers.
2. In this network, neurons of each layer send signals to the next layer's neurons. Nodes are connected to each other by some connections and each connection has its own changeable weight. Nodes are arranged parallel to each other. The first layer is called input layer and the last one is output layer. The layers in the middle are called hidden layers.
3. Each neuron or node works as a processor i.e. it receives the information from the last layer, through connections; processes it and sends the result to the next layer by output connection. Because all these nodes can work simultaneously, they form a parallel processing system.
4. When the input vector is provided, the nodes of input layer receive it and send it to the nodes the first hidden layer without any processing. These nodes do the processing on received nodes and send the result to nodes of the next layer until finally the result is sent out from nodes of output layer as an ordered output vector. This is why this kind of network is called in-advance network.

The process in the whole of nodes may be so complicated, but it is the result of serial and parallel processing in different layers of the networks.

Stages of building a model with artificial neural network

The important problems in forecasting neural networks include gathering of information, selection of input variables, selection of kind and structure of network, transfer function, learning algorithms, model validity, measuring and selection. Some of them will be solved during the procedure of building model whereas some other should be investigated at the beginning of model building.

Generally, to build a neural network model and to use it, these steps should be considered as below:

a) Specifying the network topology (understanding network details same as it geometry): In this step, the number of layers and nodes in network, its kind and dynamic and static functions are selected. Then suitable software will be provided.

About the geometry of the network, correct selection of size of the hidden layer is very important. Determining the number of hidden layer's neurons is not easy and it is usually carried out using trial and error until the performance of the network improves; of course some simple rules like using n, n/2, n+1, 2n+1 neurons exist.

b) Preparation of input data: Preparation of data is one of the complicated steps in using the neural network. A part of this complication is related to the problem of selecting correct data and other part is related to changing the scale of inputs and outputs data (normalization). The best status for neural networks is when all inputs and outputs are between zero and one; even if there is a variable which its quantities (before changing the scale) is in a smaller range of zero and 1, for example (50 to 75%), it is wiser to enforce some transformation on it till all quantities are between zero and 1.

The reason is that transfer function (e.g. sigmoid function) cannot differentiate among very large quantities. The more the inputs of these functions, the nearer their inputs get toward 1 (or -1). In short, changing data scale to range (0 and 1) helps network to know samples.

Some notes about selection of training data: Training system contains some cases that their quantity (forecast or classification) is clear. Selecting a suitable training system is very important because the quality of neural networks responds compared to the quality of its training examples is very sensitive.

The most important condition of a training system is that it should cover the whole range of input quantities. The more input variables of the network, the more the need to training examples so that the network can have better knowledge of input models. Also, the number of input variable will affect training time directly. The more the variables, the more the time needed for network convergence to answer. Redundancy of variables consumes time and causes a bigger problem. It can cause a bigger problem which is the more number of variables makes more possibility for convergence of network to achieve a suitable answer. Omitting the variables whose influence on increasing forecast ability of the network is improbable often increases forecast ability of the network considerably.

c) Teaching the network: The meaning of teaching the network is correction of network's weight quantities for

different samples, considering the kind of learning algorithms. The information about these samples are displayed several times in the form of training data for the network and the network corrects its weight quantities for each set of training models during the process o learning. After repeating this process, weights are revised in a way that they can retrieve each sample's information after seeing them. Changing the transfer functions, the number of layers and nodes of each layer and factors of influencing learning in a way of trial and error, weights will be determined. It is better to use more parameters at networks input in the beginning. During network teaching, inputs that have less weight compared to the other can be omitted.

d) Testing or generalizing the network: To be sure of network's suitable performance at the end of the training, it is tested for a set of known information and possible defects are eliminated. Then, network is ready for use.

MATERIALS AND METHODS

To select the companies being studied, first main metals manufacturer companies in Tehran Stock Exchange are selected in which the most transactions in last years have been done on them and at the next step the biggest steel manufacturer companies in the country and middle east are considered to forecast their stock price. To design an accurate model, the variables that influence the stock price of steel manufacturer companies must be identified first, and then use them to design a model. Because supply and demand determine the stock price in stock exchange and is done by agents, the information used by agents in decisions related to bargain should be identified. So after we refer to stock agents and consult with them, most of them said that investors use some information like net assets, P/E ratio, dividend per share (DPS), earning per share and the amount of stock transactions to make decisions about stock transactions of steel manufacturing companies. After identification of factors that influence stock price of manufacturers and selection of companies being studied (Isfahan and Khuzestan Steel), required information was obtained from "Rahavard e Novine Bonyadi" software.

Considering the importance of forecasting, and with long time period, more result will be achieved, because the neural network can identify information format better, using the last information and perform forecasting with minimum error. Also very long time period might be unsuitable, because it can cause interference with old information and divert the result. So, because information is entered monthly, a two year period is good for this research.

In implementing the neural network, modeling is very important because its success depends on the big size of samples as input variable and determining the amount and method of using each variable. Actually we need to determine a set of input variables to forecast. So the first step in modeling is to determine the number of suitable input neuron. Preparation of input data is one of the most complicated steps of neural networks usage that some of it relates to the selection of correct data and examples and also changing the scale of training input and output data(normalization) between zero and 1, because some transfer functions can not differentiate among very big quantities.

Because in forecasting, the number of neurons of input layer is usually equal to the number of independent variables, in this research we have 5 input neurons which are:

1- Net assets
2- Earning per share
3- Dividend per share
4- P/E ratio
5- The amount of stock transactions

Also, output neuron of the network should display the forecasted stock price, so in this research an output neuron was used that is stock price of studied companies.

These steps should be taken to design a forecast model:

1. All output and input data from the last 2 years (2008 - 2009) should be gathered.
2. Data are divided into two groups of training data (about 75 to 85% data) and test data (about 20 to 25%).
3. Teaching the network by training data.
4. Testing the network by test data.
5. Network answer.

RESULTS AND DISCUSSION

Steps of designing the model

After the input and output data of the network are provided, we should divide them into two groups of training and test data. As mentioned before, about 75 to 80% of the whole data should be selected as training data and about 20 to 25% as test data. So from the whole data in Table 3, 20 columns (random) were selected as training and 7 columns as test data. Selecting test and training data with the least mistake is very difficult. So after repeating about 125 times data selection, (from Table 3), the most desirable ones were gained as seen in Tables 4 and 5. In this research, we tried to do a long time forecast (1 month average) of stock price in contrast to other researches whose subject was a short time forecast of stock price (1 day or at most 1 week). Tables 1 and 2 show the results of monthly average of stock prices.

As mentioned before, to design a model we should adjust the information as input and output data first, then enter them into network. These data are listed in Table 5. Table 6 shows the amount of network error by changing the number of hidden layer neurons. As we can see, the error neuron decreases as the number of hidden layer neurons increases to 12 levels and it increases as the number of hidden layer neurons increases. So, 12 neurons in hidden layer for this network is the best state regarding the number of hidden layer neurons.

So according to Table 7, the best status of the network used in this research is a network with 5 neurons in input layer, 12 neurons in hidden layer, 1 neuron in output layer, 7% alpha, 2% etta, Sigma transfer function and 12500 attritions level. We can describe 35% error using for investors and research users as: this error displays the difference between network answer and test variables' real outputs in the network that is gained from square mean root of error formula. So an investor which is familiar to WNN software and neural network can forecast the stock price of steel manufacturer companies using of network inputs.

Table 1. List of networks outputs and inputs.

Row	Inputs					Outputs
	Net assets	Monthly average p/E multiple 1000	Monthly average of dividend per share (DPS)	Monthly average of earning per share (EPS)	Monthly average of transactions	Monthly average of stock price
1	18,155,398	5810	500	324	125,840,352	1882
2	18,155,398	5430	500	347	36,780,653	1880
3	22,124,753	6180	500	386	61,609,217	2391
4	22,124,753	7430	500	400	6,984,858	2970
5	25,342,688	7620	500	455	48,274,990	3442
6	25,342,688	6360	500	511	17,088,159	3251
7	28,340,722	5590	500	593	18,858,271	3399
8	23,888,539	5330	600	610	332,804,346	3250
9	23,888,539	6000	600	610	25,300,731	3661
10	29,350,143	6630	600	907	89,754,840	5561
11	32,459,998	4050	600	879	30,100,277	3612
12	32,459,998	2600	600	848	16,794,879	2305
13	31,414,290	2370	600	836	8,277,145	1978
14	31,414,290	2250	600	821	2,158,828	1850

Table 2. The whole inputs and outputs of the network.

Inputs	Outputs					Row
Net assets	Monthly average p/E multiple 1000	Monthly average of dividend per share (DPS)	Monthly average of earning per share (EPS)	Monthly average of transactions	Monthly average of stock price	
18,155,398	5810	500	324	125,840,352	1882	1
18,155,398	5430	500	347	36,780,653	1880	2
22,124,753	6180	500	386	61,609,217	2391	3
22,124,753	7430	500	400	6,984,858	2970	4
25,342,688	7620	500	455	48,274,990	3442	5
25,342,688	6360	500	511	17,087,159	3251	6
28,340,722	5590	500	593	18,858,271	3399	7
23,888,539	5330	600	610	332,804,346	3250	8
23,888,539	6000	600	610	25,300,731	3661	9
29,350,143	6630	600	907	89,754,480	5561	10
32,459,998	4050	600	879	30,100,277	3612	11
32,459,998	2600	600	848	16,794,889	2205	12
31,414,290	2370	600	836	8,277,145	1978	13
31,414,290	2250	600	821	2,158,828	1850	14
3,486,438	8840	650	487	6,901,437	4383	15
3,486,438	8530	650	577	10,916,222	4924	16
4,848,809	9180	650	607	7,011,458	5332	17
4,355,807	7480	700	714	4,724,346	5280	18
4,355,807	8440	700	797	13,041,661	6724	19
5,560,510	9900	700	1411	28,954,702	12196	20
5,560,510	5580	700	1821	6,986,313	10162	21
5,824,216	3480	700	1821	2,108,662	6329	22
5,824,216	2930	700	1575	1,780,187	4550	23
5,487,550	3310	700	1255	857,785	4153	24
3,628,716	3130	760	127	1,839,778	3934	25

Table 2. Contd.

3,931,885	21550	760	117	846,772	4000	26
3,931,885	34840	760	117	2,486,030	4425	27

Table 3. Training data.

Row	Inputs					Outputs
	Net assets	Monthly average p/E multiple 1000	Monthly average of dividend per share (DPS)	Monthly average of earning per share (EPS)	Monthly average of transactions	Monthly average of stock price
1	18,155,398	5810	500	324	125,840,352	1882
2	18,155,398	5430	500	347	36,780,653	1880
3	22,124,753	7430	500	400	6,984,858	2970
4	25,342,688	6360	500	511	17,087,159	3251
5	28,340,722	5590	500	593	18,858,271	3399
6	23,888,539	5330	600	610	332,804,346	3250
7	23,888,539	6000	600	610	25,300,731	3661
8	29,350,143	6630	600	907	89,754,480	5561
9	32,459,998	2600	600	848	16,794,889	2205
10	31,414,290	2370	600	836	8,277,145	1978
11	31,414,290	2250	600	821	2,158,828	1850
12	3,486,438	8840	650	487	6,901,437	4383
13	3,486,438	8530	650	577	10,916,222	4924
14	4,848,809	9180	650	607	7,011,458	5332
15	4,355,807	8440	700	797	13,041,661	6724
16	5,560,510	9900	700	1411	28,954,702	12196
17	5,560,510	5580	700	1821	6,986,313	10162
18	5,487,550	3310	700	1255	857,785	4153
19	3,628,716	3130	760	127	1,839,778	3934
20	3,931,885	34840	760	117	2,486,030	4425

Table 4. Training data.

Row	Inputs					Outputs
	Net assets	Monthly average p/E multiple 1000	Monthly average of dividend per share (DPS)	Monthly average of earning per share (EPS)	Monthly average of transactions	Monthly average of stock price
1	22,124,753	6180	500	386	21,761,609	2391
2	25,342,688	7620	500	455	48,274,990	3442
3	32,459,998	4050	600	879	30,100,277	3612
4	4,355,807	7480	700	714	4,724,346	5280
5	5,824,216	3480	700	1821	2,108,662	6329
6	5,824,216	2930	700	1575	1,780,187	4550
7	3,931,885	21550	760	117	846,772	4000

Conclusion

Replacing scientific researches with mental findings should not be neglected. A proper decision based on scientific principles is a good opportunity for an investor to exploit his capital and by a good knowledge of scientific methods he can allocate his resources properly. So, he should be acquainted with scientific methods of investment like artificial intelligence. The results of this research show that we can use artificial intelligence to

Table 5. The situation of square mean root of error by changing the number of neurons of hidden layer.

RMSE[1]	Number of neurons in the hidden layer
0.305	1
0.283	2
0.266	3
0.223	4
0.199	5
0.1567	6
0.123	7
0.096	8
0.0714	9
0.055	10
0.042	11
0.035	12
0.049	13
0.058	14
0.073	15

Table 6. Characteristics of a desirable network.

5	Number of the first layer neurons
12	Number of the first layer neurons
1	Number of the first layer neurons
0/7	α
0/2	η
Sigma	Transfer function
12500	Attrition

Table 7. Comparing network answer with outputs of test data of the network.

Outputs of test data of the network	Network answer
2391	43.2385
3442	025.3511
3612	44.3675
5280	021.5245
6329	88.6284
4550	36.4530
4000	095.3985

decide how to invest. We can identify complicated and nonlinear relationship among several variables and help to improve decisions, by using artificial neural networks. Because there is nonlinear relationship between economic variables decision making on investments is very important for investors. In this research, designing the model of forecasting steel stock price by artificial neural networks is done.

The results of this research show that artificial neural networks have the ability of receiving lots of inputs and outputs and make a reasonable relationship among them; they also gain desirable outputs by giving inputs to the network. It means that if correct information for learning is sent to the network and learnt correctly, it will be able to forecast stock price. So, neural networks based models can stimulate the behavior of stock price and forecast its future behavior.

Also, because of nonlinear behavior of stock price in the market, forecasting the stock prices by nonlinear methods can decrease the error of stock price forecast compared to linear methods. So the results show the preference and priority of nonlinear models compared to linear models.

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