



Pars Pharmaceutical Company Stock Price Forecast Utilizing Artificial Neural Networks and GMDH Shell Software

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Abstract

Forecasting the process of the stock price is of a high importance. This forecasting is not an easy task due to a variety of factors. Utilizing artificial neural networks based on the GMHD Shell software which leads to the stock price forecast can be really useful. In this study, the price information has been used as a dependent variable and the transactions volume data, number of transactions, value of transactions and the overall index have been used as dependent variables. For this purpose, the variations from 2014 to 2020 (1530 days) have been taken into concentration. The results suggest that there is a meaningful relationship between the above mentioned variables and stock prices.

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IndexTerms Stock price forecast, Artificial Neural Networks, Overall Index, Index, Transactions volume, Number of Transactions, Value of Transactions

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Introduction

Stock price forecast is not an easy task since lots of factors are involved and their complex structural relationships cannot be determined.

Two methods used to forecast the stock shares behavior are technical analysis and fundamental analysis. Fundamental analysis focuses on the economic forces of supply and demand which lead to the stock price

changes. The related factors (e.g. company, industry, and economic conditions), which are effective on the stock price, analyze the intrinsic value of stocks. On the other hand, it studies the technical analysis applied to historical data related to the price movements utilizing graphs and indices as its primary tools. Investors suppose that the historical patterns of stock prices will be repeated in the future and this pattern will



be used for the forecast purposes. In fundamental analysis the reasons of the market movements is analyzed while in the technical analysis its effects are studied. Technical analysis has a long history in forecasting these movements in financial time series. Nevertheless, it has been criticized by academic researchers and users for many years.

The criticism has been taken place is on the basis of two facts: first fact is the business markets viewpoint which says "Prices always reflect the existing information thoroughly." This viewpoint says that any efforts to gain profits or use of existing information is useless. The second fact states that the technical analysis is based on weak principles, e.g. expecting some historical patterns of the stock price are frequent in the future and may not take place since the market conditions change over the time and there is no explanation for these patterns repetition expectation.

Despite the noticed facts, the technical analysis has been broadly accepted as one of the vital analytical choices among the financial experts and brokerage companies. Theoretically, technical analysis attempts to predict the process of the stock prices by means of prices and previous transactions volume. Besides the broad use of technical analysis, investors are tremendously being used to algorithms and computer methods. Artificial neural networks are one of the most attractive technologies created in this financial field. They present an interesting method which can theoretically determine any nonlinear continuous function in a limited domain. This will be useful in securities investment and other financial fields where lots of assumptions and a little information regarding the essence of the processes for determining the value of properties and its value in technical analysis field must be examined. In this research we

are going to take the advantage of the neural networks in order to promote the effectiveness of the technical analysis indices in forecasting the process of the stock prices. Some major and famous technical indices are used as the input variables for teaching the neural networks. The purpose of reviewing this issue is that whether the neural networks can be used to decide for the hidden rules discovery in price movements. The capability of one of the most famous neural networks models i.e. feed forward neural network in presenting the effective forecasting the signs of the future process of stock price will be checked.

The first and the most important factor which is essential to be considered in stock market investment is the factor of stock price and consequently forecasting the future price and the forecasting methods must be selected that contain the most accuracy and the least error.

In the past, a variety of forecasting models were used among which the most important ones that can be pointed out are linear or polynomial regression, auto regression, Bucks techniques, Box and Jenkins models, moving average, structural models and time series. However, these models do not let the researcher to consider complex and non-linear factors. In recent decades, a novel method of forecasting called artificial neural networks which is adapted from the learning process of the human brain has flourished that has a high ability to learn complex and non-linear relationships. This method can be utilized to predict and optimize decisions in financial markets which allows the decision makers to use it in order to maximize the efficiency and minimize the investment risk. The results of investigations in the field of stock price forecast shows neural networks



model superiority over the previous models.

A lot of efforts have been taken in the field of price forecast in most of which smart methods have been used. In [1] forecasting the monthly value of the stock share of the Iranian automobile components group company in the stock market of Tehran the Artificial Neural network and GMDH-SHELL software have been used. Moreover, in [2] dollar (currency) rate prediction have been done by means of the effective variables of inflation rate and cash money amount in country in which the coming five years forecast has been accomplished by Time Series and Regression models in GMDH-SHELL software.

In research [3], a four-phase mixed model called ESTA-Net is suggested elicit the behavioral patterns for the stock price forecast. In the first phase, experimental state analysis is applied to analyze a price sequence depending on the Intrinsic Mode Functions. The purpose of this phase is to elicit several quasi-fixed features in different Time Scales of the price historical pricing sequence. Then, every Intrinsic Mode Function is modeled and predicted by a Temporal Attention Long Short Term Memory (TALSTM) Network. TALSTM network has been designed to illustrate the long-term dependency of each Intrinsic Mode Function. Thirdly, Deeply Learned Representations enter from Intrinsic Mode Functions into a Scale Attention Network (SANet) that comparatively selects deeply related representations of multiple time scale features extracted from historical price sequence. Finally, these deeply learned features enter into a completely-connected layer to predict future pricing. In addition, to let the suggested model learn the pricing in order to move, a new organizing expression, i.e. the direction organizing expression, we propose a

suggested model for learning. This "organizing expression" scales the conflict between the predicted movement direction and the real direction of pricing. It is claimed that the suggested model acts significantly better than the benchmark models.

In article [4], variables which are effective on Barrez Company's stock price and patterning and as a result predicting the stock price of this company in Tehran stock market by means of GMDH-SHELL are examined and recognized. These variables include:

- * Currency rate
- * Inflation rate
- *Crude oil global price
- * The price of the company's shares in the past years

The achieved results show the rising rate of the company's stock price, of which inflation and currency rates have been the most effective factors in this research, respectively.

In article [5], the minimum official payment announced by the government is predicted for the next five years using the inflation rate, cash amount and minimum payment of the past years and the statistical information of the Central Bank, Planning and Budget Organization and Iran's Center of statistics are used while reviewing various contexts in this field. Regarding the prediction of the minimum salaries and the next five years payment rates, Time Series and Regression as well as the GMDH-SHELL are used in this paper. Through this article the rates of the cash amount, inflation and the average of the past years' payments are pointed out as the most important effective factors on the enhancement or diminution of the level and rate of the minimum payment in Iran.

in article [6], a forecasting system suggested based on the phase rule with an



element that processes different aspects of the news stories. This system is taught in according to historical data in order to present one and five-day predictions of the gold price to the investors and achieve a significantly interpretable transaction strategy form the rules complexity point of view. In this paper it is claimed that the suggested system is more effective than the Extreme Learning Machines and neural Networks with Deep Learning, from the view of prediction accuracy and interpretability and the news impact element is important particularly for one-day predictions.

In [7] Iranian Oil Investment Company's price is predicted in a monthly time period using neural network and GMDH-SHELL software. In this research the final stock price is used as a dependent variable while transactions volume, number of transactions, market value and inflation rate are used as independent variables. Therefore, the process of variations from 2010 to 2014 is considered monthly. Results show that this model has the capability to forecast the stock price there is also a meaningful relationship between the above mentioned variables and the stock price.

A new mixed forecasting model to predict the process of the crude oil price is presented in [8]. For this purpose, the crude oil price series is firstly decomposed by the Variational Mode Decomposition Algorithm and Multi-Modal Data Features are elicited on the basis of the decomposition states. Crude Oil price fluctuations are simultaneously transformed into symbolic processes through symbolic time series analysis. Then, multiple categories of machine learning with the features of multidimensional data and historical fluctuations are taught as the input while the symbol of the process is taught as the output. Taught models are used for

predicting the West Texas Intermediate crude oil future price symbols. It is claimed that the proposed mixed forecasting model works better than its counterparts. Among the classifiers used, the mixed forecasting model using the Support Vector Machine classifier shows the ability to predict superiority. The accuracy of the proposed model for predicting high fluctuations in crude oil prices is better than low fluctuations.

Moreover, in [9] Khoozestan Steel Company's (KSC) stock price prediction in Tehran Stock Market takes place by means of the Artificial Neural Network and GMDH-SHELL software and the effects of impressive variables, currency rate, oil price, steel global price and production raw materials prices on this price are studied. The results show the large impact of the currency rate and global steel prices on the price of this share.

In article [10], first the relationship between energy supply and demand and its price is checked in accordance with the Existing Market Economic Model of Energy Prices and creates a dynamic differential equation. Considering different information gained via the differential equation and the difference equation, a gray dynamic forecasting model is created for the energy price. Then, parameters determination and the approximative formula of model diminution is studied. To improve the accuracy of the model, the algorithm of the Particle Swarm Optimization is used to optimize the amount of the new model background, creating an optimal gray predicting model for the energy price, and obtaining the modeling process of the optimized model. Finally, this model is applied to predict the fuel price in three normal regions: Singapore, Mediterranean Sea and Persian Gulf. Three types of gray predicting models are selected for the comparative analysis



and five criteria is used for evaluation. In this article it is claimed that the average of the relative errors of simulations and predictions of three real items are all less than 2 percent and the five evaluation criteria in the new model are better than the other three gray prediction models.

Predicting Iran's Oil Production in the next 14 years is performed by the use of artificial neural network and GMDH-SHELL software in [11]. to reach this goal the data of the past 49 years has been gathered annually through information elicitation via official webpages which includes the rate production in Iraq, KSA, UAE, USA, Canada and the rate of the oil and natural gas consumption in the world and also the crude oil price around the world. Results gained through data decomposition and analysis shows two periods of growing process in Iran's Oil Production within the next 14 years.

In [12] while referring to the use of word-based sentiment analysis in previous tasks to predict financial markets, the good results of the Transformer-based Sentiment Analysis for the decomposition and analysis of mutual emotions are addressed as well. In this method, a Deep Recurrent Neural Network is used to extract the features followed by a dense layer for the price regression. The reported results show a significant error in comparison with the base lines.

in [13], the effect of different parameters on the house price is reviewed and the random jungle machine learning technique as well as the UCI Machine Learning Repository Boston Housing standard dataset with 506 rows and 14 features are used for prediction.

In article [14], natural oil production in Iran is discussed and considering the variables which are effective on the natural gas production in Iran, a model is introduced to

predict the amount of the production by means of GMDH-SHELL software. Results have shown that the effective variables in the order of maximum impact are the price of the U.S' natural gas, crude oil price in the global market, average temperature of the weather in Boushehr province, Canada's natural gas price, natural gas import to Japan in dollars, average import price of natural gas in Germany, crude oil price of OECD (Organization for Economic Cooperation and Development) and OPEC's crude oil price, respectively.

Pars Daroo Pharmaceutical Company

Founded on October 23, 1960 and entered the stock market on June 22, 1995, this company works in the field of manufacturing and selling chemical and herbal drugs, pharmaceutical and chemical raw materials.

- * Ta'amin Pharmaceutical Investment Company- Public stock
- * Rural and Nomadic Social Insurance Fund
- * Daroopakhsh Company- Public stock
- * Shahr Financial Group Company - Ltd.
- * Tadbirgaran Atiyeh Iraniaan Investment Company
- * Omid Development Mutual Fund

According to the composition of shareholders it can be observed that most of this company's share is in investment companies' hands which makes it impossible to support operational activities; but on the other hand, this increases the liquidity of the company's share.

Familiarity with Neural Networks

Human's brain as a data processing system with a parallel and thoroughly complicated structure is used to read, breathe, move, think, search and do the whole conscious and most of the unconscious activities. Natural phenomena often have a non-linear behavior and the linear models are unable



to recognize the correct behavior of this phenomenon. Thus, it is necessary to use non-linear patterns and models to recognize the natural behavior of phenomena. Since the human's brain is a very complicated non-linear and parallel data processing system, the neural network of the brain as a smart system can recognize the non-linear and complex relationships between variables and then extend the discovered relationships to other data.

The existence of some special capabilities in the human brain raises the idea of making artificial models of some known parts of the brain. These models known as artificial neural networks are now considered to be the most accurate way to achieve smart computers that can mimic human thoughtful behavior. In these artificial networks it is attempted to create a human-brain-like structure which can have the ability to receive the information and signals massively and in parallel, evaluate, process, learn, decide, recognize, match and extend. A biological neural network includes lots of tiny components called Neurons which are responsible for receiving neural signals, analyzing them and sending messages to different parts of the human body.

The growing interest in using neural networks is due to the fact that nonlinearity has been approved by different researchers and financial analysts and neural networks are able to perform nonlinear modeling without prior knowledge of the relationships between factors.

Beyond the mere use of fundamental factors, some studies have also included a small number of technical disciplines. Moreover, Historical Time Series of the stock returns and index values are also employed in some studies as an alternative to technical analysis. Various studies have

examined the capabilities of neural networks in predicting stock price movements using popular theories of technical analysis. [13, 14]

Data Analysis

To design an accurate model, the effective variables on the stock price of the production companies should be recognized and then they are used to design a model too. In this article the information and data of transactions volume, number of transactions, value of transactions, overall index is used as the effective parameters on the stock price (the last price). According to the importance of the forecast issue, the longer the research time period is, the more accurate model will be; because neural networks can recognize their dominant pattern better and predict with minimum error using the past information. As stated, in this paper a seven-year period from March 25, 2014 to March 17, 2021 (1530 days) is considered and the information has entered the network on a daily base. The variation diagram of the dependent and independent variables in the period of 1530 days can be seen through figures 1 to 5.

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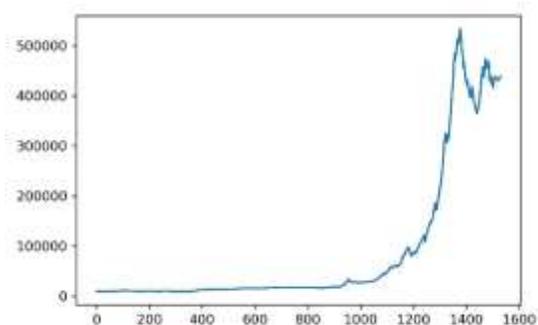


Fig.1 – The changes in the overall index in the period of 1530 days

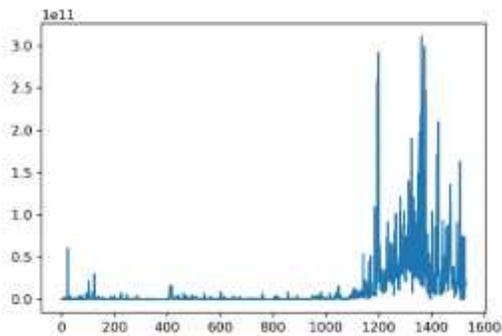


Fig.2- The changes in the value in the period of 1530 days

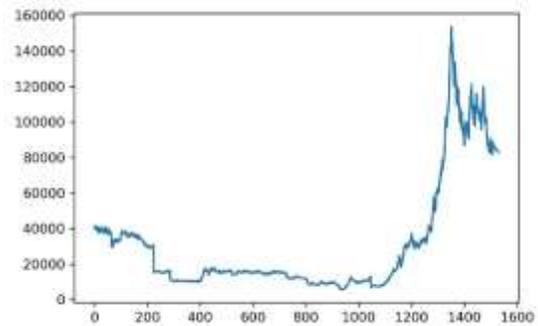


Fig.5- The changes in the last price in the period of 1530 days

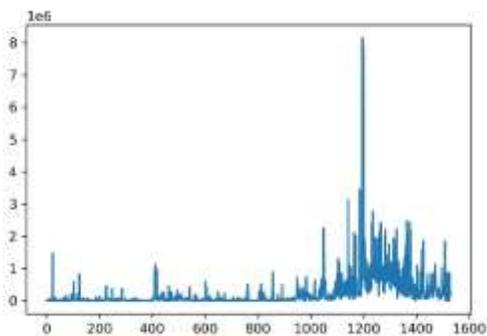


Fig.3- The changes in the transaction volume in the period of 1530 days

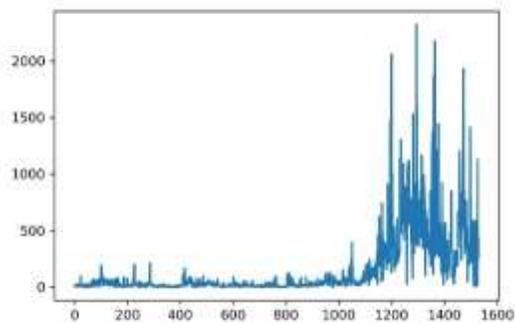


Fig.4 - The changes in the number of transactions in the period of 1530 days

First a regression was applied on the data using 1530-day data by means of GMDH-SHELL software, of which its results as well as the diagram of the occurred error can be seen in figures 6 and 7.

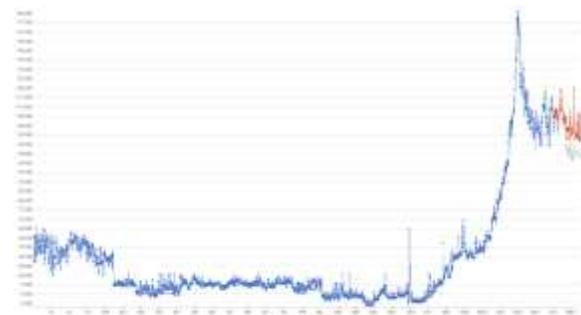


Fig.6- The diagram of Data Regression



Fig.7-The Regression error.

In this regard, to forecast stock prices in the upcoming 10-day period using GMDH-SHELL, of which its results as well as the



diagram of the occurred error can be seen in figures 8 and 9.

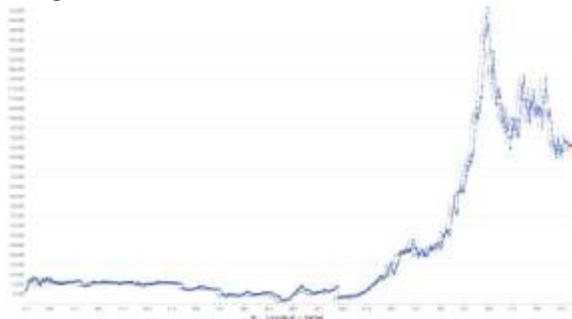


Fig.8- Forecasting the stock price within the upcoming 10 days

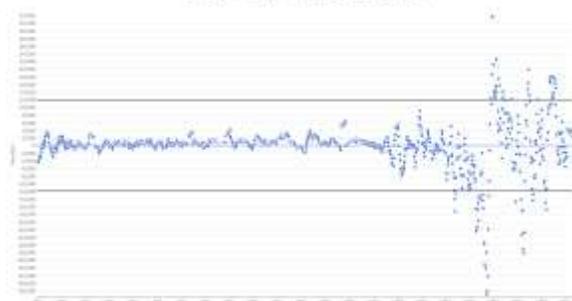


Fig.9-The error offorecasting the stock price within the upcoming 10 days

The stock price forecasting amount within the upcoming 10 days can be seen in table 1.

No	Date	Price
1	2021/03/06	87608/7
2	2021/03/07	87582/2
3	2021/03/08	87689/7
4	2021/03/09	87309/2
5	2021/03/010	87811/6
6	2021/03/013	87294/6
7	2021/03/14	87953/8
8	2021/03/15	87462/6
9	2021/03/16	87191/9
10	2021/03/17	85261/9
11	+1	85163/7
12	+2	85563/3
13	+3	86060/6
14	+4	86213/7
15	+5	85548/5

16	+6	86244/5
17	+7	85978
18	+8	85662/1
19	+9	85402/1
20	+10	85145/1

Conclusion

The obtained results show that an artificial neural network can identify the relationship between variables (even though they are complex and non-linear) and be effective in forecasting the average stock prices of the production companies (the case study of Pars Daroo Company). As only four parameters are discussed in this research, i.e. transaction volume, number of transactions, value of transactions and the overall index which are efficient factors on the average of the stock price of Pars Daroo pharmaceutical company and the process of indices was considered in the time span of 2015 to 2021 for 1530 days when these factors have an almost stable effect on the average of stock prices.



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