

# Stock prices prediction using Machine Learning techniques

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## Abstract

This paper gives an explanation of applying Machine Learning techniques to forecast stock prices. Different companies were taken to be predicted in terms of share prices based on historical data. Stock prices fluctuate at any time and tend whether to raise or fall. This trend can be tracked by several methods described in this paper. Two of them which exist many decades are shown based on practical examples. Moreover, drawbacks and disadvantages are concerned and explained. As a solution and innovative method of forecasting Artificial Neural Network is considered and explained in details. The way of applying this method, its architecture, logic and system are shown as an innovative approach to solve the problem of stock prediction. As a conclusion reader can see powerful advantages of described technique, its advantages in front of conventional methods and its high potential to solve problems in different fields.

*Keywords:* artificial neural network, stock prediction, stock analysis, machine learning, stock exchange

## 1 Introduction

From the beginning of capitalistic relationships in the markets stock exchanges became one of the market epicenters. From the first site it seems that stock market is just game of luckiness. However, stock exchanges are algorithmic systems with their rules and laws. To trade successfully on such markets it is necessary to continuously conduct analysis of the market and predict stock prices trends. Markets for now are explored by two methods: fundamental analysis and technical analysis. Recently, one of the new and innovative approaches appeared to solve stock prediction problem. It is about applying neural network for stock trends determination by finding the function between share properties and its price up to 4 days.

## 2 Fundamental and technical analysis

Fundamental analysis is the method of forecasting future stock trends based on economical, political and other fundamental factors influencing on demands and supplies. Fundamental analysis consists of 4 main blocks: overall economical analysis (Figure 1), industry analysis (Figure 2), and financial analysis of a company and investigation of stock assets quality.

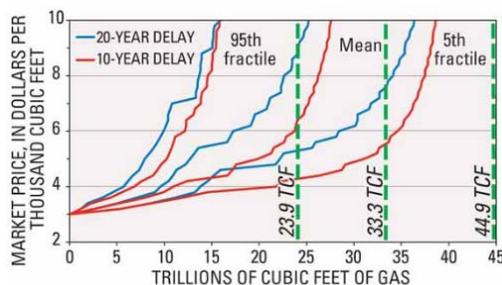
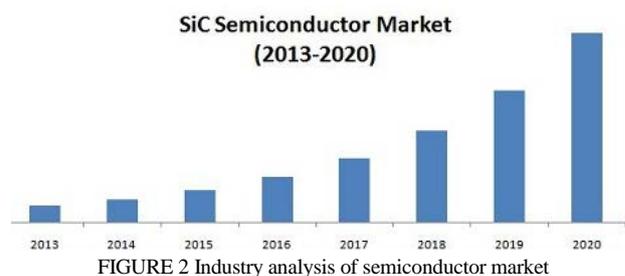


FIGURE 1 Analysis of economical condition in gas industry



Increase in product or security supply quantity can result in share price fall. Backwards logic also exists: uncompensated increase for demand leads to increase in share prices. Fundamental analysis is applied for exploring finance-economical condition of a company. With its help we can achieve two targets:

- To implement selection of the most efficient issuers which can give the biggest profit
- To determine fair or inner price of the share

The complexity of fundamental analysis is that it is hard to clearly determine economical and financial indicators.

Technical analysis is the method of predicting share prices based on graphs indicating historical stock data. There exist 3 postulates of technical analysis:

1. Stock trends consider all possible changes
2. Models or logic of stock trends exist
3. History repeats

Technical analysis does not consider reasons of share prices trends. It is influenced only by past prices. It considers only existing directions of share prices. It helps to forecast future prices depending on past changes in prices. Also the information about trade volumes and other statistical data is used in technical analysis. Charts are used to illustrate trends. One of the most popular charts is Japan candlesticks (Figure 3).



FIGURE 3 Japan candlestick chart

Here the following averaged are calculated and then explored:

1. Moving average:

$$MA_n = \frac{\sum_{i=1}^n D_i}{n}$$

Where:

n – number of periods in the moving average

D – demand in period i

2. Weighted Moving Average:

$$\text{Weighted Moving Average} = \frac{\sum_{i=1}^n P_i \times W_i}{\sum_{i=1}^n W_i}$$

Where:

W – weight for period i

P – demand for period i.

3. Other

All these lines are then put together and explored. It can show strong, average or weak signals to buy or sell a share or other security.

### 3 Artificial neural network

Artificial Neural Network is a complex information system which solves the problem of identification of some particular function of several variables (Figure 4). It is analogue for a real neural network of the human brain that processes some set of data and gives determined response. Artificial neural network consists of several nodes (which are the imitation of biological neurons) which are arranged in one layer or several layers. All nodes are interconnected and there are some weights between each pair of nodes (which are the imitation of synapse). These weights are some numbers which are used to calculate the output of a neuron based on activation function. Weights of a neural network are adjusted during the process of learning. The final error of a neural network depends on the values of network weights. Weight adjustment depends on a learning rate of neural network.

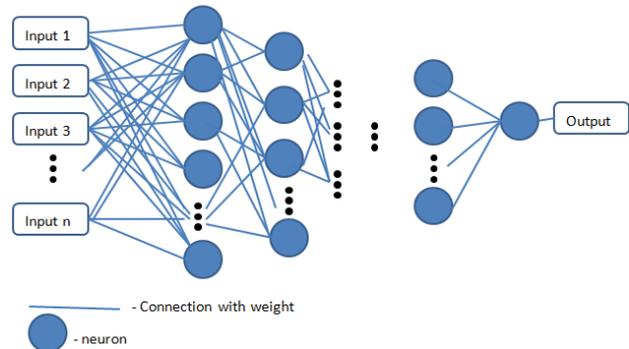
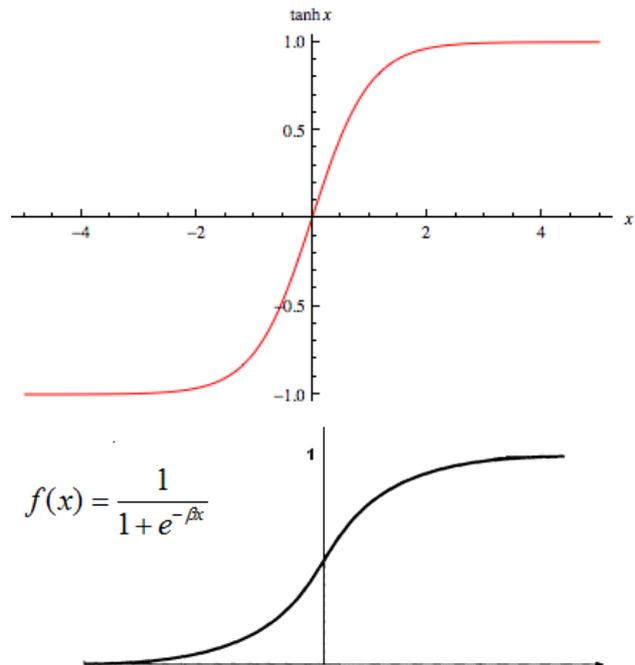


FIGURE 4 Architecture of ANN

To solve stock prediction problem we use share properties such as volume, day low, day high, OBV and other as inputs and share price as an output. For activation function we use hyperbolic tangent and sigmoid functions to compare:



Our neural network is simulated in Visual Gene Developer app on PC (Figure 5).

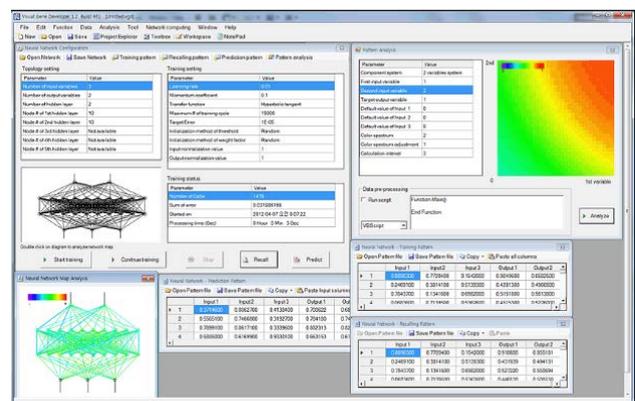


FIGURE 5 Screen of Visual Gene Developer

And then, when the optimal configurations for network are found we create program code on Python (Figure 6).

```
import math
def neuralNetwork(points, weights, p):
    m = float(len(points))
    for i in range(0, len(points)):
        u1 = points[i][0]
        u2 = points[i][1]
        Y = points[i][2]

        u3_p1 = u1 * weights[0][2] + u2 * weights[2][2] + 1
        u3 = 1 / (1 + math.exp(u3_p1 * (-3)))
        u4_p1 = u1 * weights[1][2] + u2 * weights[3][2] - 1
        u4 = 1 / (1 + math.exp(u4_p1 * (-3)))
        u5_p1 = u3 * weights[4][2] + u4 * weights[5][2] + 1
        u5 = 1 / (1 + math.exp(u5_p1 * (-3)))

        err_init = (Y - u5) * (1 - u5) * u5

        print ("\nErr init = %s" %err_init)

        err_u4 = (err_init * weights[5][2]) * u4 * (1 - u4)
        err_u3 = (err_init * weights[4][2]) * u3 * (1 - u3)

        weights[5][2] = weights[5][2] + p * err_init * u4
        weights[4][2] = weights[4][2] + p * err_init * u3
```

FIGURE 6 Python code on Eclipse IDE

For error correction we use Back-propagation algorithm:

$$W_{ij}^{(l)} = W_{ij}^{(l)} - \alpha \frac{\partial}{\partial W_{ij}^{(l)}} J(W, b)$$

$$b_i^{(l)} = b_i^{(l)} - \alpha \frac{\partial}{\partial b_i^{(l)}} J(W, b)$$

## 4 Conclusion

This paper describes the Artificial Neural Network for stock prediction problem. The algorithm clearly shows the possibility of forecasting share prices analyzing their history by neural network.

After conducting several experiments we finally get the function which describes dependency of share prices on different share properties. This will enable us to predict trends of stock with certain correlation.

This tool has a big potential to be used by non-professionals to predict stock market trends. For reaching this it needs to be improved and corrected properly with no bugs.

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