

Integration of Artificial Neural Networks for Stock Price Prediction

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Abstract - Stock market is an ever changing chaotic business area where prediction plays a major role. Prediction provides knowledgeable information regarding the current status of the stock price movement. Thus this can be put to use in decision making for consumer in deciding whether to buy or sell the particular shares of a given stock. Temporal data mining has been emerged as an interesting field in providing technologies for stock forecasting. As the data of the stock market is temporal in nature effective techniques can be applied to enhance prediction analysis. Many researchers have focused on this prediction research area, but still the results are not very accurate. It provides accurate results in stock prediction which has a great impact in decision making with respect to the clients and knowledge discovery of various useful patterns for brokers. The objective of this project is to develop a web application to predict stock prices and fluctuations and makes use of Bayesian method for short term stock prediction and Artificial Neural Networks (ANN) and Support Vector Machine (SVM) for long term stock prediction. This approach provides the clients with the ease of getting information status of any stock price movement immediately.

Keywords - Bayesian method; Artificial Neural Networks(ANN); Support Vector Machine(SVM); Stock Forecasting.

I. INTRODUCTION

A stockholder is an owner of a company. Ownership is determined by the number of shares a person owns relative to the number of remaining shares. For instance, if a company has 1,000 shares of stockpile left behind, and particular one possess 100 shares, that being would possess, and have permission to 10% of the company's possessions. The stock market is the marketplace in which shares of openly held companies are issued and trade either through connections or over-the-contradict markets. One of the key benefits of spending in the stock market is the chance to improve your money. Over time, the stock market tends to increase in value, though the prices of specific stocks rise and fall daily. Investments in stable companies that are able to develop tend to make profits for stockholders. For this reason, predicting the future values of these stocks is of extreme importance. Stock market prediction is the action of trying to control the forthcoming

price of a company stock or other commercial tool dealt on an exchange.

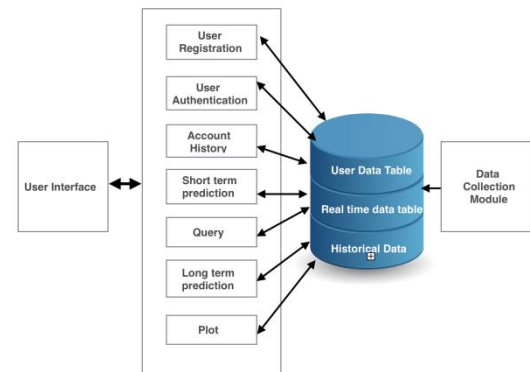


Figure 1: Architecture

The successful prediction of a stock's future price could return significant profit. The goal of this project is to develop a web application that predicts the future values of stocks, which stockholders can make use of before purchasing or retailing stocks. A massive amount of new information related to companies listed on the stock market appears constantly, with instant control on stock prices. Therefore, the idea of the project is to extract such real time stock information and historical prices made manageable by public API's that websites like Yahoo Finance provide. The movements are then analyzed to implement the prediction model.

II. PREDICTION SCHEMES

Due to the unpredictability of the financial domain, the prices associated with stocks of companies have always been subject to change. Needless to say, it is very imperative that a lot of research go into applying machine learning algorithms to predict stock prices, analyze patterns and index changes, based on the information stored in the database. This will help stock investors in knowing beforehand, to a certain extent, whether stock prices will rise or fall in the future. As a result, traders can make profits and avoid losses by buying and selling stocks at the right time.

In this project, we offer users functionalities to make short term as well as long term predictions. We have used Bayesian Prediction Methodology for short term prediction

and a combination of Artificial Neural Networks and Support Vector Machine for long term prediction.

A. Short Term Prediction:

Bayesian Estimator is based on Bayes' theorem, which describes the probability of an event, based on prior knowledge of conditions that might be related to the event. The input to the Bayesian predictor[1] is the price collected every minute during the market hours over a period of a day. The output is the prediction value for the next minute.

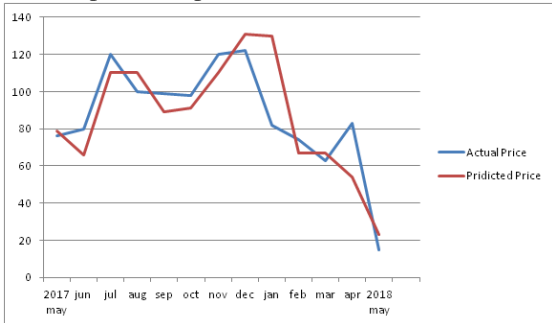


Figure 2: Short Term Prediction

The mean and variance are determined from the dataset and the probability function used to predict the future stock price is given by:

$$p(t | x, x, t) = N(t | m(x), s^2(x))$$

Where the mean and variance are given by:

$$m(x) = \frac{1}{n} \sum_{i=1}^n x_i(t)$$

$$s^2(x) = \frac{1}{n} \sum_{i=1}^n (x_i(t) - m(x))^2$$

Matrix S is given by:

$$S^{-1} = I + \frac{1}{n} \sum_{i=1}^n (x_i - m)(x_i - m)^T ; \text{ where } I \text{ is the unit matrix.}$$

B. Long Term Prediction:

i) Artificial Neural Networks - An Artificial Neural Network (ANN) is a computational model based on the construction and functions of biological neural networks. Information that flows through the network affects the structure of the ANN because a neural network changes - or learns, in a sense - based on that input and output.

An ANN is normally well-defined by three types of factors:

- The interconnection pattern between the different layers of neurons.
- The learning method for bring up-to-date the loads of the interconnections.
- The activation formula that converts a neuron's weighted input to its output activation.

The most interesting and useful aspect of neural networks is the possibility of learning. Most of the algorithms used in working out artificial neural networks hire some form of gradient descent[2], using back propagation to calculate the tangible gradients. Back propagation, an abbreviation for "backward propagation of errors", is a common method used for training a neural network in which the initial system output is compared to the preferred outcome, and the system is regulated up to the change between the two is minimized. The gradient calculated by the method is fed to

the optimization technique which in try uses it to bring up to date the loads, in an attempt to reduce the loss function. It is hence considered to be a supervised learning method.

To train the algorithm, we have used one year of historical data of each of the 10 stocks for which we make a prediction. The network consists of 3 neurons, each for maximum, minimum, and average values of five consecutive days' prices ending on the current day. Prediction for multiple days is provided by making it a closed loop system and using the predicted value in calculating the average, minimum and maximum for 5 days. Thus our implementation predicts the closing price of the stock for the next 5 days. This way, the algorithm can also be modified to predict the values for as many days as required. But the caveat here is that a slight error in the predicted value carried forward has the chance of deviating from the actual value if used for a really long period.

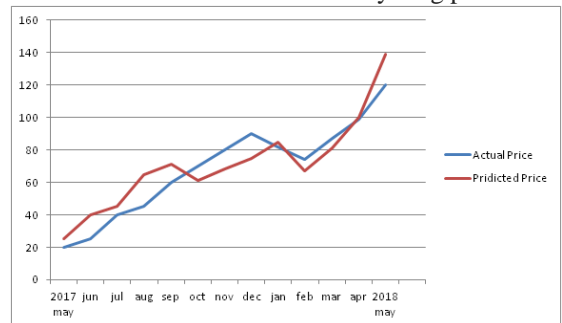


Figure 3: Long Term Prediction

ii) Support Vector Machine - A Support Vector Machine (SVM) is a discriminating classifier appropriately well-defined by a splitting hyper-plane. In further words, given labeled training information (supervised learning)[3], the algorithm yields an ideal hyper-plane which classifies new samples. Acknowledged on the unique theory of the structural threat minimization norm to valuation a function by reducing an higher bound of the generalization error, SVM is shown to be very resistant to the overfitting problem. Eventually achieving a high generalization performance.

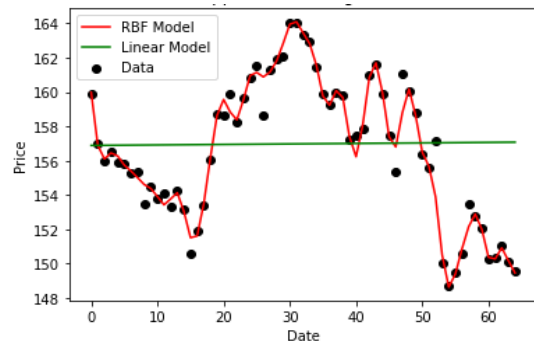


Figure 4: Graph Obtained through SVM

Another necessary property of SVM is that training SVM is equivalent to answer a linearly forced quadratic programming not easy so that the outcome of SVM is all the time unique and totally optimal, unlike neural networks

training which desires nonlinear optimization with the threat of getting permanent at local minima.

C. Objective of Study:

The objective of this study is to model the daily stock prices data using short term and long term prediction using Bayesian estimator, support vector machine technique and the artificial neural networks, and then to compare the results of these two prediction techniques.

III. TECHNICAL ANALYSIS

Technical analysis of stocks stands on historical price, volume, or (in the case of upcoming contracts) open interest data that intend to guess financial market path. Technical indicators are basic element of technical analysis and are naturally plotted as a chart outline to try to predict the market movement. Indicators usually cover up on value graph information to indicate wherever the value is available, or whether the value is in an "overbought" condition or an "oversold"[4] condition. We are using the following three indicators in our stock prediction:

A. Simple Moving Average:

A simple moving average (SMA) is an arithmetic moving average proposed by adding the closing price of the protection for a number of time periods and then separating this total by the number of time periods. A simple moving average smoothes out unpredictability and makes it easier to view the price trend of a security.



Figure 5: SMA Price Changes in AAPL

An additional popular analytical tool is to compare a couple of simple moving averages with each covering different instance frames. If a shorter-term simple moving average is beyond a longer-term average, an uptrend is predictable. On the additional hand, a long-term average above a shorter-term average signals a descending movement in the trend.

B. Exponential Moving Average:

An exponential moving average (EMA) is a kind of moving average that is equivalent to a simple moving average, excluding that more weight is given to the latest information. It's furthermore known as the exponentially

weighted moving average. This type of moving average reacts quicker to latest price changes than a simple moving average.

In common, the 50- and 200-day EMAs are used as signals of long-term trends. When the market is in a strong and continued uptrend, the EMA indicator line will also give you an idea about an uptrend and vice-versa for a downtrend. EMAs are commonly used in combination with other indicators to verify significant market moves and to gauge their validity. For traders who trade intra day and fast-moving markets, the EMA is more applicable.

The three steps to calculating the EMA are:

- Calculate the SMA.
- Calculate the multiplier for weighting the EMA.
- Calculate the current EMA.

The mathematical formula, in this case for scheming a 10-period EMA, looks similar to this:

SMA: 10-period sum/10

Calculating the weighting multiplier: $(2 / (\text{chosen time period} + 1)) = (2 / (10 + 1)) = 0.1818$ (18.18%)

Calculating the EMA: $\text{EMA}(\text{current}) = (\text{Price}(\text{current}) - \text{EMA}(\text{prev})) \times \text{Multiplier} + \text{EMA}(\text{prev})$.

The weighting given to the most latest value is greater for a shorter-period EMA than for a longer-period EMA. For instance, an 18.18% multiplier is applied to the most newest cost data for a 10 EMA, but for a 20 EMA[5], simply a 9.52% multiplier weighting is used. There are also tiny variations of the EMA arrived at by using the open, high, low or average price instead of using the closing price.

C. Moving Average Convergence Divergence:

Moving average convergence divergence (MACD) is a trend-following impetus pointer that demonstrates the connection amongst two moving averages of outlays.

The most commonly used values are 12, 26, and 9 days, that is, MACD (12,26,9).

There are three common methods used to interpret the MACD:

Crossovers - As shown in the chart beyond, when the Moving average convergence divergence falls beneath the sign line, it is a bearish signal[6], which points out that it possibly time to sell. On the other hand, when the MACD rises over the signal line, the indicator gives a bullish signal, which suggests that the price of the asset is probably to experience increasing momentum. Many investors remain for an established go over the sign line before moving into a point to keep away from getting "faked out" or moving into a position too early, as proven with the aid of the primary arrow.

Divergence - When the stock price diverges from the Moving average convergence divergence. It signals the end of the current trend.

Dramatic rise - While the Moving average convergence divergence rises dramatically that is, the shorter moving

average pulls a long away from the longer-term moving average it is an indication that the stock is overbought, and will soon come back to usual levels.

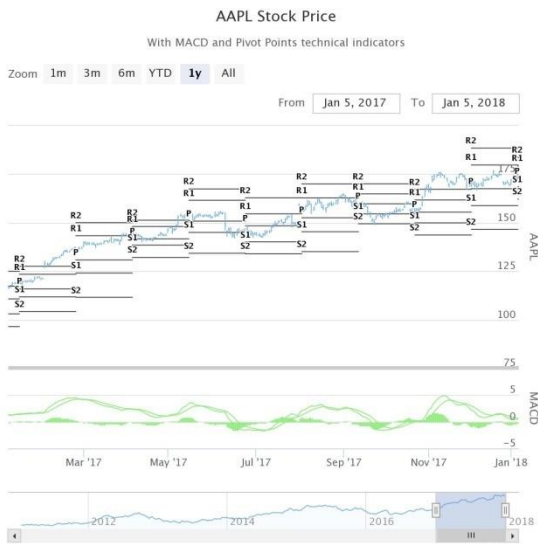


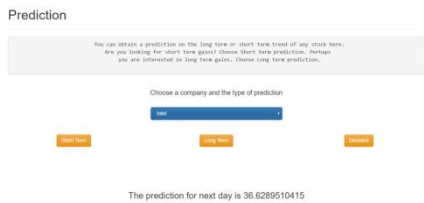
Figure 6: AAPL Stock Prices With MACD

IV. OUTPUTS

1. Short Term Prediction:



2. Long Term Prediction:



3. Plot:



V. CONCLUSION

The conclusion of this project is to develop a web application to predict stock prices and fluctuations and makes use of a Bayesian method for short-term stock prediction and Artificial Neural Networks (ANN) and Support Vector Machine (SVM) for long-term stock prediction. Prediction of a stock market, not an essay task. Developers try to develop such a methodology that

investors, brokers could get maximum profits. we see there is a huge drop in the prices which does not seem plausible. Hence Artificial Neural Networks is a better and more accurate methodology.

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