

# A Review on Usage of Machine Learning in Technical and Fundamental Analysis

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**Abstract** - There are number of studies that are published in recent years which explore the application of machine learning algorithms and related methodologies for the implementation of technical and fundamental analysis. But there still is a lack of a studies that consolidates the information. The main aim of this review paper is to analyze and sum up the content of various research studies based on their methodologies and results. Our paper gives contribution to the existing literature on application of machine learning in technical analysis and fundamental analysis.

**Key Words:** machine learning, technical analysis, fundamental analysis

## 1. INTRODUCTION

Many research studies have concluded that predicting stock market and it's the returns associated with it is a very difficult task. This is majorly due to the nonlinear and non-halting nature of stock market which makes the stock prediction system more complicated system. As stated by Ticknor [1], the price of a stock is also associated with a considerable number of factors which cannot be predicted like political events, market new, earning reports, international influence and conflicting trading behaviours. Therefore for this type of prediction we depend on technical and fundamental analysis of a stock. In the famous paper "Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation" presented by Lo, Mamaysky and Wang [2] it is stated:

"It has been argued that the difference between fundamental analysis and technical analysis is not unlike the difference between astronomy and astrology. Among some circles, technical analysis is known as "voodoo finance."

Fundamental analysis of a stock is done to find its intrinsic value. This analysis is done using various economic and industrial factors of that company. In the famous book The Intelligent Investor written by Benjamin Graham he recommends and proposes various benefits and why fundamental analysis is the way to invest in financial market. There are a set of stock selection rules in the book which were tested by Oppenheimer and Schlarbaum [3] and Metghalchi, Chang, and Marcucci [4] and concluded that indeed it was possible to obtain higher returns. Fundamental analysis is very effective at predicting the long term value of the stock and often contradicts technical in long term.

Technical analysis is approach for study of market movement using the past price action and volume that is traded for the purpose of forecasting future price trends. Technical analysis assumes the information which enters over a finite period of time affects the prices. This analysis assumes that the prices in the stock market moves in a particular trend. Efficient Market Hypothesis (EMH) states that prices follow random price action and thus cannot be predicted using their past price action. Technical analysis contradicts the Efficient Market Hypothesis. Many studies have combined these pre-existing and tested technical analysis techniques with intelligent systems like machine learning models neural networks, and various other algorithms. Technical analysis is very effective at predicting the short term movements of the stock.

In this particular paper we focus on preparing a literature review about some existing research studies which integrate the fundamental analysis and technical analysis approach with Machine Learning.

## 2. REVIEW OF LITERATURE

(Zaini, Mansor, Yusof, Sang, 2019) [5] In this study, the movement of stock is treated as a dependent variable with 2 categories -

$Y = \{1: \text{current price of closing is higher than or same as the previous closing price}, 2: \text{downward movement of the stock}\}.$

For this study seven technical indicators such as Relative Strength Index (RSI), Moving Average Convergence-Divergence (MACD), Volume Trading (VT), Stochastic Oscillators (SO), Rate of Change (ROC), Moving Average (MA), Closing Price and Exponential Moving Average (EMA) were used as the predictor variables. Therefore, the study aimed to identify the significant technical indicators to predict stock market movement by using logistic regression.

Logistic regression is common method used to predict dependent variable as a failure or a success depending on a predictor variables. The initial formulation of logit model consists of all the seven predictor variables. Out of these seven predictor variables, only four predictors (MACD, RSI, SO and ROC) contributed significantly at 1% to the logit model. Post determination of significant predictor variables, simplification of logic model was carried out by eliminating the insignificant predictor variables.

The paper comprised of In-sample and out-sample validation of Logit Model. The aim of this study was to

categorise the observation into a particular group. Categorisation of observations was carried out by initially estimating the probabilities in the indicated group which can be calculated with the application of logistic regression. This study made use of in-sample data for validation of Logit Model formulated earlier. Post observing the classification table, it was visible that the accuracy of correctly classified financial market movement stood at 86%. Post observing the out-of-sample data, the study arrived at a conclusion that out of seven days, five days were appropriately classified. Thus, the out-of-sample classification rate for the financial market movement produced accuracy of 71.43% which was inferior than in-sample prediction result.

(Choudhry, Garg, 2008) [6] In this study, a hybrid system for prediction based on Support Vector Machine (SVM) and Genetic Algorithm (GA) is followed. This study assumes that the stock prices don't move in isolation and thus can be correlated with some other stock in the market.

This study finds the companies which have the highest correlation with the target company and applies 35 technical studies to all the companies to generate features. These generated features are then fed to the Genetic Algorithm in order to obtain an optimal subset of features from large number of features generated. This optimal set is then fed to SVM with Gaussian radial basis function kernel.

This hybrid model was able to archive 55.6 to 61.7% of accuracy. Ending with a conclusion that GA-SVM produce much better result as compared to standard SVM.

(Ticknor, 2013) [1] In this study, a three layers feedforward ANN was used to predict the stock movement on daily basis. The output was the closing price on the next day of the stock which was chosen. 6 technical indicators were used in the input layer of ANN which were Exponential MA (5 and 10), Relative Strength Index (RSI), Williams R%, Stochastic K% and Stochastic D%. Bayesian regularization techniques was used along with the ANN to remove the issue of overfitting of data.

The forecasting accuracy of the Bayesian regularized ANN was 1.9-0.74 MAPE which is quite good. One issue tackled here is it reduces the potential for overfitting and local minima solution which are common hurdles Neural Nets.

(Ali, Mohammed, Khairi, 2019) [7] In this paper, for Stock Price Prognosis, data processing technique is put on using Technical, Fundamental, and News based approaches for high result. For reducing the effect of data over-fitting in Prediction Approach, they use the J48 algorithm with bagging and to extract news they used the text mining approach. The J48 algorithm with Rweka is applied to proposed system for upgrading the precision of stock price results.

They mention market EOD data which is usually available on the respective exchange website also the Essential Technological Theory and Dealings Approach are mentioned. Their model design contains 1) Stock Price Movement Analysis. 2) J48 with Bagging 3) Improvement J48 algorithm. 4) Enhancement concerning ID3 Classification Algorithm. 5) Pseudocode for building a J48 decision tree. 6) Bagging 7) News Based Approach 8) Trading Model. The root of famous

financial website URLs is provided for getting recent news for prediction of the stock result by crawler which improves the result. They mention how J48 with bagging will give information about the model concerning the independent dataset. For testing when they provide 1000 Stocks to a system then buy signal generation is predicted, compared to the current market price target price is 45% higher and the stop-loss price is 10% lower. With real-time experiments, this model provides an accuracy of 91% roughly.

(Huang, Capretz, Ho, 2019) [8] This paper presents a relative study on stock prediction using fundamental financial ratios that analyses feed-forward neural networks (FNN) and adaptive neural fuzzy inference system (ANFIS). This paper mentioned two models of neural network architectures i.e. Adaptive Neural Fuzzy Inference System (ANFIS) and Feed-forward Neural Network (FNN). Used Methodology for Data Pre-processing is 1) Feature Dropping 2) Trend Stationarization 3) Filling Missing Entries 4) Standardization 5) Fixing the Time Frame. In the experiment, instead of a simple absolute return, concerning the Dow Jones Industrial Average (DJIA) a stock's quarterly relative return is used as the target variable. The models for each of 70 stocks generate simulated results, at the end stocks are arranged according to the relative returns for the next part. To build a 'Buy' portfolio top 30 stocks with forecasted relative returns are picked out and in the 'Sell' portfolio the bottom 30 stocks are placed. Here to set up the portfolios they utilized an equal-weight strategy. So it indicates that all over the stocks in a portfolio, the hypothetical investment would be dispersed equally. In favor of each quarter, they assemble 'Buy' and 'Sell' portfolios depended on predictions given by FNN and ANFIS models.

(Ma, Ratto, Malandri, Camdria, Oneto, Merello, 2018) [9] In this paper various machine learning techniques are applied on the features extracted from stock market data. In this approach they have treated this as a classification problem predicting if the stock will go up or down. Rather than predicting only one stock here a portfolio of 20 stock was predicted with an average accuracy of 61.69%. Two over-sampling techniques Adaptive Synthetic Sampling (ADASYN) and Synthetic Minority Over Sampling Technique (SMOTE) were used to balance the data which contributed to improving the accuracy. Another cross validation technique was used called "increasing window cross-validation" instead to normal Kfold.

(Nti, Adekoya, Weyori, 2019) [10] This paper provides a good review about 122 research works reported in various journals, in the area of application of machine learning in the field of machine learning. The fundamental analysis is carried on unstructured data which tend to be a difficult in prediction, where as the technical analysis gives future prices of stocks based on the past and present stock price.

The technical indicator like EMA (exponential moving average), SMA (simple moving average), MACD (moving average convergence /divergence rules), OBV (on- balance-volume) and RSI (relative-strength index) are used.

Pre-processing of historical ticker quotes is initially performed. Post pre-processing step, suitable fundamental indicators are computed that are given to the predictive

model. There are multiple factors during the fundamental analysis of a ticker. This study reviews the historical and present state-of-art financial market forecast depending on the input dataset, quantity of sources of data along with the use of soft computation technique. Comparison of accuracy obtained, time factor and several software packages used for modelling were also reviews in this paper.

(Thethi, Pandit, Patel, Shirsath) [11] In this paper the authors have used Long Short Term Memory (LSTM) for the prediction of stock market. After comparing the results with the most widely used approach of Artificial Neural Network (ANN) LSTM had more accuracy. This was because each LSTM cell had memory and could keep track of context-specific temporal dependencies between the stock prices.

The model is more accurate if the size of the input dataset also increased. In this paper they also research the effects of public sentiment on the stock prices using the tweets. They have used tweets about top 16 most popular tech companies as stated by Yahoo finance and it was found that the changes in the sentiments do affect the stock prices and can be used to predict the markets.

### 3. CONCLUSION

The aim of this study was to review academic literature related to application of machine learning in the field of stock market. The result presented in this paper also give direction to new studies on this topic.

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