Understanding Stock Market Trends Using Simple Moving Average (SMA) And Exponential Moving Average (EMA) Indicators

Ananta Ojha
College of Computing Sciences and Information Technology
Jain (deemed to be) University
Bangalore, Karnataka, India
oc.ananta@jainuniversity.ac.in

Vineet Saxena
College of Computing and Information Technology
Teerthanker Mahaveer University
Moradabad, Uttar Pradesh, India
tmmit_cool@yahoo.co.in

2023 6th International Conference on Contemporary Computing and Informatics (IC3I) | 979-8-3503-0448-0/23/$31.00 ©2023 IEEE | DOI: 10.1109/IC3I59117.2023.10398001

***Abstract* -The task of forecasting stock market trends is widely regarded as one of the most difficult challenges in financial time series analysis, owing to the dynamic and non-linear nature of financial data. Forecasting the stock market is an essential requirement for comprehending market patterns and devising trading strategies. The present study is centred on the examination of financial data through the implementation of the present discourse pertains to two distinct technical indicators, namely the simple moving average and exponential moving average. The aim is to predict the future path of the stock market's movement. The utilization of the moving average approach has gained widespread acceptance due to its ease of implementation. The experiments were conducted utilizing a five-year historical dataset from two distinct stock markets, namely TCS and Apple. The present study draws a comparison between two companies by analysing their respective trading signals to infer the potential movement of their stock prices.**

Keywords- SMA, EMA, Stock trends, data analytics

I. INTRODUCTION

The stock market is a multifaceted system wherein individuals engage in economic transactions as buyers and sellers. The volatile and transitory nature of the stock market renders the prediction of market patterns a formidable task within the realm of financial time series analysis. The role it plays is crucial for both financial institutions and individual investors in determining their trading strategies. The notion of adaptation has been embraced as a means of addressing the temporal fluctuations inherent in stock markets [1]. The decision to purchase, sell, or retain shares in a given market is determined by trading signals. Numerous studies are currently underway in this domain with the aim of enhancing the precision of predictions. The user has classified modelling techniques into two distinct categories: linear modelling and non-linear modelling. Linear modelling is rooted in statistical and mathematical principles, while non-linear modelling utilizes artificial neural networks, fuzzy logic, and machine learning algorithms [2, 3, and 4].

The present study employs the moving average as a technical indicator for the purpose of forecasting forthcoming share market prices. The experimental findings are derived from a four-year retrospective analysis of two Indian stock markets, specifically TCS and Apple. In the present context, moving averages exhibit a delay in indicating the direction of price movement. The simplicity and ease of interpretation of charts make them a fundamental basis for other technical indicators. The principal aim of utilizing a moving average is to identify potential trends and reversals, thereby aiding in the identification of potential support levels for investment prospects. The implementation of this specific tool can be regarded as a significant strategy for risk management due to its capacity to mitigate losses. The subsequent sections of the document are organized in the subsequent manner. In Section 2, a thorough examination of prior research endeavours is presented, with an evaluation of their respective merits and limitations. The third segment of the manuscript encompasses comprehensive explications of the algorithms. The fourth section of the manuscript presents the empirical findings, whereas the fifth section provides a comprehensive conclusion for the entire investigation.

II. LITERATURE REVIEW

[5] et al. investigated the application of a probabilistic neural network in predicting the direction of an index, following the model's training. [6] et al. devised a two-stage framework that integrated self-organizing map and support vector regression techniques to forecast stock prices. In a recent study, artificial neural networks (ANN) were utilized to predict the closing prices of stocks, as reported in reference [7]. The authors of reference [8] utilized a combination of random forest, support vector regression (SVR), and genetic algorithms (GA) in hybrid models for the purpose of predicting stock market prices. In reference [9], stock market indices have been predicted through the utilization of trend deterministic techniques and machine learning algorithms. Nevertheless, these models are inadequate in analysing the dynamic fluctuations of stock market values over time. To address this limitation, one may consider the implementation of a statistical modelling approach. The linear ARMA model, as elucidated in reference [10], constitutes one of the initial domains of inquiry in the field of time series forecasting. ARMA models necessitate the time series to be both linear and stationary, which can be challenging to attain in real-time scenarios. The aforementioned circumstance facilitated the emergence and advancement of hybrid ARMA techniques. Several forecasting techniques have been proposed for machine state, including ARMA (AutoRegressive Moving Average) as well as the combination of ARMA and TDNN

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(Time-Delay Neural Network). Additionally, in the context of solar radiation forecasting, ARMA and TDNN have also been utilized. A statistical model of similar strength has been employed in reference [11], demonstrating superior performance to artificial neural networks in short-term forecasting as per the findings presented in reference.

III. Steps For Analysing Market Trends

a. The Simple Moving Average (SMA) is reliant on the closing prices, similar to other moving averages. The calculation of SMA is derived from the utilization of equation 1.

$$SMA = 1/N \sum_{i=1}^{N} cp \quad (1)$$

The variable N represents the duration of the time period during which the mean value is calculated, while cp denotes the closing price for each day.

b. The Exponential Moving Average (EMA) is a mathematical tool that assigns equal weights to all prices, resulting in a negative impact on lag. The EMA methodology endeavours to reduce the time lag by according greater significance to the most recent prices through the allocation of higher weights. The determination of the weighting multiplier, which is also referred to as the smoothing constant, involves the utilization of equation 2. The Exponential Moving Average (EMA) can be computed by utilizing equation 3.

$$\text{Multiplier} = 2 / N+1 \quad (2)$$

$$EMA(a) = \{cp - EMA(a-1)\} * \text{multiplier} + EMA(a-1) \quad (3)$$

Where EMA (a) signifies the EMA value on the a^{th} day

Exponential moving averages exhibit minimal lag and are therefore more responsive to recent price fluctuations. It is probable that they will exhibit a tendency to turn prior to the occurrence of simple moving averages. Nevertheless, Simple Moving Averages (SMAs) are the preferred method for identifying levels of support or resistance. In financial markets, support refers to the price level at which the demand for a particular asset is sufficiently high to prevent further decline in its value. In financial markets, resistance refers to the threshold at which the prevailing selling pressure is deemed to be sufficiently robust to impede any further appreciation in the asset's valuation. beyond that point. It is imperative to take into account both forms of moving averages when addressing any given problem in order to determine the optimal fit.

A. Trends prediction based on indicators

The orientation of the moving average conveys noteworthy insights regarding the prices of stocks in the market. An ascending moving average signifies an upward trend in prices, thereby presenting an opportune moment to divest shares. When the moving average declines, it indicates a decrease in prices, which may present a favourable opportunity to purchase shares. An ascending value is indicative of a prolonged upward trend, whereas a value is indicative of a prolonged downward trend. Moreover, it can be observed that moving averages function as a form of support during an upward trend and as a form of resistance during a downward trend.

An upward trend can be identified when the Simple Moving Average (SMA) has been observed to rise over the past five days and the closing price has exceeded the SMA [12, 13].

In the event that the closing price is less than the Simple Moving Average (SMA) and the SMA has exhibited a downward trajectory over the past five consecutive days, it can be inferred that the prevailing trend is indicative of a Downtrend.

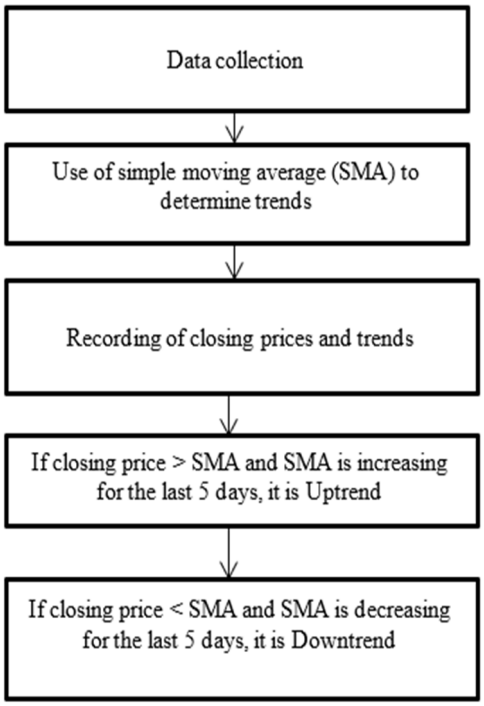

Figure 1. Steps involved in analysing of market trends

The proposed framework in figure1 starts with collection of data and making use of simple moving average to determine trends in stock markets. It follows If-then rule which states that if closing price is greater than SMA, then it shows uptrend else downtrend.

IV. Results And Discussion

The research employs a dataset that encompasses a period of five years of past stock prices from two distinct stock markets, namely Apple and TCS. The two datasets comprise a set of variables including date, closing price, SMA and direction of trends. Figure 2 and figure 5presents a clear distinction between the characteristics of the two datasets and the data set was tested using R Studio and subsequent trend analysis results were obtained. The

present study aims to extract short-term trading decisions through trend analysis. To accomplish this objective, the Simple Moving Average (SMA) has been employed to identify the fluctuations in stock prices. The Simple Moving Average (SMA) is considered to be a straightforward method for calculating the moving average.

TABLE I. EXAMPLE OF TREND DETERMINATION FROM SMA OVER THE SAMPLE DATA SET FOR APPLE

Time series	Closing Price	SMA	Trend
1	96.54	97.65	Down
2	97.21	98.10	Down
3	98.56	97.34	Up
4	100.12	98.34	Up
5	101.56	97.89	Up
6	99.65	98.12	Up
7	93.45	96.45	Down
8	94.65	97.34	Down
9	95.78	98.32	Down
10	93.87	94.56	Down
11	94.67	97.56	Down
12	96.32	98.78	Down
13	100.21	97.65	Up
14	96.89	98.82	Down
15	96.56	92.17	Up

Table 1 shows set of closing price and SMA values to determine direction of trends based on If-then else condition. Example in time series 2, closing price is 97.21 and SMA is 98.10 which mean SMA is greater thereby shifting towards downtrend.

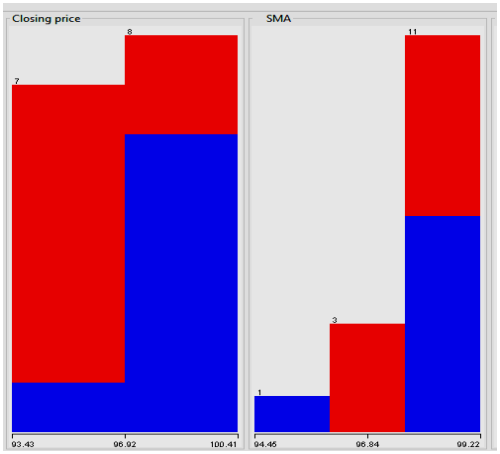

Figure 2. Plotting of values of closing price and SMA for Apple using R

In figure 2, the values of closing price and SMA are plotted using visualization graphs in R studio**.**

Based on values above, the trend analysis is shown in figure 3.

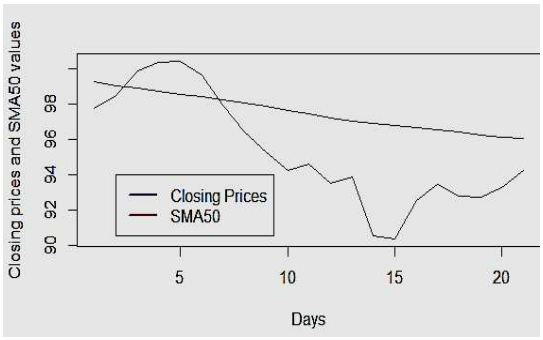

Figure 3. Trend analysis using SMA for apple [1]

TABLE II: EXAMPLE OF TREND DETERMINATION FROM SMA OVER THE SAMPLE DATA SET FOR TCS

Time series	Closing Price	SMA	Trend
1	2500.12	2510.34	Up
2	2478.23	2563.12	Up
3	2489.54	2678.32	Up
4	2565. 78	2210.12	Down
5	2645.65	2567.12	Down
6	2667.67	2667.12	Down
7	2651.67	2765.89	Up
8	2658.3	2789.65	Up
9	2600	2650.78	Up
10	2558.27	2512.98	Down
11	2768.21	2678.98	Down
12	96.32	98.78	Up
13	100.21	110.78	Up
14	96.89	95.82	Down
15	96.56	92.17	Down

Table 2 shows dataset to determine trends using SMA approach for company TCS.

In figure 4, the values of closing price and SMA are plotted using visualization graphs in R studio.

In figure 5, we can see the plotting of values taking x-axis as closing price and y-axis as SMA.

Figure 4. Plotting of values of closing price and SMA for TCS using R studio

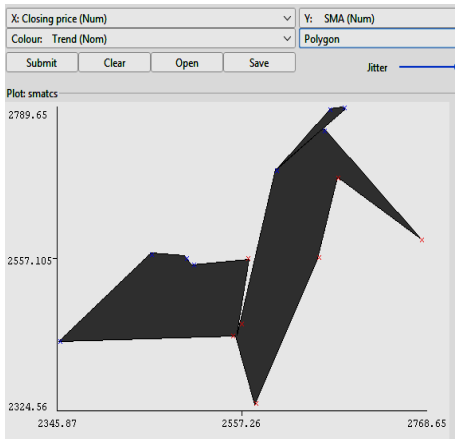

Figure 5. Joining coordinates of SMA and closing price to form polygon

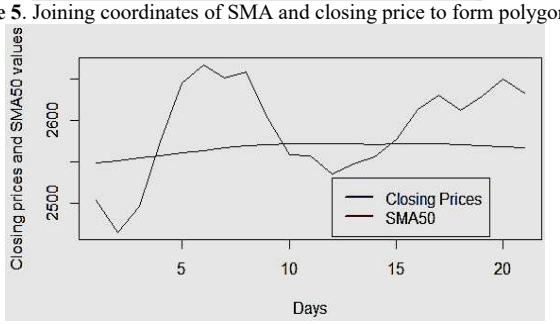

Figure 6: Trend analysis using SMA for TCS [1]

In figure 6, graph is shown between days (x-axis) and closing price and SMA values at y-axis. Closing price start from 2500 and SMA value is between 2500 and 2600.

V. Conclusion & Future Work

The present study introduces a methodology for examining the fluctuation of stock prices through the utilization of trend analysis. The method utilized capitalizes on the utilization of moving averages as a straightforward approach to analysing the trend of numerical data, proving to be a highly effective technique for making short-term predictions. Furthermore, this study establishes a comparison between the datasets under examination is subject to computation of Simple Moving Average (SMA) and Exponential Moving Average (EMA) values [14, 15]. Moreover, the trading strategies elucidated in the paper provide a noteworthy benefit to stakeholders. The application of the moving average technique a technical indicator can be employed in the development of trading decisions within the stock market.

Moreover, the scope of the study can be broadened by integrating multiple technical indicators to generate a more refined outcome. Further exploration of similar technical analyses will be conducted in the future.

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