Stock Market Prediction using Time Series Analysis

Kamalakannan J[1], Indrani Sengupta[2] and Snehaa Chaudhury[3]

[1]SITE, VIT, Vellore, India (e-mail: jkamalakannan@vit.ac.in)
[2]SITE, VIT, Vellore, India (e-mail: indrani.sengupta2017@vit.ac.in)
[3]SITE, VIT, Vellore, India (e-mail: snehaa.chaudhury2017@vit.ac.in)

ABSTRACT

Stock market is a market that enables seamless exchange of buying and selling of company stocks. Every Stock Exchange has their own Stock Index value. Index is the average value that is calculated by combining several stocks. This helps in representing the entire stock market and predicting the market's movement over time. The Equity market can have a profound impact on people and the country's economy as a whole. Therefore, predicting the stock trends in an effective manner can minimize the risk of investing and maximize profit. In our paper, we are using the Time Series Forecasting methodology for predicting and visualizing the predictions. Our focus for prediction will be based on the technical analysis using historic data and ARIMA Model. Autoregressive Integrated Moving Average (ARIMA) model has been used extensively in the field of finance and economics as it is known to be robust, efficient and has a strong potential for short-term share market prediction.

I. INTRODUCTION

The stock market is a general term which refers to the collection of markets where the issuing and trading of equities, bonds and other sorts of securities takes place through various physical and electronic exchanges and over the counter market.

The stock market is one of the most important components of a market economy, because it provides companies with access to capital by allowing investors to buy shares of ownership in a company. The arena of stock market is constantly developing under the process of refinements. Considering the variations, investors need to plan intensively to make profit.

Forecasting the stock exchange data includes an assumption that the information publicly available at present has some predictive relationships to the future stock returns. Stock trend forecasting is one of the most difficult tasks to achieve in finance market because of the difficulty in the highly intricate world of stock market.

The investors in the stock market always find a technique that can guarantee easy profiting by forecasting the stock trends and minimize the risk of investing. This motivates the researchers in the domain field to develop new forecasting models.

Stock prices are not randomly generated values rather they can be treated as a discrete time series model which is based on a set of well-defined numerical data items collected at successive points at regular intervals of time.

Since, it is essential to identify a model in order to analyse trends of stock prices with adequate information for decision making, it recommends that transforming the time series using ARIMA is a better algorithmic approach than forecasting directly, as it gives more authentic results. Autoregressive Integrated Moving Average (ARIMA) model converts a non-stationary data to a stationary data before working on it. It is one of the most popular model to predict linear time series data.

R is a programming language and environment for statistical processing and graphics. The R dialect is generally utilized by data analysts for statistical programming and data analysis. R language was created by Ross Ihaka and Robert Gentlemen at the University of Auckland, New Zealand and is presently maintained by the R development core team. R Studio is a free and powerful integrated development environment for R language which allows the user to implement ARIMA Model.

In this paper, we have mainly focused on the accuracy of forecasting stock values for various sectors which will aid new investors understand the market and make a wise decision to invest in the stock market.

II. RELATED WORKS

The author [Banerjee D] [1] has tried to develop a model that helps forecast the future Indian stock market values, based on the past information collected on the monthly closing stock indices. Using ARIMA model he has predicted the future stock indices which have strong performance on the economy of India.

The authors [Adebiyi] [Ayodele A] [2] have made use of the ARIMA model to develop a stock price predictive model by taking data from NYSE and NSE. Model Artificial Neural Networks is popular for making various patterns and deduce

solutions. The results obtained from real time data reveals the strength of ARIMA model to help investor's decision making process.

The authors [Devi, B. Uma] [D. Sundar] [P. Alli.] [3] has applied ARIMA to overcome the real life problems of the share market by predicting the share prices with the top companies in Nifty with the help of MATLAB and some performance measures.

The authors [Jarrett] [E. Jeffrey] [Eric Kyper] [4] have used ARIMA for analysis and forecasting in the database named PACAP-CCER China, which was developed by the Pacific.

The authors[J.Contreras][R. Espinola][F. J.Nogales][A.J. Conejo] [5]have provided a
method of using ARIMA model for predicting or forecasting electricity price more specifically of the next day.

The authors [PrapannaMondal] [LabaniShit] [Saptarsi Goswami] [6] have conducted a study to predict amount of accuracy for various sectors of Indian stocks using ARIMA model. As a result, it has been found that accuracy of in predicting stock prices using ARIMA model is above 85%.

The authors [M. Angadi] [A. Kulkarni] [7] have attempted to develop a model for predicting the trends of the share market by analysing historical time series trends using ARIMA model. The experimental results reveal that the potential of ARIMA model to predict future indices of stock price is strong. This provide guidance for the investors in the to make a decision of profitable investment in stock market.
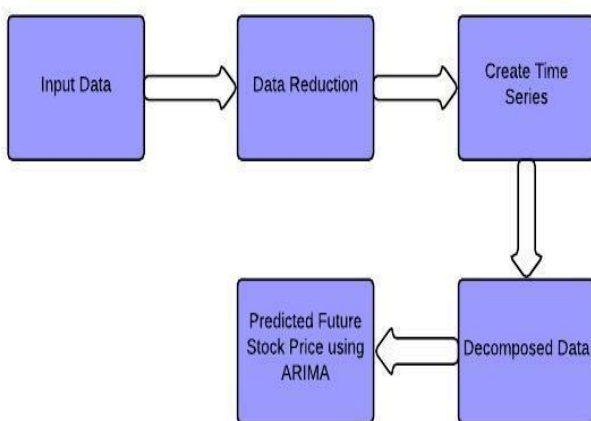
III. METHODOLOGY

Fig.1.   Architecture of stock price prediction using ARIMA Model

In this approach, we download the historic data set of the company on which stock prediction needs to be performed.

If the data storage environment is limited or if someone wants to work with limited data set then data reduction should be performed. Data reduction improves the storage

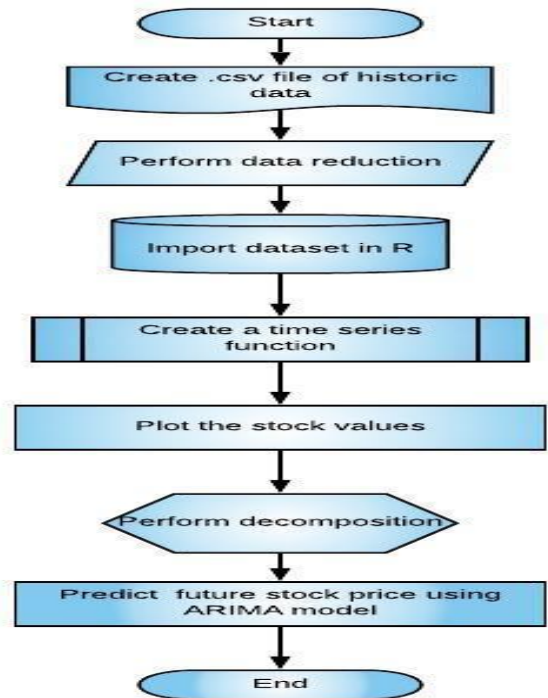efficiency. Time series means that the data is arranged as a series over time.

Fig. 2.   Flow Chart of of stock price prediction using ARIMA Model

For in-depth understanding and visualization of results, we have used the Quantmod package in R Studio. Quantmod package allows technical analysts to make use of various technical indicators with minimal effort. It makes it simpler to model and analyse plots.
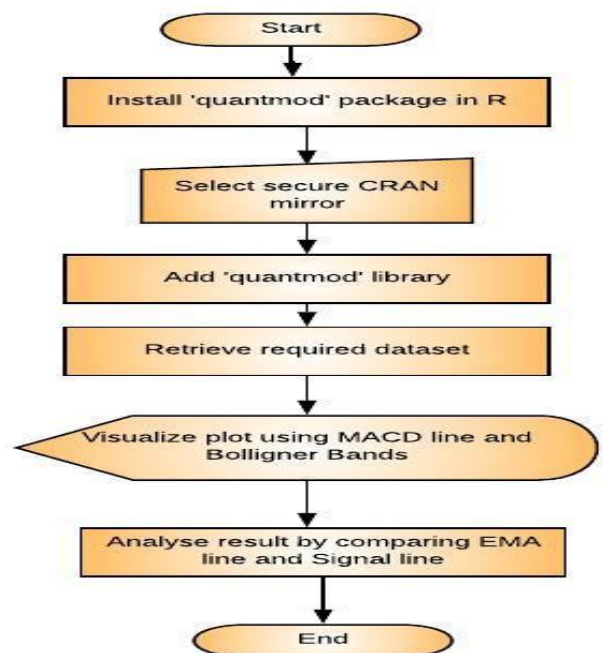

Fig. 3.   Flow Chart of of stock price prediction using Quantmod package

2

IV. RESULTS AND DISCUSSIONS

	AAPL.Open	AAPL.High	AAPL.Low	AAPL.Close	AAPL.Volume	AAPL.Adjusted
2015-01-02	111.39	111.44	107.35	109.33	53204600	103.86647
2015-01-05	108.29	108.65	105.41	106.25	64285500	100.94039
2015-01-06	106.54	107.43	104.63	106.26	65797100	100.94989
2015-01-07	107.20	108.20	106.70	107.75	40105900	102.36544
2015-01-08	109.23	112.15	108.70	111.89	59364500	106.29853
2015-01-09	112.67	113.25	110.21	112.01	53645500	106.41255
2015-01-12	112.60	112.63	108.80	109.25	49650800	103.79047
2015-01-13	111.43	112.80	108.91	110.22	67091900	104.71200
2015-01-14	109.04	110.49	108.50	109.80	48956600	104.31299
2015-01-15	110.00	110.06	106.66	106.82	60014000	101.48190
2015-01-16	107.03	107.58	105.20	105.99	78513300	100.69338
2015-01-20	107.84	108.97	106.50	108.72	49012100	103.28696
2015-01-21	108.95	111.06	108.27	109.55	48575900	104.07549
2015-01-22	110.26	112.47	109.72	112.40	53796400	106.78306
2015-01-23	112.30	113.75	111.53	112.98	46051200	107.33408
2015-01-26	113.74	114.36	112.80	113.10	55615000	107.44807
2015-01-27	112.42	112.48	109.03	109.14	95568700	103.68597
2015-01-28	117.63	118.12	115.31	115.31	146477100	109.54764
2015-01-29	116.32	119.19	115.56	118.90	84436400	112.95824
2015-01-30	118.40	120.00	116.85	117.16	83745500	111.30518
2015-02-02	118.05	119.17	116.08	118.63	62739100	112.70172
2015-02-03	118.50	119.09	117.61	118.65	51640300	112.72072
2015-02-04	118.50	120.51	118.31	119.56	70149700	113.58526
2015-02-05	120.02	120.23	119.25	119.94	42246200	114.39597
2015-02-06	120.02	120.25	118.45	118.93	43372000	113.43264
2015-02-09	118.55	119.84	118.43	119.72	38889800	114.18613
2015-02-10	120.17	122.15	120.16	122.02	62008500	116.37981
2015-02-11	122.77	124.92	122.50	124.88	73561800	119.10761
2015-02-12	126.06	127.48	125.57	126.46	74474500	120.61459
2015-02-13	127.28	127.28	125.65	127.08	54272200	121.20593
2015-02-17	127.49	128.88	126.92	127.83	63152400	121.92125
2015-02-18	127.63	128.78	127.45	128.72	44082300	122.77013
2015-02-19	128.48	129.03	128.33	128.45	37362400	122.51260
2015-02-20	128.62	129.50	128.05	129.50	48948400	123.51408
2015-02-23	130.02	133.00	129.66	133.00	70974100	126.85228

Fig. 4. Dataset of Apple Inc.

The historical data set of APPLE has been collected from Yahoo Finance. The historical data of any company can be downloaded. A csv file is generated which we will import in R studio for our analysis.

We need to select a secure CRAN Mirror
CRAN Mirror allows us to select a download site close to us for better bandwidth/latency.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
2015								
2016	175.2800	174.2900	174.3300	174.3500	175.0000	173.0300	172.2300	172.2600
2017	175.0100	175.0100	174.3500	174.5400	176.4200	173.9700	172.2200	172.2700

	Sep	Oct	Nov	Dec
2015		178.7994	176.1900	177.0900
2016	169.2300	171.0800	170.6000	170.5700
2017	171.7000	172.6700		

Fig. 5. Time Series of 2 years data with frequency 12.

For creating the Time Series function, the closing prices are listed in the 5th column is used. In addition, we also take the log of values and place them both in an accessible data frame. We have saved the closing values and the log values in a separate file.
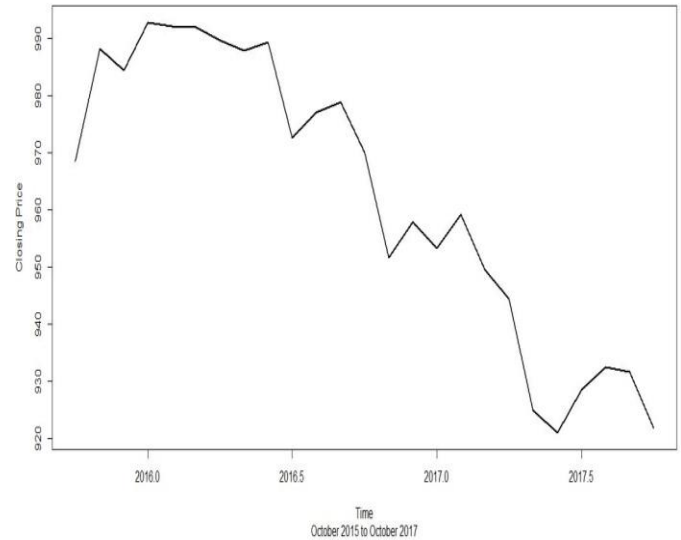

Fig. 6. Based on the closing price value the Apple Stock price is plotted

The data frame is plotted with x-axis as year and y-axis as the closing price. We have taken data from October 2015 to October 2017.
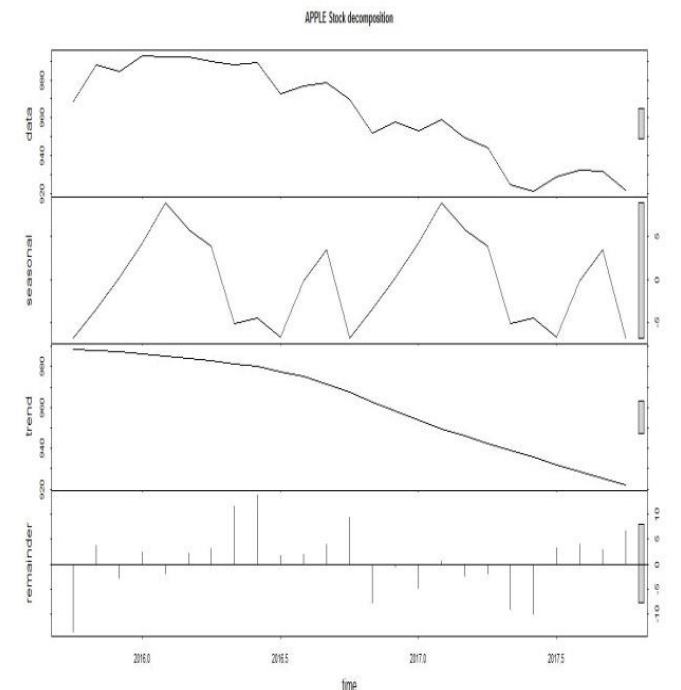

Fig. 7. Decomposition of the dataset

Decomposition is performed to remove the seasonal component from the data set and the trend is found after smoothening the remainder.
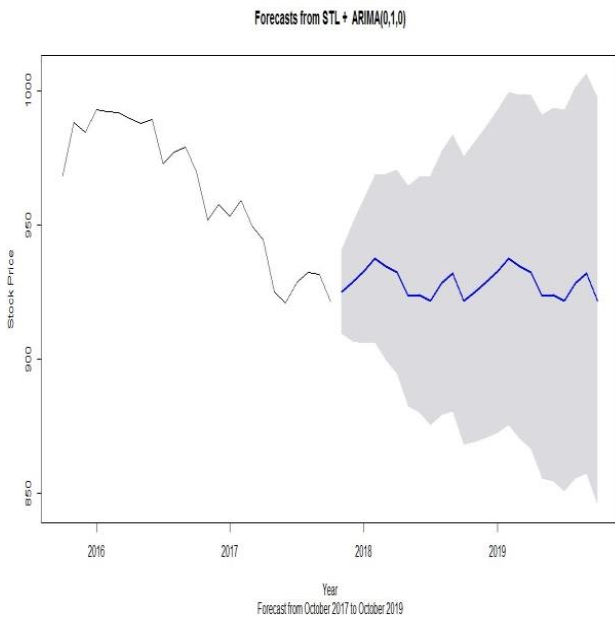

Fig. 8. Prediction of the stock price over the next 2 years

We use the forecast package to predict the stock price over the next 2 years using ARIMA Model as the prediction method.

The OHLC data cannot be downloaded directly from Google Finance, we need to call the getSymbols method.

Fig. 9. Plot showing MACD Line and Bollinger Band

Moving Average Convergence Divergence (MACD) is a centred oscillator that fluctuates above and below the zero line. It helps us analyse the strength, weakness or direction of momentum of a security's move.

BBands allows us in comparing the volatility and price levels of a stock over a period of time.

The MACD line is plotted by taking the difference between the value of 12 day and 26 day Exponential Moving Average (EMA).

Fig. 10. Plot showing the comparison between EMA line and signal line

Then a 9 day EMA of the MACD line is superimposed over the MACD as a 'signal line'.

MACD produces signals from 3 sources for prediction

- MACD/signal line crossovers - They are the most common signals sent out but are not very reliable as most of the times it sends a false signal. When the MACD line crosses above the signal line it is considered as bullish moving average and when the MACD is below the signal line it is considered as bearish moving average crossover.

- MACD central line crossover - MACD line below the centre line crossing over the centre line indicates bullish crossover and vice versa.

- Divergence with price - It is the least frequent signal that MACD generates but it the most powerful and reliable signal. During an uptrend, when the share price makes a higher high, but the MACD line makes a lower high there is a divergence with the actual price. During a downtrend, when the share price makes a lower low but the MACD line makes a higher low divergence occurs. Whenever a divergence is spotted there is a higher chance of price retracement

V. CONCLUSION

In this paper we have predicted the share market trends by considering a company's historical time series data. The ARIMA Model played a key role in predicting the short-term

4

trends of a stock market. To get the short-term predictions, correlations can be found out once we plot the results.

The naive share market investors can easily predict the share prices by making use of the Arima model and forecasting package.

The Quantmod package will allow specialists and analytical experts to make use of technical indicators to gain in-depth knowledge about the uptrends and downtends of the share market. The investors can do a thorough analysis of the share market by visualizing the graphical plots.

For accurate prediction the MACD line should be compared with the signal line indicator. The divergence with price signal is generated very rarely but is the most effective technique for precise analysis. This can help the investors make a profitable decision on whether to buy/sell/hold a stock.

REFERENCES

[1] D.Banerjee, "Forecasting of Indian stock market using time-series ARIMA model", 2nd IEEE International Conference on Business and Information Management (ICBIM), (January2014), pp. 131-135.

[2] Ayodele A. Adebiyi, Aderemi O. Adewumi, Charles K. Ayo, "Stock price prediction using the ARIMA model", 16th IEEE International Conference on Computer Modelling and Simulation (UKSim), (March 2014), pp. 106 -112.

[3] B. UmaDevi, D. Sundar, and P. Alli, "An Effective Time Series Analysis for Stock Trend Prediction Using ARIMA Model for Nifty Midcap-50.", International Journal of Data Mining & Knowledge Management Process (IJDKP) Vol.3 ,(January 2013.)

[4] Jarrett, E Jeffrey,E.Kyper,"ARIMA modelingwith intervention to forecast and analyze chinese stock prices",International Journal of Engineering Business Management 3.3 (2011).

[5] J. Contreras, R. Espinola, A.J. Conejo, F. J.Nogales "ARIMA model to predict next day

electricity prices", IEEE Transactions on Power Systems (Aug. 2003).

[6] P. Mondal ,L.Shit, S. Goswami,"Study of effectiveness of time series modeling (ARIMA) in forecasting stock prices", International Journal of Computer Science, Engineering and Applications (April 2014).

[7] M. Angadi, A. Kulkarni, "Time Series Data Analysis for Stock Market Prediction using Data Mining Techniques with R" International Journal of Advanced Research in Computer Science (August 2015)