International Journal of Management (IJM)
Volume 11, Issue 4, April 2020, pp. 5 – 14, Article ID: IJM_11_04_002
Available online at http://www.iaeme.com/ijm/issues.asp?JType=IJM&VType=11&IType=4
Journal Impact Factor (2020): 10.1471 (Calculated by GISI) www.jifactor.com
ISSN Print: 0976-6502 and ISSN Online: 0976-6510

APPLICATION OF TIME SERIES MODELS IN FORECASTING AUTOMOBILE SECTORS VOLATILITY FOR SELECTED PERIOD.

Ajay S. Ghangare
Assistant Professor – DMT (Department of Management Technology), Shri Ramdeobaba College of Engineering and Management, Ramdeobaba Tekdi, Gittikhadan, Katol Road, Nagpur – 440013, India

Tanmay Gupta
Assistant Professor – DMT (Department of Management Technology), Shri Ramdeobaba College of Engineering and Management, Ramdeobaba Tekdi, Gittikhadan, Katol Road, Nagpur – 440013, India

Mr. Shubham Singh
Student, Shri Ramdeobaba College of Engineering and Management, Ramdeobaba Tekdi, Gittikhadan, Katol Road, Nagpur – 440013, India

ABSTRACT

The Bombay Stock Exchange is extensive and fully regulated trading system in India. Exploration and forecasting of stock market time series data have developed considerable interest from the researchers over the last decade. Time Series modelling techniques perform pivotal role in prediction of data for future demands. Volatility forecasting has become crucial for investors, policy holders, retailers since bringing preciseness in estimating the future is very difficult. Automotive sector has gone through severe crash in their operations in last decade mostly due to policy changes, policy paralysis and confusion among retailers about several new changes to be brought by the authority. This paper suggested a review on some of the most crucial works gives a meticulous view of recent machine learning (ML) techniques in the quantitative share price prediction showing that these are the methods transcend some traditional approaches. This paper using time series analysis found out the volatility forecasting using machine learning and by applying volatility forecasting model ARIMA. The present study focuses on analyzing the suitability of ARIMA model for forecasting share prices of four major companies of automobile sectors Hero Motor Corp, Ashok Leyland, TVS Motors, Eicher Motors. The data collection was done on monthly basis for the period 11th August, 2014 to 16th August,2019 from the website of Bombay stock exchange.

Keywords: Automobile sector, ARIMA modelling, volatility forecasting, machine learning, volatility estimators, data analysis, BSE, time series analysis.

Cite this Article: Prof. Ajay S. Ghangare, Prof. Tanmay Gupta and Mr. Shubham Singh , Application of Time Series Models in Forecasting Automobile Sectors Volatility For Selected Period, *International Journal of Management*, 11 (4), 2020, pp. 5–14.
http://www.iaeme.com/IJM/issues.asp?JType=IJM&VType=11&IType=4

1. INTRODUCTION

Automobile sector in India witnessed 100 percent FDI through automatic route and de licensing since 1991.It has been catering to almost 5 lakh employment generation opportunities in India and makes a significant contribution to the tune of 4.7% to India's GDP figure. The purchasing power of Indian middle class has increased over the past few years which is able to attract the major auto manufacturers of Indian automobile market. From 2001 to 2006,this sector has shown growth rate of over 18 percent in terms of value of output and auto spare part sector has been witnessed with a growth rate of 26 percent giving a fair amount of chance to a retail investor to invest in this sector.(1)

Volatility being a crucial aspect of financial market plays a key role while pricing of stock market securities. For a retail investor, precise calculation of volatility assists in evaluation of assets and forecasting of returns in future. This volatility parameter has been helpful to investors in financial terms like derivative pricing, trading as well as in formulating strategies, (2)

Many researchers have done humongous amount of research in predicting accurate volatility by applying different time series models including ARIMA and others. Since Indian automobile sector has gone through tremendous policy changes during last decade and suffered the most, the paper tries to apply ARIMA model in selected companies and thereby tries to give exact idea to the investors so as to minimize their risk (3).As'ad (2012) applied four ARIMA models to calculate electricity demand in future. The ARIMA model with the specification three months past data had been found to be the best fitted model. (4)

Devi, Sundar, and Alii 2013 studied time series analysis in relation with the five stocks prices from Nifty Midcap 50 and best of the best fitted model forecasted the stock prices (5).Rotela Jr., Salomon, and Pamplona (2014) evaluated the performance of ARIMA model in analogous to other models for forecasting the Bovespa Stock Index. A study was directed in computation and forecasting of volatility using ARIMA technique with time - series data from the S&p 500 Index. (6) Ariyo, Adewumi, and Ayo (2014) performed different ARIMA models' making process for price prediction of stocks for a short time. Researchers found that the ARIMA model had boom prospective for stock prediction in short term in comparison of other prevailing prediction techniques.(7)

The motive of the study is to understand the suitable model for forecasting the share price of Automobile sectors of India. Hence, the data is gathered on monthly basis for share prices for the period 11th August, 2014 to 16th August, 2019 from the website of Bombay stock exchange and is referred to as Model Data in the analysis. To apply the model, the test data is collected on daily basis from 11th August, 2014 to 16th August, 2019 for the share prices of Automobile sectors on important four companies Hero Motor Corp, Ashok Leyland, TVS Motors, Eicher Motors from Bombay stock exchange. The various steps were applied for model formulation is: Model Identification, Variables Estimation and Model Selection, Test Data Analysis and Validation and finally Model Performance Evaluation.

The following graph depicts the flow of share prices of automobile companies for the period 11th August, 2014 to 16th August, 2019.

a). Hero Motor Corp share prices (Red color)

b). Ashok Leyland share prices (Blue color)

c). TVS Motors (Green color)

d). Eicher Motors share prices (Violet color)

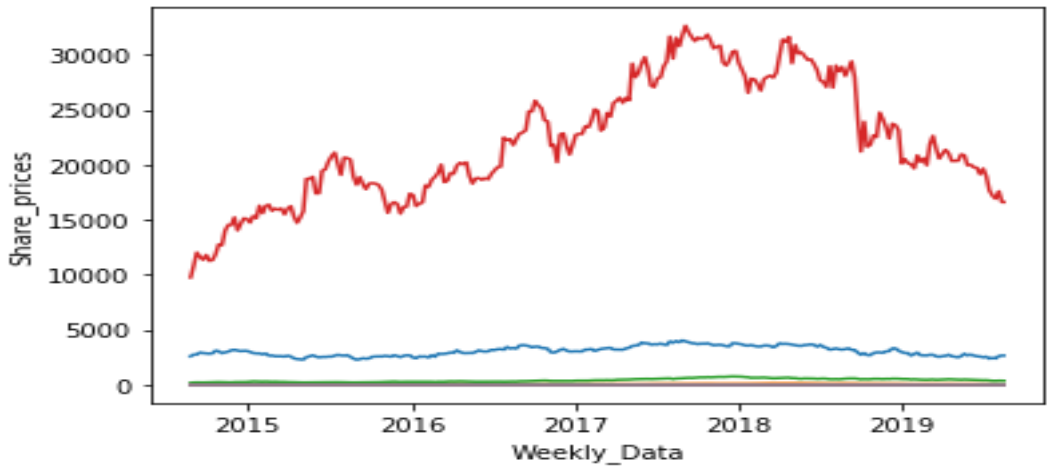


Figure 1

The data is arranged using Autoregressive Integrated Moving Average, ARIMA (p,d,q) model which is a joint-method of Autoregressive (AR) model showing the relationship between the present and the past values, random value and a Moving Average (MA) model showing the correlation with the past residuals. The generalized ARIMA (p,d,q) model is given as below:

$$X_t = \mu + \sum_{i=1}^{i=p} \boldsymbol{\beta i}\, \boldsymbol{X}_{t\text{-}i} - \sum_{j=1}^{j=q} \boldsymbol{\theta j}\, \boldsymbol{e}_{t\text{-}j} + q_t$$

A unit root test is applied for model identification and the stationarity of the series is tested using the Augmented Dicky Fuller (ADF) test. Use correlation diagram analysis to estimate p and q values for model estimation. This generates an autocorrelation function (ACF) and a partial autocorrelation function (PACF). The next step is to perform a step-by-step ARIMA estimation to identify the appropriate model and perform a unit root test on the residuals to determine the validity of the model.

2. MACHINE LEARNING

Machine learning is related to statistics, which focuses on computer-aided predictions. The scientific study of algorithms and statistical models used by computer systems to perform a particular task without using explicit instructions, instead of relying on patterns and conclusions. Data mining is an area of machine learning and focuses on the analysis of research data through unsupervised learning. In its application through business problems, machine learning is also known as predictive learning.(8,9).

NumPy focuses on Python using Python, which is not a good byte code interpreter. The mathematical procedure for this version of Python is generally slower than the equations. NumPy solves viscosity problems, provides matrices and more energy and agents that work well in matrices, need rewrite, loops start using NumPy in general(10)

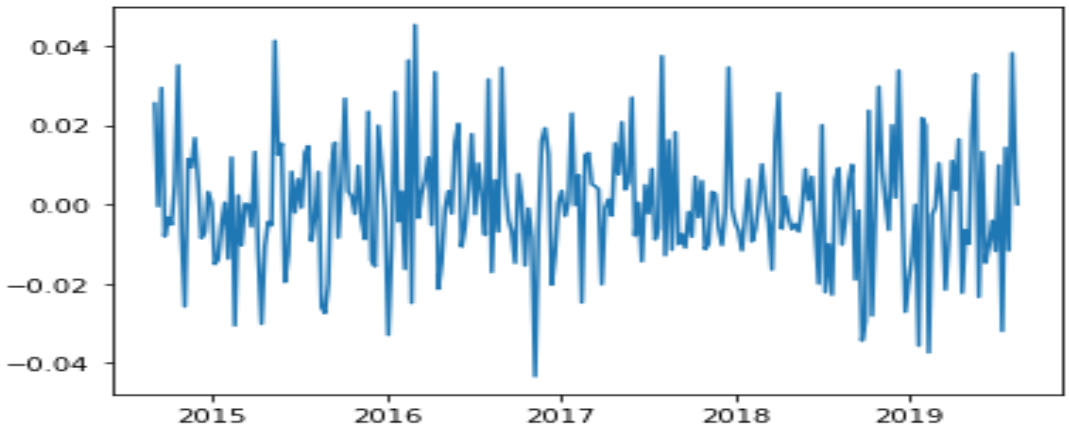
Scikit-learning uses this rich environment to provide sophisticated implementations of many common machine learning algorithms. Maintain an easy-to-use interface and is fully

integrated with Python. Research on non-specialized statistical data in the software and web industry responds to increasing demands for information, as well as in fields outside computers, such as biology or physics. (11).

In order to full-fill the necessity of ARIMA model, Automobile companies share prices **(ACSP)** must have no unit root (stationary).

D (ACSP) with no unit root.

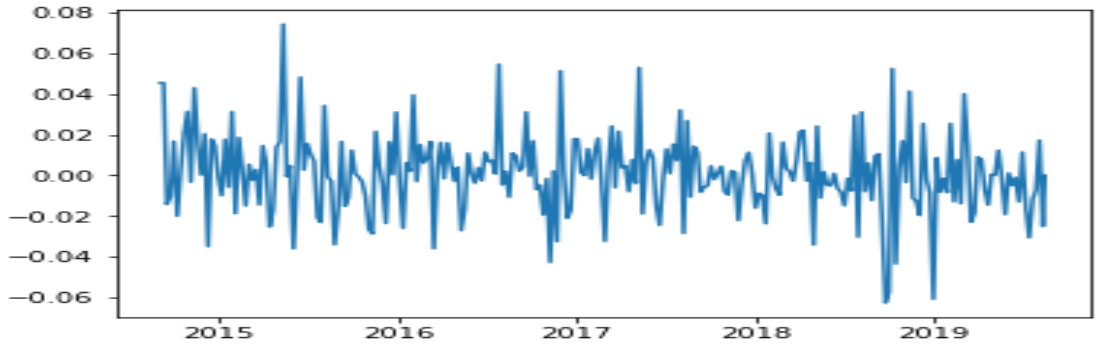
The following graphs of four companies using no unit roots as shown below.



a). Hero Motor Corp share prices

b). Ashok Leyland share prices

c). TVS Motors



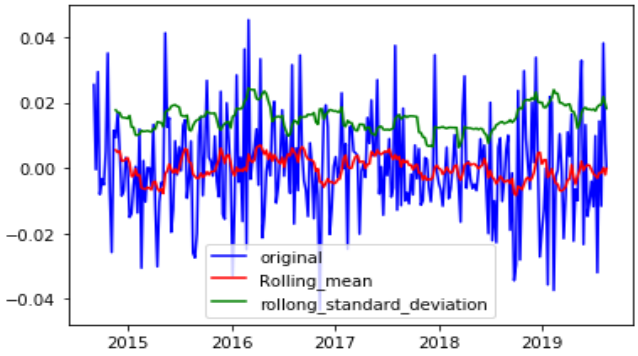
d). Eicher Motors

3. THE AUGMENTED DICKEY-FULLER (ADF) TESTS

The Dickey Fuller (ADF) test is a single root test of stationarity. Unit routes can have unpredictable results in time series analysis.

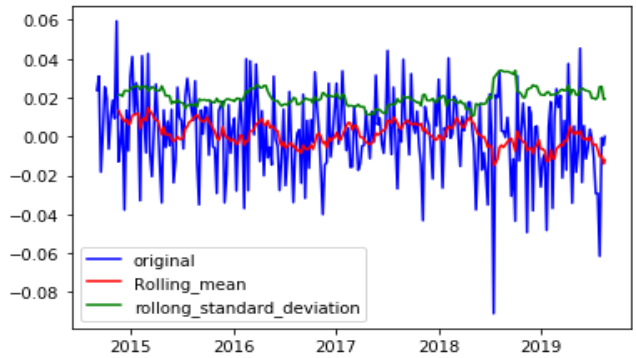
a). Hero Motor Corp share prices

test statistic	-1.633456
P value	0.0459032
Number of observations used	258.000000
Critical value (5%)	-2.892809
Critical value (1%)	-3.435953
Critical value (10%)	-2.582775



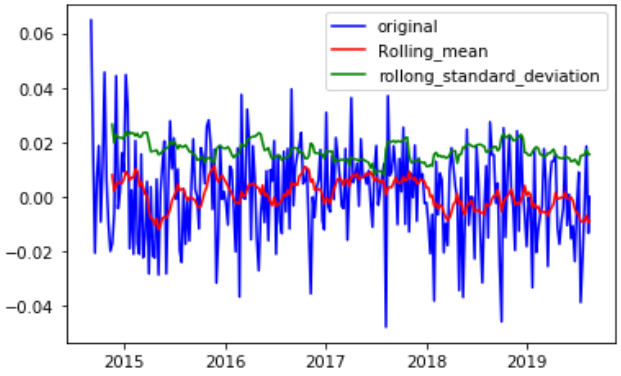
b). Ashok Leyland share prices

test statistic	-2.147992
P value	0.0249313
Number of observation used	258.000000
Critical value (5%)	-3.405656
Critical value (1%)	-2.852678
Critical value (10%)	-2.592705



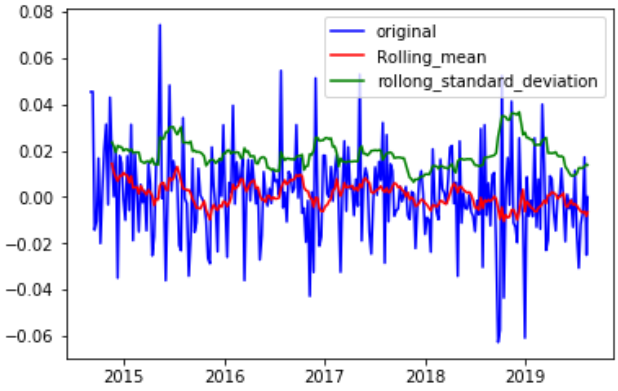
c). TVS Motors share prices

test statistic	0.805007
P value	0.0371701
Number of observation used	258.000000
Critical value (5%)	-3.457464
Critical value (1%)	-2.883033
Critical value (10%)	-2.552895



d).Eicher Motors share prices

test statistic	0.804007
P value	0.0291701
Number of observation used	258.000000
Critical value (5%)	-3.756464
Critical value (1%)	-2.873033
Critical value (10%)	-2.934568



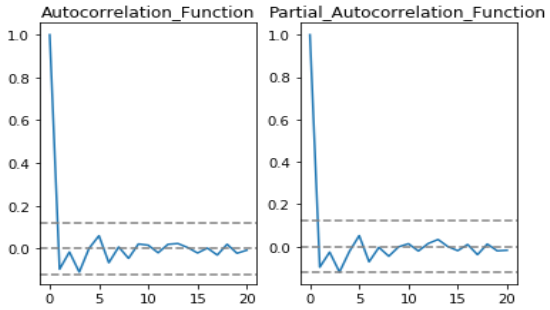
The test result shows that ACSP has a unit root at level since the p value of ADF test statistics is less than 0.05. After taking the first difference the series ACSP becomes stationary. Thus, we have d = 1

4. VARIABLES ESTIMATION AND MODEL SELECTION

The graph shows the autocorrelation and partial correlation function with the 95% confidence level.

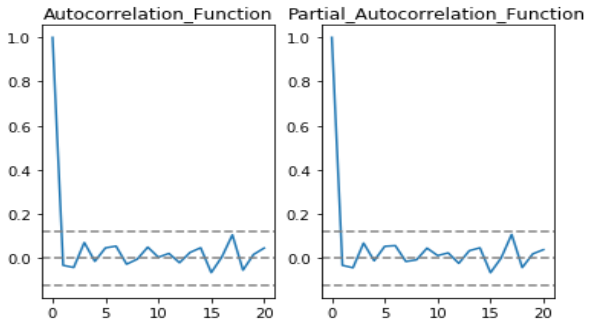
a). Hero Motor Corp share prices

Order (p,d,q)	Residual value
(4,1,1)	0.1342
(3,1,3)	0.1558
(1,1,1)	0.1165
(3,1,1)	0.1413



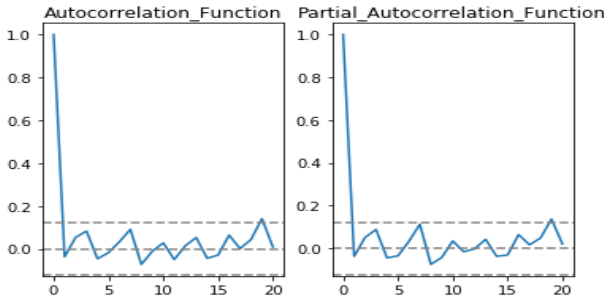
b). Ashok Leyland share prices

Order (p,d,q)	Residual value
(4,1,1)	0.4342
(3,1,3)	0.6528
(1,1,1)	0.0065
(3,1,1)	0.0213



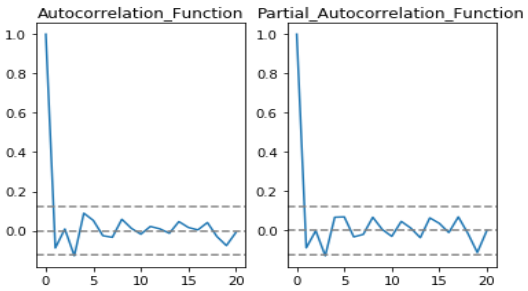
c). TVS Motors share prices

Order (p,d,q)	Residual value
(4,1,1)	0.1242
(3,1,3)	0.1528
(1,1,1)	0.1065
(3,1,1)	0.1213



d).Eicher Motors share prices

Order (p,d,q)	Residual value
(4,1,1)	0.3082
(3,1,3)	0.4107
(1,1,1)	0.1670
(3,1,1)	0.2755



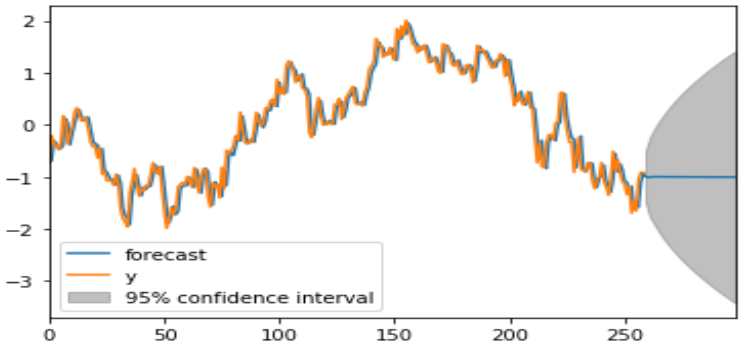
The values of Autocorrelation Function and Partial Autocorrelation Function is taken at the point where the graph initially cut the line y=0.

so, we can see that by using graph and the formula of Resudial value (1,1,1) model gives the smallest residual error with good accuracy level of forcasting share price.

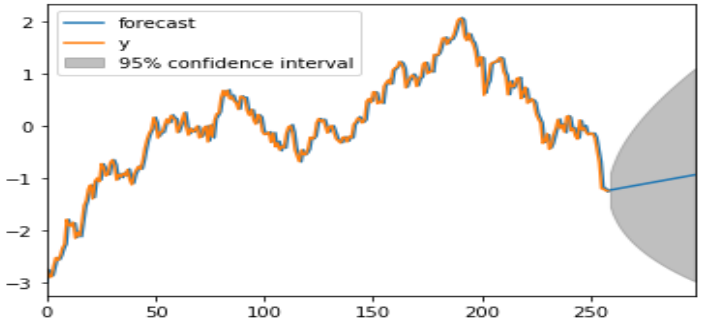
Residual-Error (p+1) = b0 + b1*r-error(p-1) + b2*r-error(p-2) ...+ bn*r-error(p-n)

4. FORECASTING REPRESENTATION

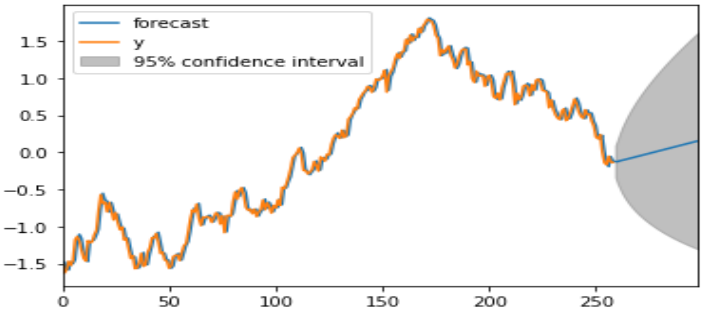
Stock market forecasting is the process of examining the value of a company's available assets or other instruments traded on an exchange. There are many ways to predict stock prices in the future.



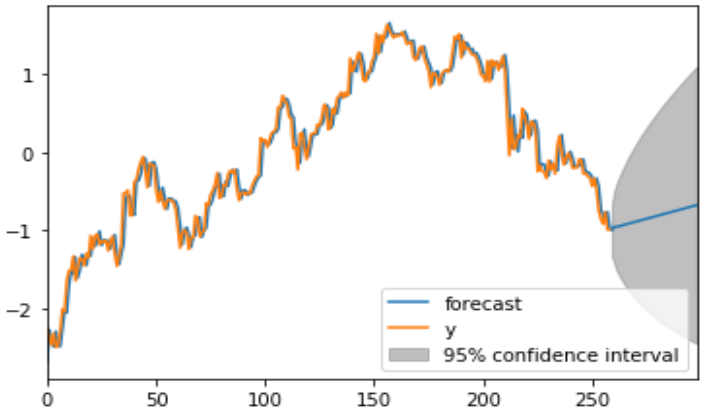
a). Hero Motor Corp share prices



b). Ashok Leyland share prices



c). TVS Motors



d). Eicher Motors share prices

5. CONCLUSION

India is industrializing exponentially, and the demand for strong transport networks between large cities and rural areas is increasing. India's automotive industry accommodates for 50% of the country's manufacturing GDP and is strongly supported by close forward and backward links with many keen parts of the economy[2].

Due to all these reasons the volatility of share price of automobile sector is important to help investors to actually, gain the insight about the forecasted share prices of the automobile sector. Especially, for this research we selected three major companies of automobile sector for the volatility of share prices and forecasting (Mahindra& Mahindra, Maruti Suzuki and Tata Motors)

The study concludes that ARIMA (1,1,1) is the most appropriate model for Automobile Sector forecasting in India.

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