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ASSESSING THE ROBUSTNESS OF AUTO REGRESSIVE INTEGRATED MOVING AVERAGE IN PREDICTING BANKNIFTY MOVEMENTS

Manochandar S
Assistant Professor, Department of Master of Business Administration,
CARE College of Engineering, Trichy-620009

Vasanth R
Student, Department of Master of Business Administration,
CARE College of Engineering, Trichy-620009

Abstract
The main objective of this study is to predict the BANKNIFTY stock price using Time series analysis using Auto Regressive Integrated Moving Average (ARIMA) method. The study was conducted on top five BANKNIFTY stocks based on the weightage in the National stock exchange (NSE). Under the BANKNIFTY stock AXIS bank, HDFC bank, SBI bank, ICICI bank, Kotak Mahindra bank are considered for this study. This study mainly focuses on the Forecasting the stock price of BANKNIFTY using time series model specifically on ARIMA model. This gives the better understanding of long-term performance of the stock for better investment decision making. At the same time, it also helps to create a portfolio. This helps the investors to make smart investment decision making and reduces risk depends.
Keywords: Time Series, Stock, Prediction, ARIMA, correlogram

INTRODUCTION

The stock market is an exchange place where the buying and selling of the shares, derivatives, equities, currencies, commodities happen oven an electronic platform executed by the brokers. The stock market is the place where the investors can buy and sell the stocks of the public companies through the exchange by the trading. SEBI (Securities and Exchange Board of India) controls and oversees the two major stock exchanges of India, known as the Bombay stock exchange (BSE) and the National Stock Exchange (NSE)(Hiransha, M., Gopalakrishnan, E.A., Menon, V.K. and Soman, K.P., 2018; Hiransha, M., Gopalakrishnan, E. A., Menon, V. K., & Soman, K. P. (2018)). The stock can be bought and sold at any market; all these activities are supported by the stock exchange. These two exchanges allow the investors to buy and sell stocks at their own phase. With the use of latest technology, the prices are updated very second for the investor to get a clear picture about the performance of the stock. The stock market plays a major role in economic development of the country. India is the country of 1.5 billion people in the recent survey more people have started investing the stock market to gain the long-term capital growth (Karuppiah, K., Umamaheswari, N., & Venkatesh, R. (2021)). The investors aim to maximize the

wealth trough trading, there are two types of investment mode for the investors to maximize the wealth, short term trading and long-term trading.

The technical analysis is used to predict the short term or intra days movement of the stocks, the technical analysis gives clear buying and selling signal for the traders. The fundamental analysis is used to predict the long-term growth of the stock. Fundamental analysis is considered as the powerful technique the investor uses to attain the long-term capital gain.

With increase in volume of data, Data is considered as the new oil if interrupted and predicted accurately helps investors with huge profit. The data are available in huge and the data is updated every second and stored at the yahoo finance website. Machine learning is a powerful technique that can predict the future value. In this project the data of five major Indian banks AXIS bank, SBI bank, HDFC bank, KODAK bank, ICICI bank are taken from yahoo finance for our analysis purpose. The data are taken from (2000 to 2022) in the form of .csv file in excel. The algorithmic trading is the latest techniques that helps investors and traders to mint money in the market now a day. Time series prediction is particularly useful in financial matters. In this project, the time series model- ARIMA is used to forecast the stock market for five popular Indian banks. This prediction will help the investor in future investment decision process. In the modern economy, the stock market or equity market is more significant. Both upward and downward share price patterns are significant factors in choosing an investment strategy. Forecasting the stock market is usually quite difficult. The stock market attracts a lot of investors and economists since it is thought to carry great risks and potential rewards. Based on analysis, people make stock market investments. (Choi, H. K. 2018; Pai, P.F. and Lin, C.S., 2005; Montgomery, D.C., Jennings, C.L. and Kulahci, M., 2015)

The prediction made after studying the past stock data is known as forecasting. Time series data forecasting offers investors vital information needed for the investment decision-making process. A time series is a chronological list of observations for a particular variable that is used in forecasting (stock price). Pattern analysis aids in identifying the best-performing companies over a given time period. As a result, time series analysis and forecasting are important areas of study. When the information contained in stock prices has less social value, it is more informative. Stock market forecasting is always uncertain; however, an examination of time series data can assist in identifying patterns, trends, and periods or cycles that exist in the data. It is demonstrated that there is a fundamental tension between the informing nature of stock prices and the effectiveness of corporate governance, limiting the disciplining role of stock prices. (Brockwell, P.J., Davis, R.A. and Calder, M.V., 2002)

The main objective of this study to predict the stock price of top five BANKNIFTY stocks using Time series Analysis (ARIMA).

REVIEW OF LITERATURE

Devadoss, A., & Ligori, A. (2013). conducted a detailed analysis on the common parameters for designing a neural network for forecasting economic time series data. **Ariyo, A. A., Adewumi, A. O., & Ayo, C. K. (2014, March)** described the long process of developing time series models for

stock price prediction using the ARIMA model. They conducted their investigation using data from the New York Stock Exchange (NYSE) and the Nigeria Stock Exchange (NSE). The data consists of four elements: open price, low price, high price, and closing price. The closing price was chosen for study to reflect the price of the index to be anticipated.

Mondal, P., Shit, L., & Goswami, S. (2014). indicates the effectiveness of the ARIMA model on stock price. Many surveys and review papers have been published to assess the accuracy of various statistical techniques for stock forecasting. ARIMA is employed as both an analytical and forecasting model in the Pacific's PACAPCCER China Database.

Menon, V.K., Vasireddy, N.C., Jami, S.A., Pedamallu, V.T.N., Sureshkumar, V., Soman, K.P (june,2016) used linear models to assess NSE (National Stock Exchange) stocks (AR and ARMA). According to the study, AR forecasts are favourable, but ARMA is improving. Despite stock splits, their estimate was correct for virtually all of the stocks. Another insight they received was that AR forecasts were generally favourable, but ARMA had an exaggerated trend.

Choi, H. K. (2018) conducted study on Stock Price Correlation Coefficient Prediction using ARIMALSTM Hybrid Model. Predicting the price correlation of two assets over time is critical in portfolio optimization. We forecast the stock price correlation coefficient of two individual stocks using LSTM recurrent neural networks (RNN). RNNs are capable of comprehending temporal dependencies. The addition of LSTM cells improves its long-term prediction qualities even further. We use the ARIMA model to account for both linearity and nonlinearity in the model. The ARIMA model filters the data for linear trends and provides the residual value to the LSTM model. Other classic predictive financial models, such as the whole historical model, constant correlation model, single-index model, and multi-group model, are examined alongside the ARIMA-LSTM hybrid model. In our empirical analysis, the ARIMA-LSTM model's prediction abilities outperformed all other financial models by a wide margin. Our findings suggest that using the ARIMALSTM model to anticipate correlation coefficients for portfolio optimization is worthwhile.

DATA ANALYSIS AND INTERPRETATION

In this chapter, the detailed Data analysis and corresponding interpretations are listed. Time series analysis is used in this study. The work deals with the test of stationarity using correlogram. Finally, the time series ARIMA is used as forecasting model.

AXIS BANK

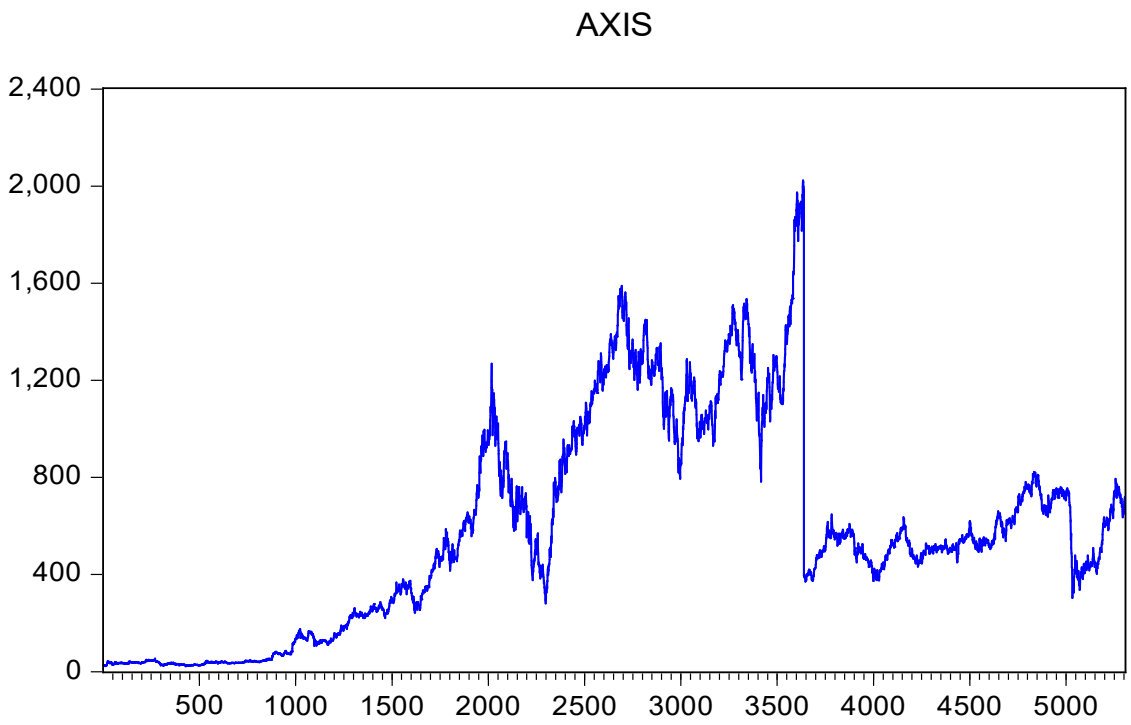

Figure 1: Descriptive analysis for AXIS BANK

The total number of observations considered for the analysis is 5306 (from the year of 2000 to 2022). The mean value for Axis bank stock is 585.8939, median is 519.500, maximum value is 2023.530, minimum value is 22.15000 and standard deviation is 436.6498.

AXIS-TEST FOR STATONARITY

A correlogram is a chart of correlation statistics which is mainly used to test the stationarity of the time series data. It consists of Autocorrelation function, partial autocorrelation function and Q stat. Correlogram for AXIS has been identified using 36 lags. The graphical representation of ACF values are tested and which indicates that the AXIS level data are non-stationary based on the spikes cross over the threshold standard deviation values. The graph clearly indicates that the ACF and PACF values lies within the range of standard deviation values. This shows that the values are stationary at first difference.

AXIS-ARIMA

The ARIMA (Autoregressive integrated Moving Average) is used for forecasting process. ARIMA(4,1,3) model is chosen as the best model for predicting the AXIS stock price. The significance of this model is shown in **Table 1**.

Table 1: Equation and Significance of the ARIMA for AXIS Bank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.122628	0.339825	0.360858	0.7182

AR(1)	0.839917*	0.012631	66.49389	0
AR(2)	-0.842964*	0.010755	-78.3801	0
AR(3)	1.013128*	0.00997	101.6223	0
AR(4)	-0.032719*	0.010185	-3.212487	0.0013
MA(1)	-0.815578*	0.008908	-91.55313	0
MA(2)	0.815843*	0.009849	82.83318	0
MA(3)	-0.989558*	0.008897	-111.229	0
SIGMASQ	774.947*	2.208643	350.8701	0
R-squared	0.004474	Mean dependent var		0.129727
Adjusted R-squared	0.00297	S.D. dependent var		27.90298
S.E. of regression	27.86151	Akaike info criterion		9.494157
Sum squared resid	4111094	Schwarz criterion		9.505314
Log likelihood	-25174.25	Hannan-Quinn criter.		9.498055
F-statistic	2.974963	Durbin-Watson stat		2.000218
Prob(F-statistic)	0.002514			

* indicates that the coefficient values are significant at 0.05 significance level

HDFC BANK

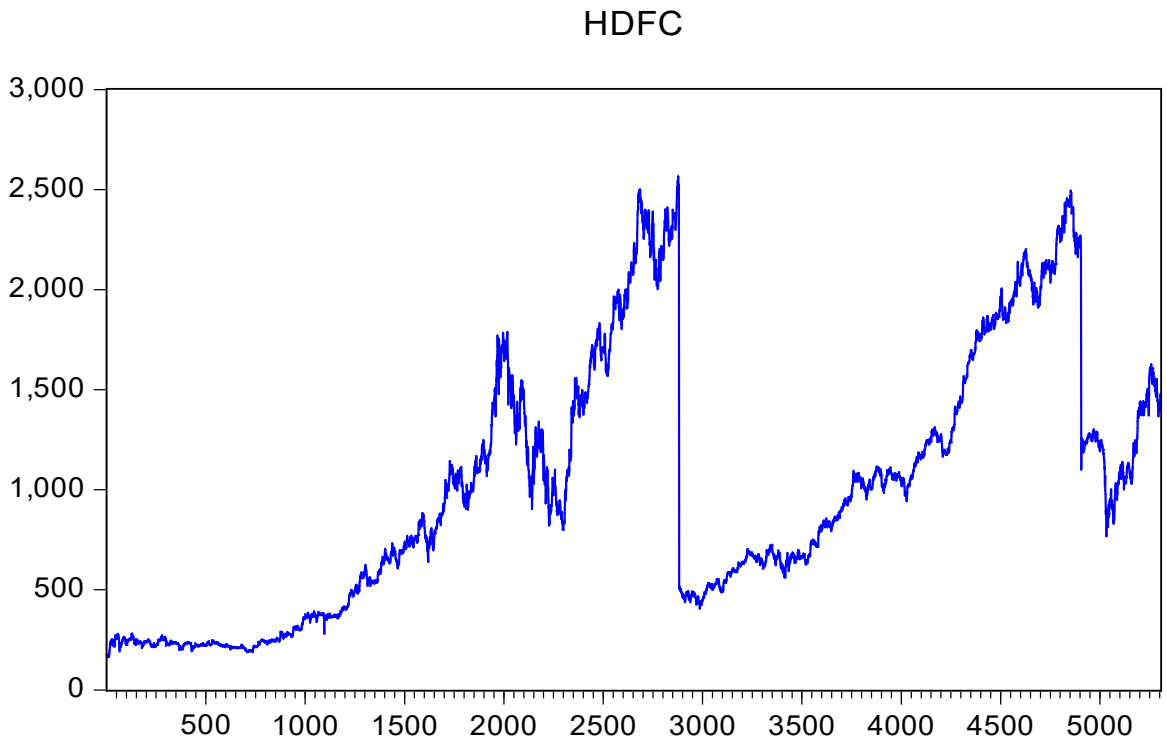

Figure 2: Descriptive analysis for HDFC BANK

The total number of observations considered for the analysis is 5306 (from the year of 2000 to 2022). The mean value for HDFC bank stock is 1007.330, median is 935.7250, maximum value is 2565.8, minimum value is 163.40 and standard deviation is 635.6750.

HDFC-TEST FOR STATONARITY

Correlogram for HDFC has been identified using the data for 36 lags. The ACF values are tested and it indicates that the HDFC level data are non-stationary based on the spikes cross over the threshold standard deviation values The graph clearly indicates that the ACF and PACF values are lies within the range of standard deviation values. This shows that the values are stationary at first difference.

HDFC-ARIMA

Table 2: Equation and Significance of the ARIMA - HDFC BANK

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.234175	0.512804	0.456657	0.6479
R-squared	0.000000	Mean dependent var		0.234175
Adjusted R-squared	0.000000	S.D. dependent var		37.35030
S.E. of regression	37.35030	Akaike info criterion		10.07875
Sum squared resid	7399316.	Schwarz criterion		10.07999
Log likelihood	-26732.88	Hannan-Quinn criter.		10.07918
Durbin-Watson stat	2.015281			

* indicates that the coefficient values are significant at 0.05 significance level

The ARIMA (Autoregressive integrated Moving Average) is used for forecasting process. ARIMA(0,1,0) model is chosen as the best model for predicting the HDFC stock price. The model is chosen by varying the p and q values in the ARIMA(p,d,q), where p represents the lags used for Auto regressive model and q represents the lags used for moving average model and d represent the difference used to convert the data into stationary.

ICICI BANK

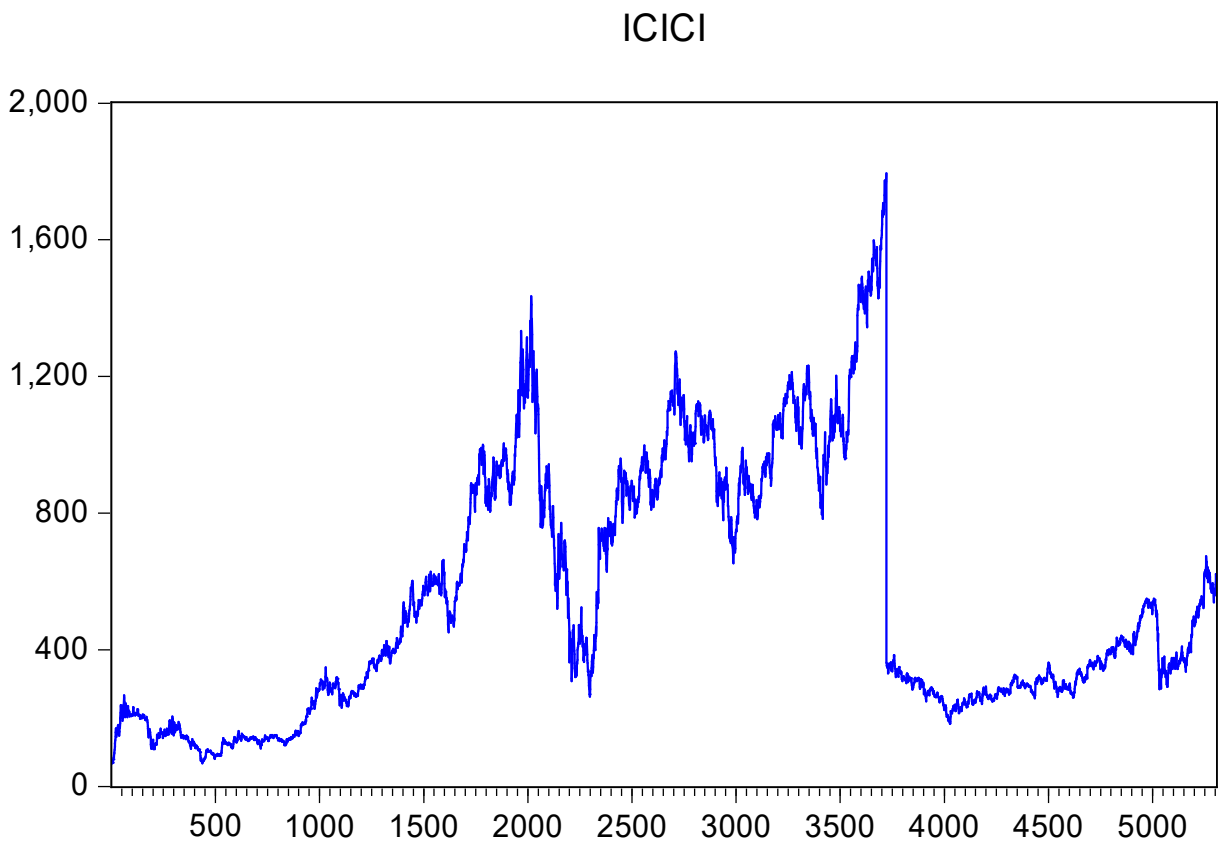

Figure 3: Descriptive analysis for ICICI BANK

The total number of observations considered for the analysis is 5306 (from the year of 2000 to 2022). The mean value for ICICI bank stock is 550.9955, median is 398.1750, maximum value is 1794.100, minimum value is 67.40000 and standard deviation is 368.7254.

ICICI-TEST FOR STATONARITY

Correlogram for ICICI has been identified using the data for 36 lags. The graphical representation of ACF values clearly indicates that the ICICI level data are non-stationary based on the spikes cross over the threshold standard deviation values. The graph clearly indicates that the ACF and PACF values are lies within the range of standard deviation values. This shows that the values are stationary at first difference.

ICICI-ARIMA

Table 3: Equation and Significance of the ARIMA-ICICI BANK

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.099019	0.516179	0.191831	0.8479
AR(1)	1.565142*	0.255580	6.123893	0.0000
AR(2)	-1.603292*	0.205690	-7.794707	0.0000
AR(3)	0.755781*	0.252125	2.997642	0.0027

MA(1)	-1.539691*	0.256078	-6.012586	0.0000
MA(2)	1.550472*	0.201121	7.709138	0.0000
MA(3)	-0.714235*	0.241279	-2.960211	0.0031
MA(4)	-0.029002	0.025521	-1.136405	0.2558
MA(5)	-0.003670	0.016444	-0.223177	0.8234
SIGMASQ	629.1803*	1.805281	348.5220	0.0000
R-squared	0.004278	Mean dependent var		0.099105
Adjusted R-squared	0.002586	S.D. dependent var		25.13966
S.E. of regression	25.10714	Akaike info criterion		9.286112
Sum squared resid	3337801.	Schwarz criterion		9.298508
Log likelihood	-24621.41	Hannan-Quinn criter.		9.290444
F-statistic	2.527699	Durbin-Watson stat		1.999823
Prob(F-statistic)	0.006868			

* indicates that the coefficient values are significant at 0.05 significance level

The ARIMA (Autoregressive integrated Moving Average) is used for forecasting process. ARIMA (3,1,5) model is chosen as the best model for predicting the ICICI stock price. The model is chosen by varying the p and q values in the ARIMA(p,d,q), where p represents the lags used for Auto regressive model and q represents the lags used for moving average model and d represent the difference used to convert the data into stationary.

KOTAK BANK

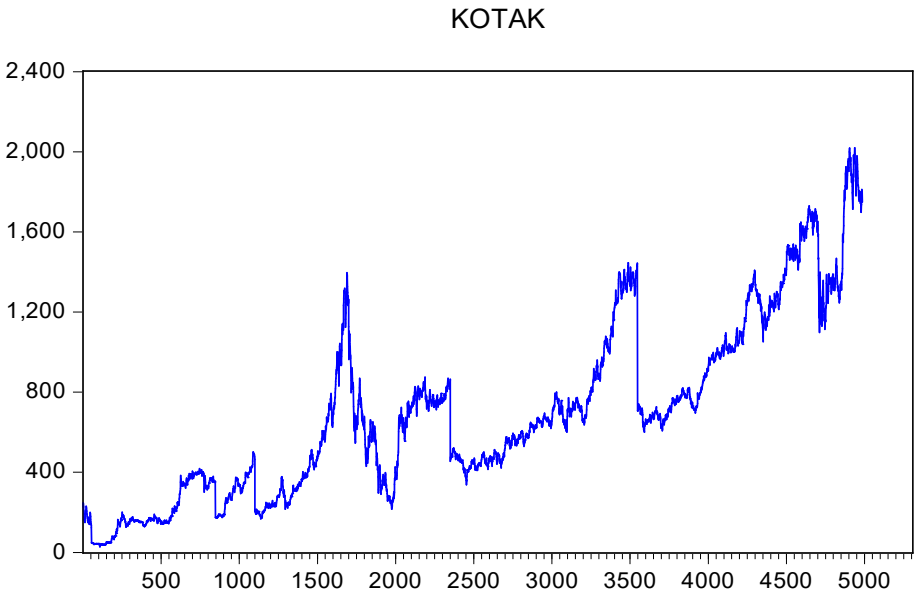

Figure 4: Descriptive analysis for KOTAK BANK

The total number of observations considered for the analysis is 5306 (from the year of 2000 to 2022). The mean value for KOTAK bank stock is 696.6151, median is 651.2000, maximum value is 2019.650, minimum value is 27.30000 and standard deviation is 440.9387.

KOTAK-TEST FOR STATONARITY

Correlogram for KOTAK has been identified using the data for 36 lags. The graphical representation of ACF values clearly indicates that the KOTAK level data are non-stationary based on the spikes cross over the threshold standard deviation values. The graph clearly indicates that the ACF and PACF values are lies within the range of standard deviation values. This shows that the values are stationary at first difference.

KOTAK-ARIMA

Table 4: ARIMA Equation output - KOTAK BANK

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.304898	0.373070	0.817267	0.4138
AR(1)	-0.144106*	0.011291	-12.76347	0.0000
AR(2)	-0.351791*	0.012735	-27.62309	0.0000
AR(3)	-0.905675*	0.014000	-64.69089	0.0000
AR(4)	-0.336523*	0.013707	-24.55175	0.0000
AR(5)	-0.119581*	0.012997	-9.200457	0.0000
AR(6)	-0.970940*	0.011108	-87.40908	0.0000
MA(1)	0.157197*	0.013640	11.52431	0.0000
MA(2)	0.354812*	0.015093	23.50841	0.0000
MA(3)	0.917666*	0.016603	55.27203	0.0000
MA(4)	0.335023*	0.016431	20.38939	0.0000
MA(5)	0.114168*	0.015698	7.272561	0.0000
MA(6)	0.956825*	0.013233	72.30638	0.0000
SIGMASQ	470.5570*	1.508417	311.9542	0.0000
R-squared	0.012266	Mean dependent var		0.304866
Adjusted R-squared	0.009683	S.D. dependent var		21.82879
S.E. of regression	21.72286	Akaike info criterion		8.997740
Sum squared resid	2345256.	Schwarz criterion		9.016037
Log likelihood	-22408.37	Hannan-Quinn criter.		9.004154
F-statistic	4.747698	Durbin-Watson stat		1.994673
Prob(F-statistic)	0.000000			

* indicates that the coefficient values are significant at 0.05 significance level

ARIMA(6,1,6) model is chosen as the best model for predicting the KOTAK stock price. The model is chosen by varying the p and q values in the ARIMA(p,d,q), where p represents the lags

used for Auto regressive model and q represents the lags used for moving average model and d represent the difference used to convert the data into stationary.

SBI BANK

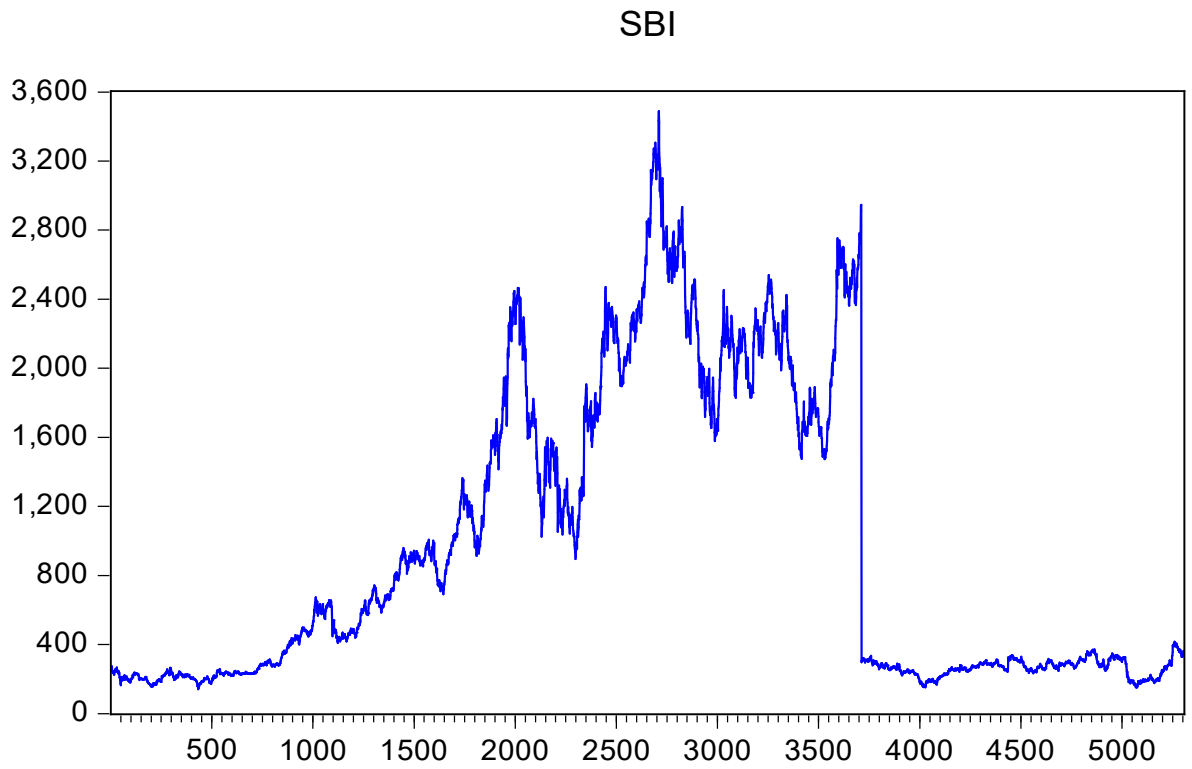

Figure 5: Descriptive analysis for SBI BANK

The total number of observations considered for the analysis is 5306 (from the year of 2000 to 2022). The mean value for SBI bank stock is 965.8955, median is 475.2750, maximum value is 3489.950, minimum value is 141.4500 and standard deviation is 857.7665

SBI-TEST FOR STATONARITY

Correlogram for SBI has been identified using the data for 36 lags. The graphical representation of ACF values clearly indicates that the SBI level data are non-stationary based on the spikes cross over the threshold standard deviation values. The graph clearly indicates that the ACF and PACF values are lies within the range of standard deviation values. This shows that the values are stationary at first difference.

SBI-ARIMA

Table 5: Equation and Significance of the ARIMA – SBI BANK

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.020257	0.986153	0.020541	0.9836

AR(1)	1.382222	0.015651	88.31743	0.0000
AR(2)	-0.979334	0.015832	-61.85677	0.0000
MA(1)	-1.335289	0.016794	-79.50975	0.0000
MA(2)	0.905348	0.024927	36.31941	0.0000
MA(3)	0.014915	0.024634	0.605472	0.5449
MA(4)	0.040745	0.018552	2.196199	0.0281
MA(5)	-0.040593	0.009359	-4.337106	0.0000
SIGMASQ	2105.309	2.949990	713.6665	0.0000
R-squared	0.008297	Mean dependent var		0.020707
Adjusted R-squared	0.006799	S.D. dependent var		46.07954
S.E. of regression	45.92262	Akaike info criterion		10.49351
Sum squared resid	11168665	Schwarz criterion		10.50467
Log likelihood	-27825.04	Hannan-Quinn criter.		10.49741
F-statistic	5.538751	Durbin-Watson stat		1.999583
Prob(F-statistic)	0.000001			

* indicates that the coefficient values are significant at 0.05 significance level

ARIMA (4,1,3) model is chosen as the best model for predicting the SBI stock price. The model is chosen by varying the p and q values in the ARIMA(p,d,q), where p represents the lags used for Auto regressive model and q represents the lags used for moving average model and d represent the difference used to convert the data into stationary.

From the above analysis clearly shows that all five banks data are converted into stationary at the first difference. The ARIMA model is constructed for each bank nifty data. This helps the investors to create portfolio and investment related decision. The above-mentioned models help to reduce risk and clear vision of customized portfolio creation.

CONCLUSION

The forecasting of stock price plays a crucial role in making investment decision. The Five bank nifty is chosen for the study. The model for the five Banknifty stocks based on their ARIMA model. The time series ARIMA model is built for the chosen for stocks for the investment. The nature of the stock data is analysed trough the descriptive statistics to get a clear idea about the distribution of the data. The stationary check was conducted using correlogram to check if the data is stationary, the correlogram clearly shows that the data is not stationary. Further the data is made stationary in first difference. ARIMA model was built using the first difference data for the chosen five banks. For each bank the ARIMA model is constructed, the p and q value for the ARIMA model is chosen based on the AIC value finally the model is used for the prediction purpose. The limitation of this study is only five banks are used for the study. The basic ARIMA model is used in this study, in future the study could be extend by adopting ARCH and GARCH models. Further the Deep learning methods also included to get better prediction value.

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