FORECASTING NIFTY BANK SECTORS STOCK PRICE USING ARIMA MODEL

Mohamed Ashik. A* and Senthamarai Kannan. K
Department of Statistics, Manonmaniam Sundaranar University
Tirunelveli, TamilNadu – 627 012

Abstract

The National Stock Exchange is widest and fully automatic trading system in India. Analysis and prediction of stock market time series data have involved considerable interest from the researchers over the last decade. Time Series Model is an essential tool for a data prediction in future demands. ARIMA Model is a forecasting model in time sequence records. In this paper, Bank sectors of Nifty daily closing stock market prices were computed and predicted of stock market fluctuations using Box-Jenkins (ARIMA) approach. From the study, it can be observed that the Private Bank sector of Mean Absolute Percentage Error is (0.603) tiny for other bank sectors. Hence, the Private Bank sector would be a minimum risk of investors for forthcoming trading days.

Keywords: *Stock Market, National Stock Exchange, ARIMA Model, Error Rate*.

1. Introduction

Predicting the trends in stock market trading prices are an extremely challenging task due to the uncertainties factors involved that influence the market value on a day such as economic conditions, investor's sentiment, political events etc. A Stock is a share in the pretension of a company. The Stock represents a claim on the company assets and incomes. Most shares are traded on exchanges, which are locations where buyers and sellers will meet and make a decision on a price. The scope of a stock market is to make possible the trade of securities between buyers and sellers, reduce investment risks. The National Stock Exchange (NSE) is a large stock market traded in Republic of India, which is set up in November 1992. NSE is being the first exchange in the country to provide a modern and fully automated screen-based electronic trading structure which accessible easy and quick trading facilities to the investors over the country.

Similarly, The Nifty (NSE) is an indicator of the several sectors. Such as Automobiles, Bank, Real Estate, Media, Pharmaceuticals, Information Technology, Energy, etc. Stock market price is most concerned about the stock open, low, high, close, and volume. In nature, a trading day closing price is not only associated with the previous trading day closing price. In this paper, consider about only banking sectors of Nifty closing stock price (in Rs.) data was used i.e. Bank, Private Bank, PSU Bank. The Bank sectors of NSE data were initially examined and then ARIMA model is used to well the data. The Data time period between July-2016 to June-2017, with 247 observations. Data is obtained from the part of nseindia.com and the computations are done by using SPSS software package.

2. Review of Related Study

Box et al (1970) proposed the Autoregressive Integrated Moving Average model using stationary concept for the forecast purpose. Pankratz (2008) studied are helpful to the proper construction of univariate cases for Box-Jenkins forecasting method in various fields. Paulo Rotela Junior et al (2014) described ARIMA model to obtain short-term forecasts for the next month in order to minimize prediction errors for the Bovespa Stock Index. Renhao Jin et al (2015) used ARIMA model for predicting in Shanghai Composite Stock Price Index and they are considered to closing stock price. Mohamed Ashik et al (2017) applied ARIMA model to forecast the upcoming daily closing stock price of Nifty50.

3. Methodology

3.1 Error Rate

Error rate is used to measure of forecast precision technique in statistics. Forecast error is a measure of how accurate our forecast was in a given time period. In this paper, consider about the Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE); Y_t – Actual Value; F_t – Forecast Value.

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(Y_t - F_t)^2} \qquad MAPE = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{Y_t - F_t}{Y_t}\right| \times 100$$

3.2 ARIMA Model

In time series study, an ARIMA model is a mixture of Auto-regressive and Moving Average with a difference. These models are fitted to time series data either to better identify with the data or to predict upcoming points in the series. It is also known as Box-Jenkins method. In case the data is found to be non-stationary is achieved by differencing technique and it's reduced. Generally, Box-Jenkins method are marked ARIMA (p, d, q) where parameters are p, d, q refer to autoregressive (φ), difference (∇) and moving average (θ) also can be expressed as

$$y_t = c + \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \ldots + \varphi_p y_{t-p} + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \ldots - \theta_q e_{t-q} \qquad \ldots\ldots (1)$$

φ – Autoregressive model; θ – Moving Average model; ∇ (Difference) – $Y_t - Y_{t-1}$; c – constant.

ARIMA model is analysis of the following four stages:

3.2.1 Identification

The identification stage finding the time series data is stationary or not and compare the estimated Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) to find a match.

3.2.2 Estimation

The parameters are estimated by modified least squares and maximum likelihood estimation techniques appropriate (ACF & PACF) to time series data.

3.2.3 Diagnostic Checking

The third stage of ARIMA model (Diagnostics Check) is necessary to test the appropriateness of the selected model. Model selection can be made based on the minimum values of Bayesian Information Criteria (BIC) given by

$$BIC = -2\log(L) + k\log(n) \qquad \ldots\ldots (2)$$

If the model selection is done, it is requisite to verify the satisfactoriness of the estimated model. The values of serial correlation can be studied to verify that the series of correlation residuals is white-noise. After the tentative model has been fitted to the data, it is important to perform the diagnostic check to test the suitability of the model. It has been found that it is effective to measure the chosen model by examining as Ljung-Box (Q) statistic; then the (Q) value is compared to critical values from chi-square distribution.

$$Q = n(n+2)\sum_{p=1}^{h}(n-k)^{-1}r_p^2 \qquad \ldots\ldots (3)$$

3.2.4 Forecasting

The final step of ARIMA model (Forecast) is an essential application of time series analysis. It is the prediction values based on identified past values of that variable or other related variables. In analysis part, the suitable model is found satisfactory, and the fitted model can be used for future prediction purpose.

4. Results

4.1 Descriptive Statistics

During the period of bank sectors (Bank, PVT Bank and PSU Bank) in NSE, there are no outliers identified (Figure 1). In Table 1, the summary statistics results for Minimum, Maximum, Mean, Standard Deviation, Skewness and Kurtosis are computed in the selected bank sectors closing stock price of Nifty.

Table 1. Summary Statistics of Bank sectors of Nifty closing stock price

Sector	N	Min	Max	Mean	Std.Dev	Skew	Kurt
BANK	247	17655.6	23742.2	20204.45	1699.81	.649	-.750
PVT BANK	247	9743.2	13208.6	11237.14	922.15	.629	-.585
PSU BANK	247	2742.5	3841.3	3238.06	244.24	.267	-.505

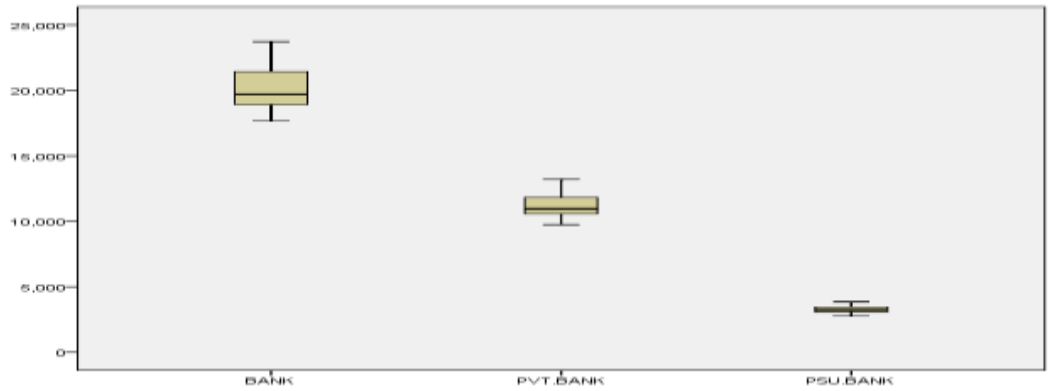

Figure 1. Whisker-Box diagram of Bank sectors of Nifty closing stock price

4.2. Stationary Sequence

A time plot diagram is firstly used of NSE Nifty50 sectors data based on closing price. As shown in Figure 2(a), a clear non-stationary fluctuations trend can be found, which is corresponding the Indian Economics. This fluctuation trend breaks the hypotheses of weaker stationary. In many application cases, the weaker stationary is used instead of strongly stationary. In Box-Jenkins method, a First order differencing is computed for the data after that time plot of the differencing data is shown in Figure 2(b). The differencing data shows a stationary model and thus the value of d (I) was 1. In Figure 3, the ACFs (MA) and PACFs (AR) are done based on the differentiating data, which display a short-term serial correlation and confirm the difference data is stationary. To construct a precise inference of the data, serial correlation is a check for white noise.

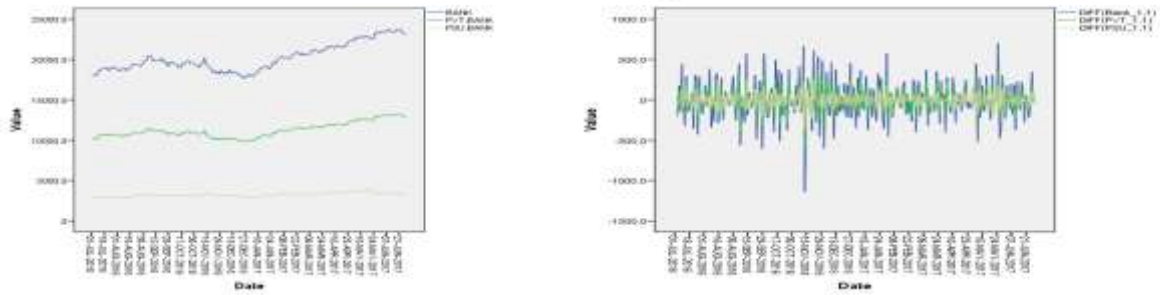

Figure 2. (a) Time plot of bank sectors (b) Time plot of first order differencing on bank sectors

4.3 ARIMA Modeling

Modern statistical methods have been able to aid companies to predict the future in the certain process. According to the identification rules on time series, the corresponding model can be established. If PACF and ACF of the stationarity sequence are truncated and tailed, it can be concluded the sequences for AR (p) model. If PACF and ACF of the stationarity sequence are tailed and truncated, it can be strong that the MA(q) model can be fitted for the sequence. If

PACF of a stationarity sequence and ACF is a tail; ARMA (p,q) model is appropriate for the sequence. Based on the results from an ARIMA model can be fitted to the bank sectors of Nifty, also the parameters in ARIMA (p,1,q) need to be determined. From the Figure 4, the Autocorrelation and Partial Autocorrelation are safe to the concluded.

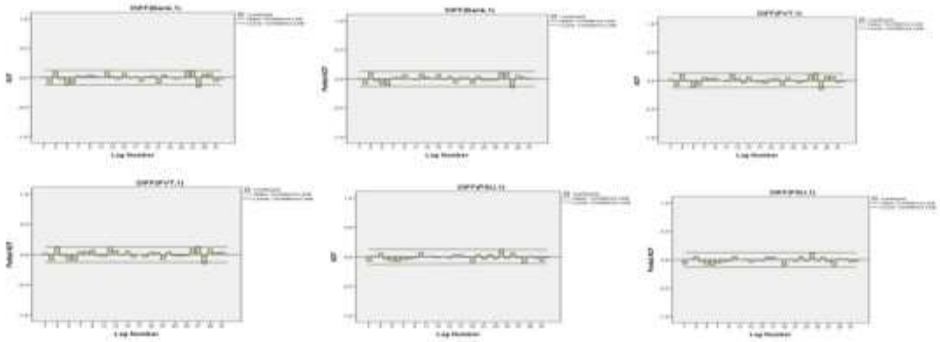

Figure 4. ACF and PACF of the first order differencing on bank sectors of Nifty

In addition, using SPSS package for different values of p and q (0, 1 and 2), various ARIMA models were monitored from equation 2. The appropriate model was chosen to correspond minimum value of BIC. In this approach, ARIMA (0, 1, 1) model was established to be the most suitable model for all sectors (Table 2). Then the model authentication is described with checking of residuals of the chosen ARIMA model. This can be done through examine autocorrelations and partial autocorrelations of the residuals of diverse orders. In Figure 4, the residuals of ACF and PACF of ARIMA (0, 1, 1) model are suitable for the original data.

Table 2. Model Statistics of bank sectors of Nifty closing stock price

Sectors	ARIMA	R^2	RMSE	MAPE	Ljung-Box (Q)	
					Statistics	Sig
BANK	(0,1,1)	.988	188.331	.696	17.757	.404
PVT BANK	(0,1,1)	**.989**	105.585	**.603**	16.855	.337
PSU BANK	(0,1,1)	.947	85.925	1.204	9.884	.908

From the Table 2, The Private Bank sector is highest R^2 values and lowest MAPE. Therefore (eq.1) the fitted ARIMA (0, 1, 1) model for Private (PVT) Bank sector closing stock price is

$$\hat{Y}_t = C + Y_{t-1} - \theta_1 \varepsilon_{t-1} + \varepsilon_t$$

$$\hat{Y}_t = 11.433 + Y_{t-1} + 0.021\varepsilon_{t-1} + \varepsilon_t$$

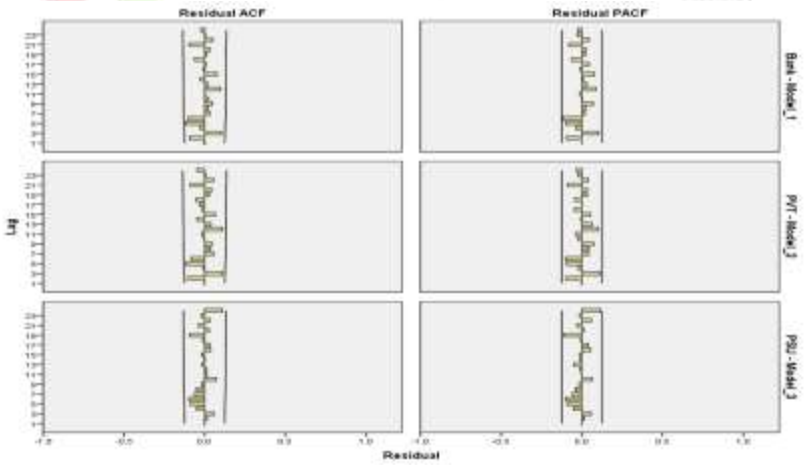

Figure 4. Residual ACF and PACF diagram of Nifty Bank sectors

As Table 3, Model parameters of Private Bank sector concluded with Difference (1), moving average (lag 1). These measures show that the future prediction error is low and the forecasting graph of Private Bank sector closing stock price is given in Figure 5. The volatility of Nifty sectors stock prices are can be caused by various factors, such as India financial, RBI policy, International events, and policies.

Table 3. Model Parameters of Nifty Private Bank sector closing stock price

			Estimate	SE	T	Sig
CL Price N50	No Transformation	Constant	11.433	6.875	1.663	.098
		Difference	1			
		MA Lag 1	-.021	.064	-.333	.740

Table 4. Comparison of Actual and Forecast Stock Prices with Error Rates

Date	Actual Price			Forecast Price			|Error|		
	BANK	PVT	PSU	BANK	PVT	PSU	BANK	PVT	PSU
03-Jul-17	23272.8	13016.7	3319.9	23232.2	13001.7	3303.2	40.6	15	16.7
04-Jul-17	23214.2	12998.5	3288.4	23253.5	13013.1	3305.5	39.3	14.6	17.1
05-Jul-17	23352.6	13098.1	3313.4	23274.7	13031.6	3307.7	77.9	66.5	5.7
06-Jul-17	23466.6	13117	3391.3	23296	13036	3310	170.6	81	81.3
07-Jul-17	23449.1	13096.5	3380.7	23317.2	13047.4	3312.2	131.9	49.1	68.5
10-Jul-17	23675	13195	3474.9	23338.4	13058.9	3314.5	336.6	136.1	160.4
11-Jul-17	23584.6	13140.7	3431	23359.7	13073.3	3316.7	224.9	67.4	114.3
12-Jul-17	23695.4	13193.6	3477.1	23380.9	13091.7	3319	314.5	101.9	158.1
13-Jul-17	23888.6	13330.4	3486.4	23402.2	13109.2	3321.2	486.4	221.2	165.2
14-Jul-17	23937.7	13349.6	3519.9	23423.4	13126.6	3323.5	514.3	223	196.4
Mean Absolute Error (MAE)							233.7	**97.58**	98.37
Mean Absolute Percentage Error (MAPE)							0.98	**0.733**	2.838

From the table 4, Comparisons of Actual closing stock price and Forecast closing stock price for Bank sectors. Then, the calculated of forecast error rates (MAE and MAPE). Hence, the private bank sector is obtained lowest MAE and MAPE. So that, this sector is more appropriate for accurate future forecast.

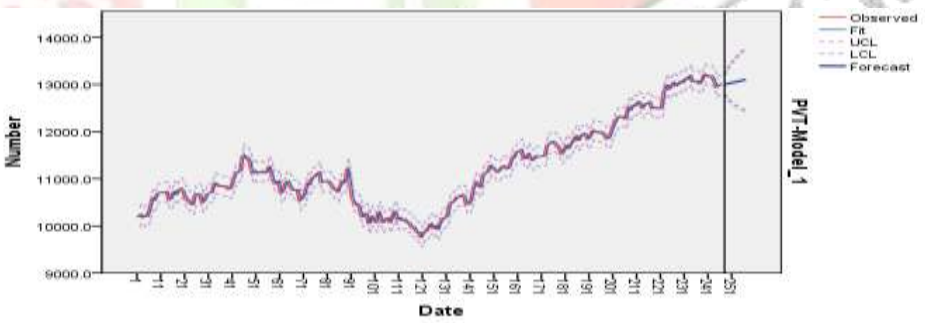

Figure 5. Forecast graph on the Private Bank sector of Nifty data

5. Conclusion

In this study, Box-Jenkins method offers an excellent technique for forecasting the importance of any variables. In the function of model construction, the originally bank sector's data of are found to be Non-Stationary, but the first order differentiating of all sectors data is stationarity. Then the monitoring of BIC values for various tentative ARIMA models we obtained the lowest BIC values for the fitted model of banking sectors. After that, ARIMA (0, 1, 1) model is developed for analyzing and forecasting of selected bank sectors closing stock prices. From the empirical results, it can be observed that the Private Bank sector of R-Squared value is high and MAPE is very small for other bank sectors. Thus the future prediction accuracy is more fitting for the Private Bank sector. Hence, the Private Bank sector was a minimum risk of investors for upcoming trading days.

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