Forecasting SGD-INR Exchange Return: An application of Autoregressive Integrated Moving Average

Dr. Sunil Kumari
Assistant Professor, Government College. Mehem

Ms. Jaya Gupta
Assistant Professor, New Delhi Institute of Management, New Delhi

Abstract
Predicting currency has always been open to doubt because in financial as well as in managerial decisions making process it plays a crucial role and it is not easy to forecast foreign rates with higher accuracy than a naive random walk model. The main goal of this paper is to use the Arima model to forecast the yearly exchange rate, here we use real foreign exchange data to check the suitable level of the Arima model for forecasting and it also shows how suitable the Arima model is to estimate foreign exchange. There has been considerable improvement in profitability of MNC which conducts substantial currency transfer in business courses and forecasts exchange rate accurately. The time series Arima model is applied to forecast the exchange return of SND to INR. To better understand how the Arima model applies within the period 1st February 2011 - 1st February 2021. In this report monthly or daily exchange returns are used for variable inputs. This model is based on a few observations on the Arima model to help predict and solve financial forecasting problems for the best and worst possible situations which results in demonstrating the predictive strength and potential but is still a problematic task.

Keywords: ARIMA, Exchange Rate, Exchange rate forecasting, forecasting, time series analysis

Introduction

The exchange rate is a price which measures the worth of domestic currency in terms of other nation's currency and it is always a topic of discussion in financial literature. Exchange rate is also known as forex and foreign exchange rate. It is an important factor in the growth of the economy of most developed countries where high volatility becomes a major obstacle in economic growth of the country. Currency in forecasting rate at least predicts the trend accurately with the underlying process by obtaining more efficient and some statistical model that represents variability which is important for future investments and also demanding application for time series forecasting but it doesn't assure the complete information.

Exchange rate is hard to foresee. Thus, exchange rate development is constantly beginning with the utilization of the adaptable flexible exchange rate to forecast the exchange standards. This is so because changes in rate effects import, external trades, inflation and balance of payments. In this regard, exchange rate is a significant factor in an economy for indicating demand and furthermore for its use in the monetary strategies and their values. Exchange rates are not completely predictable moments with exchange rates profoundly changing disorderly and with noisy structure. This makes difficult and significant topic in socialistic system in business life. Constantly, this has been a principle worry of academicians and other specialists in multinational financing. Endeavors to make more understanding and prediction of exchange rate movements have united numerous methodologies to predict but, all of them have their own limitations which are full of

complexities. None of them claim 100% accuracy in future exchange rate because these are derived by calculating values of foreign currency for a particular time period. Here the question arises how to identify the closet return of a particular stock which is given. For this many researchers have made efforts by using different methodology which affects the profitability and value of the firm.

Based on popular notion ARIMA (Auto Regressive Integrated Moving Average) technique is used to identify the forecast stock return on the basis of their error term and previous values due to removing obstacles in forecast due to non- stationary nature. In respect to this, ARIMA is a mathematical model introduced by Box-Jenkins in 1976, basically this method presents the future value of a time series as linear combination which is a series of values and past errors, that's why ARIMA model is the best model to forecast the series because special attention is given by Box-Jenkins for evaluation and selection of the model. To forecast the series both statistical and artificial intelligence models have been developed because it benefits both institutional investors as well retailers because before it works on data it helps in changing the information from non-stationary to stationary. This method gives an adaptable methodology in choosing the model and in estimating the parameters and boundaries for forecasting.

There have been a lot of investigations conducted on various areas that have applied ARIMA model for estimating different time series variables which includes stock cost also. However, less examination had been directed on different sectors using the ARIMA model. Forecasting helps in reducing the risks and uncertainty involved in currency exchange by fluctuations and analysis of exchange rate. They find out that this method for forecasting the exchange rate is the most promising alternative for forecasting the future, which is based on a fixed parameter design plan. Based on a set of historical information, the model structure as well as boundaries is resolved and estimated. Then the fitted model is used to predict what will fit in. In functional situations when new data is added the boundaries need re-estimation and hence this methodology gives restricted forecasting accuracy.

The strategy for developing ARIMA model is to explore the time series accompanying the principal step:

- Distinguishing the test pattern,
- Assessment of model parameters and identifying the ampleness of the model
- The utilization of models to predict.

Forecasting exchange rate seems to be an interesting topic in international finance and the main objective of this study is to forecast the exchange rate by using ARIMA techniques. The forecast of the exchange rate is led with the assistance of R software. The rest of the paper is coordinated as follows. The following section manages a short review of literature basically identifying the forecasting by time series based on which ARIMA model is formulated and proposed, followed by the data and methodology. The succeeding topics gives the result and discussion of the forecasting which is finished by applying ARIMA model and the last section gives the conclusion part of this paper.

Review of Literature

Prapanna Mondal Labani Shi and Saptarsi Goswami (2014) discuss that the prediction of stock price has always attracted interest because of the direct financial benefit and the associated complexity. In this paper, a study is conducted on the effectiveness of Autoregressive Integrated Moving Average (ARIMA) model, on fifty-six Indian stocks from

different sectors. The simplicity and wide acceptability of the ARIMA model is the reason the author has chosen this model. For understanding the time series data and forecasting generally ARIMA models Minakhi Routa, Babita Majhi, Ritanjali Majhi and Ganapati Panda (2013) suggests a simple but unique mixed prediction model by easily and compatibly combining an adaptive autoregressive moving average (ARMA) architecture and differential evolution (DE) which are based on training of its feed-forward and feed-back factors. By using a sliding window of past data a simple statistical feature is extracted for each exchange rate and for DE optimization strategy data are employed as input to the prediction model for training its internal coefficients.

Nyoni, Thabani (2019) utilizes yearly time series information on the Indian Rupee/USD Exchange Rate from1960 to 2017, to demonstrate and estimate trade rates utilizing the Box-Jenkins ARIMA technique. Analytic tests indicate that R is an I (1) variable. In light of Theil's U, the examination presents the ARIMA (0, 1, 6) model, the analytic tests further show that this model is very steady and thus adequate for estimating the Indian Rupee/USD trade rates. The chosen ideal model, the ARIMA (0, 1, 6) model shows the Indian Rupee/USD exchange. Exchange rate expectation is one of the demanding uses of present-day time series forecasting (Nwankwo, 2014). The rates are inherently loud, non-fixed and deterministically disordered (Box and Jenkins, 1994). Creating quality forecasts is certifiably not a simple task (Mustafa et al, 2017). Given the examination and forecasts of this investigation, our proposal is that policy makers in India should degrade the Rupee to re-establish and keep up exchange rate steadiness. In case of implementation of devaluation of money in India, the local manufacturing sector is one of the sectors that will see a rise exceptionally well. This is mainly due to the inflows of the foreign capital which have been waiting for a long span of time.

Abdullah, L. (2012) applied Auto-Regressive Integrated Moving Average (ARIMA) is crucial time series models used in forecasting the foreign exchange markets but not usually used to forecast gold prices. This paper proposes to forecast the price of gold bullion coins. The autoregressive integrated time series was proposed by Box-Jenkins Moving Average (ARIMA) Forecasting model. It needs historical time, like all others, for forecasting. This model also presumes that future values of the data time series have a defined relationship with current, past values and noise. This method has been used already in various divisions including fishery landings. Steve C Nwankwo (2014) applied ARIMA model's usage for examining exchange rate to contribute towards economic decisions. It was mainly done to help the ones who are on the peculiar and unpredictable pattern in the Nigerian exchange rate framework, to differentiate the exchange rate model, examine the boundaries of the model and to predict what is there in the box for future. The final objective to observe about the conversions, this framework of ARIMA model was applied to foreign rates from Naira to Dollar inside for the time period 1982 to 2011 using box Jenkins strategy, AR1 was developed as it was preferred through the diagnostic rate of Naira-dollars based on future expectations and computational necessities.

Ismail and Al-Gounmeein (2019) tells that be it national, regional or international levels, the use of forecasting for the exchange rate is very important. It can assist investors to reduce the financial risk involved as well as maximize earnings within the volatility of the global economy. The objective of their research was to use the time series model in order to forecast the Jordan dinar exchange rate based on the monthly data that was collected for Jordanian dinar vs. US dollar. The prediction is done with the help of 2 models that are ARIMA and SARIMA. When comparing the forecasting method, they found that SARIMA led to low mean total error, mean absolute square error, mean absolute fraction error as well as low root

mean square error. Therefore, they concluded that it is considered to be the best method to determine the exchange rate of the US dollar vs Jordanian dinar

Data and Methodology

The topic on which we conducted our study is 'forecasting exchange rates' by employing the ARIMA model, developed by Box and Jenkins in 1970. The primary objective of this study is to forecast the exchange rates of the currencies like SGD-INR for the years starting from Feb 1, 2011 till Feb 1, 2021. The data has been extracted from a secondary source; an internet website named 'investing.com.' ARIMA is an abbreviation for 'Auto Regressive Integrated Moving Average.' It is a model similar to the other statistical models that work on the assumption that time series value consists of linear correlation structures. The ranges of over forecasted values lie between 0.21% and 1.62% thereby proving that this model is the best for prediction. In this study ARIMA model is used to forecast the exchange rates of different currencies for 5 years using R Studio.

The model is said to believe that the information gathered is hidden either in the past of the time series such as Yt-1, Yt-2 and so on and so forth or in the series' residuals like et-1, et-2, and so on and so forth. (Yt being the response variable at time t and e being the error term). ARIMA model is comprised of 3 terms namely p, d, q

where,

p is the order of AR term q is the order of MA term
d is the number of differencing required to make the time series stationary

The three terms are to be described as follows:

AR in ARIMA stands for 'autoregressive' which functions on an assumption that the information is hidden in the past values of the time series like Yt=f(Yt-1, Yt-2,…)

Similarly, MA in ARIMA stands for 'moving average.' this functions on the assumption that the data is hidden in the errors like Yt= f(et-1,et-2,…)

ARIMA model of forecasting is a simple four-step process- firstly transforming the series in order to obtain stationary values by way of differencing. Once data transformation is done then the researcher ascertains the p, d, and q parts of the model i.e. autoregressive progression, number of times the series is required to be differenced and the moving average process. In the further stage of the model, estimations of the parameters are made. In the final stage, the assumptions made and how normal the residuals are verified.

Empirical Result and Interpretation

It is observed from table 1 that the minimum and the maximum values of the SGDINR are 34.96 and 55.51 respectively. The mean value of the SGDINR is calculated to be 47.41. The variation in the currency rates can be seen with the value of the Standard Deviation which came out to be 4.6269. This implies that there is some volatility in the market and deviation in the stock return from mean. Above figure 1 depicts the time series graph of the Singapore Dollar prices which were 35.811 on 1st Feb 2011. This is expected to be non-stationary in nature thus this shows that the currency rates seem to be non-stationary, so our first step is to convert it into Stationary. Thus, to make the currency rates stationary the return on the currency rates have to be calculated.

To calculate the return the following formula can be used:

Return on Currency= ln (p2/p1)*100

Ln= Log normal

P2= Price on 31st Jan

P1= Price on 1st Feb

Where, prices did not follow any trend but majorly it was the upward trend. The prices were rising but it fluctuated a bit and was falling but then it started rising again.

Table 1: Descriptive Statistics

	SDR- INR
Mean	47.41
Maximum	55.51
Minimum	34.96
Standard Deviation	4.626915

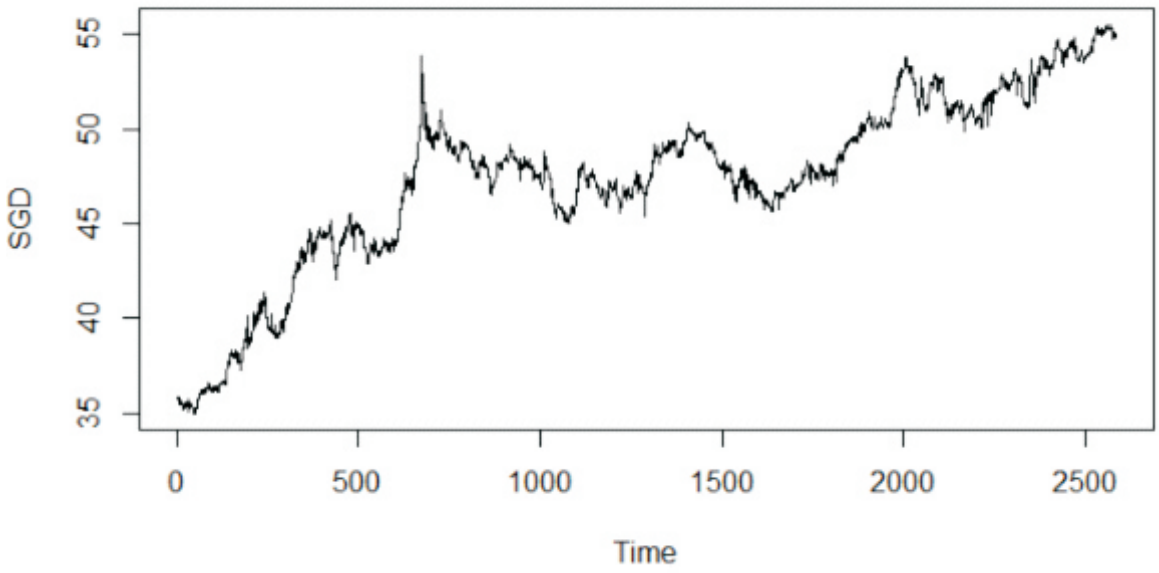

Figure 1: Time series plot of SGD

In order to check whether the SGD price returns are Stationary or not, researchers have to apply ADF test statistics on level at 5% significance level.

The hypothesis for the test was:
H0 : The series is non stationary
H1 : The series is stationary

The results of the ADF test which has been employed on the Currency rates return series of SGDINR depicts the ADF value as -14.682 and the probability value as 0.01 which is less than 5%, this confirms that the series is stationary.

Model Identification

After achieving the results of stationarity in the series through log normal currency rates return values, researchers introduced the Box Jenkins methodology. The initial step is to identify the appropriate model. So as to identify the best fitting ARIMA model for the currency returns of SGD-INR a function "auto.arima" has been applied in the R Studio. After applying the function, the best model has been estimated. This will identify the number of AR and MA terms on which the returns of the currency rates depend. Finally, the ARIMA model (2,0,2) came out to be the best fit model for the prediction of the SGD-INR currency rates returns. In the estimated model, the value of AR comes out to be 2 which explains that currency rates return of SGD-INR can be forecasted by considering currency rates return of previous two days whereas I stand as 0 which shows stationarity of natural log returns series at first differencing. Moreover, the value of MA comes out to be 2 which represents that stock returns of currency rates of SGD-INR are affected by the error term of the previous two days.

Using R studio, following are the estimated parameters on the basis of model identified:

Table 2: ARIMA (2,0,2) Model

Coefficients:

	ar1	ar2	ma1	ma2	mean
	0.8089	-0.2702	-1.0472	0.4391	2e-04
s.e.	0.1315	0.0717	0.1279	0.0719	1e-04

sigma^2 estimated as 2.693e-05: log likelihood=9930.63
AIC=-19849.27 AICc=-19849.24 BIC=-19814.13

From the above table 2, the coefficients depict the AR and MR terms of ARIMA model whereas S.E. shows the standard error.

Conclusion and Summary

This study is based on the concepts of the ARIMA model. By applying we forecast the foreign currency exchange rate of different countries to show the effectiveness of the method, it not only helps in potential forecast of the values in the short term but it also helps in decision making to know what is best or worst possible situations. Using ARIMA in forecasting and analyzing helps the investors for guidance related to investing or disinvesting at the correct time. Exchange rates have long fascinated challenged and puzzled researchers in international finance. Exchange rate prediction is one of the demanding applications of modern time series forecasting. This research applies the ability of the Arima model in forecasting foreign exchange rate of SND to INR, CHF to EUR, KWD to USD, INR TO JPY, CAND. to DOLLAR. The R software was utilized for prediction of exchange rates. The ARIMA technique was constructed and three main steps for constructing the model were identified namely, Identification, Estimation and Model Checking. The results show that the Arima Model is absolutely suitable for forecasting. The policy makers should apply the Arima Model in forecasting foreign exchange rate. The financial planners should apply the Arima model in forecasting as well as the results of forecasting in measuring foreign exchange rate risk in order to make more benefit for their bank.

References

1. Prapanna Mondal1 , Labani Shit1 and Saptarsi Goswami (2014), Study of effectiveness of time series modeling (ARIMA) in forecasting stock prices, International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol.4, No.2, 13-19
2. Ngan, T. M. (2016). Forecasting foreign exchange rate by using ARIMA model: a case of VND/USD exchange rate. Research Journal of Finance and Accounting, Vol.7, No.12(ISSN 2222-1697), 1-7
3. Minakhi Rout a , Babita Majhi, Ritanjali Majhi d and Ganapati Panda (2016). Forecasting of currency exchange rates using an adaptive ARMA model with differential evolution based training, Journal of King Saud University – Computer and Information Science
4. Al-Gounmeein, I. (2019). Forecasting the Exchange Rate of the Jordanian Dinar versus the US Dollar Using a Box-Jenkins Seasonal ARIMA Model. International Journal of Mathematics and Computer Science(ISSN 1814-0432), 27–40
5. Adewole, A. P., Akinwale, A. T., & Akintomide, A. B. (2011). Artificial neural network model for forecasting foreign exchange rate.
6. Abdullah, L. (2012). ARIMA model for gold bullion coin selling prices forecasting. International Journal of Advances in Applied Sciences, 1(4), 153-158.
7. Ngan, T. M. U. (2013). Forecasting foreign exchange rate by using ARIMA model: A case of VND/USD exchange rate. Methodology, 2014, 2015.
8. Nwankwo, S. C. (2014). Autoregressive integrated moving average (ARIMA) model for exchange rate (Naira to Dollar). Academic Journal of Interdisciplinary Studies, 3(4)