Business Forecasting: End-Term Project

Project report on Foreign Exchange rates Forecasting

Submitted By
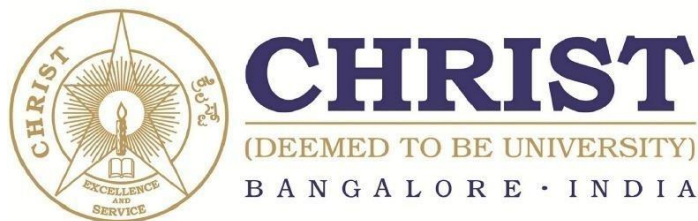
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Abstract

The prime purpose of this study is to examine the relationship between the exchange rate with exports and imports of Indian organizations. A global import/export organization performs strategic planning for purchasing and selling goods. Planning for the scheduled date for generating a purchase order is vital for these organizations to maximize profit and mitigate losses relevant to the foreign exchange rates. In turn, planning to purchase or import goods well beforehand in case of increasing volatility of the Indian rupee against the US- Dollar might help mitigate the losses. The Time series forecasting approach model is employed to forecast the daily foreign exchange rate relationship between US-Dollar and the Indian Rupee from 2020-present.

The presented work contributes to the modeling and forecasting Indian Rupee against US-Dollar using a time series approach. The result shows how historical demand data can predict future data and how these forecasts can benefit import/export organizations. These results will provide the managers of thismanufacturing firm with reliable guidance for making decisions based on the forecasted foreign exchange rate.

Introduction

Forex forecasting, a field of predictive analytics, attempts to automate the identification of technical indicators or chart patterns across a range of currency pairs to identify the trade entry and exit points. It involves using data, mainly historical data, of the forex rate of currencies. Any global import/ export organization in India must conform to the foreign exchange rates before issuing a purchase order or approving a sales order to increase profitability and mitigate risks. Application and sharing of deep expertise up and down the organization, processing of all relevant data, including forecasting forex rates, enhance the chance to create opportunities for improvement. Forex rate forecasting is vital for import/export organizations to schedule their purchases or sales accordingly. It is a tool that helps to stock the inventory before the Indian rupee depreciates or to perform strategic hedging to fix an exchange rate in case of exports. It also determines the time frame and exchange rate volatility for future use.

The rate at which one currency is exchanged for another is referred to as the foreign exchange rate between two currencies. The extant literature shows that various exchange rate regimes are used in the global economy. Except for World War I, the economies were initially governed by the Gold Standard, which was in place from 1879 until 1934. This system represented the fixed exchange rate system. The Bretton Woods system then predominated until 1971, whereby the US dollar was pegged to a specific amount of gold, and other currencies were tied to the US

dollar.

There are many approaches to forecast forex rates, among which we can find, for example, LSTM.

Problem Statement

Drafting a purchase order and approving a sales order is risky for import-export organizations because it is difficult to predict future foreign exchange rates due to the volatility of the currency. Not knowing the variation of the foreign exchange rates in the future might cause a risk of monetary loss to the organization if the home country's currency depreciates. Therefore crucial decisions should be taken while drafting the date in a purchase order, approving a sales order, and whether or not to opt for hedging to eradicate any risk of monetary loss. Managers in these companies must link forecasting to improvement goals and use past performance to avoid errors and achieve a high-efficiency level.

Literature Review

In today's organizations, which are subject to sudden and enormous changes that affect even the most established structures, and where all the requirements of the business sector require an accurate and practical reading into the future, forecasts become essential because they are a sign of survival. And the language of business in the world. Forecasting is the science of estimating the future level of some variables. The variable is often price, but it can also be something else, such as supply or demand. Forecasting is making assumptions about the future values of the studied variables.

It is frequently stated that since the foreign currency market is efficient, it is pointless to predict foreign exchange values. The market is efficient if the major players are thought to have access to and have digested all recent information that could have an impact on price and, as a result, this information is already reflected in the price (strong efficiency) or, at the very least, if the historical record of exchange rates does not contain any information that market participants could use to predict future spot exchange rates with any degree of accuracy (weak efficiency). The foreign exchange market, in effect, is a fair game; no trading rule, including one based on foreign exchange rate forecasts, can be profitable.[1]

Economic vulnerability considers how sensitive a company's worth is to changes in exchange rates. Contrasting accounting-based transaction and translation exposures described in terms of the book values of assets and liabilities denominated in foreign currencies is the focus on economic valuation. It is common knowledge that a firm's ability to compete in export markets will suffer as the currency of its home nation appreciates.

Underlying this prediction is the assumption that the firm's costs are primarily denominated in the home currency, while revenues are contingent on the relative purchasing power of foreign currencies. A firm in a country with an appreciating currency has a cost disadvantage relative to firms in countries with stable or declining absolute currency values. This decline in competitiveness should reduce future export profits.

A firm's ability to pass through currency rate fluctuations to customers depends on the price elasticity of customer demand, which, in turn, depends on the degree of product differentiation.[2] Exchange-rate movements affect expected future cash flows, and therefore the value, of large multinationals, small exporters (importers), and import competitors, by changing the home currency value of foreign revenues (costs) and the terms of competition. In light of this, it is surprising that previous research in the area (Jorion,1990; Amihud, 1993; Bodnar & Gentry, 1993) finds that US multinationals, exporters, and manufacturing industries are not significantly affected by exchange rate movements. One possible explanation is that corporations extensively use foreign currency derivatives and other hedging instruments (e.g., foreign debt) to protect themselves from unexpected movements of exchange rates.

Background Work

Aim of the project

The aim is to determine accurate forecasts of the foreign exchange rate of the Indian rupee against the US dollar to help aid Indian import/export firms. The expected benefits from these forecasts are strategic planning of a firm to draft the date of a purchase order, approve a sales order or resort to hedging to maximize profit or mitigate loss.

About the dataset

The dataset contains historical data on the foreign exchange rates of INR against US-Dollar. The dataset consists of 733 records of foreign exchange rates of Indian Rupee over the years 2020-present.
The dataset contains no missing values under Indian Rupee records.The data also does not contain information on records on weekends as the market is closed on weekends.

	Date	Price	Open	High	Low	Volume	Chg%
0	01-01-2020	71.227	71.365	71.377	71.225	1.16K	-0.18%
1	02-01-2020	71.350	71.235	71.408	71.235	4.63K	0.17%
2	03-01-2020	71.770	71.610	71.844	71.520	7.49K	0.59%
3	06-01-2020	71.867	72.011	72.123	71.834	7.44K	0.14%
4	07-01-2020	71.845	71.765	71.923	71.670	6.69K	-0.03%

In the dataset, all columns are formatted as characters and must be reformatted, for example, "Date" to DateTime and "rate" to numeric.

Objective

The objective is to forecast the foreign exchange rate for the next 30 days since the latest data month is OCT 2022. forecast uses the mean absolute percentage error value as a performance metric.

Forecasting Methods

Some of the methods used for forecasting are

➢ ARIMA (Autoregressive Integrated Moving Average)
➢ Prophet
➢ Linear regression
➢ LSTM

The data will be tested with different models to determine which best fits the rate data patterns. The performance will be compared using MAPE. After the best model is selected, a product forecast will be made by the model trained on the latest data values.

Need for the Solution

The forecasting concept creates forecasts using historical data to make informed guesses, which helps determine future trends' direction. Similarly, accurate demand forecasting can be crucial for a business as it would produce the correct information at the right time, thereby leading to better managerial decisions. Effective and efficient planning can be achieved with the help of forecasting.

Proposed Solution

Different forecasting models have to be implemented on datasets such as ARIMA, Linear regression, Prophet, and LSTM. The best option is based on the values of MAPE (Mean absolute percent error). After that, we will have a clear view of which model should be used to get the bestpossible forecast for the foreign exchange rate in our data.

By comparing the MAPE values of different models, the most negligible MAPE value has to be taken for forecasting. Based on the historical data present, forecasting has to be done.

Analysis of the Solution

Since the data has foreign exchange rates for many countries and our problem statement concerns the organizations from India, forecasting is done only for the Indian currency. So, the Indian rupee exchange rate against the US dollar was taken for analysis and forecasting. The data pre-processing was done, whichincluded importing the libraries, and dataset, treating missing values, and reformatting each column in the correct data type.
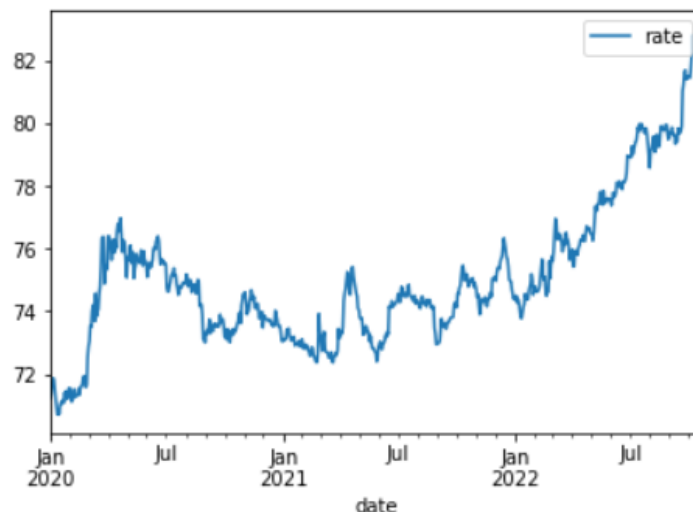
This plot shows that the data is non-stationary, with a trend and non-observable seasonality. Moreover, since there is no exponential increase in amplitude over time, we have to choose the additive instead of the multiplicative decomposition method.

**Lag scatter plot of daily price of INR Against Dollar**
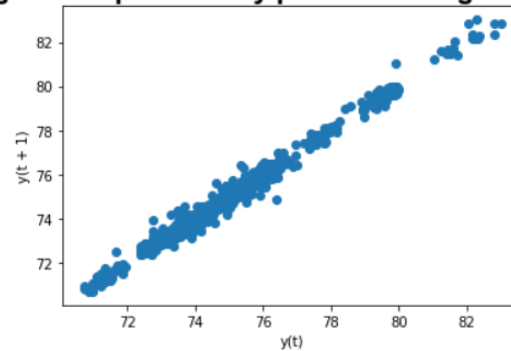
From the above lag plot, we can see that the values of exchange rates at time periods T and T-1 are highly positively correlated. This means that the values are highly dependent on the previous values.

By visual inspection, it was found that the data was non-stationary. Therefore Ad-Fuller test has to be done to confirm the stationarity/non-stationarity of the data. Below are the results of the test.

```
Test Statistic                    -0.079226
p-value                            0.951469
Lags Used                          0.000000
Number of Observations Used      732.000000
Critical Value (1%)               -3.439315
Critical Value (5%)               -2.865497
Critical Value (10%)              -2.568877
dtype: float64
Failed to Reject Ho - Time Series is Non-Stationary
```

```
Test Statistic                   -28.193330
p-value                            0.000000
Lags Used                          0.000000
Number of Observations Used      731.000000
Critical Value (1%)               -3.439327
Critical Value (5%)               -2.865502
Critical Value (10%)              -2.568880
dtype: float64
Reject Ho - Time Series is Stationary
```

The results in the left picture depict that the p-value is more significant than 0.05, and hence the data is not stationary. Therefore, the First order differencing was done, and the ad-fuller test was run again to check the stationarity of the data. The results of the ad-fuller test run for the second time are shown in the picture on the right, which depicts the p-value as close to zero, and the data is now stationary.
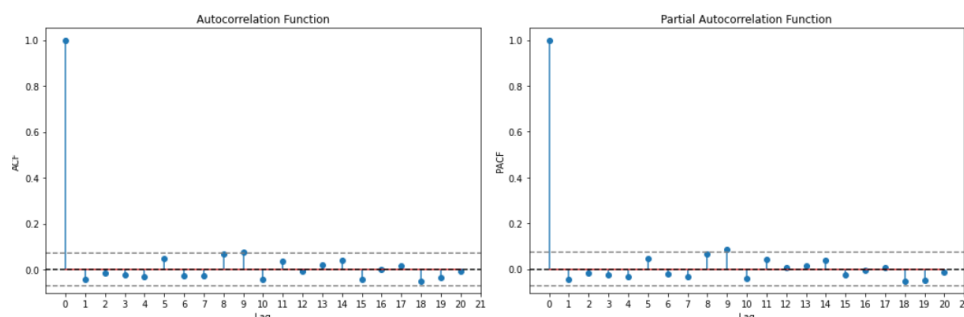
From the above AC and PACF plots (Lollipop charts), we can see that the initial lag values show a correlation with previous values. We'll have to select the appropriate values of p and q for building our ARIMA model, and this will be done using the Lollipops chart above. The p and q values are 0,0 respectively, as after these, the lollipops in our charts go below the band of error and are no more significant. And as we have done the differencing only once, the value of d is 1.

MODEL TRAINING

The dataset was split in a way that the test dataset contains data about the last 5 months. Hence 153 records were stored in test data, and the rest 580 records were stored in training data.

1) LINEAR REGRESSION

Exchange rate of INR against US $ Linear Regression Plot

The MAPE value for this model was found to be '2.907'. But the graph does not work well on test data , so the model is not a good fit.

2) ARIMA MODEL

Dep. Variable:	rate	No. Observations:	732
Model:	ARIMA(0, 1, 0)	Log Likelihood	-41.420
Date:	Sat, 22 Oct 2022	AIC	84.840
Time:	10:51:28	BIC	89.435
Sample:	01-02-2020	HQIC	86.613
	- 10-21-2022		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
sigma2	0.0656	0.002	32.571	0.000	0.062	0.070

Ljung-Box (L1) (Q):	1.42	Jarque-Bera (JB):	440.96
Prob(Q):	0.23	Prob(JB):	0.00
Heteroskedasticity (H):	0.70	Skew:	0.23
Prob(H) (two-sided):	0.01	Kurtosis:	6.78

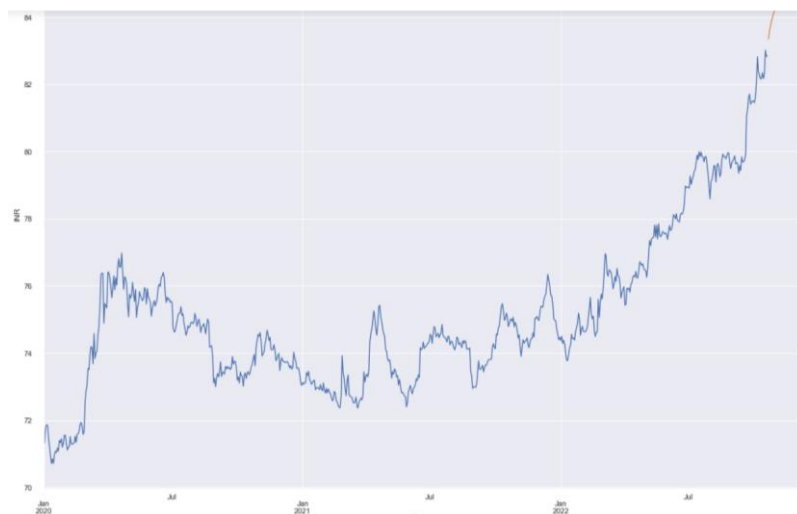The order of (0,1,0) was used in this model as per the (p,d,q) values. The graph of the model is as follows.
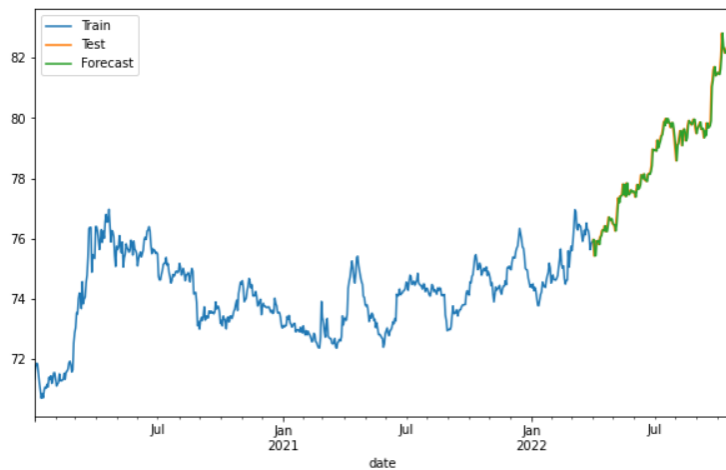
The predictions work well on the test data. The mean squared error value was found to be 0.24. This model is a good fit. The forecast is given as below.
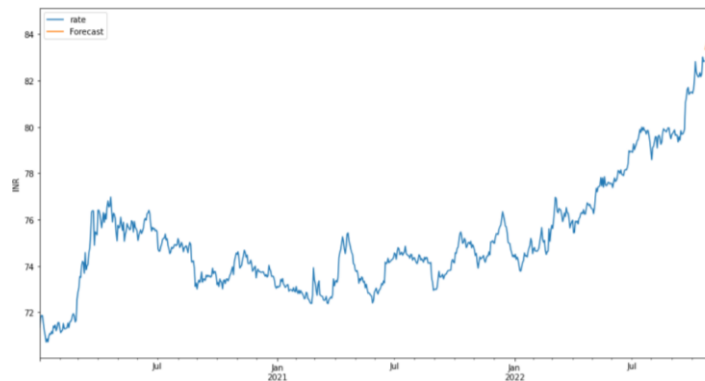
3) PROPHET

An Interval width of 0.1 was used for this model, and the graph of the model is given below.

The RMSE was found to be 3.2423. The model is a good fit.

4) LSTM MODEL

The LSTM model shows a perfect fit for the data. The MAPE value for the training and testing dataset was found to be 0.49 and 0.60.

Limitations of this forecast:

1. No external factors explained: The forecast is based on historical data only and does not incorporate any external information like economic conditions, product price policy changes, etc.

2. No data for weekends: As the stock market is usually closed on Saturdays and Sundays, the data for the weekends are absent. So the volatility of the rate between Friday and Monday can not be explained.

3. Interpolating ND(No Data) values: Interpolating values for the null data can reduce the accuracy of the predictions.

Recommendation

The forecasting process is ongoing. Forecasters must learn from their mistakes. The entire forecasting exercise must be placed in an administrative framework that facilitates the evaluation process and the error correction process.

- The forecasters must investigate the forecast to check if the home currency is predicted to appreciate or depreciate in the future time period and take measures accordingly.

- If the home currency is predicted to depreciate over the coming time period, it is sensible to import large numbers of goods to stock from the US to mitigate the losses they are probabilistic to face.

- If the home currency is predicted to appreciate, then the purchase order must be drafted

such that the date of the contract has to be set when the exchange rate is low, as predicted by the forecast, to benefit the profit, given the company has emergency stock.

- The sales order for the Indian firms should not be approved if the home currency is predicted to depreciate in the future to mitigate losses. Yet the contract can be mended by hedging, where a condition is sustained that the sale order will only be accepted at a fixed exchange rate regardless of foreign exchange rate fluctuation.

Conclusion and future scope of work

Conclusion

Foreign exchange rate forecasting is a very crucial process for managing import/ export organizations. It helps in maximizing profit and mitigating losses and provides a way to averse the risk. This will help in setting the date while drafting a purchase order, approving a sales order, or deciding whether to use hedging at a set exchange rate to averse risk of monetary loss. The ARIMA and LSTM model can be very helpful in finding accurate predictions. Using LSTM and ARIMA, time series forecasting models can predict future values based on previous, sequential data. This provides greater accuracy for demand forecasters, which results in better decision-making for the business.

Future Work

As a future work for this work, it is to compare the performance evaluation results of the chosen model with real-time data or an even more extensive time-series dataset to establish the results in a better "solid" way. This project can be proposed for future research because thework uses a dataset with historical data that we modify for our needs, if we have a live connection with the software, we can use only the data that we need without using any other program, but only our script and we don't need any dataset preparation.

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