Currency Exchange Prediction System

Final Project Report

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1. Abstract:

In this report, I have focused on analyzing the Currency Exchange rate data fetched from Bloomberg Terminal for various Currencies and predict the foreign exchange rates and then compare empirical results.

I have chosen the ARIMA model, and the results are evaluated in the terms of Mean Squared Error. Arima model is a type of regression analysis that also takes into consideration the randomness of a future data point; thus, the currency exchange rate depends on various factors and thus some model that will account the randomness of the data points was crucial choice. The results of all the currencies prediction concludes the report.

2. Introduction:

The very basics of currency exchange rates is that the higher values currency makes a country's export more expensive. A lower valued currency makes imports more expensive. A greater value of exchange is a sign of imbalance of trade.

The currency exchange rate is one of the most important factors of a country's relative economic status. The exchange rates are relative in nature and are expressed as a comparison of currencies between two countries only.

Now, due to globalization the exchange rate is a crucial factor. The exchange rate fluctuations matters when there is trade ongoing between say 2 countries, the amount invested is very huge and thus, even small changes can have a significant impact.

The primary objective of the project is to be to predict the exchange rate for the next day. The main motive behind the project is to help individuals have a look at the currency predictions to make a better decision.

There are majorly 4 ways one can make predictions of currencies.

1. Purchasing power parity (PPP)
2. Relative economic strength approach
3. Econometric models
4. Time series analysis

The evaluation metric used involves observing actual currency value and then calculating the mean squared error. This will be implemented using Python programming language and various libraries within it.
Pandas for data manipulation, Matplotlib for plotting graphs and Stats model to deploy and evaluate ARIMA model.

3. Proposed Method:

Data Source: Bloomberg Terminal

Steps performed to fetch data:

1. Firstly, using the Citrix Receiver, I opened the Bloomberg Terminal on my local desktop computer.
2. Now, using the Bloomberg Excel API, within the excel sheet I used a Bloomberg terminal command to fetch the required data with required fields.
3. There were two ways I was able to fetch the data.
   a) Spreadsheet Builder function **->**
   Selected the security of USDINR Curncy, USDCAD Curncy, USDEUR Curncy, USDNOK Curncy **->**
   Selected px_last field **->**
   Selected the Date Range from 1/2/2001 to 1/1/2019
   and thus, a historical Table was created

   b) Using the Bloomberg BDH (Bloomberg Data History) command is for historical end of day and historical intraday data.
   The **syntax** for BDH is as follows:
   =BDH (“Security”, “Field”, “Start Date”, “End Date”, “Optional arguments”)

   In this problem statement, we needed the security of Currency value against that of US dollar. Secondly the field used in the dataset is px_last which provides the last price of security. In our case Optional arguments is as follows:
   1. Start Date
   2. End Date
   3. FX = USD

   =@BDH(B$1,"PX LAST","2001-01-01","2019-01 01","Dir=V","CDR=5D","FX=USD","Days=A","Dts=S","cols=2;rows=4697")

   The proposed method involves analyzing the fetched data. The data that is of Time series data. It has a special property that the data is captured at regular intervals and in our case, it is the daily data for exchange rates of various Currencies. We have considered 4 currencies to be compared against US Dollar rate. Using the above API and command we have collected data for the past 18 years starting from 2001 to 2019.

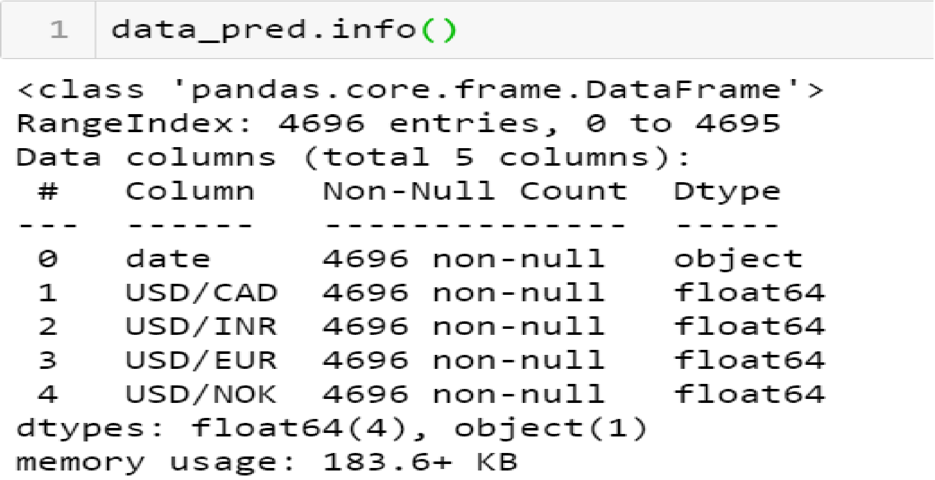
Data Description:

Number of columns: 5
Number of Rows: 4696
Column name: Date, USD/CAD, USD/INR, USD/EUR, USD/NOK

Analysis

a) Exploratory Data Analysis

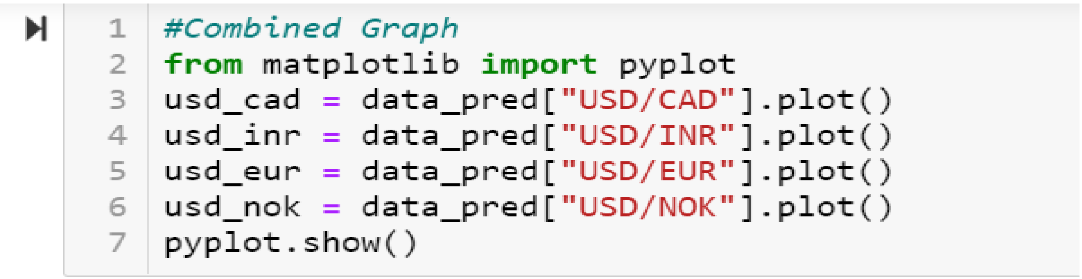
1. There is no missing data in any columns



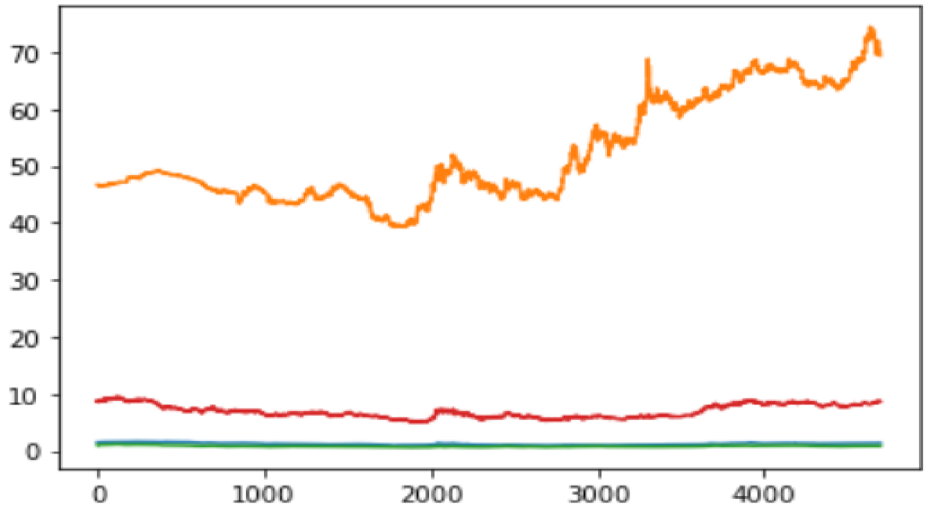
```
data_pred.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4696 entries, 0 to 4695
Data columns (total 5 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
 0   date     4696 non-null   object
 1   USD/CAD  4696 non-null   float64
 2   USD/INR  4696 non-null   float64
 3   USD/EUR  4696 non-null   float64
 4   USD/NOK  4696 non-null   float64
dtypes: float64(4), object(1)
memory usage: 183.6+ KB
```

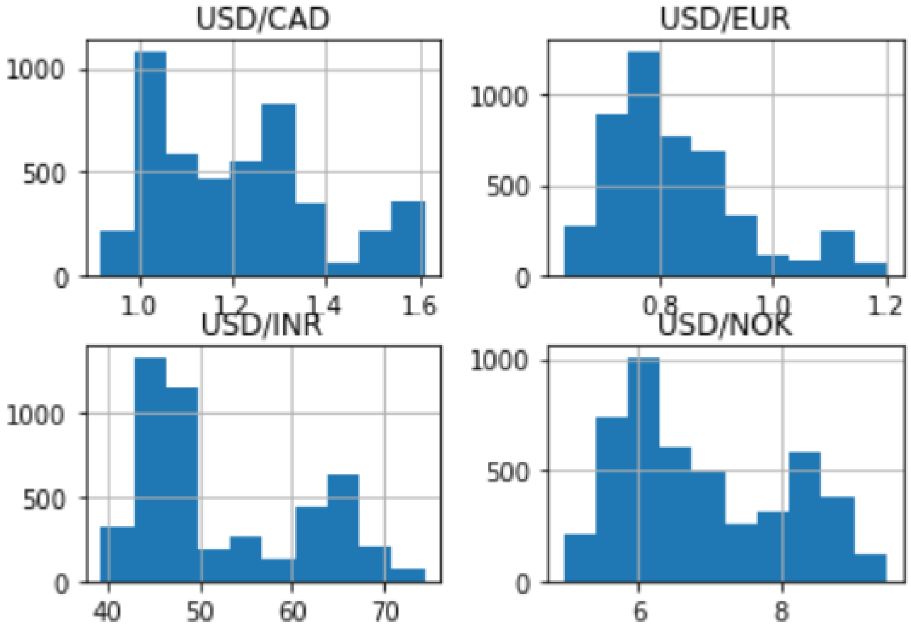
2. Line graph of each of the currencies to observe the trend.



```python
#Combined Graph
from matplotlib import pyplot
usd_cad = data_pred["USD/CAD"].plot()
usd_inr = data_pred["USD/INR"].plot()
usd_eur = data_pred["USD/EUR"].plot()
usd_nok = data_pred["USD/NOK"].plot()
pyplot.show()
```



3. Histogram to see the density of data points



b) Modeling:

ARIMA Model

In this, I have implemented ARIMA (Autoregressive Integrated Moving Average) model. It is a statistical model used to forecast the data which has time series nature to it. It is composed of three baseline models that is Auto-regression (AR), Integration(I) and moving average (MA). The AR's job is to perform regression on current data point based on the previous (historical Data). Here the historical data points are called lagged points.

Parameters:

An Arima model is characterized by three parameter: P, d, q

1. p= order of AR term
2. q= order of MA term
3. d = difference required to make time series stationary

If, time series has seasonal term, it becomes Seasonal ARIMA, but our data is not seasonal.

Auto Regressive (AR) model: This is where Yt depends only on is own lags.

$$y_t = c + \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \ldots + \varphi_p y_{t-p} + \varepsilon_t$$

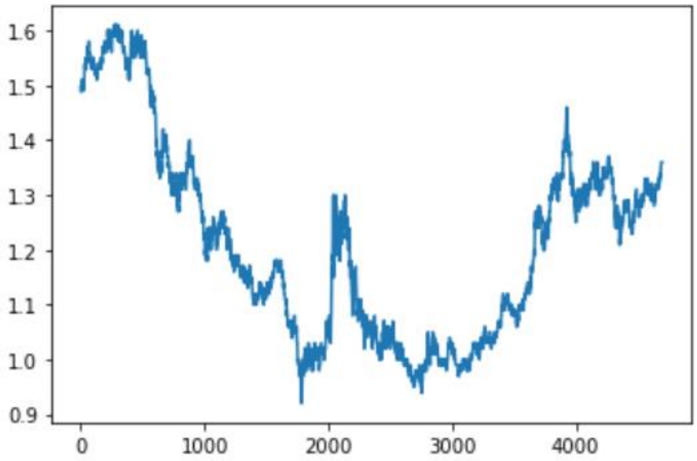
where,

y{t-1} = lag 1 of the series
beta = coefficient of lag that the model estimates
Alpha = intercept term, estimated by the model

Moving Average Model: It is where Yt depends on lagged forecast errors

$$y_t = c + \varepsilon_t + \vartheta_1 \varepsilon_{t-1} + \vartheta_2 \varepsilon_{t-2} + \cdots + \vartheta_q \varepsilon_{t-q}$$

Now, we need to know the value of these parameter in our use case to be able to fit the currency exchange rate dataset. We plot a line graph between two countries say USD and CAD.

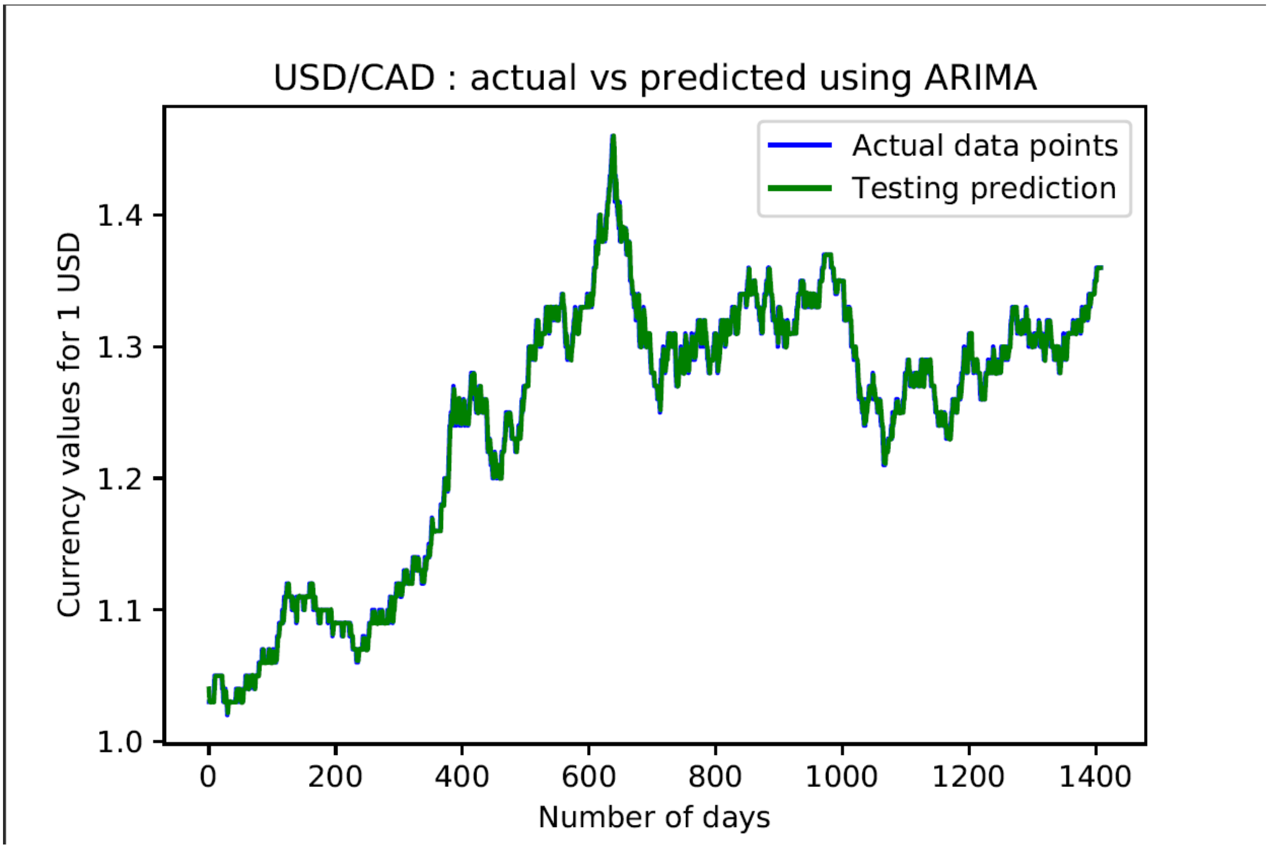


By looking at the graph, we see that the data is not seasonal, and not with just one currency but all other currencies line graph is not seasonal. For this use case, I have substituted p=3, q=1 and moving average factor r=0.

The original dataset is partitioned into training and testing datasets & 70% of the data is Training data and remaining 30% is testing set. I have used the stats model package to implement arima model.

c) *Experimental Results:*

The goal is to predict the rate of exchange for the given columns. The Mean Squared error is very low for all the columns prediction is that because we have used historical data for predicting one future data point. If we would have used the previous day's data, it would not have considered any trend and dips that might be present, thus ARIMA with Mean Squared error gives us a good prediction value.



Error term: Mean Squared Error

	USD/CAD	USD/INR	USD/EUR	USD/NOK
Predition for next day	1.3599667	69.793681	0.8701329	8.6438192
Mean Squared Error	5.32E-05	0.0712365	3.376678	0.0026235

4. References:

- Jason Brownlee. (2017, January 09). *How to Create an ARIMA Model for Time Series Forecasting with Python*. Retrieved from http://machinelearningmastery.com/arima-for-time-series-forecasting-with-python/
- Joseph Nguyen. (n.d.). *4 Ways To Forecast Currency Changes*. Retrieved from http://www.investopedia.com/articles/forex/11/4- ways-to-forecast-exchange-rates.asp