Forex Analysis and Forecasting

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Introduction

Objective

To analyse historical exchange rate data of major currencies and forecast using time series analysis (ARIMA, SARIMA, and SARIMAX) techniques.

Currencies involved

- US Dollars (USD)
- Euro (EUR)
- UK Pound Sterling (GBP)
- Indian Rupees (INR)
- Japanese Yen (JPY)
- and Chinese Yuan (CNY)

Importance

Exchange rates play a crucial role in

- Managing Volatility
- Mitigating Risk
- Identifying Investment Opportunities
- Shaping Policy Decisions
- Facilitating Exports and Imports

Source of Data
Federal Reserve Economic Data (FRED) API

Data Extraction and Storing

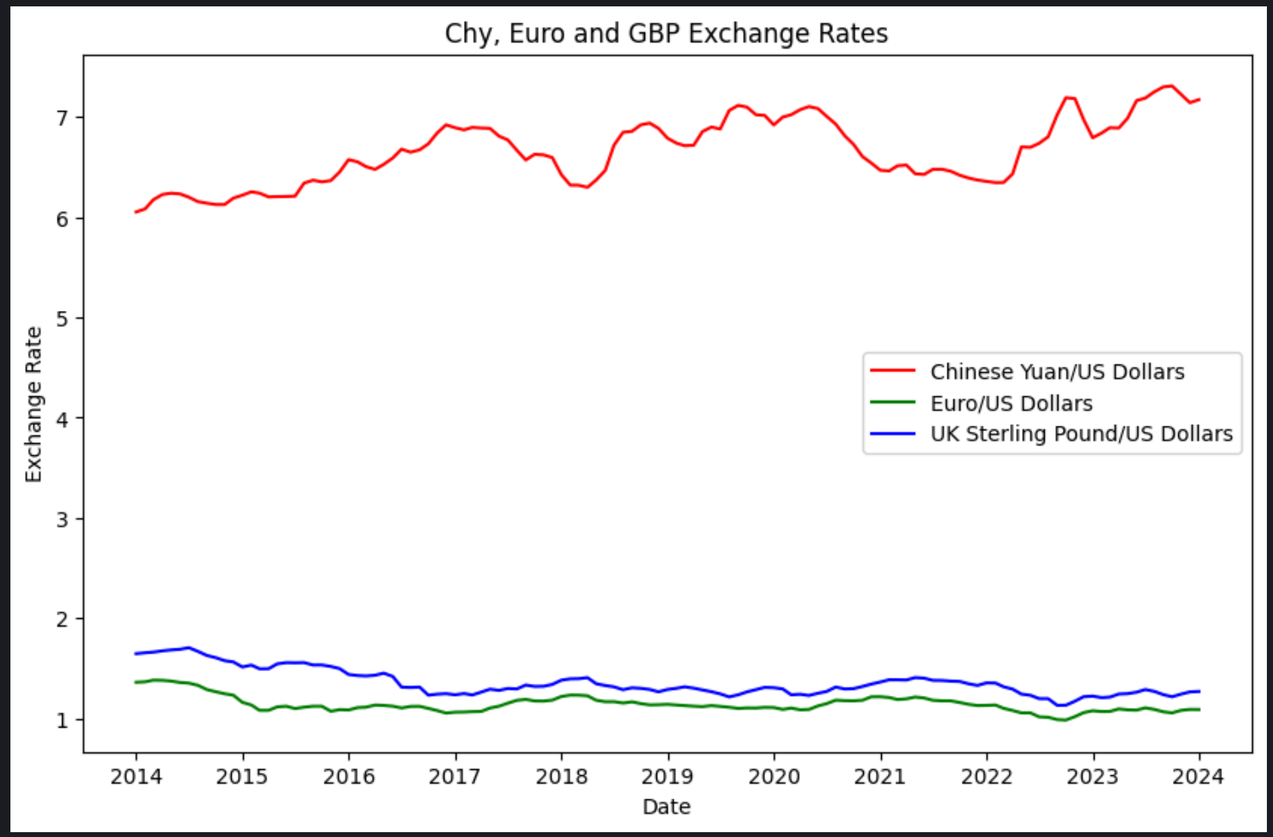
Data Cleaning and Preprocessing

Time Series Analysis
Stationarity Testing and Seasonal Decomposition

Time Series Forecasting
using ARIMA, SARIMA and SARIMAX

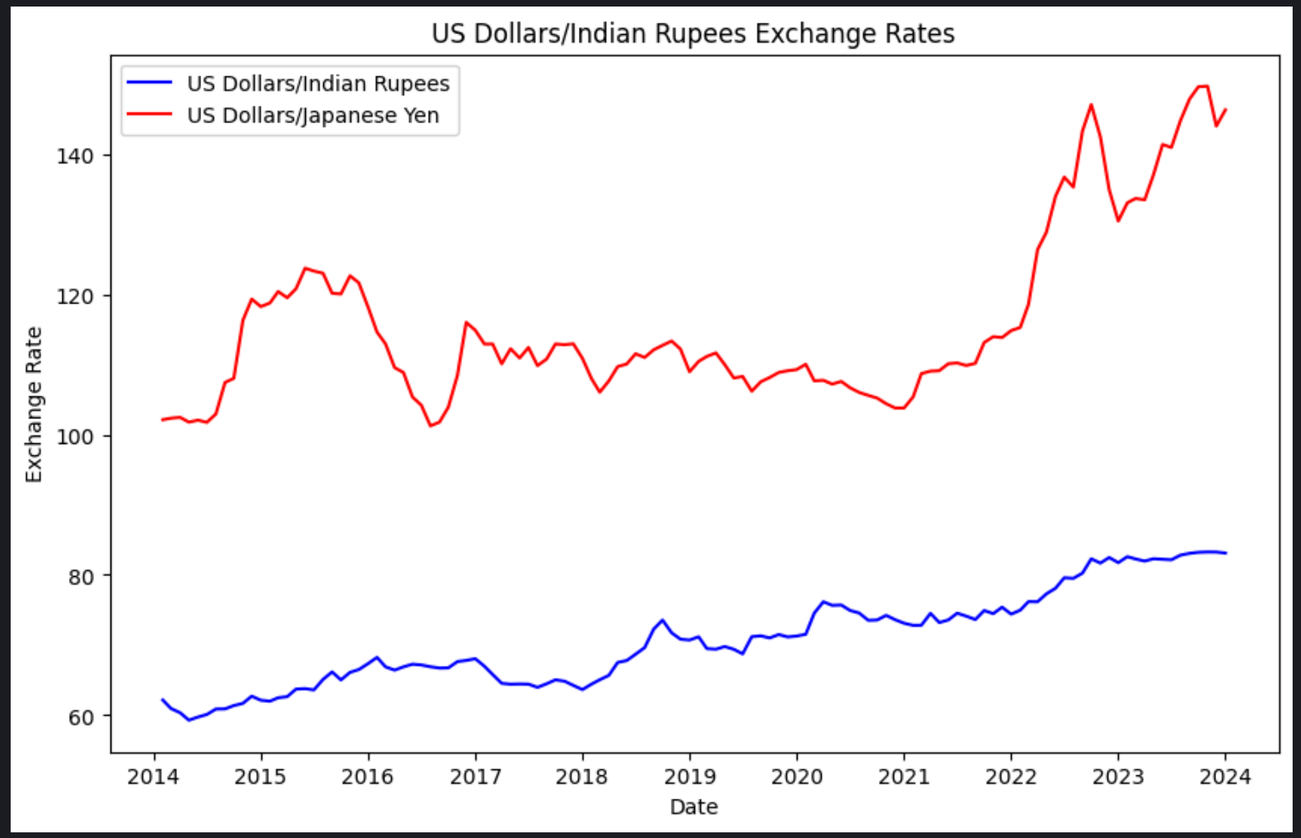
Line Plots of Historical Exchange Rates

Currencies with greater value than USD



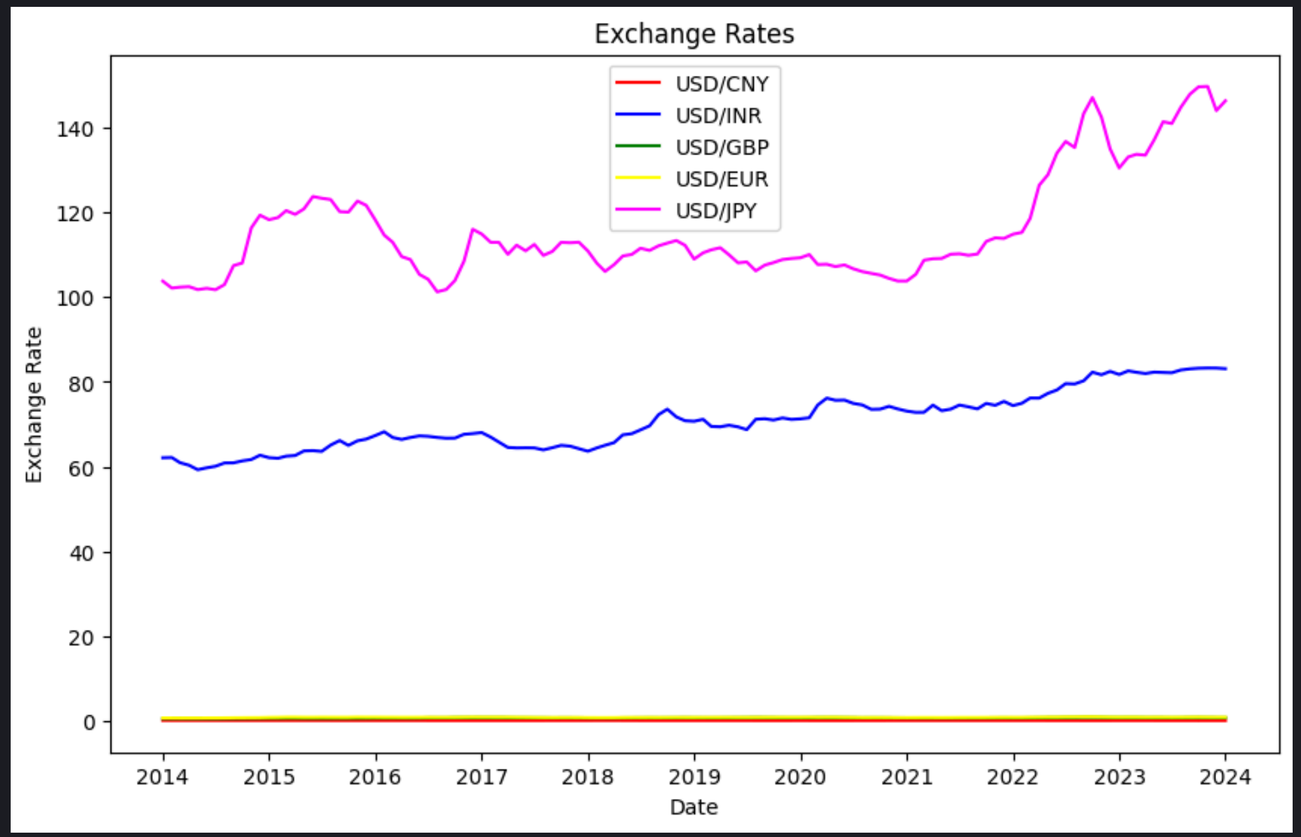
Line Plots of Historical Exchange Rates

Currencies with lesser value than USD



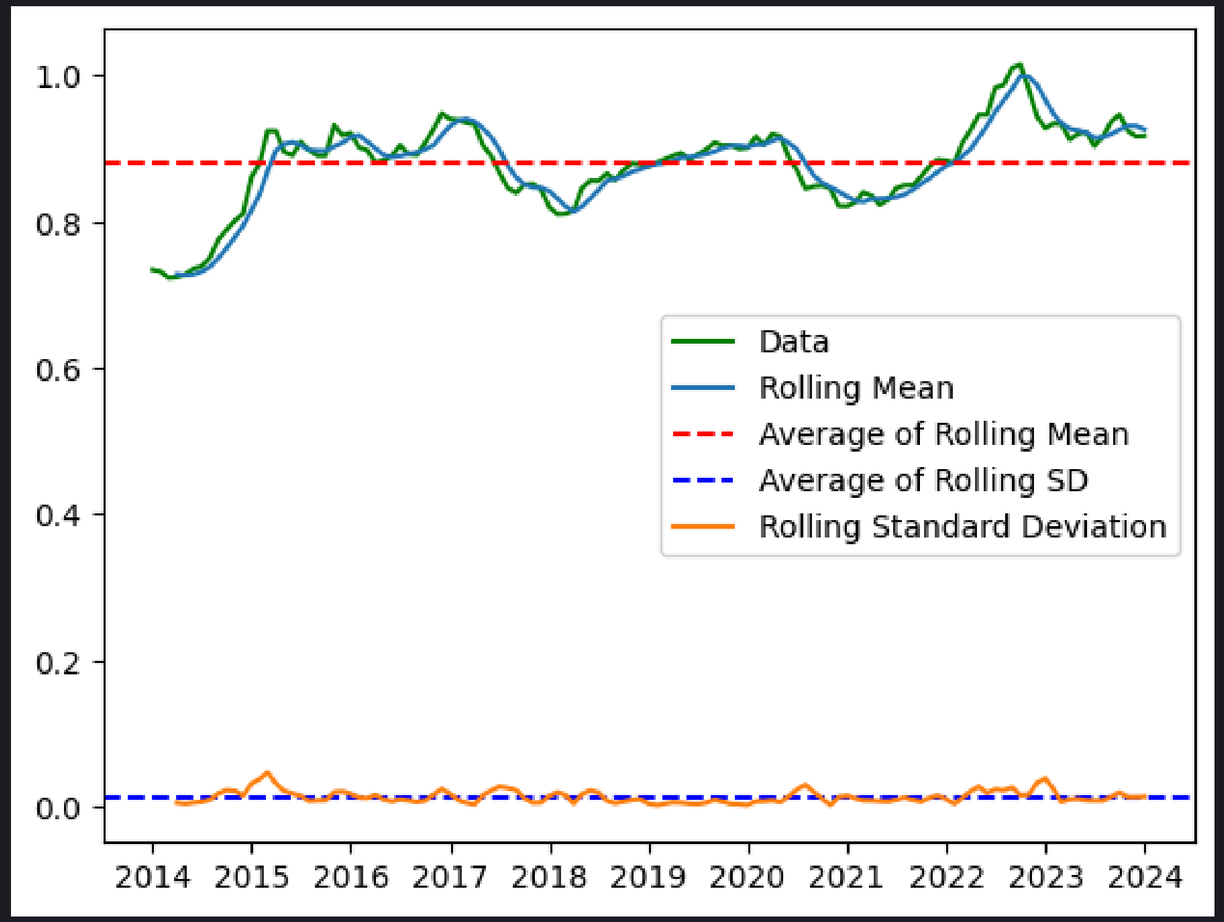
Standardizing Exchange Rates

1 USD = x Foreign Currency



Stationarity Testing Rates

Mean and Standard Deviation



Conclusion

The data does not have a constant mean throughout the time range and therefore, is Non-stationary.

Augmented Dickey-Fuller Test

ADF Statistic: -2.911397428466999
p-value: 0.04403859407094815

The p-value is only slightly below the 5% significance level, and the ADF statistic is only slightly more negative than the critical value at the 5% significance level. It is almost 0.05, the Null Hypothesis is accepted, i.e., the data is **Non-stationary**. Therefore, it's essential to interpret the results cautiously and consider the specific context of the analysis.

Dealing with Non-Stationarity

Methods

- Decomposing the time series
- Differencing the Exchange rates
- Auto-Correlation and Partial Auto-Correlation Function

Interpretation

- The differenced dataset has a constant mean and standard deviation over time, thus, it is a weakly stationary dataset.
- The p-value for the ADF test is almost 0, therefore, the Null Hypothesis is rejected and the dataset is considered to be Stationary

Conclusion

Both tests prove that the data has been converted to **stationary**.

Prediction and Forecasting

ARIMA

For modeling on the differenced data

SARIMA

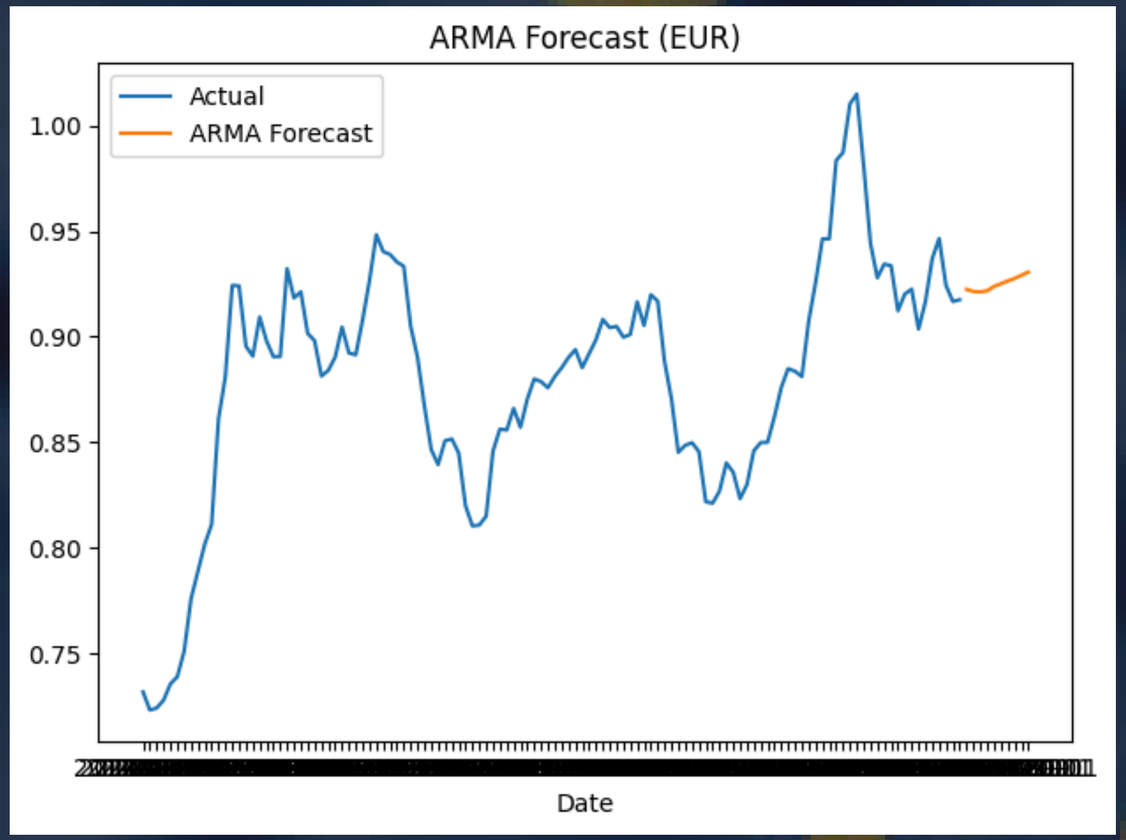
For modeling on the differenced data with the seasonal orders

SARIMAX

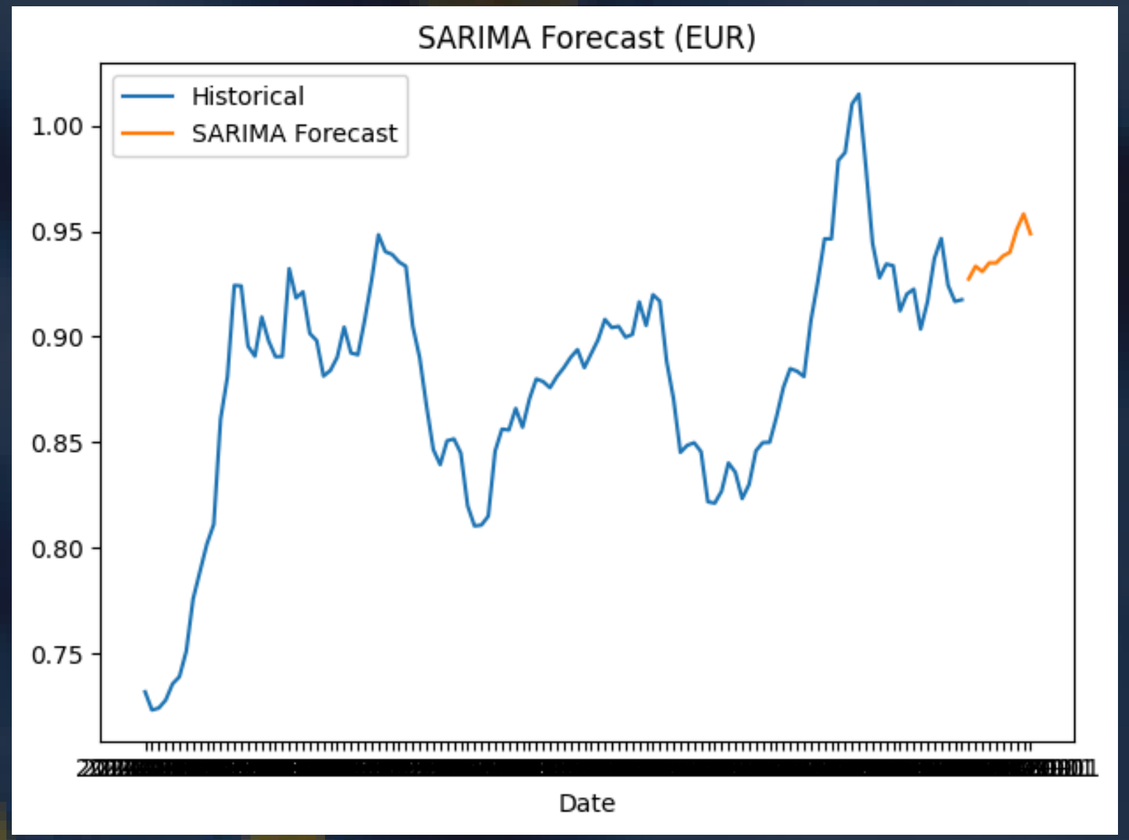
For modeling on the differenced data considering indicators of Inflation, Interest Rates, and Current Account Deficits as exogenous variables. We consider the USD/INR exchange rate only for SARIMAX forecasting.

EURO (EUR)

ARIMA

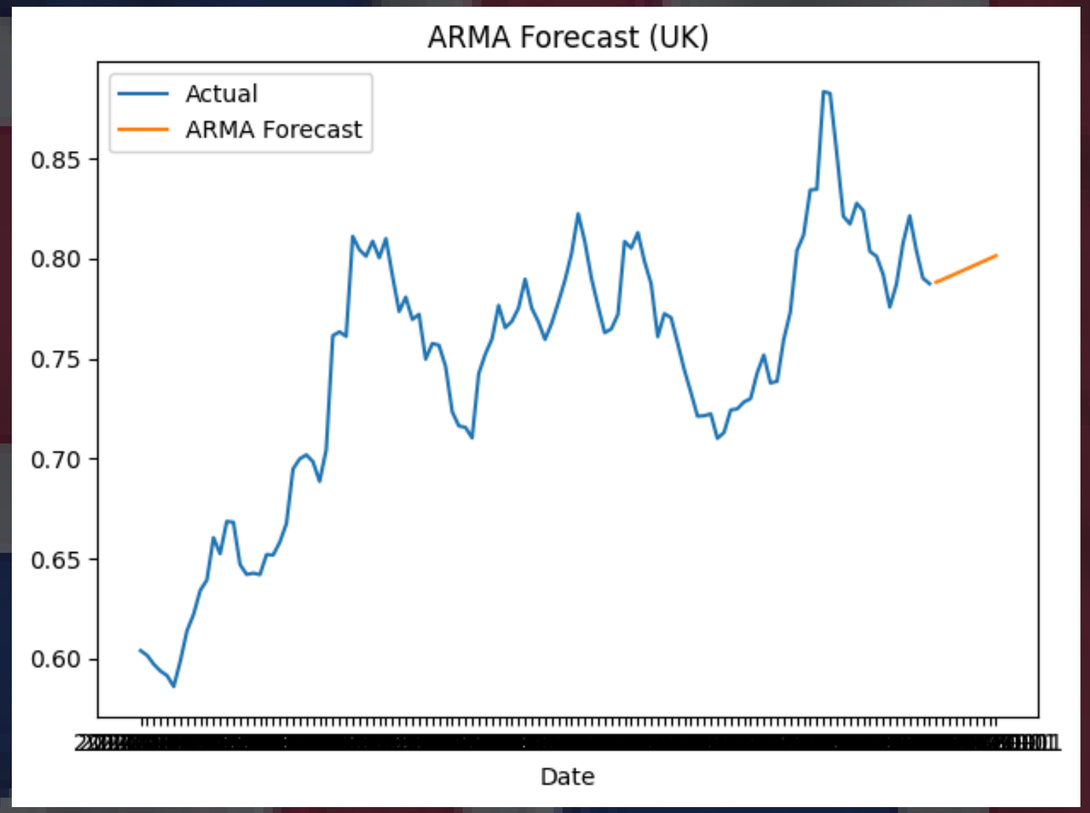


SARIMA

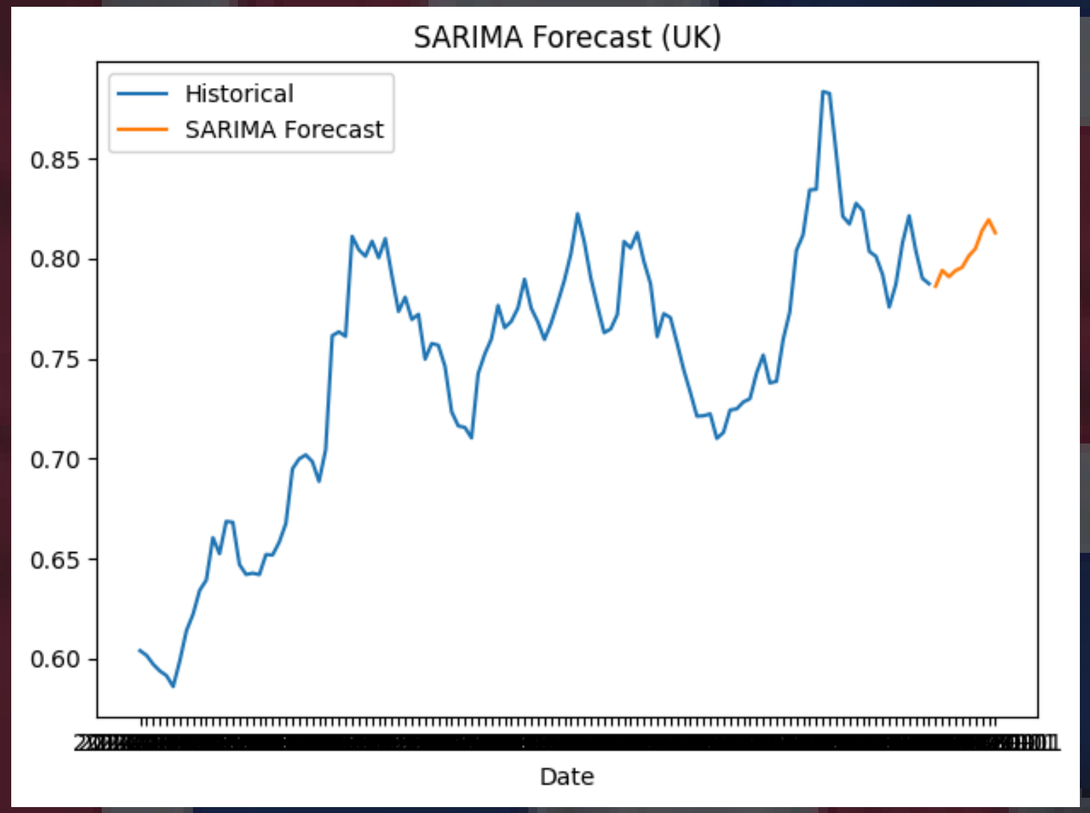


UK STERLING POUNDS (GBP)

ARIMA

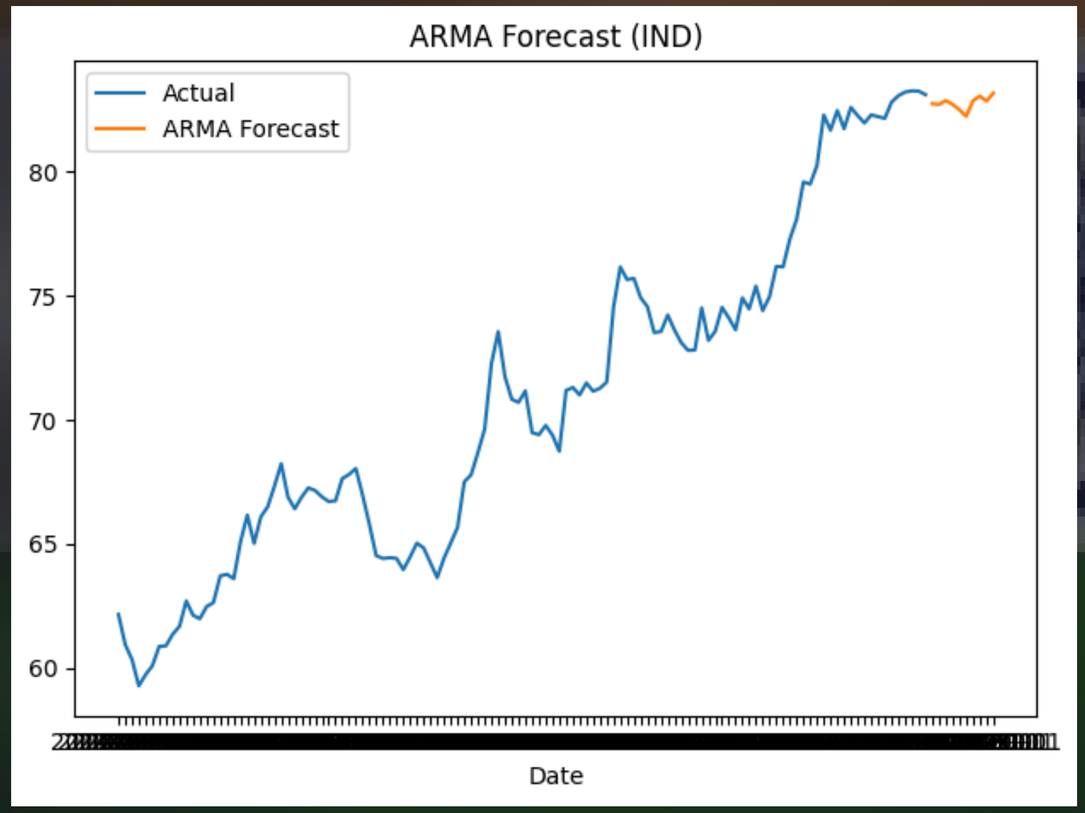


SARIMA

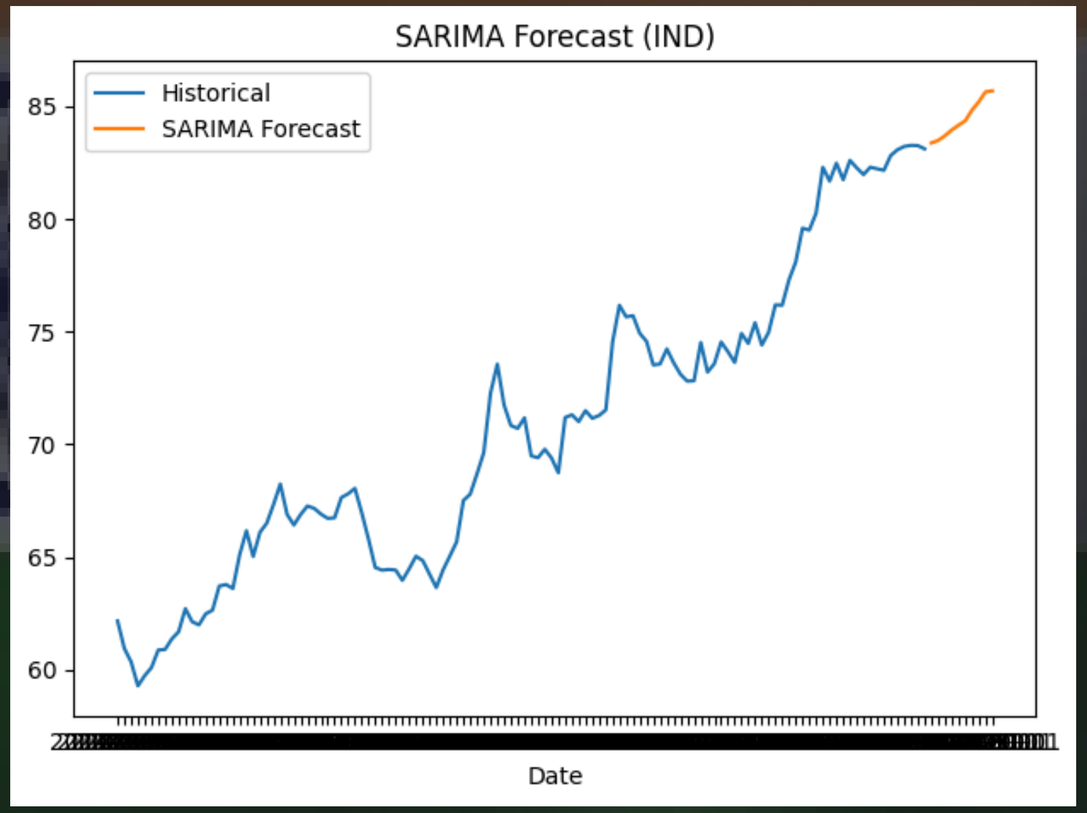


INDIAN RUPEES (INR)

ARIMA

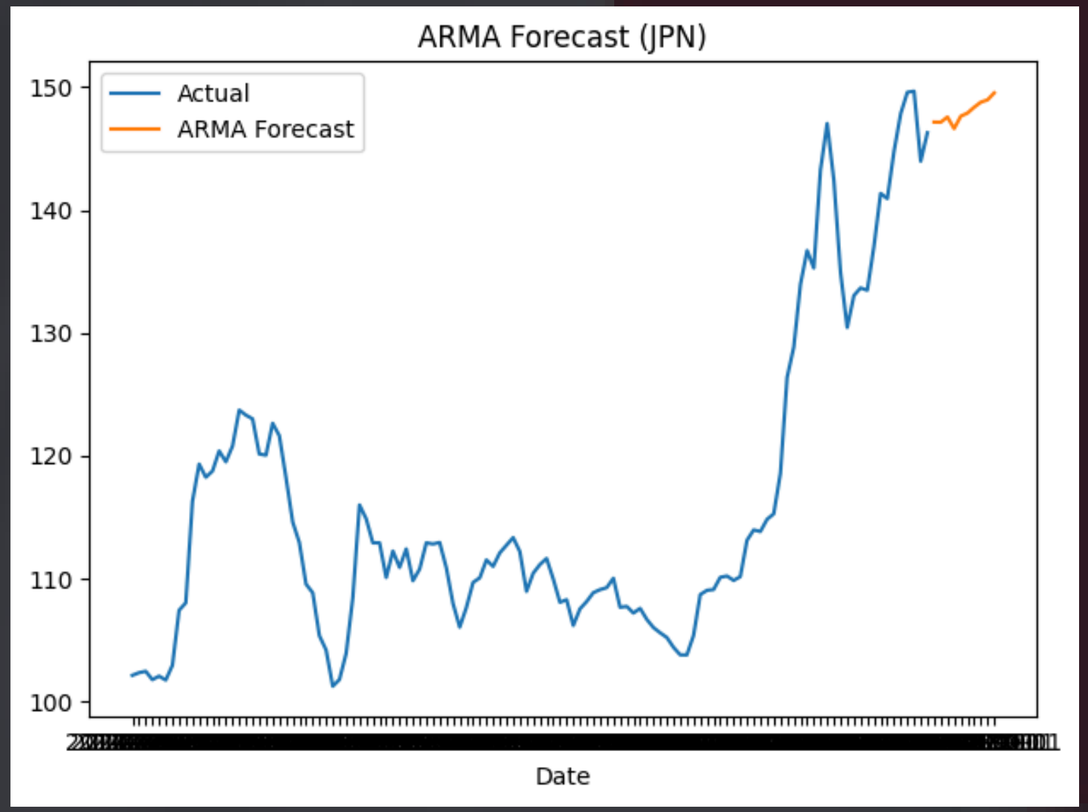


SARIMA

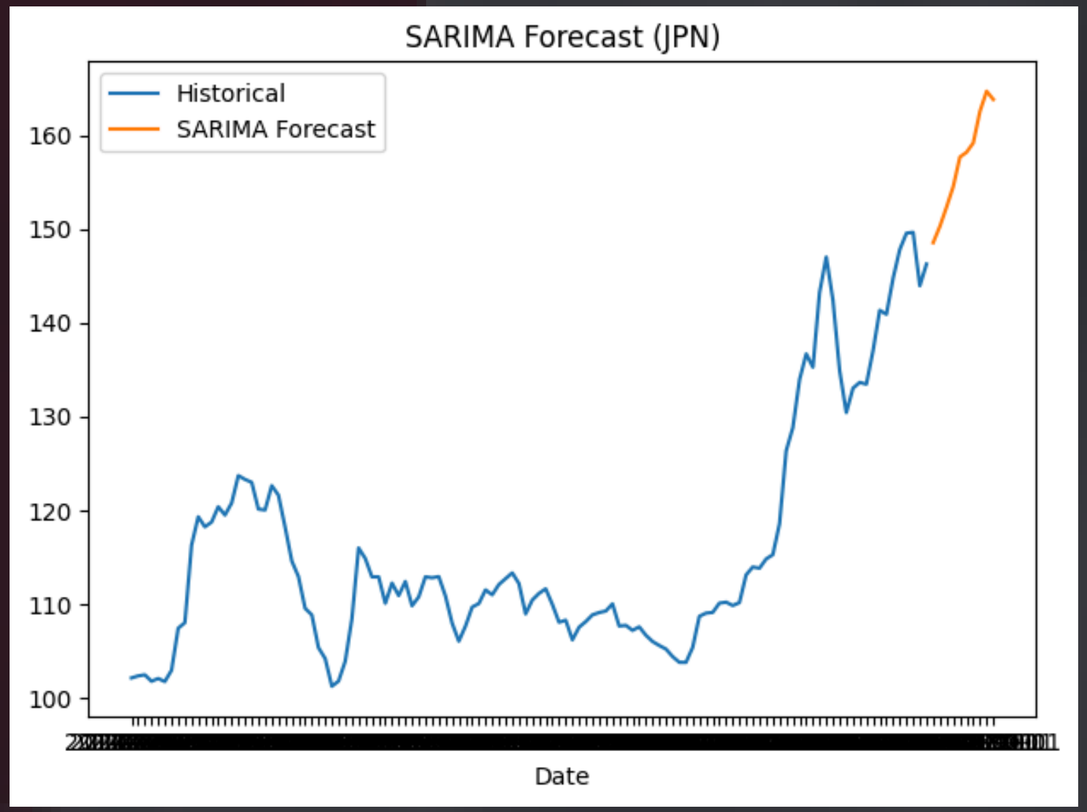


JAPANESE YEN (JPY)

ARIMA

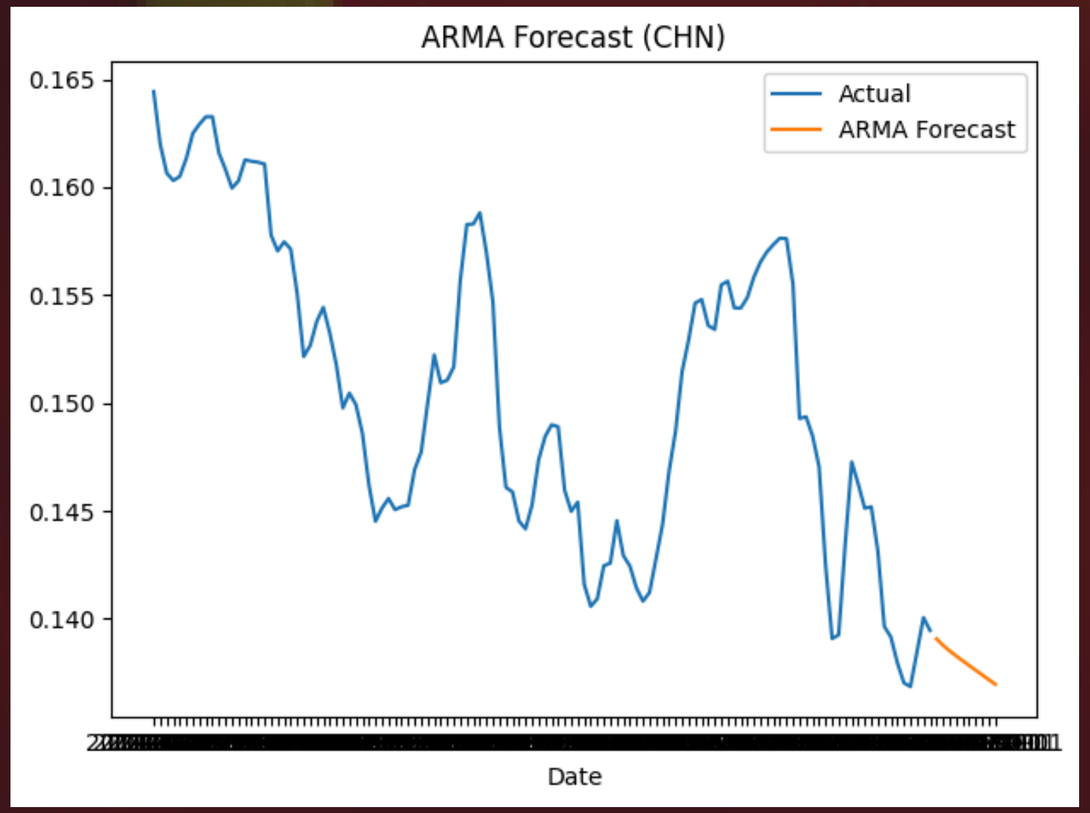


SARIMA

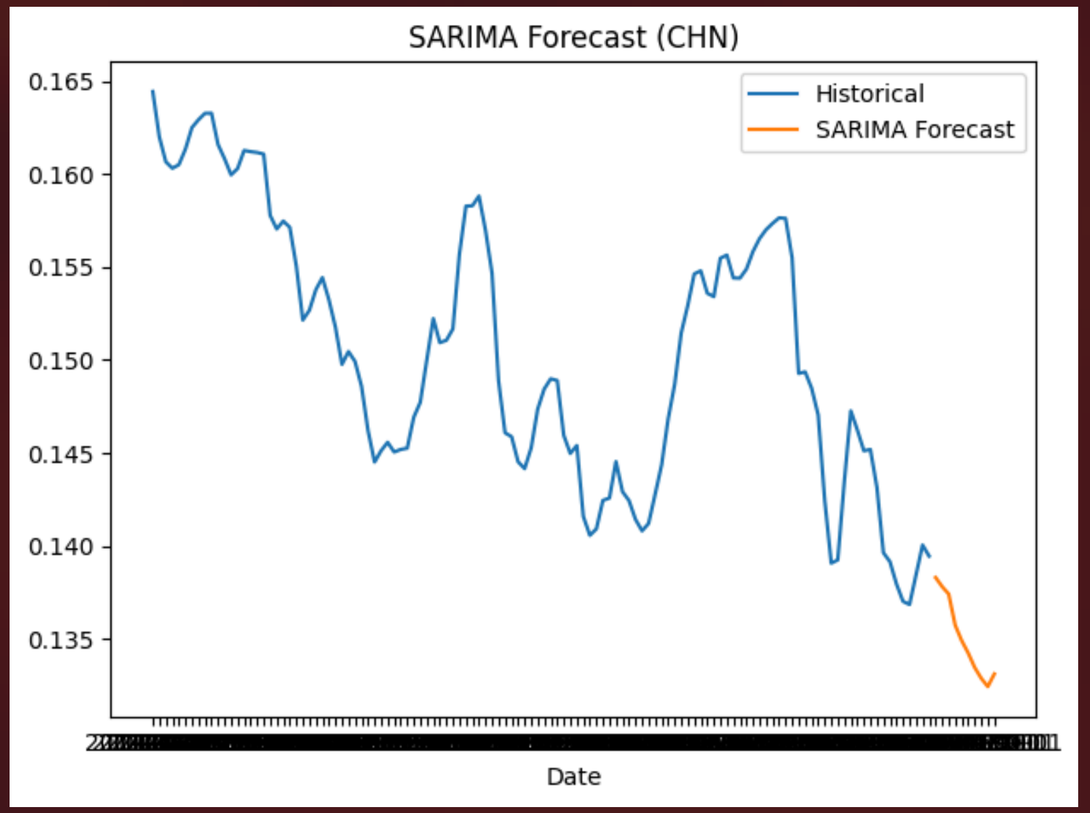


CHINESE YUAN (CHY)

ARIMA



SARIMA



Performance Analysis

Performance Metrics

ARIMA				**SARIMA**			
Currency	MAE	MSE	RMSE	Currency	MAE	MSE	RMSE
Euro	0.011013	0.000180	**0.013405**	Euro	0.012668	0.000237	0.015390
UK Pound	0.012539	0.000193	**0.013878**	UK Pound	0.012365	0.000193	0.013887
Indian Rupees	0.473409	0.444581	0.666769	Indian Rupees	0.546200	0.364700	**0.603904**
Japanese Yen	2.470955	9.181426	3.030087	Japanese Yen	2.597536	8.722368	**2.953366**
Chinese Yuan	0.001237	0.000002	**0.001531**	Chinese Yuan	0.001074	0.000002	0.001548

Inference

- The models perform based on the dataset.
- ARIMA works better for Euro, GBP, and CHY.
- SARIMA works betterwith INR and JPY.
- The performance metrics show very small differences in the performance, however, the models give contradicting outputs when observed closely.

Insights

- Among all the currencies, the Chinese Yuan tends to be in a strengthening phase against the US Dollar.
- The strengthening phase of the Chinese Yuan presents a good opportunity for investing in US exporting companies that deal with Chinese exports, as they can sell goods at lower prices in China.
- During the weak dollar phase, Chinese buyers can purchase more goods from US exporters for the same amount of Chinese Yuan.
- The US can attract more tourists from China during the weak dollar phase, benefiting the US tourism industry.
- For other countries and the EU, it's a strong dollar period, which would benefit them in exporting goods to the US.
- A US investor investing in a Chinese company will gain, whereas a US investor investing in India, the UK, or the EU will incur losses.

Conclusion

“Patterns don't work 100% of the time. But they are still critical because they help you define your risk. If you ignore patterns and focus on hunches, feelings, and hot tips, just forget about achieving consistency.”

– IFAN WEI, FINANCIAL ADVISOR, MORGAN STANLEY