**CURRENCY EXCHANGE RATE FORECASTING BY USING SARIMA MODEL**

### MINI PROJECT REPORT

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**BONAFIDE CERTIFICATE**

Certified that this Report titled “**CURRENCY EXCHANGE RATE FORECASTING BY USING SARIMA MODEL**” is the bonafide work of **“SANJAI S(2116210701230), SHOBAN KUMARESAN(2116210701245) SIDDARTH V(2116210701249) ”**who carried out the work under my supervision. Certified further that to the best of my knowledge, the work reported herein does not form part of any other thesis or dissertation based on which a degree or award was conferred on an earlier occasion on this or any other candidate.

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## ABSTRACT

In an increasingly globalized economy, currency exchange forecasting helps firms and investors manage risks and maximize rewards. It is a critical component of financial decision-making. Time series analytic techniques that can capture temporal patterns and exchange rate variations, like SARIMA (Seasonal Autoregressive Integrated Moving Average), have become more popular. This work provides a thorough analysis and implementation of the SARIMA algorithm.  
The SARIMA algorithm is a powerful tool for modeling and predicting the intricate dynamics of exchange rates because it combines seasonal fluctuations with the autoregressive (AR), differencing (I), and moving average (MA) components. SARIMA models can uncover underlying trends, seasonal patterns, and irregular variations by integrating historical exchange rate data. This can offer decision-makers insightful information. Data gathering, preprocessing, model selection, parameter estimates, and forecast evaluation are some of the processes in the methodology. To ensure data quality and consistency, historical exchange rate data is first gathered from reputable sources. Preprocessing methods are used to improve the analysis's dependability. Examples include eliminating outliers and managing missing data.  
The exchange rate time series' stationarity and seasonality characteristics are then used to choose the SARIMA model. The best SARIMA parameters are found by applying model selection criteria, such as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Using the historical data, parameter estimation techniques like maximum likelihood estimation are used to calibrate the model parameters.

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# CHAPTER 1 INTRODUCTION

In today's worldwide economy, anticipating currency exchange rates is essential to financial planning and decision-making. To manage risks, maximize investments, and seize market opportunities, firms, investors, and regulators need to be able to forecast exchange rates with enough accuracy. Modern statistical techniques, like Seasonal Autoregressive Integrated Moving Average (SARIMA) models, have become effective instruments for time series analysis and foreign currency forecasting in recent years.With trillions of dollars changing hands every day, the foreign exchange market, or forex market, is the biggest and most liquid financial market in the world. Exchange rates, which show how much one currency is worth in relation to another, are affected by a wide range of variables, such as monetary policies, market sentiment, geopolitical developments, and economic data. Because of this, exchange rates display intricate and dynamic patterns that are marked by trends, seasonality, and erratic volatility, which makes predicting with accuracy difficult.Conventional methods of projecting currency exchange rates frequently depend on technical analysis, fundamental analysis, or a mix of the two. In order to determine the underlying worth of currencies, fundamental analysis looks at macroeconomic variables including interest rates, inflation, trade balances, and political stability. In contrast, technical analysis examines past price patterns and market trends to predict possible future moves.

# CHAPTER 2 LITERATURE SURVEY

Due to their intrinsic complexity, currency exchange rates are impacted by a wide range of factors, from geopolitical events to fundamentals in the economy. extend\_more Precisely predicting these rates can yield significant information for individuals, businesses, and investors. Extend\_more The use of the SARIMA (Seasonal Autoregressive Integrated Moving Average) method for forecasting currency exchange rates is examined in this review.  
  
Exchange rates and other financial time series data frequently show trends and seasonality. The power of SARIMA resides in its capacity to depict these traits.extend\_more The autoregressive (AR) component simulates how historical exchange rates will affect current and future values.extend\_more When dealing with non-stationary data, the integrated (I) portion differeces the data until it reaches stationarity (constant mean and variance over time).

Although SARIMA provides a strong foundation, researchers have looked for ways to increase the forecasting accuracy of the model. For predicting bitcoin exchange rates, Abu Bakar and Rosbi (2017) suggested a hybrid method combining SARIMA and a Genetic Algorithm (GA). More accurate forecasts may result from the GA's optimization of the SARIMA model's parameters, especially for highly volatile currencies like Bitcoin [3]. In order to forecast financial time series, Najamuddin et al. (2022) investigated a hybrid model that combines SARIMA and a Bidirectional Recurrent Neural Network (BRNN). extend\_more With the SARIMA managing seasonalityand the BRNN capturing complex non-linear interactions.

SARIMA has drawbacks in spite of its benefits. It makes the assumption that past and future values follow a linear relationship, which may not always be the case for exchange rates affected by unforeseen circumstances.exclamation\_pen\_spark Statistical knowledge is also needed for model selection and parameter estimates, which are essential for accurate projections.

SARIMA's power comes from its capacity to simulate seasonality and patterns in exchange rate data. Monthly data, for example, may show cyclical variations due to economic cycles. These recurring patterns can be taken into consideration by SARIMA, which could result in projections that are more accurate.

Etuk (2013) used the daily Euro-Dollar exchange rates as the basis for a SARIMA model. The model's good performance suggests that SARIMA has the ability to capture dynamics in the short term. In a similar vein, SARIMA's effectiveness in predicting Malaysia's electricity consumption was discovered by Ismail and Mahpol (2005), indicating its versatility beyond currency exchange.

Najamuddin and Fatima (2022) presented a hybrid model for financial time series forecasting that combines a Bidirectional Recurrent Neural Network (BRNN) with SARIMA. This method makes use of the advantages of machine learning and statistics. Some scholars support adding economic indicators as extra variables, even though SARIMA primarily focuses on historical exchange rate data. By incorporating the impact of more general economic patterns, this may increase forecast accuracy

# EXISTING SYSTEM

Get historical data on the exchange rates between the two target currencies first. Financial institutions, internet currency trading platforms, and economic databases are good sources for this information. Although it's typical practice to use daily or weekly data, the frequency can be changed depending on the intended forecast horizon.Examine the data to comprehend its properties through analysis. To spot trends, seasonality (such as daily, weekly, monthly, or annual swings), and possible outliers, visualize the exchange rates across time. Verify stationarity, a critical SARIMA model assumption. Use differencing techniques (such as subtracting the prior value) if the data shows a trend in order to achieve stationarity 'q' denotes the quantity of moving average terms (previous errors impacting the present result). 'P', 'D', and 'Q' identify seasonal components with comparable interpretations, but for lags in the seasons.  
Fit the selected SARIMA model to the preprocessed data using R tools like "forecast" or Python software libraries like Statsmodels. Numerous political and economic factors affect currency exchange rates. For maybe better forecasting, think about adding pertinent external data (inflation, interest rates, etc.) to the model.Understand that SARIMA models are statistical instruments and that they are not a perfect forecast for future exchange rates. Although the projections offer insightful information about possible trends, unforeseen circumstances can have a big impact on currency markets.These methods will help you create a working system that uses a SARIMA model to forecast currency exchange rates while taking limits into account. Recall that the system's effectiveness depends on the accuracy of the data as well as continued model monitoring and improvement.

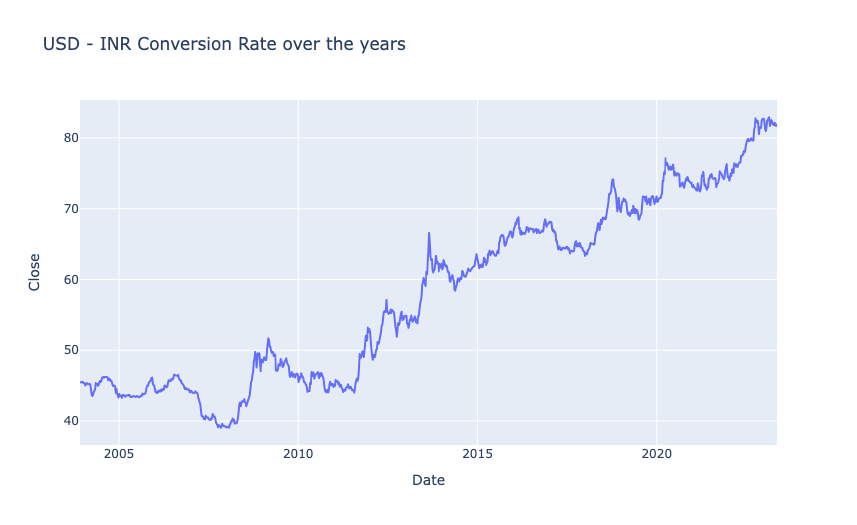
Refine the model parameters (p, d, q, P, D, Q) iteratively in light of the evaluation outcomes. This could entail experimenting with various configurations and contrasting their performance indicators.

# CHAPTER 3 PROJECT DESCRIPTION

For forecasting currency exchange rates, the Seasonal Autoregressive Integrated Moving Average (SARIMA) model provides a structured method. In terms of currency exchange, the architecture is broken down as follows.

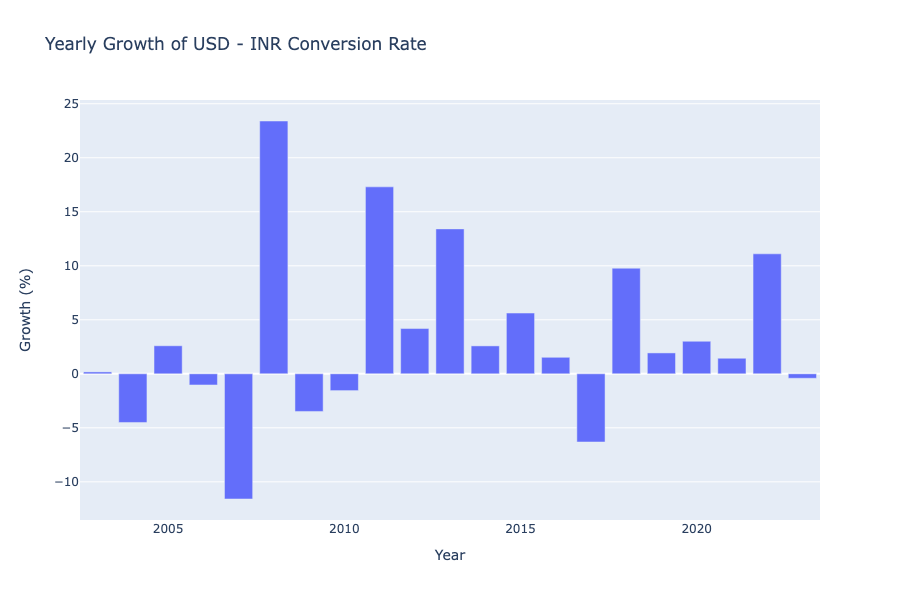
### 3.1 USD – INR Conversion Rate Analysis

Since the USD - INR conversion rates data is what we are using, let's examine the historical conversion rates between the two currencies. To begin, below figure 1 is a line graph that illustrates the historical pattern of conversion rates:



**3.2 Yearly Growth of USD – INR Conversion Rate**

As illustrated in Figure 2, The line chart shows the annual growth of the US dollar to Indian rupee conversion rate. The conversion rate fluctuates between -10% and 25% over a period from 2005 to 2020. There seems to be an increasing trend in the conversion rate over the years.



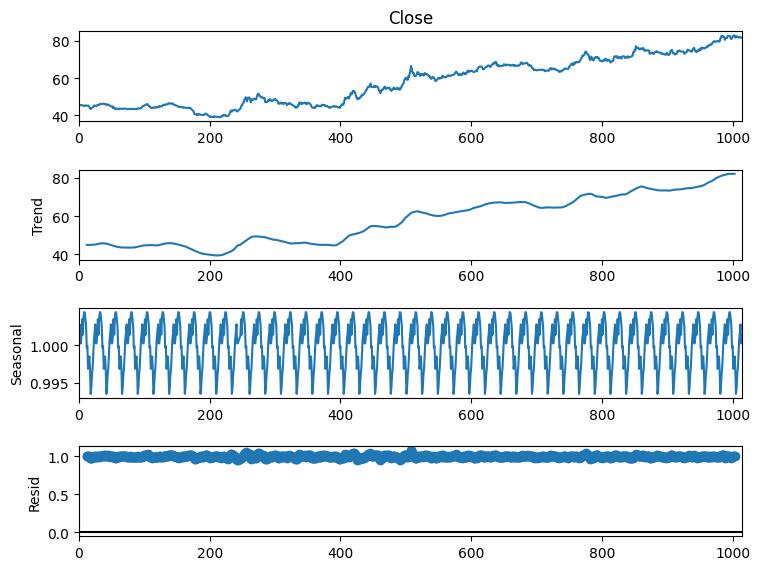
**3.3 Monthly Growth of USD – INR Conversion Rate**

From Figure 3, The chart displays the average monthly growth of the USD-INR conversion rate. The growth fluctuates around 0.5% over a year, with occasional dips below zero.

We may observe that the value of the USD always decreases in January and March, increases annually in the second quarter, peaks in August and then declines in September, and climbs annually in the final quarter before declining once more in December.

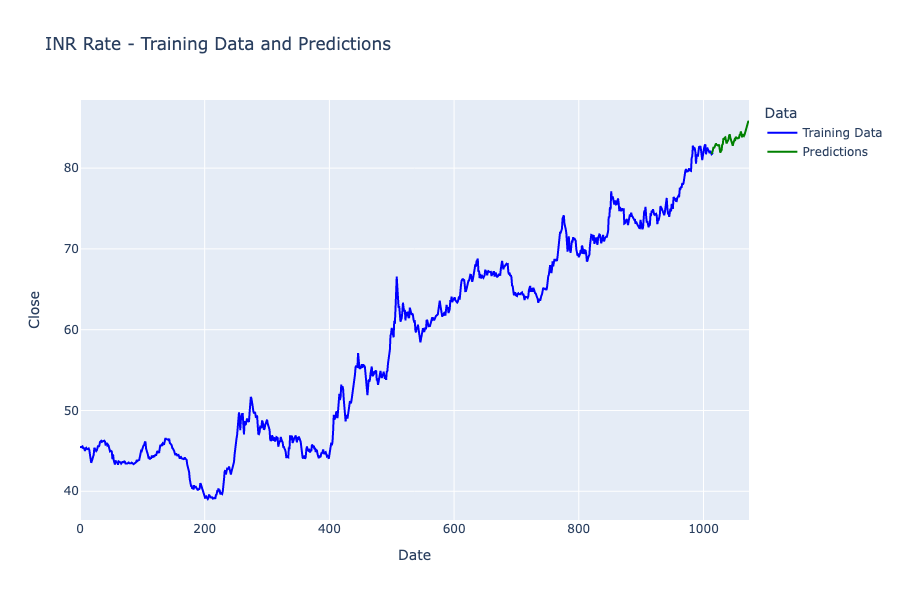
### Aggregated Monthly Growth of USD - INR Conversion Rate3.4 Forecasting Exchange Rates Using Time Series Forecasting

To forecast exchange rates, time series forecasting will be used. From the figure 4 ,We must perform seasonal decomposition in order to determine the best time series forecasting model. This will enable us to see any long-term trends, recurrent patterns, and random fluctuations in the USD - INR exchange rate data.



So we can see that there’s a seasonal pattern in this data. So SARIMA will be the most appropriate algorithm for this data. Before using SARIMA, we need to find p,d, and q values. Here, I will be using the pmdarima library to find these values. You can install this library in your Python environment by executing the command mentioned below.

**3.5 INR TRAINING DATA AND PREDICTIONS**



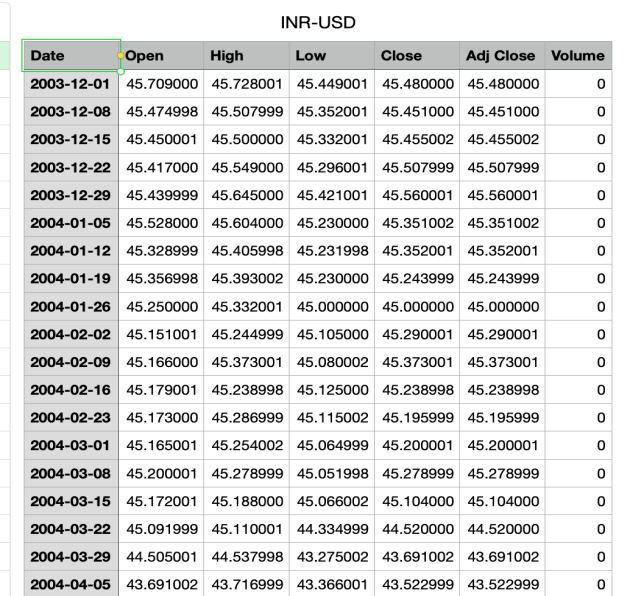
The chart title mentions “Training Data and Predictions.” The two lines on the graph appear to be:

* A solid line representing the historical exchange rate data (possibly INR/USD). This is likely the “Training Data” as it is used to train the forecasting model.
* A dashed line representing the forecasted exchange rate. This is likely the “Predictions” line.

The chart suggests that the INR has been depreciating (weakening) against the other currencies over the training period. The forecast line indicates that this depreciation is expected to continue soon.

**4. DATASET**

It looks like from the figure 6, the data is a time series for currency exchange rates in the financial domain. The dates in the rows are probably daily dates spanning from December 2003 to March 2004. The currency rate in Indian rupees (INR) for one US dollar (USD) on that date is displayed in the columns. A stock or future tracking the exchange rate may be the subject of the additional columns for high, low, closing, and modified closing prices.

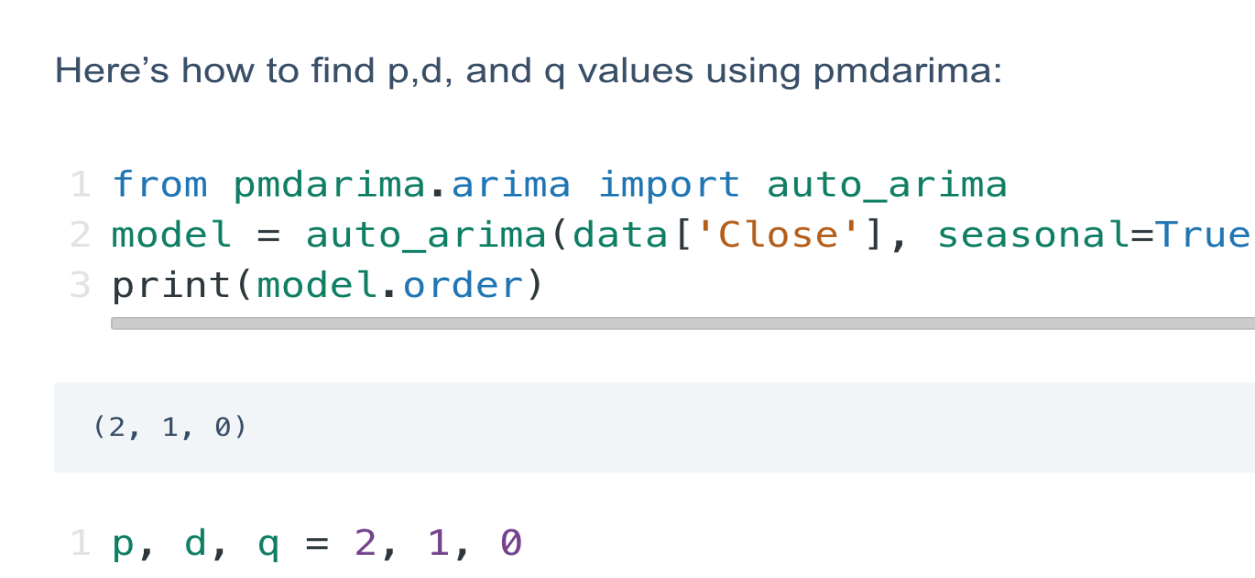


## REQUIREMENTS

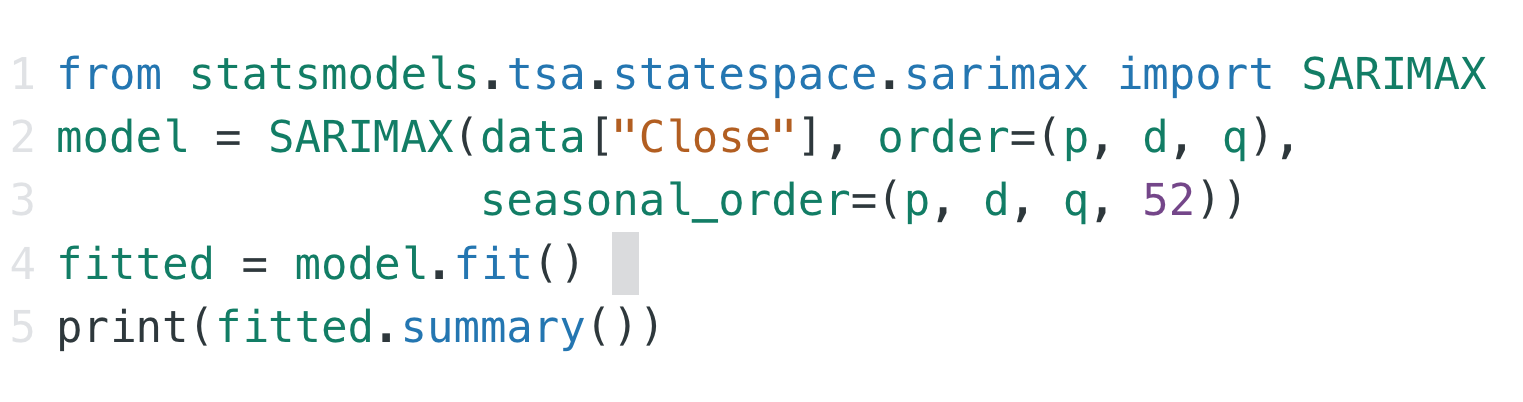
The system requirements for training and evaluating models are 32 GB of RAM, an Nvidia Titan Xp GPU, and an Intel Core i5-7700 CPU running at 3.60 GHz.

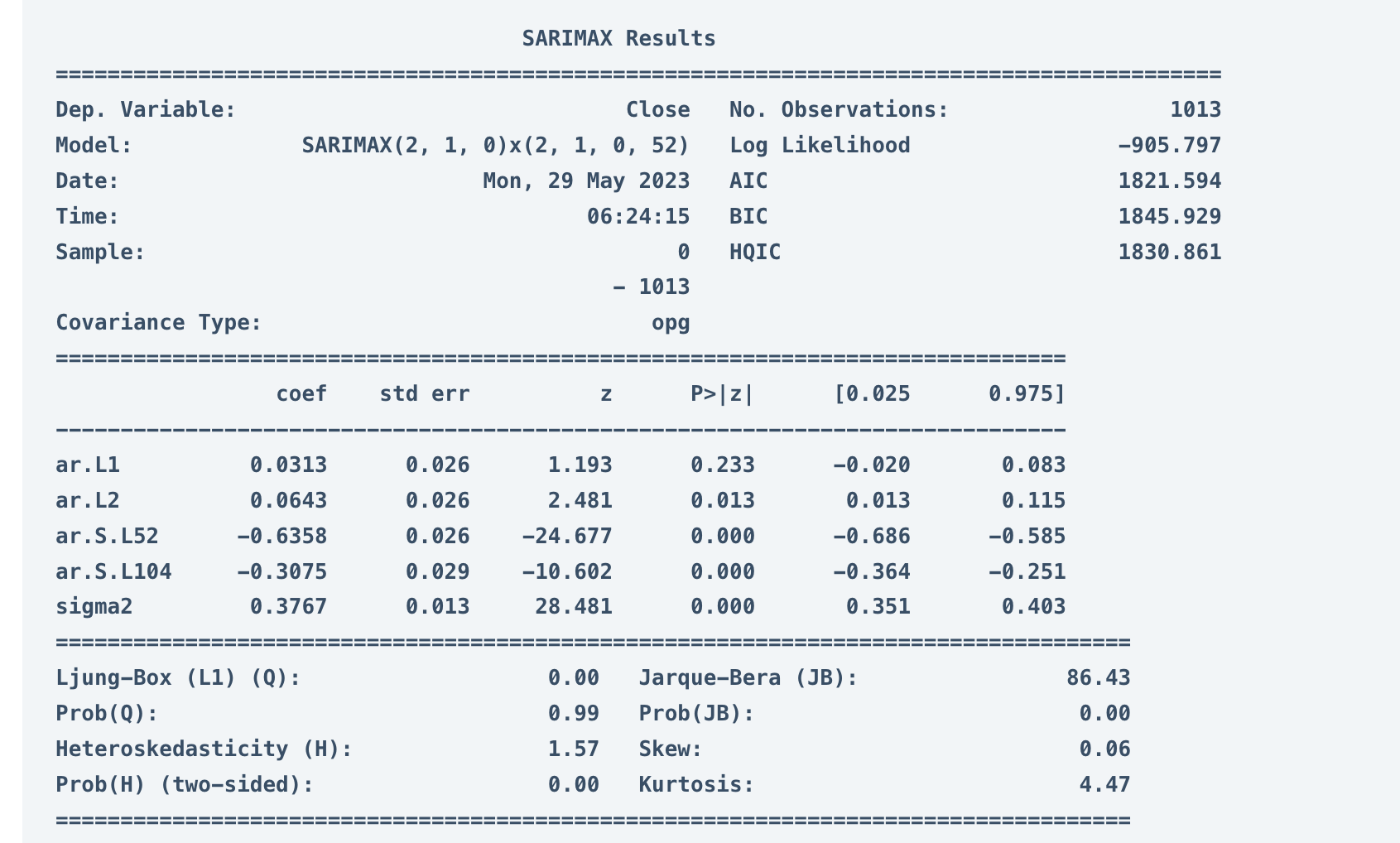
1. **RESULTS AND DISCUSSION**

Here’s how to find p,d, and q values using pmdarima

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Now, here’s how to use SARIMA to train a model to forecast currency exchange rates.



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SARIMAX (2, 1, 0)x(2, 1, 0, 52) - This is the specific SARIMA model formula used in the analysis. It defines the number of autoregressive (AR) terms (2), differencing steps (1), and moving average (MA) terms (0) for the model itself, along with seasonal AR terms (2), seasonal differencing (1), and seasonal MA terms (0, 52). **Log Likelihood:** -1013.797 - This is a statistical measure used to assess how well the model fits the data. Lower values indicate a better fit.

Now here’s how to make predictions about future currency exchange rates:1



So this is how you can use time series forecasting for the task of Currency Exchange Rate Forecasting using Python.

## CONCLUSION AND FUTURE WORK

Beyond forecasting, implementing USD-INR conversion rates requires careful consideration. Several methods cater to different needs. Currency converter APIs offer a convenient and accurate solution, fetching real-time or historical data through code integration. Web scraping provides a free alternative, but requires programming knowledge and maintenance due to potential website changes. Manual lookups on financial websites are readily available but lack real-time updates and may be cumbersome for bulk conversions. Lastly, storing historical data offline presents a cost-effective option, but the data can become outdated.

In conclusion, the USD-INR conversion rate remains a captivating puzzle for financial analysis. While SARIMA models offer valuable forecasting insights, understanding their limitations is crucial. When implementing these rates, the most suitable method depends on the desired level of accuracy, frequency of updates, and technical resources available. As the global economy continues to evolve, so too will the dance of the USD-INR conversion rate, demanding a blend of forecasting prowess, strategic implementation, and an awareness of the ever-changing economic landscape.

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