Project Report

Forecasting RMB/USD Exchange Rate Using Time Series Models for Strategic Business Planning

1. Executive Summary:

This report presents the results of an exchange rate forecasting project using ARMAX models (with the United States Fed Funds Interest Rate as an exogenous variable) and Neural Network models. The objective is to provide international companies in China with a predictive outlook on the RMB/USD exchange rate to inform their pricing strategies, financial planning, and decision-making processes regarding market operations.

2. Introduction:

The project aims to utilize time series models to forecast the exchange rate between the Chinese RMB and the US Dollar. With China's significant role in the global economy, accurate exchange rate predictions are crucial for international businesses to optimize their operations and mitigate financial risks.

3. Project Description:

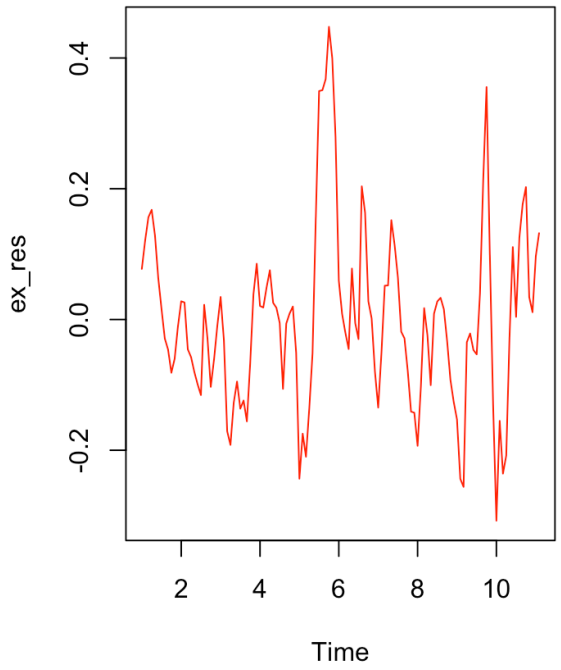
The project covers a detailed analysis period, using historical exchange rate data along with relevant economic indicators, such as the US Fed Funds Interest Rate. The forecast aims to support strategic business decisions for the next 3 years.

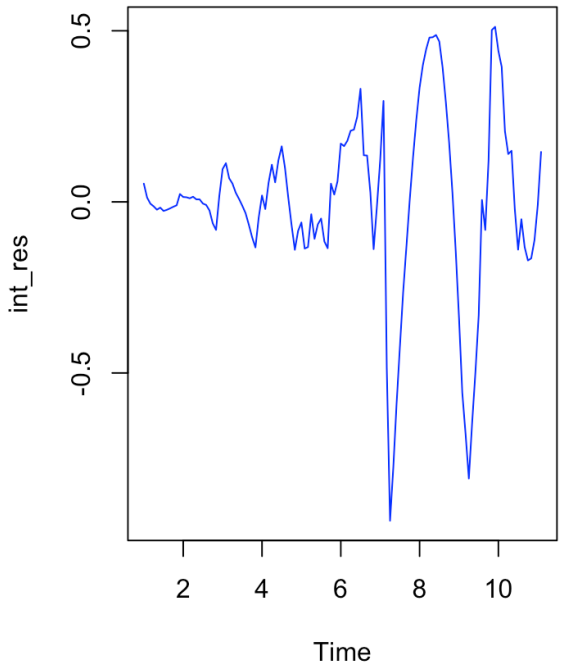
4. Methodology:

4.1 ARMAX Model

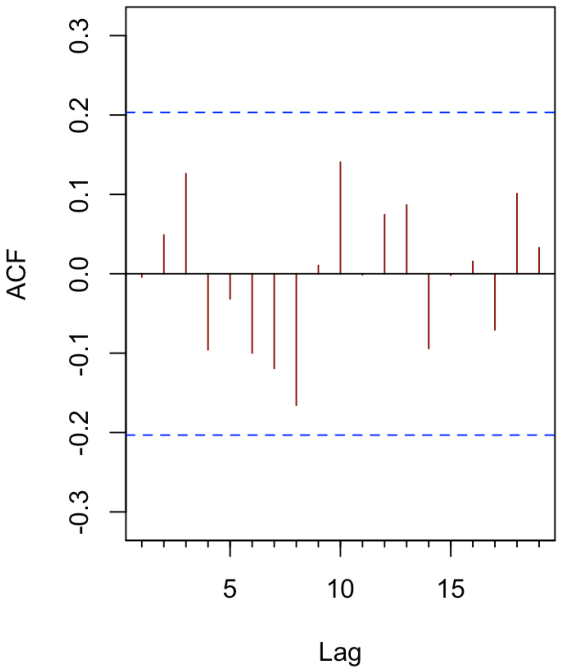
Our ARMAX model captures the effect of the US Federal Funds Interest Rate at a lag of 2 periods. The choice of $p = 1$ and $q = 1$ for the autoregressive and moving average terms respectively is motivated by ACF and Pacf charts. We incorporate a second lag of the US Federal Funds Interest Rate as the exogenous variable based on correlation suggesting that monetary policy decisions tend to influence exchange rates with a lag.

Prior to fitting the ARMAX model, both the RMB/USD exchange rate and the US Federal Funds Interest Rate series are detrended to remove any non-stationary components. Before estimating the model, we conducted unit root tests (Augmented Dickey-Fuller test) to confirm that the detrended series are stationary. After estimating the model, we perform diagnostic checks, including analyzing the residuals for autocorrelation and ensuring that they are normally distributed.

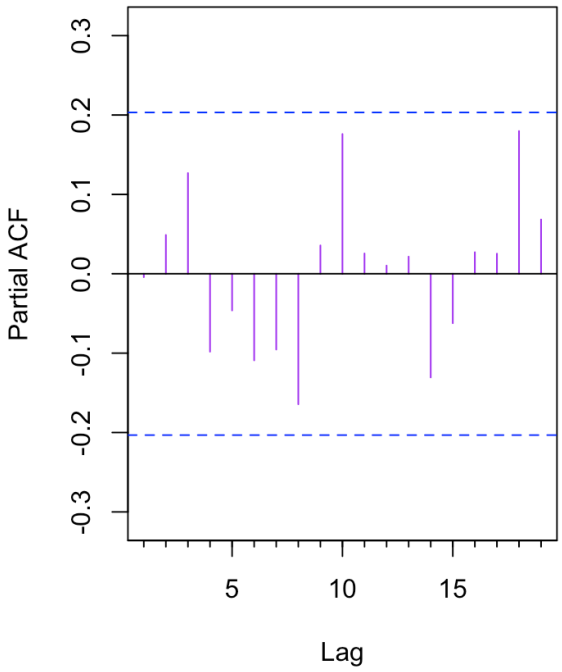




ACF of the ARMAX residuals



PACF of the ARMAX residuals



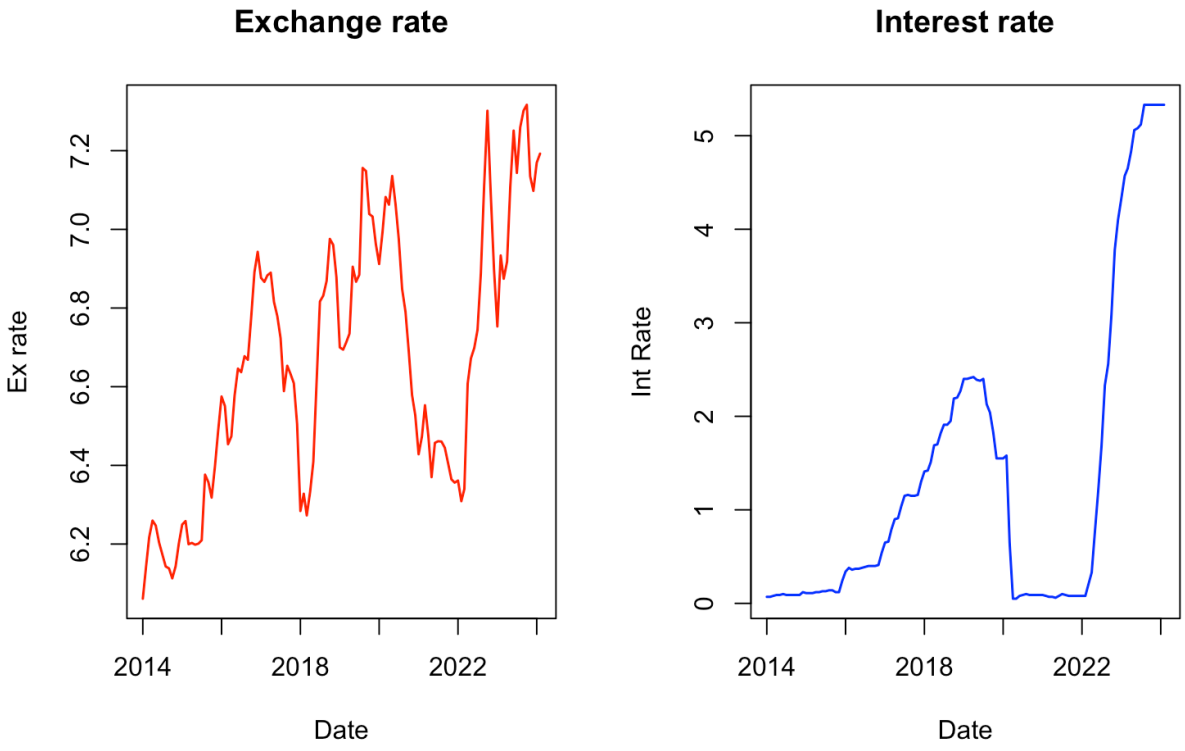
4.2 Neural Network Model

The neural network is trained using historical exchange rate data. We use a sliding window approach for time series forecasting where input nodes receive data from a fixed number of previous time steps, and the output node predicts the future exchange rate.

We use a backpropagation algorithm with a specified learning rate and momentum to optimize the weights of the neural network.

4.3 Data Preparation

We scraped historical data for the RMB/USD exchange rate and the US Federal Funds Interest Rate using API. The time frame of the data covers from 2014 to 2024, with 122 intervals. The data underwent preprocessing steps such as normalization or standardization to ensure it is suitable for modeling. We also addressed missing values and outliers to improve the quality of the input data.



4.4 Model Evaluation

To assess the forecasting accuracy of our models, we used the Root Mean Square Error (RMSE) and the Mean Absolute Percentage Error (MAPE). The models were validated through cross-validation techniques to ensure that the performance metrics are reliable and the model does not suffer from overfitting.

5. Findings and Analysis:

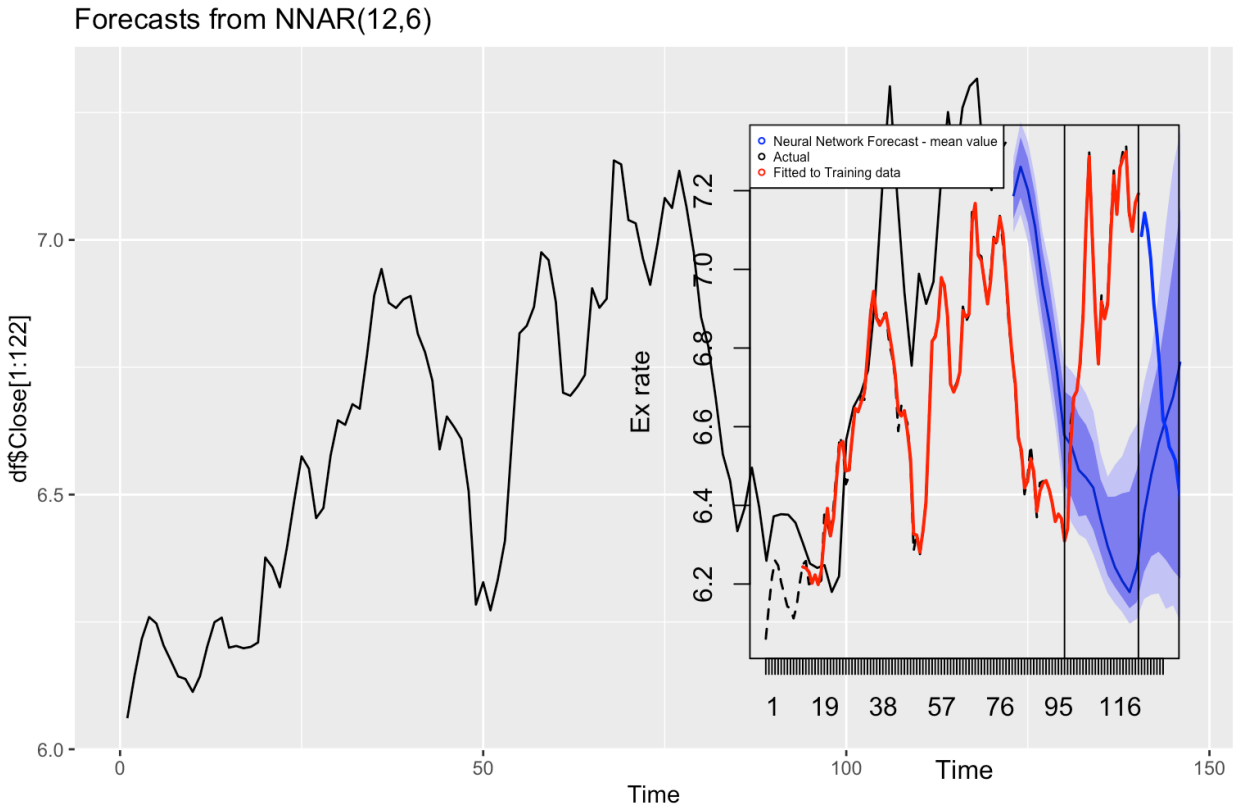
a) Initial Decrease: The initial downward trend in the exchange rate may suggest that the RMB is weakening against the USD, which could be due to various

economic factors such as lower interest rates in China, increased demand for USD, or other macroeconomic conditions.

b) Subsequent Increase: The increase after the decrease may indicate an expected strengthening of the RMB against the USD. This could be attributed to anticipated economic policies, market sentiment, or changes in the global economic environment.

c) Forecast Confidence Interval: The shaded area represents the confidence interval of the forecast, with the outer bounds showing greater uncertainty as time progresses. The widening of the interval indicates increasing uncertainty in the long-term forecast.

d) Potential Volatility: The forecast plot shows potential volatility in the future exchange rates, as indicated by the breadth of the confidence interval. This implies that while the central trend is upwards, there is significant uncertainty about the future rate.



6. Actionable Recommendations:

Based on the decrease followed by an increase in the exchange rate:

a) Short-Term Pricing Strategy: Given the short-term decrease, the company could temporarily lower prices for exports to the U.S. to remain competitive or pre-purchase USD if imports from the U.S. are significant.

b) Long-Term Planning: Prepare for the subsequent increase in the exchange rate by adjusting long-term contracts and pricing strategies accordingly. This could mean gradually increasing the USD prices of goods and services as the RMB strengthens.

c) Hedging Strategies: Use financial instruments to hedge against the forecasted short-term decrease and subsequent increase in the exchange rate. Options can be particularly useful in this scenario as they provide the right, but not the obligation, to exchange currency at a predetermined rate.

d) Budget Adjustments: Revise budget forecasts to account for the expected decrease and then increase in the exchange rate. This may involve adjusting the timing of currency conversions and capital expenditures.

e) Inventory Management: If the exchange rate decrease is expected to be temporary, consider stockpiling inventory when the RMB is weaker to benefit from cost savings before the anticipated strengthening.