timeseries

November 25, 2024

[1]:
```
import pandas as pd
df = pd.read_csv('/content/exchange_rate.csv', parse_dates=['date'])
df.set_index('date', inplace=True)
```

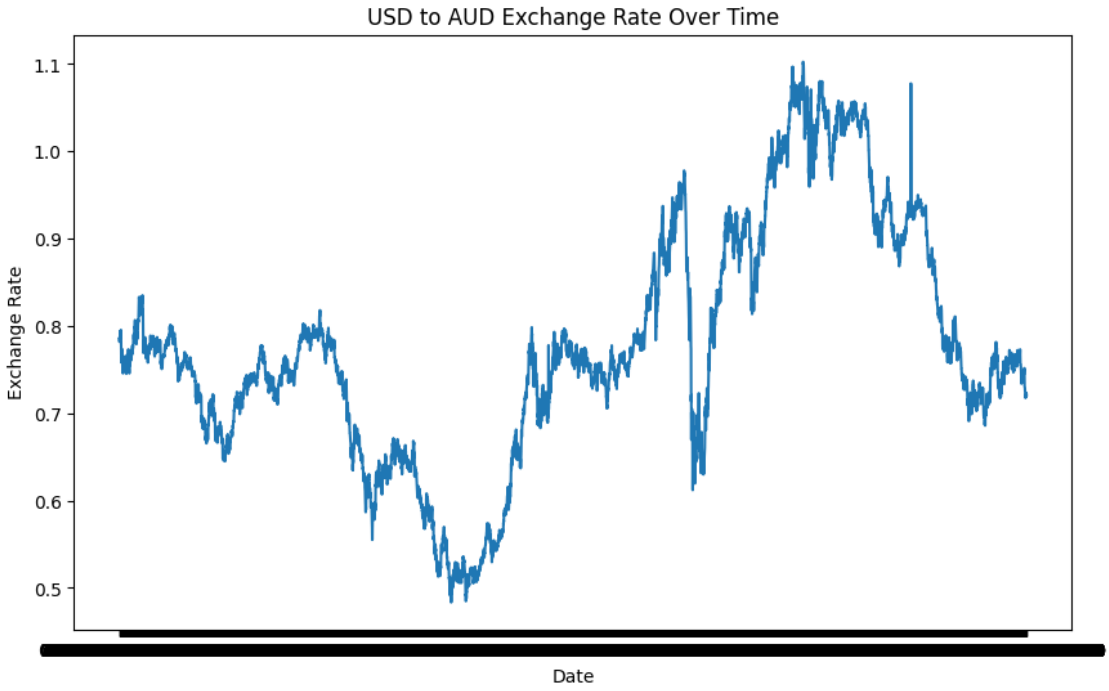
[3]:
```
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv('/content/exchange_rate.csv', parse_dates=['date'])
df.set_index('date', inplace=True)

# Check for the correct column name in the DataFrame
print(df.columns)

# Assuming the actual column name is 'Ex_rate' based on the global variables
# Correct the column name in the plot function
plt.figure(figsize=(10, 6))
plt.plot(df['Ex_rate'])  # Changed from 'USD_to_AUD' to 'Ex_rate'
plt.title('USD to AUD Exchange Rate Over Time')
plt.xlabel('Date')
plt.ylabel('Exchange Rate')
plt.show()
```

```
Index(['Ex_rate'], dtype='object')
```



[4]:
```
df.isnull().sum()  # Check for missing values
df.fillna(method='ffill', inplace=True)  # Handle missing values
```

```
<ipython-input-4-e0bca0acf71b>:2: FutureWarning: DataFrame.fillna with 'method'
is deprecated and will raise in a future version. Use obj.ffill() or obj.bfill()
instead.
  df.fillna(method='ffill', inplace=True)  # Handle missing values
```

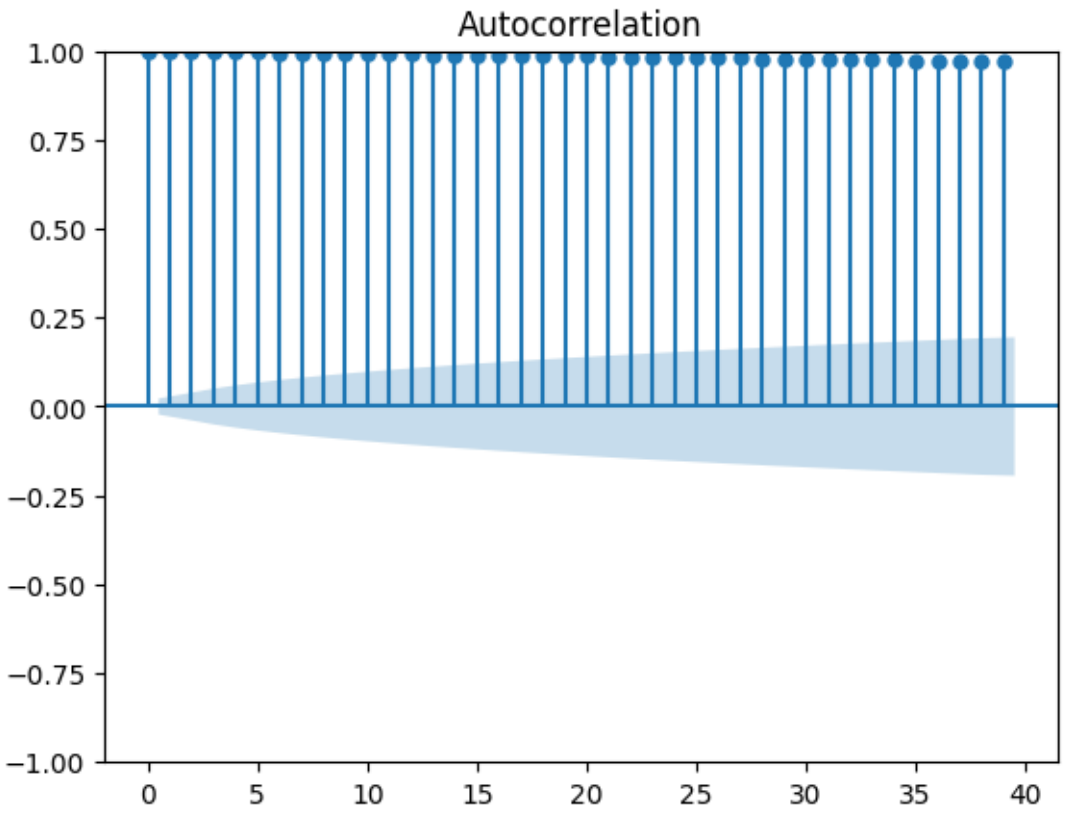
[6]:
```
!pip install statsmodels
import pandas as pd
import matplotlib.pyplot as plt
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf

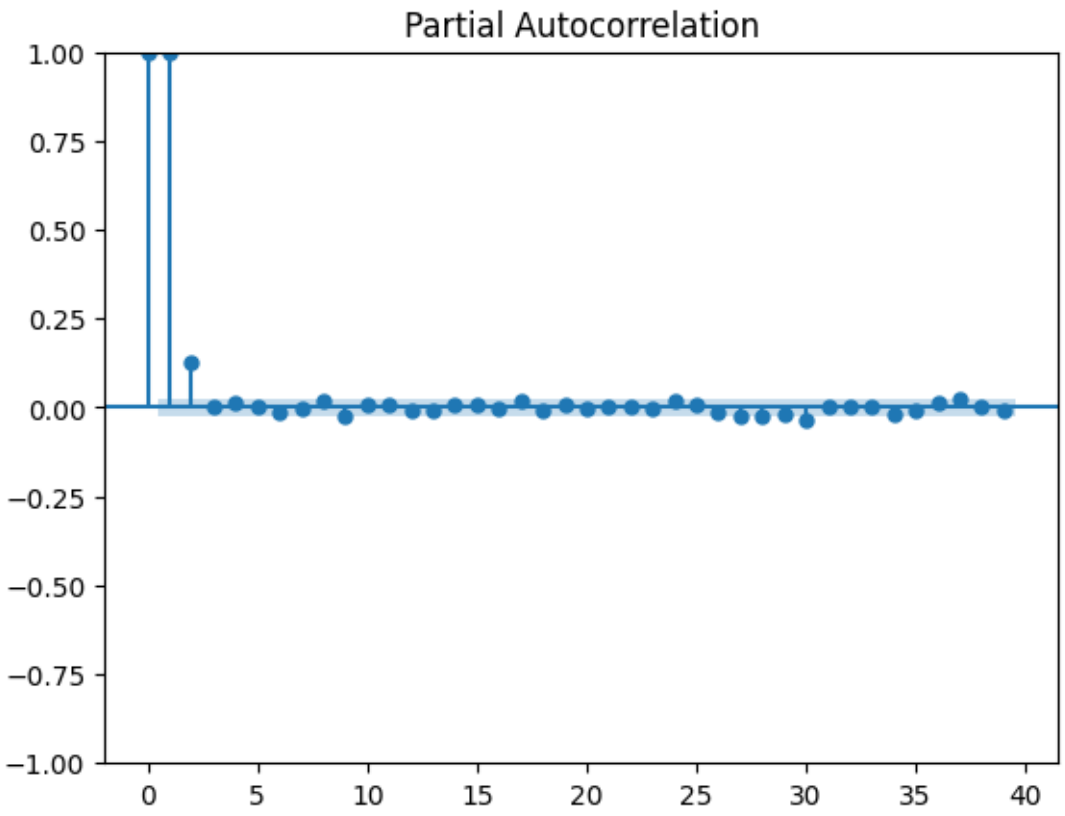
# ... (your existing code to load and preprocess the data) ...

# Replace 'USD_to_AUD' with 'Ex_rate' in the plot functions
plot_acf(df['Ex_rate']) # Changed 'USD_to_AUD' to 'Ex_rate'
plot_pacf(df['Ex_rate']) # Changed 'USD_to_AUD' to 'Ex_rate'
plt.show()
```

```
Requirement already satisfied: statsmodels in /usr/local/lib/python3.10/dist-
packages (0.14.4)
Requirement already satisfied: numpy<3,>=1.22.3 in
/usr/local/lib/python3.10/dist-packages (from statsmodels) (1.26.4)
Requirement already satisfied: scipy!=1.9.2,>=1.8 in
```

```
/usr/local/lib/python3.10/dist-packages (from statsmodels) (1.13.1)
Requirement already satisfied: pandas!=2.1.0,>=1.4 in
/usr/local/lib/python3.10/dist-packages (from statsmodels) (2.2.2)
Requirement already satisfied: patsy>=0.5.6 in /usr/local/lib/python3.10/dist-
packages (from statsmodels) (1.0.1)
Requirement already satisfied: packaging>=21.3 in
/usr/local/lib/python3.10/dist-packages (from statsmodels) (24.2)
Requirement already satisfied: python-dateutil>=2.8.2 in
/usr/local/lib/python3.10/dist-packages (from pandas!=2.1.0,>=1.4->statsmodels)
(2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-
packages (from pandas!=2.1.0,>=1.4->statsmodels) (2024.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.10/dist-
packages (from pandas!=2.1.0,>=1.4->statsmodels) (2024.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-
packages (from python-dateutil>=2.8.2->pandas!=2.1.0,>=1.4->statsmodels)
(1.16.0)
```





[8]:
```
from statsmodels.tsa.arima.model import ARIMA

# Define the order of the ARIMA model
p = 5  # Example value for the autoregressive (AR) component
d = 1  # Example value for the integrated (I) component
q = 0  # Example value for the moving average (MA) component

model = ARIMA(df['Ex_rate'], order=(p, d, q))
model_fit = model.fit()
print(model_fit.summary())
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473:
ValueWarning: An unsupported index was provided. As a result, forecasts cannot
be generated. To use the model for forecasting, use one of the supported classes
of index.
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473:
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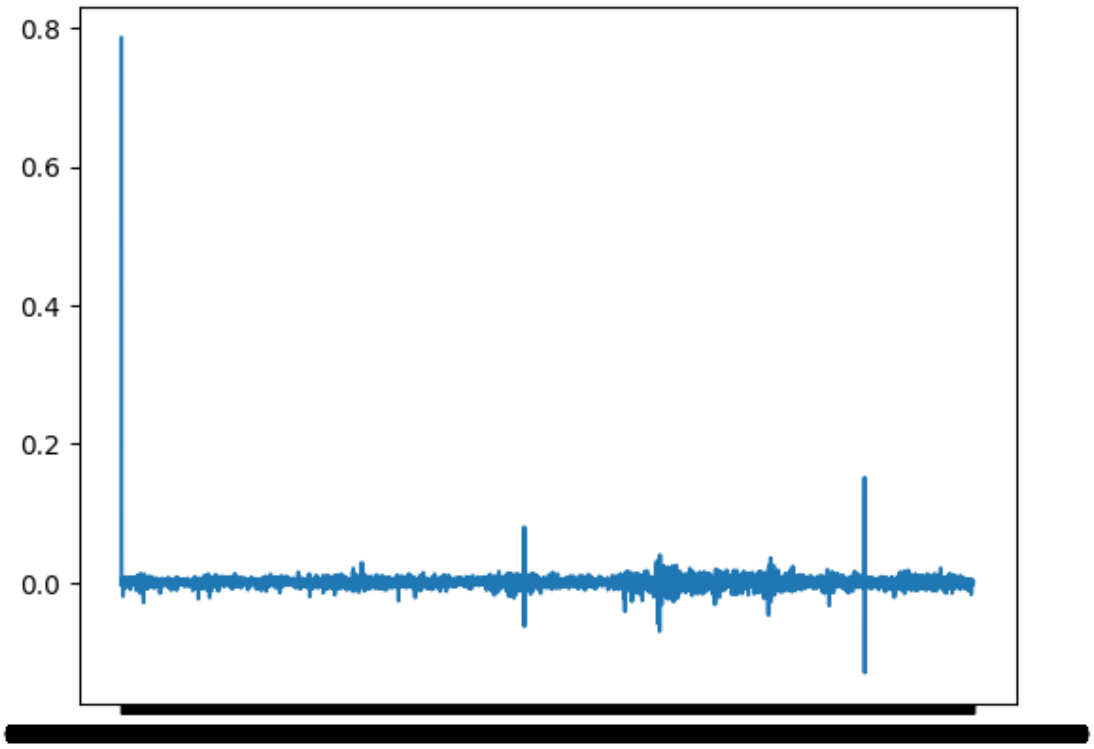
of index.
  self._init_dates(dates, freq)

                               SARIMAX Results
==============================================================================
Dep. Variable:                 Ex_rate   No. Observations:                 7588
Model:                 ARIMA(5, 1, 0)   Log Likelihood               28055.685
Date:                Mon, 25 Nov 2024   AIC                         -56099.370
Time:                        09:07:07   BIC                         -56057.765
Sample:                             0   HQIC                        -56085.091
                                 - 7588
Covariance Type:                  opg
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
ar.L1         -0.1314      0.002    -63.382      0.000      -0.135      -0.127
ar.L2         -0.0025      0.006     -0.406      0.685      -0.015       0.010
ar.L3         -0.0167      0.007     -2.452      0.014      -0.030      -0.003
ar.L4          0.0003      0.009      0.028      0.977      -0.018       0.018
ar.L5          0.0112      0.009      1.271      0.204      -0.006       0.029
sigma2      3.594e-05   1.01e-07    354.596      0.000    3.57e-05    3.61e-05
===================================================================================
===
Ljung-Box (L1) (Q):                   0.00   Jarque-Bera (JB):
2864559.53
Prob(Q):                              0.99   Prob(JB):
0.00
Heteroskedasticity (H):               2.97   Skew:
0.25
Prob(H) (two-sided):                  0.00   Kurtosis:
98.19
===================================================================================
===

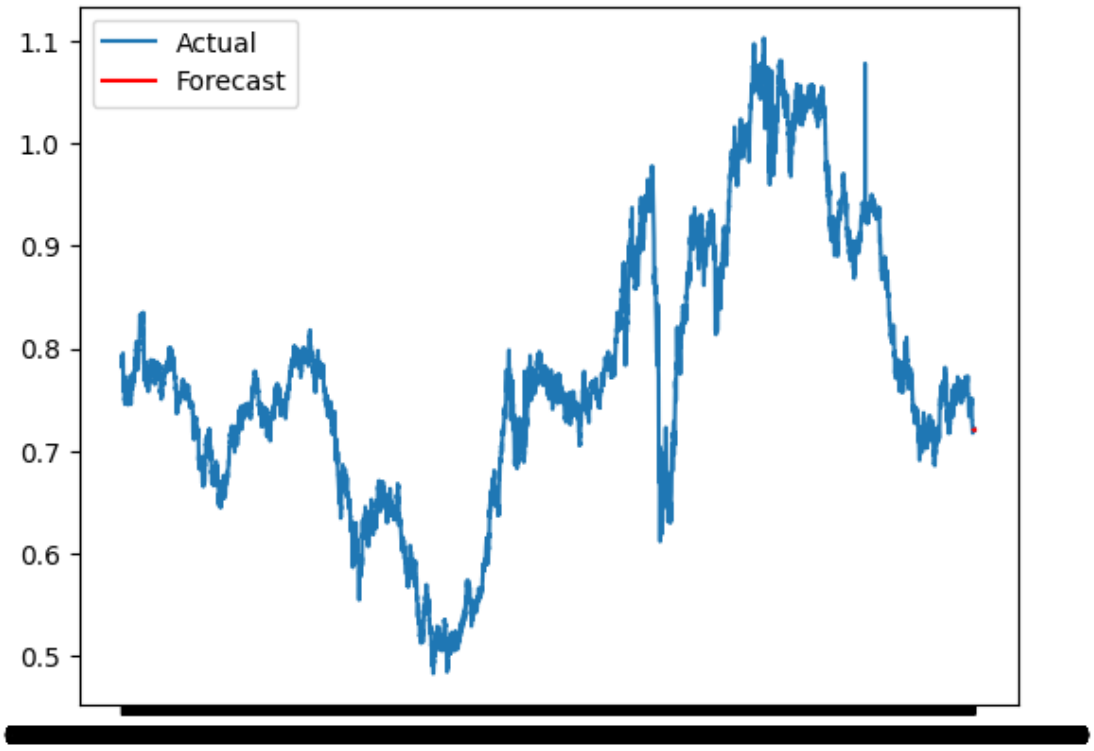
Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-
step).
```

[9]:
```
residuals = model_fit.resid
plt.plot(residuals)
plt.show()
```



[11]:
```
forecast = model_fit.forecast(steps=10)
plt.plot(df.index, df['Ex_rate'], label='Actual')
plt.plot(forecast.index, forecast, label='Forecast', color='red')
plt.legend()
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:837:
ValueWarning: No supported index is available. Prediction results will be given
with an integer index beginning at `start`.
  return get_prediction_index(
```



[ ]:

[12]:
```
from statsmodels.tsa.holtwinters import ExponentialSmoothing

model = ExponentialSmoothing(df['Ex_rate'], trend='add', seasonal='add',␣
 ↪seasonal_periods=12)
model_fit = model.fit()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473:
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```

[13]:
```
# Grid search or AIC-based optimization
```

[14]:
```
forecast = model_fit.forecast(steps=10)
plt.plot(df.index, df['Ex_rate'], label='Actual')
plt.plot(forecast.index, forecast, label='Forecast', color='red')
plt.legend()
plt.show()
```

```
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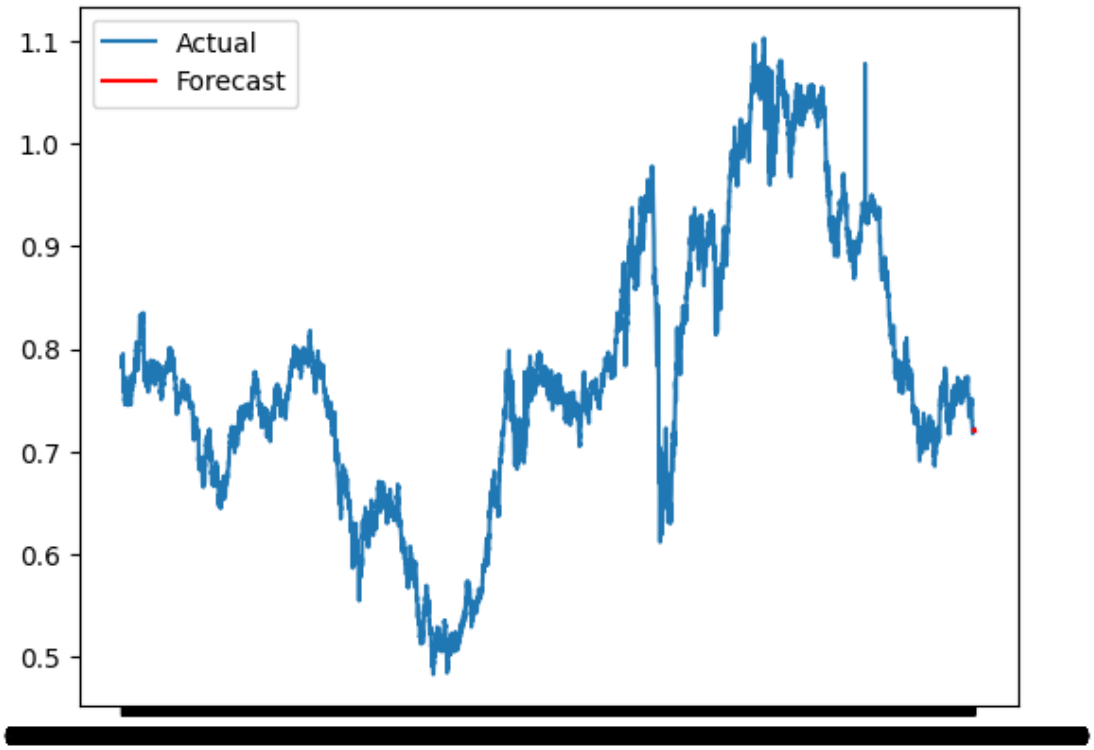

[16]:
```
import numpy as np # Import the numpy library and assign it the alias 'np'
from sklearn.metrics import mean_absolute_error, mean_squared_error

mae = mean_absolute_error(df['Ex_rate'][-10:], forecast)
mse = mean_squared_error(df['Ex_rate'][-10:], forecast)
rmse = np.sqrt(mse) # Now you can use np.sqrt since numpy has been imported
```

[17]:
```
import pandas as pd
import numpy as np
from sklearn.metrics import mean_absolute_error, mean_squared_error,␣
 ↪mean_absolute_percentage_error
from statsmodels.tsa.arima.model import ARIMA
from statsmodels.tsa.holtwinters import ExponentialSmoothing
import matplotlib.pyplot as plt
```

```
# Load dataset
df = pd.read_csv('/content/exchange_rate.csv', parse_dates=['date'])
df.set_index('date', inplace=True)

# Split the dataset into training and testing sets
train_size = int(len(df) * 0.8)
train, test = df[:train_size], df[train_size:]

# ARIMA Model
arima_model = ARIMA(train['Ex_rate'], order=(p, d, q))  # Replace (p, d, q)␣
 ↪with actual values
arima_fit = arima_model.fit()
arima_forecast = arima_fit.forecast(steps=len(test))

# Exponential Smoothing Model
exp_model = ExponentialSmoothing(train['Ex_rate'], trend='add', seasonal='add',␣
 ↪seasonal_periods=12)
exp_fit = exp_model.fit()
exp_forecast = exp_fit.forecast(steps=len(test))

# Error Metrics Calculation
mae_arima = mean_absolute_error(test['Ex_rate'], arima_forecast)
rmse_arima = np.sqrt(mean_squared_error(test['Ex_rate'], arima_forecast))
mape_arima = mean_absolute_percentage_error(test['Ex_rate'], arima_forecast)

mae_exp = mean_absolute_error(test['Ex_rate'], exp_forecast)
rmse_exp = np.sqrt(mean_squared_error(test['Ex_rate'], exp_forecast))
mape_exp = mean_absolute_percentage_error(test['Ex_rate'], exp_forecast)

# Print Error Metrics
print(f"ARIMA - MAE: {mae_arima}, RMSE: {rmse_arima}, MAPE: {mape_arima}")
print(f"Exponential Smoothing - MAE: {mae_exp}, RMSE: {rmse_exp}, MAPE:␣
 ↪{mape_exp}")

# Visualization
plt.figure(figsize=(12, 6))
plt.plot(train.index, train['Ex_rate'], label='Training Data')
plt.plot(test.index, test['Ex_rate'], label='Test Data')
plt.plot(test.index, arima_forecast, label='ARIMA Forecast', color='red')
plt.plot(test.index, exp_forecast, label='Exponential Smoothing Forecast',␣
 ↪color='green')
plt.legend()
plt.title('Model Comparison: ARIMA vs Exponential Smoothing')
plt.xlabel('Date')
plt.ylabel('Exchange Rate')
plt.show()
```

```
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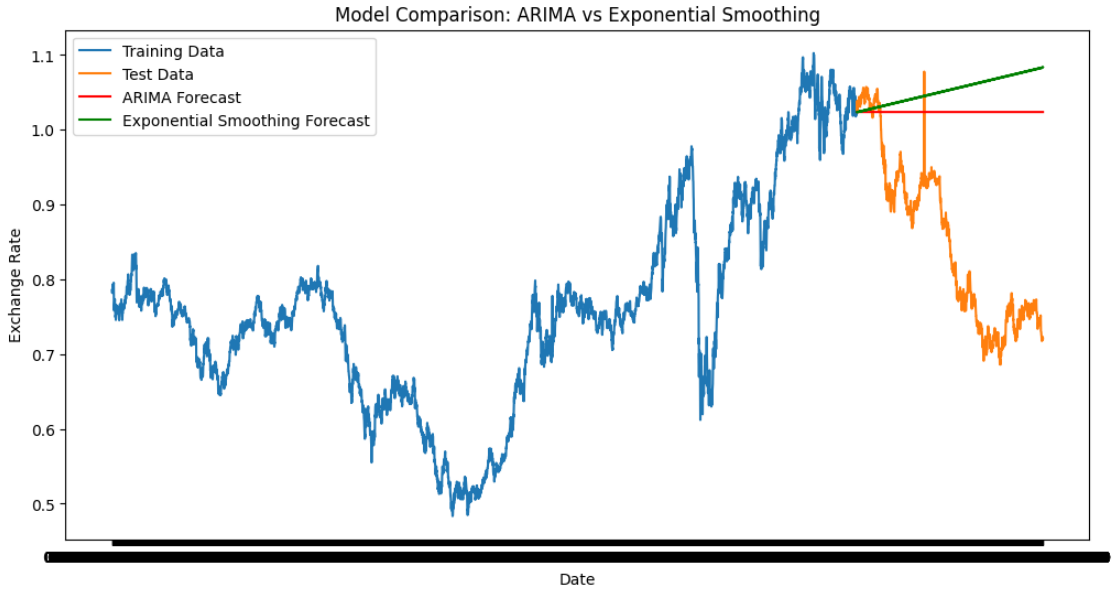
FutureWarning: No supported index is available. In the next version, calling
this method in a model without a supported index will result in an exception.
  return get_prediction_index(
```

```
ARIMA - MAE: 0.17780239504335849, RMSE: 0.2055405871355618, MAPE:
0.22809757924533444
Exponential Smoothing - MAE: 0.20675470865512963, RMSE: 0.23928931038324866,
MAPE: 0.26529010158066424
```


Model Comparison: ARIMA vs Exponential Smoothing
Training Data
Test Data
ARIMA Forecast
Exponential Smoothing Forecast
Exchange Rate
1.1
1.0
0.9
0.8
0.7
0.6
0.5
Date

[ ]: