Moving Average Smoothing For Data Preparation

Aim:
To Implement a program to apply moving average smoothing for data preparation and time series forecasting.

Algorithm:

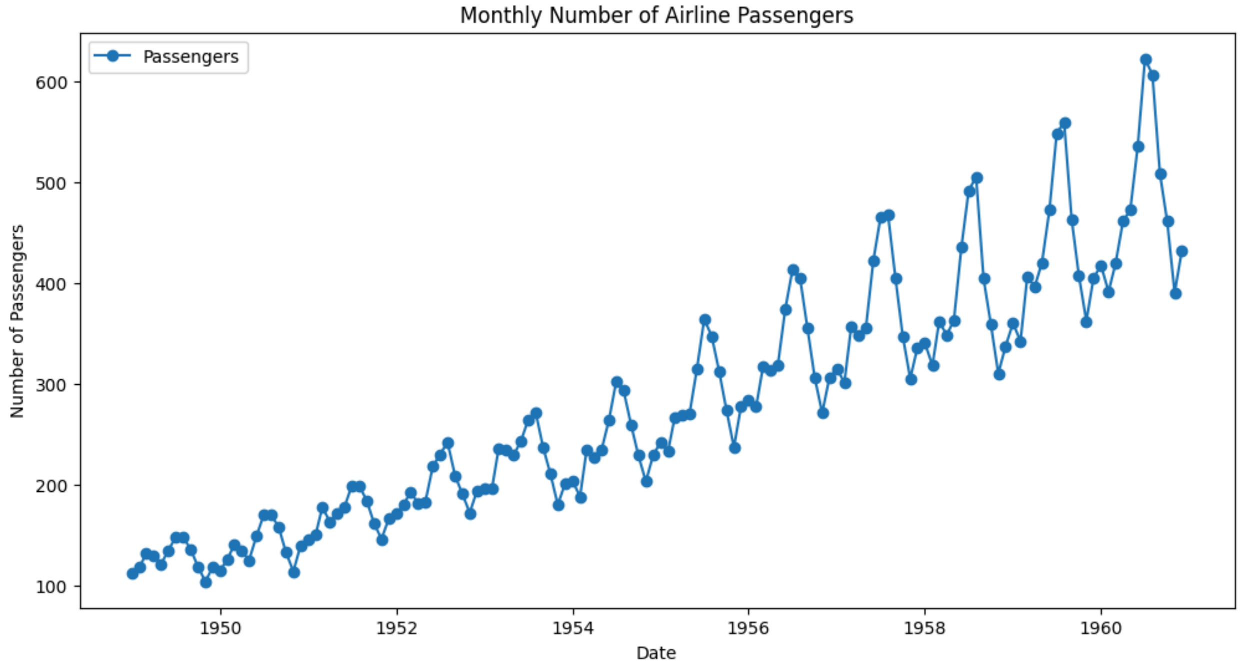
1. Import all necessary libraries for data processing, visualization, and forecasting.
2. Load the online dataset and set the date column as the index after converting it to datetime format.
3. Plot the original time series to visually inspect the data trends and patterns.
4. Calculate the moving average with a specified window size to smooth the series.
5. Overlay the moving average on the original series to highlight the underlying trend.
6. Extract the last smoothed value and generate a naive forecast for the next defined period.
7. Plot the original, smoothed, and forecasted series together to compare their behaviors.
8. End the forecasting and visualization process.

Program Code:

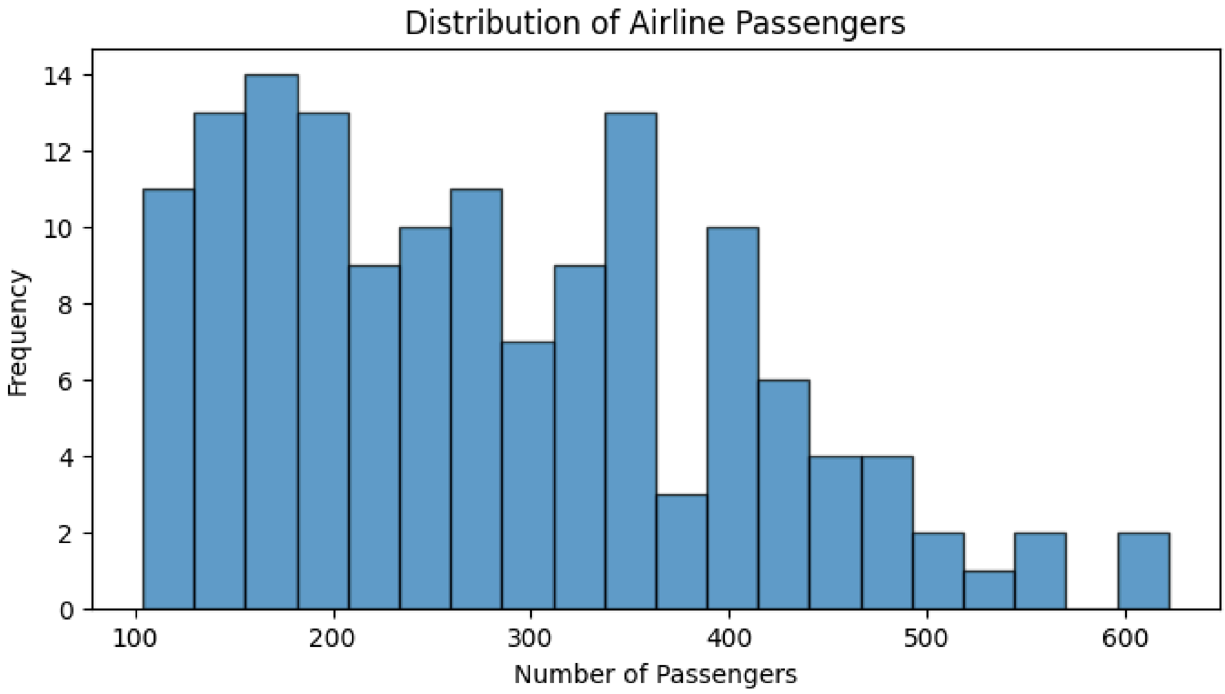
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from statsmodels.tsa.holtwinters import ExponentialSmoothing

%matplotlib inline

url = 'https://raw.githubusercontent.com/jbrownlee/Datasets/master/airline-passengers.csv'
df = pd.read_csv(url, parse_dates=['Month'])
df.set_index('Month', inplace=True)
ts = df['Passengers']

ts.head()
```

```
          Passengers
Month
1949-01-01     112
1949-02-01     118
1949-03-01     132
1949-04-01     129
1949-05-01     121

dtype: int64
```

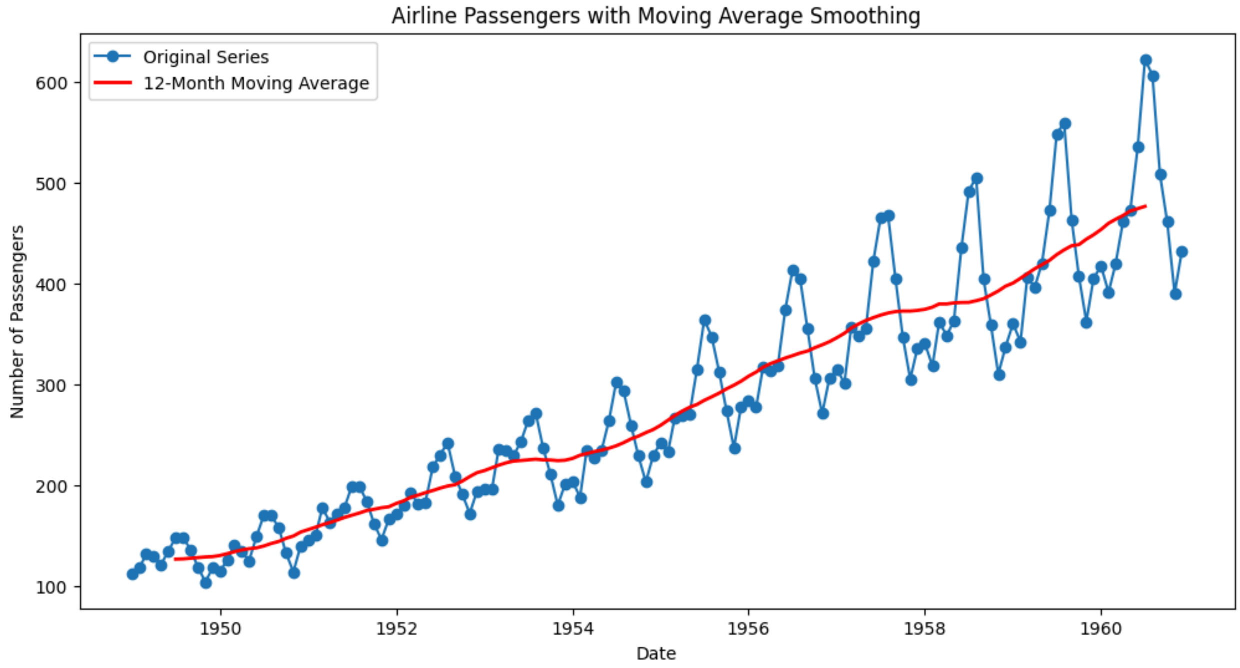
```
plt.figure(figsize=(12,6))
plt.plot(ts, marker='o', linestyle='-', label='Passengers')
plt.title('Monthly Number of Airline Passengers')
plt.xlabel('Date')
plt.ylabel('Number of Passengers')
plt.legend()
plt.show()
```



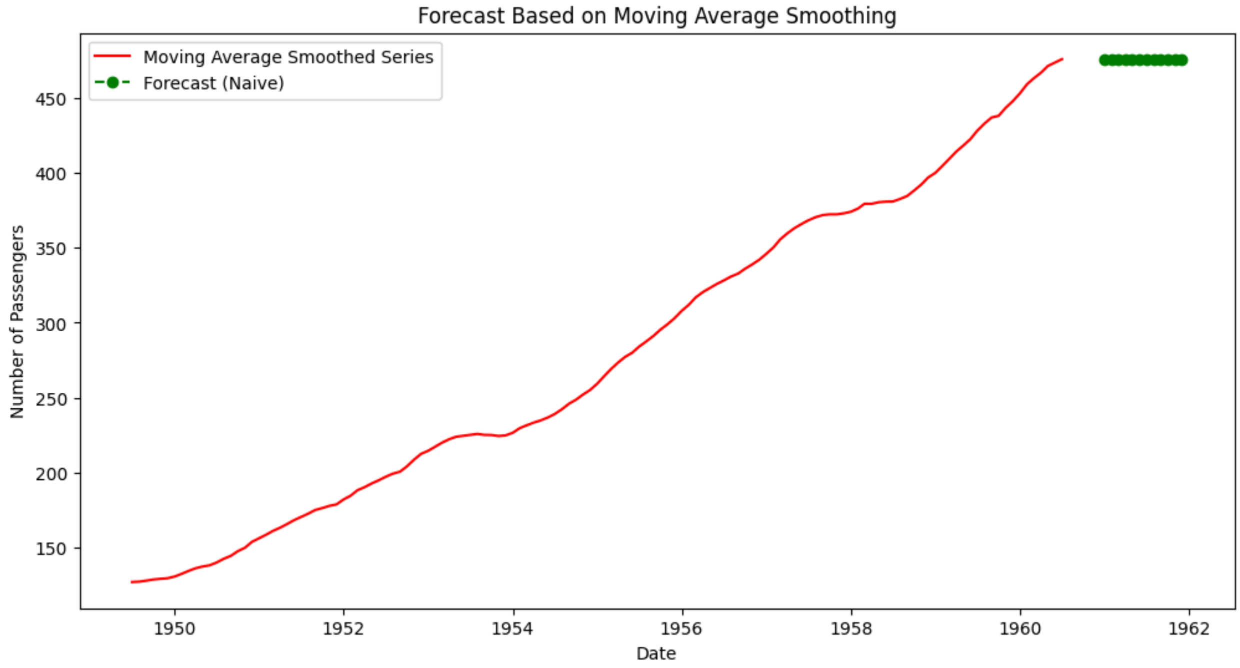
```
plt.figure(figsize=(8,4))
plt.hist(ts, bins=20, edgecolor='k', alpha=0.7)
plt.title('Distribution of Airline Passengers')
plt.xlabel('Number of Passengers')
plt.ylabel('Frequency')
plt.show()
```



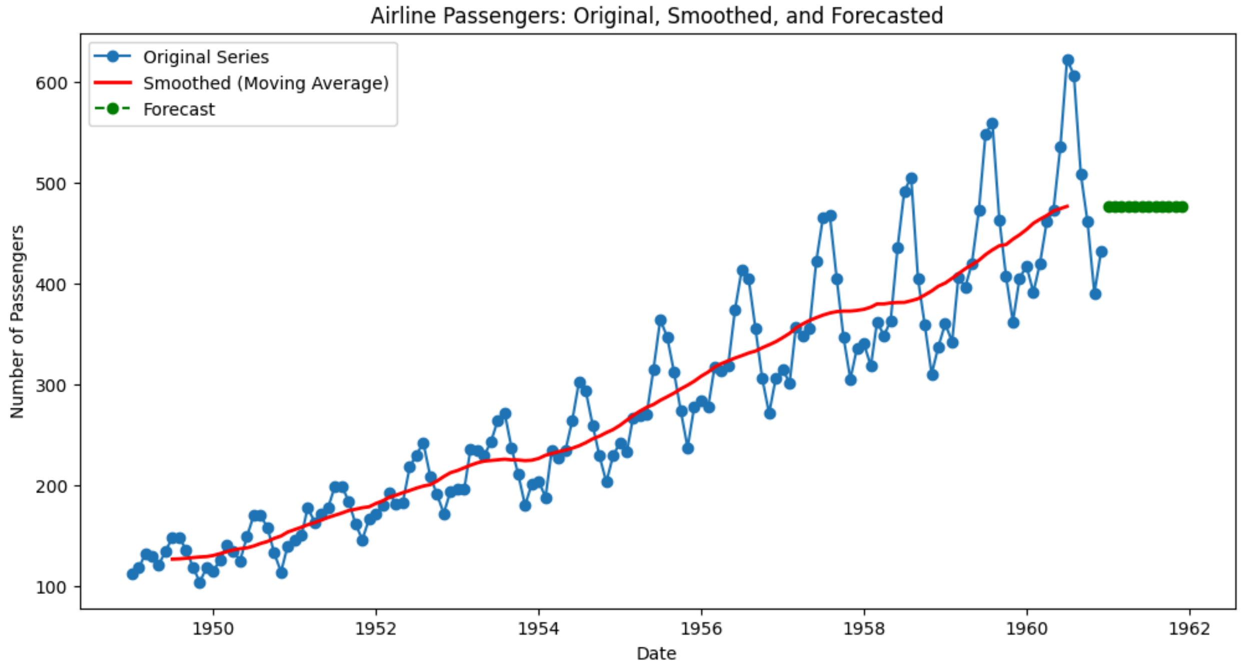
```
window_size = 12
ma_smoothed = ts.rolling(window=window_size, center=True).mean()

plt.figure(figsize=(12,6))
plt.plot(ts, marker='o', linestyle='-', label='Original Series')
plt.plot(ma_smoothed, color='red', linewidth=2, label='12-Month Moving Average')
plt.title('Airline Passengers with Moving Average Smoothing')
plt.xlabel('Date')
plt.ylabel('Number of Passengers')
plt.legend()
plt.show()
```



```
last_smoothed_value = ma_smoothed.dropna().iloc[-1]


forecast_index = pd.date_range(start=ts.index[-1] + pd.DateOffset(months=1), periods=12,
freq='MS')

forecast = pd.Series([last_smoothed_value]*12, index=forecast_index)


plt.figure(figsize=(12,6))

plt.plot(ma_smoothed, color='red', label='Moving Average Smoothed Series')

plt.plot(forecast, color='green', linestyle='--', marker='o', label='Forecast (Naive)')

plt.title('Forecast Based on Moving Average Smoothing')

plt.xlabel('Date')

plt.ylabel('Number of Passengers')

plt.legend()

plt.show()
```



```
plt.figure(figsize=(12,6))
plt.plot(ts, marker='o', linestyle='-', label='Original Series')
plt.plot(ma_smoothed, color='red', linewidth=2, label='Smoothed (Moving Average)')
plt.plot(forecast, color='green', linestyle='--', marker='o', label='Forecast')
plt.title('Airline Passengers: Original, Smoothed, and Forecasted')
plt.xlabel('Date')
plt.ylabel('Number of Passengers')
plt.legend()
plt.show()
```



RESULTS:

The program has been created and implemented successfully for applying moving average smoothing for data preparation and time series forecasting..