

Eliminating Trend in Time Series Data

Aim:

Implement programs for estimating & eliminating trend in time series data- aggregation, smoothing.

Algorithm:

1. Import Necessary Libraries.
2. Load the Dataset.
3. Plot the Original Time Series.
4. Plot the Distribution of the Data.
5. Convert Date Column to Datetime and Set as Index.
6. Calculate and Plot the Moving Average Trend.
7. Apply Exponential Smoothing and Plot the Trend.
8. Detrend the Series Using Exponential Smoothing and Plot.

Program Code:

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

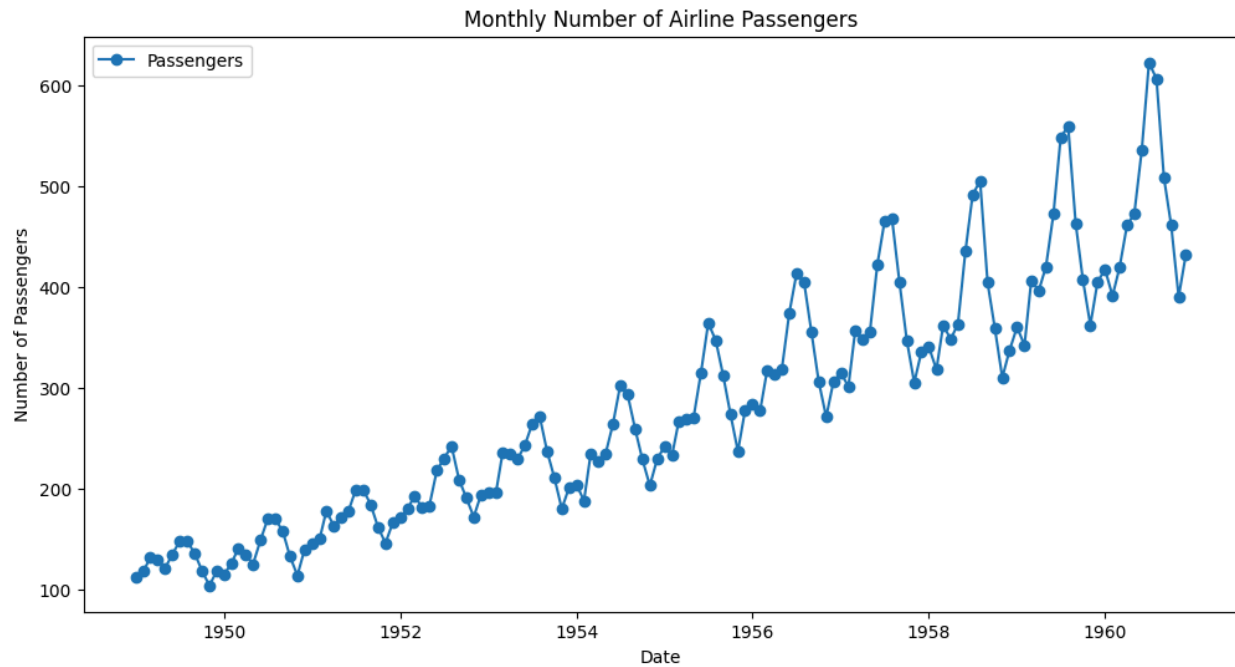
%matplotlib inline

url = 'https://raw.githubusercontent.com/jbrownlee/Datasets/master/airline-passengers.csv'
df = pd.read_csv(url)

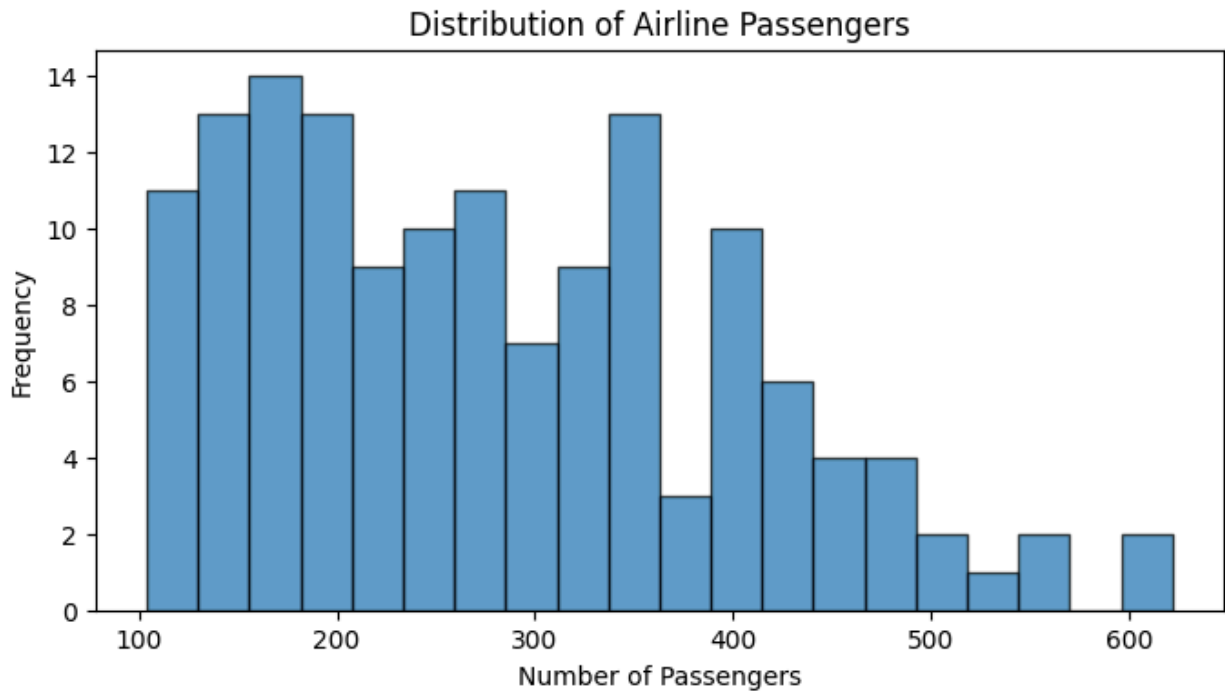
df['Month'] = pd.to_datetime(df['Month'])
df.set_index('Month', inplace=True)
ts = df['Passengers']

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
```

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

```
fig, axs = plt.subplots(2, 1, figsize=(12,10))
```

```
axs[0].plot(ts, label='Original Series')
```

```
axs[0].plot(trend_ma, color='red', label='Moving Average Trend')
```

```
axs[0].set_title('Airline Passengers & Estimated Trend (Moving Average)')
```

```
axs[0].set_xlabel('Date')
```

```
axs[0].set_ylabel('Passengers')
```

```
axs[0].legend()
```

```
detrended_ma = ts - trend_ma
```

```
axs[1].plot(detrended_ma, color='green', label='Detrended Series (MA)')
```

```
axs[1].set_title('Detrended Series using Moving Average')
```

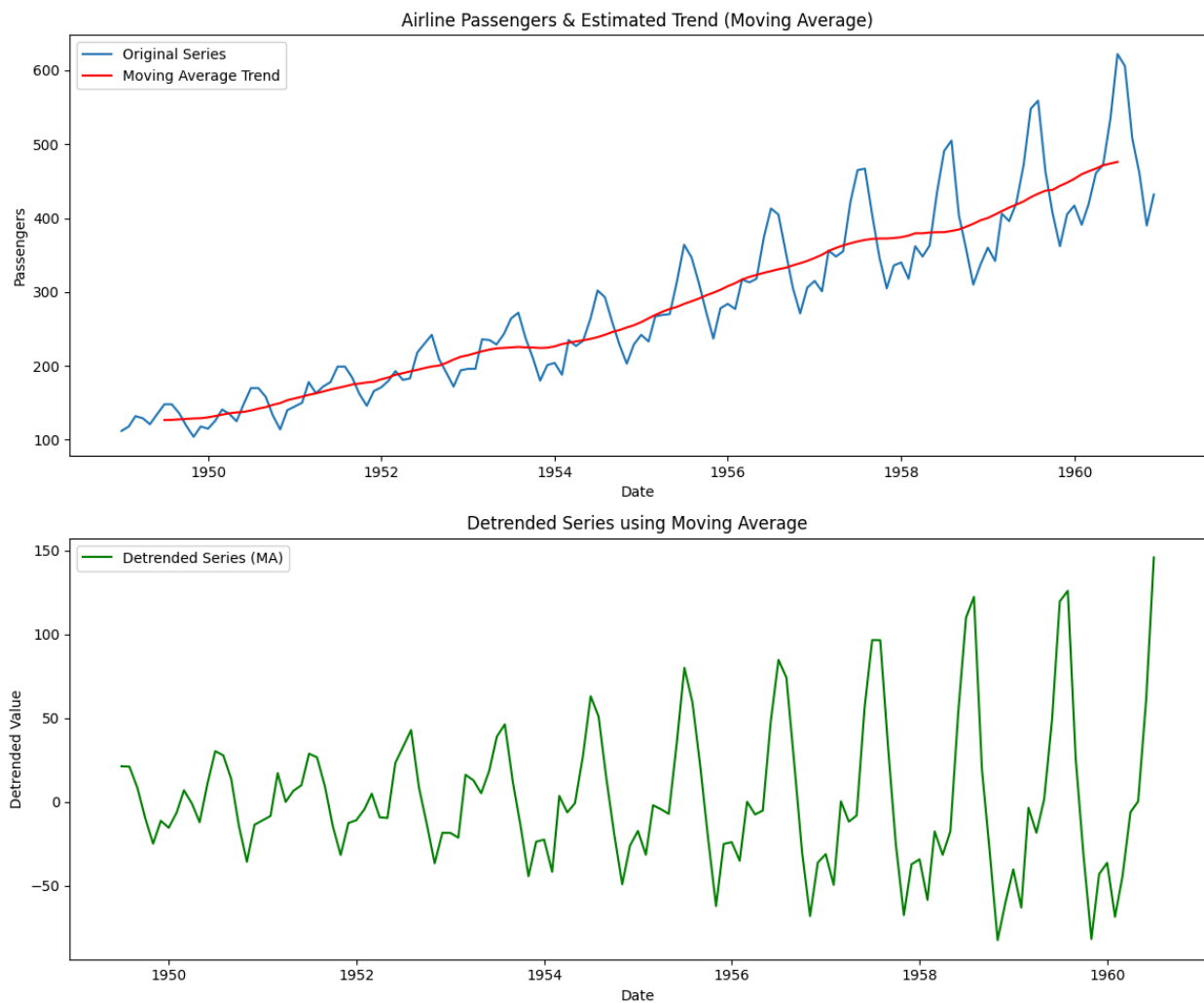
```
axs[1].set_xlabel('Date')
```

```
axs[1].set_ylabel('Detrended Value')
```

```
axs[1].legend()
```

```
plt.tight_layout()
```

```
plt.show()
```



```
model_es = ExponentialSmoothing(ts, trend='add', seasonal='add', seasonal_periods=12)
```

```
fit_es = model_es.fit(optimized=True)
```

```
trend_es = fit_es.trend
```

```
fig, axs = plt.subplots(2, 1, figsize=(12,12))
```

```
axs[0].plot(ts, label='Original Series')
```

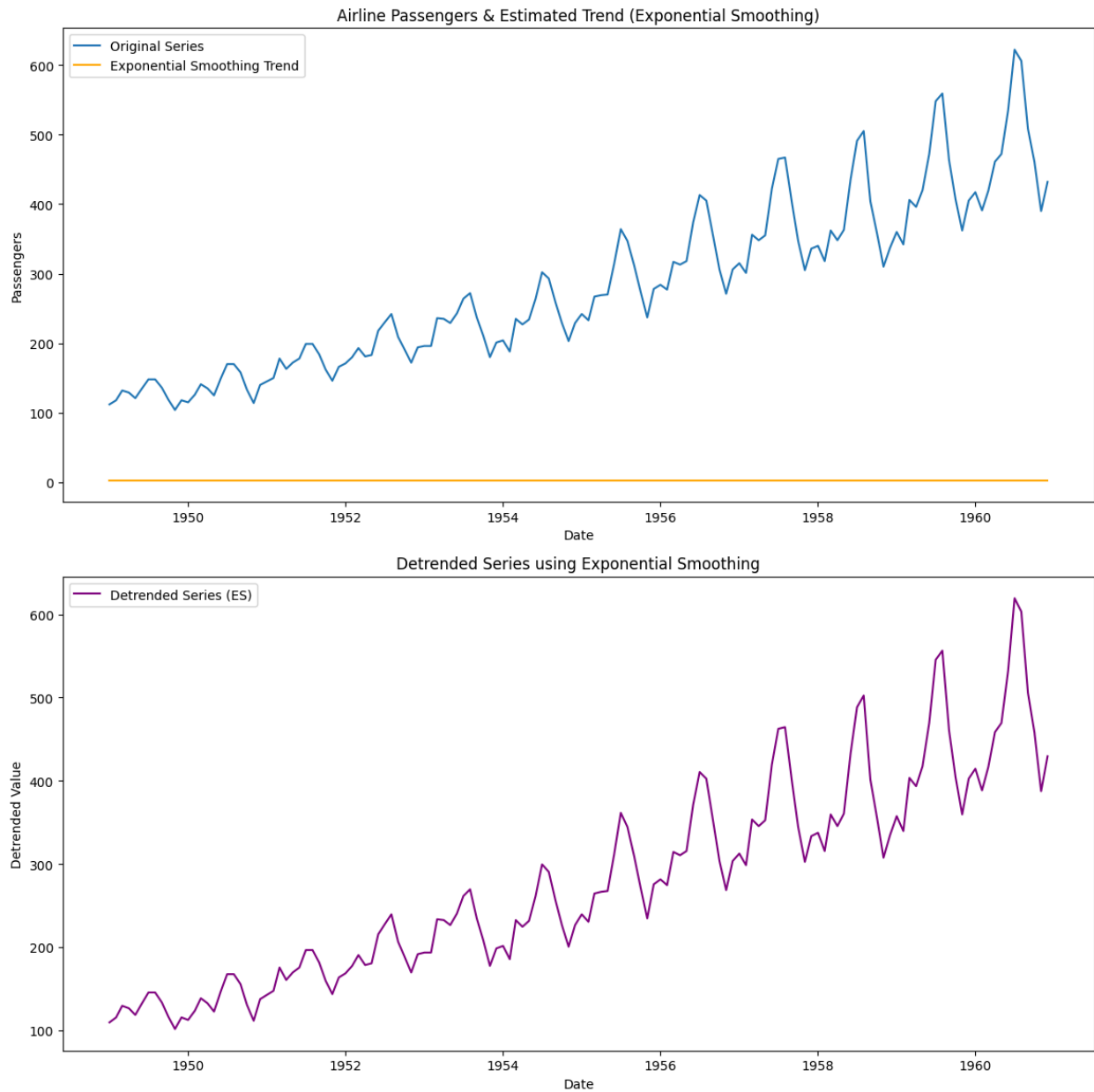
```
axs[0].plot(trend_es, color='orange', label='Exponential Smoothing Trend')
```

```
axs[0].set_title('Airline Passengers & Estimated Trend (Exponential Smoothing)')
```

```
axs[0].set_xlabel('Date')
axs[0].set_ylabel('Passengers')
axs[0].legend()
```

```
detrended_es = ts - trend_es
axs[1].plot(detrended_es, color='purple', label='Detrended Series (ES)')
axs[1].set_title('Detrended Series using Exponential Smoothing')
axs[1].set_xlabel('Date')
axs[1].set_ylabel('Detrended Value')
axs[1].legend()
```

```
plt.tight_layout()
plt.show()
```



RESULTS:

The program has been created and implemented successfully for time series analysis for eliminating trend.