EXP:5 27/03/2025	**ESTIMATING & ELIMINATING TRENDS IN TIME SERIES DATA.**

AIM:

      To Implement a program for estimating & eliminating trend in time series data-aggregation, smoothing

PROCEDURE:

```python
1) Load the dataset
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import statsmodels.api as sm


file_path = "monthly-beer.csv"
df = pd.read_csv(file_path)


2) Convert 'Month' to datetime format
df['Month'] = pd.to_datetime(df['Month'])


df.set_index('Month', inplace=True)


3) Apply a 12-month moving average for trend estimation
df['Moving_Avg_12'] = df['Monthly beer production'].rolling(window=12,
center=True).mean()


4) Apply exponential smoothing for trend estimation (alpha=0.2 for
moderate smoothing)
df['Exp_Smoothing'] = df['Monthly beer production'].ewm(alpha=0.2).mean()


5) Plot original data and smoothed trends
plt.figure(figsize=(12, 6))
plt.plot(df.index, df['Monthly beer production'], label="Original Data",
alpha=0.5)
plt.plot(df.index, df['Moving_Avg_12'], label="12-Month Moving Avg",
linewidth=2)
```

```python
plt.plot(df.index, df['Exp_Smoothing'], label="Exponential Smoothing",
linewidth=2, linestyle="dashed")
plt.legend()
plt.title("Trend Estimation using Moving Average & Exponential Smoothing")
plt.xlabel("Year")
plt.ylabel("Beer Production")
plt.grid()
plt.show()


# 6) Visualizing data before and after smoothing
plt.figure(figsize=(12, 6))
plt.plot(df.index, df['Monthly beer production'], label="Original Data",
alpha=0.5)
plt.plot(df.index, df['Exp_Smoothing'], label="Smoothed Data",
linewidth=2, linestyle="dashed")
plt.legend()
plt.title("Comparison of Original and Smoothed Data")
plt.xlabel("Year")
plt.ylabel("Beer Production")
plt.grid()
plt.show()


df['Differenced'] = df['Monthly beer production'].diff()

X = np.arange(len(df)).reshape(-1, 1)
y = df['Monthly beer production'].dropna()
X = sm.add_constant(X)


model = sm.OLS(y, X).fit()
df['Detrended'] = y - model.predict(X)

# 7) Plot detrended series
plt.figure(figsize=(12, 6))
plt.plot(df.index, df['Differenced'], label="First-Order Differencing",
alpha=0.7)
plt.plot(df.index, df['Detrended'], label="Regression Detrended",
alpha=0.7, linestyle="dashed")
plt.axhline(0, color='black', linewidth=0.5)
plt.legend()
plt.title("Trend Elimination using Differencing & Regression Detrending")
```
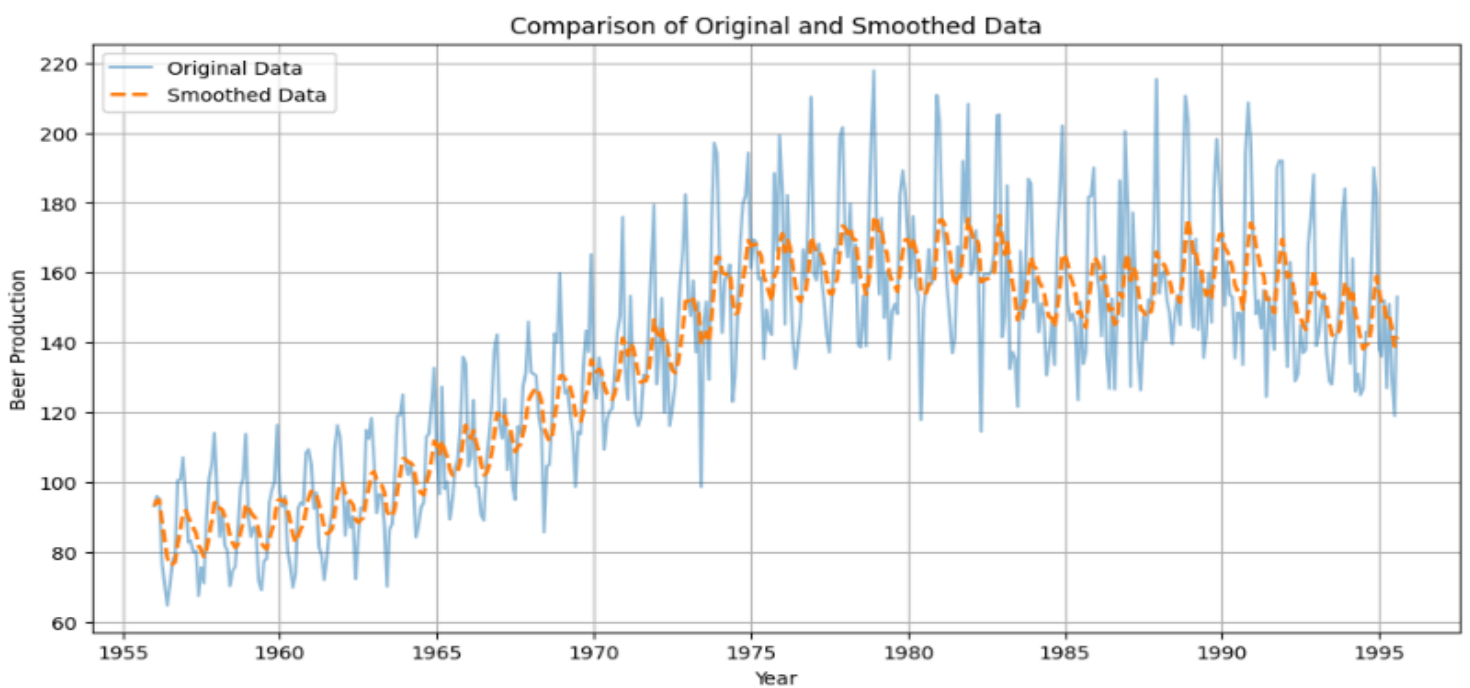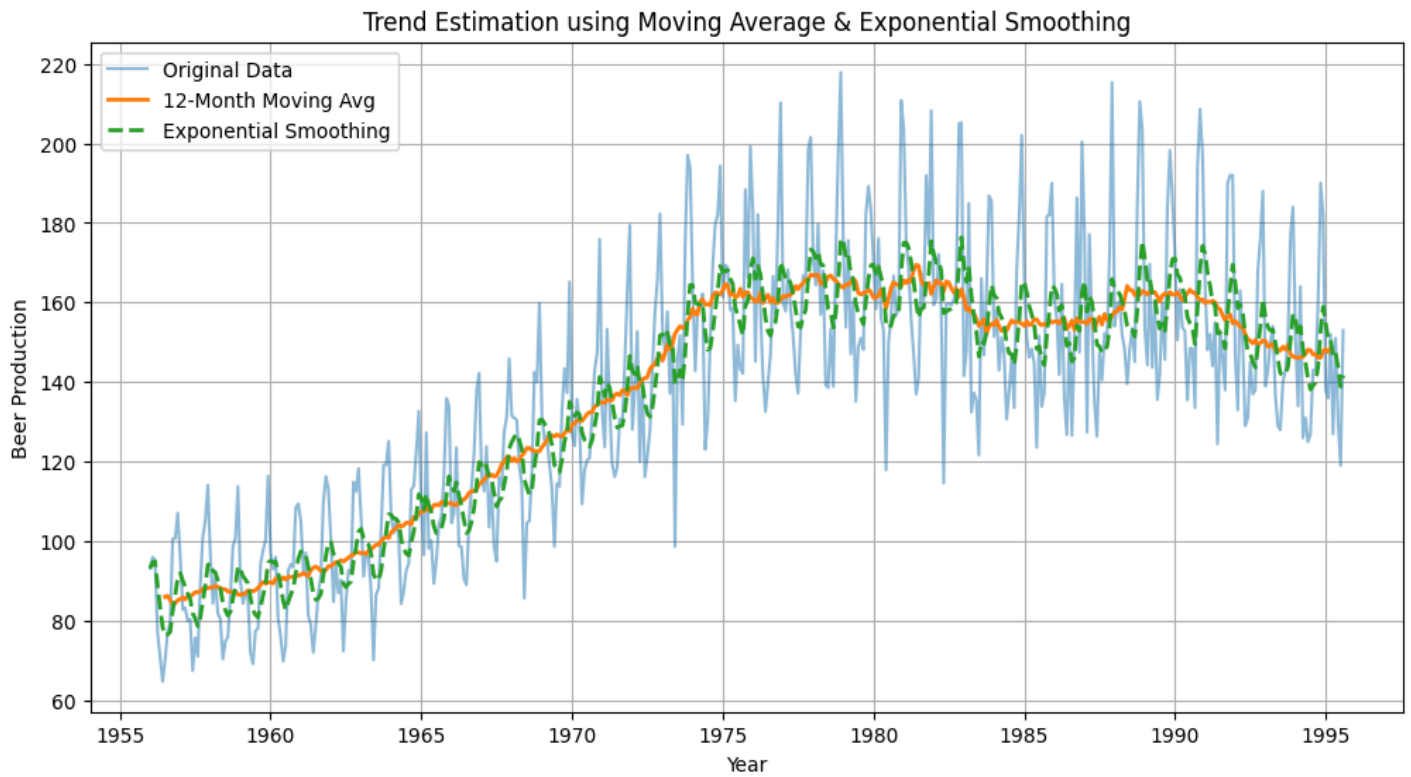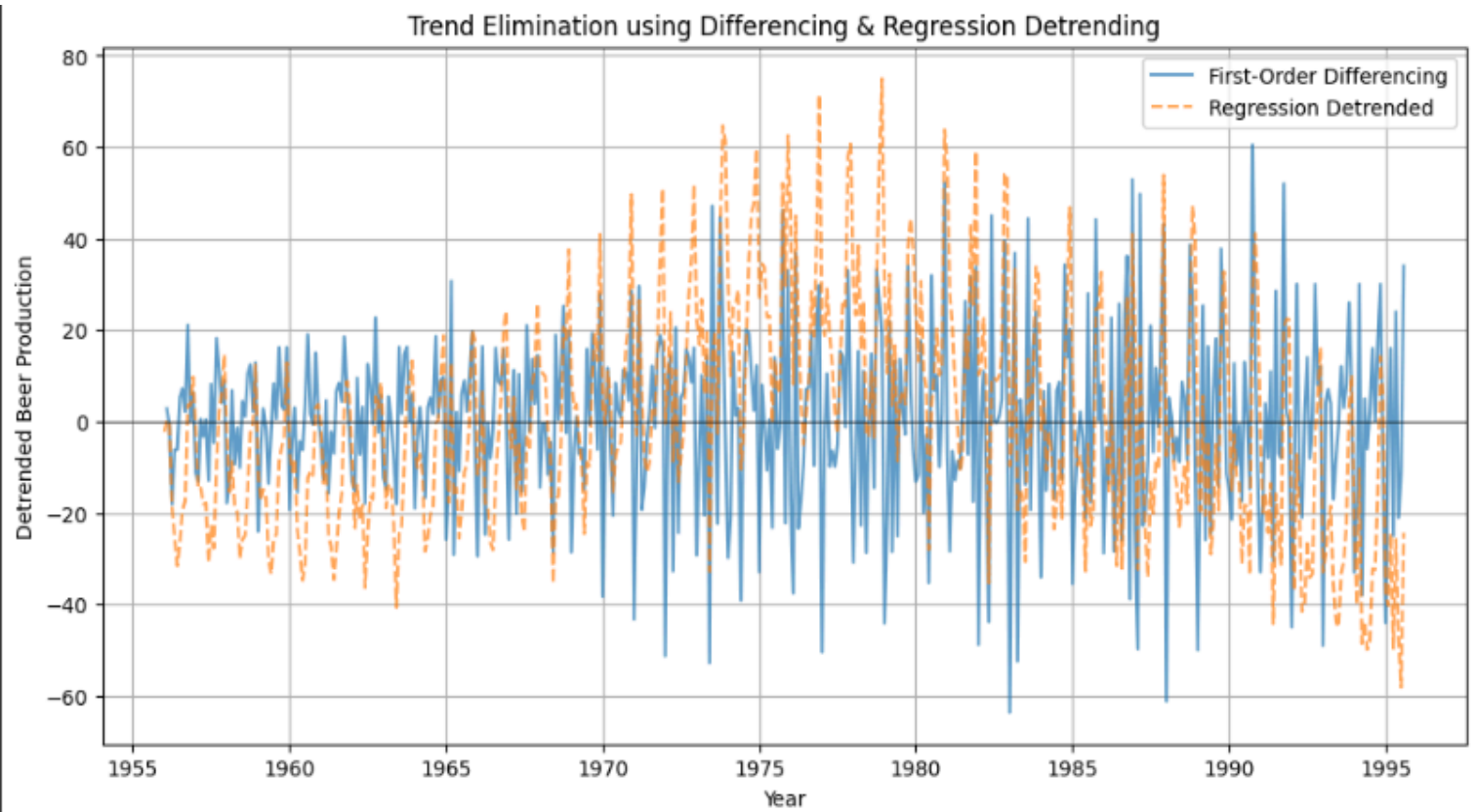
```
plt.xlabel("Year")
plt.ylabel("Detrended Beer Production")
plt.grid()
plt.show()
```

OUTPUT:

Trend Estimation using Moving Average & Exponential Smoothing

Comparison of Original and Smoothed Data

RESULT :

    Thus the Program has been Implemented and executed successfully