EX:No.5 DATE:29/3/2025	**Develop a linear regression model for forecasting time series data.**

AIM:

To develop a linear regression model for forecasting time series data.

ALGORITHM:

1. Import Required Libraries
2. Load and Prepare the Time Series Data
3. Convert Time Index to Numerical Format
4. Split Data into Features (X) and Target (y)
5. Train the Linear Regression Model
6. Create Future Time Points for Forecasting
7. Predict Future Values Using the Model
8. Visualize Historical and Forecasted Data
9. Evaluate Model Performance .

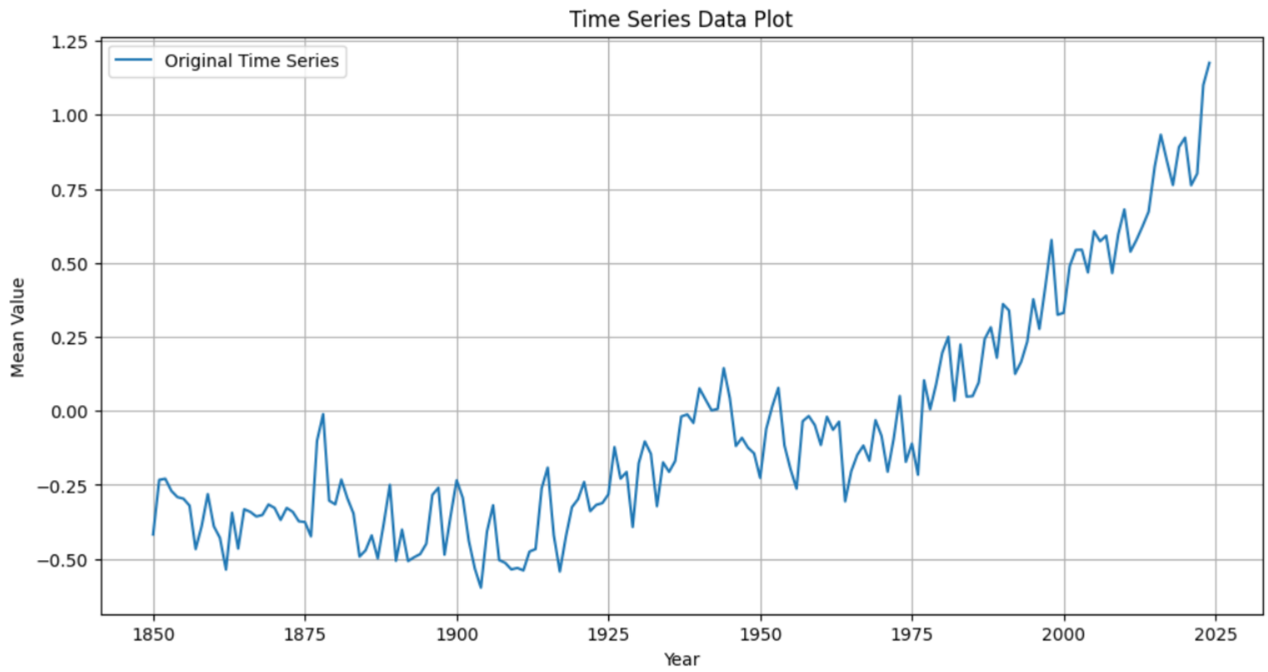
CODE:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import statsmodels.api as sm
from statsmodels.tsa.stattools import adfuller
from statsmodels.tsa.seasonal import seasonal_decompose
import statsmodels.graphics.tsaplots as tsaplots
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error

# Load data
filepath = 'C://Users//Jayashrinidhi
V//OneDrive//Documents//VScode//TimeSeriesAnalysis//globaltemp.csv'
df=pd.read_csv(filepath)
df.set_index('Year', inplace=True)

# Remove duplicate indices
df = df[~df.index.duplicated(keep='first')]

# Ensure column selection for plotting
if 'Mean' not in df.columns:
    raise ValueError("Column 'Mean' not found in the dataset. Check the CSV file.")

# Plot original time series
```

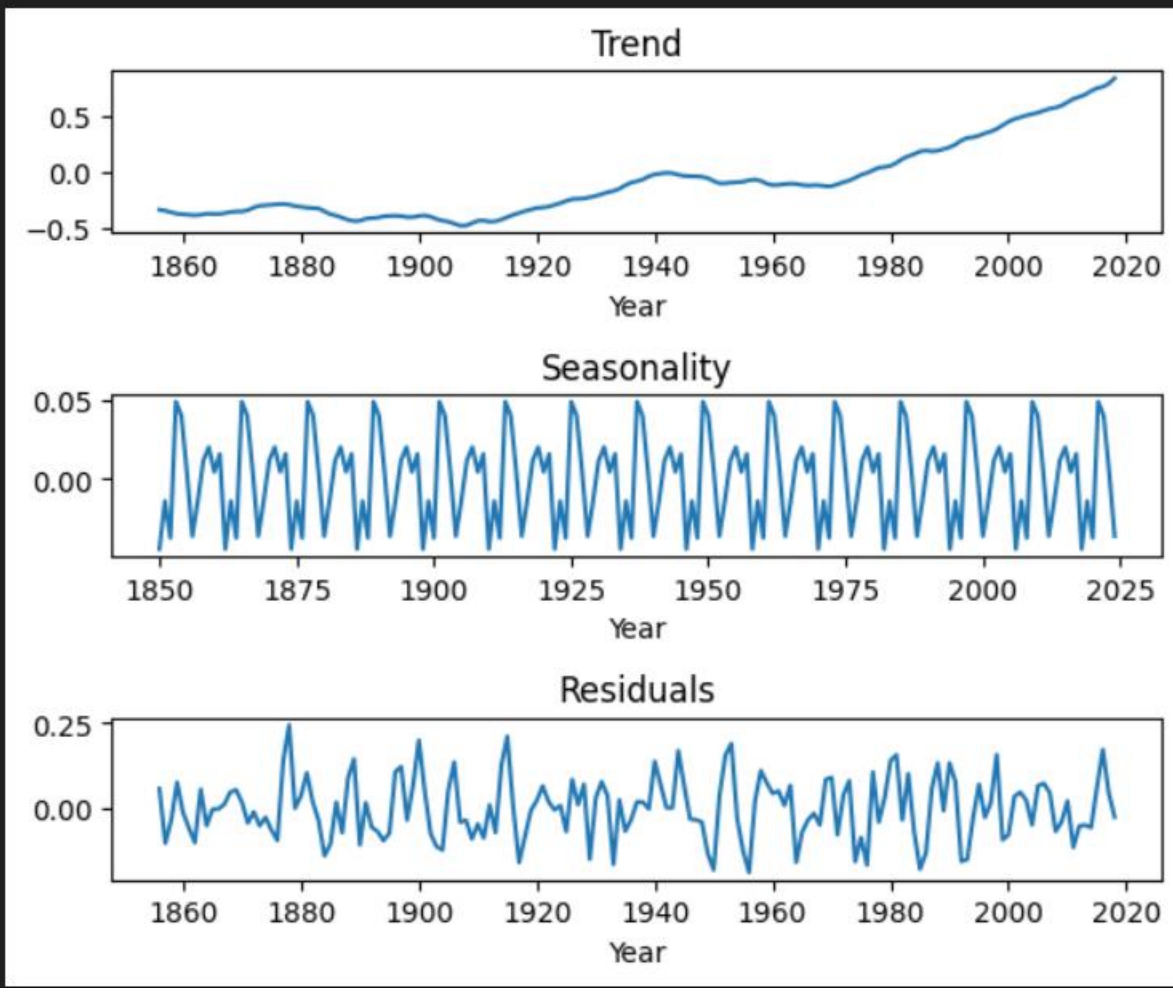
```python
plt.figure(figsize=(12, 6))
plt.plot(df.index, df['Mean'], label='Original Time Series')
plt.xlabel("Year")
plt.ylabel("Mean Value")
plt.title("Time Series Data Plot")
plt.legend()
plt.grid()
plt.show()

# Perform ADF test before differencing
result = adfuller(df['Mean'].dropna())
print("ADF Statistic:", result[0])
print("p-value:", result[1])
print("Critical Values:")
for key, value in result[4].items():
    print(f"   {key}: {value}")
if result[1] <= 0.05:
    print("Conclusion: Data is stationary (Reject H0)")
else:
    print("Conclusion: Data is not stationary (Fail to Reject H0)")

# Seasonal Decomposition
decomposition = seasonal_decompose(df['Mean'], model='additive', period=12)
fig, (ax1, ax2, ax3) = plt.subplots(3, 1, figsize=(12, 10))
decomposition.trend.plot(ax=ax1, title='Trend')
decomposition.seasonal.plot(ax=ax2, title='Seasonality')
decomposition.resid.plot(ax=ax3, title='Residuals')
plt.tight_layout()
plt.show()

# Apply differencing
df['Mean'] = df['Mean'].diff(1)
df.dropna(inplace=True)

# Plot differenced series
plt.figure(figsize=(12, 6))
plt.plot(df.index, df['Mean'], label='Differenced Time Series', color='red')
plt.xlabel("Year")
plt.ylabel("Differenced Mean Value")
plt.title("Time Series Data After Differencing")
plt.legend()
plt.grid()
plt.show()

# Perform ADF test after differencing
result = adfuller(df['Mean'].dropna())
print("ADF Statistic after differencing:", result[0])
print("p-value:", result[1])
print("Critical Values:")
for key, value in result[4].items():
```

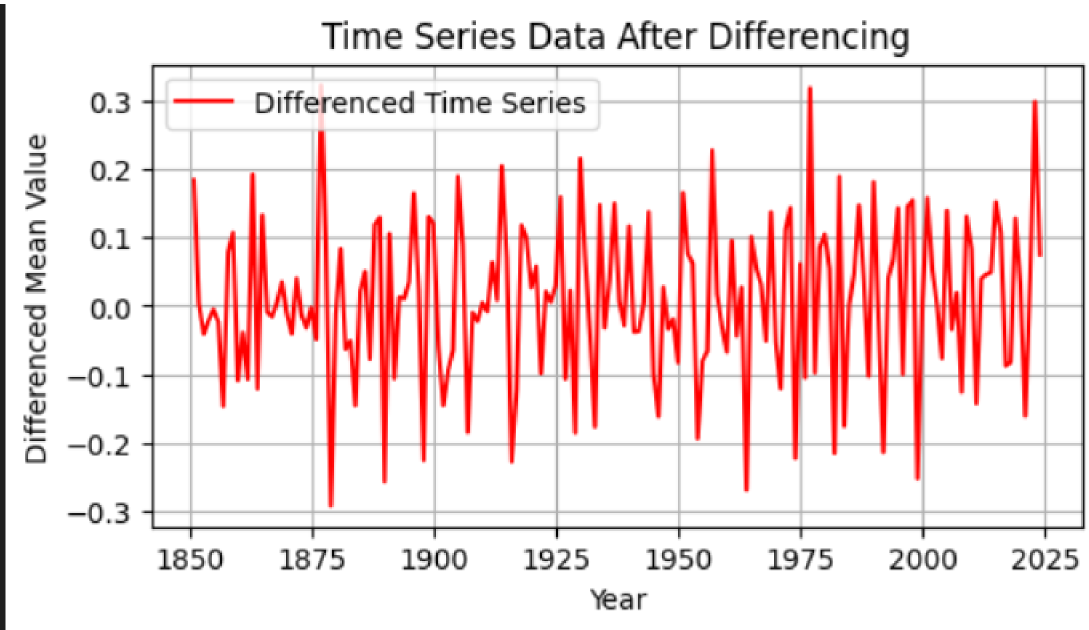
```
    print(f"    {key}: {value}")
if result[1] <= 0.05:
    print("Conclusion: Data is stationary (Reject H0)")
else:
    print("Conclusion: Data is not stationary (Fail to Reject H0)")

# Plot ACF and PACF
tsaplots.plot_acf(df['Mean'].dropna(), lags=20)
tsaplots.plot_pacf(df['Mean'].dropna(), lags=20)
plt.show()
```

OUTPUT:

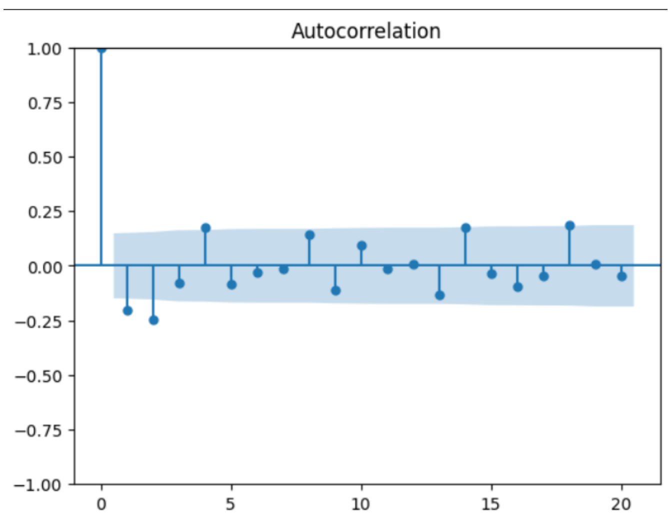


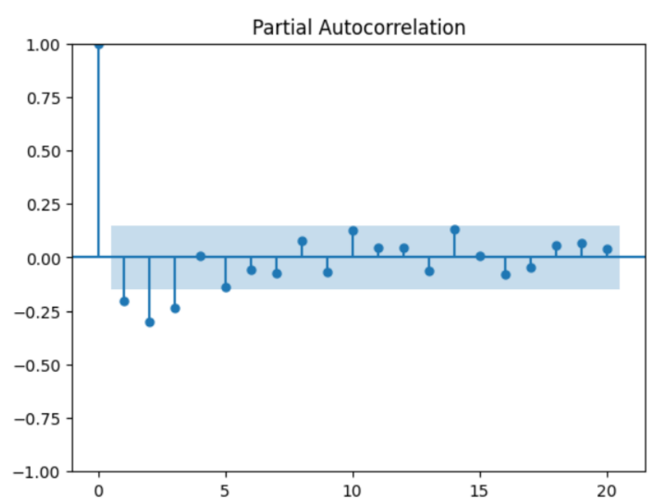
```
ADF Statistic: 2.476446005370727
p-value: 0.999041859406313
Critical Values:
   1%: -3.470126426071447
   5%: -2.8790075987120027
   10%: -2.5760826967621644
Conclusion: Data is not stationary (Fail to Reject H0)
```






```
ADF Statistic after differencing: -8.259943524108992
p-value: 5.115453198086792e-13
Critical Values:
   1%: -3.469648263987657
   5%: -2.878798906308495
   10%: -2.5759713094779593
Conclusion: Data is stationary (Reject H0)
```





RESULT:

Thus the program has been completed and verified successfully.