EX: 5 **DEVELOP A LINEAR REGRESSION MODEL**

DATE: **FOR FORECASTING TIME SERIES DATA**

AIM:

To develop a Linear Regression model for forecasting time series data and evaluate its performance using error metrics and residual analysis.

ALGORITHM:

1. Load Data – Import the dataset and convert the date column to datetime format.
2. Preprocess Data – Convert dates into numerical values for regression.
3. Split Data – Divide the dataset into training and testing sets.
4. Train Model – Fit a Linear Regression model using the training data.
5. Make Predictions – Predict values on the test set using the trained model.
6. Evaluate Model – Calculate MAE, MSE, and RMSE for performance assessment.
7. Visualize Results – Plot a residual plot to analyze prediction errors.

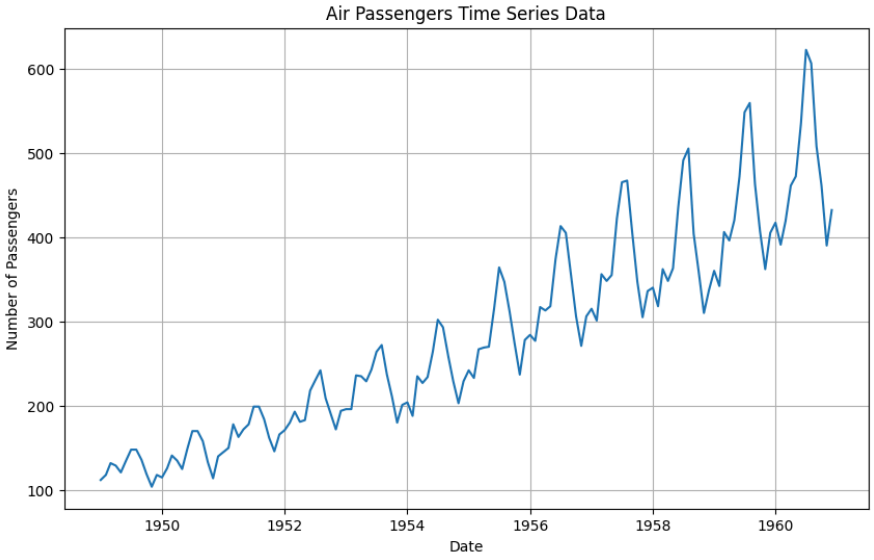
PROGRAM:

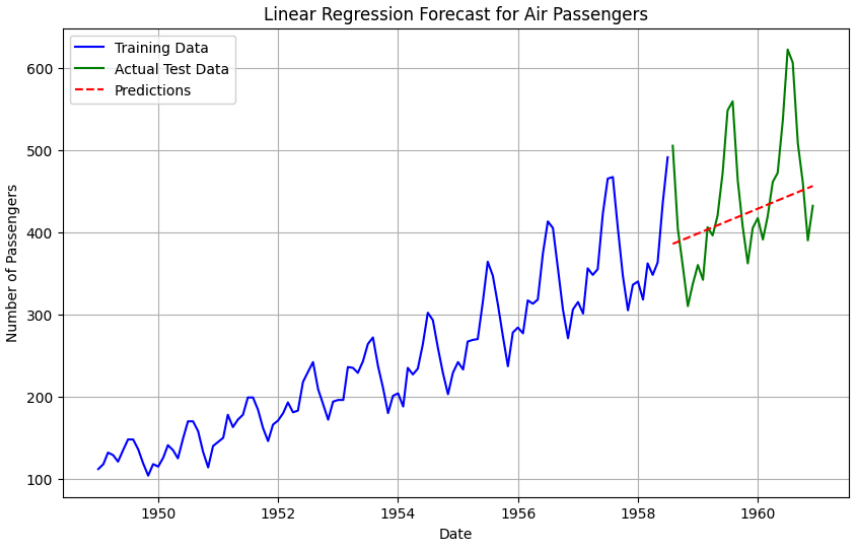
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error

# Load your Air Passenger dataset (update the file path accordingly)
df = pd.read_csv('/content/airline-passengers.csv')  # Replace with your
dataset file path

# Convert 'Month' column to datetime type if it exists
df['Month'] = pd.to_datetime(df['Month'], format='%Y-%m')  # Adjust if the
date format is different

# Visualize the original time series
plt.figure(figsize=(10, 6))
```

```
plt.plot(df['Month'], df['Passengers'])
plt.title('Air Passengers Time Series Data')
plt.xlabel('Date')
plt.ylabel('Number of Passengers')
plt.grid(True)
plt.show()

# Feature preparation for Linear Regression
df['Time'] = np.arange(len(df))  # Create a 'Time' column with sequential
time steps

# Split the data into training and test sets
X = df[['Time']]  # Feature: Time (index)
y = df['Passengers']  # Target: Passengers (number of passengers)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
shuffle=False)

# Train a Linear Regression model
model = LinearRegression()
model.fit(X_train, y_train)

# Make predictions
y_pred = model.predict(X_test)

# Visualize the predictions vs the actual values
plt.figure(figsize=(10, 6))
plt.plot(df['Month'][:len(X_train)], y_train, label='Training Data',
color='blue')
plt.plot(df['Month'][len(X_train):], y_test, label='Actual Test Data',
color='green')
plt.plot(df['Month'][len(X_train):], y_pred, label='Predictions',
color='red', linestyle='--')
plt.title('Linear Regression Forecast for Air Passengers')
plt.xlabel('Date')
plt.ylabel('Number of Passengers')
plt.legend()
plt.grid(True)
plt.show()

# Evaluate the model
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
print(f'Mean Squared Error: {mse}')
print(f'Root Mean Squared Error: {rmse}')
```

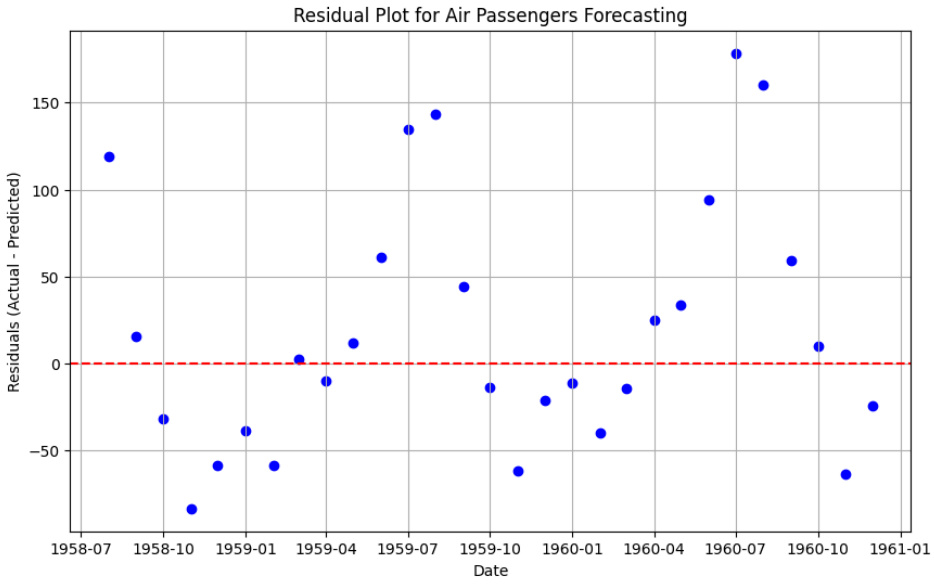
```
# Residual Plot
residuals = y_test - y_pred  # Calculate residuals (actual - predicted)

plt.figure(figsize=(10, 6))
plt.scatter(df['Month'][len(X_train):], residuals, color='blue')
plt.axhline(y=0, color='red', linestyle='--')
plt.title('Residual Plot for Air Passengers Forecasting')
plt.xlabel('Date')
plt.ylabel('Residuals (Actual - Predicted)')
plt.grid(True)
plt.show()
```

OUTPUT:





Mean Squared Error: 5447.163612684265
Root Mean Squared Error: 73.8049023621349



RESULT:

Thus, the Linear Regression model for forecasting Time Series data using Air passenger dataset was successfully developed and evaluated.