Experiment No. 04

Aim :- Implement Time Series Analysis for rainfall in R/Python Programming.

Objective:- To understand the use of time series models for prediction.

Description:-

• Time series analysis is a specific way of analyzing a sequence of data points collected over an interval of time. In time series analysis, analysts record data points at consistent intervals over a set period of time rather than just recording the data points randomly.

A time-series data is a series of data points or observations recorded at different or regular time intervals. In general, a time series is a sequence of data points taken at equally spaced time intervals. The frequency of recorded data points may be hourly, daily, weekly, monthly, quarterly or annually.Time-Series Forecasting is the process of using a statistical model to predict future values of atime-series based on past results.

Components of a Time-Series

Trend - The trend shows a general direction of the time series data over a long period of time. A trend can be increasing(upward), decreasing(downward), or horizontal(stationary).

Seasonality - The seasonality component exhibits a trend that repeats with respect to timing, direction, and magnitude. Some examples include an increase in water consumption in summer due to hot weather conditions.

Cyclical Component - These are the trends with no set repetition over a particular period of time. A cycle refers to the period of ups and downs, booms and slums of a time series, mostly observed in business cycles. These cycles do not exhibit a seasonal variation but generally occur over a time period of 3 to 12 years depending on the nature of the time series.

Irregular Variation - These are the fluctuations in the time series data which become evident when trend and cyclical variations are removed. These variations are unpredictable, erratic, and may or may not be random.

Different Time Intervals

The value of the frequency parameter in the ts() function decides the time intervals at which the data points are measured. A value of 12

indicates that the time series is for 12 months. Other values and its meaning is as below −

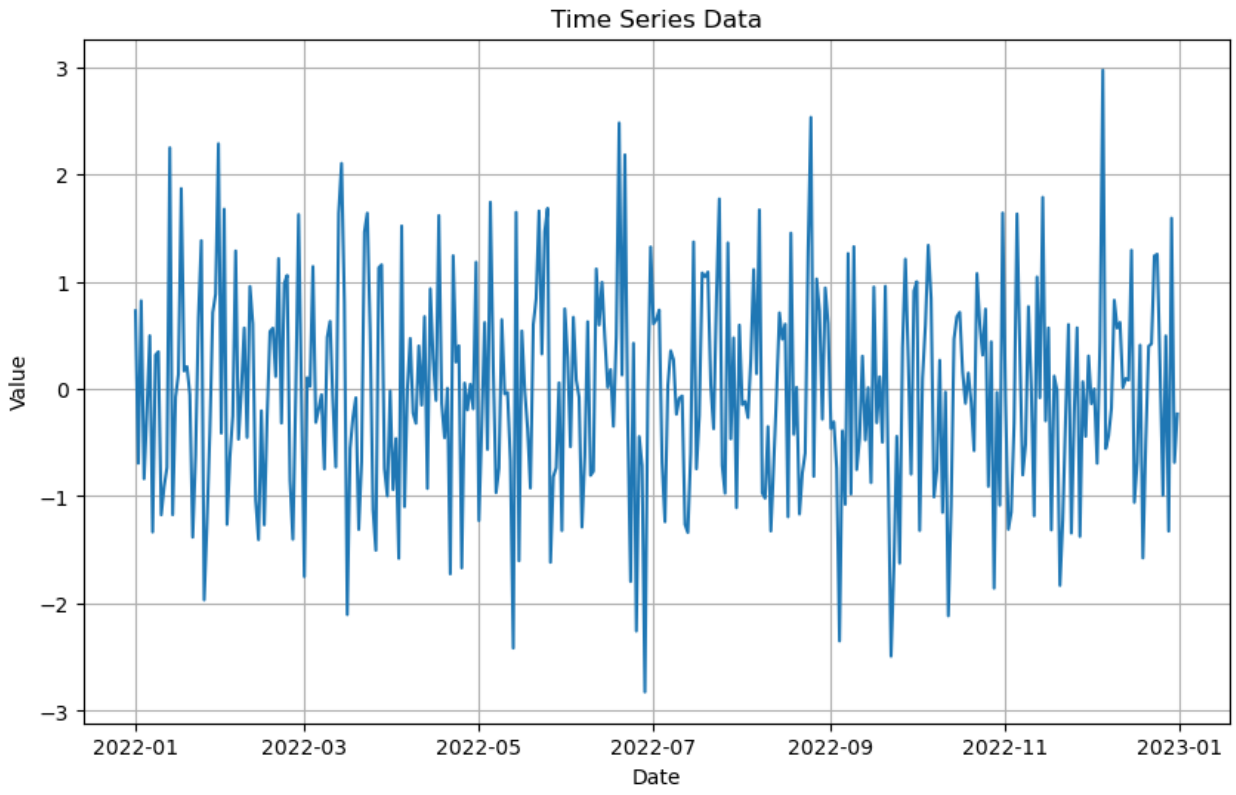
- frequency = 12 pegs the data points for every month of a year.
- frequency = 4 pegs the data points for every quarter of a year.
- frequency = 6 pegs the data points for every 10 minutes of an hour.
- frequency = 24*6 pegs the data points for every 10 minutes of a day.

Program(Code):-

```
# Import necessary libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from statsmodels.tsa.seasonal import seasonal_decompose

# Create a sample time series data
date_range = pd.date_range(start='2022-01-01', end='2022-12-31', freq='D')
data = np.random.randn(len(date_range))  # Random data for demonstration
ts = pd.Series(data, index=date_range)

# Visualize the time series data
plt.figure(figsize=(10, 6))
plt.plot(ts)
plt.title('Time Series Data')
plt.xlabel('Date')
plt.ylabel('Value')
plt.grid(True)
plt.show()

# Decompose the time series into trend, seasonal, and residual components
decomposition = seasonal_decompose(ts, model='additive', period=365)

# Plot the decomposed components
plt.figure(figsize=(10, 8))
plt.subplot(411)
plt.plot(decomposition.observed, label='Original')
plt.legend(loc='upper left')
plt.subplot(412)
plt.plot(decomposition.trend, label='Trend')
plt.legend(loc='upper left')
plt.subplot(413)
plt.plot(decomposition.seasonal, label='Seasonal')
plt.legend(loc='upper left')
plt.subplot(414)
plt.plot(decomposition.resid, label='Residual')
plt.legend(loc='upper left')
plt.tight_layout()
```

```
plt.show()
```

Output:



Conclusion :-

1. An orderly set of data arranged in accordance with their time of occurrence is called

An orderly set of data arranged in accordance with their time of occurrence is called a "time series." Time series data typically consists of observations collected at regular intervals over a period of time, such as daily, weekly, monthly, or yearly. This type of data is commonly encountered in various fields including finance, economics, meteorology, and signal processing. Analyzing time series data involves identifying patterns, trends, and seasonal variations over time, as well as making forecasts or predictions about future values based on historical observations.

2. The graph of time series is called

The graph of a time series is typically called a "time series plot" or simply a "time plot." This type of graph displays data points collected at different points in time, usually with time on the x-axis and the variable of interest on the y-axis. Time series plots are used to visualize the behavior of a variable over time, including trends, seasonal patterns, and any other temporal patterns that may exist in the data. They are commonly used in various fields such as economics, finance, environmental science, and engineering for analyzing and interpreting time-dependent data.

3. Use of plt.fill_between()-

the `plt.fill_between()` function in Matplotlib is a powerful tool for visualizing and highlighting regions between two curves in a plot. It allows you to easily fill the area between two curves with a specified color and transparency, enhancing the clarity and interpretability of your plots. Whether you're comparing datasets, showing confidence intervals, or emphasizing specific regions of interest, `plt.fill_between()` provides a straightforward way to convey complex information in your plots.