Experiment NO:-6.

Aim:- Time series Analysis.
(a) Checking stationary
(b) Converting a non-stationary data to stationary
(c) Implementing Dickey Fuller Test.
(d) Plot ACF and PACF
(e) Generating the ARIMA plot.
(f) TSA Forecasting.

Objective:- To study and implement
(a) checking stationary
(b) Converting a non-stationary data to stationary
(c) Implementing Dickey fuller Test
(d) Plot ACF and PACF
(e) Generating the ARIMA plot.
(f) TSA Forecasting.

Theory:-
Time series Analysis (TSA) is a branch of statistics and data analysis that focuses on analyzing and modeling data points collected over time. It deals with understanding the underlying patterns, trends, and dependencies within the data to make predictions or forecasts about future values. TSA is widely used in various fields, including finance, economics, weather forecasting, stock market.

(a) Checking stationarity:

In time series analysis, checking for stationarity is an important step. stationarity refers to the property of a time series where the statistical properties, such as the mean and variance, remain constant over time. Stationarity, one can visually inspect the time series plot for any obvious trends, seasonality, or irregular patterns. Additionally, statistical tests like the Augmented Dickey-Fuller (ADF) test can be formally test for stationary.

(b) Converting a Non-Stationary Data to stationary.

If a time series is found to be non-stationary, it can be transformed to stationary through various methods. common techniques like differencing, logarithmic transformation, and seasonal differencing. Differencing involves taking the difference between consecutive observations to remove trends or seasonality. logarithmic transformation can be useful when the time series exhibits exponential growth or large variations in magnitude. Seasonal differencing is performed to remove seasonality by differencing the series with a lag equal to the length of the seasonal pattern.

(c) Implementing Dickey-Fuller Test:

The Dickey-Fuller test is a statistical test commonly used to determine if a time series is stationary. It evaluates the null hypothesis of stationarity. The test calculates a test statistics and compares is to critical values to make a decision. If the test statistics is less than the critical value, the null hypothesis is rejected, indicating stationary. Python libraries such as statsmodel provide functions to implement the Dickey-Fuller test easily.

(d) Plot ACF and PACF:

Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots are useful tools for understanding the correlation structure within a time series. ACF measures the correlation between a time series and its lagged values at different time lags. PACF, on the other hand measures the correlation between a time series and its lagged values while controlling for the effects of intermediate lags. These plots help identify the order of auto agressive (AR) and moving average (MA) components in the time series models.

(e) Generating the ARIMA Plot:
ARIMA (Autoregressive Integrated Moving Average) is a popular time series forecasting model. To generate an ARIMA plot, one typically follows these steps:
(1) Identify the order the differencing (d) needed to make the time series stationary.
(2) Identify the order of the autoregressive (p) and moving average (q) components using ACF and PACF plots.
(3) construct the ARIMA model by specifying the values of p, d, and q.
(4) Fit the ARIMA model to the data and assess its goodness of fit.
(5) Generate the ARIMA plot, which typically includes the observed values, the fitted values, and confidence intervals.
(6) Validate the ARIMA model by assessing its forecast accuracy using appropriate metrics such as mean square error (MSE) & or mean absolute Error (MAE).

(f) TSA forecasting.
Time series forecasting is the process of predicting future values of a time series based on historical data. Various techniques can be used for time series forecasting

including ARIMA, exponential smoothing methods and state space models. The choice of forecasting methods depends on the characteristics of the time series and the specific requirements of the forecasting task.

Conclusion:-

In conclusion, time series analysis involves several key concepts and techniques. Checking for stationary is crucial to ensure the statistical properties remain constant over time. If a time series is non-stationary, it can be transformed using methods like differencing or logarithmic transformation. The Dickey Fuller test is a commonly used statistical test to determine stationary. ACF and PACF plots are useful tools for understanding the correlation structure within a time series and identifying the order of autoregressive (AR) and moving average (MA) components in time series models.

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