**FORECASTING USING TIME SERIES ANALYSIS**

**GRADED ASSIGNMENT 3**

**DEADLINE: 18th JUNE 2023**

**Dataset: Load the dataset using the following code and use the adjusted closing price column for all the tasks.**

import yfinance as yf

dataset = yf.download('AAPL')

**Task 1: Handle Missing Values and Remove Outliers**

* Load the "Apple Adjusted Close Price" dataset into your preferred programming environment.
* Check for any missing values in the dataset and handle them appropriately (e.g., interpolation, filling with mean/median).
* Detect and remove outliers in the dataset using the z-score method or any other suitable outlier detection technique.

**Task 2: Decompose the Time Series**

* Plot the time series data to visualize the overall trend and seasonality patterns.
* Apply the seasonal decomposition of time series (e.g., using the seasonal\_decompose function in Python's statsmodels library) to decompose the time series into its components: trend, seasonality, and residual.
* Plot the decomposed components and interpret the results.
* Additionally, use the Hodrick-Prescott (HP) filter to decompose the time series into trend and cyclical components.

**Task 3: Check for Stationarity**

* Perform both the Augmented Dickey-Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test on the original time series data.
* Interpret the test results to determine if the time series is stationary or not.
* Repeat the ADF and KPSS tests on the residual obtained from the decomposition and interpret the results.

**Task 4: Make the Series Stationary**

* Visualize the original series and the residual series after decomposition.
* Apply different methods to make the residual series and the original series stationary (e.g., differencing, logarithmic transformation).
* Compare the results visually and choose the best method for further analysis.

**Task 5: Test for Normality**

* Perform the Shapiro-Wilk test to test for normality of the original and transformed series.
* Plot QQ-plots to visually inspect the normality assumption.
* Interpret the test results and the QQ-plots to determine if the series can be considered normally distributed.

**Task 6: Test for Homoscedasticity and Apply Box-Cox Transformation**

* Test for homoscedasticity in the transformed series using appropriate statistical tests (e.g., Breusch-Pagan test).
* Apply the Box-Cox transformation to the series to normalize the data and stabilize variance.
* Visualize the transformed series and assess the improvement in homoscedasticity.

**Task 7: Fit a Simple Autoregressive Model**

* Fit a simple autoregressive (AR) model (as demonstrated in the notebook) to the transformed and stationary series.
* Validate the model by splitting the data into training and testing sets.
* Evaluate the model's performance using appropriate metrics (e.g., mean squared error, mean absolute error).

**Task 8: Test for Autocorrelation and Plot ACF/PACF**

* Plot the ACF and PACF to visualize the autocorrelation in the transformed series.
* Interpret the ACF and PACF plots to identify the potential autoregressive (AR) and moving average (MA) components.*( optional)*