Copilot

The **Augmented Dickey-Fuller (ADF) test** is a common statistical test used to determine whether a given **time series** is **stationary** or not. It plays a crucial role in time series analysis, especially when dealing with autoregressive models.

Here are the key points about the ADF test:

1. **Unit Root Test**:
    - The ADF test belongs to a category of tests called **"Unit Root Tests."**
    - A **unit root** is a characteristic of a time series that makes it non-stationary.
    - Technically, a unit root exists when the value of the coefficient **α** in the equation: [Y_t = αY_{t-1} + X_e] is equal to 1.
    - The presence of a unit root indicates that the time series is non-stationary.
    - The number of unit roots corresponds to the number of differencing operations required to make the series stationary.

2. **Dickey-Fuller Test**:
    - Before the ADF test, there's the **Dickey-Fuller test**.
    - The Dickey-Fuller test is a unit root test that checks the null hypothesis that **α = 1** in the following model equation: [Y_t = αY_{t-1} + \Delta Y_{t-1}]
    - If the null hypothesis is not rejected, the series is considered non-stationary.

3. **Augmented Dickey-Fuller (ADF) Test**:
    - The ADF test is an **"augmented"** version of the Dickey-Fuller test.
    - It expands the Dickey-Fuller equation to include higher-order autoregressive processes.
    - The ADF test computes a **test statistic** and **p-values** to determine whether a given series is stationary or not.

4. **How It Works**:
    - Given a time series, the ADF test checks whether the series has a unit root.
    - If the p-value is below a certain significance level (commonly 0.05), we reject the null hypothesis of a unit root.
    - A low p-value suggests that the series is stationary, while a high p-value indicates non-stationarity.

In Python, you can use the `adfuller()` function from the `statsmodels` library to perform the ADF test. By default, it computes the optimal number of lags based on the observations in the series .