**Stationarity in Time Series**

A time series is said to be **stationary** if its statistical properties like mean, variance, and autocorrelation are constant over time. This means that the time series data does not show trends, seasonal patterns, or changing variance over time. Stationarity is a critical assumption in many statistical models, like the **ARIMA** (AutoRegressive Integrated Moving Average) model, where stationarity is required to make accurate forecasts.

There are two main types of stationarity:

1. **Strict Stationarity**: The entire distribution of the data does not change over time. This means that the joint distribution of values over time is the same regardless of when you observe the series.
2. **Weak Stationarity**: Only the first two moments (mean and variance) are constant over time, and the autocovariance between values depends only on the time gap (lag), not on the actual time of observation.

In practice, most time series models assume weak stationarity.

**Ways to Test for Stationarity**

There are several methods to check if a time series is stationary. A common approach is the **Augmented Dickey-Fuller (ADF) test**, which tests the null hypothesis that a unit root is present in the series (i.e., the series is non-stationary). If the null hypothesis is rejected, then the series is considered stationary.

**Visual Inspection**

* **Plotting the time series**: By observing the time series plot, you can sometimes visually detect trends or seasonality, which indicate non-stationarity.
* **Rolling Statistics**: Calculating and plotting the rolling mean and rolling variance can also help detect non-stationarity.

**Step-by-Step Guide to Check for Stationarity**

1. **Visual Inspection**
   * Plot the time series and check for trends or seasonality.
   * Plot rolling statistics like the rolling mean and rolling standard deviation.
2. **ADF Test (Augmented Dickey-Fuller Test)**
   * A statistical test to check for the presence of a unit root (non-stationarity).

**Code Example for Stationarity Check:**

Let’s implement both visual checks and the ADF test in Python.

