How to Perform an Augmented Dickey-Fuller Test in Python

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A time series is said to be "stationary" if it has no trend, exhibits constant variance over time, and has a constant autocorrelation structure over time.

One way to test whether a time series is stationary is to perform an **augmented Dickey-Fuller test**, which uses the following null and alternative hypotheses:

H0: The time series is non-stationary. In other words, it has some time-dependent structure and does not have constant variance over time.

HA: The time series is stationary.

If the from the test is less than some significance level (e.g. $\alpha = .05$), then we can reject the null hypothesis and conclude that the time series is stationary.

The following step-by-step example shows how to perform an augmented Dickey-Fuller test in Python for a given time series.

Example: Augmented Dickey-Fuller Test in Python

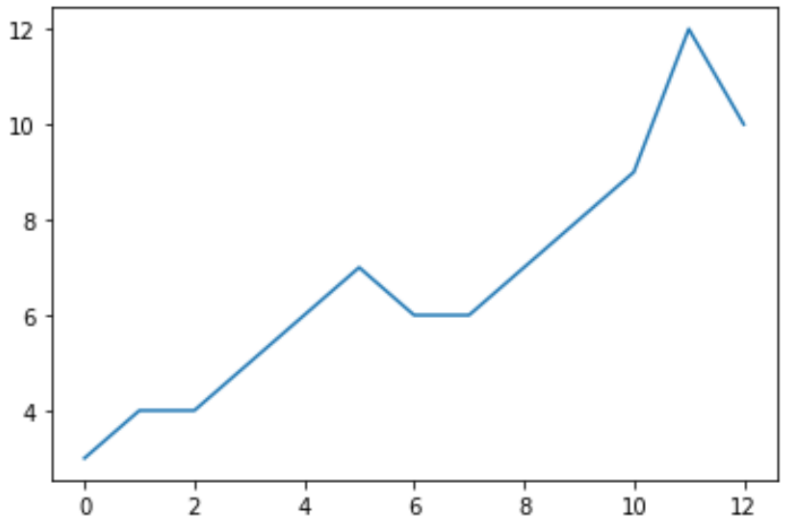
Suppose we have the following time series data in Python:

data =

Before we perform an augmented Dickey-Fuller test on the data, we can create a quick plot to visualize the data:

import matplotlib.pyplot as plt

plt.plot(data)



To perform an augmented Dickey-Fuller test, we can use the function from the **statsmodels** library. First, we need to install statsmodels:

pip install statsmodels

Next, we can use the following code to perform the augmented Dickey-Fuller test:

from statsmodels.tsa.stattools import adfuller

#perform augmented Dickey-Fuller test
adfuller(data)

(-0.9753836234744063,
0.7621363564361013,
0,
12,
{'1%': -4.137829282407408,
'5%': -3.1549724074074077,
'10%': -2.7144769444444443},
31.2466098872313)

Here's how to interpret the most important values in the output:

Test statistic: **-0.97538**
P-value: **0.7621**

Since the p-value is not less than .05, we fail to reject the null hypothesis.

This means the time series is non-stationary. In other words, it has some time-dependent structure and does not have constant variance over time.