

# Augmented Dickey-Fuller test

Statistical tests make strong assumptions about your data. They can only be used to inform the degree to which a null hypothesis can be rejected or fail to be reject. The result must be interpreted for a given problem to be meaningful.

Nevertheless, they can provide a quick check and confirmatory evidence that your time series is stationary or non-stationary.

The Augmented Dickey-Fuller test is a type of statistical test called a unit root test.

The intuition behind a unit root test is that it determines how strongly a time series is defined by a trend.

There are a number of unit root tests and the Augmented Dickey-Fuller may be one of the more widely used. It uses an autoregressive model and optimizes an information criterion across multiple different lag values.

The null hypothesis of the test is that the time series can be represented by a unit root, that it is not stationary (has some time-dependent structure). The alternate hypothesis (rejecting the null hypothesis) is that the time series is stationary.

- **Null Hypothesis (H0):** If failed to be rejected, it suggests the time series has a unit root, meaning it is non-stationary. It has some time dependent structure.
- **Alternate Hypothesis (H1):** The null hypothesis is rejected; it suggests the time series does not have a unit root, meaning it is stationary. It does not have time-dependent structure.

We interpret this result using the p-value from the test. A p-value below a threshold (such as 5% or 1%) suggests we reject the null hypothesis (stationary), otherwise a p-value above the threshold suggests we fail to reject the null hypothesis (non-stationary).

- **p-value > 0.05:** Fail to reject the null hypothesis (H0), the data has a unit root and is non-stationary.
- **p-value <= 0.05:** Reject the null hypothesis (H0), the data does not have a unit root and is stationary.

Below is the output of the python program for Augmented Dickey-Fuller Test for checking the existence of a unit root in Case-Shiller Index series.

```
ADF Statistic: -0.298866
p-value: 0.925665
Critical Values:
    1%: -3.449
    5%: -2.870
   10%: -2.571
```

With a p-value of 0.925665 we fail to reject the null hypothesis (H0) and thus the Case-Shiller Index has a unit root and thus it is non-stationary.