Kernel Based Approaches for Change-Point Detection — Report 2

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1 Autocovariance and Auto correlation

Autocovariance function (ACVF) and autocorrelation (ACF), as the name suggests, measures the variance of the time series sample $x_t$with respect to a future time sample x_{t+h}. The formula for finding the autocovariance and autocorrelation is given in definition 1.4.4 of [1]. As per the definition

$$\hat{\gamma}(h) \coloneqq n^{-1} \sum_{t=1}^{n-|h|} (x_{t+|h|} - \bar{x})(x_t - \bar{x}) \tag{1}$$

Where -n < h < n

Also the correlation function is given by

$$\hat{\rho}(h) = \frac{\hat{\gamma}(h)}{\hat{\gamma}(0)} \tag{2}$$

Using these two formulas we can find the ACVF and ACF for a time series. The plot of the time series and the power spectral density obtained by np.fft is given below

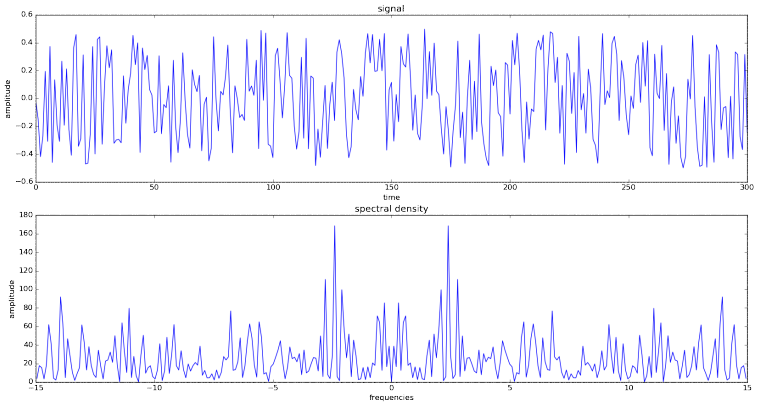

Figure 1: Plot of power spectral density (bottom) obtained after using fourier transform numpy module on the timeseries given in the topplot.

2 Questions

There are a number of questions I have got while working on this.

1. What exactly is the difference between Spectral Density and Power Spectral Density.

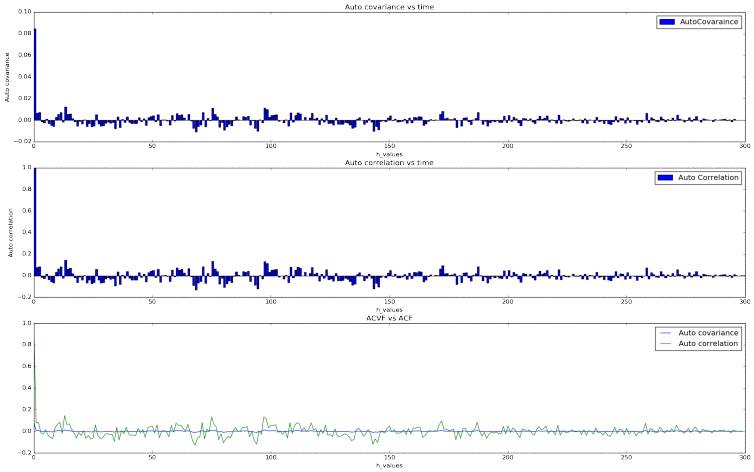

Figure 2: ACVF and ACF of the time series.

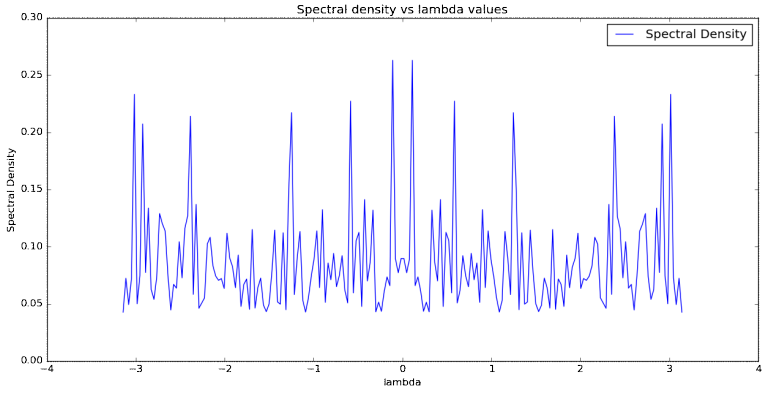

Figure 3: Spectral density for lambdas ranging from -3.14 to 3.14.

2. Why are we not bother about the frequency component while calculating the spectral density.

3. Difference between weekly stationary and strongly stationary.

References

[1] Peter J Brockwell. *Introduction to Time Series and Forecasting, Second Edition.* New York, Springe, 2002.