STATS 3005 Time Series III
Practical 3
2018

1 Outline

At the end of this practical you should be able to:

- Obtain a periodogram in `R` by applying the `spectrum` function.
- Understand how certain features arise in the periodogram through the examination of artificial examples.
- Interpret the periodogram for real data.

2 Artificial Data

1. The purpose of the following questions is to illustrate the properties of the periodogram for various simple deterministic series.

   (a) Construct the series

   `x=c(1:512)/512`

   Obtain a time series plot of `x` and also the periodogram using the all four combinations of the optional arguments `log="no"` and `detrend="F"`. Explain why `spectrum(x)` produces an error. Try to interpret the periodograms when `detrend` is set to False.

   (b) Obtain a time series plot for the series `y=cos(2*pi*x)`.

   i. Plot the spectrum using both the logged and unlogged versions.

   ii. The periodgram ordinates can be obtained by saving the the result of the spectrum function and extracting the components `spec` and `freq`

   ```
   y.spectrum=spectrum(y,plot=F)
   y.spec=y.spectrum$spec
   y.freq=y.spectrum$freq
   ```

   Examine the first 10 pairs of frequencies and spectra. Is there a discernible peak? At what frequency does this occur? Interpret the frequency in the context of the original series.

   (c) Repeat (b) for the series `y=sin(2*pi*x)`, `y=cos(4*pi*x)`, `y=cos(8*pi*x)`, `y=cos(8.5*pi*x)` and comment in each case.

   (d) Repeat (b) for the series `y=sin(2*pi*x)+cos(20*pi*x)/2`

   (e) Repeat (b) for the series `y=sin(2*pi*x)+cos(20*pi*x)/2`

2. Construct a white noise series `u=rnorm(512)`. Obtain time series plot of the data and both the logged and unlogged periodograms. Comment.

3. Obtain time series plots and periodograms for the series `y+u`, `y+u/2` and `y+2*u` where `y=sin(2*pi*x)+cos(20*pi*x)/2` and `u=rnorm(512)`.

3 Analysis of the Mauna Loa data

Load the Mauna Loa CO2 data into R. Obtain time series plots and periodograms for the original data and also the residuals from a cubic regression. Compare the two periodograms and comment, keeping in mind the fact that the periodogram is calculated for the detrended data.

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