ASSIGNMENT 7. DETRENDING

1. Run geosa7.m, selecting one series from the V3 dataset for analysis. You will generally want to run the detrending script on the full length of series, and certainly want to focus on a period that has trend in mean.

   Choose either ratio detrending or difference detrending. This choice is data dependent. Beware that the data should be everywhere positive for use of the ratio method, and even then the method may be invalid if the fitted trend line crosses zero. Usually, ring widths are detrended by the ratio method.

   Interactively vary the choice of spline flexibility. Observe the effect of choice of spline on 1) the frequency response function of the spline, and 2) the tracking of the original series by the trend line. Settle on a final choice of spline flexibility that you decide adequately represents the "trend."

   Adjust the plotted spectra of the original series and detrended series by varying the lag window and toggling the log/linear y axis if needed to improve readability.

   You should end up with four Figure windows.

2. (Caption to Fig. 1) Time series plots of original series, straight-line trend and cubic-smoothing-spline trend. Circle a region where the slopes of the two fitted trend lines differ. Explain how this difference could affect the interpretation of a climatic trend over that same sub-period from the detrended series. [If your time series has no relevance to climate, explain the interpretation in terms of whatever is thought to drive the series (e.g., economic activity)].

3. (Caption to Fig 2) Amplitude of frequency response function of selected spline. What frequency range is strongly tracked by the spline; what range is barely tracked at all? Explain by referring to the frequency response function how your selected spline is or is not consistent with Granger's "trend in mean" concept.

4. (Caption to Fig 3) Time series plots of series detrended by straight line and spline. Zoom in with "horizontal zoom" and mark some period when the two series have a relatively large departure from one another. Explain why one series is higher than the other by referring back to the fitted trend lines in Figure 1.

5. (Caption to Fig 4) Normalized spectra of the detrended series. What is the ratio of the areas under the two spectra? Which spectra is highest at the infinite wavelength and why?

Running goesa7.m

1. >geosa7
2. Message box: message introducing geosa7.m; click OK to remove message and move on
3. Respond to input dialog with the name of your data file; click OK
4. Menu: select V3 as the source structure for your time series
5. Menu: click on the time series to be analyzed. You can only select one series, and when you do, an asterisk appears in its box. If you click again on another series, that series becomes your selection. When satisfied with your choice, click "Accept Selection"
6. Click OK to acknowledge the message box with information on your selection
7. Input dialog: usually accept the default (full length) period for analysis
8. Click OK to acknowledge the message box with information on your selection
9. Menu: choose difference or ratio method for detrending

   Time series plot with straight-line fit appears in Fig 1. The R^2 for the linear regression is annotated. This R^2 measures the importance of linear trend as a percentage of variance accounted for by straight-line trend. Also, an input dialog box ...

10. Input dialog: enter the desired spline-stiffness in terms of the period at which the amplitude of frequency response drops to ½. The default is a 0.70 times the series length. Press OK...

    Plot of frequency response function of the spline appears in Fig 2. Annotated at the top of the figure is the "spline parameter", as given by equation 8 in the notes. Also appearing is a menu allowing you to select a different spline-stiffness or accept the spline.

11. Menu: change or accept spline. At this point, you can click back and forth between Fig windows 1 and 2 to see how well the spline tracks the series as well as the frequency response. Pick "Change Spline" and observe changes in Figs 1 and 2. Keep revising until satisfied, then click "Accept"

12. Figs 3 and 4 appear. Fig 3 has time series plots of the series detrended by the selected spline and by a straight line for comparison. Fig 4 has normalized spectra of the detrended series. A menu also appears allowing you to tailor the spectra by changing the lag window and the scale of the y axis. Generally the linear scale is best because it preserves the relationship between area under the spectrum and variance. But the semilog axis might be needed if the

spectrum is overwhelmed by the low frequencies. Note that the instructions say to turn in a "zoomed" version of Figure 3.

13. Menu: Experiment with various settings for the spectrum; finally, press "Accept Spectrum"

14. The closing message refers to a structure Results that remains in the workspace. Typing Results.what at the Matlab prompt will list the fields in Results. Among other things, Results holds the time series of original data, trend lines, and detrended data.

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PROGRAMMING NOTES

This script makes use of the spline and signal processing toolboxes.

Selected Matlab functions called :
csaps – computes cubic smoothing spline

Selected user-written Matlab functions called:
splinep -- computes spline parameter for specified wavelength of 50% frequency response
splfres – frequency response of spline
cfspl – curve fit by cubic spline