Haar

Basic Summary

Haar fluctuations characterize the variability for processes with $-1<H<1$. On log-log plots the slope of the $q=1$ moment is H. When $H<0$ the Haar fluctuation is close to the tendency fluctuation (the average "anomaly"). When $H>0$ it is close to the difference flucuation (hence when $q=2$, the usual structure function). To make the agreement better one can "calibrate" the Haar fluctuation by multiplying by a calibration factor ("calib"). The default value is calib=2, which works well for many geophysical series (for more information about Haar fluctuations see sections 5.5 and 10.2 in "The Weather and Climate" by Lovejoy and Schertzer). The Haar function finds values of H (scaling exponent of mean field), C1 (codimension which measures mean inhomogeneity), and α (multifractality index). To do so it uses inputs of independent strings of data ("field" input), a value used to calibrate the time-space axis ("calibcoord" input), and the values ("lowpts" and "highpts") that represent the number of points at low and high lags, respectively, that should be dropped before estimating exponents.

Inputs

"field" is the field of data. Inputting the transpose of this matrix will not make a difference.
"calibcoord" is basically the resolution. For example if you wish your result to be in units of years and your data has monthly resolution, calibcoord=1/12.
"lowpts" should be very low, 1 or 0 are typical values, and "highpts" can not be greater than "points".

Outputs

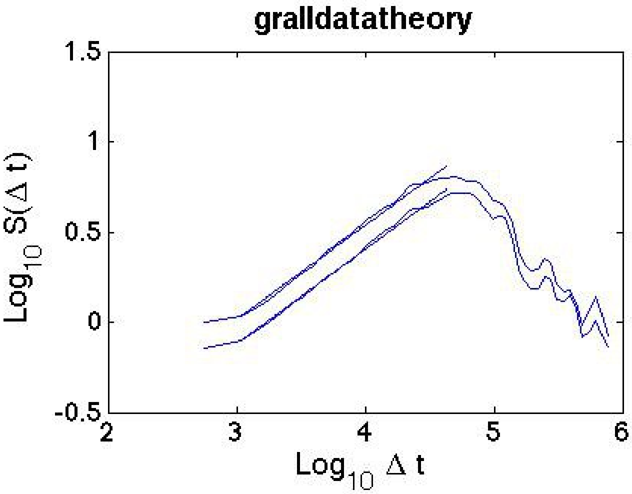
The outputs are the values of H,C1, and α and five graphs. The first is a graph of Log(M) vs.Log(λ); the blue lines on this graph are reference lines. The next is a graph of   (q) vs. q. Figure 3 is a graph of "grC1" and the theoretical grC1 superimposed. The logarithmic slope of grC1 gives C1. Figure 4 is a graph of "grRMSsmooth" and "grq1smooth" with theory lines superimposed. The final graph shows "grKppsmooth" and "grC1" with their theory lines superimposed. All graphs with "smooth" in the name have been smoothed, which is often important if using a single data series since statistics at 20 lags per order of magnitude can be poor. Graphs with "theory" in the name are straight lines to be used as references. RMS stands for root mean square.

Note: This function requires Smooth1D

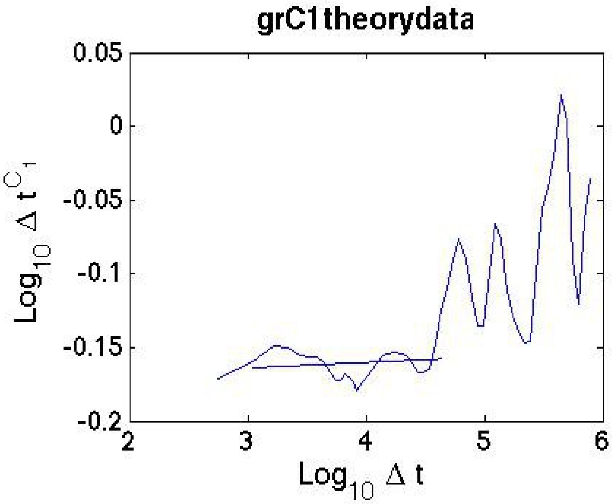
Example

Input: field= "Epica" (1x2895 series of ice core temperature data interpolated to half the original number of points)
calibcoord=276.995 (data had less than yearly resolution)
lowpts=1
highpts=25

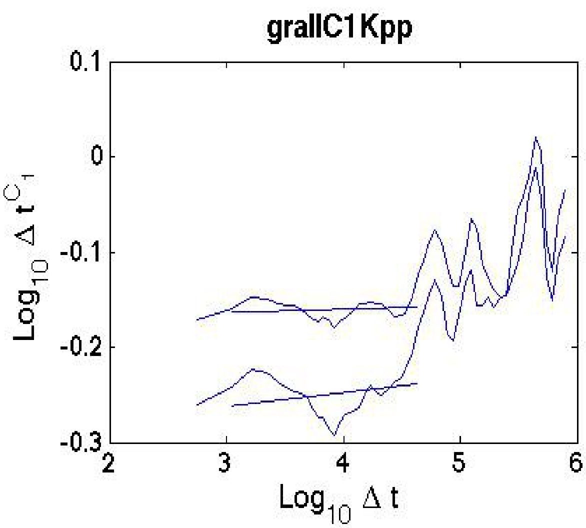
Output: H = 0.5243
derivativeC1 = 0.0030
alpha = 3.8165



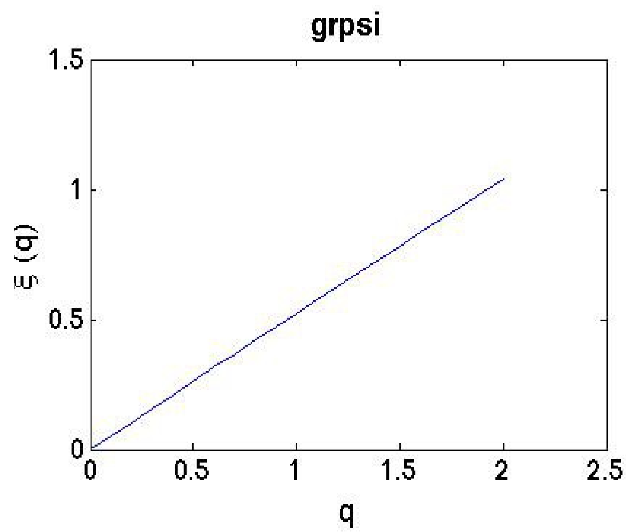
This shows the q=1 structure function (bottom) and RMS (top) with regressions



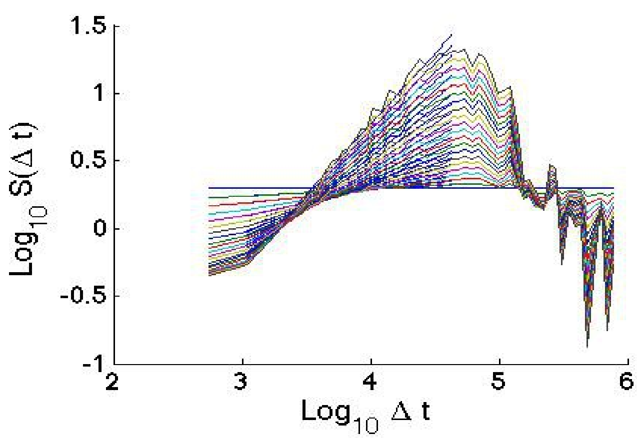
This characterizes the intermittency. The slope is C1



*The top has slope C1, the bottom has slope K''(1)=C1*α*



These are the exponents from the slopes estimated over the regressions in the following graph



These are all the structure functions order 0 to 2 in measurements of 0.1

Errors

Index exceeds matrix dimensions.
Error in Haar (line 64)
take=T(low:high,1:2);

- This error will occurs if “low” is larger than “high”. Consider revising choices for “lowpts” and “highpts”