

QMDA Homework 8

Convolution

The file 'NYC_temp.csv' contains daily minimum and maximum air temperatures (Tmin and Tmax) measured at the Central Park weather station between 1/1/1995 and 12/31/2014. The first three columns contain weather station information and the last two temperatures in degrees Celsius times 10. The data were downloaded from the National Climatic Data Center at

<https://www.ncdc.noaa.gov/data-access/land-based-station-data>

A) Read the data into Matlab (use the function 'csvread'). Construct a time vector in years (an approximate time that ignores leap years is fine). Plot a standard “look at the data” with both Tmin and Tmax versus time in years. The data should show a clear yearly cycle and a lot of short-period weather-related “noise”.

B) Obtain a smoothed version of the temperatures by convolving the data vectors with an appropriate filter. The goal of this filtering operation is to highlight the yearly cycle. You can do it by one of these methods:

- Compute the filtered data as $\mathbf{d}^{\text{filt}} = \mathbf{G}\mathbf{d}$, where the rows of the matrix \mathbf{G} contain shifted copies of the filter;
- Loop over the data points and obtain the filtered data by multiplying the temperatures by a filter window centered on each data point; or
- Perform the convolution in the frequency domain.

Compute smoothed versions of both Tmin and Tmax.

C) Discuss your choice for the shape and width of the smoothing filter.

D) Plot as a function of time in years the original Tmin and Tmax data as dots (or similar markers) and the smoothed curves as continuous curves.

E) Plot as a function of time in years the difference of the original Tmax minus Tmin as dots (or similar markers) and the difference between the smoothed temperatures. Are the largest differences between Tmax and Tmin in the winter or in the summer?