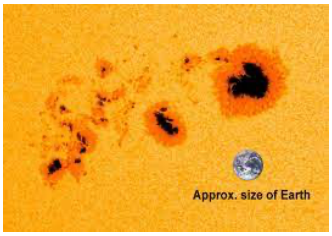
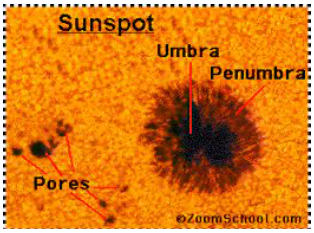
DS 2001: Introduction to Programming with Data / Lab Practicum
Prof. Rachlin / Northeastern University

The Sunspot Cycle



Overview

Let's learn a little about Astronomy and do a little scientific computing this week! Sunspots appear on the surface of the sun (the *photosphere)* and are regions of relatively cooler temperatures and high magnetic activity. With an appropriate solar filter, sunspots are easily visible through a telescope. (Warning: never look at the sun through binoculars or a telescope without the right solar filters or you will be permanently blinded!). Some sunspots are so large that they can be seen during a sunset with the naked eye.

The number of sunspots varies over an approximately 11-year cycle. Visualize the data provided using a python visualization library of your own choosing. The data provided is from the SILSO: Sunspot Index and Long-term Solar Observations website. (https://wwwbis.sidc.be/silso/datafiles). The file contains the month-by-month average daily sunspot numbers going back to 1749! Your task is to plot the number of sunspots over time from 1749 to the present day and use your visualization to manually derive an estimate for the length of the sunspot cycle. Try a figure size of 10 inches by 2 inches with a dpi of 200. Call this first plot **sunspot_history.png**. To determine your estimate, divide the number of years by the number of peak-to-peak intervals that occur during those years. *Record your calculations and estimate in the comments section of your program.*

Visualizing Cycles

As an additional visualization experiment, let's say you estimated your cycle length. Now let's overlay the cyclic data onto a single scatter plot spanning the length of the cycle. To do this we simply transform each date to (date % cycle). For example, if we assume an 11.5-year cycle, the date 1800.288 gets transformed to (1800.288 % 11.5 = **6.288**) and notice that *all* dates will now be transformed to a range between 0…cycle. A spread in the cyclic plot shows that the solar cycle exhibits some variability. Try experimenting with different values for *cycle* and see if you can tighten up the variability and thus improve your estimate for the length of the solar cycle. I recommend you try values between 10.5 and 11.5 in increments of 0.1. You'll want your single-cycle plots to have square dimensions. Try a 5x5 plot with dpi=200. Call this second plot **sunspot_cycle.png**.

What to Submit

Submit your code and visualizations (sunspot_history.png and sunspot_cycle.png). You can include your derived estimate of the length of the sunspot cycle as a triple-quoted comment embedded at the top of your python code.