HW 2

Nathan Wolthuis*
Haverford College
(Dated: February 11, 2020)

1. PROBLEM 31

The first problem primarily involved a standard python plot for a set of predetermined data points. Part a) involvedd all 3000 months since January 1749, part b) limited the data to the first 1000 months, part c) involved plotting a localized average for each point based on the 5 points surrounding it in each direction, which I accomplished through the use of a nested for loop and a lambda function. Part c) was definitely the most difficult part of the assignment, mostly due to me mistaking what the book called a running average for something other than a local average.

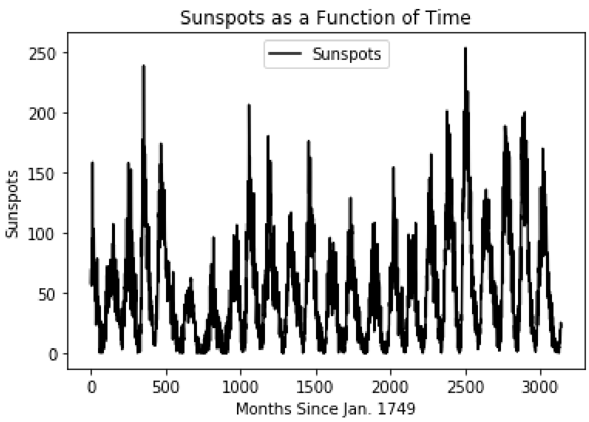

FIG. 1: Sunspots over time w/o limits

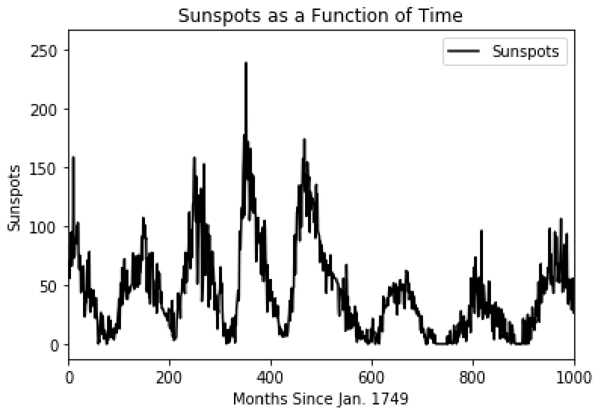

FIG. 2: Sunspots over time w/ limits

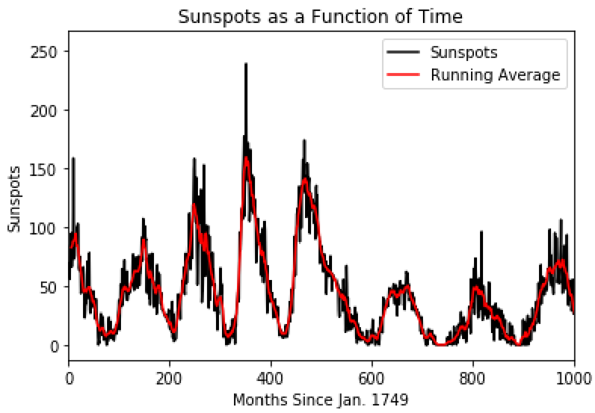

FIG. 3: Sunspots over time w/ limits and average

2. PROBLEM 3.2

Problem 2 was the most straightforward problem in this homework assignment. I ended up plotting the Deltoid Curve, a Galilean Spiral, and Fey's function (a popular favorite). The parametric equations for the Deltoid Curve were:

$$x = 2cos(\theta) + cos(2\theta)$$
$$y = 2sin(\theta) - sin(2\theta)$$

The Galilean Spiral and the Fey's Function only had

*Electronic address: email; URL: `Optionalhomepage`

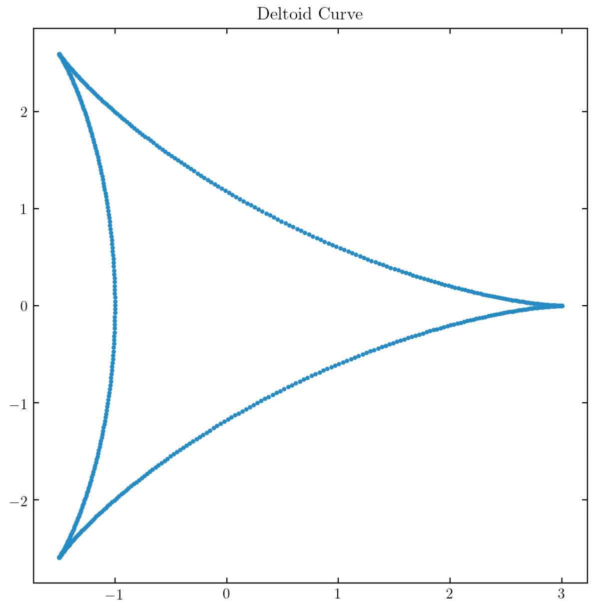

FIG. 4: Deltoid Curve

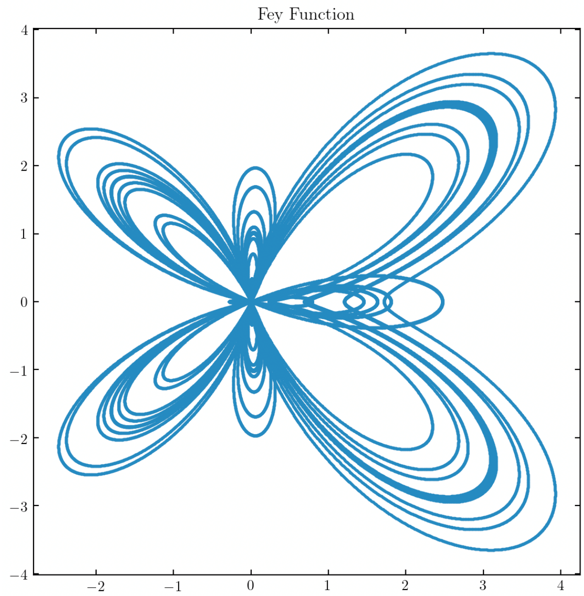

FIG. 6: Fey's Function

an equation each, their respective equations are:

$$r = \theta^2$$

$$r = e^{cos(\theta)} - 2cos(4\theta) + sin^5(\frac{\theta}{12})$$

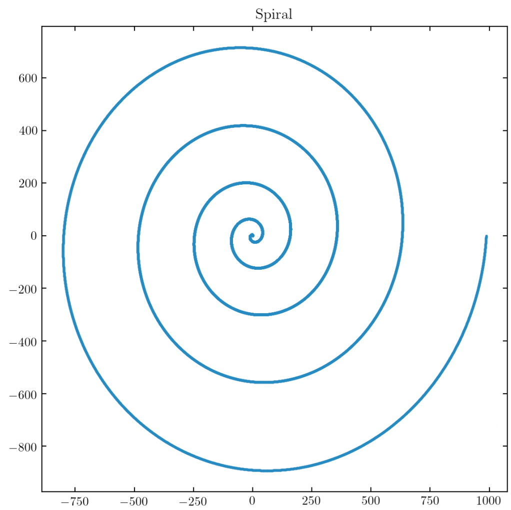

FIG. 5: Galilean Spiral

3. PROBLEM 3.6

Problem 3 was easily the most difficult of this assignment. The majority of my difficulties seem to have stemmed from indices management again, and figuring out the proper formatting for the necessary looping patterns. I chose to do the chaos problem, and get a cool looking plot, featured below. a) For a given value of r, a fixed point would have only one x value for a given r, so long as the iterations have "settled" down. A limit cycle alternates between two values, as seen when r reaches 3. Chaos is when there seems to be no fixed point or alternating points, each iteration could produce vastly different results.

b) Based on my plot, r seems to move from orderly to chaotic behavior around r = 3.5. At this point the limit cycles are gone, and the behavior delves deep into chaos.

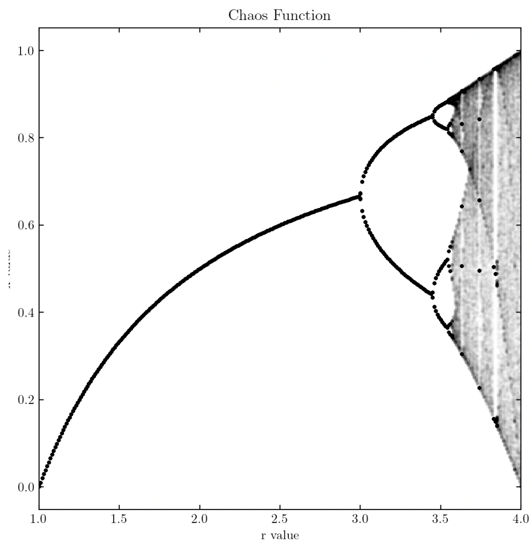

FIG. 7: Feigenbaum Plot

4. SURVEY RESPONSE

This problem set took around 4 to 6 hours. I managed to get it done pretty much all by myself, which was nice, although I did check my Chaos plot against Dom to make sure everything was looking good. Despite some struggling with indices, I managed to get everything done okay, and was able to help others with the assignment.