The Logistic Map continued

Nickolas Arustamyan[1]

[1]Undergraduate Student, Mathematical Sciences
Florida Atlantic University

Nonlinear Dynamical Systems, Fall 2020

Introduction

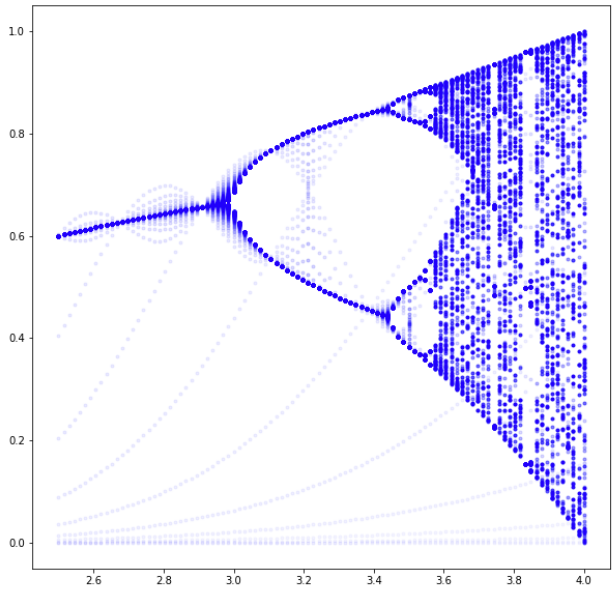
As we know, the logistic map is the recursive function defined by $x_{n+1} = rx_n(1 - x_n)$. The function has two parameters, the initial condition x_0 and the growth ratio r. This lab focused on some ways to analyze and investigate the convergence of this map.

Poincare Plot

The poincare plot examines a sequence of points (x_i, x_{i+1} and plots them. This plot gives us an upside down parabola. This makes sense as the function we have is a negative quadratic. Then we examined a plot of random points and it is clear that the chaos of the logistic map is actually not chaos like the randoms points and is very deterministic and understood.

Bifurcation Diagram

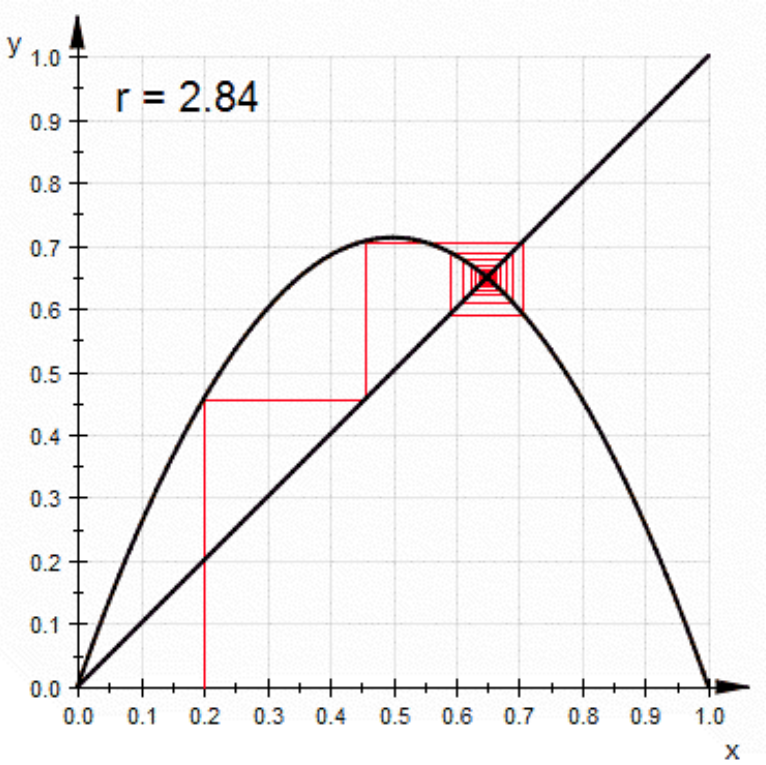
As we saw in previous labs, the function begins splitting around the value 3 and continues to become more and more chaotic as we get to 3.57 and then becomes very difficult to examine. Below is the figure.



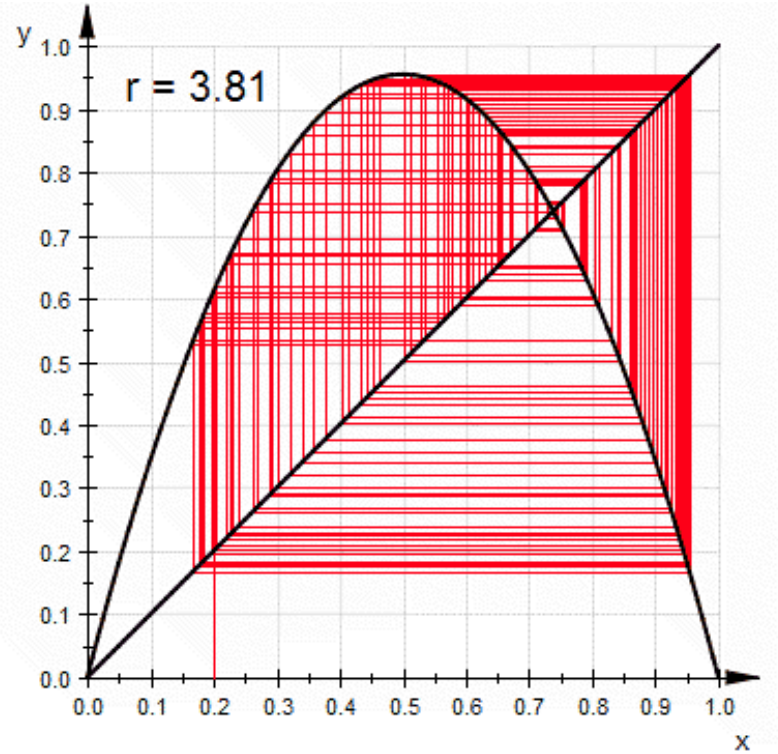
Cobweb Plot

The cobweb plot is a function that helps examine the convergence of the function for differing values of r. Following an iterative process, the cobweb plot gives a better idea of how the function changes are r changes. Below is the cobweb plot for $r = 2.84$ and another for $r = 3.81$

Images



Images


r = 3.81
y
x
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0