

## Check +

### Logan Maier Activity 8

2. Yes
3. Yes

#### Damped undriven

1. Done
2. Yes
3. I used  $\theta_0 = 0.5$  and alpha values of 0, 0.3, and 1.7 for undamped, underdamped, and critically damped respectively.

#### Damped Driven

1. The points do have good value as they show when the driving force is dominant.
2. Looking at the plot, around 25-30ish seconds the output appears to become periodic.
3. Setting start to 25, the transients have gone away. The frequency of the asymptotic  $\theta(t)$  seems to be closely related to the driving force.

#### Looking for Chaos

1. Done
2. After plotting, I can deduce the first blank row is a limit cycle with 2 periods. The second blank doesn't really seem to fit a recognizable cycle so I would say it is mode locking, and the third is a pre. attract as it is well defined. To tell if  $f(t)$  is built from  $x$  frequencies I can see how many distinctive order points are present. This method suggests that the  $f(t)$  is built from two frequencies.
3. From all the combinations of initial conditions, the graphs show how sensitive the outcomes are to the initial conditions. This makes sense given the code, and theoretically makes sense as it references the butterfly effect.