

# Najib Ishaq

## Assignment 1, Part a.

Due Oct 6<sup>th</sup> 2020

1.

During the initial rounds, the population of the Striped Bass stays near zero while the population of Menhaden grows exponentially, nearly doubling every round. After a few rounds have passed, we start to see a cyclic trend in the populations. As the Menhaden population grows, the Striped Bass population also starts to grow. Then the Menhaden population starts to fall and soon the Striped Bass population also starts to fall. This cyclic behavior persists for the remaining rounds.

2.

The Striped Bass need to feed on too many Menhaden for their population to grow meaningfully. It is exceedingly unlikely that the Striped Bass would ever outnumber the Menhaden, and we never see it happen.

3.

The populations cycle counter-clockwise in the phase plot. This is because the prey is drawn on the x-axis while the predator is drawn on the y-axis. In any predator-prey model, when both populations are small, the population of the prey starts to grow due to the lack of predators. As the prey becomes abundant, the small number of predators have more prey to eat and more opportunities to catch that prey; the predator population starts to grow. When there are too many predators, they start to eat too many prey and the prey population falls. When there are too few prey, the predators cannot find enough food and start dying out. This cycle continues unless one (or both) species go(es) extinct, or they reach some stationary equilibrium.

4.

If, in each round, all Striped Bass only eat enough to survive and every Menhaden that gets eaten is replaced by the reproduction of a surviving Menhaden, the populations would have reached a steady state.

The plot of the average populations from different models shows an inverse relationship. This indicates an implied carrying capacity on the Striped Bass population; this carrying capacity is inversely proportional to the Menhaden population.

**5.**

If a fishery were added on the Menhaden, the Menhaden population would fall in proportion. This would in-turn cause the Striped Bass population to fall. Further, the maximum populations of both species will be smaller. Since there will be fewer Striped Bass, they will be slower, as a whole, at eating the Menhaden. This may cause the cycles in the populations to be stretched out in time.

**6.**

The maximum Striped Bass population would be higher, and so we would see more pronounced peaks in the cycle of Striped Bass population.

**7.**

The data look chaotic. I expect to see very interesting nonlinearities in the long-term behavior of these models.