
New York City College of Technology
MAT 4880 - Spring 2020
Project 1

Make sure to follow the instructions:

- The collection of this project will be done on CoCalc on Monday, March 2, at 11:59 pm.
- Go to the course project (not the shared project) and look for a folder named Project 1. In this folder you will find these instructions. This is also where you will upload two files when you are ready: “yourlastname_proj1.pdf” and “yourlastname_chapter4.pdf”
- No late submission will be accepted.

PART 1: 20%

Write an essay explaining to a friend what you learned in Chapter 4. Make sure to cover the three sections.

- Use one-inch margins all around.
- The essay should be single-spaced.
- Use a single tab to clearly delineate your paragraphs.
- Use 12 pt font.
- When you are done, save your essay as “yourlastname_chapter4.pdf”

PART 2: 80%

- Use Markdown to provide complete answers as if you were a consultant.
- When you are done, save your work as “yourlastname_proj1.pdf”

Problem 5 in the textbook. In the whale problem of Example 4.2 we used a logistic model of population growth, where the growth rate of population P in the absence of interspecies competition is

$$g(P) = rP \left(1 - \frac{P}{K} \right).$$

In this problem we will be using a more complex model,

$$g(P) = rP \left(\frac{P - c}{P + c} \right) \left(1 - \frac{P}{K} \right)$$

in which the parameter c represents a minimum viable population level below which the growth rate is negative. Assume that $\alpha = 10^{-8}$ and that the minimum viable population level is 3,000 for blue whales and 15,000 for fin whales. Use the same intrinsic rates and environmental carrying capacities given in Example 4.2.

- (a) Can the two species of whales coexist? Use the five-step method, and model as a dynamical system in steady state.

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- (b) Sketch the vector field for this model. Make sure to adjust the window accordingly so that you have a good view. Classify each equilibrium point as stable or unstable.
 - (c) Assuming that there are currently 5,000 blue whales and 70,000 fin whales, what does this model predict about the future of the two populations?
 - (d) Suppose that we have underestimated the minimum viable population for the blue whale, and that it is actually closer to 10,000. Now what happens to the two species?