

4. [12 points] Consider the predator-prey model with harvesting (harvesting here implies hunting by humans, e.g., fishing if the populations are fish) given by

$$x' = x(3 - x - y) - 2, \quad y' = y(-3 + x).$$

Note that as x and y are populations, we must have $x, y \geq 0$.

- a. [3 points] Explain what each term in the equation for x models. Is x or y the predator? Which population is being harvested?

- b. [7 points] By doing an appropriate linear analysis, sketch a phase portrait for this system.

- c. [2 points] Based on your answer to (b), sketch what you expect the behavior of the solution to the system will be as a function of time if $x(0) = 3$ and $y(0) = 1$. How would you expect this to differ from the behavior with the initial condition $x(0) = 1$, $y(0) = 1$?