Part One: *Interacting Species...*

Consider the autonomous system

$$\begin{aligned} \frac{dx}{dt} &= -5x + 100xy \\ \frac{dy}{dt} &= \frac{1}{10}y + \frac{1}{100}xy \end{aligned}$$

that models the population of two species, x and y, over time.

1. Does the system model a predator-prey system, a competitive species system, or a cooperative species system? Noting the magnitude and sign of the constants, what can be inferred about the species and their interaction?

2. Rewrite the system using vector notation.

3. Find all equilibriums of the system.

4. Draw a few vectors in the vector field. Draw a few vectors in the direction field.

5. Sketch the solution curve in the phase plane and the $x(t)$ and $y(t)$ graphs for the solution with $x(0) = 1$ and $y(0) = 1$.

Part Two: *More "Interacting" Species...*

Consider the autonomous system

$$\begin{aligned} \frac{dx}{dt} &= 2x \\ \frac{dy}{dt} &= x + y \end{aligned}$$

that models the population of two species, x and y, over time.

1. Does the system model a predator-prey system, a competitive species system, or a cooperative species system? Noting the magnitude and sign of the constants, what can be inferred about the species and their interaction?

2. Rewrite the system using vector notation.

3. Find all equilibriums of the system.

4. Find the general solution $\mathbf{P}(t) = (x(t), y(t))$ for the system.