

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECTION 4.4

Math 1001 Worksheet

WINTER 2024

For practice only. Not to be submitted.

1. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= 5x - 2xy \\ \frac{dy}{dt} &= -y + 3xy.\end{aligned}$$

- (a) This is a predator-prey system. Which population is the predator? Which population is the prey?
- (b) Does any factor besides predation inhibit the growth of the prey population?
- (c) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?

2. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= -4x + 8xy \\ \frac{dy}{dt} &= 3y - 6y^2 - xy.\end{aligned}$$

- (a) This is a predator-prey system. Which population is the predator? Which population is the prey?
- (b) Does any factor other than predation inhibit the growth of the prey population?
- (c) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?

3. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= -4x + 4xy \\ \frac{dy}{dt} &= 3y - 6y^2 + xy.\end{aligned}$$

- (a) Does this model describe predation, co-operation or competition?
- (b) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?

4. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\frac{dx}{dt} = 6x - 2x^2 - 5xy$$

$$\frac{dy}{dt} = 8y - 5y^2 - 4xy.$$

- (a) Does this model describe predation, co-operation or competition?
- (b) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?