

Mathematics 172 Homework.

1. For the Lotka-Volterra for competing species given by

$$\begin{aligned}\frac{dx}{dt} &= .3x \left(\frac{100 - x - .333y}{100} \right) \\ \frac{dy}{dt} &= .45x \left(\frac{200 - y - .5x}{200} \right)\end{aligned}$$

- (a) Find the equilibrium points of this system? *Answer:* (0, 0), (100, 0), (0, 200), (40, 180).
(b) Which of these are stable? *Answer:* (40, 180).
(c) Which of these are unstable? *Answer:* (0, 0), (100, 0), (0, 100)
(d) What is the long term behavior of this system? *Answer:* Competitive coexistence.

2. For the Lotka-Volterra for competing species given by

$$\begin{aligned}\frac{dx}{dt} &= .3x \left(\frac{400 - x - 1.333y}{400} \right) \\ \frac{dy}{dt} &= .45x \left(\frac{500 - y - 2.5x}{500} \right)\end{aligned}$$

- (a) Find the equilibrium points of this system? *Answer:* (0, 0), (400, 0), (0, 400), (114.3, 214.3).
(b) Which of these are stable? *Answer:* (400, 0), (0, 500)
(c) Which of these are unstable? *Answer:* (0, 0), (114.3, 214.3).
(d) What is the long term behavior of this system? *Answer:* Competitive exclusion.

3. For the Lotka-Volterra for competing species given by

$$\frac{dx}{dt} = .3x \left(\frac{200 - x - .666y}{200} \right)$$

$$\frac{dy}{dt} = .45x \left(\frac{500 - y - 1.25x}{500} \right)$$

- (a) Find the equilibrium points of this system? *Answer:* $(0, 0)$, $(200, 0)$, $(0, 500)$.
- (b) Which of these are stable? *Answer:* $(0, 500)$,
- (c) Which of these are unstable? *Answer:* $(0, 0)$, $(200, 0)$.
- (d) What is the long term behavior of this system? *Answer:* The y species takes over.

4. For the Lotka-Volterra for competing species given by

$$\frac{dx}{dt} = .3x \left(\frac{240 - x - .48y}{240} \right)$$

$$\frac{dy}{dt} = .45x \left(\frac{300 - y - 1.5x}{300} \right)$$

- (a) Find the equilibrium points of this system? *Answer:* $(0, 0)$, $(240, 0)$, $(0, 300)$
- (b) Which of these are stable? *Answer:* $(240, 0)$.
- (c) Which of these are unstable? *Answer:* $(0, 0)$, $(240, 0)$, $(0, 300)$.
- (d) What is the long term behavior of this system? *Answer:* The x species takes over.