

Math 172 Spring 2011 WS 8

1. You are studying competition between red and black desert ants. The populations are measured in millions of individuals.

If only a single species is present, it would grow following the logistic model, with a carrying capacity $K_1 = 100$ for the red scorpion, and $K_2 = 150$ for the black scorpion.

a. Write the Lotka-Volterra competition model equations for the two species, assuming competition coefficients of $\alpha = 2$ for the red scorpion, and $\beta = 3$ for the black scorpion. Use $r_1 = r_2 = 10$.

b. Assume the initial populations are 44 million red ants and 31 million black scorpions. Use Euler's method with $\delta t = 1$ in order to estimate the values of both populations at $t = 1, 2, 3$. Also find the values of N_1 and N_2 at some large values of t . It is up to you how large to choose t but it should be large enough to show the long run behavior of the system.

c. Sketch the state-space and show the values that you found in b. as points in the state-space. Which equilibrium value seems to be approached in the long run?

3. Repeat problem 1 with $r_1 = r_2 = 10$, $K_1 = 100$, $K_2 = 150$, $\alpha = 0.5$, $\beta = 2$. Assume the initial values to be:

a. $N_1 = 80$, $N_2 = 45$

b. $N_1 = 50$, $N_2 = 40$.

4. Repeat the questions in problem 1 with $r_1 = r_2 = 30$, $K_1 = 100$, $K_2 = 150$, $\alpha = 0.5$, $\beta = 0.75$. Assume the initial values of the population to be $N_1 = 50$, $N_2 = 70$.