

1. Consider the discrete logistic growth model given by

$$P_{n+1} = 1.5P_n - 0.0025P_n^2.$$

a. Suppose that the initial population  $P_0$  is 50. Find the population of the next three generations,  $P_1$ ,  $P_2$ , and  $P_3$ .

b. Sketch a graph of the updating function with the identity map,  $P_{n+1} = P_n$ . Be sure to show the intercepts of the parabola as well as the vertex. Find the equilibria and identify them with your graph.

2. Consider the discrete logistic growth model given by

$$P_{n+1} = f(P_n) = 1.25P_n - 0.00125P_n^2.$$

a. Suppose that the initial population  $P_0 = 250$ . Find the population of the next three generations,  $P_1$ ,  $P_2$ , and  $P_3$ . Find all equilibria.

b. Sketch a graph of the updating function,  $f(P)$ , with the identity map,  $P_{n+1} = P_n$ . Find the intercepts and the vertex of the parabola.

3. Assume that the growth rate of a population  $P$  satisfies

$$g(P) = 0.03P(1 - P/600).$$

The discrete logistic growth model for this population is given by:

$$P_{n+1} = P_n + g(P_n).$$

a. Find the population when the growth rate  $g(P)$  is zero (the  $P$ -intercepts) and when it is a maximum (the vertex). Sketch the graph of  $g(P)$ .

b. Let  $P_0 = 100$  and compute  $P_1$ ,  $P_2$ , and  $P_3$ . Find all equilibria.

4. Assume that the growth rate of a population  $P$  satisfies

$$g(P) = 0.02P(1 - 0.0004P).$$

The discrete logistic growth model for this population is given by:

$$P_{n+1} = P_n + g(P_n).$$

a. Find the population when the growth rate  $g(P)$  is zero and when it is a maximum. Sketch the graph of  $g(P)$ .

b. Let  $P_0 = 5000$  and compute  $P_1$ ,  $P_2$ , and  $P_3$ . Find all equilibria.

5. A modified version of the discrete logistic growth model that includes emigration is given by

$$P_{n+1} = f(P_n) = 1.1P_n - 0.0001P_n^2 - 9.$$

a. Suppose that the initial population  $P_0$  is 500. Find the population of the next three generations,  $P_1$ ,  $P_2$ , and  $P_3$ .

b. Sketch a graph of the updating function with the identity map,  $P_{n+1} = P_n$ . Be sure to show the intercepts of the parabola as well as the vertex. Find the equilibria and identify them on your graph.

6. A modified version of the discrete logistic growth model that includes immigration is given by

$$p_{n+1} = f(p_n) = 1.2p_n - 0.0001p_n^2 + 44.$$

a. Suppose that the initial population  $p_0 = 1000$ . Find the population of the next three generations,  $p_1$ ,  $p_2$ , and  $p_3$ .

b. Sketch a graph of the updating function with the identity map,  $p_{n+1} = p_n$ . Be sure to show the intercepts of the parabola as well as the vertex. Find the equilibria and identify them on your graph.

7. Consider Hassell's model that is given by

$$p_{n+1} = H(p_n) = \frac{5p_n}{1 + 0.002p_n}.$$

- a. Assume that  $p_0 = 500$  and find the population for the next three generations,  $p_1$ ,  $p_2$ , and  $p_3$ .
- b. Find the  $p$ -intercepts and the horizontal asymptote for  $H(p)$  and sketch a graph of  $H(p)$  for  $p > 0$  along with the identity map,  $p_{n+1} = p_n$ .
- c. By solving  $p_e = H(p_e)$ , determine all equilibria for this model.

8. Consider Hassell's model that is given by

$$p_{n+1} = H(p_n) = \frac{10p_n}{1 + 0.0001p_n^2}.$$

- a. Assume that  $p_0 = 100$  and find the population for the next three generations,  $p_1$ ,  $p_2$ , and  $p_3$ .
- b. Find the  $p$ -intercepts and the horizontal asymptote for  $H(p)$  and sketch a graph of  $H(p)$  for  $p > 0$  along with the identity map,  $p_{n+1} = p_n$ .
- c. By solving  $p_e = H(p_e)$ , determine all equilibria for this model.