

QUESTION 2. A population of butterflies lives on a meadow, surrounded by forest. We want to investigate the dynamics of the population. We denote the number of butterflies at the beginning of season t by x_t . Over the course of a season, 30% of the butterflies that were there at the beginning die. During each season, 20 new butterflies arrive from other meadows.

a) Write the DTDS for the number of butterflies, i.e. $x_{t+1} =$

b) The updating function is $f(x) =$

c) Starting with 40 butterflies in season 0, calculate their number in seasons 1, 2, 3.

$x_1 =$ $x_2 =$ $x_3 =$

d) The fixed point of the DTDS is $x^* =$

e) The solution of the DTDS in terms of a general initial condition x_0 is

$x_t =$

f) In the space below, draw the cobweb for this DTDS, starting at $x_0 = 40$. Also draw the solution as a function of time.

g) Suppose that through some conservation measures, we can improve the quality of the pond and reduce the death rate of the butterflies. To which level do we have to reduce the death rate if we want the steady state butterfly population to be 100? Answer: The death rate should be %.

Draw your cobweb and solution here.

QUESTION 3. Consider the nonlinear DTDS $x_{t+1} = \frac{rx_t}{1+0.2x_t}$, where $r > 0$ is some parameter.

a) The fixed point(s) of this DTDS is (are)

(Note: the answer may contain parameter r .)

b) Now set $r = 3$. Calculate x_1, x_2, x_3 starting form $x_0 = 8$.

$x_1 =$ $x_2 =$ $x_3 =$

c) Keeping $r = 3$, calculate x_1, x_2, x_3 starting form $x_0 = 12$.

$x_1 =$ $x_2 =$ $x_3 =$

d) Do you observe a trend in these values?

Show your work here.