

Homework for Lecture 7 of Dr. Z.'s Dynamical Models in Biology class

Version of Sept. 26 (thanks to Anna Janik, who won a dollar) Email the answers (as a .pdf file) to

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by 8:00pm Monday, Sept. 29, 2025.

Subject: hw7

with an attachment hw7FirstLast.pdf

1. For each of the following non-linear (quadratic) first-order-linear recurrences

(i) Determine all steady-states

(ii) decide which of them are stable

(iii) test it empirically, by taking a number close to each steady state, using either a calculator or Maple, find its orbit of length 10 and verify that for stable steady-states, the orbit is attracted to it, but for the unstable ones it runs away.

a. $x(n+1) = \frac{5}{2} x(n) (1 - x(n))$.

b. $x(n+1) = \frac{29}{10} x(n) (1 - x(n))$.

c. $x(n+1) = \frac{31}{10} x(n) (1 - x(n))$.

2.: For each of the following non-linear (cubic) first-order-linear recurrences

(i) Verify that the given points are steady-states

(ii) decide which ones are stable

(ii) decide which of them are stable

(iii) test it empirically, by taking a number close to each steady state, using either a calculator or Maple, find its orbit of length 10 and verify that for stable steady-states, the orbit is attracted to it, but for the unstable ones it runs away.

a. $x(n+1) = \frac{1}{5} x^3 - \frac{6}{5} x^2 + \frac{16}{5} x - \frac{6}{5}$

Set of steady-states : $\{1, 2, 3\}$

b. $x(n+1) = \frac{1}{8} x^3 - \frac{5}{4} x^2 + \frac{39}{8} x - \frac{15}{4}$

Set of steady-states : $\{2, 3, 5\}$