

# Homework 3

Math 469, Spring 2024

This homework is due on Friday, Feb. 2 at 11:30 am. (Turn in your answers – via Gradescope – to questions 1–5.)

- Find the difference equation for which the general solution is  $X_t = c_1 5^t + c_2 (-2)^t$ , where  $c_1, c_2 \in \mathbb{R}$ .
  - Consider the sequence  $X_t = 5^t + 3t(5)^t$ . Determine the difference equation for which  $X_t$  is a solution, and the corresponding initial values.
- In class, we considered a second-order homogeneous linear difference equation that has a complex-conjugate pair of eigenvalues:

$$X_{t+2} - 2X_{t+1} + 2X_t = 0 . \quad (1)$$

We found two linearly independent solutions (if you missed class, compute them),  $X(1)_t$  and  $X(2)_t$ .

- Show that  $X(1)_t$  satisfies the difference equation (1) for  $t = 0, 1, 2$ .
  - (Optional – bonus problem, 2 points.) Show that  $X(1)_t$  satisfies the difference equation (1) for ALL  $t = 0, 1, 2, \dots$ .
- Section 1.8 #3, 4, 7
  - This problem pertains to the article, *Models in biology: ‘accurate descriptions of our pathetic thinking’* by Jeremy Gunawardena (BMC Biology 2014), available here: <https://doi.org/10.1186/1741-7007-12-29>
    - Read pages 1–3. What is the difference between forward and reverse modeling?
    - Read the description of one of the three models, and page 10 (especially the guidelines). For the model you picked, what is the main message of the author?
  - Pick a published mathematical biology paper (for instance, from the list on the class Piazza site).
    - State the title and authors.
    - State (in several sentences) the main scientific and/or mathematical question(s) that the paper addresses.
    - Does the paper involve forward or reverse modeling (or neither)? Explain.
    - (How well) does the paper follow the 3 guidelines Jeremy Gunawardena suggests (*Ask a question. Keep it simple. If the model cannot be falsified, it is not telling you anything.*)? Explain.