Homework for Lecture 6 of Dr. Z.'s Dynamical Models in Biology class

Email the answers (either as .pdf file or .txt file) to

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by 8:00pm Monday, Sept. 27, 2021.

Subject: hw6

with an attachment hw6FirstLast.pdf and/or hw6FirstLast.txt

Also please indicate (EITHER way) whether it is OK to post

1. In a certain population there are are only 4 age groups:

0-year-olds; 1-year-olds; 2-year-olds; 3-year-olds;

We have the following data

• The probability of survival from 0-year old to 1-year old is 0.95

• The probability of survival from 1-year old to 2-year old is 0.97

• The probability of survival from 2-year old to 3-year old is 0.9

• The fertility rate of 0-year olds is 0.1

• The fertility rate of 1-year olds is 1.2

• The fertility rate of 2-year olds is 0.9

• The fertility rate of 3-year olds is 0.1

Set up a recurrence, in human language, for $n_0(t)$, the number of 0-year-olds at time t. Also express it in our Maple notation, as a list `REC`.

Use procedure `GrowthCe` from `https://sites.math.rutgers.edu/~zeilberg/Bio21/M5.txt` to find the growth constant of the population.

2. Set up the **Leslie Matrix** for the population from the previous question. Verify that the largest eigenvalue agrees with the growth constant that you found in Problem 1.

3. In a mini-internet there are four websites, let's call them S_1, S_2, S_3, S_4.

If a random surfer is currently at a given site, his or her

- Probability of staying at site S_1 is 0.5
- Probability of staying at site S_2 is 0.4
- Probability of staying at site S_3 is 0.3
- Probability of staying at site S_4 is 0.2

We also assume that, **for each of the four sites** , the probabilities of moving to another site are the same. In other words, for example, the probability of moving from site 1 to site 2, probability of moving from site 1 to site 3, probability of moving from site 1 to site 4 are the same, and similarly for the departures from each site. (Of course, it is not possible that the probability of moving from any site to a different site are all equal to each other).

a: Set up the **transition matrix P** for this Markov chain.

b. By using the Linear Algebra package in Maple, find P^{1000}, make sure that all the rows are identical (up to the floating point approximation done by Maple). What fraction of the surfers stay in each of the above web-sites? Use this to determine the the **page-ranks** of these four web-sites in this mini-internet. In other words rank them according to "popularity".