

Introduction to Mathematical Modeling

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Age Class Model

Our goal is to build our first model allowing for different age classes within a population.

We are going to be modeling a species of bird whose population is currently in decline. We would like to be able to discuss which parameters are most important to the long term population and which age group is most important to protect.

ASSUMPTIONS

1. We will be following nesting bird pairs and all of our rates and initial populations have units of pairs of animals.

2. The oldest birds live to be 5 years old with very few exceptions, so we will only model the population up to 5 years.
3. We will have a total of six stages with the first stage being the egg followed by each of the five years of life.
4. We assume rates are constant and do not account for population movements or emigration/immigration.

The table of values for your parameters is given below

Variable	P_1	P_2	P_3	P_4	P_5	P_6
Stage Name	Egg	Baby	Young Adult	Adult	Mature Adult	Elderly
Survival Rate	.5	.7	.9	.7	.3	-
Birth Rate	0	0	0.5	1.5	1	0
Initial Population	30	20	40	40	30	15

Please do the following

1. Draw a State Diagram for this system
2. Write down the Recurrence Relations for this system
3. Write the system in Matrix Form
4. Build a computer model for the system. You can either use a spreadsheet or edit the Matlab code from last time. I would suggest trying Matlab.

After your model is built try changing some parameters in the model to test sensitivity and discuss whether there is one parameter that helps more than the others to stop the population decline. What class does that parameter belong to? Which class is most important to the survival of the population?

If you use Matlab, then you can find the eigenvalues and eigenvectors of the system. Explain what these mean in terms of the long term population.