AMATH 422/522
Problem set 3

Working together is absolutely encouraged. Please do not refer to previous years' solutions.

For each problem: together with any analysis or explanations, turn in both all code and all relevant plots, labeled and with all line styles, marker sizes etc. adjusted for readability.

Please note: E+G stands for our book, by Ellner and Guckenheimer.

I **Continuation from previous HW:**. (Taken with modifications from Ellner and Guckenheimer Ex 2.12). According to Lande (1988), females of the northern spotted owl begin breeding at age a=3 and are estimated to have an average of 0.24 female offspring until they die ($f_a = 0.24$ for $a \geq 3$). The survival probability from birth to age 3 is estimated to be 0.0722, and the annual survival probability of adults (p_a for age $a = 3$ to $a = 49$) is 0.942. In our model we will take the maximum age $A = 50$. (These values refer to age-structured conventions, so newborns are age 0).

The owl has been controversial in our region, because of the conflict of interest between the need for old-growth forests as habitat, and the interest of logging companies in harvesting those forests.

- Compute the matrix of elasticities for your projection matrix. Is the elasticity for fecundity values f_a the same for all ages a? Is the elasticity for annual survival probabilities values p_a the same for all ages a? Give an intuitive explanation for your findings in two to three sentences, and state one possible implication for management plans.

II AMATH 522 ONLY: Ellner and Guckenheimer Exercise 2.15. HOWEVER: modify the rule they state there so that can never get a negative number of individuals: $n_a(t+1) = [An(t)-h]_a$ if $[An(t)-h]_a \geq 0$ and $n_a(t+1) = 0$ otherwise, where the subscript means take the ath element. Note, you'll need to look at Ex. 2.13 to get the A matrix you need to get started.

One approach to this problem by numerical simulation of the stated dynamical rule and testing different h values — one possibility is a for loop and logical operations to automate testing of a large number of values.