

Mathematical Modeling Homework
Week 1 (Final Version)

1. In class, we discussed the Fibonacci problem where R_n represented the number of pairs of rabbits in generation n . Let N_n be the number of **newborn pairs** in generation (month) n . These were denoted by open circles on our tree in class.
 - (a) Find the biological meaning of N_0 if $N_0 = 1$ and $N_1 = 1$. (hint: In the model in class, R_0 refers to the first month the rabbits were placed in the field.)
 - (b) Find N_2, N_3, N_4, N_5 . What do you notice? Write out the model.
 - (c) Write N_2, N_3, N_4 , and N_5 as functions of N_0 and N_1 . What do you notice about the coefficients?
2. Run a search for the golden ratio in biology (ex. google). Find three examples where ϕ shows up in biological phenomena. Choose one of these examples and write a short paragraph explaining the example. Please cite your sources.
3. For the following questions, consider the growth of an aphid population. Use the model developed in class:

$$a_n = [fr(1 - m)]^n a_0.$$

- (a) If the fractional mortality of aphids is 80% and the sex ratio (ratio of females to the total number of aphids) is 50%, what minimum fecundity is required to prevent extinction?
- (b) Establish a general condition on the fecundity of aphids to guarantee population growth given a fixed survivorship and a known sex ratio.