

Mathematical Modeling Class Supplements Week 1

Fibonacci Question

Suppose a newly born pair of rabbits, one male and one female, are put in a field. Rabbits are able to mate at the age of 1 month so that at the end of its second month, a female can produce another pair of rabbits. Suppose that rabbits never die and that the female always produces one new pair (one male and one female) every month from the second month on. Note: Rabbits only mate with their 'pair'. How many pairs will there be in a year?

Insect Population

Consider the reproduction of the poplar gall aphid. Adult female aphids produce galls on the leaves of poplars. All the progeny of a single aphid are contained in one gall. Some fraction of these will emerge and survive to adulthood. Although generally the capacity for producing offspring (fecundity) and the likelihood of surviving to adulthood (survivorship) depends on their environmental conditions, on the quality of their food, and on the population sizes, let us momentarily ignore these effects and study a naive model in which all parameters are constant. When will the population of female aphids increase over successive generations and when will it decrease?

Annual Plants

Plants produce seeds at the end of their growth season (say August), after which they die. A fraction of these seeds survive the winter, and some of these germinate at the beginning of the season (say May), giving rise to the new generation of plants. Seeds cannot survive more than two winters. The fraction that germinates depends on the age of the seeds. Derive an equation for the number of plants in generation n .