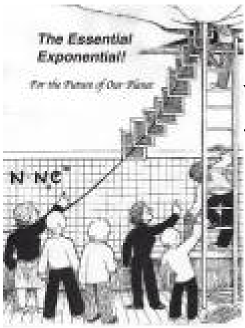
Populations

Models without density dependence

They describe the growth of a population at a constant rate. Therefore, there is no regulation associated with its growth. They are the simplest models of population dynamics, and they serve as a basis for other more complex models,

Basic discrete and continuous time models



Here you will learn about the basic models of dense-independent dynamics. You will also understand the difference between a discrete and continuous time model, and how to make the equivalence between them.

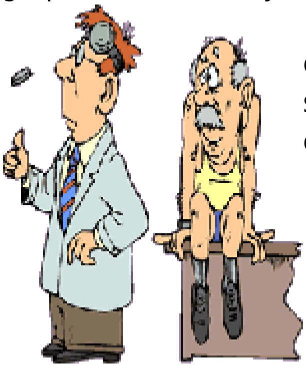
- Route Basic Models: discrete and continuous time

Environmental Stochasticity

The environment is not constant, which should affect population growth rates. Here's how the models from the previous section behave when the population growth rate changes over time. This effect is environmental stochasticity.

- Environmental Stochasticity Roadmap

Demographic Stochasticity



Vital rates are not the same for all individuals in the population. The effects of this intrapopulation variability are called demographic stochasticity. Here's the behavior of simple models that incorporate this effect.

- Stochasticity Demographic Roadmap

Density Dependent Models

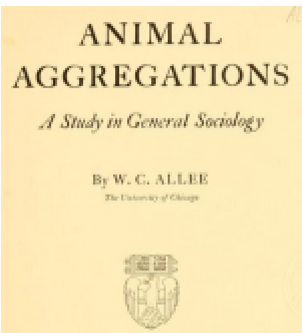
These models predict that the rate at which the population grows is influenced by the size of the population. For example, population growth may be restricted by its overcrowding and resource constraints, or the population may have its mortality rate decreased by some clustering effect. We present here two models that represent these examples.

Logistics Model

In this topic we model populations whose growth is controlled by population density. It is a simple model that predicts a reduction in population growth as population density increases, either by decreasing births or increasing the mortality rate *per capita*. Although it does not explicitly model the resource constraint, it is the mechanism that is implicitly related to the model.

- Roteiro Logistic model

Allee Effect

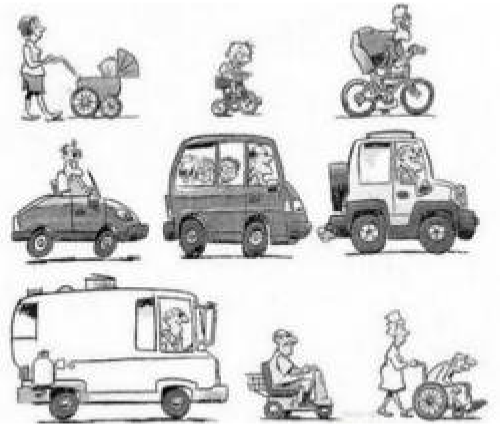


A variant of the above logistic model is to include a minimum size for the population to be viable. Below this size the population declines, and above it grows with dense dependence.

With the inclusion of the Allee effect, logistics now have more than one equilibrium point, with a sudden transition between them.

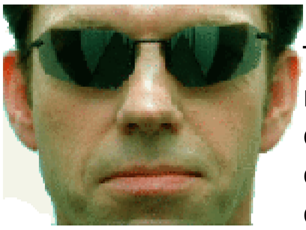
- Allee Effect

Structured populations



Models that classify individuals in a population by life stages, which can be age classes or developmental stages. Population changes due to class stay, class change, or death.

Leslie's Matrix



The growth of an age-structured population can be projected using matrix algebra. Leslie matrices contain information about the birth and death rates of different age groups in a population and are a robust way of calculating population growth and making population projections for different scenarios. A generalization of the Leslie matrix occurs when the population is classified by stages (Leftkovicth matrix), where an individual of a given class can, in addition to dying, growing and reproducing, remain in the same stage over time cycles. In this generalization, the basic vital rates (growth, survival and reproduction) are embedded in the values of the transition matrices where we compute the effect that each state (or size) class has on the others in the next time cycle. The objective of this exercise is to understand how we can treat structured populations with matrix models.

- Leslie's Matrix Screenplay

Dense Dependency in Structured Populations

A simple example of a structured population model with density-dependent growth.

- Dense-Dependency in Structured Populations

Sensitivity and Elasticity

An important tool in matrix analysis is to understand how the probabilities of transition and permanence of each class affect population growth. Knowing which vital rates are most important for population stabilization or growth is a powerful tool, both for understanding different life history strategies and for managing threatened populations or for the sustainable use of plant resources. ....

- Sensitivity and Elasticity