Study of Predator-Prey Dynamics

Vincent Edwards, Julia Corrales, and Rachel Gossard

April 13, 2025

Lotka-Volterra Model (LVM)

The Lotka-Volterra Model (LVM) models the dynamics between a predator species (y) and a prey species (x) over time (t).

$$\frac{dy}{dt} = -ay + bxy \quad \frac{dx}{dt} = +dx - cyx$$

The model depends on four parameters.
- a: decay rate of the predators
- b: proportionality for how predators grow due to eating prey
- c: proportionality for how prey decay due to being eaten by predators
- d: growth rate of the prey

Dividing the differential equations by each other yields $\frac{dy}{dx}$.

$$\frac{dy}{dx} = \frac{b}{c}\frac{y\left(x - \frac{a}{b}\right)}{x\left(\frac{d}{c} - y\right)}$$

Since this equation does not depend explicitly on time, it can be used to create phase portraits. The solutions swirl counter-clockwise around $x = \frac{a}{b}$ and $y = \frac{d}{c}$.

Types of Simulation Outcomes

Conditions for Good Modeling

Main Simulation Parameters

breed_time

energy_gain

breed_energy

Circular Initialization

Extension