Lotka-Volterra equations - Problem XI

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February 13, 2025

1 Lotka-Volterra equations

We solve the following system of ordinary differential equations

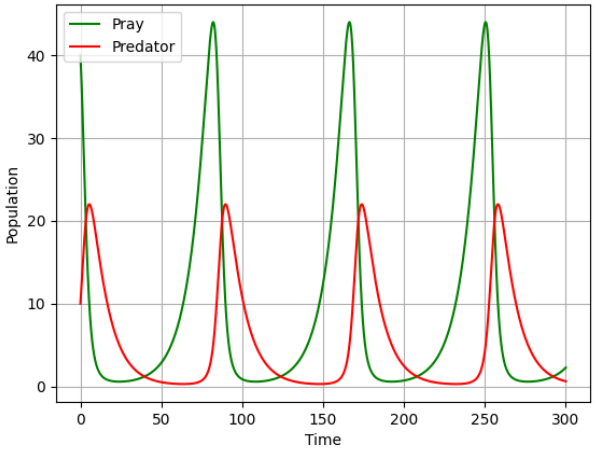
$$\frac{dx}{dt} = \alpha x - \beta xy$$
$$\frac{dy}{dt} = \delta xy - \gamma y$$

where x is the prey population, y is the predator population, α is the prey growth rate, β is the predation rate coefficient, δ is the predator reproduction rate coefficient, and γ is the predator death rate. We set $\alpha = 0.1$, $\beta = 0.02$, $\delta = 0.01$, and $\gamma = 0.1$. Initial conditions: $x(0) = 40$, $y(0) = 10$.

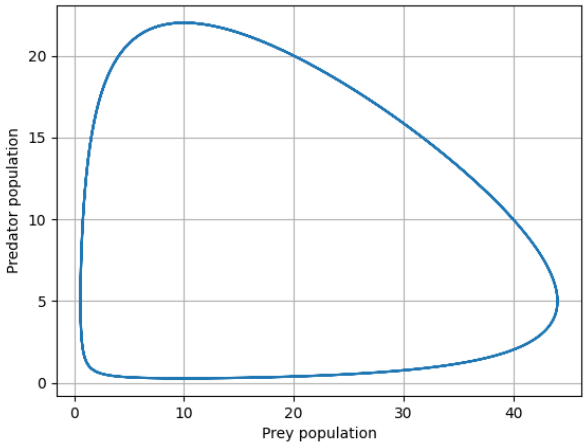
We decide to use the RK4 method to solve the system of ODEs.

1.1 Code structure

- Function
  - for the system of ODEs ("Lotka_Volterra")
  - performing one "RK4 step" in vectorial form ("rk4_step")
  - performing all the RK4 steps ("solve_Lotka_volterra")
- We set t_start=0, t_end=15, and n_points=300000 ($\delta t = 0.001$).
- We solve the system and plot $x = x(t)$ and $y = y(t)$, and the phase diagram $x(t)$ vs $y(t)$.



(a) Time evolution of x and y



(b) Phase diagram