Question 8

Predator Prey Model

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Predator-Prey Model also called Lotka–Volterra equations are used to describe the dynamics of biological systems in which two species interact, one as a predator and the other as prey. The populations change through time according to the set of differential equations:

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

Where x is the number of prey, y is the number of some predators

α, β, γ, δ are positive real parameters describing the interaction of the two species.

Solving the differential equation for different starting values of N1,N2:

N1: 0 , N2: 0

Roots: [0. 0.]

N1: 1 , N2: 1

Roots: [2. 2.]

N1: 2 , N2: 2

Roots: [2. 2.]

N1: 3 , N2: 3

Roots: [2. 2.]

N1: 4 , N2: 4

Roots: [2. 2.]

N1: 5 , N2: 5

Roots: [2. 2.]

N1: 6 , N2: 6

Roots: [2. 2.]

N1: 7 , N2: 7

Roots: [2. 2.]

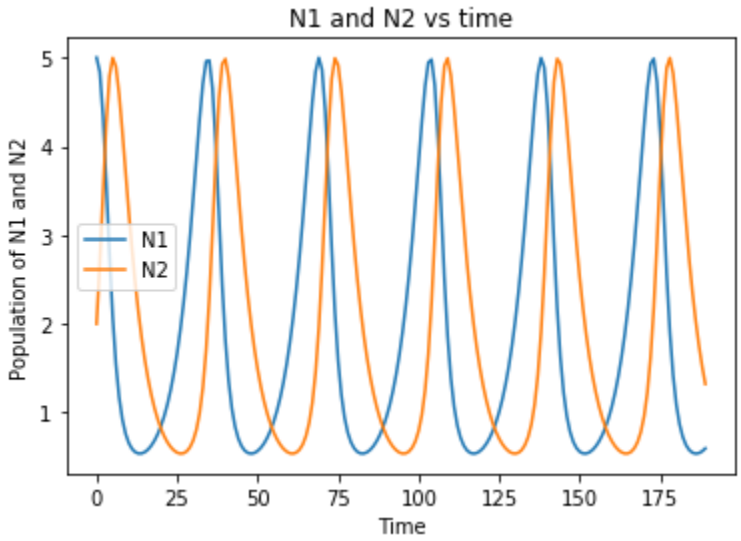
N1: 8 , N2: 8

Roots: [2. 2.]

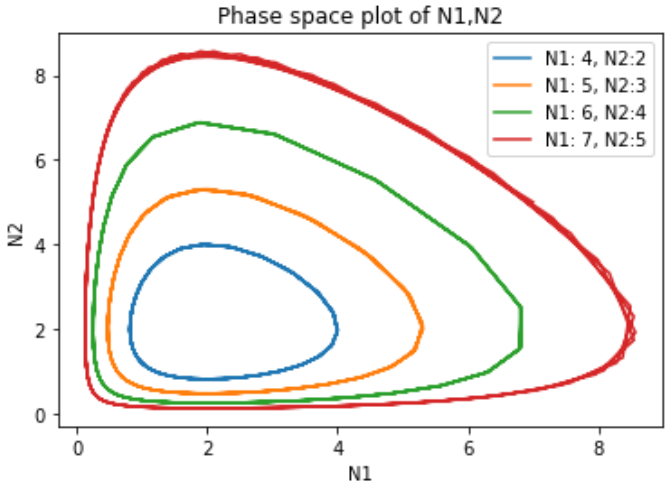
N1: 9 , N2: 9

Roots: [2. 2.]

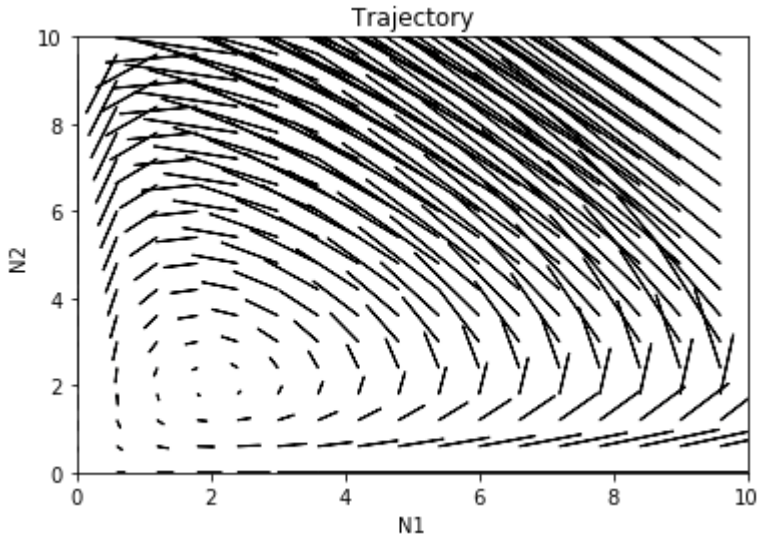
Plotting N1 and N2 against time:



Phase-space plot of N1,N2:



Trajectory:



We observe from the model that there is a cycle of growth and decay. The predators thrive when prey is high, then it reaches a peak and due to lack of prey they start decaying, due to which the prey again grows and so on.