Introduction to Theoretical Ecology Assignment 2

Exponential Population Growth with Constant Immigration

1. You are a curious student in the Introduction to Theoretical Ecology course. After the class, you decide to do a small experiment on population growth. You set up a "massive" fish tank and introduce N_0 flatworm individuals. Also, each day you add I new individuals into the tank, hoping that the population will increase faster. Assuming that the intrinsic rate of increase is r (per day) and there is no factor limiting the growth and reproduction of these flatworms, the population dynamics can be described by the following differential equation:

$$\frac{dN}{dt} = rN + I$$

The analytical solution to this differential equation is:

$$N = N_0 e^{rt} + (e^{rt} - 1)\frac{I}{r}$$

Please use what you have learned in the lecture to derive the solution for this differential equation step by step. (You can either write down the answer on a paper and embed a picture of it or directly type the equations in Word.)

2. Suppose that N_0 = 10, r = 1.2, and I = 3, how will the flatworm population change over a week? Solve the differential equation numerically and visualize the population trajectory. Please show the figure along with the R code you used to generate the results. (You can use any R graphic system you like for plotting).

3. Compare the population growth with and without constant immigration and explain the model dynamics in your own words. How does the constant immigration term I affect population dynamics? Do you think your daily addition of new flatworm individuals make a big difference?