Population ecology assignment: Population regulation

Due at noon on Fri 4 Mar

1. A population of bacteria have a constant instantaneous death rate of 0.25/day. When they are not crowded, they have an instantaneous birth rate of 0.6/day. Assume that they experience density dependence, but not Allee effects.

a. (1 point) What is the instantaneous growth rate of this population when at very low density (r_0)?

b. (1 point) What is the reproductive number of this population when at very low density ($\mathcal{R}_0$)?

c. (2 points) Use the function `bd` to plot the relationship between population size and *total* growth rate for a population like this. What is the carrying capacity (stable equilibrium) for your population? You will have to choose your own scale for density dependence, and to make sure that the equilibrium value is shown on your plot. Read the documentation at `http://bio3ss.github.io/materials/bd.export.html`

d. (2 points) Show *one* time plot for your population, starting from a low population density (relative to equilibrium), but not zero. What size does the population approach? Make your time window long enough that you can show this clearly.

e. (2 point) Rescale your last plot above by changing all necessary unit-ed values to show time in units of weeks instead of days.

2. What might happen if the population above experienced Allee effects?

a. (2 points) Show a plot of *per-capita* growth vs. population size, and also *one* time-series plot, reflecting what might happen to this population if Allee effects were operating.

b. (2 points) Explain what you assumed about the Allee effect, and what dynamics resulted.

c. Is this a strong or weak Allee effect (how does R_0 compare to 1)? Try different values of N0 (i.e. before, between, after the equilibriums).