June 17 REU Talk

Simulating antibiotic resistant bacteria populations

Recap

- The goal of our project is to simulate growing bacteria populations in order to explore population dynamics.
- We have two populations – susceptible and resistant. Each grows at its own constant rate, but the resistant population grows slightly more slowly.
- Susceptible can turn into resistant by acquiring a plasmid, called transformation.

This week

- alpha is the rate of transformation of S->R
- 3 main cases: Constant alpha, then add dependency on number of available plasmids with linear alpha, recycling alpha

Constant alpha

- Can solve exactly for the regions where R dominates using the diff. eqs
- As alpha increases, R dominates more heavily
- We can predict long term behavior with our differential equations

Linear alpha

- Most interesting case so far – most dynamic
- alpha scales linearly with amount of free plasmids compared to starting amount
- Nonmonatonic change in R/S dominance as alpha increases - peak region in contour
  - Past peak: R population grows very quickly, then runs out of plasmids

Recycled alpha

- When an R dies, it releases its plasmid back into the environment
- This tends to the same behavior as the constant alpha case, since there's an abundance of plasmids.
- Still probing parameter space for more interesting behaviors

Next steps

- Convert simulation timescales to real time scales
  - We have set birth rates for each population - we can arbitrarily map these to real, physical rates of reproduction, and set the timescale for the whole simulation.