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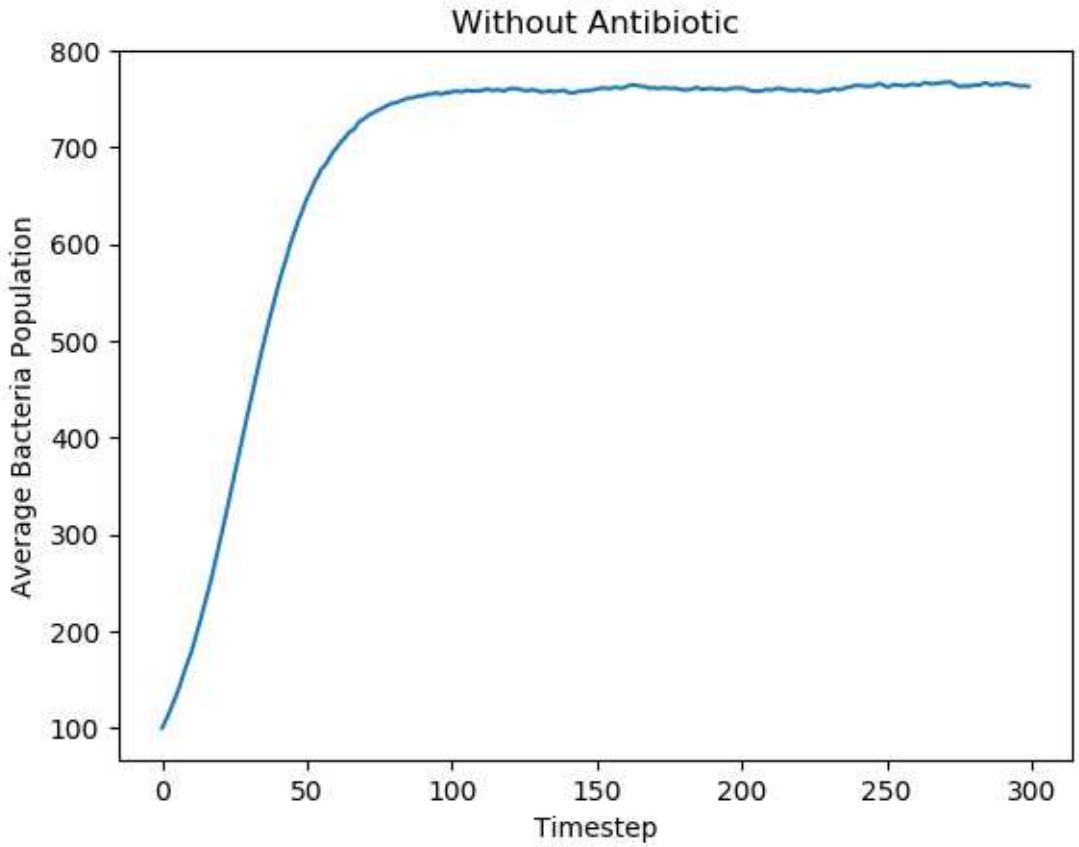
6.0002 – Problem Set 4

Problem 2:

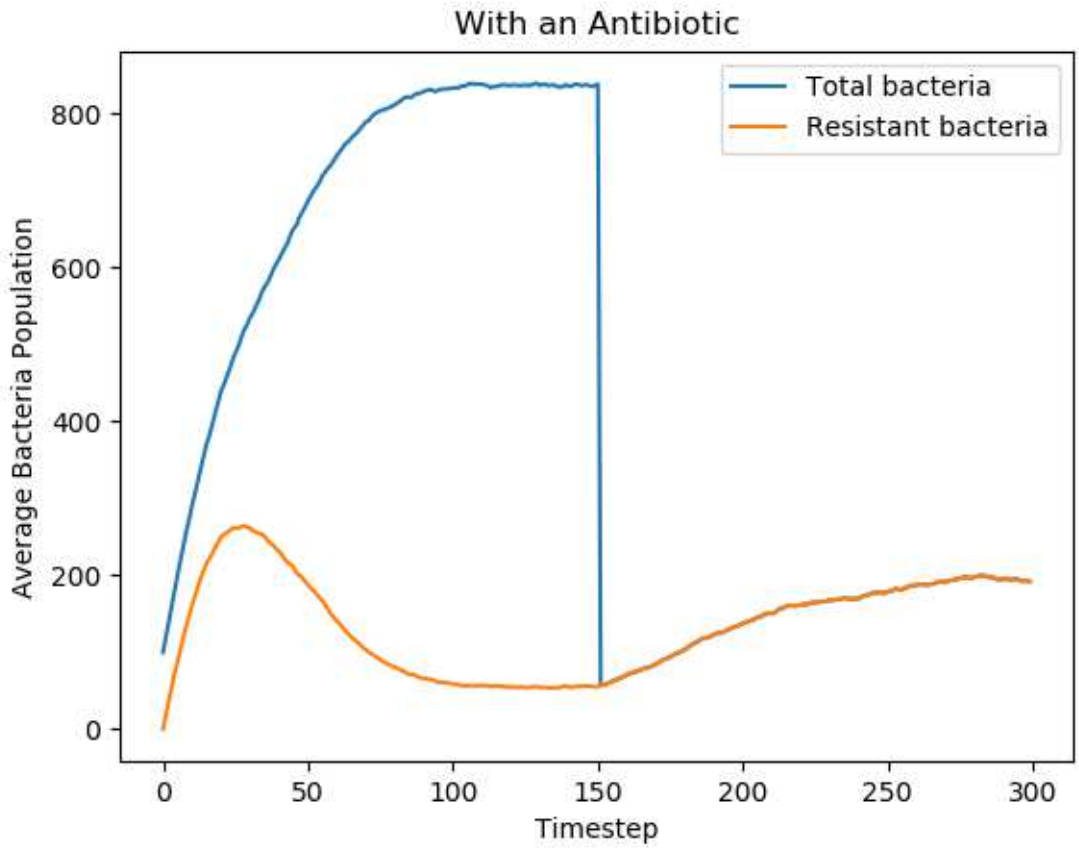


Problem 3:

The bacteria population at time step 299 is 768.58 ± 4.96, with a 95% confidence interval.

Problem 5:

Simulation A (higher birth probability):



The total bacteria population at time step 299 is 202.26 ± 8.99, with a 95% confidence interval.

The resistant bacteria population at time step 299 is 202.26 ± 8.99, with a 95% confidence interval.

They're the same because the entire population is resistant by time step 299.

1. What happens to the total population before introducing the antibiotic?

It climbs quickly to a high percentage of the maximum population allowed, and plateaus there.

2. What happens to the resistant population before introducing the antibiotic?

It steadily lowers and plateaus around 100 bacteria or so.

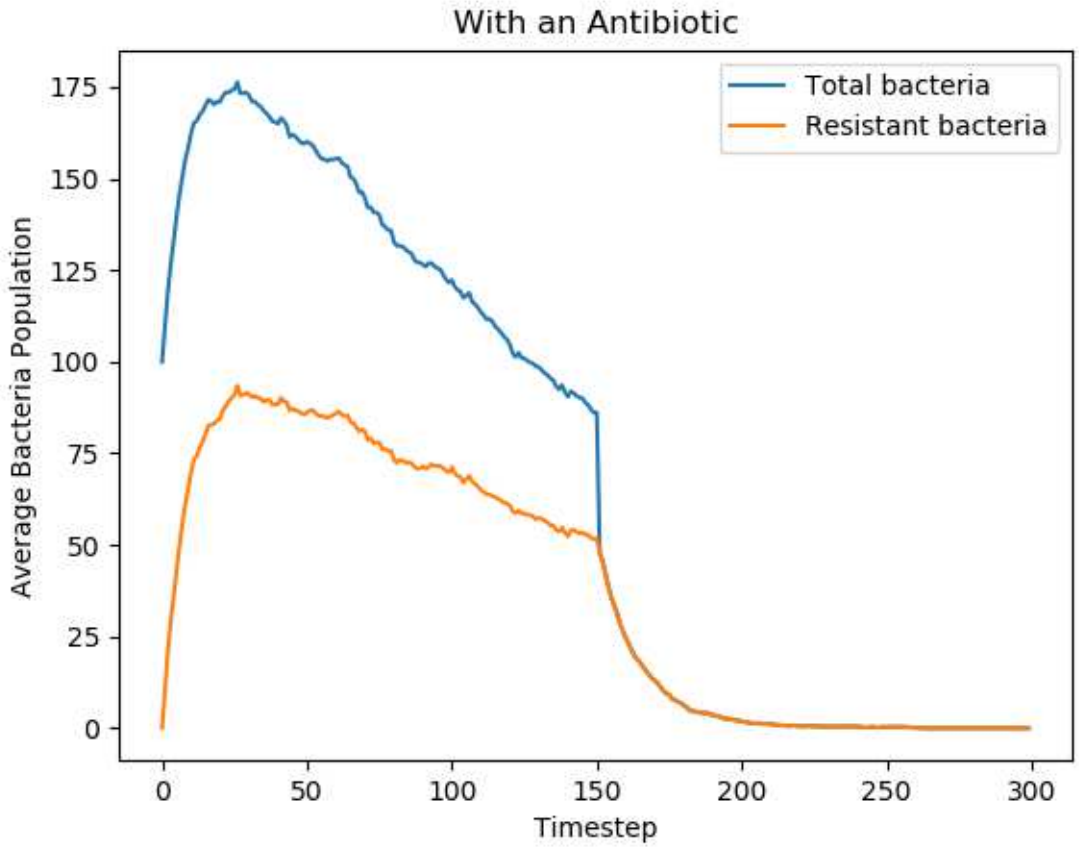
3. What happens to the total population after introducing the antibiotic?

It drops immediately to match the resistant population (that is, all non-resistant bacteria die).

4. What happens to the resistant population after introducing the antibiotic?

It starts to climb steadily as resistant bacteria only give birth to new resistant bacteria.

Simulation B (lower birth probability):



The total bacteria population at time step 299 is 0.0 ± 0.0, with a 95% confidence interval.

The resistant bacteria population at time step 299 is 0.0 ± 0.0, with a 95% confidence interval.

This time, the numbers are the same because all of the bacteria are dead.

1. What happens to the total population before introducing the antibiotic?

It climbs initially, then starts a steady decline because of the low birth rate. It never approaches the maximum allowed population.

2. What happens to the resistant population before introducing the antibiotic?

It also climbs initially, then starts a decline, but it declines more slowly than the non-resistant population because of its altered birth probabilities.

3. What happens to the total population after introducing the antibiotic?

It drops immediately to match the resistant population (that is, all non-resistant bacteria die).

4. What happens to the resistant population after introducing the antibiotic?

It drops steadily to zero, thanks to its lower birth rate.