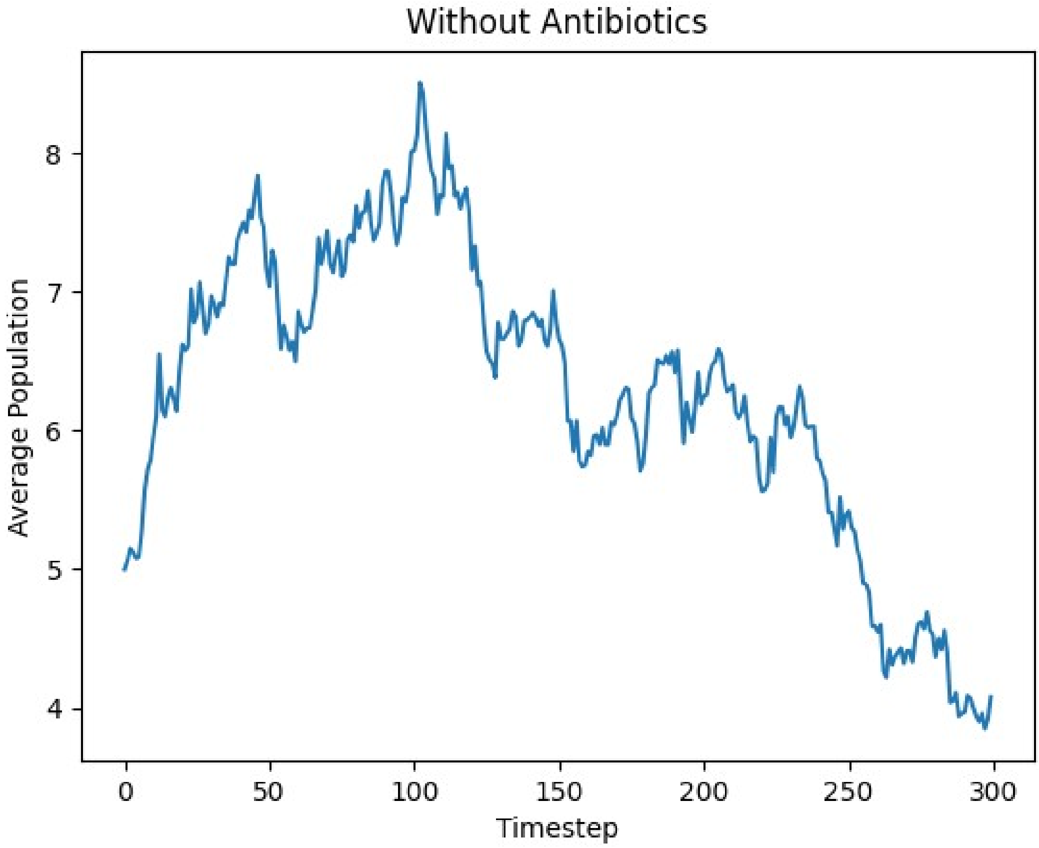
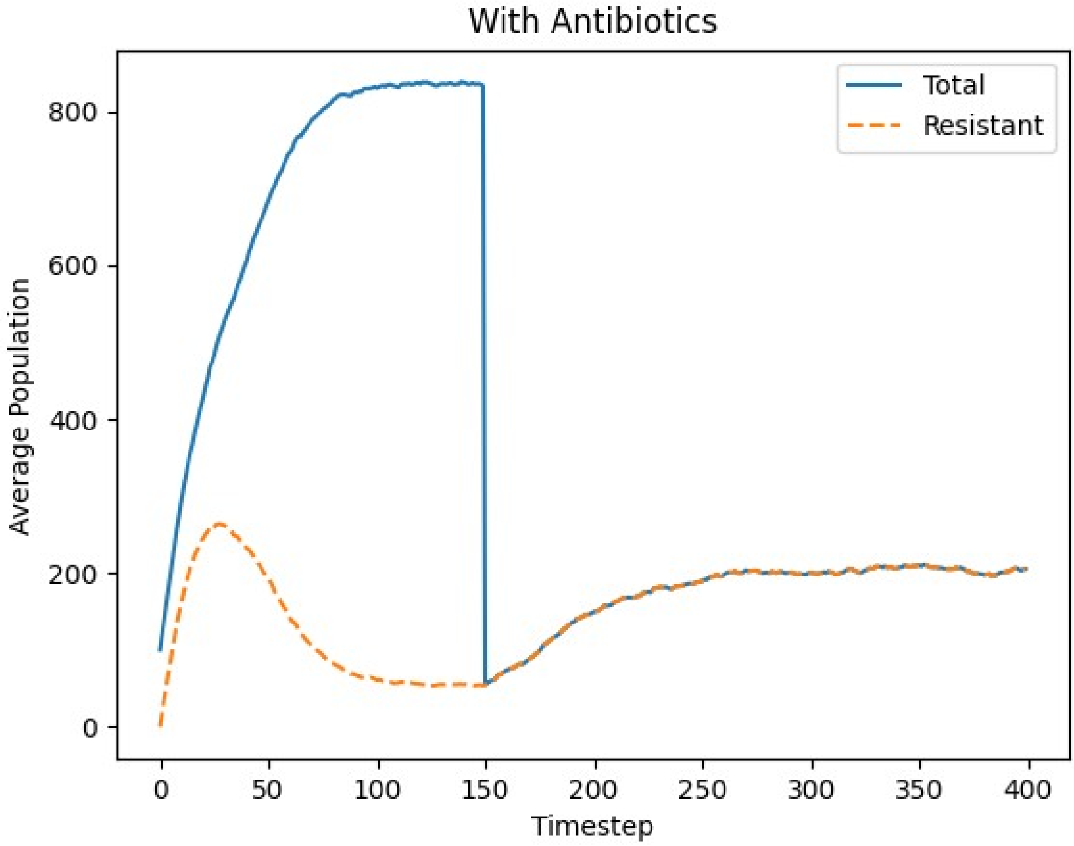
PS4

Problem 2 graph:



Problem 5 graphs:

Simulation A:



Average **Total** Population at step 299 = 200.14

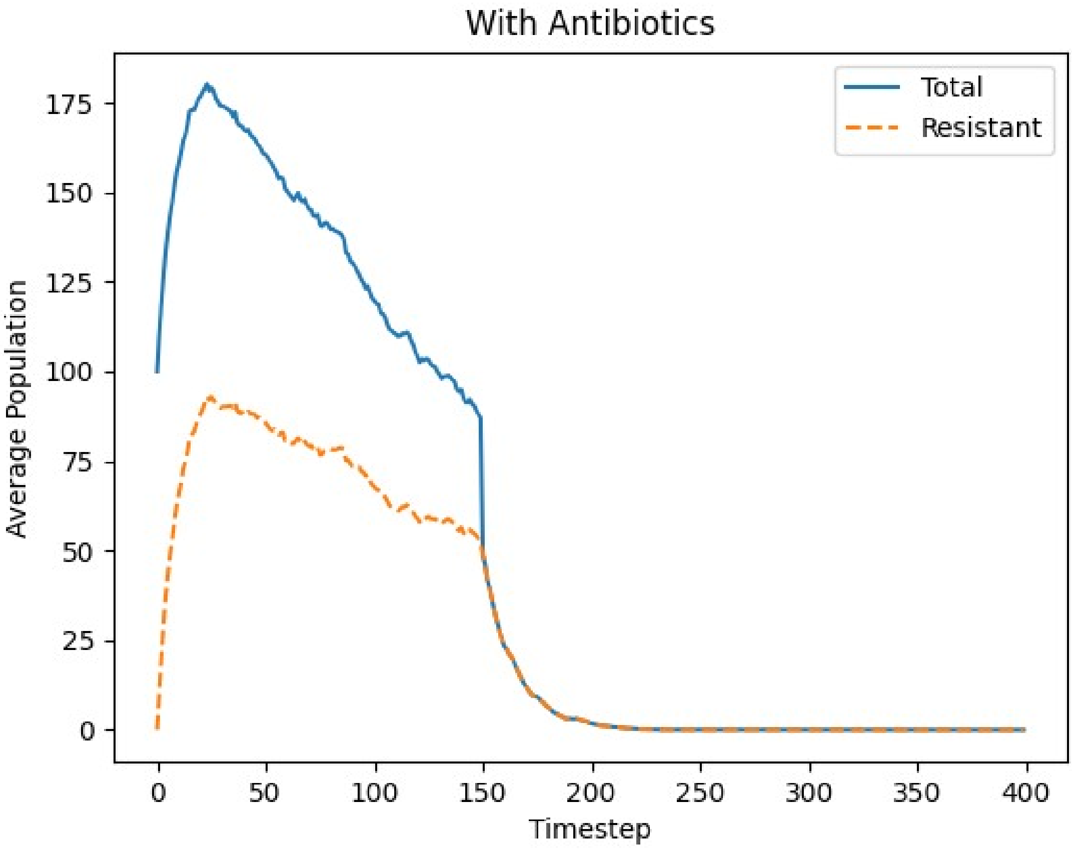
95% Confidence Level at of the average = 7.457692598438206

Average **Resistant** Population at step 299 = 200.14

95% Confidence Level at of the average = 7.457692598438206

The answers are the same quite unsurprisingly, as by definition all bacteria that are non-resistant to antibiotics die. At step 150 we started treated our patient with antibiotics, hence the 2 curves converge.

Simulation B:



Average **Total** Population at step 299 = 0.0

95% Confidence Level at of the average = 0.0

Average **Resistant** Population at step 299 = 0.0

95% Confidence Level at of the average = 0.0

The answers are the same quite unsurprisingly, as by definition all bacteria that are non-resistant to antibiotics die. At step 150 we started treated our patient with antibiotics, hence the 2 curves converge.

<u>Differences between simulation A and B</u>:

1. In both simulations the total population increase exponentially until it reaches a point where it is improbable for the colony of bacteria to keep growing due to population density.

   In simulation **A** the population rate reaches an equilibrium and stays at a somewhat constant value due to the birth-to-death ratio, which favours birth.

   In simulation **B** the population reaches a peak early and starts decreasing due to birth-to-death ratio which favours death, especially with reproduction more likely to occur in a less populated patient.

2. In both cases the resistant population reaches a peak, then start decreasing, dominated solemnly by the birth, death, and mutation probability. In simulation **B** the decrease more moderate since the change in population density is not as drastic as in simulation **A** (which changes orders of magnitudes rapidly).

3. At the point of introduction of antibiotics, a fair share of the population in both cases died right away due to vulnerability to the substance.

   In simulation **A** the drop is much more significant than simulation **B** due to the order of magnitude of the total population.

   After the drop, both scenarios reaches an equilibrium in population more or less, which reflects the birth-to-death ratio differences. Simulation **A** stabilizes on a population of around 200 subjects, rising above the population at time of introduction to antibiotic treatment, while simulation **B** stabilizes on a population of exactly 0 subjects.

4. As mentioned before, in both cases the Total and Resistant bacteria converge as the non-resistant subjects dies immediately with introduction of antibiotics, therefore the previous answer is valid here as well.