AT Computer Science Project: Simulations of Antibiotic Efficacy

Project Overview

This interdisciplinary project explores the effectiveness of various **antibiotics** and **home remedies** in preventing bacterial growth, using real experimental data from the AP Biology lab.

You, as an **AT Computer Science student**, will analyze biological data using **simulation tests** and interpret the results in context. You will also be responsible for finding appropriate ways to model the results of the simulations so they can be interpreted by others. This project brings together students from **AP Literature**, **AP Biology, and AP Statistics** to provide depth, relevance, and communication across disciplines:

👩‍🔬Context: The Biology Experiment

In the biology lab, students tested the effects of various antibiotics and one home remedy on *E. coli* bacterial growth. After plating the bacteria and applying antibiotic discs, students incubated the plates and measured zones of inhibition (the clear area around each disc where bacteria could not grow).

The biology students recorded the diameter of the inhibition zones in millimeters for each treatment. Each group applied multiple antibiotic discs to each plate, allowing for paired comparison across treatments.

📊 AP Statistics	📝 AP Literature	💻 AT Computer Science (You)
• Perform _____ to compare the effectiveness of an assigned **antibiotic**, a **home remedy**, and a **control**.	• Conduct interviews with family and community members about **home remedies** they use or trust. • Summarize the cultural, historical, and anecdotal	• Create **simulations** of bacterial growth under various treatment conditions. • Develop **interactive visualizations** of statistical and biological

● Interpret the results and explain potential **Type I** and **Type II** errors. ● Write a formal data analysis report using statistical reasoning and evidence.	significance of these remedies. ● Write the **narrative and final report**, incorporating statistical results, biological background, and community insight.	data (e.g., growth curves, comparison graphs, dynamic models). ● Present findings in a format suitable for public or classroom presentation.

Your Task as a Programmer

You will analyze the biology group's results using **simulation tests**. Your assigned data will consist of bacterial growth inhibition zone measurements for:

- One assigned **antibiotic**
- One **home remedy**
- A **control** (no treatment)

Data can be found on Classroom

Your role is to:

1. Use existing data to run additional simulations in order to reveal trends based on the combinations below. Make sure the results of simulations conform to Standard Deviation of a presumed normal distribution.
    - Your assigned **antibiotic vs. a remedy**
    - Your assigned **antibiotic vs. control**
2. Once you run the simulations to gather additional hypothetical data, find a way to properly model and display your findings.
3. Did your results reveal additional trends?:
    - Compare this to the original data, what might lend credibility or discredit your findings

Steps for the project/Submission requirements

Your final submission should include the following:

1. Simulation Runner (code with written description)

- Include the code you used to read run additional simulations creating data using the following 3 scenarios for each of the substances your group was assigned
    - Double the results, include original numbers and run just as many simulations
    - Run enough simulations so that you have 100 datapoints total including the original
    - Run 100 simulations, use the data as the guide but do not include those numbers in this set
    - Note: the calculations for standard deviation can be done ahead of time using typical tools and resources such as calculators, you do not need to write code to calculate standard deviation

- Include a description of your code approach along which discusses how you applied standard deviation calculations to your ranges

2. Data Modeling (graphs modeling various data simulations)

- Using tools such as AI or spreadsheets, model your simulations so that others can interpret the results of additional hypothetical tests
    - Ideally you should have 3 bell curve graphs one for each scenario, each would have multiple lines. Scatter plots could also be an appropriate graph type for this example.

3. Analysis (doc answering the questions below)

- What are some of the differences you noticed as you ran the three different scenarios? Did some seem more reliable than others? Why?
- Determine if there are new trends that emerge based on the simulations compared to the original experiments. Be sure to identify any strengths or weaknesses that may exist in running these simulations as a way to justify your conclusions.
- If the simulations match the original findings be sure to discuss why that might occur and whether or not it makes the findings more valid.