

The problem: The University of Texas houses an algae collection. Samples from the collection are sold to other universities for research and educational purposes. The samples from the collection are not axenic or bacteria free, but occasionally a researcher needs to have an axenic sample. The project is to analyze a procedure for making an axenic sample and determine the parameters that make the procedure efficient.

Your Task: Both algae and bacteria can reproduce indefinitely to expand their population size. One method to create an axenic sample is to draw twenty small samples of the liquid culture and place the samples in separate flasks. The samples are allowed to grow and then each sample is examined to see if there are algae present and if there is no bacteria present. If one of the samples is bacteria free, but still has algae, then the biologist has succeeded in getting an axenic culture. Note that in order for this to work the bacteria must not cling to the algae. This is the case in most situations, so we make this assumption. Now here is your problem. First based on the concentration of bacteria (b bacteria per cc) and the concentration of algae (a algae per cc) determine what sample volume of the culture one should use to maximize the probability that a sample would have at least one algae and no bacteria. Second, for what ratio $\frac{b}{a}$ is this method feasible? By that I mean, what is the maximum ratio so that the probability is greater than or equal to .95 that at least one of the 20 samples will be an axenic algae culture?

The report: In your project report you should model the situation using probability distributions, show your calculations, state carefully what assumptions you are making and why it is reasonable to make these assumptions, and provide graphs or charts if needed.