Luke Floden CSE-622 11/4/21

Rumors Simulation

GitHub Repo

Assumptions

1. Random pairs are created without replacement
    a. No one is paired with themselves unless there is an uneven amount of students
2. Unique pairs can talk multiple times
    a. Previous talking partners are not tracked.
3. If both partners have heard the rumor exactly once, they tell each other about it, incrementing both of their times heard.
4. Physical distance is not considered. Students do not have to be within proximity to pair.
5. Time = 0 at noon, the start of the rumor
6. Averaging over 1000 iterations is sufficient for finding a stable result

Software Design (GitHub Repo)

For each variation of the simulation, I used the same core simulation and tweaked the student count (100,1000,10000), target time (Q1-Q3), and target percentage (Q4, Q5). The core simulation at a high level:

1. Create N students
2. Enter simulation loop
    a. Create Pairs
        i. Shuffle the student list
        ii. split list in half
        iii. Join pairs
    b. Conversate
        i. If both students are able to spread the rumor they tell each other
        ii. Else only one tells the other
    c. Stop if target percentage is set and met
    d. Stop if target time is set and met

This core simulation is wrapped in a method that runs each variation multiple times and returns the average.

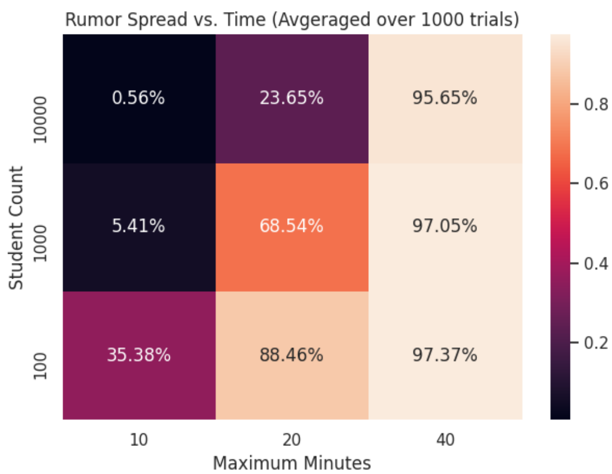
Questions

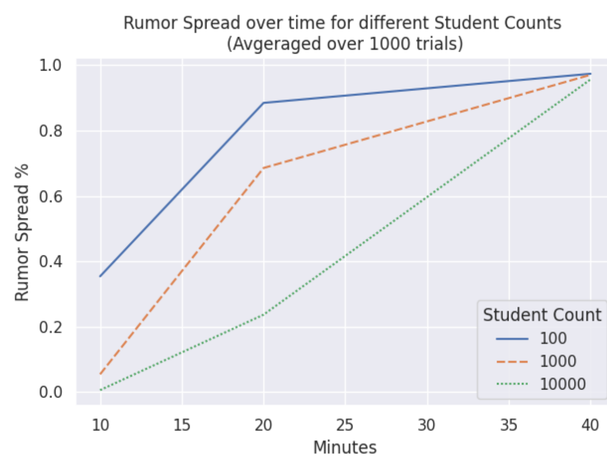
* Each question is averaged over 1000 trials

[Q1-Q3]

For N = {100, 1000, 10000}, On average, what % of the attendees will have heard the rumor after **M** minutes?

- **M** = 10 minutes?
    - **35.38%**, **5.41%**, and **0.56%** respectively for values of N
- **M** = 20 minutes?
    - **88.46%**, **68.54%**, and **23.65%** respectively for values of N
- **M** = 40 minutes?
    - **97.37%**, **97.05%**, and **95.65%** respectively for values of N

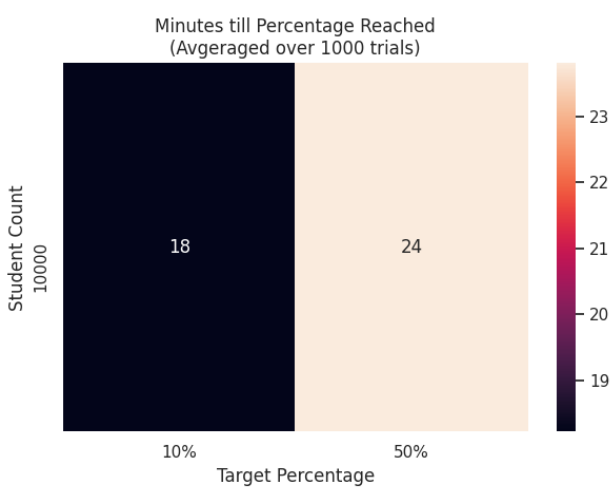


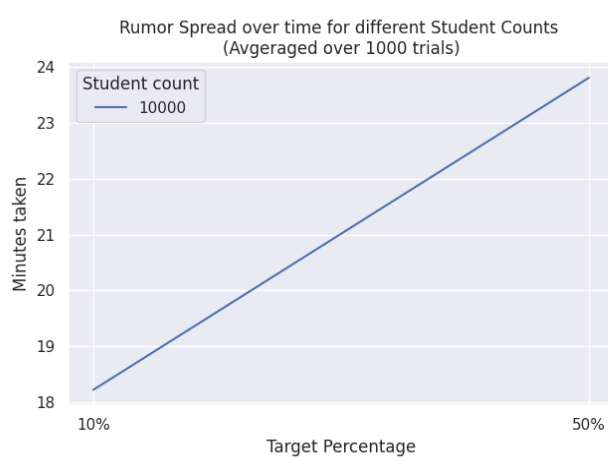


[Q4-Q5]

At what time, t, will **P**% of the party have heard the rumor? N = 10,000.

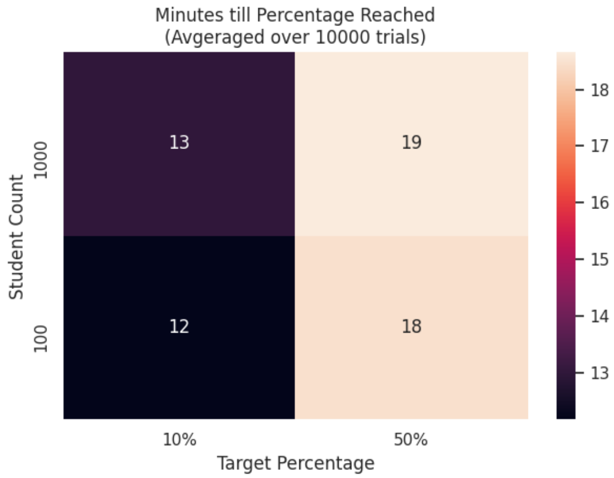
- **P** = 10%
    - **18 minutes** for N = 10,000
- **P** = 50%
    - **24 minutes** for N = 10,000

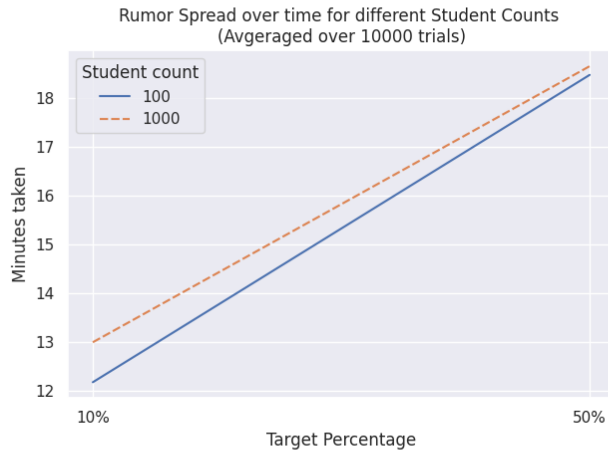




[Q4-Q5] (Extended)

I also decided to run this experiment on N = 100 and N = 1000. I decided to run these with 10,000 trials because I was seeing unstable behavior from N = 100.





Observations

From questions 1-3 I noticed that at the 40-minute mark, practically everyone had heard the rumor. This happened despite the difference in student count. In questions 4 and 5 it took 18 minutes for only 10% (1000) students to hear the rumor, but only an additional 6 minutes for 4000 more students to hear it. Because this simulation is modeling a dampened exponential growth function, this phenomenon is expected.

Relations with Infectious Disease Modeling

Rumor spreading is similar to disease infestation with a few key differences. The main one being that a rumor is more likely to stay within a smaller group of people who are concerned with it rather than spreading to all possible connections.

The 50% chance of deciding to tell the conversion partner about the rumor you have heard can be conflated with the infection rate of a disease. The random pairs simulate chance encounters within a population (trips to the grocery or restaurant). The rule of stopping the spread after being exposed to the rumor twice can be loosely compared to becoming immune to a particular disease after having it.

There is no mechanism in this simulation of rumor spreading that can be seen as a parallel to social networks. Humans do not base their social interactions on complete randomness, they form smaller communities nested within larger ones. These communities have sparse connections and this structure behaves much differently than a uniform group of individuals. However, this could be added to this rumor-spreading simulation.

Finally, vaccination has no pure comparison in rumor spreading. One could claim that if a rumor is debunked, the spreading of this correction would act as a vaccine. To an extent this is related, but believing the truth is not the same as developing antibodies. It is a choice.