

Pandemic Agent-Based Modeling in a Learning Environment

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Research Question

How effective is the intervention of splitting in-person classes in a college campus to limit student-to-student transmission?

Motivation

Several universities, including ASU, have taken initiatives to limit COVID-19 transmission on campus through classroom precautions. These actions include splitting classes into smaller sizes and transitioning to a hybrid classroom format. We study the impact & effectiveness of splitting classrooms in limiting transmission rates due to interactions in the classroom. This is accomplished by creating an agent-based model that simulates a semester in which different implementations are compared and analyzed.

Model

The Cornell University Dataset includes registration data of undergraduate students to provide student ID numbers and their respective semester schedules. Fig. 1. shows the flow chart of the created model & Fig 2. shows the network comprised of student & course agents.

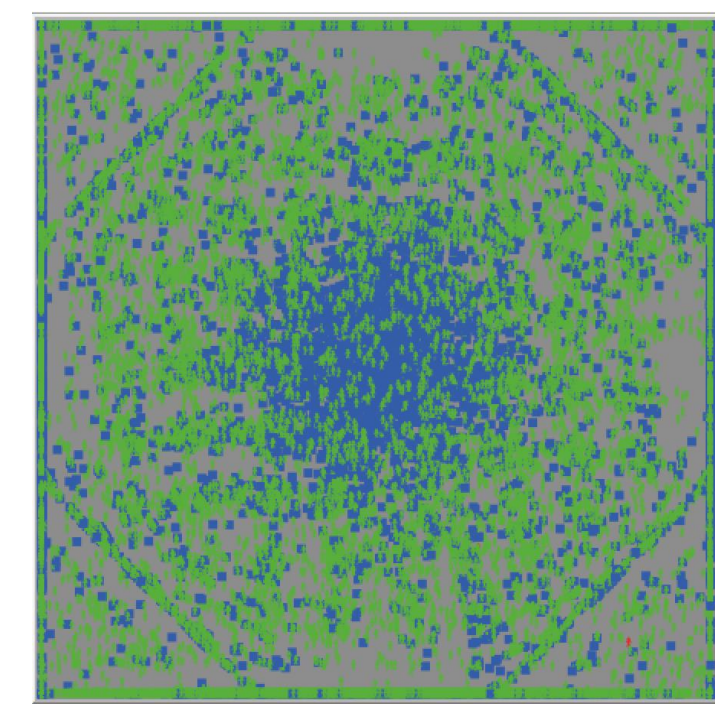


Fig. 2. Network of student and classroom agents

Results

Question: Does splitting reduce the number of cumulative infections by the end of the semester?

- Splitting classes results in reduced number of cumulative infections by the end of semester
- A lower split threshold split will result in more classes being split and reduce the cumulative number of infections

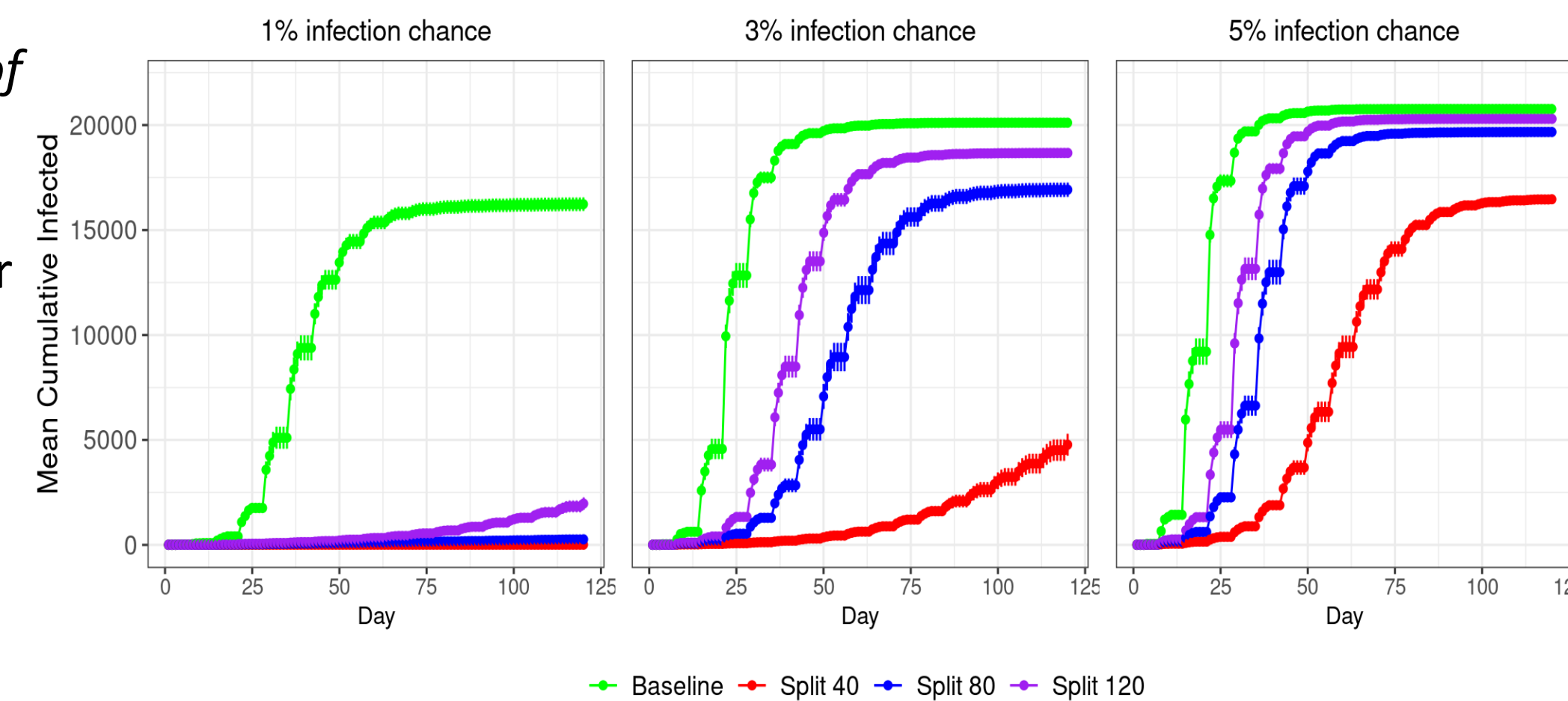


Fig. 3. Unsplit Baseline Case VS. Ordered Split with 40, 80, & 120 thresholds meet once a week

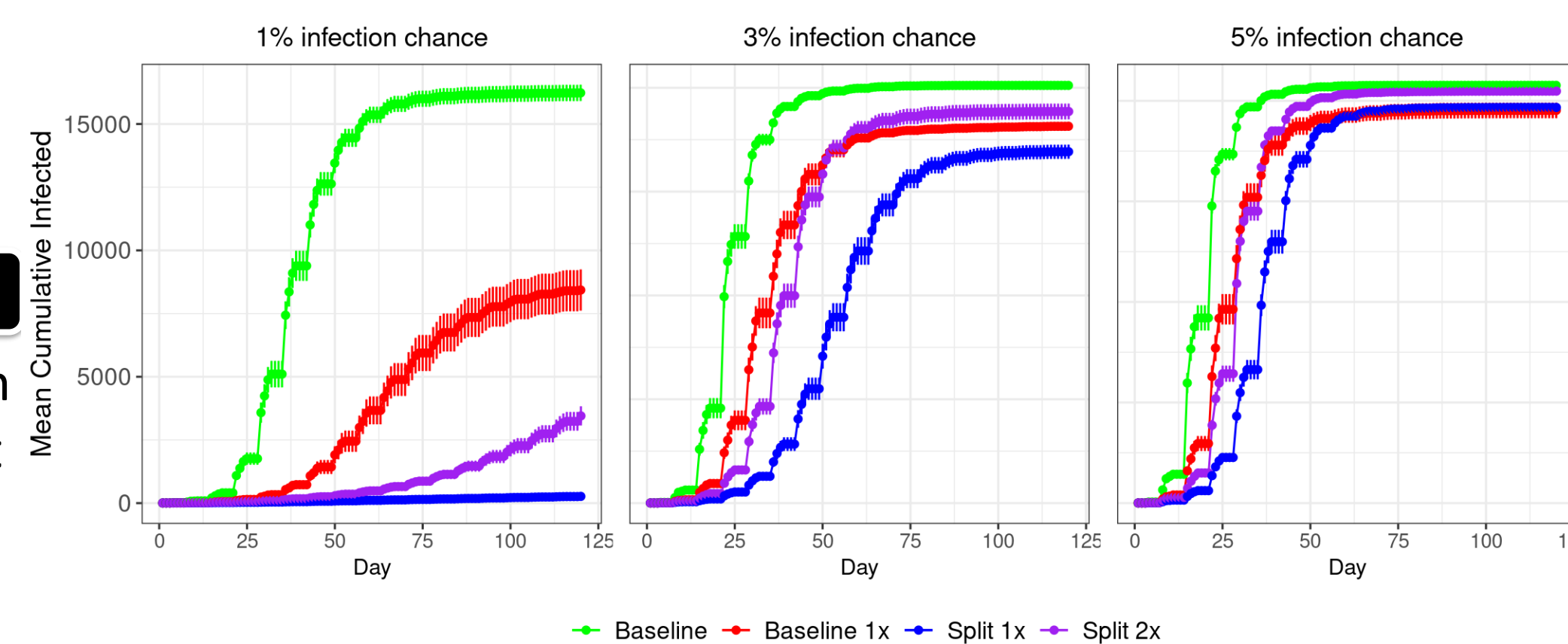


Fig. 4. Unsplit Baseline Case VS. Unsplit Meet once a week VS. Ordered Split w/ 80 threshold meet once a week VS. Ordered Split w/ 80 threshold meet twice a week

Question: Does splitting work because students interact with only half the class, or because students only go to class once a week?

- This plot compares methods of instruction
- Classes will either meet twice a week with separate sections or meet once a week in person (the other class session is online)
- We see that a large portion of the reduction in cumulative infections in splitting is due to meeting only once a week

Question: Does the type of splitting make a difference -- shuffle vs. ordered split?

- This plot compares a shuffle split which splits each class "randomly" –students separated in one class may interact due to another class
- Very negligible difference between ordered and shuffled split, indicating that the way in which classes are split does not have a big impact on effectiveness

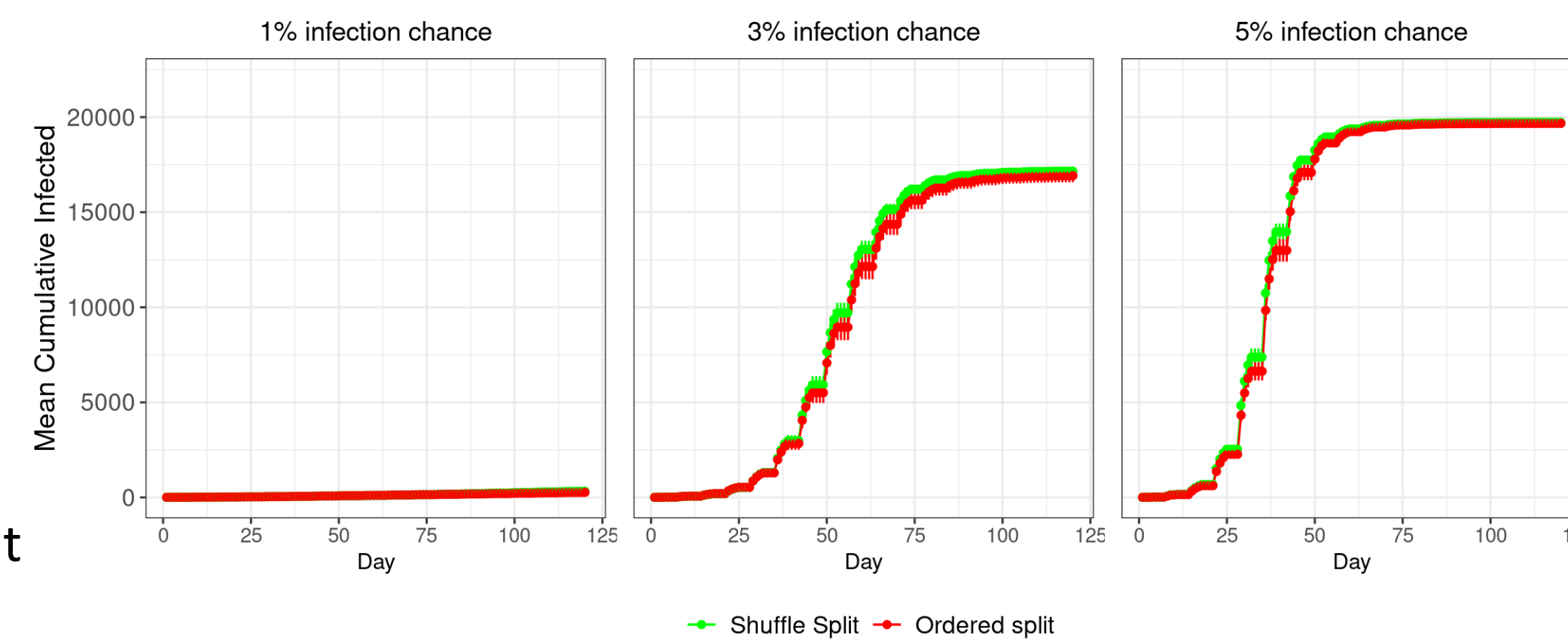


Fig. 5. Ordered Split w/ 80 threshold VS. Shuffled Split w/ 80 threshold

Assumptions

Each scenario experiment was run for a total of 120 days, simulating a standard academic semester length, in 100 parallel runs. Each experiment was run at 1%, 3%, & 5% infections probabilities resulting from a class interaction with an infected person. Fig. 3 - 5 show the mean cumulative infected number of students with a 95% confidence interval for each experiment.

Factors Considered

We test the influence of the following factors:

- **Split Threshold:** We tested values of 40, 80, and 120 as the thresholds for splitting. For example, under split threshold 80, a class of 125 students will be split into two sections of 63 and 62. Only classes that are over the split threshold will be affected
- **Number of interactions per week:** Students interacting with half of class. Whole or split classes meeting once or twice a week
- **Type of splitting:**
 - Ordered Split: Students are split by their ID No.
 - Shuffled Split: Students are randomly split

Future Work

For future work, we would like to study the impact of

- externally introduced infections
- school-wide random testing programs
- vaccinated agents

In addition, we will explore the effectiveness of holding longer lectures once a week and reducing the semester length, etc.

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