Online Simulation Guide: Simulating the Spread of a Common Cold

Class/Professor:	
Student Roles (for groups of 3-5): Simulator 1	Recorder 1
Simulator 2	Recorder 2 (unless a group of 3)
	Recorder 3 (if a group of 5)

Idea Behind the Simulation

This simulation is meant to introduce the idea of a differential equation model and investigate the impact of heightened hygiene and decreased interactions on the spread of an infectious disease. The focus of this simulation is on the common cold, a recurring, but mild, disease. The analysis and conclusions, however, can be extended to other more serious infectious diseases.

The simulation begins with a certain number of residents on a floor of a residence hall who have the common cold (start with $x_0=1$ out of a total of N residents) and have left traces of the virus at various places in the residence hall. In this simulation, dots randomly placed onto a printed floor plan represent the virus spreading to rooms where residents may reside who are susceptible to the cold virus. Those that come in sufficient contact with the virus become infected and leave more traces of the virus to be spread throughout the dorm floor.

Guiding questions:

How does the number of residents infected, x(t), vary with time? How effective are measures that can be put in place to slow/stop the spread of the cold virus? How does your analysis for the common cold inform our preparation for more serious diseases?

Set-Up Instructions in Zoom (or other conference call software):

- Join a breakout session for your group (or start your own meeting). **Recorder 1** opens this Guide to the last page and shares their screen. While the simulator is getting set up, choose a room number at random for each floor to be the initial infected room in that floor.
- Each **Simulator** chooses a floor to manage and counts out the number of habitable rooms (you decide which are inhabited) and give this N value to the **Recorder**. You will "randomly" mark on the floorplan to represent where the infected individuals visit. Talk with your groupmates about a good plan to ensure consistent randomness (such as closing your eyes to mark, marking every five or so from a random start, etc.).
- Each **Recorder** accesses the shared class spreadsheet (see link posted by your instructor) and creates their group tab by making a copy of the template tab (e.g. "Group 3b" for the second run done by Group 3). Go to the first entry of the "Data: Infected" line and type in "1" for the initial infected, in the column where Time (rounds) is 0. In "Total" row type in the value of N=___ (see your Simulator). Looking back at your spreadsheet, you should notice some of the fields, such as "Data: Susceptible" are automatically filling in. Do not overwrite their values.

Simulation on shared screen in Zoom

- 1. Each Simulator randomly puts a check mark for each X mark on their floor to simulate a place an infected individual visited and left sufficient traces of the virus.
- 2. Each Recorder then determines if the visit results in an infected room and which room becomes infected according to the chosen Scenario below. Then they put an X mark on each newly infected room and records the total (x) and the change (Δx) in the spreadsheet.
- 3. Repeat steps 1-2 until there are no more susceptible rooms left or you reach 14 rounds.

Scenarios: For each run, choose a different scenario (starting with Normal for the first run). See your professor for how many scenarios are required.

Normal (Control) Scenario: Anytime an infected individual visits a shared space (hallway, bathroom, stairs, elevator, etc), infect a susceptible room (chosen at random). This is a person getting infected by visiting this shared space. Also, whenever an infected room is visited, nothing happens.

- A) Surface Sterilization Response: Anytime an infected individual visits a shared space, no additional rooms are infected.
- **B) Reduced Exposure Response** (mobility is halved): Similar to Normal but only half (rounded up) of the infected rooms (X's) make visits.
- C) Both A and B: Shared spaces are safe from infection and only half (rounded up) of the infected rooms (X's) make visits.



