TOPIC 1: INFECTIOUS DISEASES

Reproduce the simulations of how infectious diseases spread from this Washington Post article about the coronavirus. I'm sure you've heard and read a lot about how infectious disease experts and epidemiologists have tried to understand this new virus, including:

- How easily it spreads from person to person. In other words: if a healthy person comes into contact with an infection person, what is the probability they will contract the virus?
    - Relatedly, the issue of "super spreaders." The dots in the simulation all have the same cross section (and, therefore, the same probability of interacting with another dot). Perhaps super spreaders can be simulated with larger cross sections.
- The time period over which infected people are contagious (and whether or not a survivor can be re-infected at a later time)
- Show how social distancing ("locking" a portion of the population in place) and restricting large-scale travel leads to "flattening the curve."
- The mortality rate (the fraction of infected individuals who die of the disease)

Replicate the simulations from the Washington Post article, and then modify it to study any (or all) of the points above. To do this, you need to create a "box," and fill it with "people" that move and bounce off the walls and each other. This is very much an analogy to the classic thermodynamics system, where gas particles move about in a box, bouncing off each other and the walls, and it's easy to find examples of how to code this up through a Google search. I suggest you find one of these examples and then modify it for the infectious disease application.

Note: while this subject has been at the forefront of our awareness since the beginning of the year due to the pandemic, this is very much a crash course in what some epidemiologists do for *any* kind of infectious disease (from world-changing pandemics to the common cold).

WHAT TO TURN IN:

- Your final report should include:
    - A thorough introduction to the subject, with references to published literature and/or recent studies or news articles to orient the reader to your topic.
    - A description of your simulation(s), including (but not necessarily limited to): what numerical method(s) or algorithm(s) you used, any assumptions or initial conditions, and what parameters were left to "tune" to measure different outcomes
    - A clear summary or outline of the questions you will investigate and discuss in your report
    - A detailed analysis of the results of your simulation (the answers to the questions you posed earlier)
    - As many figures and tables as necessary to support your conclusions. All graphs and tables should be properly labeled and described in the text. Do not take screen shots of tabular output from your code and paste it into your final report – you wouldn't get away with that in a reputable academic journal, and you won't get away with it here.
    - A portion of your grade *will* be based on correct writing style: grammar, punctuation, and word usage matter!
    - You must provide a references/works cited list. I am not picky about the format here, but there needs to be enough information so that I could track down the reference if I wanted to: author(s) names, year of publication, name of journal, volume/page number/link to webpage

  - Although there is no strict minimum or maximum length for your report, it is *almost* certainly going to be longer than the midterm (likely 10-15 pages, including relevant figures, tables, equations, references, etc.)
  - Use 12-point font (something fairly standard like Times New Roman, Arial, Calibri, etc.), 1-inch margins on all sides, single line spacing.
  - Reports should be in Word, LaTeX, etc., and submitted in PDF format. You may use either one- or two-column format.
- One or more Jupyter notebooks showing how you generated plots, performed calculations, etc.

Compile *all* files into a single folder and compress it into a .zip format. Please upload **ONE .zip FILE TO BLACKBOARD**. I am not picky about the naming convention of this file, but it should be something obvious that includes your name and the final project you selected. For example, if I selected this topic for my final, I might name my file: **BBinder_Final1.zip**.

Final projects are due **DECEMBER 8 by 1pm**. Late work *will* be penalized by -10% per calendar day late, and no final projects will be accepted after 5pm on December 11.