HW2

Pandemic Model: In this homework, you will continue to work with your lab partner from Lab 7.2 (Second lab on Thursday 1/28) to create a simple model[1] of pandemic spread. The NetLogo model should have a complete Info section (at the Info tab) with categories including Your names as well as "What Is It", "How It Works", "How To Use It". "Things To Notice", "Things to Try", and "Credits and References".

The homework is due in the course dropbox by 5pm (EST) on Tuesday February 2, with the name **HW2-YourLastNames.nlogo**.

Begin by completing the model described in the Lab 7.2 handout. Note that the lab handout specifies some aspects of the model, but it does not specify all decisions that will need to be made to complete the model. Some additional questions or considerations for design include:

- *If a person is infected, how long do they remain infected before either recovery or mortality?* Rather than a constant, this length of time might best be represented over a probabilistic distribution such as a normal distribution. Discuss this with your partner and justify or explain your coding decision.
- *When and how should the simulation introduce infected individuals into the population?* One possibility is create a button that inserts an infected person into the system. Another is to allow a slider specifying the number of initially infected persons. Another is to introduce infected persons into the population at each time step with some given probability.
- *What sort of output would help visualize the pandemic in the community?* (Number of mortalities is important. What other statistics, monitors, or plots are valuable? How might you also represent number or percentages of current infections? Infections over time? Rate of infections?)
- *Are there any efforts at social distancing?* What percentage of the population practices it?

Once the basic model form 7.2 is working and you have tested it, do some additional research about pandemic science.[2] Incorporate at least one theory or value into your model to modify the assumptions made above or justify your approach to the parts below. Be sure

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[1] Although this model follows some basic principles of modeling a pandemic, the specific values are intended for the purposes of teaching programming. As one possible term project, this model could be researched further, extended, and made more realistic. This 2009 NIH research paper describes an agent-based model for disease spread: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2729742/. This more recent (October 2020) paper in Nature describes an agent-based model specifically for the SARS-CoV-2 epidemic in France: https://www.nature.com/articles/s41591-020-1001-6.

[2] Read two or three well-researched articles that can provide values for various variables or problems, or other important theories that can provide a framework for modeling decisions. These might include effectiveness of masks at reducing transition, mortality rates under different conditions, effectiveness of vaccines, vaccination rates, demographic information such as age and the impact on susceptibility, availability of health care resources, etc. There are numerous such articles readily available.

to explain those choices in the Info section, and include the sources in the "Credits and References" section.

After doing your reading, add one of the following features to extend and improve the model. (Bonus points will be awarded if you add two or more of the following features). Be sure to indicate which you have added.

1. The mortality rates of covid-19 are not constant across all conditions and may be impacted by treatment. Modify the mortality rate (probability of mortality) so that it is not constant, but varies depending on the proportion of the population currently infected (or some other combination of factors). In particular, if a high enough percentage of the population becomes infected and symptomatic, the mortality rate will rise to reflect pressure on medical care facilities. Does flattening the curve matter?
2. Add vaccination to the model. *At what rate are uninfected persons vaccinated? What is the effectiveness of the vaccine?* Experiment with different assumptions about vaccination rates. This might be combined with demographic information about vulnerability of different categories of individuals.
3. The simple demo model form Lab 7.2 has no "environment"; agents move randomly except for the case of uninfected agents avoiding symptomatic persons (and even then the movement is still partly random). Extend the model by adding a more explicit spatial model and movement of persons based on spatial aspects. For example:
    a. The scale could be local such as a town or campus with areas of congregating (grocery stores, bars, churches, classrooms). Transmission rates would be very low outdoors, but higher in indoor spaces. Experiment with different policies such as mask regulations, maximum capacities of buildings, or business closures.
    b. The scale could be a regional or national scale (states or countries) with controlled travel between regions. Experiment with different travel regulations or vaccination regulations.
4. Incorporate into the model other policies or regulations that have been proposed or enacted. Be sure to explain or justify the choices.