COMP90083 Computation Modelling & Simulation
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Assignment 2

Proposal

Group 19

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Research question: How effective is increasing stagger recess times between lectures within the classroom in reducing the contact rate on campus.

Summary

Influenza and seasonal infectious diseases can have serious negative effects on health and the economy. This year for example, Covid-19 outbreaks all over the world and result in public places closing. However, shutting down all the public places is not a sustainable approach. Public services such as schools are in a socially dense environment, and school-based outbreaks usually precede and promote the spread of seasonal and pandemic influenza throughout the community. An important way to protect students from virus spreading is to reduce contacts through non-pharmaceutical intervention strategies. Thus, this project is to find out how effective is increasing stagger recess times between lectures within the classroom in reducing contact rate on campus.

Although closures of schools can effectively reduce the spread of influenza, they are destructive and are currently only recommended for pandemics. Therefore, lessening the impact of pandemics via public health interventions is critical. Assessing the feasibility of implementing other social distancing practices in K-12 schools as a first step in seeking an alternative to pre-emptive school closures[1]. After conducted 36 focus groups with education and public health officials across the United States, they found out that due to the limited daily implementation and the use of personalized timetables in primary schools, it is generally believed that in-school practices in primary schools are more feasible than in secondary schools and shortening the school week and the school day was considered the most feasible.

Wearing a mask, increasing hand washing frequency and class suspension is the first line of defence against such threats because it can be implemented quickly. These types of interventions are designed to reduce the number of effective contacts between individuals in the community[2]. Using an individual-based computer simulation model to track the connection between school children in the stereotyped school environment, they demonstrated how school-based alternative disease interventions have the potential to be as effective as traditional school suspensions without causing a corresponding labour force and economic impact[3].

1. Purpose and patterns

The model aims to explore issues related to epidemic control methods, such as Covid-19 in a Semi-closed environment like campus. Specifically, will increasing stagger start and dismissal times between lectures within the same classroom reduce contact between people when everyone is back on campus? The model draws on the theory of the human-to-human transmission of the virus. The parameters of the model do not represent a specific disease or a specific school. Therefore, it is only a hypothesis and simulation of a conventional epidemic disease. Specific parameters do not represent actual life results.

2. Entities, state variables, and scales

The model has two kinds of entities: person and square patches of land. The patches make up a square grid landscape of 100 by 100 patches. Persons are characterized by their location, described as the patch they are on. Persons' locations are in discrete units, the x and y coordinates of the centre of their patch. Patch size and the length of one-time step in the simulation are not specified because the model is generic, but when real landscapes are used, a patch corresponds to 1m by 1m which is the usual seat size of a classroom in a campus. In the model, the unit of time is 10 seconds. The simulation process will be iterated 2880 times, representing 8 hours of a classroom.

3. Process overview and scheduling

There is only one process in the model, movement of the persons. On each time step, each person moves once. People who are having a lecturer in the classroom don't allow to move. They stay in the seats until the end of class.

4. Design Concept

The number of contacts is expected to change and vary in an unpredictable way based on the length of stagger time, the total number of agents and the distance between each spot (seat). For the current class agents, once an agent enters the room, it picks an available spot within the room and changes its state to stationary and faces north. After a certain tick, agents within the room set stationary to false and leave one after another. For the next class agents, they can only enter the room within the range of stagger time, the rest of the process is the same as the current class agents. Agents try to increase their distance between each other as long as possible to reduce the average contact rate per agent.

Every agent is aware of how many other agents are within their pre-defined radius. When they move, they tend to reduce the number of agents within radius as much as possible. We can set the length of a lecture, thus, after the lecture ends, agents in the room will move out and agents outside the room will start moving in. Agent's movement might be affected by other agents around it as it tries to stay away from the crowd as far as possible. It is assumed that the spot each agent takes in the classroom is random. Also, the time each agent in the second class decides to enter the classroom is random.

There are two groups in Covid-19 Campus ABM, which are Class A and Class B respectively. The primary goal for this model is to explore the best strategy to avoid contact within the university campus, therefore, contact rate is collected for testing and understanding.

5. Initialization

At time t = 0, we can set the total number of agents in Class A as 100, Class B as 100, the range of stagger time as 30 ticks and the distance between each spot as 1 patch in the classroom, and the length of a lecture as 360 ticks.

6. Input data

The environment is assumed to be constant, so the model has no input data.

7. Submodels

There are two submodels in the experiment. First submodel is Baseline, which is defined as no restriction applied to any behaviour of the agents and they can enter the classroom any time after the previous lecture ends and do not follow social distancing. Second submodel is Distance and Schedule Restriction where agents have to remain a certain distance between each other and follow a strict schedule between lectures.

Reference

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2. Halder N, Kelso JK, Milne GJ. Analysis of the effectiveness of interventions used during the 2009 A/H1N1 inuenza pandemic. BMC Public Health. 2010;10 [PMC free article] [PubMed] [Google Scholar]

3.Ridenhour BJ, Braun A, Teyrasse T, Goldsman D. Controlling the spread of disease in schools. PLoS One. 2011;6(12):e29640. doi:10.1371/journal.pone.0029640