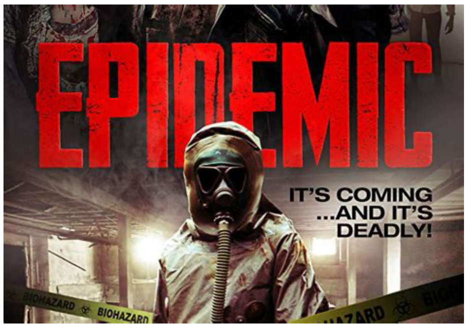
USTH 2024 – Project 5
Flu Virus



How can local isolation reduce the diffusion of an epidemics?

Influenza, commonly known as "flu", is an infectious disease caused by *influenza viruses*. The symptoms begin from one to four days after exposure to the virus (typically two days) and last for about 2–8 days. Here we consider that the disease is not fatal: after a symptomatic period, the patient recovers.

In flu epidemics, healthy people (also called *Susceptibles*) may become sick (*Infected*) when they meet other people already carrying the disease. In turn, they contribute to spreading the disease when they meet other people. The probability to become infected when in contact with an infected person is 33%. The recovery rate can be a fixed infectious period of 10 days or a probability of 10% to recover each day. After this period, a sick person recovers.

The aim of this project is to propose a model to represent the spread of a disease in a city (using GIS data of buildings and roads). In the morning, inhabitants go to work: they move from their home to their workplace (chosen randomly among the buildings) before returning home in the evening. We consider that local authorities can test people (1% of the population every day). When a person tested is infected, he or she is isolated at home for 12 days.

For building and road data, you can use the shapefiles used in previous exercises, or download new data as discussed in class.

Extension 1: add the notion of family. Each building houses a family of 3 to 6 people (0-2 children). The city's largest building is a school, where children spend their day.

Extension 2: Add the notion of vaccination: every day, the authorities can vaccinate 0.05% of the population (unvaccinated people only). Once vaccinated, a person's probability of contagion is divided by 3.

Extension 3: Add the notion of a variant: every day, a virus has a probability of 0.1% to mutate and give rise to a new variant, which has a probability of infection *Pi* different from its "parent"' one *Pj* (*Pi* = *Pj* * random float between 0.5 and 1.5). A vaccine is 2 times less effective against a new variant. The authorities can change the vaccine to be administered, considering the number of patients affected by each variant. Someone who has recovered from a variant can be infected by a new variant.

Extension 4: Create a batch simulation where you analyze the impact of the percentage of vaccinated people on the spread (is vaccinating 10% of the population useful? 50%? 90%?).