Meeting Record for meeting with Chris Jewell 2015/6/25

Jiaming Shen

1 page 1

We discussed a parameter to measure the current infected people called R_t The definition is

$$R_t = \frac{\beta S_t}{\gamma} \tag{1}$$

$$\tag{2}$$

For the model we have, the changing rate of suspected people and infected people can express as follows

$$\frac{dS}{dt} = -\frac{\beta SI}{N} = -\beta S^* I^* \tag{3}$$

$$\frac{dI}{dt} = \beta SI - \gamma I \tag{4}$$

Look at the change rate of infected people, The increase part is about suspected infected and decreasing part is infected people get removed. So the ratio between increasing part and decreasing part is R_t For average, then we can get

$$R = \frac{\beta I \frac{S}{N}}{\gamma \frac{I}{N}} \tag{5}$$

In a situation completely susceptible population$\rightarrow$ I small enough? and S big enough? how R becomes to R_0

$$R_0 = \frac{\beta}{\gamma} \tag{6}$$

Thinking: this R_0 related to $R_t = \frac{\beta S_t}{\gamma}$ when S_t equals to 1??!! The comment for this is "The average number of new infectious an infected individual creates in a completely susceptible population" From the comments, the divided by N is to an infected individual to infect others rather than all infected.

1.1 Reminder of model

Figure 1: Model showing

2 Page2

2.1 Some probability and model explanation

Definition 2.1

$$Pr(j\ removed\ at\ end\ of\ day\ t) = exp(-\gamma) \tag{7}$$

There are two explanation of the infected probability

2.1.1 The "infected pressure" model

This model assume that one infected people make a infectious pressure. On the contrast, one suspected have pressure of surrounding infected object. In homogeneous model, each infected object get same pressure to suspected object, then the total pressure is the sum of every pressure. Then transform the "pressure" to "probability" by following formula

Definition 2.2

$$Pr(j\ infected\ at\ end\ of\ day\ t) = exp(-\beta I \delta) \tag{8}$$

δ is 1 day in this formula

2.1.2 The "infected probability" model

Another explanation of the suspect to infected is as following: Each infected people have a probability p_I to infect other people. So, if one suspected object once infected by one infected object, it becomes infected. Which means the probability of j get infected is at least one infected people infected him. So it is 1 minus no one infected j.

Definition 2.3

$$Pr(j\ infected\ at\ end\ of\ day\ t) = 1 - (1 - p_I)^I \tag{9}$$

We will focus on the definition 2.2 to discuss the infected people.

2.2 sensible choice for β

If N=50,$\gamma = 0.1$ Then we have initial $\beta = 1.000 \times 0.1/49$ Reason: From the equation(1), we have

$$\beta = \frac{R_0 \gamma}{S_0} \tag{10}$$

$S_0 = N - 1$,$R_{(0)} = 1.001$ as a sensible choice. Actually R_0 move from 0.5 to 10 make sense. In some extreme situation, it can go to more than 50.(Very dangerous infectious)

3 Page4,More detail on "infected pressure" model, with heterogeneous model

$$\lambda_j = \sum_{i \in \mathscr{I}(t)} \beta_i j \beta_{ij} = \beta_0 e^{-\|x_i - x_j\|/\phi} \tag{11}$$

So the probability can be wrote as follows

$$Pr(j\ infected\ at\ end\ of\ day\ t) = exp(-\lambda_j(t)) \tag{12}$$

Then the $\lambda_j(t)$ is the "infected pressure" on j

4 Page4, a optimal method in calculation(but not useful for huge datasets)

We can pre-calculate the distance, then calculate β_{ij} and store it into a matrix, then we can use from the matrix to calculate the probability in the process. If the dataset is large, we have to change another way to store the dataset. I forget the name of it, it seems like (coordinate,value), and we calculate $\beta_i j$ when it is needed. Maybe search whether a value is exist is also a problem about efficiency? Maybe can use some method like pre-searching? For example, every not removal infected have pressure until it be removed. So we only need to calculate as new infected

5 Page3, Dissertation

The structure of the section:
1. Describe Homogeneous epidemic
2. How to simulate spatial points
3. How to simulate epidemic for spatial population

6 Page5, Next week task

1.start with CSR
2.Implement spatial simulation(With pre-calculate β matrix discuss in 4)
3.Animate the epidemic