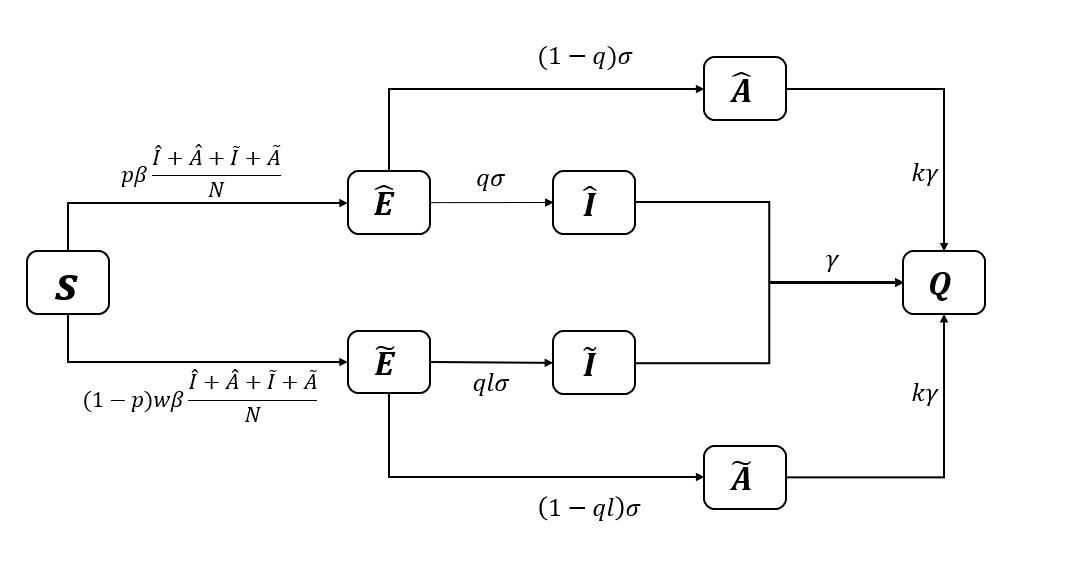
疫苗分配

## 模型



### 传染病方程

（1）

\left\{\begin{array}{l}

\Delta S\_{i}=-p \beta \sum\_{j=1} C\_{i j} \frac{\hat{I}\_{j}+\hat{A}\_{j}+\tilde{I}\_{j}+\tilde{A}\_{j}}{N\_{j}} S\_{i}-(1-p) w \beta \sum\_{j=1} C\_{i j} \frac{\hat{I}\_{j}+\hat{A}\_{j}+\tilde{I}\_{j}+\tilde{A}\_{j}}{N\_{j}} S\_{i} \\

\Delta \hat{E}\_{i}=p \beta \sum\_{j=1} C\_{i j} \frac{\hat{I}\_{j}+\hat{A}\_{j}+\tilde{I}\_{j}+\tilde{A}\_{j}}{N\_{j}} S\_{i}-\sigma \hat{E}\_{i} \\

\Delta \tilde{E}\_{i}=(1-p) w \beta \sum\_{j=1} C\_{i j} \frac{\hat{I}\_{j}+\hat{A}\_{j}+\tilde{I}\_{j}+\tilde{A}\_{j}}{N\_{j}} S\_{i}-\sigma \tilde{E}\_{i} \\

\Delta \hat{A}\_{i}=(1-q) \sigma \hat{E}\_{i}-k \gamma \hat{A}\_{i} \\

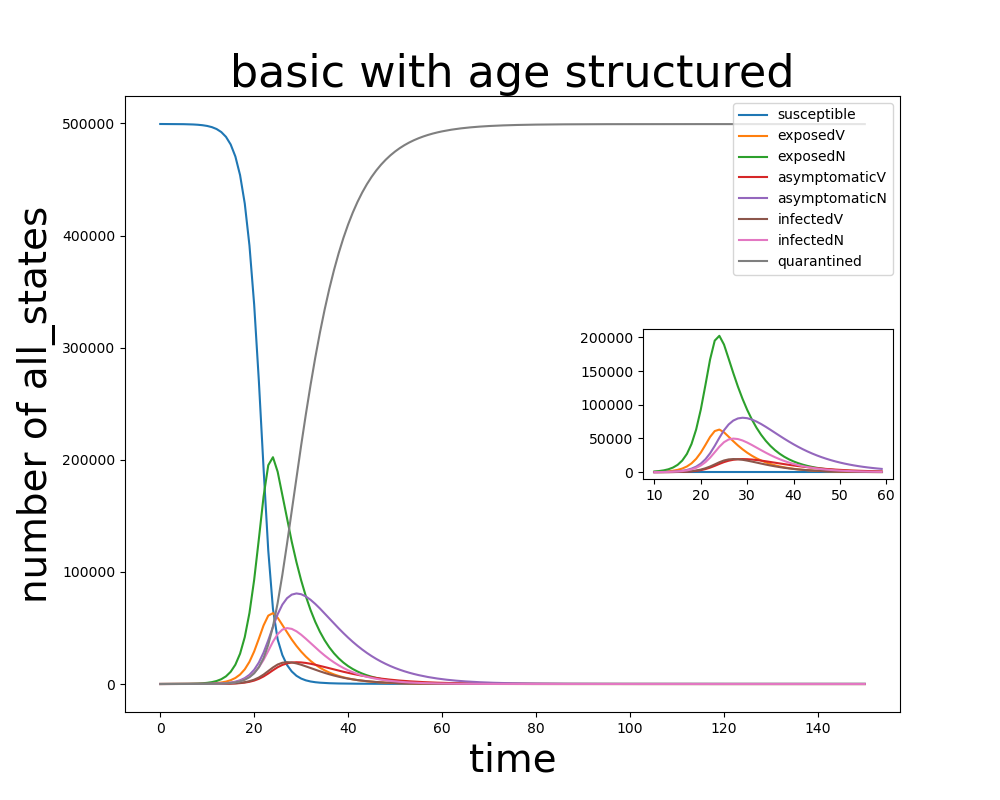
\Delta \tilde{A}\_{i}=(1-q l) \sigma \tilde{E}\_{i}-k \gamma \tilde{A}\_{i} \\

\Delta \hat{I}\_{i}=q \sigma \hat{E}\_{i}-\gamma \hat{I}\_{i} \\

\Delta \tilde{I}\_{i}=q l \sigma \tilde{E}\_{i}-\gamma \tilde{I}\_{i} \\

\Delta Q\_{i}=k \gamma\left(\hat{A}\_{i}+\tilde{A}\_{i}\right)+\gamma\left(\hat{I}\_{i}+\gamma \tilde{I}\_{i}\right)

\end{array}\right.



如果不包含年龄结构

传播部分

转移部分；

接着，计算下一代矩阵K：



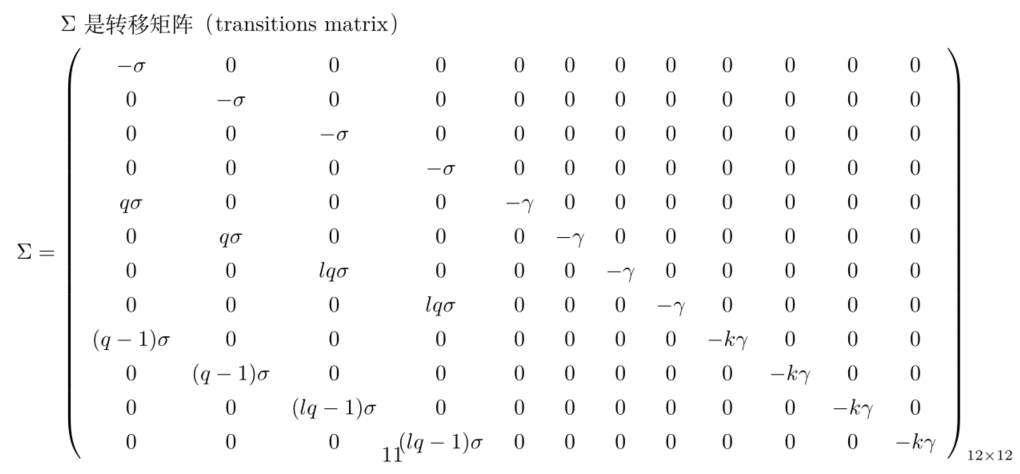
得到K的最大特征值为基本再生数R0：

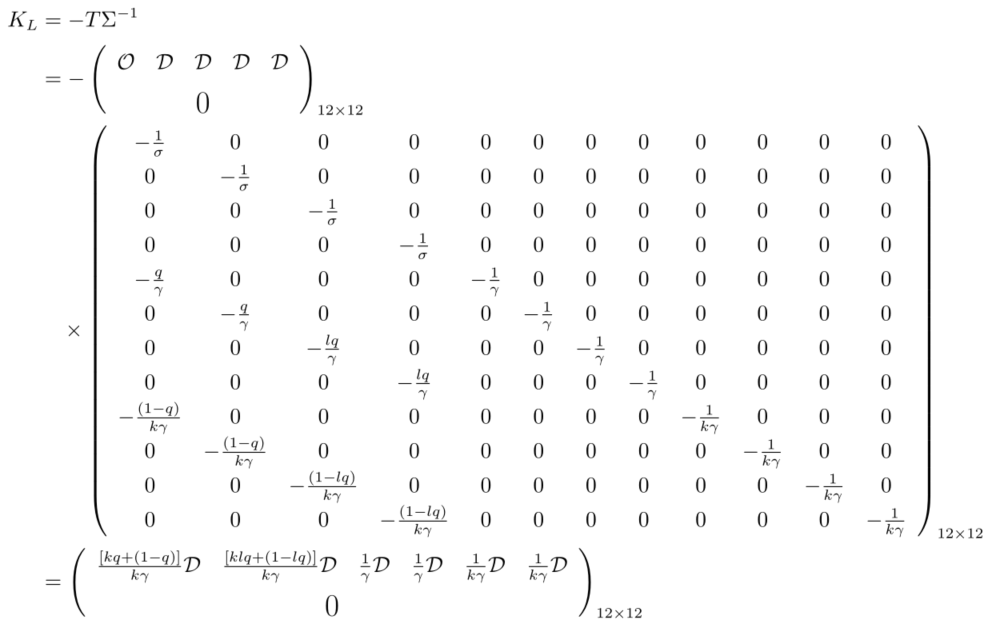
### 加入年龄结构计算两个group的再生数[7]

设，将该感染系统写成一下形式：

则传播部分T

其中





所以i和j的R就是

如果i年龄段p变化，用表示此次分配给i组的疫苗量。所以 ,新的, 发生扰动，则导致发生变化，所以i年龄段势必会引起总体传播的变化，量化为如下：

#### 药物干预-疫苗分配算法[6]

1. Divide the vaccine stock into units as.
2. For each group ***i*** {

For each group ***j*** {

Calculate

}

Calculate

}

1. For each unit of vaccine to :

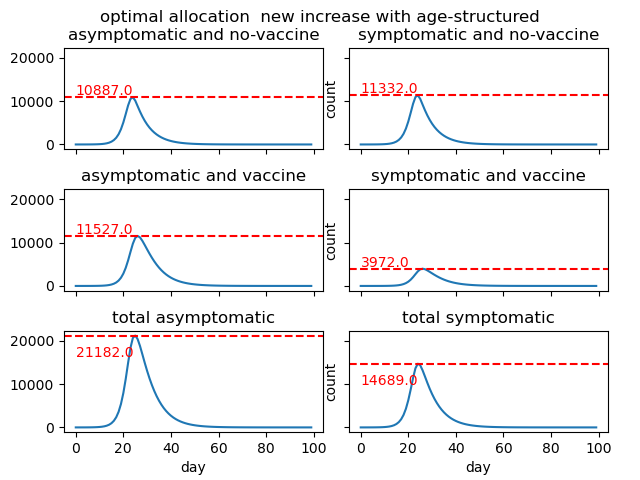
Find max ;

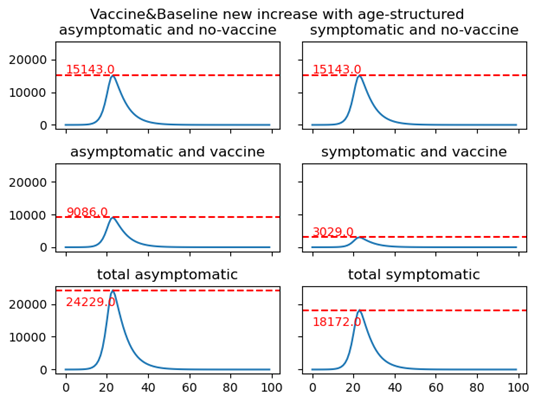
Allocate vaccine to group ***i*** ;

Calculate and update the vaccinate proportion of group i;

Calculate the new of group ***i*** and update;



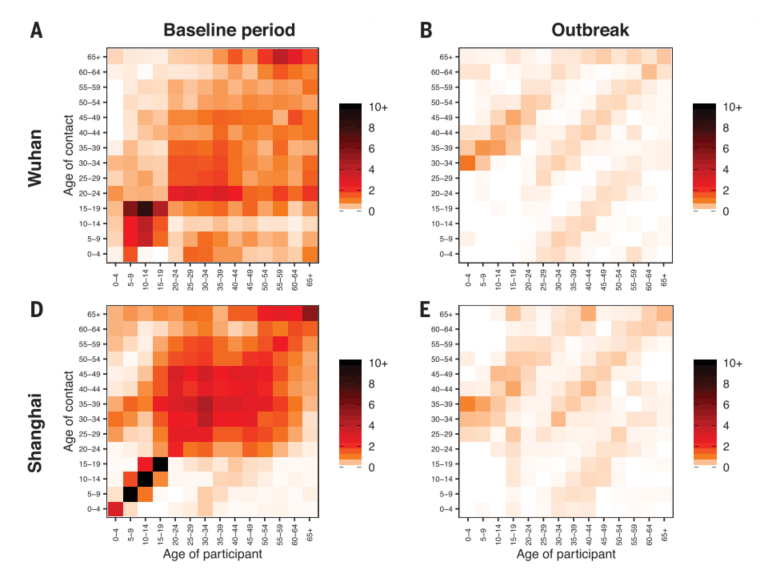




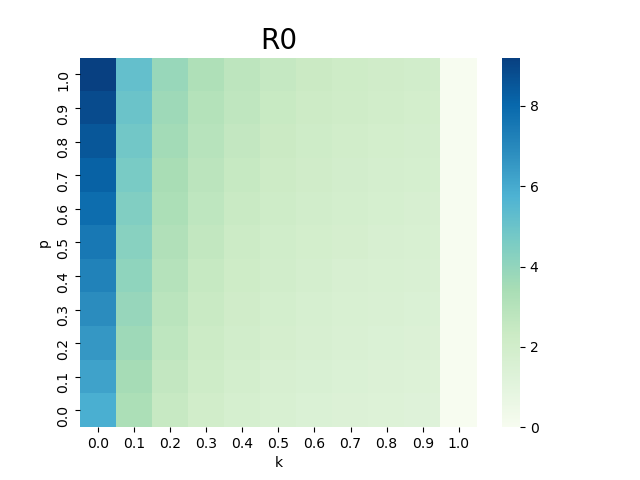
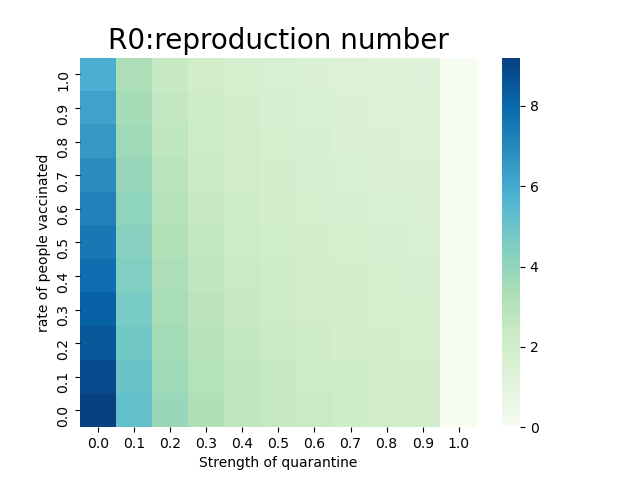
### 非药物干预

社交限制，学校关闭，和限制办公。(Lai et al. 2020)

(Zhang et al. 2020)



筛查和隔离。

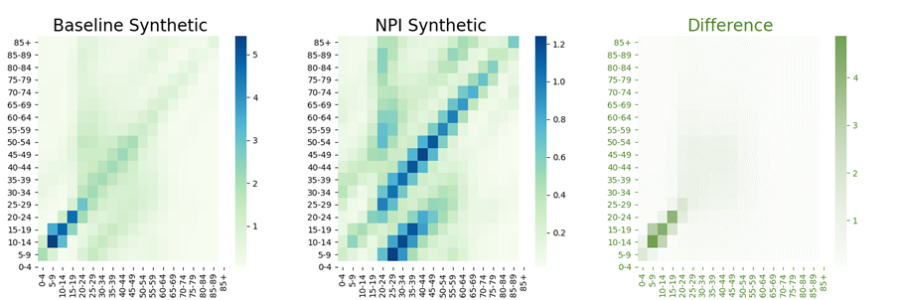


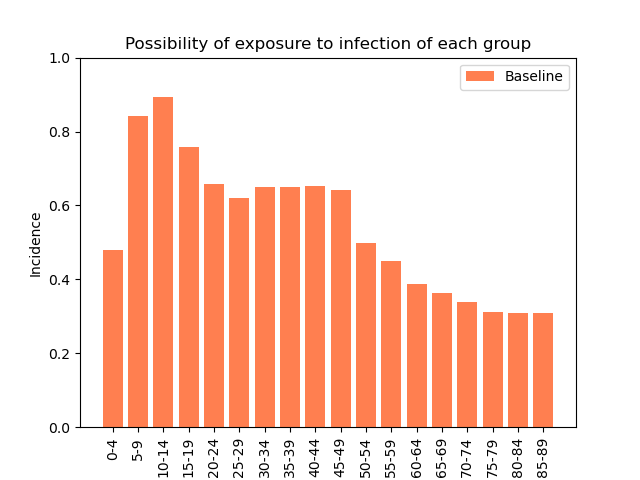
不打疫苗的比例和无症状隔离发现率的上升

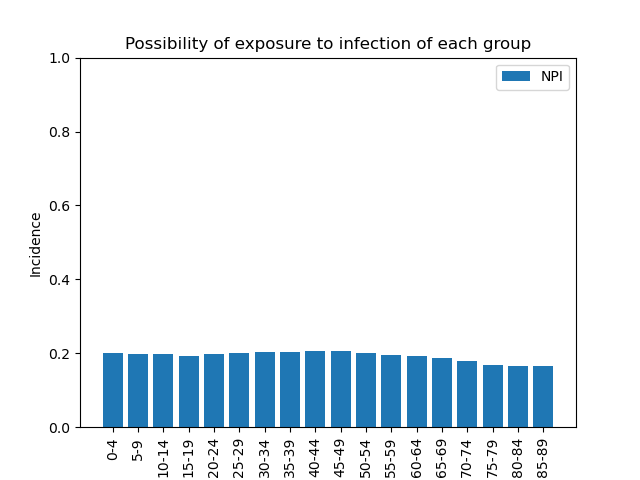
baseline

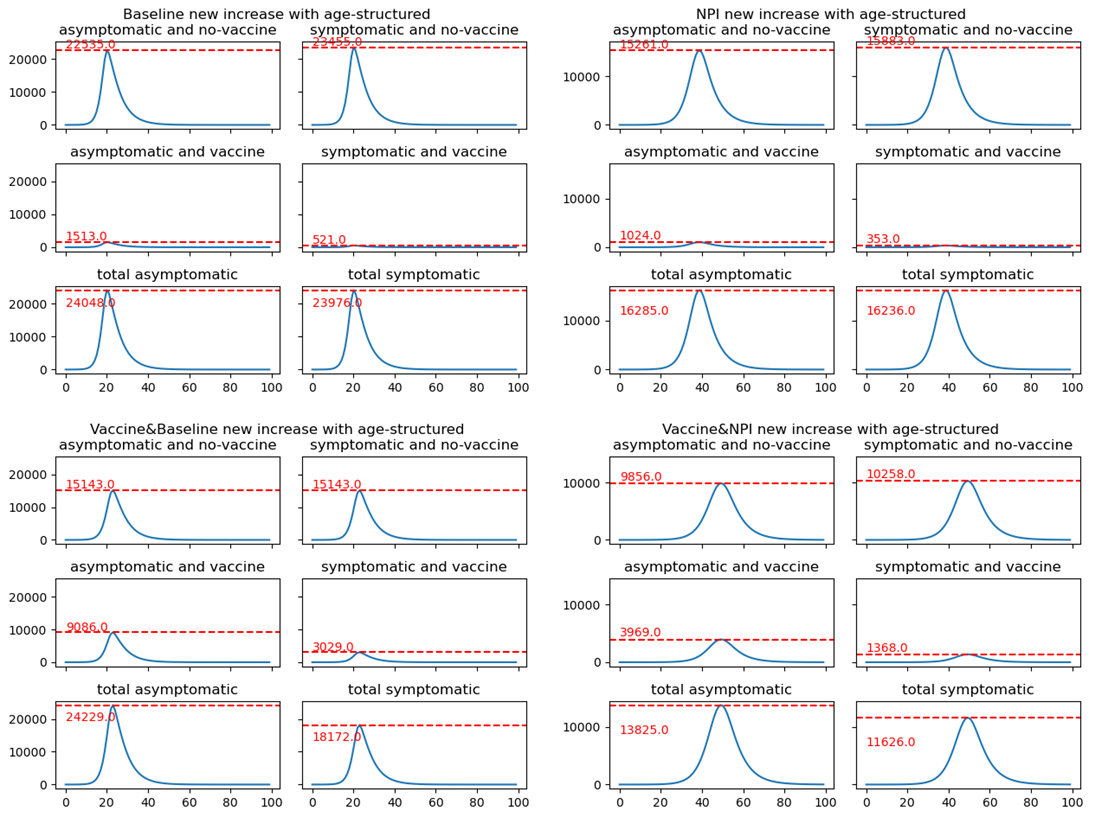
总感染人数 417537.8157754197

总感染率 0.8359048491612073









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2 Zhang, J., M. Litvinova, Y. Liang, Y. Wang & H. Yu (2020) Changes in contact patterns shape the dynamics of the COVID-19 outbreak in China. *Science,* 368**,** eabb8001.

对参数进行分析，固定参数，分析参数

W固定，q和l分析，p分析，k分析

分析不同的情况下无症状感染者，打了疫苗的无症状感染者和没打疫苗的无症状感染者

1nature那片在NPI期间就是对其进行SEIR模型的参数进行改动

