Model Proposal

Epidemiological Models – COVID-19 Data Science Task Force

We consider $\Omega = \bigcup_{i \in K} \Omega_i$ a number of $\#K$-boxes and for each unit period of time $[t_0, t_1]$ is divided in two regimes:

First regime

For $t_0 \leq t \leq t^*$ the system behaviour is a classical SEIR for each $i \in K$ for a given $(\mu = 0, \beta, \gamma, \sigma)$ and $(S_i(t_0), E_i(t_0), I_i(t_0), R_i(t_0))$ we compute the solution

$$\dot{S}_i(t) = -\beta S_i I_i, \tag{1}$$

$$\dot{E}_i(t) = \beta S_i I_i - \sigma E_i, \tag{2}$$

$$\dot{I}_i(t) = \sigma E_i - \mu I_i, \tag{3}$$

$$\dot{R}_i(t) = \gamma I_i - \mu R_i, \tag{4}$$

denoted by $(S_i(t), E_i(t), I_i(t), R_i(t))$ for $t_0 \leq t \leq t^*$

Original model $\mu = 0$

Second Regime I

For $t^* \leq t \leq t_1$ and $i \in K$ let be $S_{i,j}(t)$ (respectively, $I_{i,j}(t)$) denotes the susceptible individuals (the infected individuals) that lives in box i and moves to box j. In a similar way $N_{i,j}$ are the individuals that lives in box i and moves to box j. Clearly,

$$N_i = \sum_{j \in K} N_{i,j}.$$

Then ratio of infected individuals in the box i is computed as

$$I_i(t) = \frac{1}{N_i} \sum_{j \in K} I_{i,j}(t),$$

where

$$\sum_{j \in K} I_{i,j}(t) \sim \mathcal{B}\left(\sum_{j \in K} S_{i,j}(t^*), \beta \frac{\sum_{j \in K} I_{i,j}(t^*)}{\sum_{j \in K} N_{i,j}} \right)$$

Original model $\mu = 0$

Second Regime II

Then ratio of susceptible individuals in the box i is computed as

$$S_i(t) = \frac{1}{N_i} \sum_{j \in K} S_{i,j}(t),$$

where

$$\sum_{j \in K} S_{i,j}(t) \sim \mathcal{B}\left(\sum_{j \in K} I_{i,j}(t^*), \beta \frac{\sum_{j \in K} I_{i,j}(t^*)}{\sum_{j \in K} N_{i,j}} \right)$$