SEIR Agent-based Model

This paragraph describes the assumption needed to set up four different agent-based models that can be used to generate the fundamental deterministic SEIR compartmental model which illustrates the changes of each individual within four states in the following direction: from state S (Susceptible) to state E (Exposed), followed by state I (Infectious), and finally, ended at state R (Recovered).
By mapping the states in ascending order according to the given direction of flow,

- State S is mapped to State 1.
- State E is mapped to State 2.
- State I is mapped to State 3 .
- State R is mapped to State 4.

From the previous description of the changes in the states, it follows that whenever two individuals from different states interact with one another within a distance of d (feet), only an individual whose state corresponds to a smaller integer can shift to a new state which corresponds to a larger integer, but not vice versa.
Consider a fixed distance of close contact of $d = 6$ feet, a population of $N = 500$ people, and the observation period of 14 days.
Let t denotes the t^{th} day of observation. It follows that $1 \leq t \leq 14$ (days).
For each day, $S(t) + E(t) + I(t) + R(t) = N = 500$ (people).
The agent-based SEIR Model is described as below:
Each of the four states is associated with two parameters, μ_i and δ_i (for $1 \leq i \leq 4$), and a 4-tuple α_{ij} of four parameters $\beta_{ij}, \epsilon_{ij}, \theta_{ij}, \sigma_{ij}$ (for $1 \leq i < j \leq 4$), followed by these rules:

- At the beginning of day 0, each agent is randomly assigned to a state, from State 1 to State 4, and μ_i denotes the probability of the populating starting at state i at $t = 0$ (day), in other words, on day 0.
- During the observation period, there exists a baseline death rate δ_i per day in each state, which represents the number of agents randomly getting removed each day.
- When two agents in different states come into contact with one another within a specified distance of d feet, depending on the state of each agent, there exist different transmission coefficients from one state to another, β_{ij}, which also follow the ascending order of possible transition of states of each agent.
- The time it takes (in days) for an individual to be able to move from one state to another is recorded in parameter ϵ_{ij}.
- The probability of whether any other different individual's health issues, age, and external factors which can affect the transition between the states is recorded in parameter θ_{ij}.

- Due to either a symptomatic or an asymptomatic case of an individual in each state, the probability of true negative is recorded in parameter σ_{ij}.
- A 4-tuple α_{ij} represents the information of the transmission coefficients from one state to another, b_{ij}, the time it takes for each agent to move from one state to another, ϵ_{ij}, the probability of reception and transmission risk, θ_{ij}, and the probability of true negative, σ_{ij}.

The figure below summarizes the previously described agent-based SEIR Model.

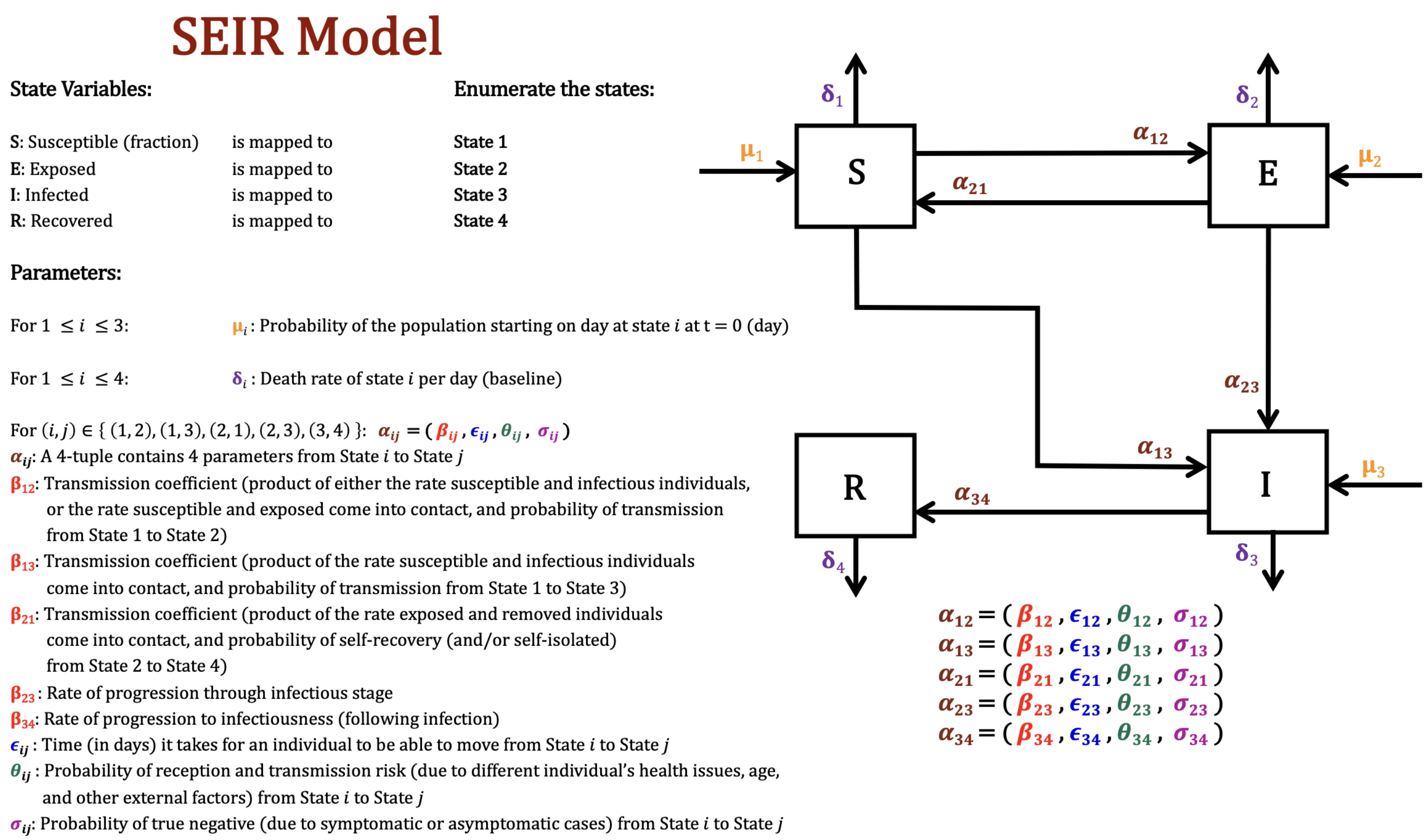

Figure 1 Agent-based SEIR Model.