The model is an agent-based one, involving N individuals. Constant characteristics of an individual:

a age (or age group)

g sex

y type (student, worker, other)

... possibly some others (serve only for construction of the graph)

Variable characteristics

s one of I epidemiological states (S, E,etc.)

Individuals associate in

N_f families,

N_s schools,

N_s services (shops etc, sometimes coinciding with businesses)

N_b businesses

N_g gatherings (include culture, sport, religion and pubs)

N_t public transportation routes

All these possess a location $x_\bullet$,public transport two ones: x and y.

The transition between epidemiological states (except for S) are given by a matrix Θ, the infectiousness (reproduction number) of state i is given by a constant $\mu(i)$.

There are J types of tests, reliability of which is given by $\Lambda = (\lambda_{j,i})_{j \leq J, i \leq I}$ where $\lambda_{j,i}$ is the probability of the positive result given that the state of the tested is i.

Possible contacts are given by $P = (p_{i,j}, m_{i,j})_{i<j}$ where p's are contact probabilities and m's are expected durations, respectively (always the same contacts may be modeled by setting $p = 1$). In particular, $P = P_f \cup \ldots \cup P_t$, where $P_\bullet$ are analogous collection corresponding to meeting types, which need not be disjoint (people can meet in transport as well as in theater). P may differ between states (Sundays different from weekdays, different customers, hospitalizations, quarantines), hence we write P_t.

At each t, quarantine policy π_t and testing policy $\tau_t = (\tau_{t,i})_{i<N}$ are being applied, both possibly dependent on the history of observable information $H_{t-1} = (\tau_{\tau,\bullet}, \rho_{\tau,\bullet}, E_\tau)_{\tau<t}$, were, $\tau_{\tau,i}$ is the type of test applied to i, ($= 0$ if no test) $\rho_{\tau,i}$ is the result (if applied) and E_τ are the past contacts. More than one day delay in testing may be modeled by ignoring the last values by the policy. The result of π are altered potential contact information $P_t^* = \pi(H_{t-1}, P_t)$.

The actual contacts at t are given by

$$E_t = \{(e, D_e) :\in P_t^* : I_e = 1\}$$

where $I_{(i,j)}$ is a Bernoulli variable with probability $p_{i,j}$ and $D_{(i,j)} \sim \mathrm{Exp}(m_{i.j}^{-1})$ is the duration (may have another distribution if needed).

The distribution of s_i is as follows: if the last state was other than S then the (conditional) distribution of s_i is given by Θ, otherwise

$$\mathbb{P}[s_i = E] = 1 - \prod_{i \in e, e \in E_t} (1 - D_e \frac{\mu(s_{\neg i}^{last})}{h}), \qquad h = \frac{1}{N} \sum_{i<j} m_{(i,j)}$$

where the m's are computed from as an average of values of P_t over a week, and $\neg i$ is the other index in e.

The test results ρ are random, determined by Λ.