Title: Hyperparameter Setting, Initial Conditions & Iterations

Author: Qian Dong, Wentian Tian, Qitian Ma, Gabriele Carta.

Date: 16/08/2020

Notation

j = 1 year 20-49
j = 2 year 50-64
j = 3 year 65+

Hyperparameter (Feb. 24th 2020 - May 3rd 2020)

1. $L_j(t)$ lockdown policy
   $L_j = \begin{cases} 0.6 & j = 1,2 \\ 1 & j = 3 \end{cases}$

NOTE: Based on the policy adopted by the Italian government during the lockdown period, $L_j(t)$ is supposed to be 0.6 for the young and middle group while for the old group, it's set to be 1. θ is taken as set in Acemoglu's paper for now.

2. $\{\rho_{i,j}\}_{3*3}$ symmetric matrix $\rho_{i,j} \in [0,1]$ contact rate between group i and j
   $\rho_{\{i,j\}} = 1, \forall i, j = 1,2,3$

NOTE: The $\rho_{\{i,j\}}$ here are also taken from the baseline model set in Acemoglu's paper, which are the same for any inter-group interactions.

3. $\alpha \in [1,2]$ index of scale in matching

NOTE: We may compare the results of these two different matching case and then see which one fits better the data. It's very likely that the reality is between 1 and 2.

4. β infection rate
   $\beta = 0.134$

NOTE: It's set in the baseline model of Acemoglu's paper.

5. θ lockdown efficiency
   $\theta = 0.75$
6. $\iota_j \in [0,1]$ fraction of infected people who need ICU
   $\iota_j = \sigma \bar{\delta}_j^d$
7. $\kappa_j \in [0,1]$ fraction of recovered agents allowed to work freely
   $\kappa_j = 0$
8. $\gamma_j \in [0,1]$ Non-ICU patients recover rate
   $\gamma_j = 1/18$
9. $\sigma = 0.0076$ Coefficient of H(t) equation

NOTE: It's taken from the Acemoglu's paper.

10. $\phi_j \in [0,1]$ (conditional) probability that an individual of type j needing ICU care is detected and isolated
    $\phi_j = 0.1$
11. $\tau_j \in [0,1]$ the constant probability that an infected individual of type j not needing ICU care becomes isolated
    $\tau_j = 0.1$
12. $\bar{\delta}_j^d$ The case fatality rates for the three age groups conditional on infection and ICU services being available.

j	$\bar{\delta}_j^d$
1	0.001
2	0.01
3	0.06

NOTE: The values are taken from Ferguson et al. (2020) and summarized by Acemoglu.

Determined Parameter

1. $H(t) = \sigma \sum_k \bar{\delta}_k^d I_k(t)$
2. $\underline{\delta}_j^d = (\bar{\delta}_j^d \gamma)/\iota_j$
3. $\delta_j^d(t) = \underline{\delta}_j^d \cdot [1 + \lambda H(t)]$
4. $\delta_j^r(t) = \gamma_j - \delta_j^d(t) \in [0,1]$ ICU patients recover rate
5. $\eta_j = 1 - [\iota_j \phi_j + (1-\iota_j)\tau_j] \in [0,1]$ rate of infected person fail to be isolated

Initial Condition

1. $POP_{Lom} = 8269281$

NOTE: Here we only consider the population of and above 20 years old considering the age groups we are focusing on.

2. $POP_{Ven} = 4033961$

NOTE: Here we only consider the population of and above 20 years old considering the age groups we are focusing on.

3. $NInfInit_{Lom} = 10$

NOTE: Initial infected population in Lombardia, which is the same as assumed in Favero's paper.}

4. $NInfInit_{Ven} = 5$

NOTE: Initial infected population in Veneto, which is the same as assumed in Favero's paper.

5. $I_j(0) = NInfInit_{Lom} * N_j$
6. $S_j(0) = N_j * Pop_{Lom} - I_j(0)$

Iteration

$\Delta S_j(t) = -\Delta I_j(t)$
$\Delta I_j(t) = \beta[1-\theta_j L_j(t)] S_j(t) \sum_k \rho_{jk} \eta_k I_k(t)(1-\theta_k L_k(t))/\{\sum_k \rho_{jk}[(S_k(t) + \eta_k I_k(t) + (1-\kappa_k)R_k(t)][1-\theta_k L_k(t)] + \kappa_k R_k(t)\}^{2-\alpha} - \gamma_j I_j$
$\Delta D_j(t) = \delta_j^d(t) H_j(t)$
$\Delta R_j(t) = \delta_j^r(t) H_j(t) + \gamma_j (I_j(t) - H_j(t))$