1 Step 1 Algorithm Pseudo-code

Algorithm 1 Step 1 Algorithm

Input: Reported infections time sequence D_{reported}, baseline parameterization $\mathbf{p} = \textsc{Calibrate}(O_M, \{D_{\text{reported}}, \text{others}\})$.

CostDictionary = {}

for $\alpha_{\text{reported}} \in [0.01, 0.02, \cdots, 0.99]$ **do**

$D = \frac{D_{\text{reported}}}{\alpha_{\text{reported}}}$

$D_{\text{unreported}} = D - D_{\text{reported}}$

p' = $\textsc{Calibrate}(O_M, \{D_{\text{reported}}, D_{\text{unreported}}, \text{others}\})$

CostDictionary$[\alpha_{\text{reported}}] = L(D_{\text{reported}}, D, \mathbf{p'}, \mathbf{p})$

end for

$\alpha^*_{\text{reported}} = \arg\min_{\alpha_{\text{reported}}}$ CostDictionary$[\alpha_{\text{reported}}]$

Output: $\alpha^*_{\text{reported}}$

2 Step 2 Algorithm Pseudo-code

Algorithm 2 Step 2 Algorithm

Input: Reported rate $\alpha^*_{\text{reported}}$, reported infections time sequence D_{reported}, baseline parameterization $\mathbf{p} = \textsc{Calibrate}(O_M, \{D_{\text{reported}}, \text{others}\})$, .

$D = \frac{D_{\text{reported}}}{\alpha^*_{\text{reported}}}$

while $L(D_{\text{reported}}, D, \mathbf{p'}, \mathbf{p})$ not converge using Nelder-Mead **do**

D = Nelder-Mead updated new D

$D_{\text{unreported}} = D - D_{\text{reported}}$

p' = $\textsc{Calibrate}(O_M, \{D_{\text{reported}}, D_{\text{unreported}}, \text{others}\})$

end while

$D^* = D$

Output: D^*