Numerical Method and Simulations

0.1 Results

The results for the different test controls for the different strategies are below:

0.1.1 Isolation-only

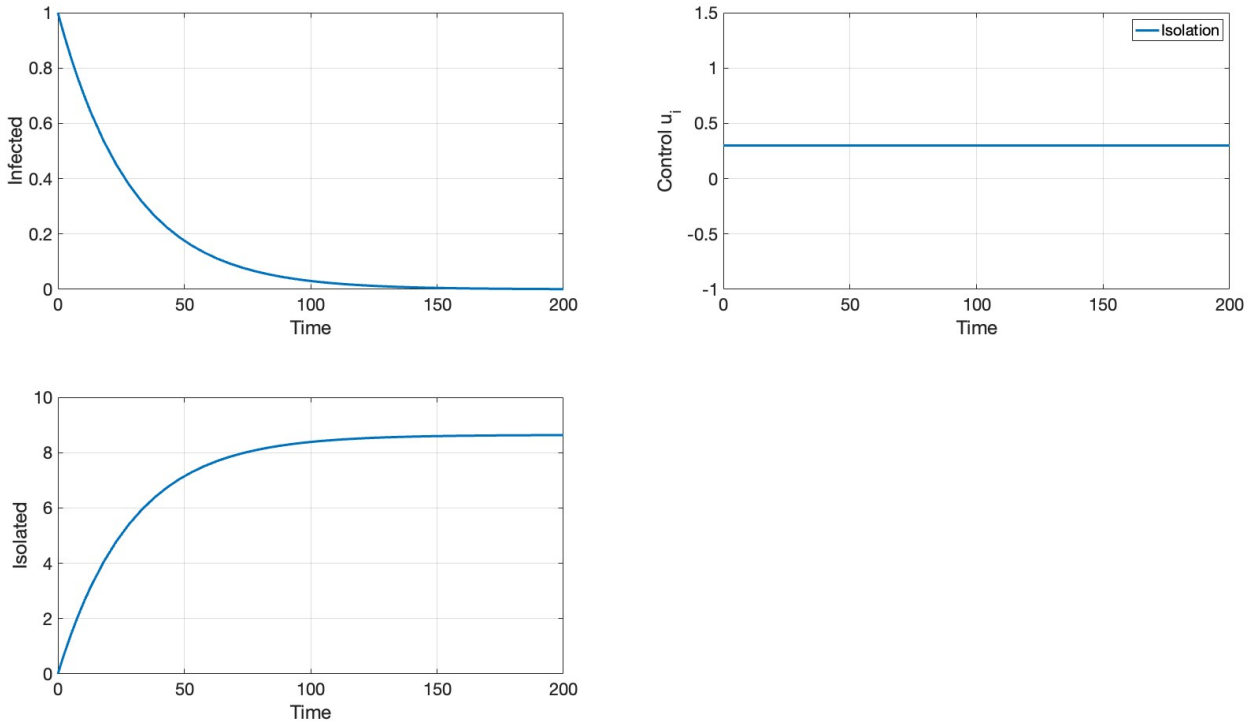

Figure 1: Dynamics of isolation-only model for $w_{max} = 500,\ t_0 = 0$

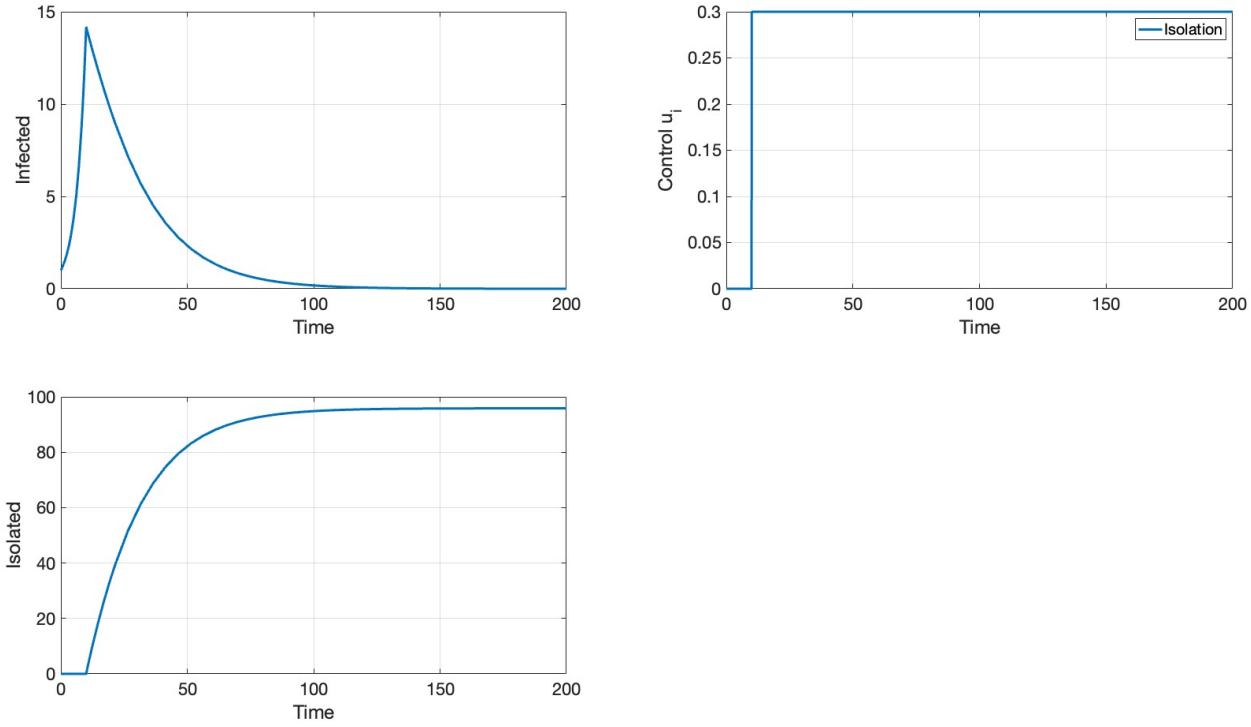

Figure 2: Dynamics of isolation-only model for $w_{max} = 500,\ t_0 = 10$

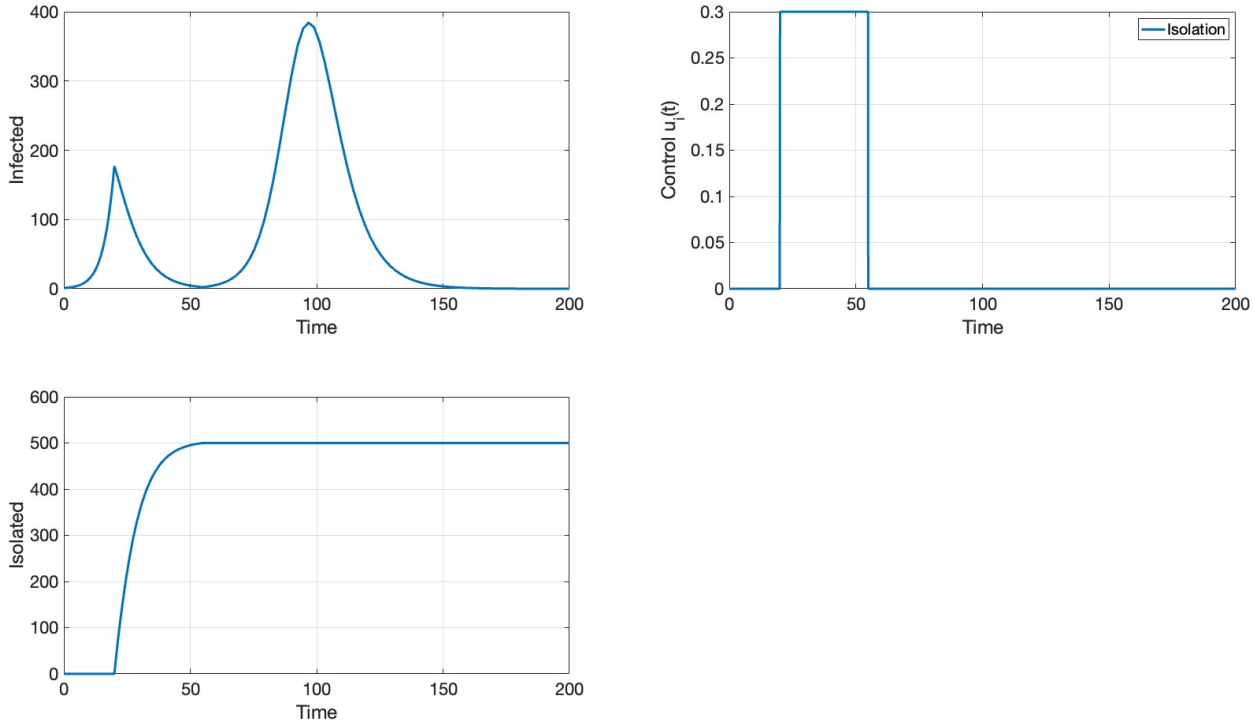

Figure 3: Dynamics of isolation-only model for $w_{max} = 500,\ t_0 = 20$

Isolation-only	
Timing (t)	Objective Function Value (J)
Start control at $t = 0$	15.3799
Start control at $t = 10$	192.5949
Start control at $t = 20$	3795.6885

These results from the isolation-only model indicate that the timing of isolation has a great impact on the peak of infection as long as we are working with limited resources. Delaying isolation results in higher or multiple peaks of infections.

0.1.2 Travel Restrictions-only

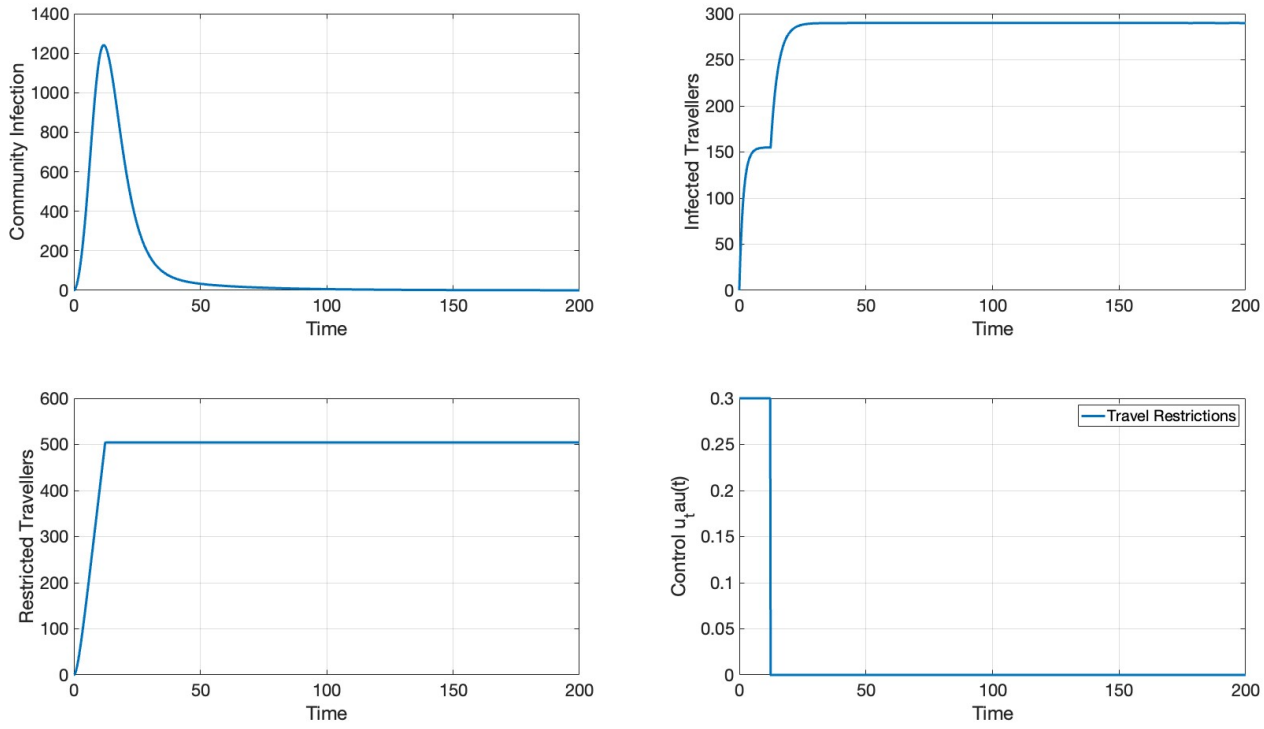

Figure 4: Dynamics of Travel Restrictions-only model when the control is initiated at the start of the epidemic for $z_{max} = 500$

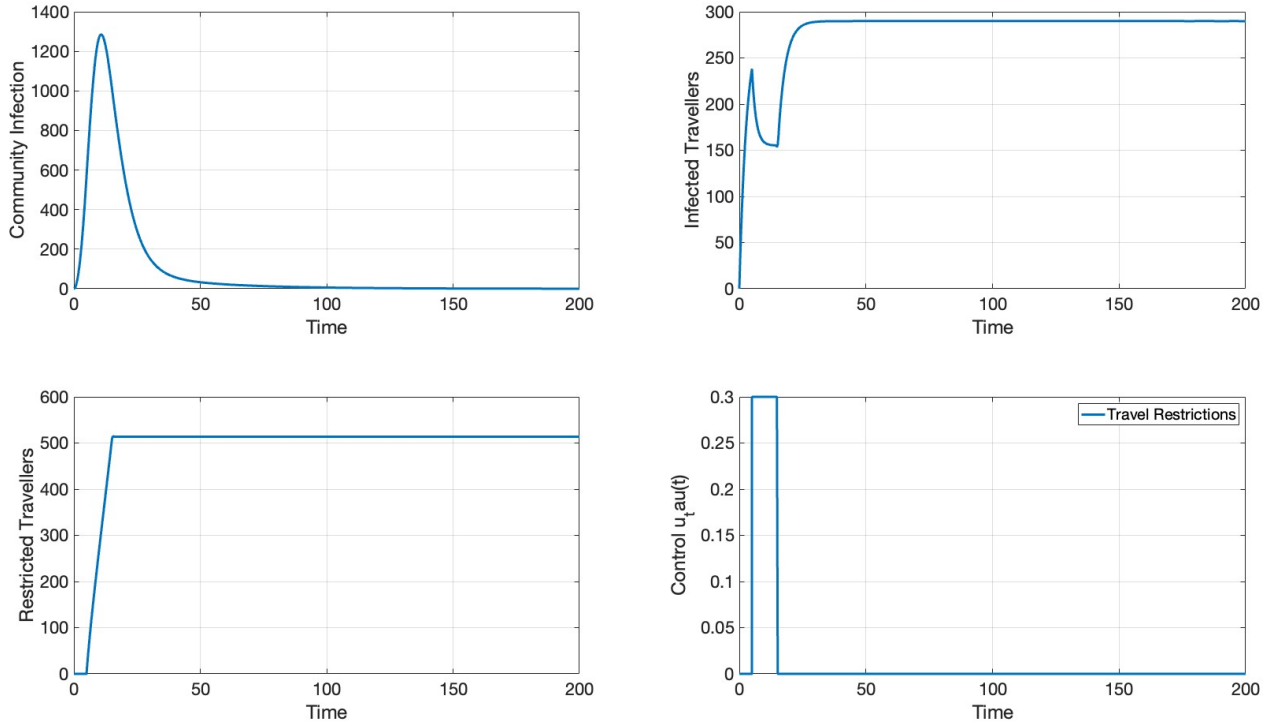

Figure 5: Dynamics of Travel Restrictions-only model when the control is initiated at time $t = 5$ for $z_{max} = 500$

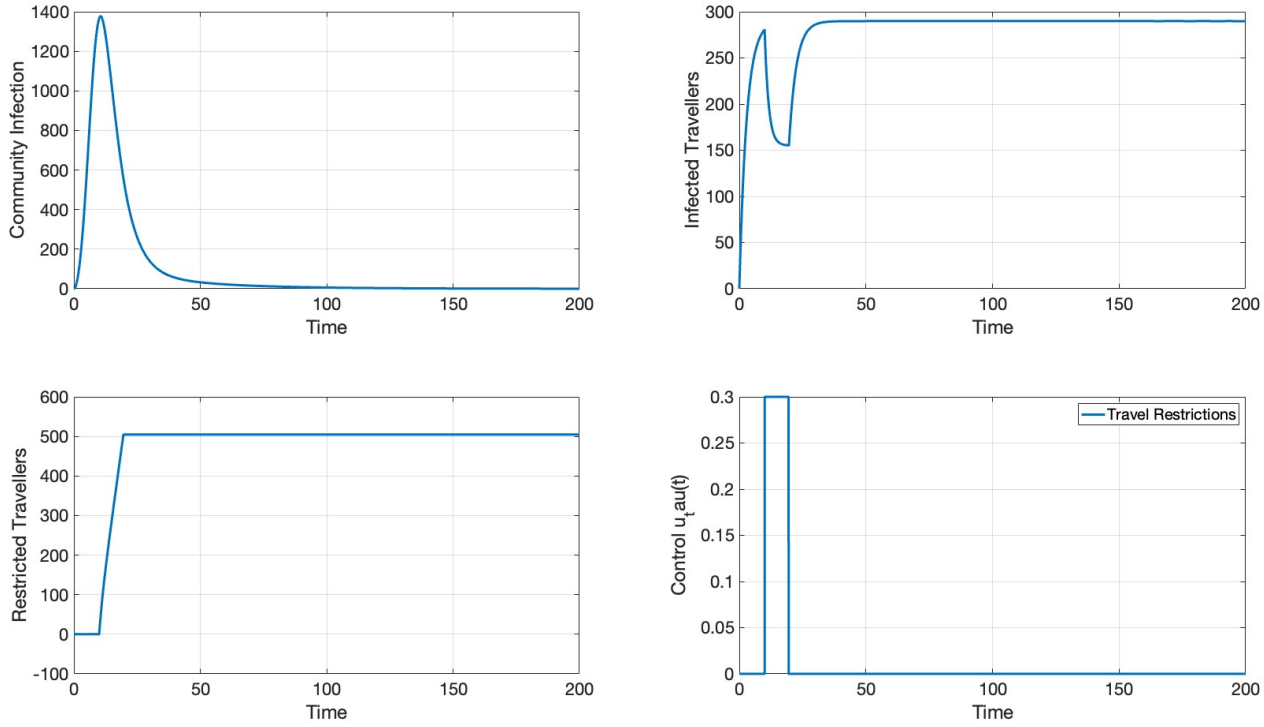

Figure 6: Dynamics of Travel Restrictions-only model when the control is initiated at time $t = 10$ for $z_{max} = 500$

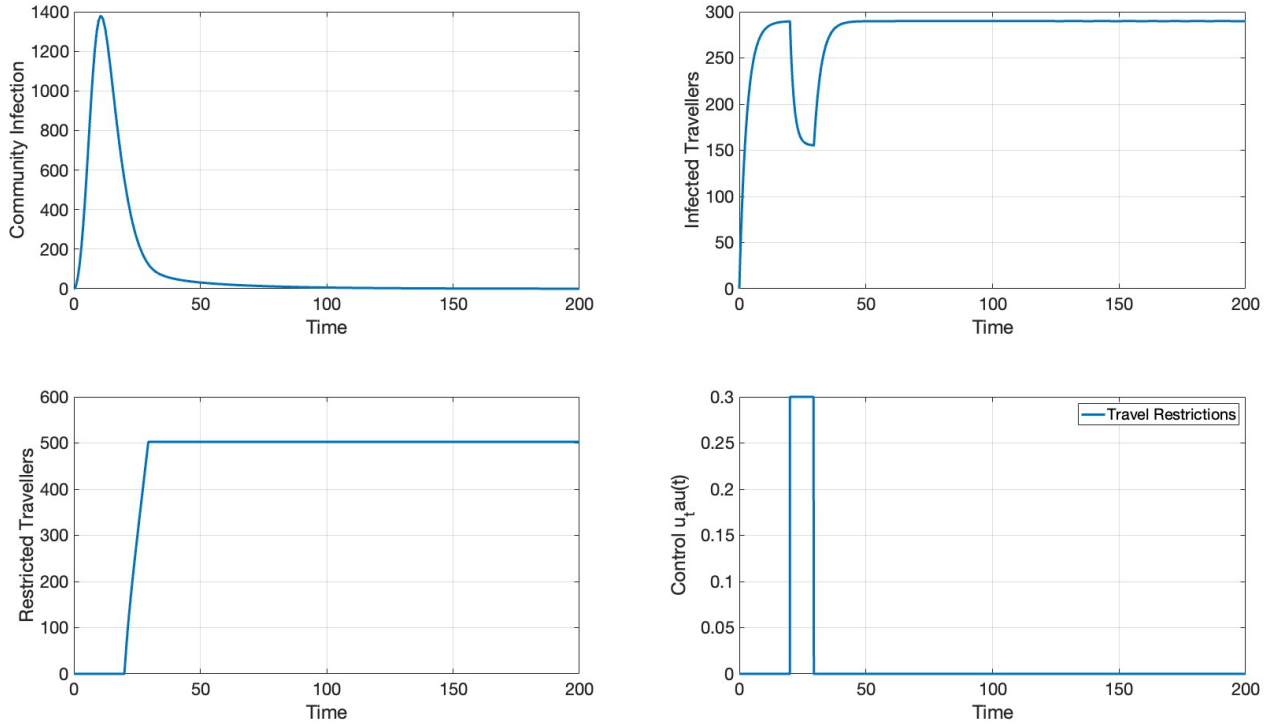

Figure 7: Dynamics of Travel Restrictions-only model when the control is initiated at time $t = 20$ for $z_{max} = 500$

Travel Restrictions-only	
Timing (t)	Objective Function Value (J)
Start control at $t = 0$	5046.8924
Start control at $t = 5$	5021.2436
Start control at $t = 8$	4986.0178
Start control at $t = 10$	4968.6757
Start control at $t = 15$	5036.5653
Start control at $t = 20$	5077.5662

When travel restriction is implemented initially, we observe a lower peak of infection but at a higher cost. The lowest value of the objective function is observed when travel restriction is enforced just before or after the peak of infection.

0.1.3 Mixed Model

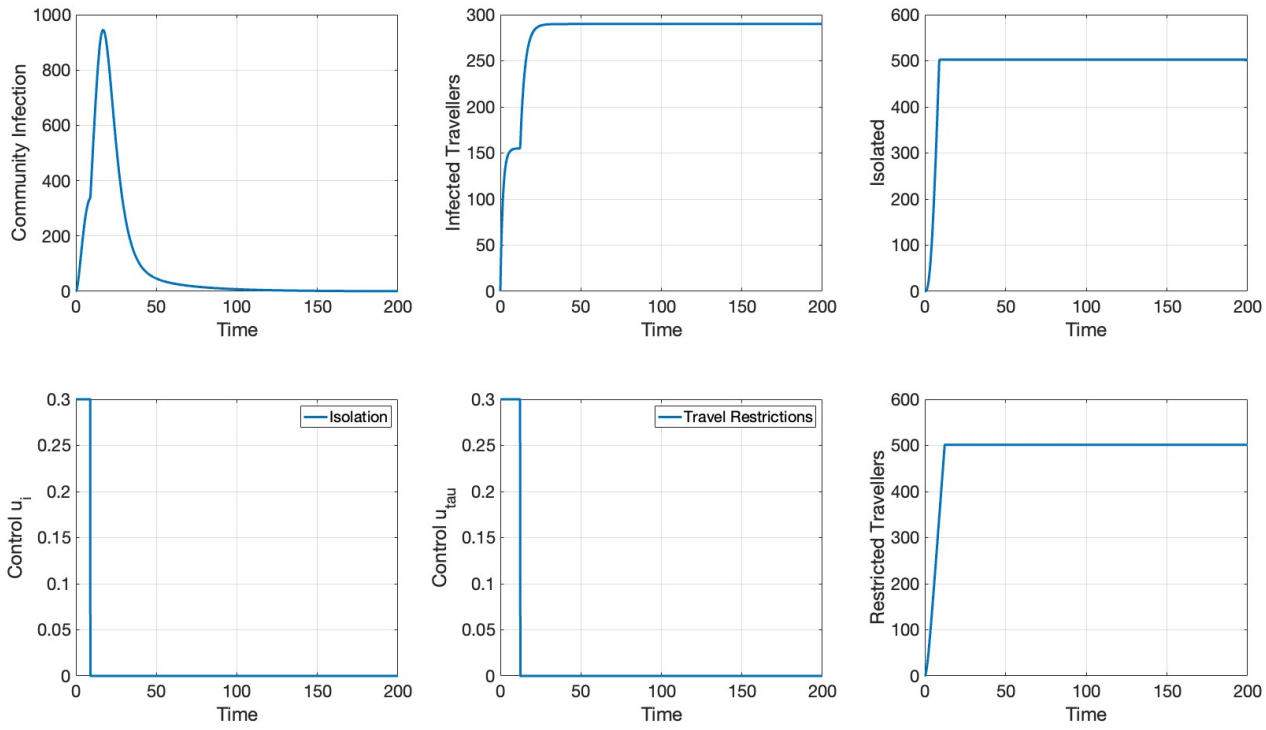

Figure 8: Dynamics of mixed model when the controls are initiated at the start of the epidemic for $w_{max} = 500,\ z_{max} = 500$ (both immediately until all available resources used up)

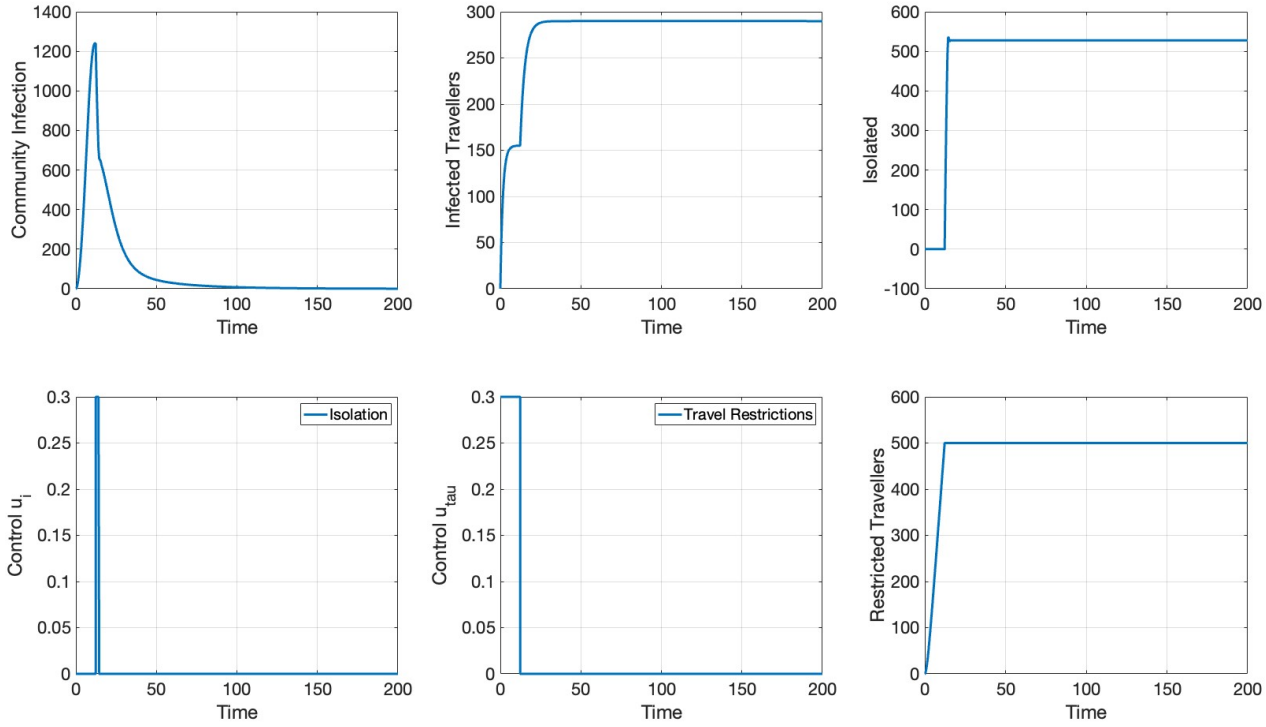

Figure 9: Travel-restrictions first starting at $t = 0$ until all resources used up, then isolation only for $w_{max} = 500,\ z_{max} = 500$

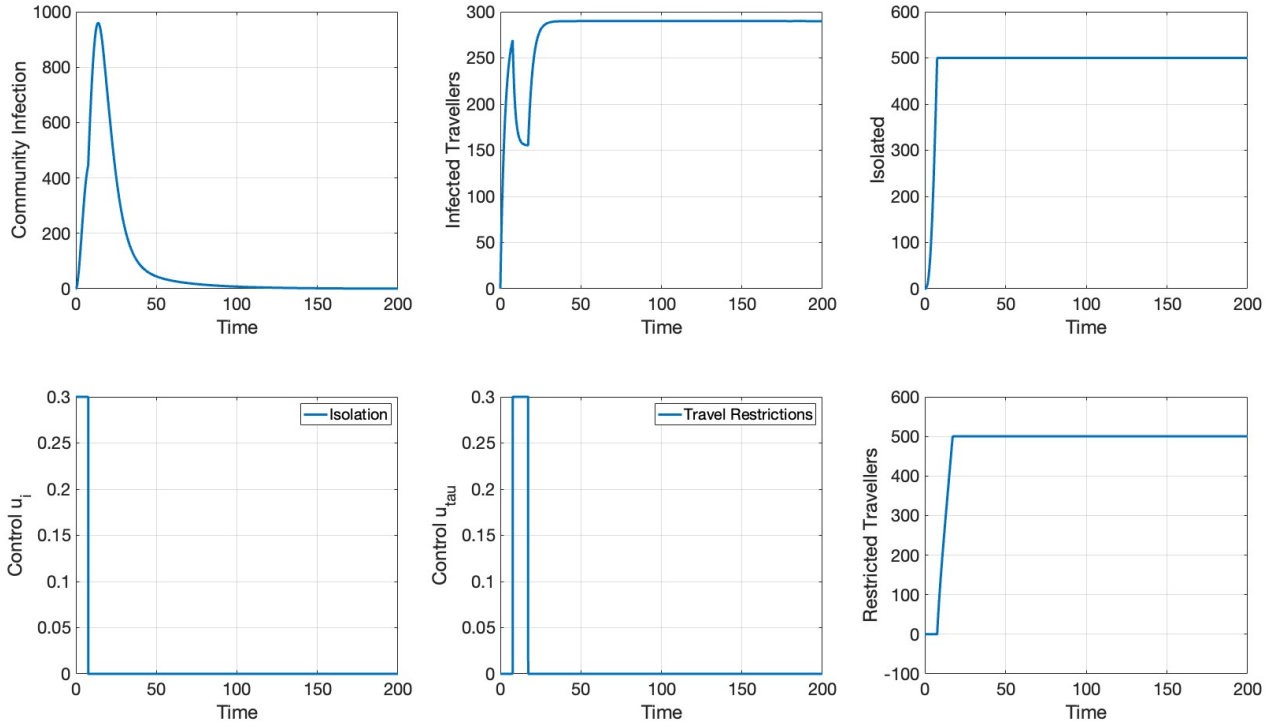

Figure 10: Isolation-only first starting at $t = 0$ until all resources used up, then travel-restrictions only; for $w_{max} = 500,\ z_{max} = 500$

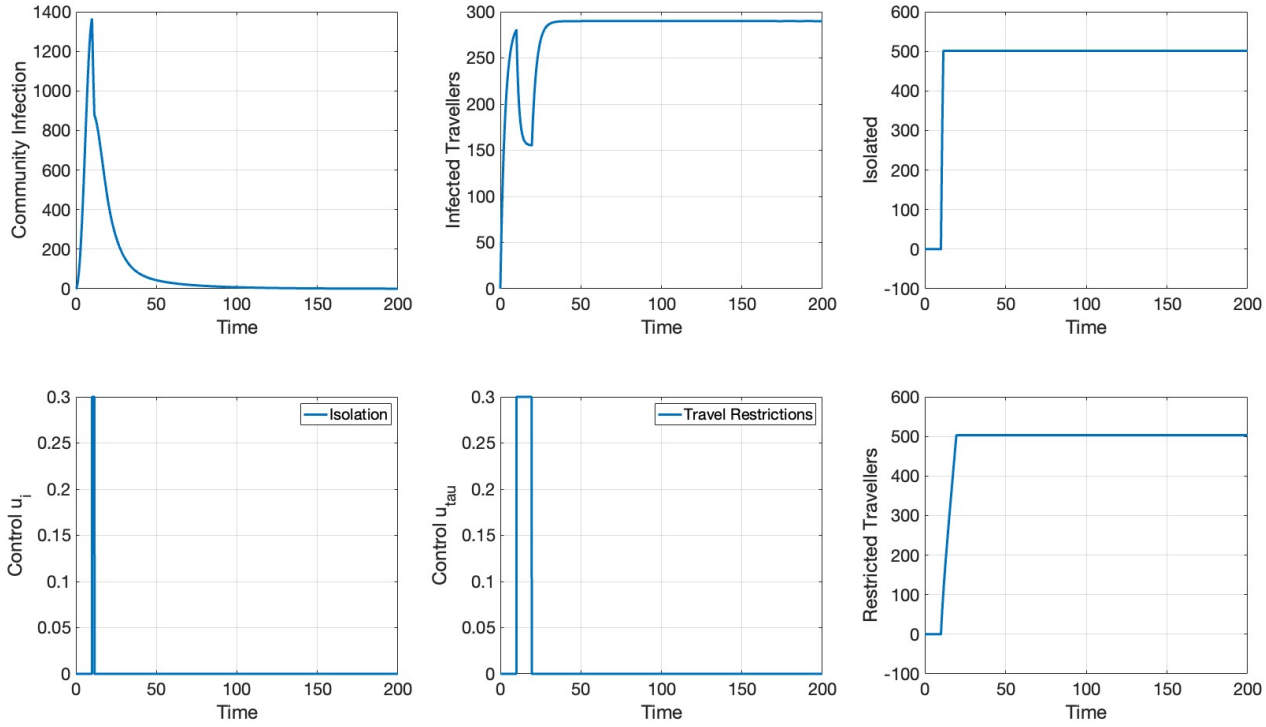

Figure 11: Wait 10 days with no controls, and then do both controls until each resource is all used up for $w_{max} = 500,\ z_{max} = 500$

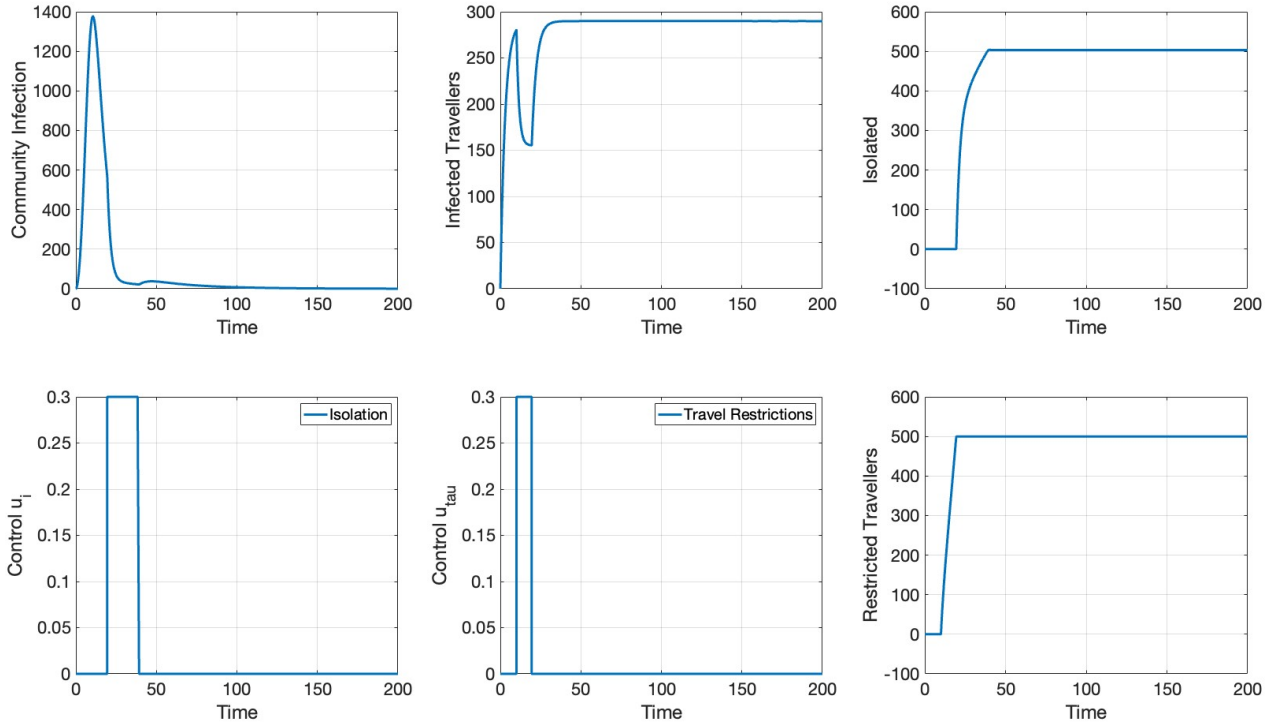

Figure 12: Wait 10 days; then do travel-restrictions first until all used up; then isolation-only for $w_{max} = 500,\ z_{max} = 500$

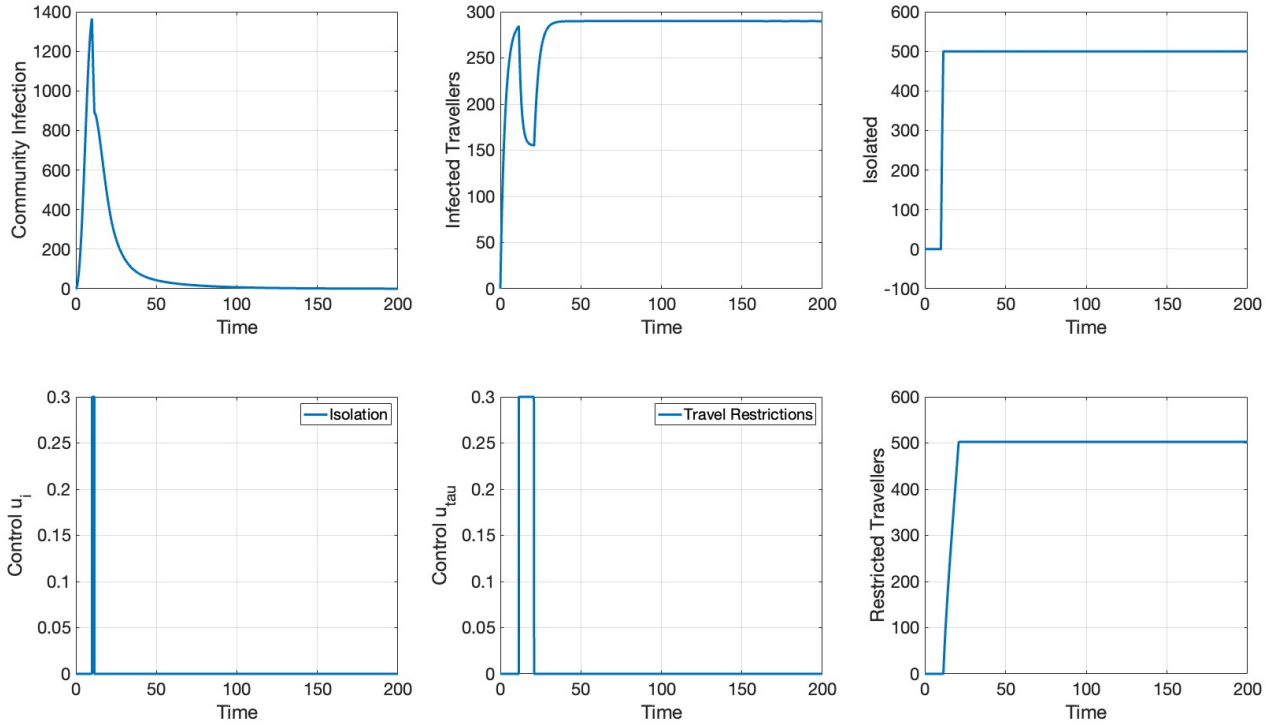

Figure 13: Wait 10 days; then do isolation first until all used up; then travel restrictions-only for $w_{max} = 500,\ z_{max} = 500$

Mixed Policy	
Timing (t)	Objective Function Value (J)
Start control at $t = 0$	5078.7862
Travel restrictions first, then isolation	5026.8161
Isolation first, then Travel restrictions	5044.1513
Start both controls at $t = 10$	4958.4881
Start Travel restrictions at $t = 10$, then Isolation	4961.6379
Start Isolation at $t = 10$ then Travel restrictions	4953.8546

The mixed model results also indicate that if we can start both controls at the initial time, we can minimize the infection peak but at a higher cost. Again, we observe that isolation is most effective compared to travel restrictions.