Supplementary Material to Allocation of COVID-19 Testing Budget on a Commute Network of Counties

Yaxuan Huang[1], Zheng Tracy Ke*[2], and Jiashun Jin[3]

[1]Department of Statistics, University of California, Berkeley, California, USA
[2]Department of Statistics, Harvard University, Massachusetts, USA
[3]Department of Statistics, Carnegie Mellon University, Pennsylvania, USA

This is the supplementary to paper *Allocation of COVID-19 Testing Budget on a Commute Network of Counties*. In Section A and B, we provide additional information for the synthetic experiments on the commute network of Massachusetts and Hubei. And in Section C, we provide some additional information for the parameter estimation.

A Additional information for Massachusetts

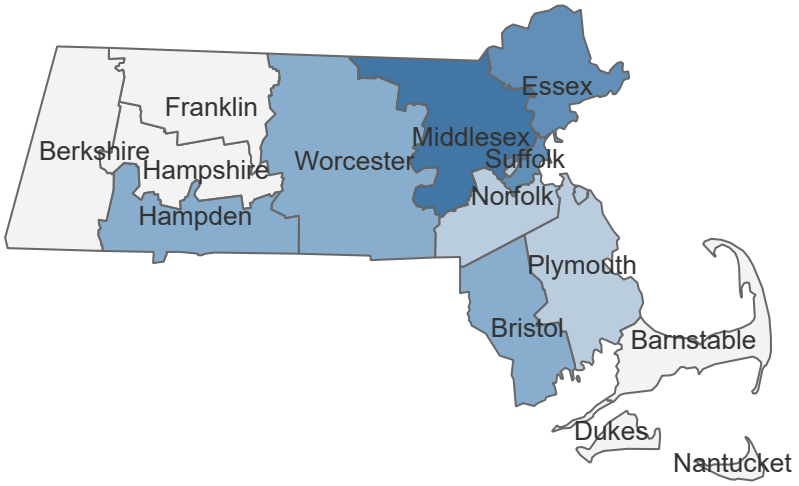

Figure S1: COVID-19 map of Massachusettes county. The color denotes the culmulative confirmed cases at September 30th, 2020. Darker blue means larger number of cases.

In Section 3.1 of the main paper, we provide our experiment results on the commute network of Massachusettes network and Figure 2(left) show the network structure constructed based on traffic distance. Here we provide the map of Massachusetts in Figure S1. This is download from the COVID-19 Interactive Data Dashboard from Mass.gov. It shows the culmulative confirmed case numbers of counties in Massachusettes at September 30th, 2021. This is different from our

experiment settings. In our synthetic analysis, we use the confirmed case numbers of March 19th and 20th, 2020, the beginning stage of COVID-19 pandemic, as the start point of our simulation.

Based on the commute network, we conduct simulations under different strategies and compare the strategy proposed by our screening strategy with the allocation strategy based infection rates. We present 10 days allocation in Figure 4 in the main paper, and in Figure S2, we present the full plot under our default seting for Massachusettes, $\lambda = 100$, $\beta = 0.16$, $\gamma = 1/15$, $\alpha = 0.3$, M = 100K.

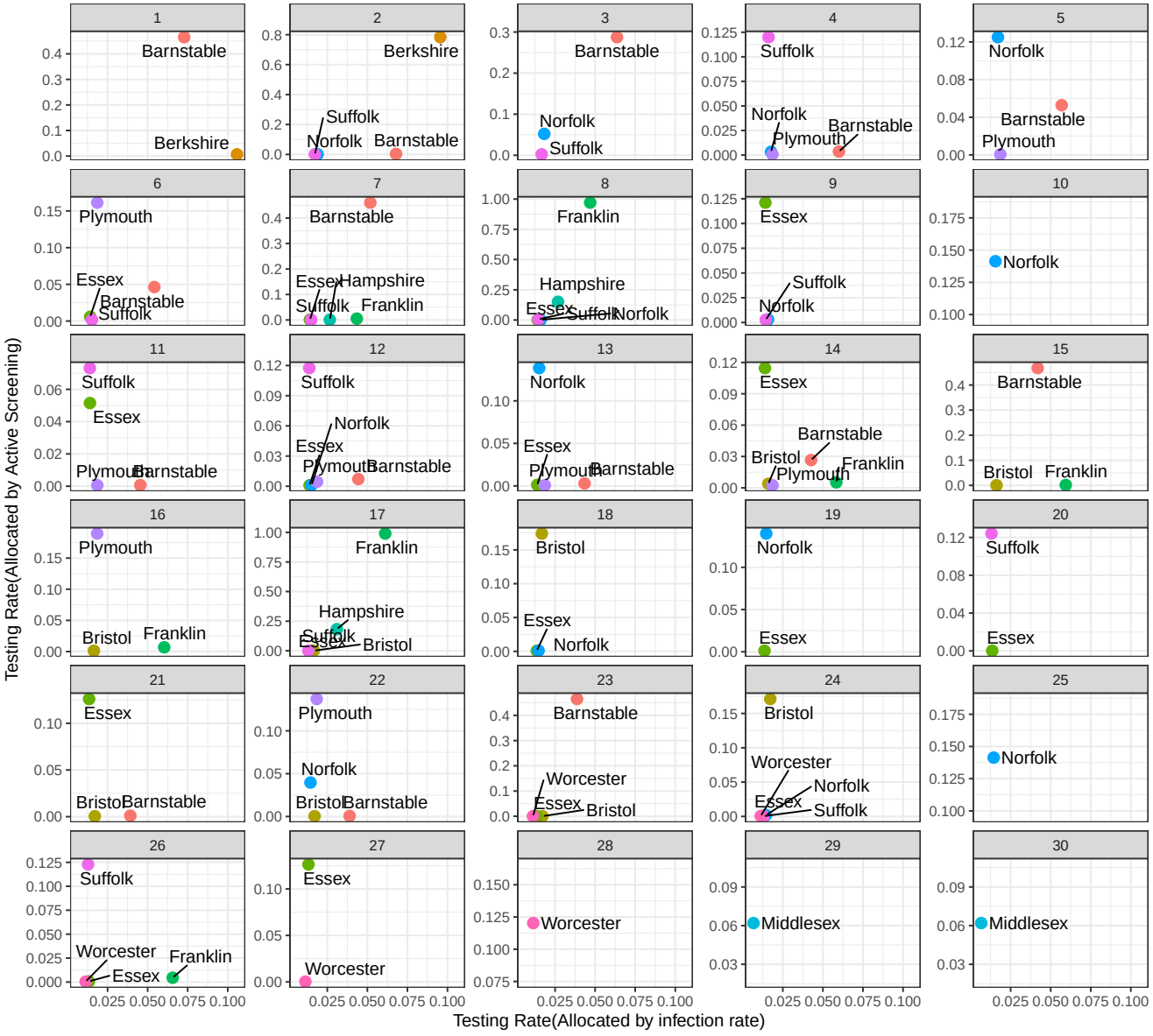

Figure S2: Comparison of the allocated testing rate by our method versus the infection rate in Massachusetts. We only plot counties with a non-zero testing rate in our method. The parameters are $\lambda = 100$, $\beta = 0.16$, $\gamma = 1/15$, $\alpha = 0.3$, M = 100K.

B Additional information for Hubei

Figure S3: City map of Hubei province (Download from Wikipedia.).

Similarly, we also conduct simulation on commute network of Hubei. The network structure in Figure 2(right) is constructed based on the map of Hubei shown in Figure S1. This is download from Wikipedia. In our synthetic analysis of Hubei, we use the confirmed case numbers of Febrary 1st and 2nd, 2020, the beginning stage of COVID-19 pandemic, as the start point of our simulation.

Based on the commute network, we conduct simulations under different strategies and compare the strategy proposed by our screening strategy with the allocation strategy based infection rates. We present 10 days allocation in Figure 4 in the main paper, and in Figure S4, we present the full plot under our default seting for Massachusettes, $\lambda = 50$, $\beta = 0.16$, $\gamma = 1/15$, $\alpha = 0.3$, M = 200K. As we mentioned in the Section 3.1 of the main paper, M = 200K is not enough for such big population in Hubei province. And in this case, our algorithm will choose an relatively extreme strategy by concentrating all resources on Wuhan and Ezhou. If the budget increase, say M = 500K, the algorithm will provide similar results as our discussion for Massachusetts. Figure S4 presents allocation strategies on this setting ($\lambda = 50$, $\beta = 0.16$, $\gamma = 1/15$, $\alpha = 0.3$, M = 500K). In this case,besides Wuhan and Ezhou, the algorithm will also allocate testing resources to cities like Huangshi, Suizhou and Xiaogan, which are also key nodes for the commute network of Hubei.

C Additional information for parameter estimation

In the Section 2.3 of the main paper, we propose two methods for estimating λ and α. The estimation results on real data of the second method are discussed in Section 3.2 in the main paper. Here we show the estimation results of the first method. Using the same data preriod as main paper, from March 15, 2021 to April 1, 2021, the optimal parameters given by the first method is $\hat{\alpha} = 0.50$ and $\hat{\lambda} = 19.61mi$. This infection rate is smaller than the results given by the second method. Therefore, in fitting and prediction, it tends to underestimate the number of confirmed cases as shown in Figure S6.

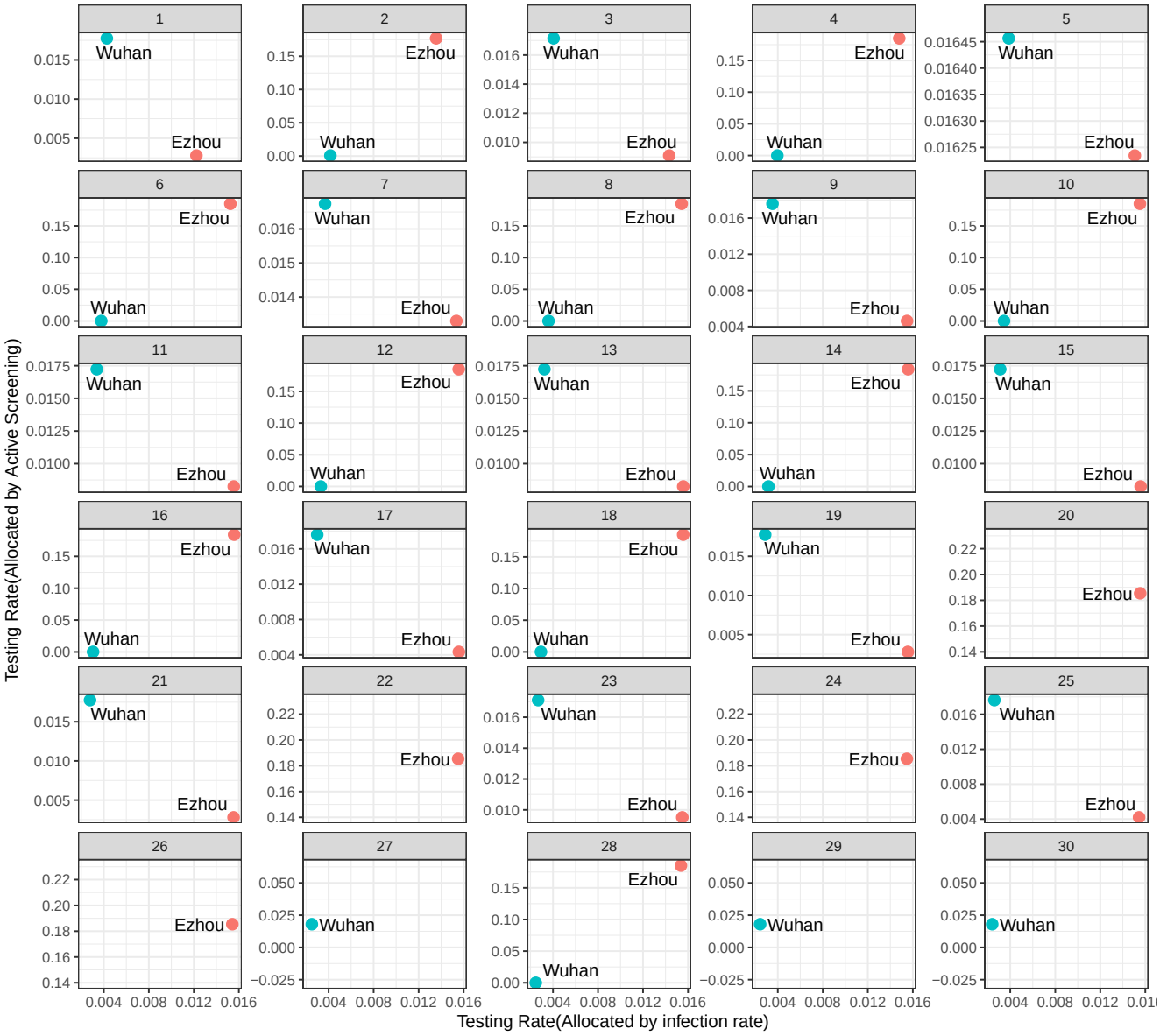

Figure S4: Comparison of the allocated testing rate by our method versus the infection rate in Hubei. We only plot counties with a non-zero testing rate in our method. The parameters are $\lambda = 50$, $\beta = 0.16$, $\gamma = 1/15$, $\alpha = 0.3$, M = 200K.

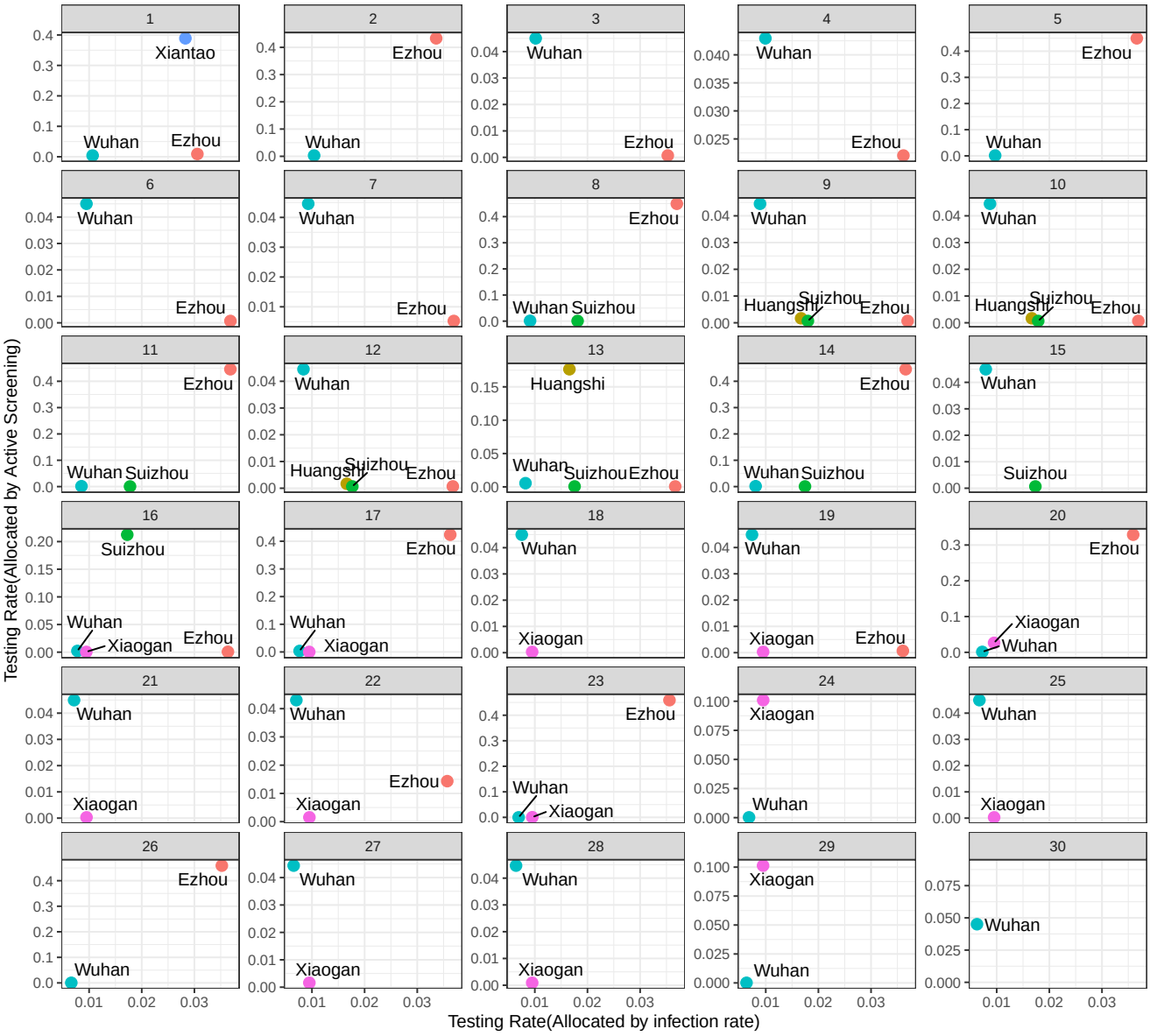

Figure S5: Comparison of the allocated testing rate by our method versus the infection rate in Hubei. We only plot counties with a non-zero testing rate in our method. The parameters are $\lambda = 50$, $\beta = 0.16$, $\gamma = 1/15$, $\alpha = 0.3$, M = 500K.

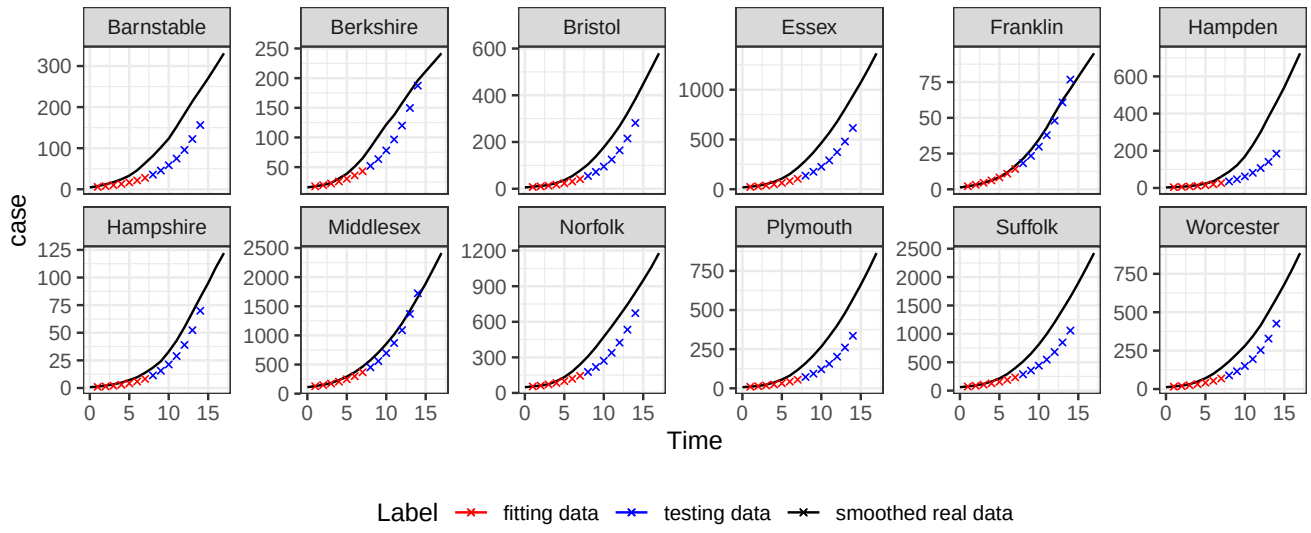

Figure S6: Parameter estimation for Massachusetts via the first estimation method proposed in Section 2.3 in the main paper. The black lines are the smoothed real data of cumulative confirmed cases during March 15–April 1, 2021. The red crosses are the fitting values for March 16-22, 2021, and the blue crosses are the predictions for March 23-29, 2021.