Shelter in Place Triggers

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Purpose

Evaluate potential triggers to intervene on COVID transmission (e.g. shelter in place or other method to reduce contact and transmission) from signals in testing data.

Testing

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## Warning: Removed 12 rows containing missing values (geom_path).
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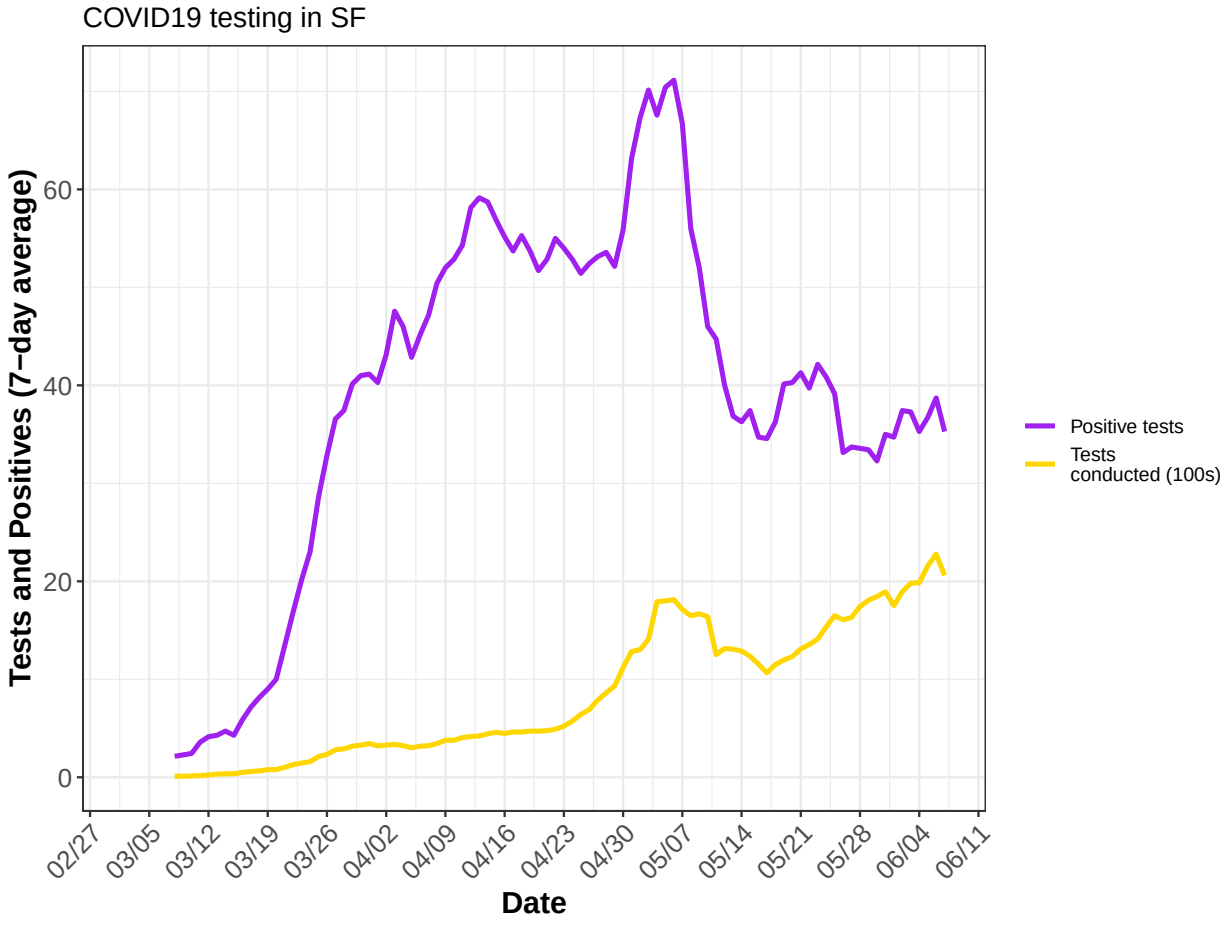

Model

We use a slight tweak to LEMMA to add an explicit deaths compartment in order to fit to deaths data in addition to hospitalizations

Table 1: Best fit model parameters

	Value	Definition
N	883305	population size
t.sim	113	time to run simulation
E_0	5.921	starting number of exposed
c_r	1	Relative contact rate between S and Ir
c_h	1	Relative contact rate between S and Ih
σ	0.333	1/serial interval
α	0.039	proportion severely symptomatic (will be hospitalized)
ρ	0.25	time between symptom onset and hospitalization
γ_r	0.2	1/time to recovery (non-infectiousness) for mildly symptomatic
γ_h	0.083	1/time hospitalized
μ	0.112	proportion of hospitalized cases who die

$$
\begin{aligned}
\dot{S} &= -\beta S(I_R + I_H)/N \\
\dot{E} &= \beta S(I_R + I_H)/N - \sigma E \\
\dot{I_R} &= \sigma(1-\alpha)E - \gamma_R I_R \\
\dot{I_H} &= \sigma\alpha E - \rho I_H \\
\dot{H} &= \rho I_H - \gamma_H H \\
\dot{D} &= \gamma_H \mu H \\
\dot{R} &= \gamma_R I_R \gamma_H (1-\mu) H
\end{aligned}
$$

Model fit

```
## Warning: Removed 22 rows containing missing values (position_stack).
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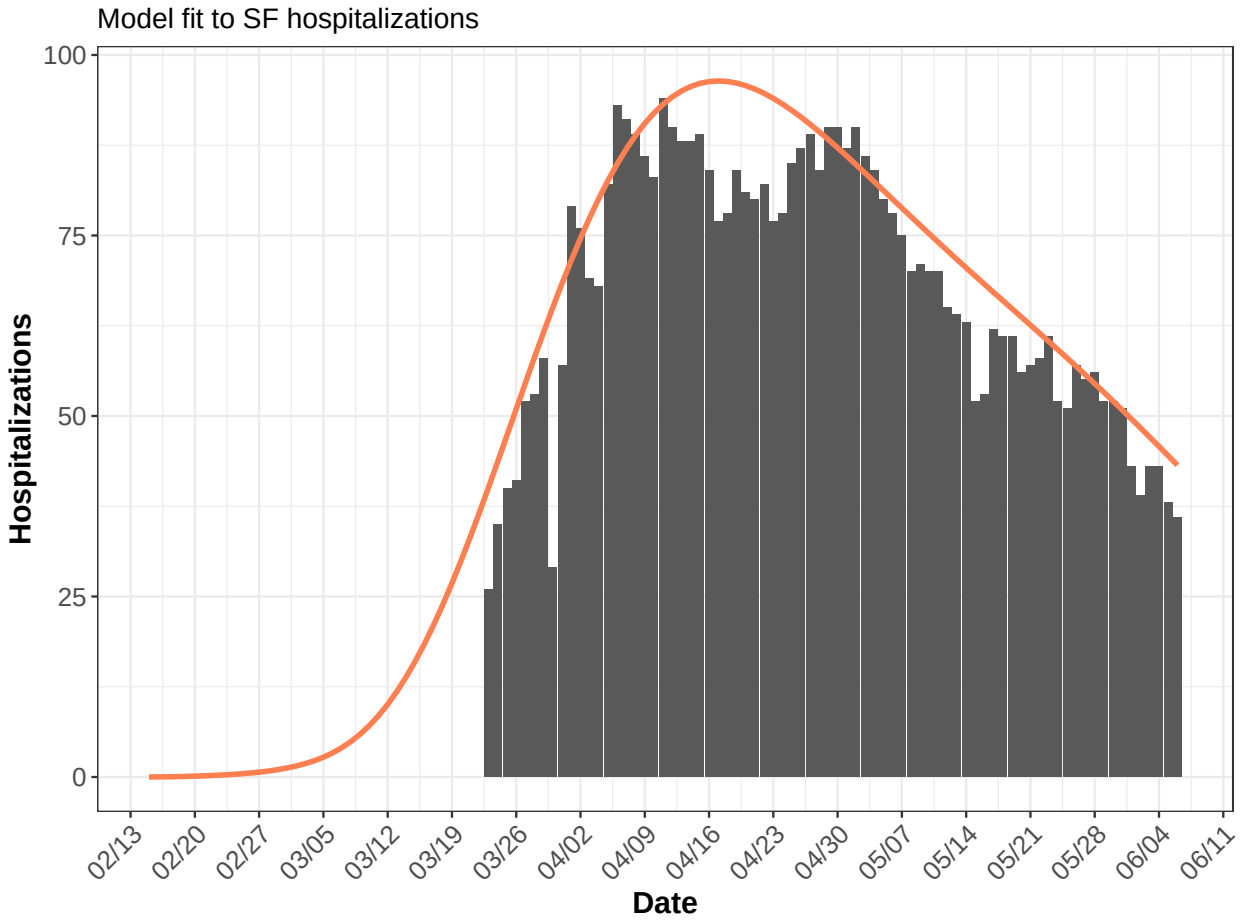


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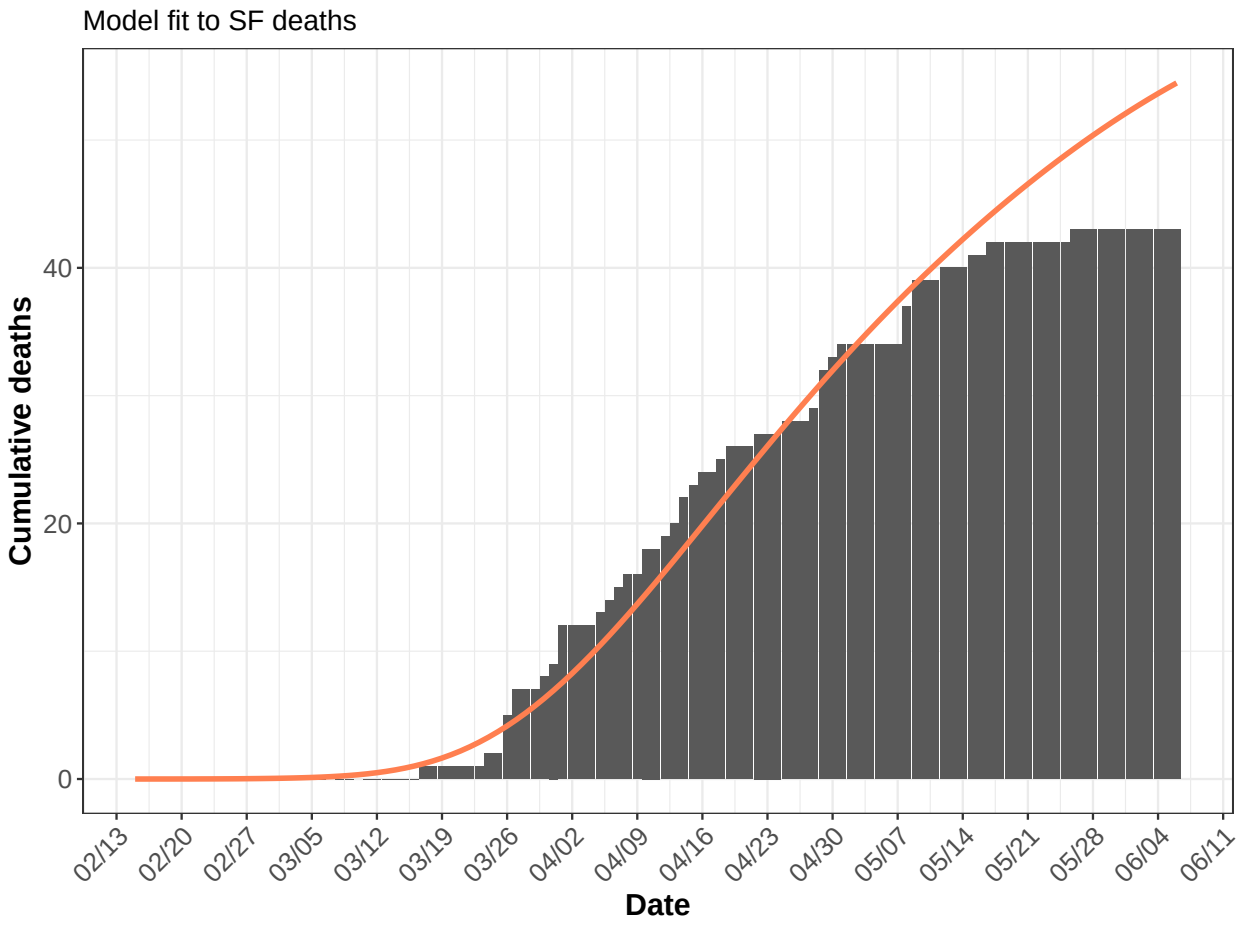


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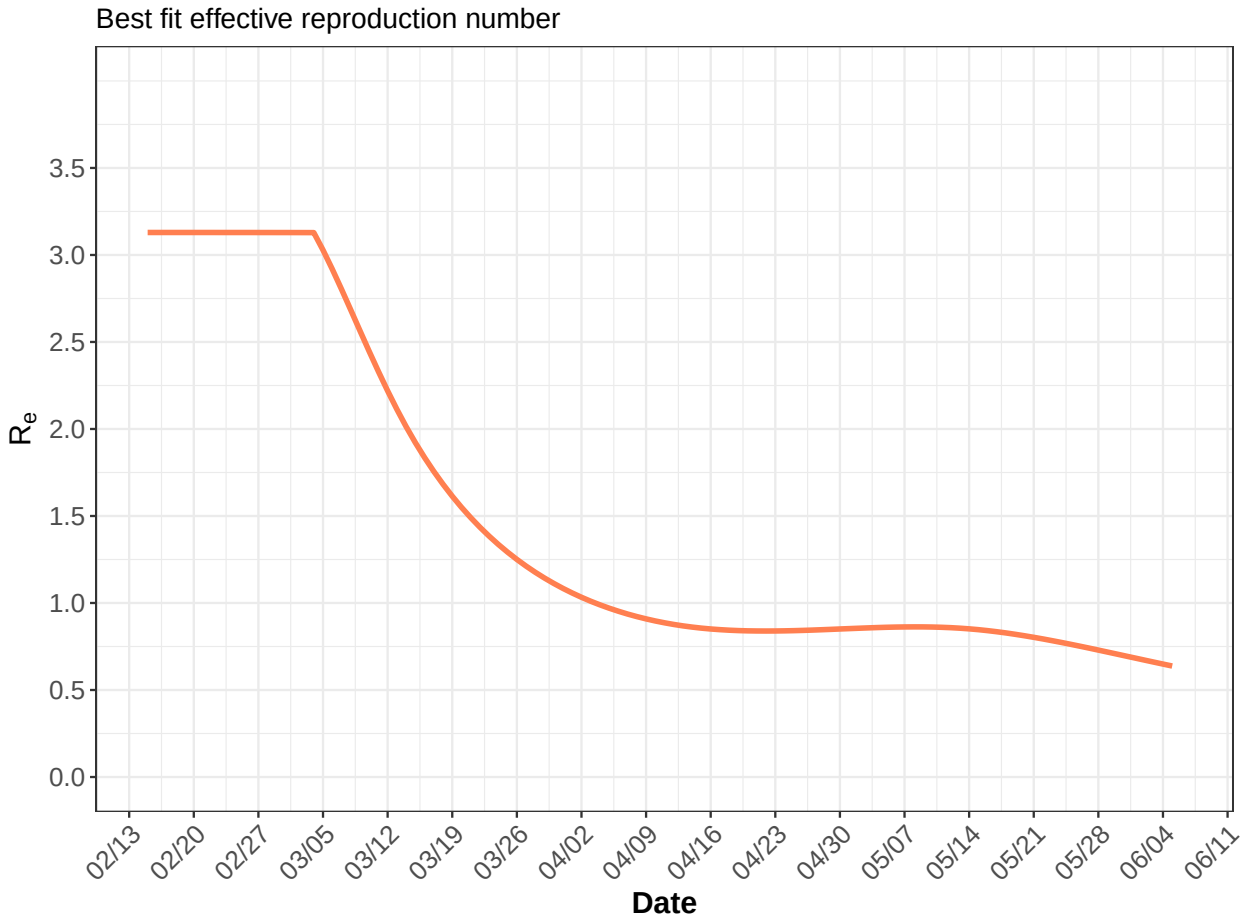

Comparison to testing data

```
## Warning: Removed 13 rows containing missing values (geom_path).
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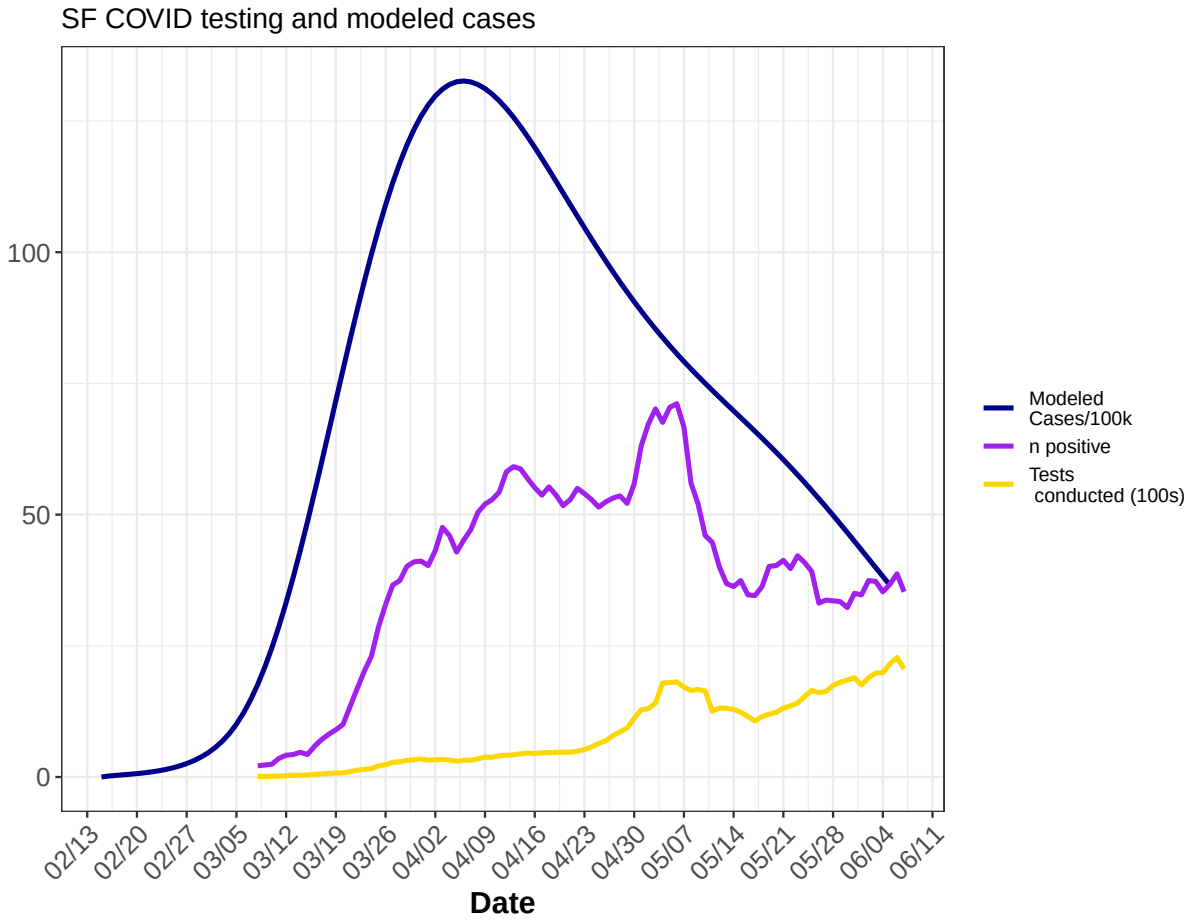


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## Warning: Removed 16 rows containing missing values (geom_path).
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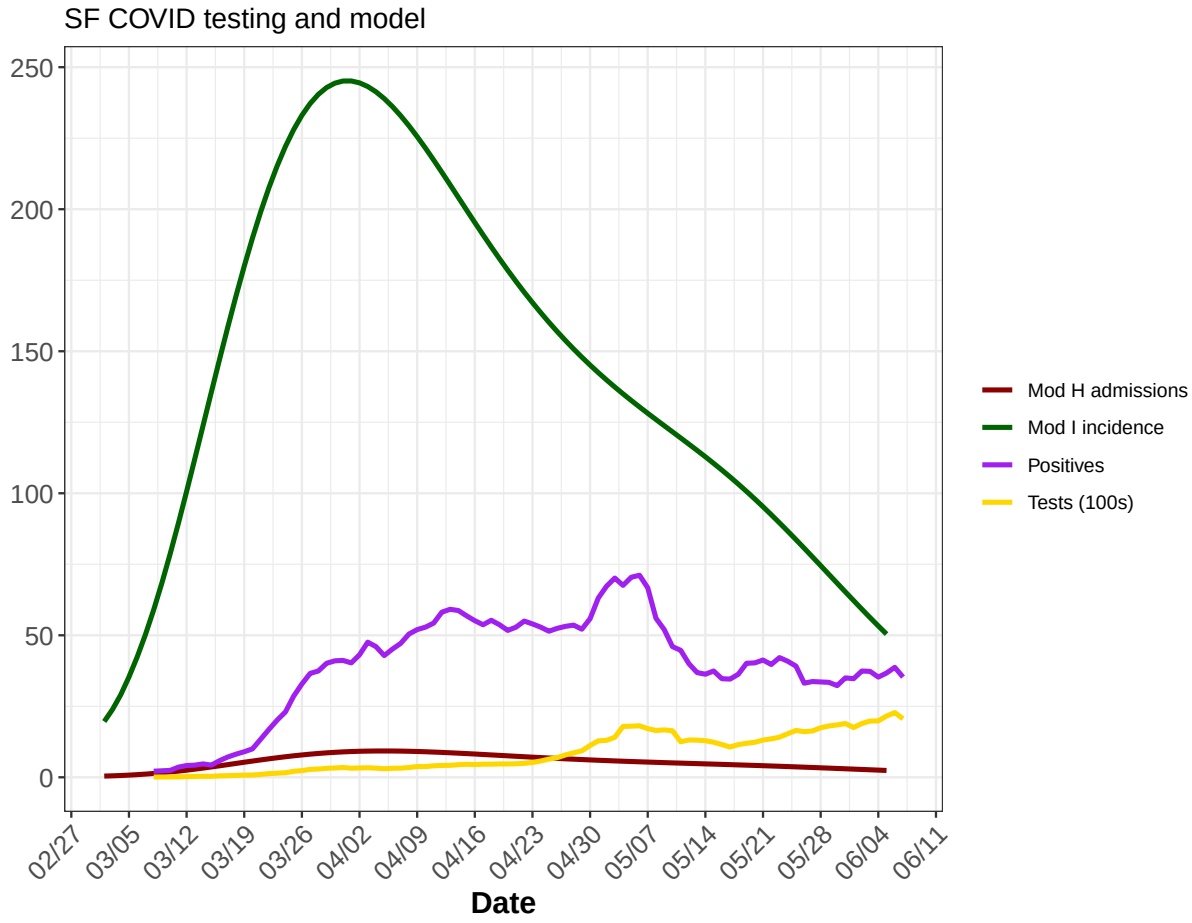

Match modeled testing to observed testing

Assume all new hospitalized cases are tested and confirmed positive, then assume remaining tests are allocated to non-hospitalized population. In the model, this is equivalent to a sample of S, E, and $I_r + I_h$. In reality, lots of nuance in the E and R compartments with regard to testing, but for simplicity, we'll assume positive tests from this sample only come from $I_r + I_h$ and Rs are not tested. So want to solve for sampling bias, $\mathcal{B}$, from:

$$\frac{+Tests - H_{new}}{Tests - H_{new}} = \frac{\mathcal{B}(I_r + I_h)}{S + E + I_r + I_h}$$

```
## Warning: Removed 8 rows containing missing values (geom_path).
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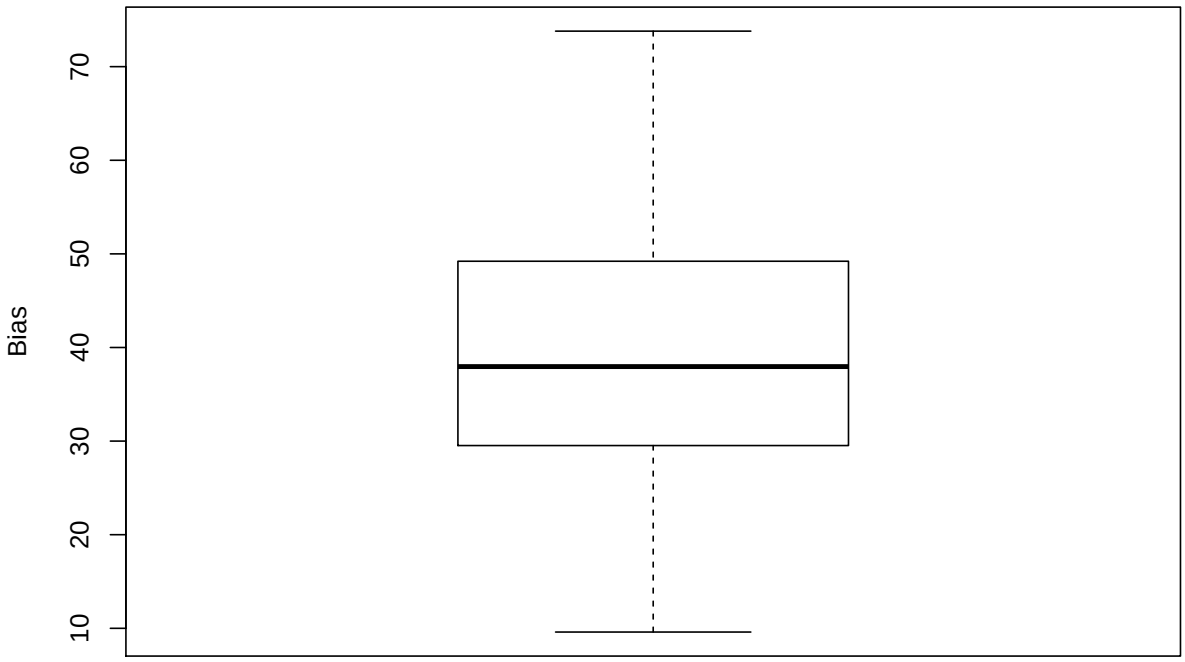
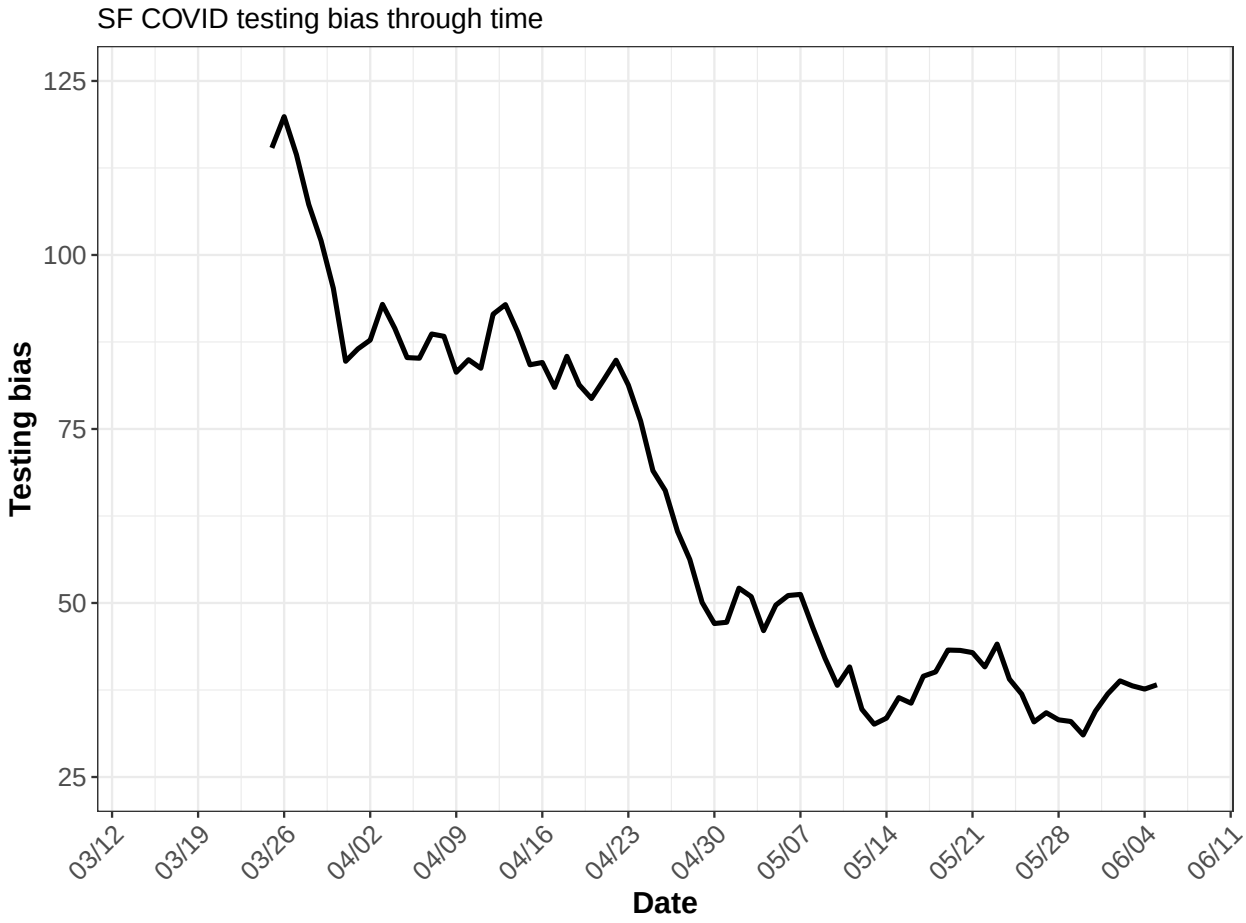
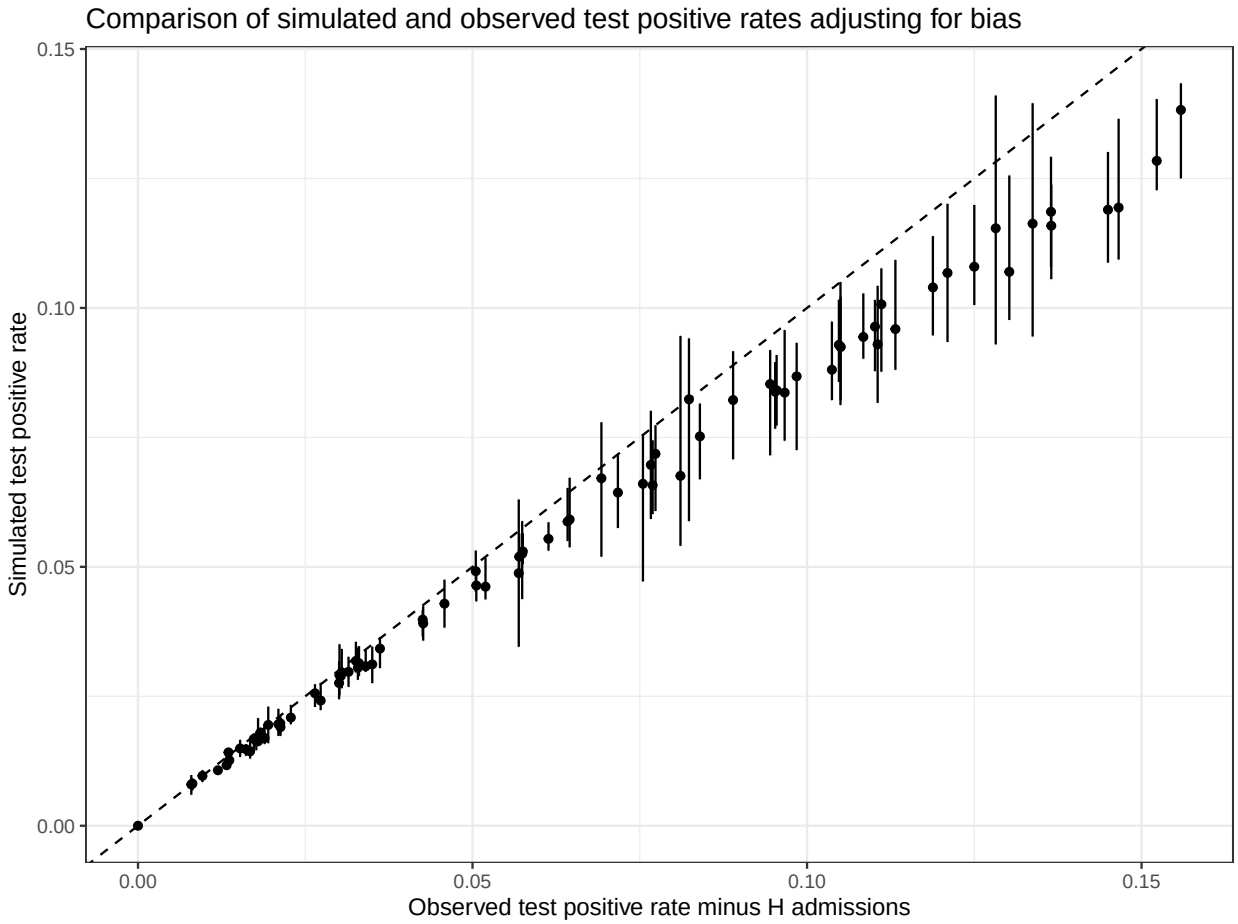


Figure 1: Distribution of estimated sampling bias since end of April


SF COVID testing bias through time
125
100
75
50
25
Testing bias
03/12
03/19
03/26
04/02
04/09
04/16
04/23
04/30
05/07
05/14
05/21
05/28
06/04
06/11
Date



Model forecast

$\mathcal{R}_e \rightarrow 1.4$

```
## Warning: Removed 22 rows containing missing values (position_stack).
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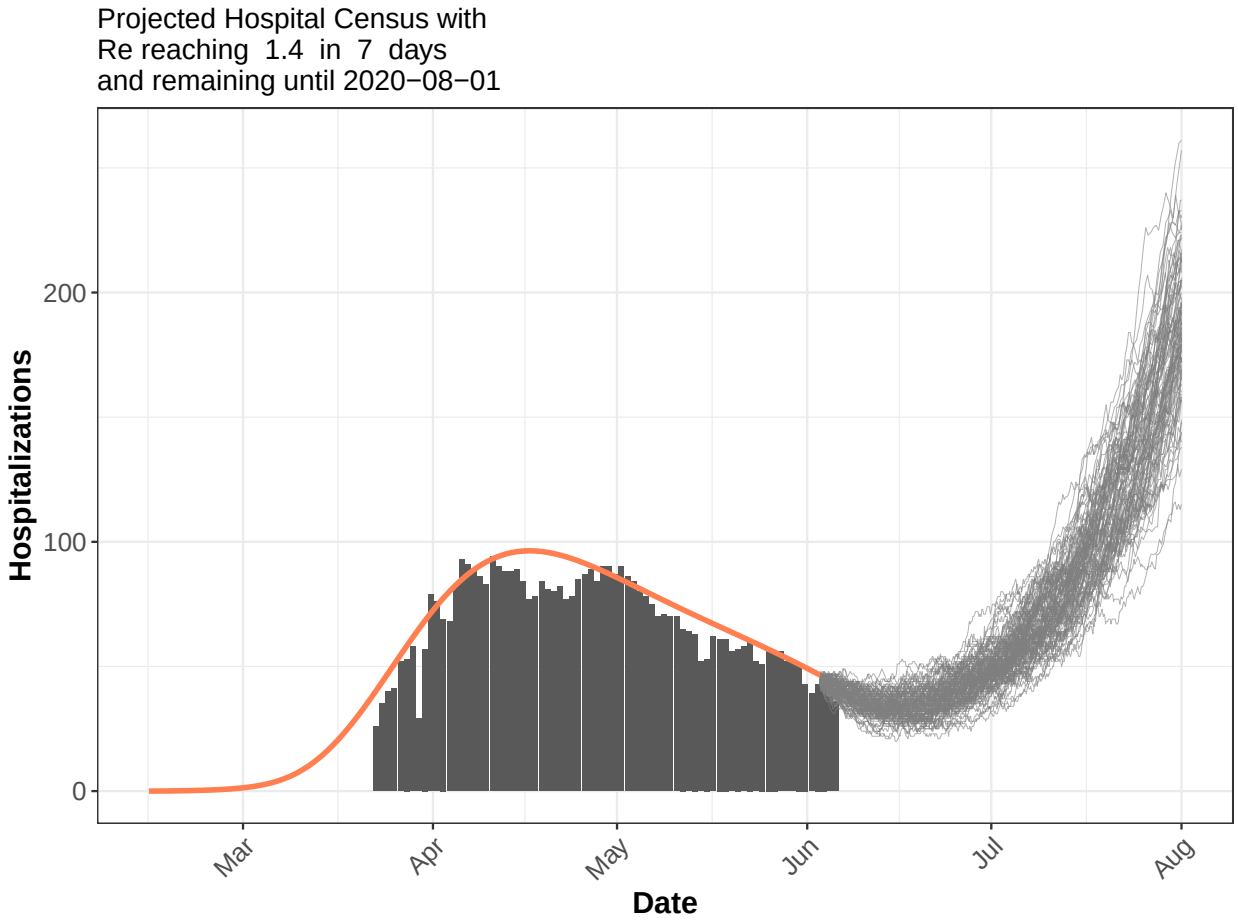
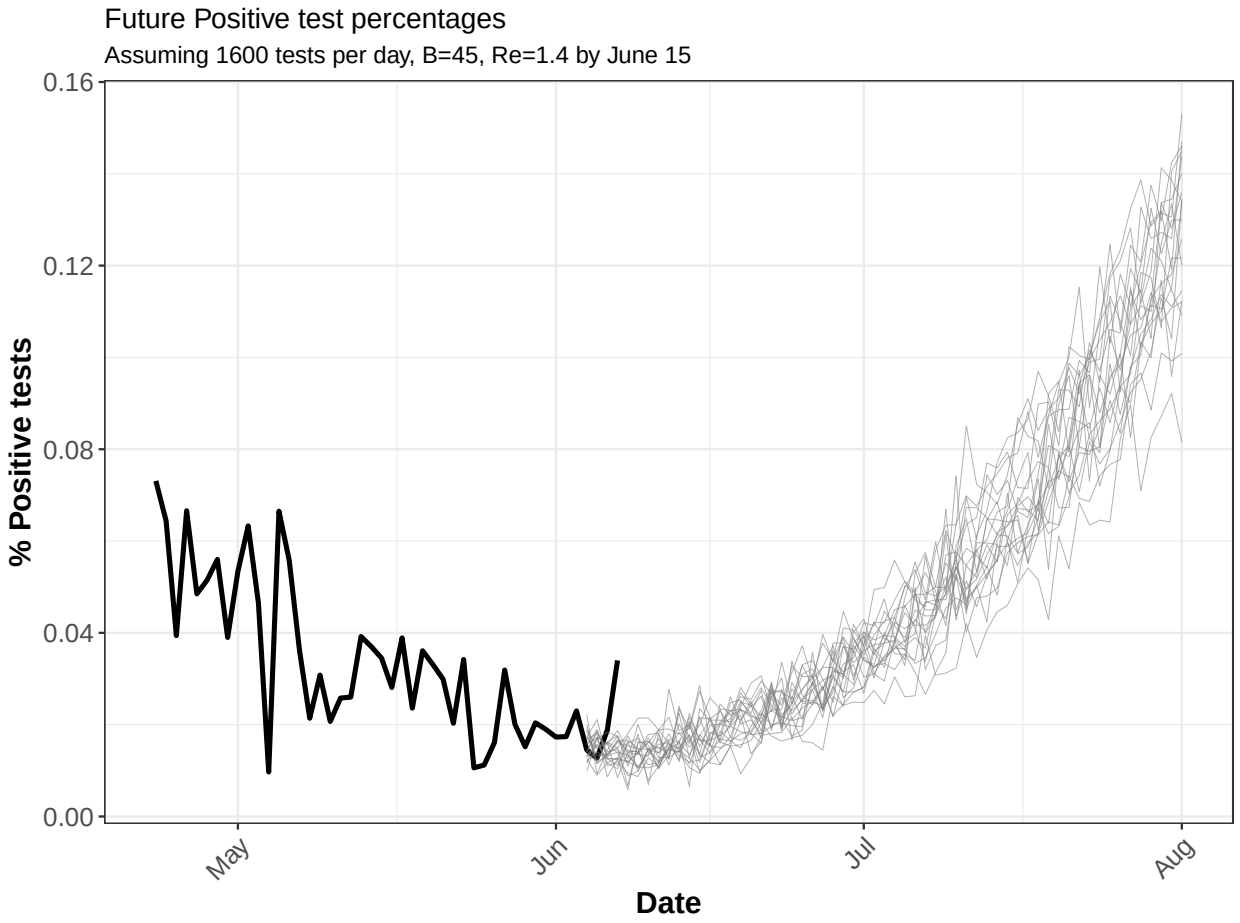
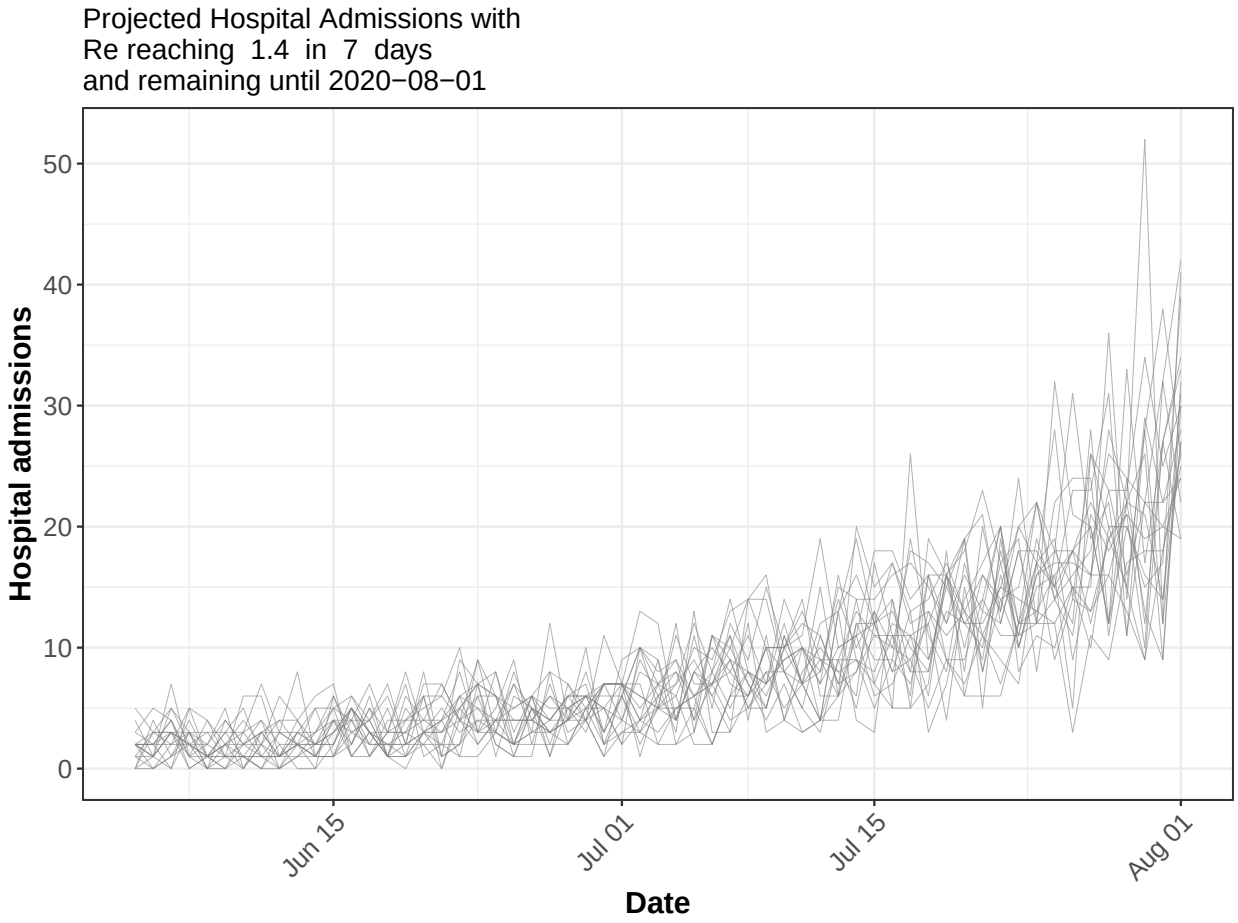
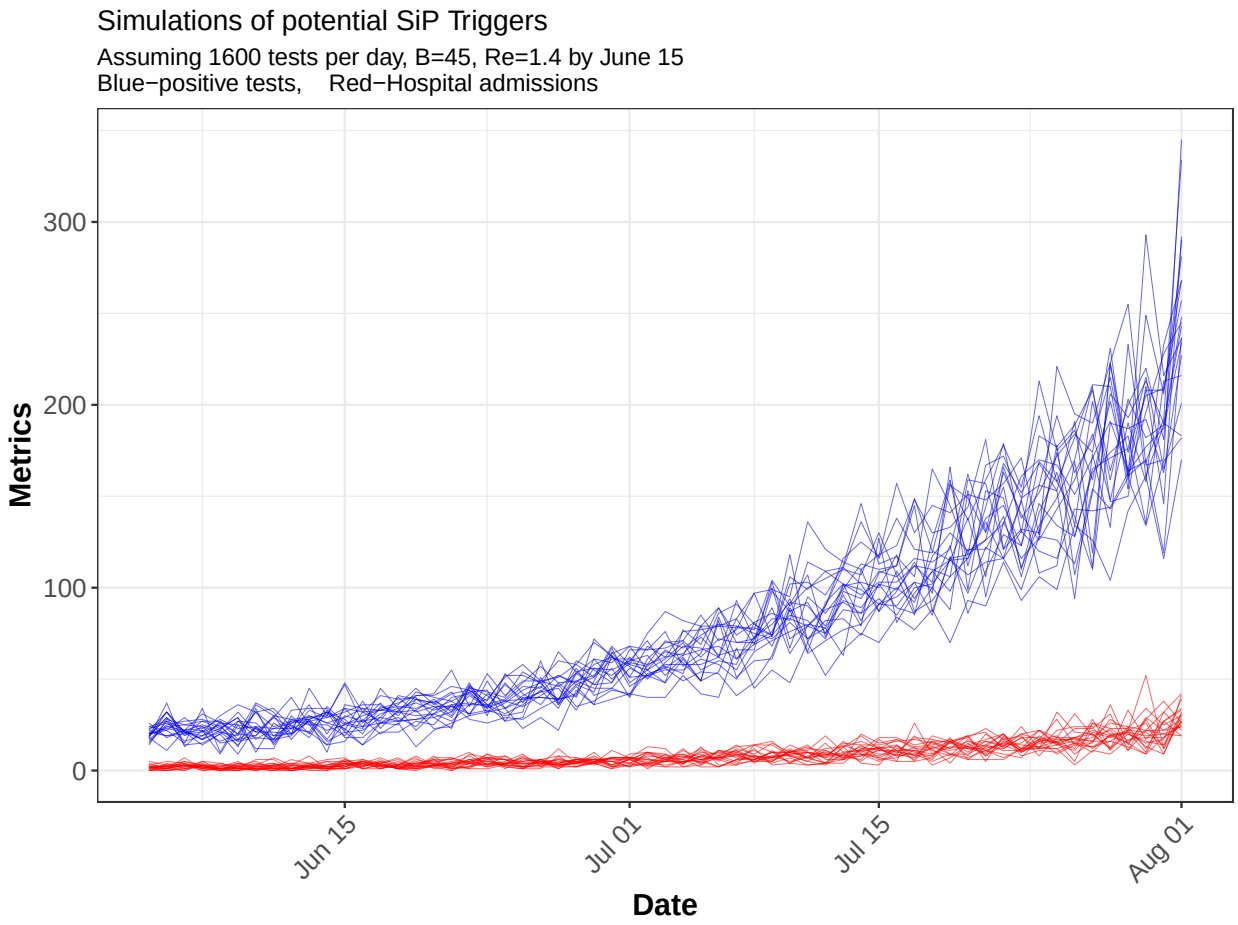

Projected Hospital Census with
Re reaching 1.4 in 7 days
and remaining until 2020−08−01
Hospitalizations
200
100
0
Mar
Apr
May
Jun
Jul
Aug
Date


Future Positive test percentages
Assuming 1600 tests per day, B=45, Re=1.4 by June 15
0.16
0.12
0.08
0.04
0.00
% Positive tests
May
Jun
Jul
Aug
Date


Projected Hospital Admissions with
Re reaching 1.4 in 7 days
and remaining until 2020−08−01
Hospital admissions
0
10
20
30
40
50
Jun 15
Jul 01
Jul 15
Aug 01
Date

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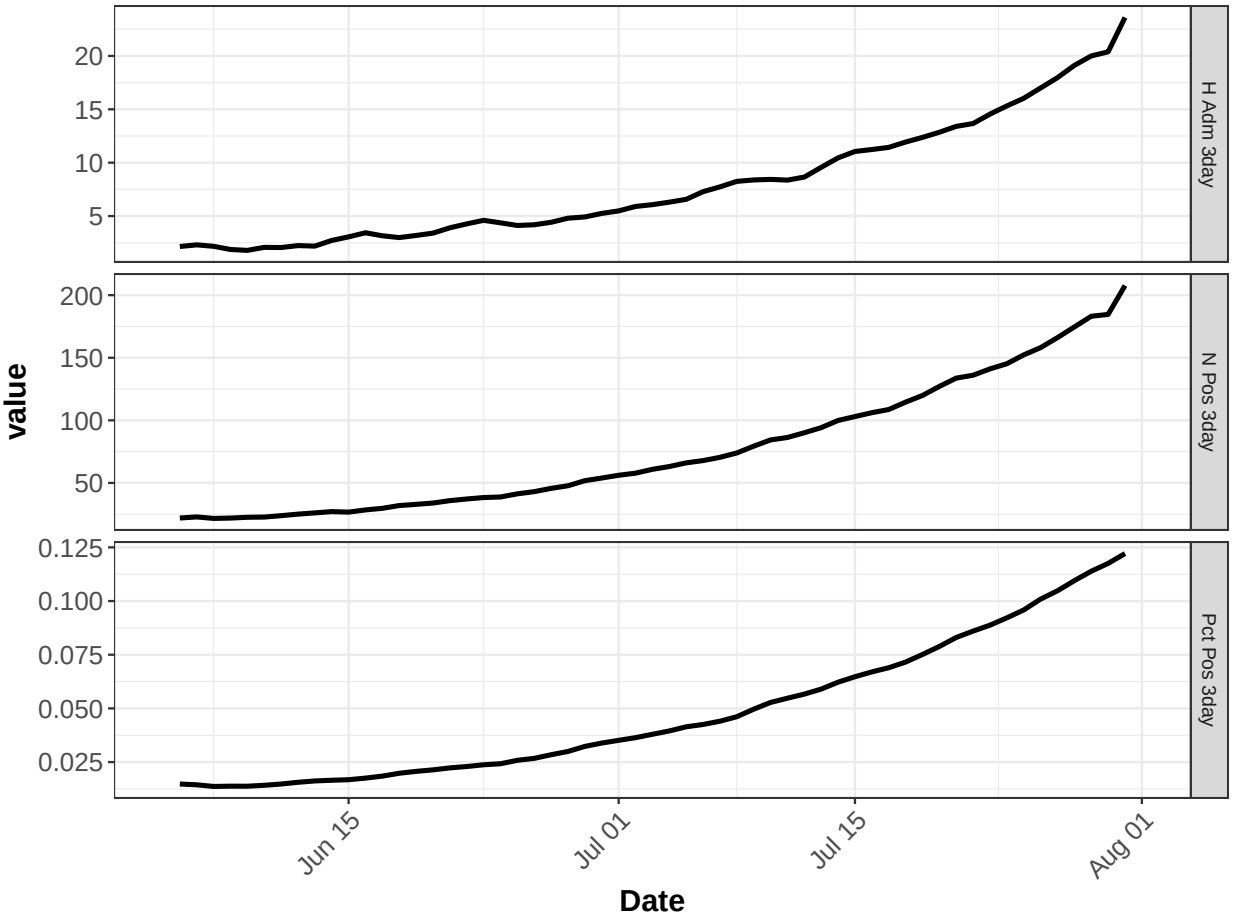
H Adm 3day
N Pos 3day
Pct Pos 3day
value
Date
Jun 15
Jul 01
Jul 15
Aug 01