

Shelter in Place Triggers

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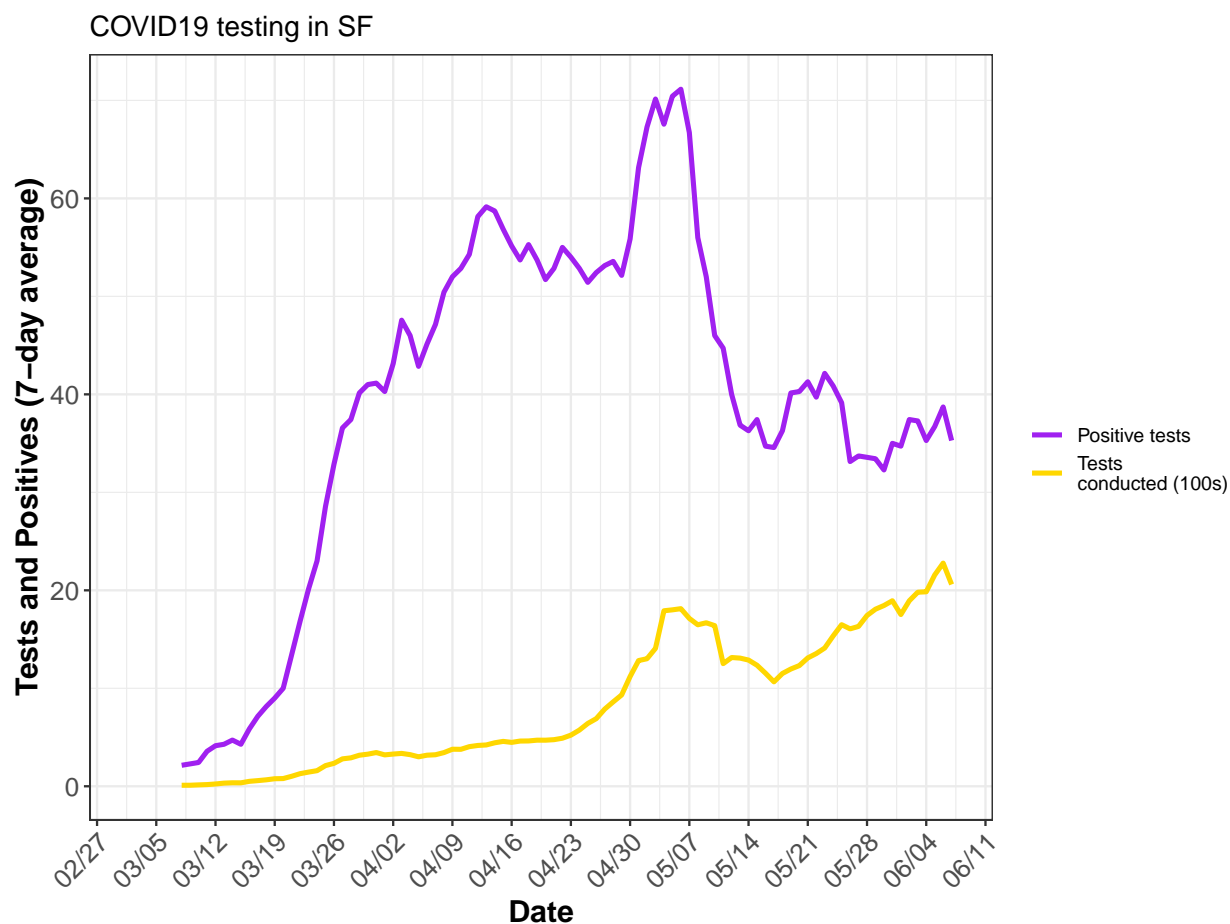
6/4/2020

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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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

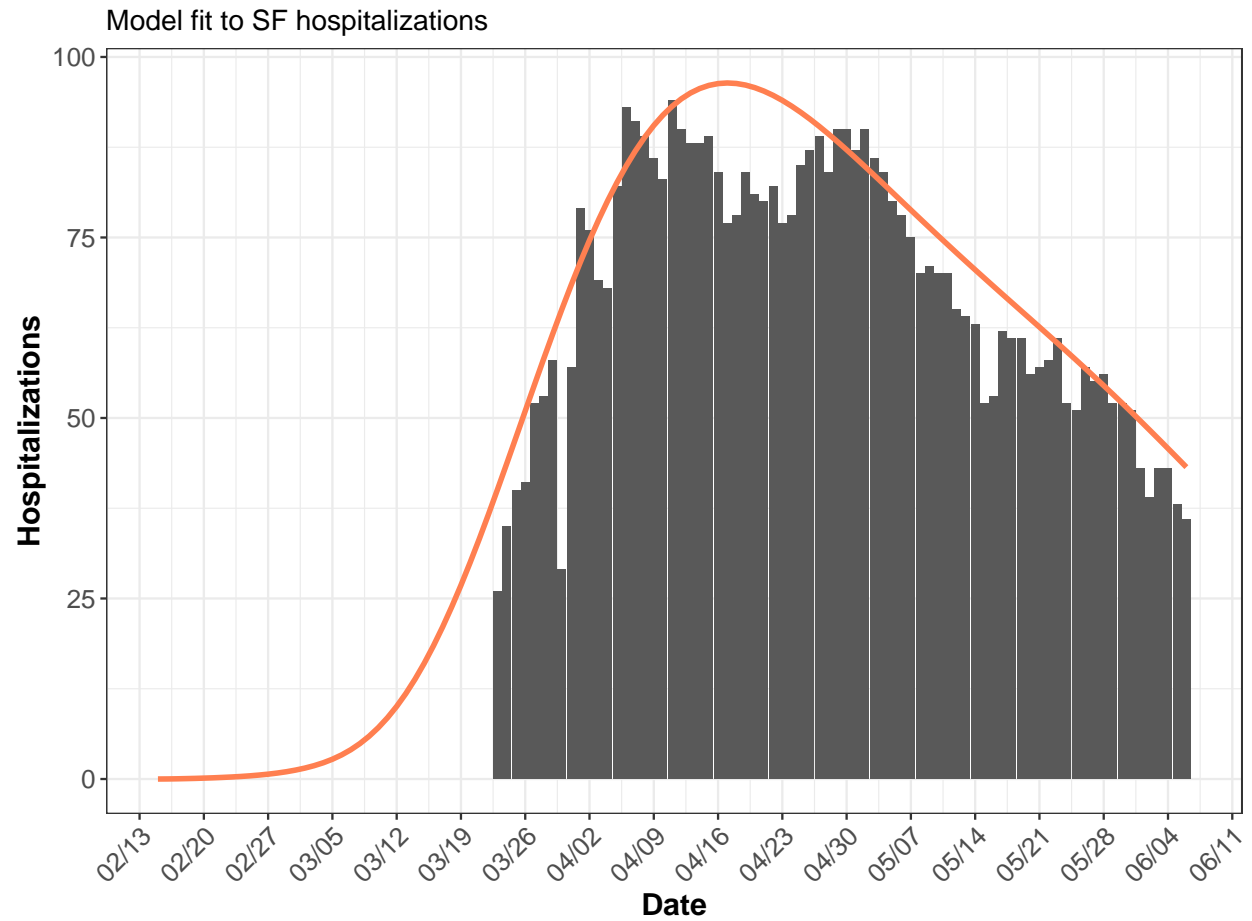
Table 1: Best fit model parameters

	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

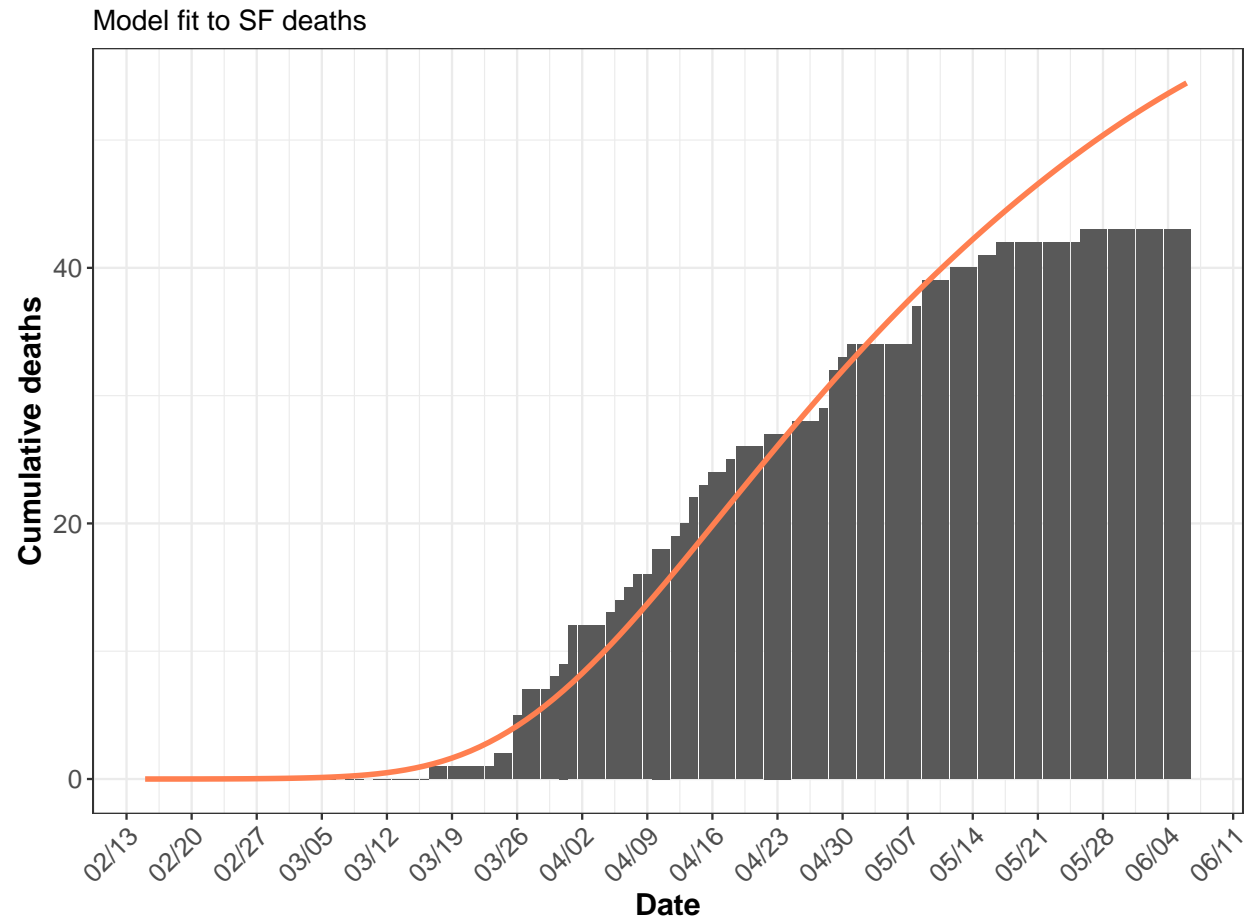
$$\begin{aligned}
\dot{S} &= -\beta S(I_R + I_H)/N \\
\dot{E} &= \beta S(I_R + I_H)/N - \sigma E \\
\dot{I}_R &= \sigma(1 - \alpha)E - \gamma_R I_R \\
\dot{I}_H &= \sigma\alpha E - \rho I_H \\
\dot{H} &= \rho I_H - \gamma_H H \\
\dot{D} &= \gamma_H \mu H \\
\dot{R} &= \gamma_R I_R + \gamma_H (1 - \mu)H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

Model fit

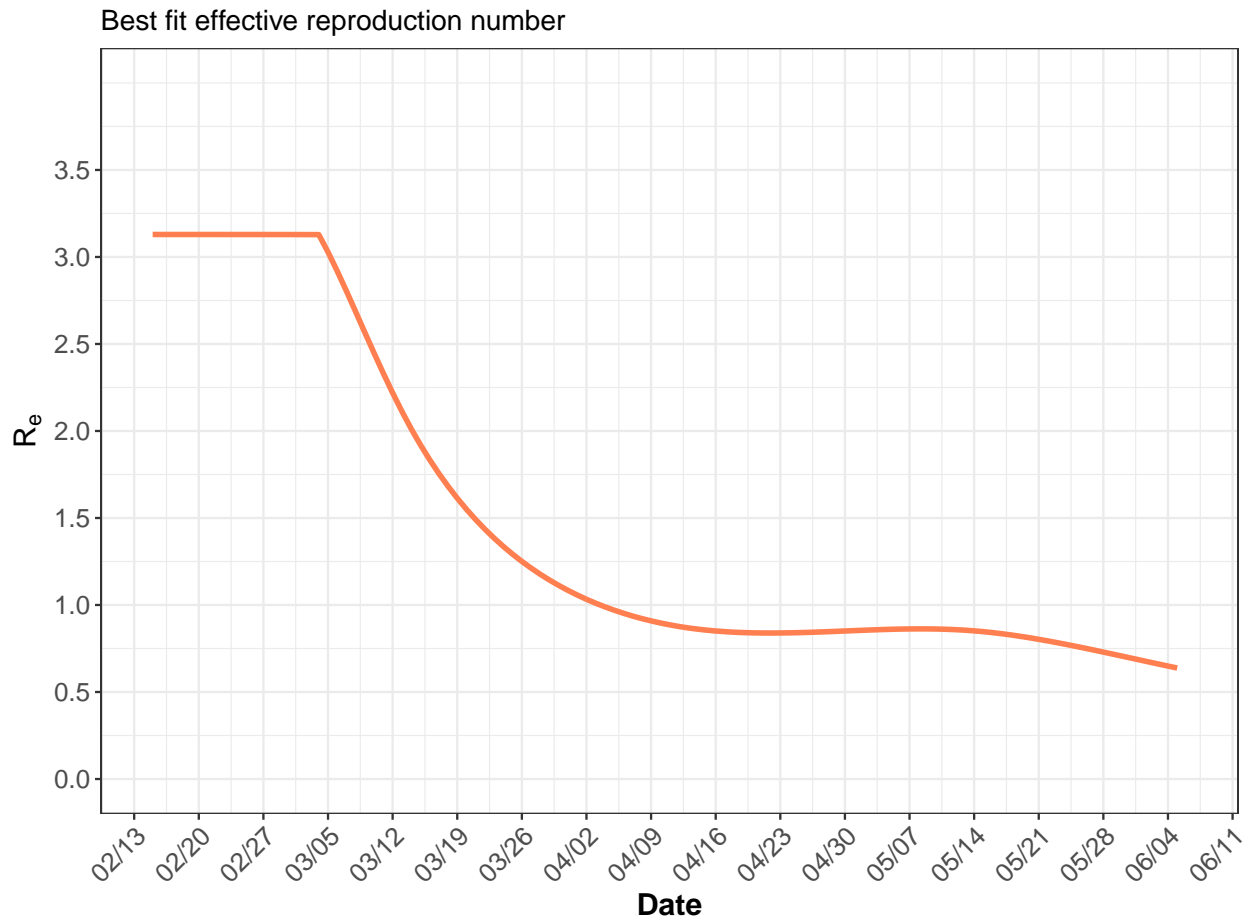
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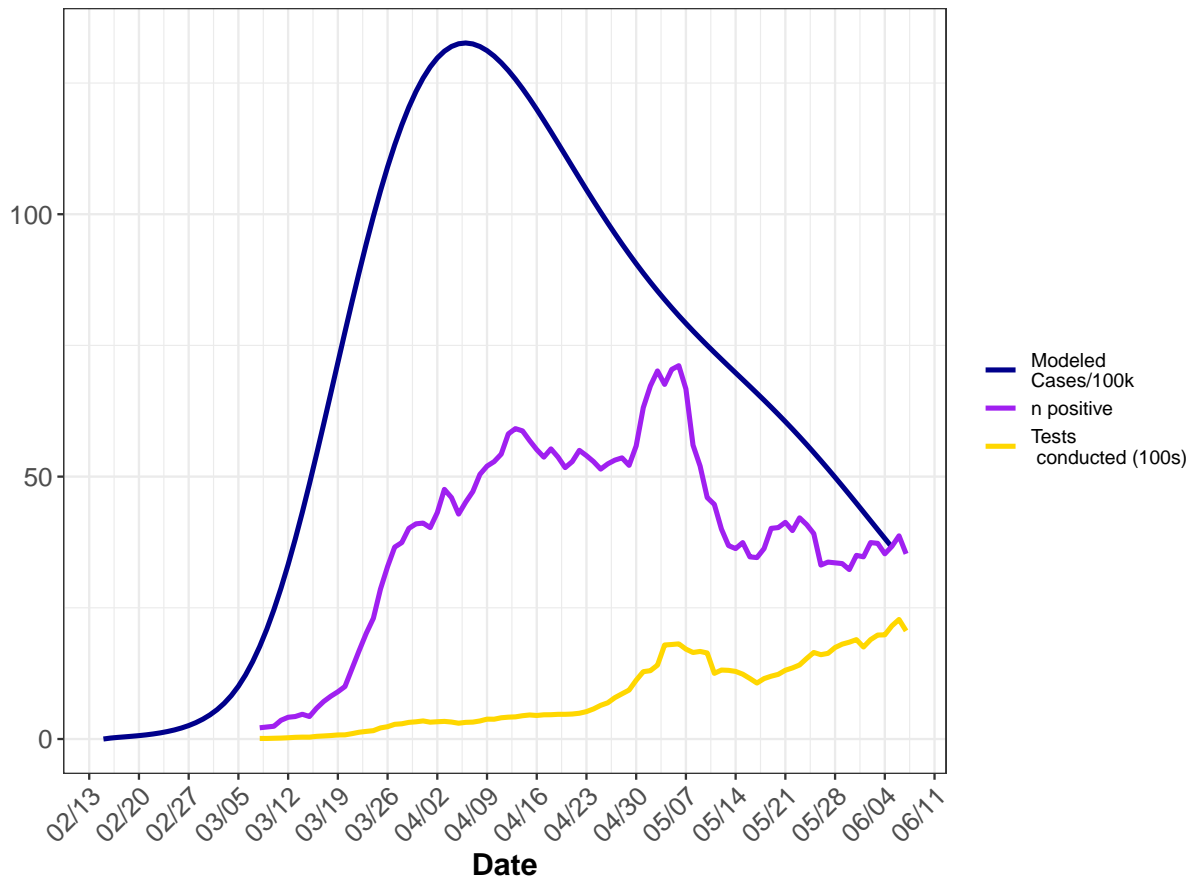
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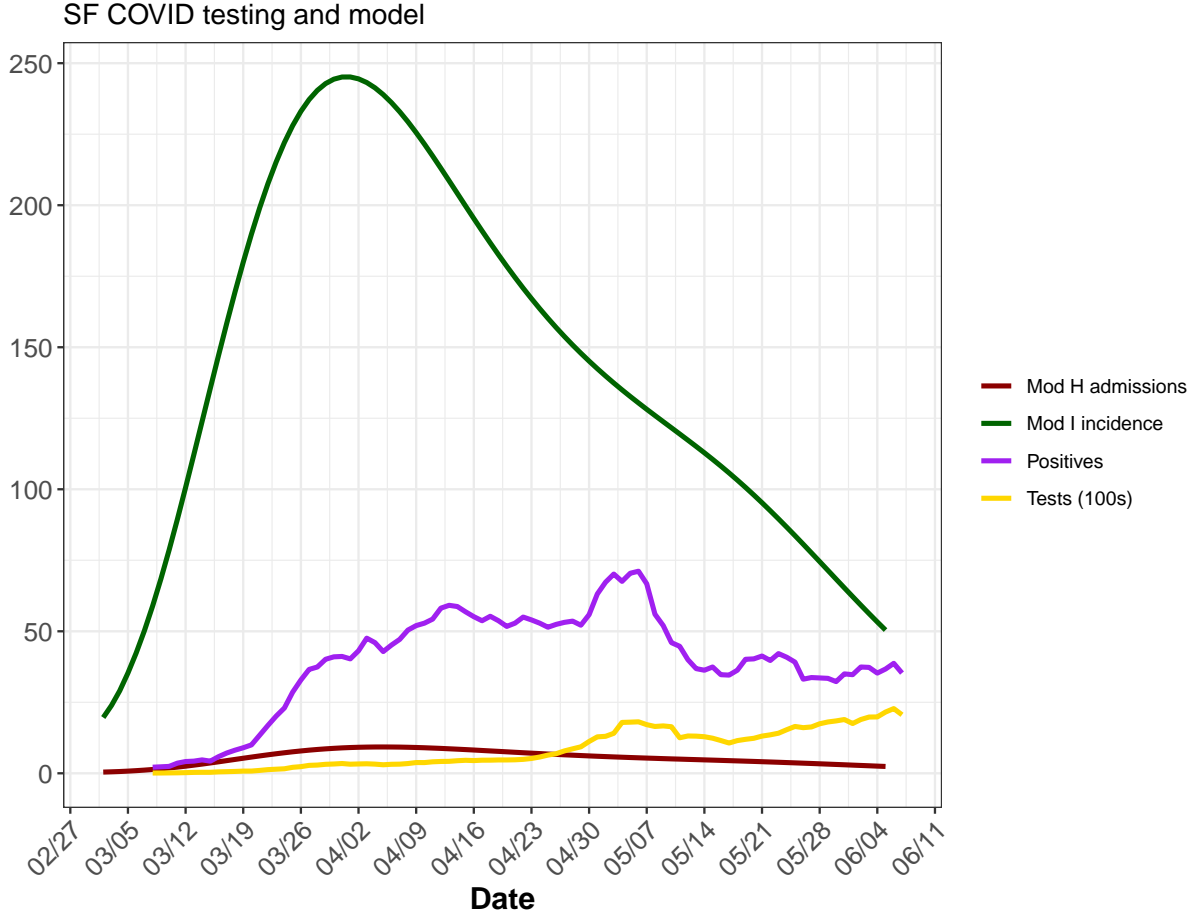
Comparison to testing data

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SF COVID testing and modeled cases



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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 R s are not tested. So want to solve for sampling bias, \mathcal{B} , from:

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

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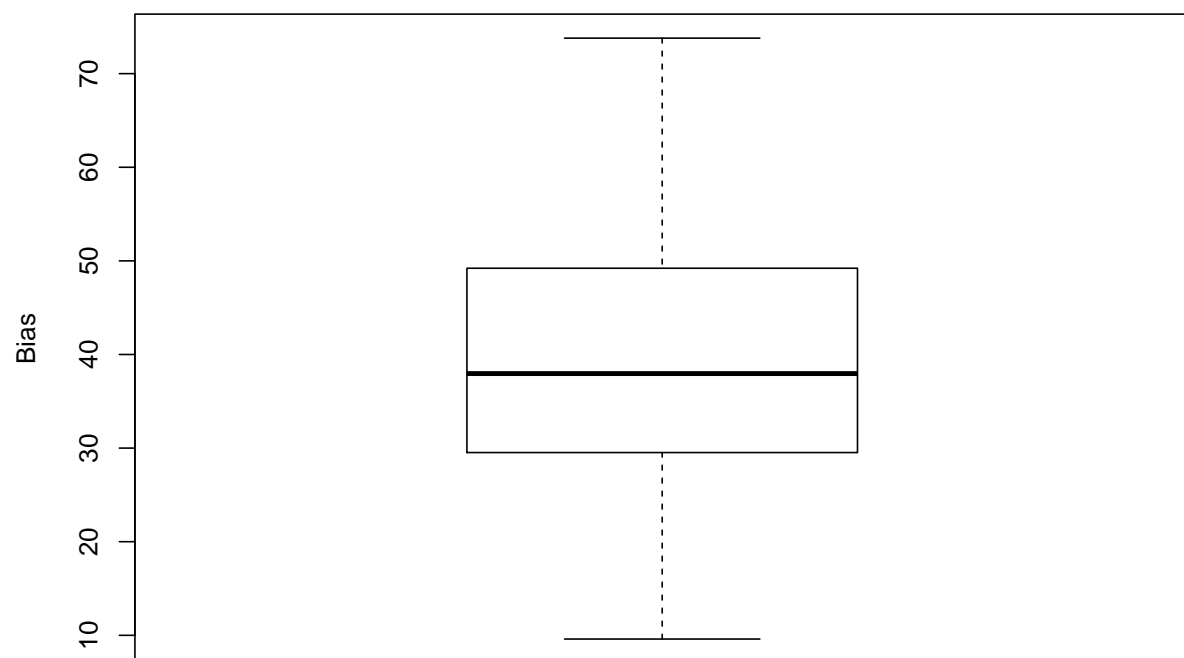
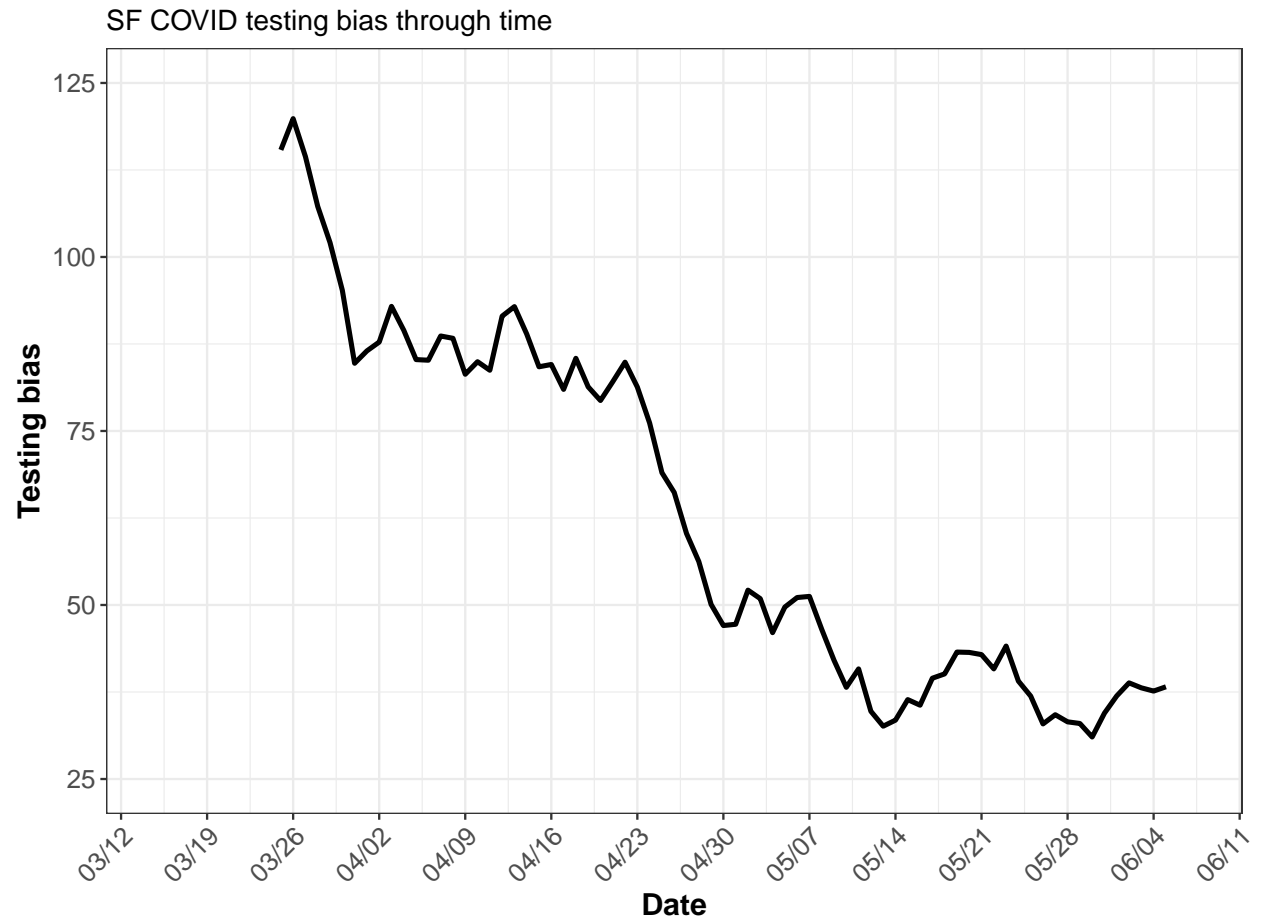
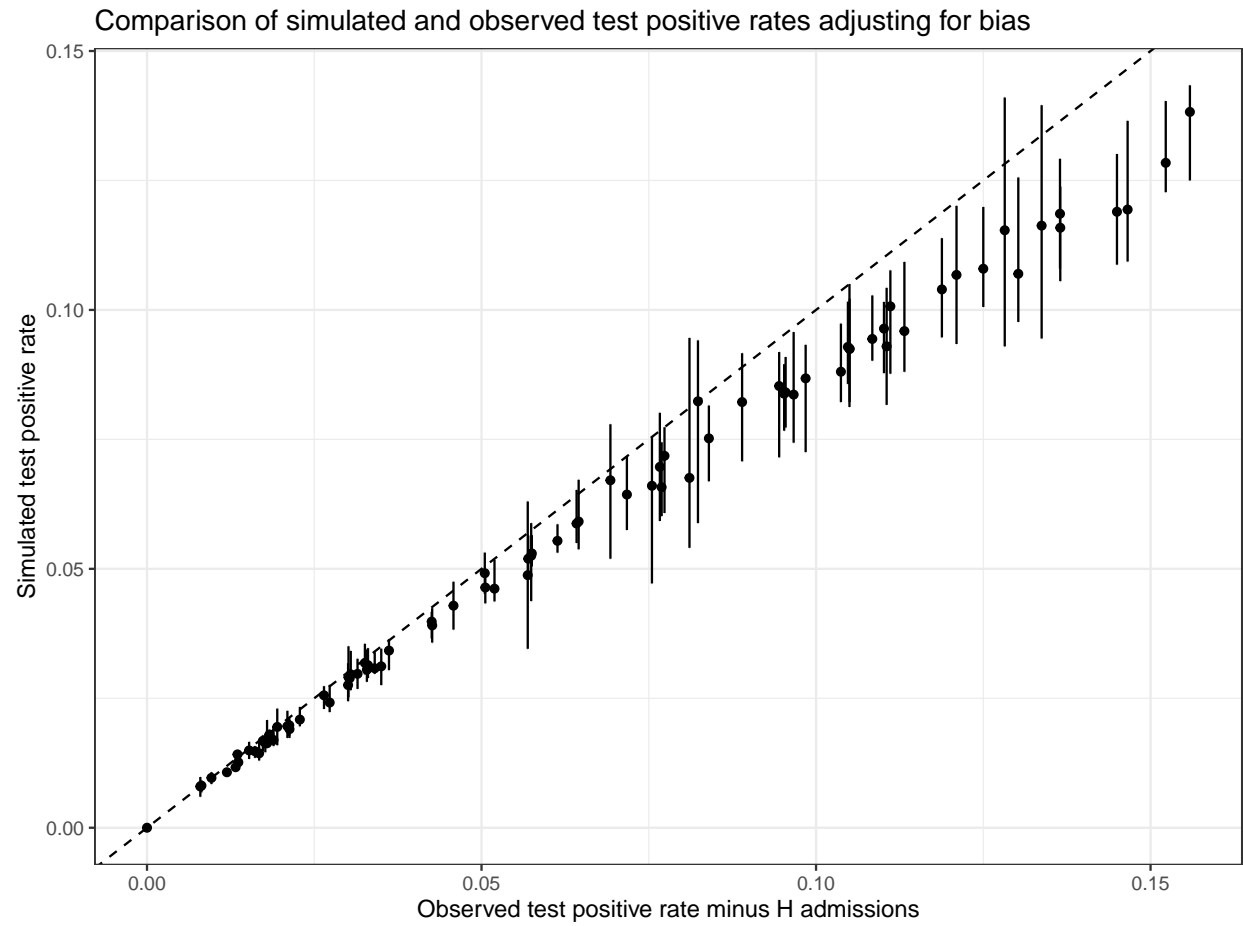


Figure 1: Distribution of estimated sampling bias since end of April



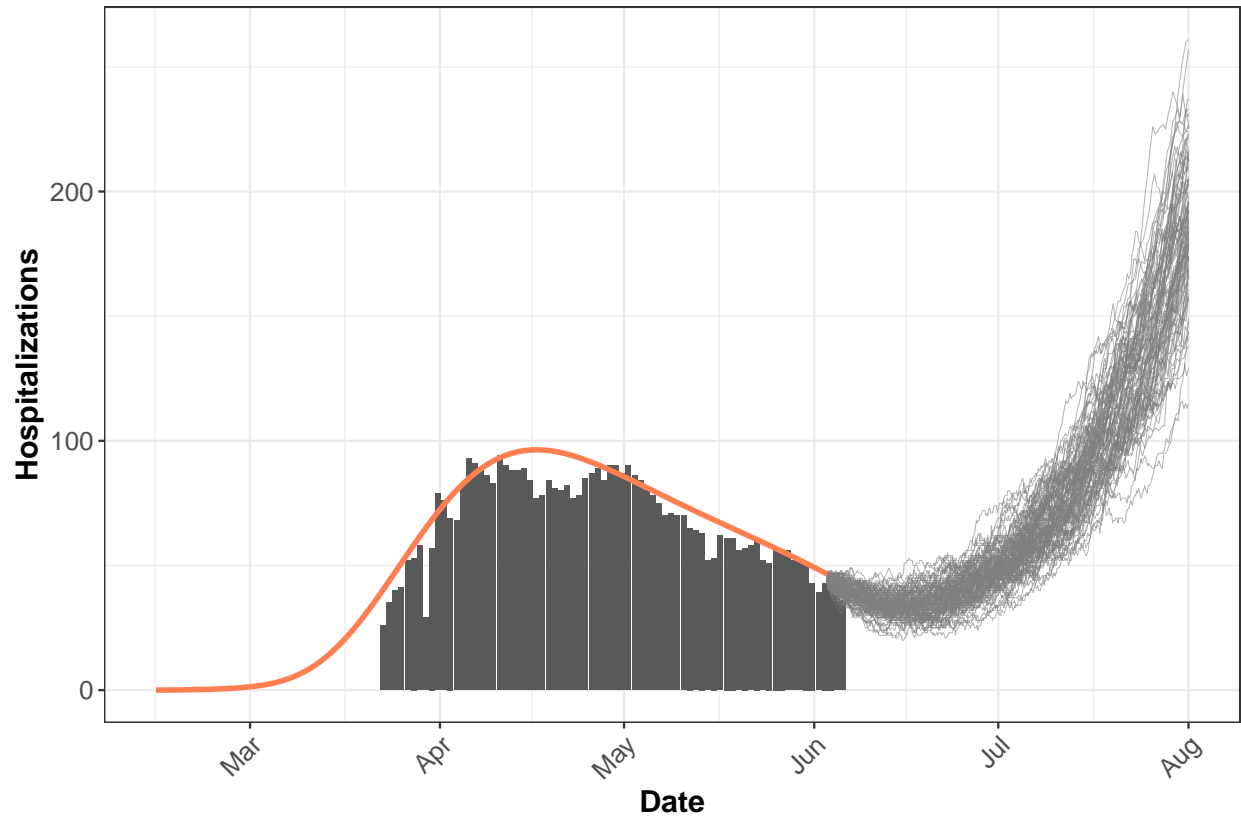


Model forecast

$\mathcal{R}_e \rightarrow 1.4$

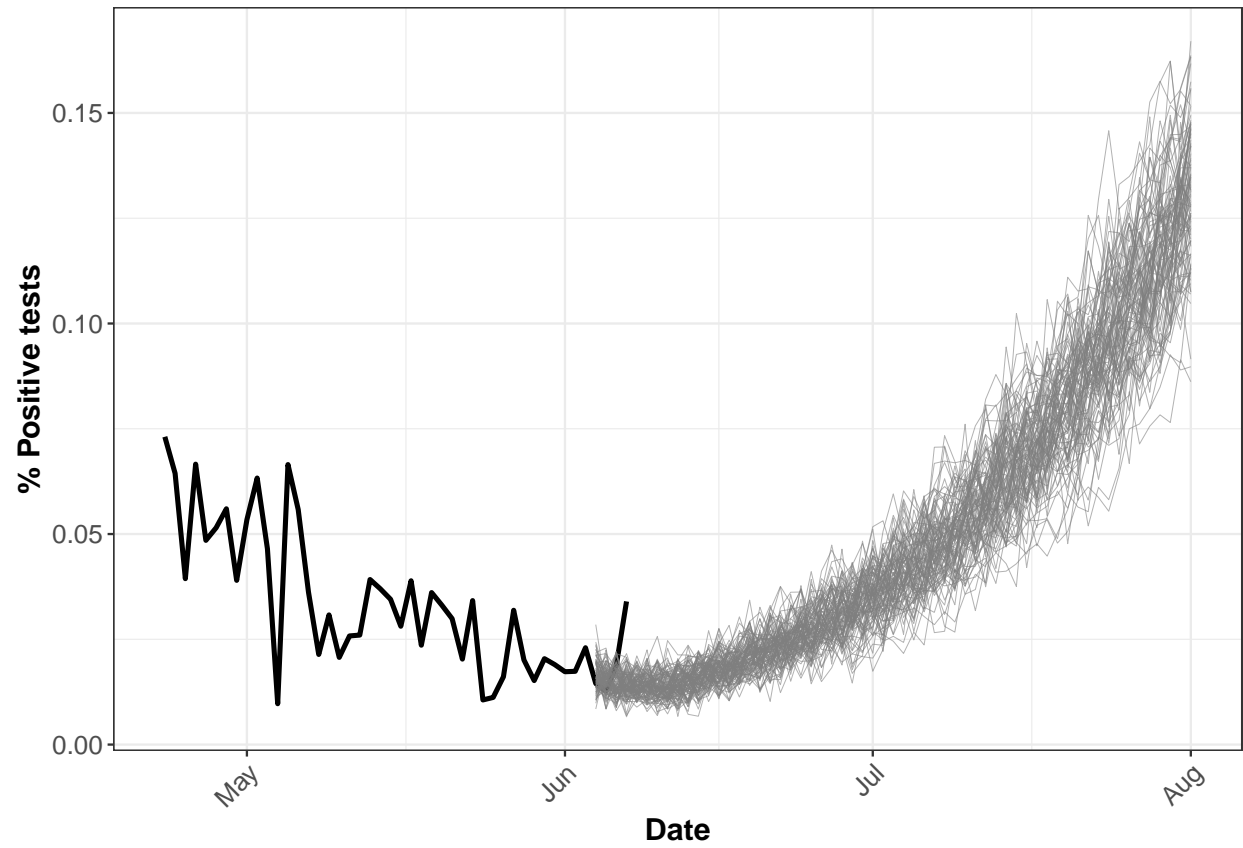
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Projected Hospital Census with
Re reaching 1.4 in 7 days
and remaining until 2020-08-01

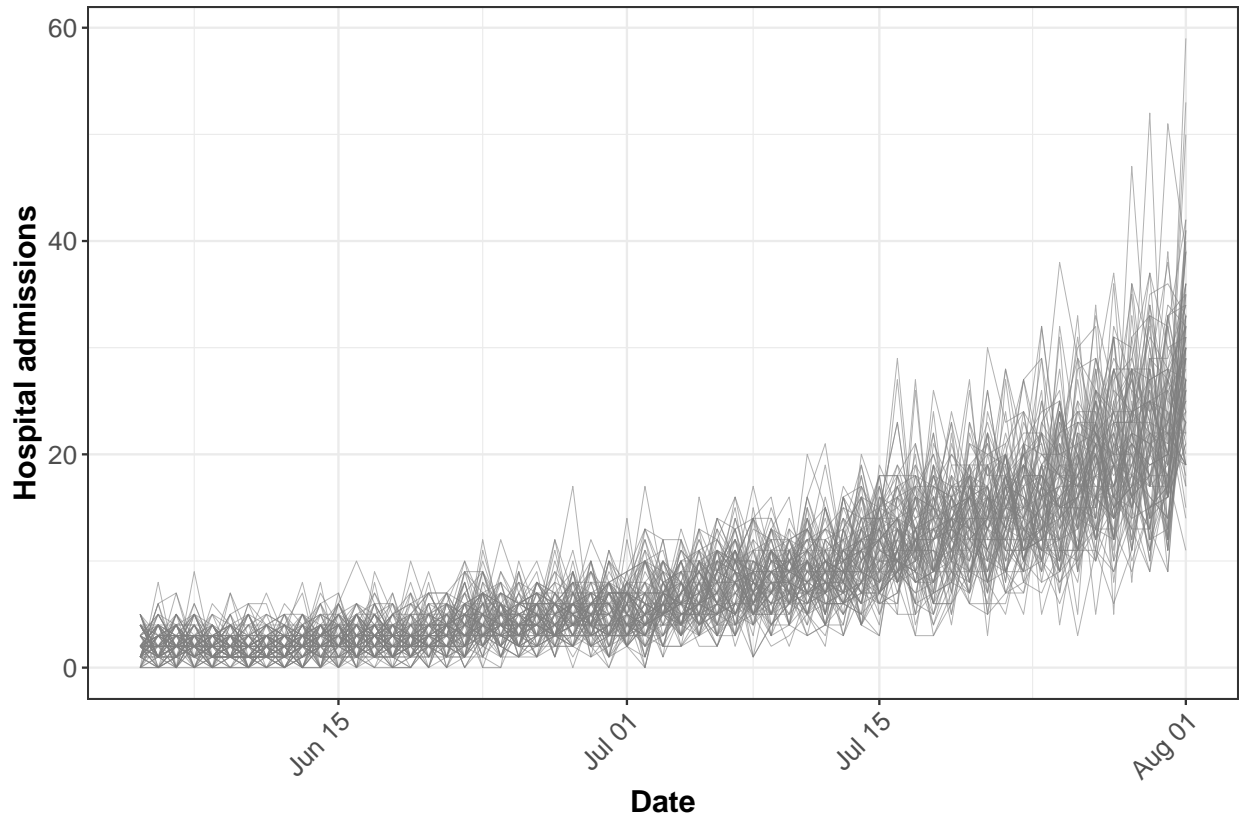


Future Positive test percentages

Assuming 1600 tests per day, $B=45$, $Re=1.4$ by June 15



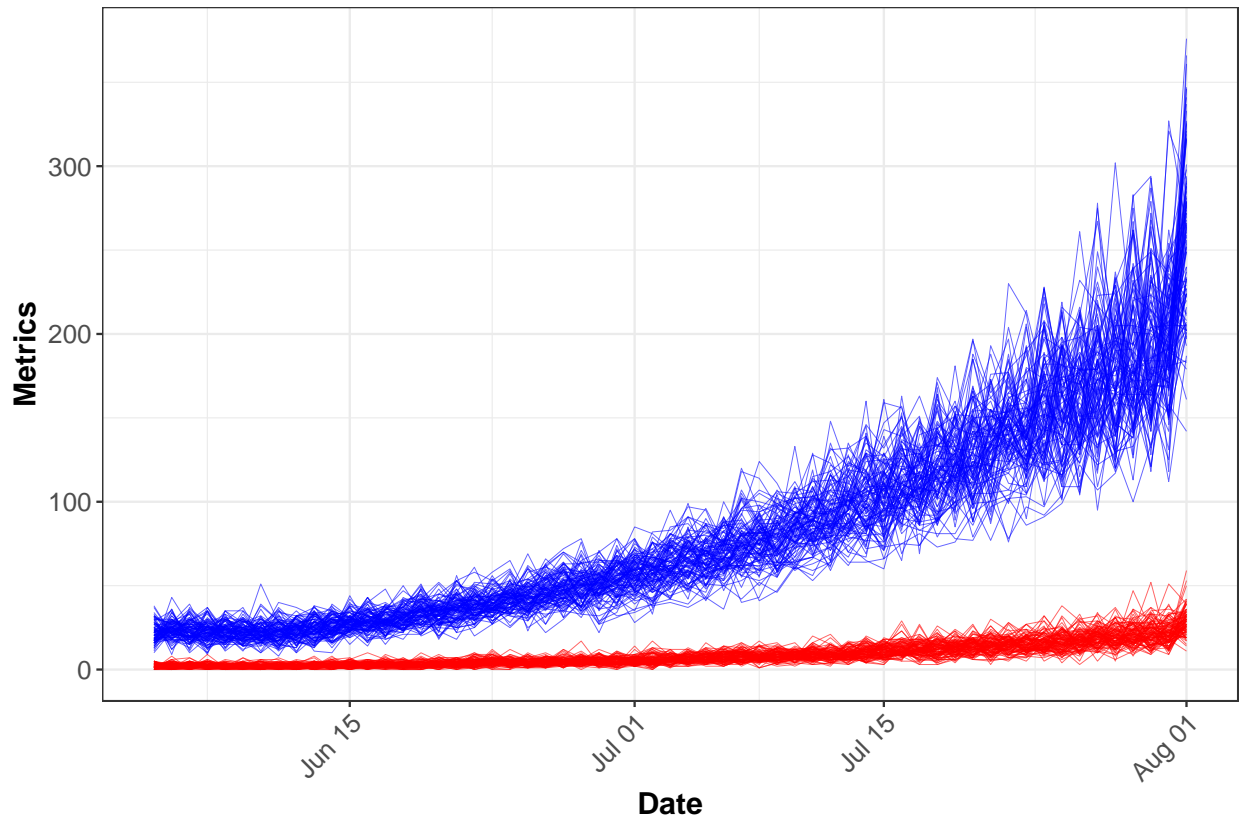
Projected Hospital Admissions with
Re reaching 1.4 in 7 days
and remaining until 2020-08-01



Simulations of potential SiP Triggers

Assuming 1600 tests per day, $B=45$, $Re=1.4$ by June 15

Blue—positive tests, Red—Hospital admissions



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