Mask Effect: Exploring methods to reduce COVID-19 spread

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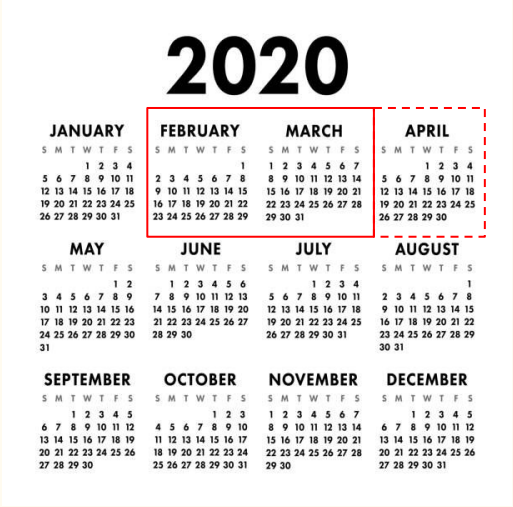
Background

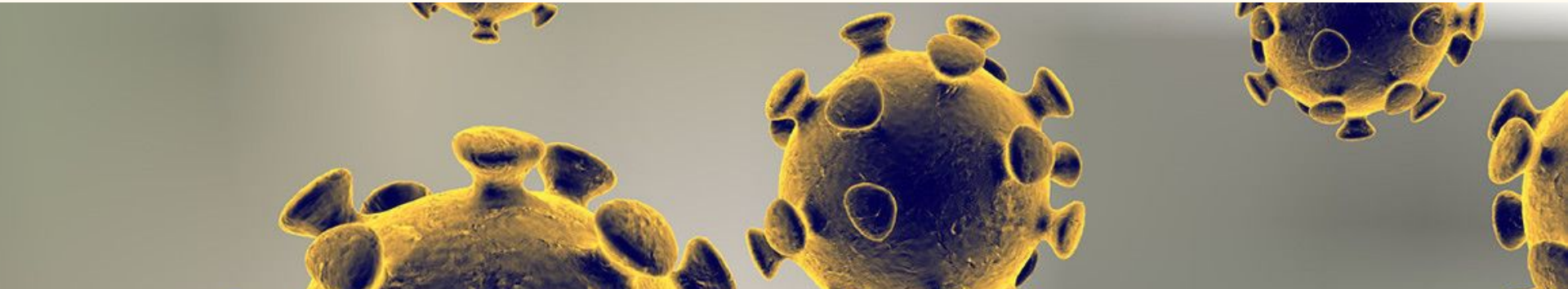
Significant Dates:

March 11: WHO declares pandemic

March 17: Ontario lockdown begins



*Role of masks = inexpensive protective method

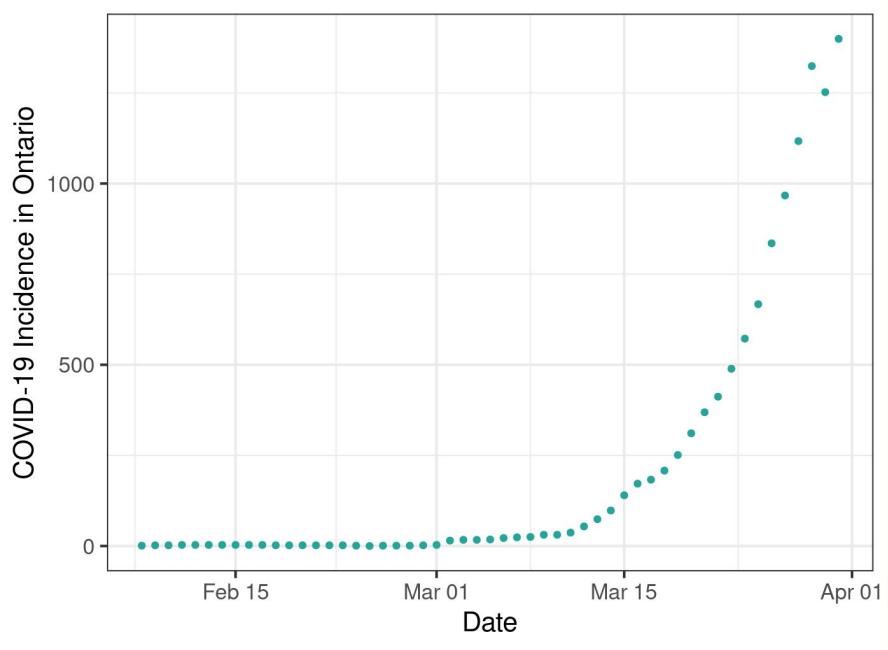


Objectives

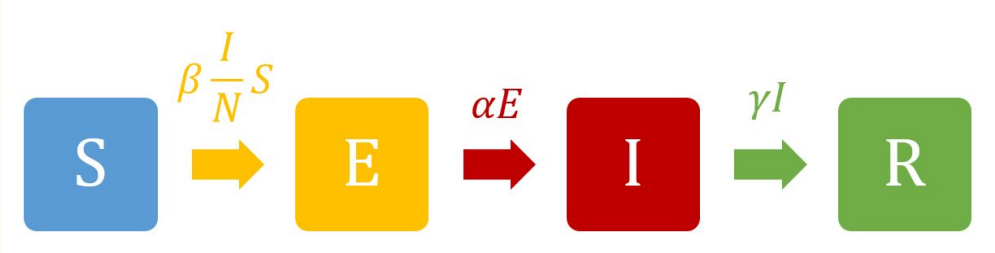
1. Fit a model to represent COVID-19 transmission in Ontario up to March 31, 2020

2. Forecast COVID-19 incidence from April 1-30, 2020

3. Quantify the impact of a potential mask mandate on COVID-19 incidence



Model Overview and Parameter Definitions



Key Parameters

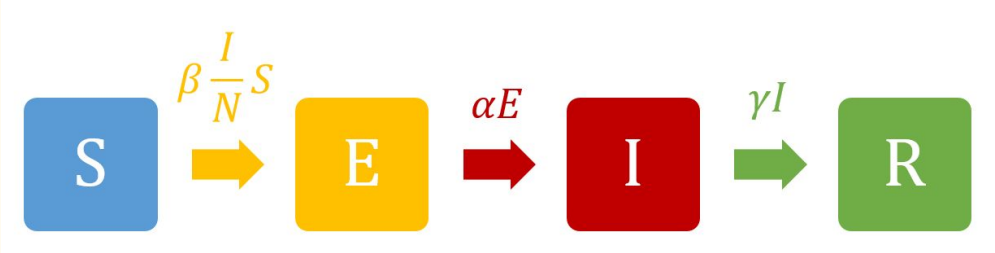
-Average rate that infectious individuals infect susceptible individuals (effective contact rate; β)

-Average length of time in exposed compartment (latency period; $1/\alpha$)

-Average length of time in infectious compartment ($1/\gamma$)

Model Diagram: Irena Papst -Thanks, Irena!

Model Parameterization



<u>Key Parameters</u>

-Population: 14.8 million

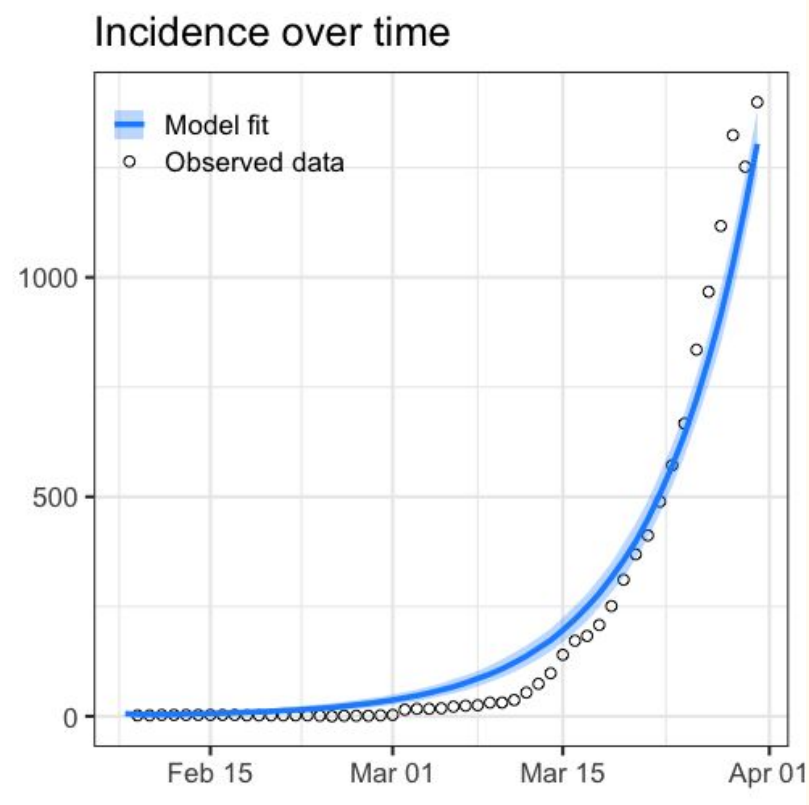
-Effective contact rate (β): 0.575 → Calculated from $R_0 = \beta/\gamma$, with $R_0 = 2.3$

-Latency period ($1/\alpha$): 5 days → Incubation period = 5 days (no asymptomatic transmission)

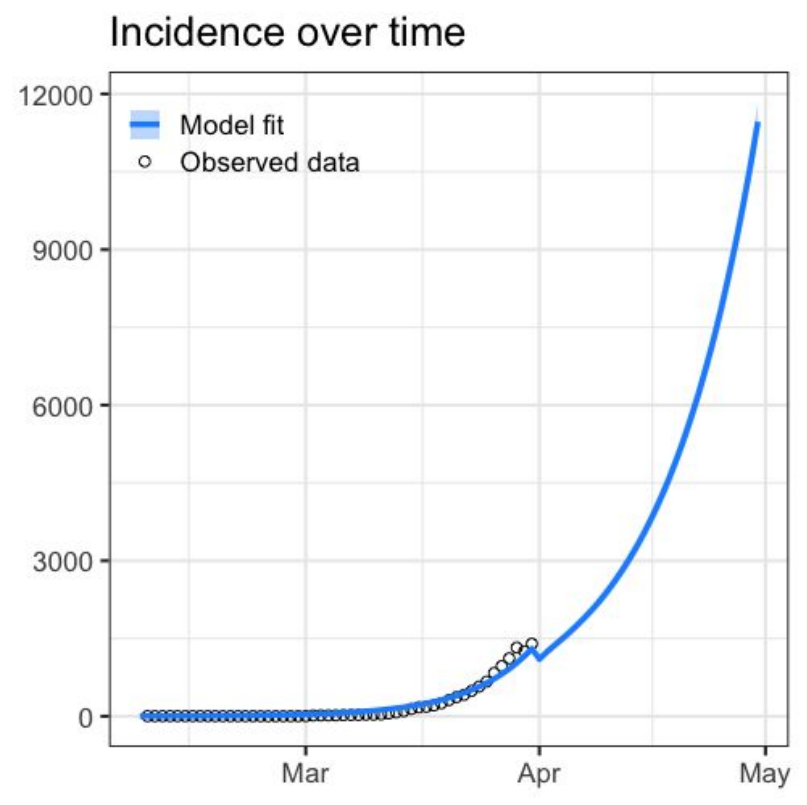
-Time to recovery ($1/\gamma$): 4 days → Assumption, time from infectiousness to PCR test results & isolation

Kurcharski et al. 2020; Stephen et al. 2020; Model Diagram: Irena Papst

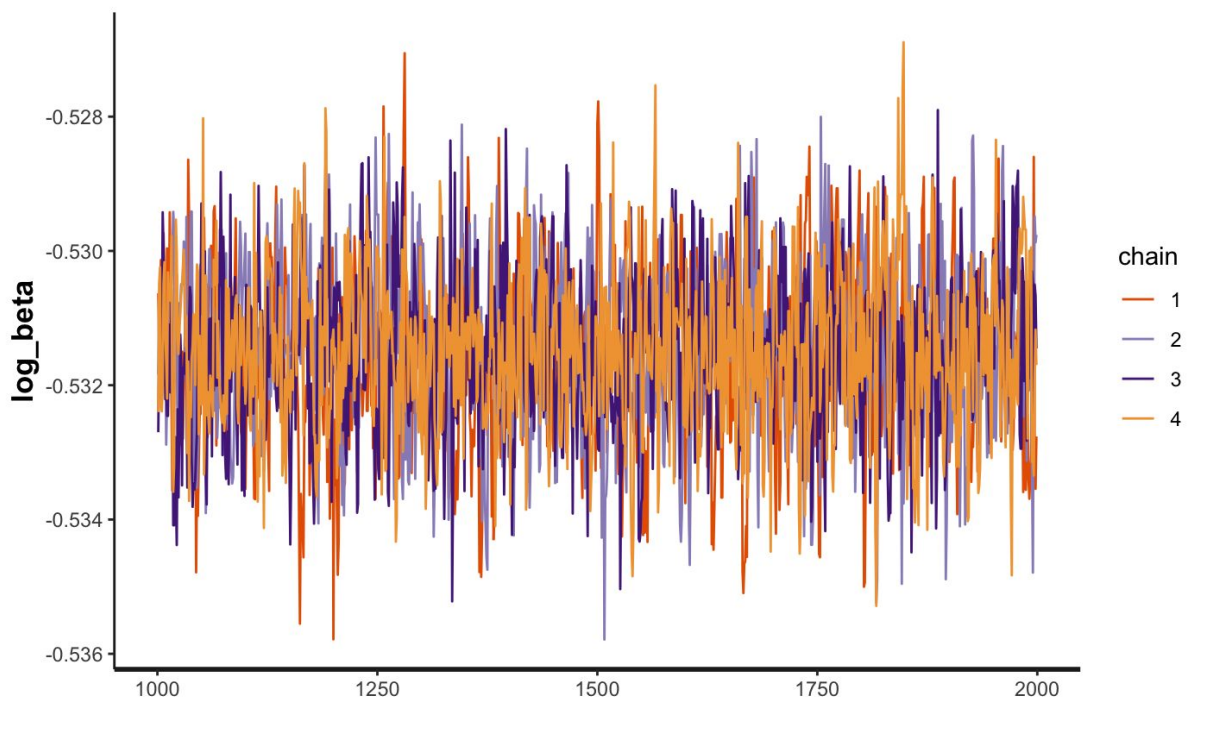
- Fit:



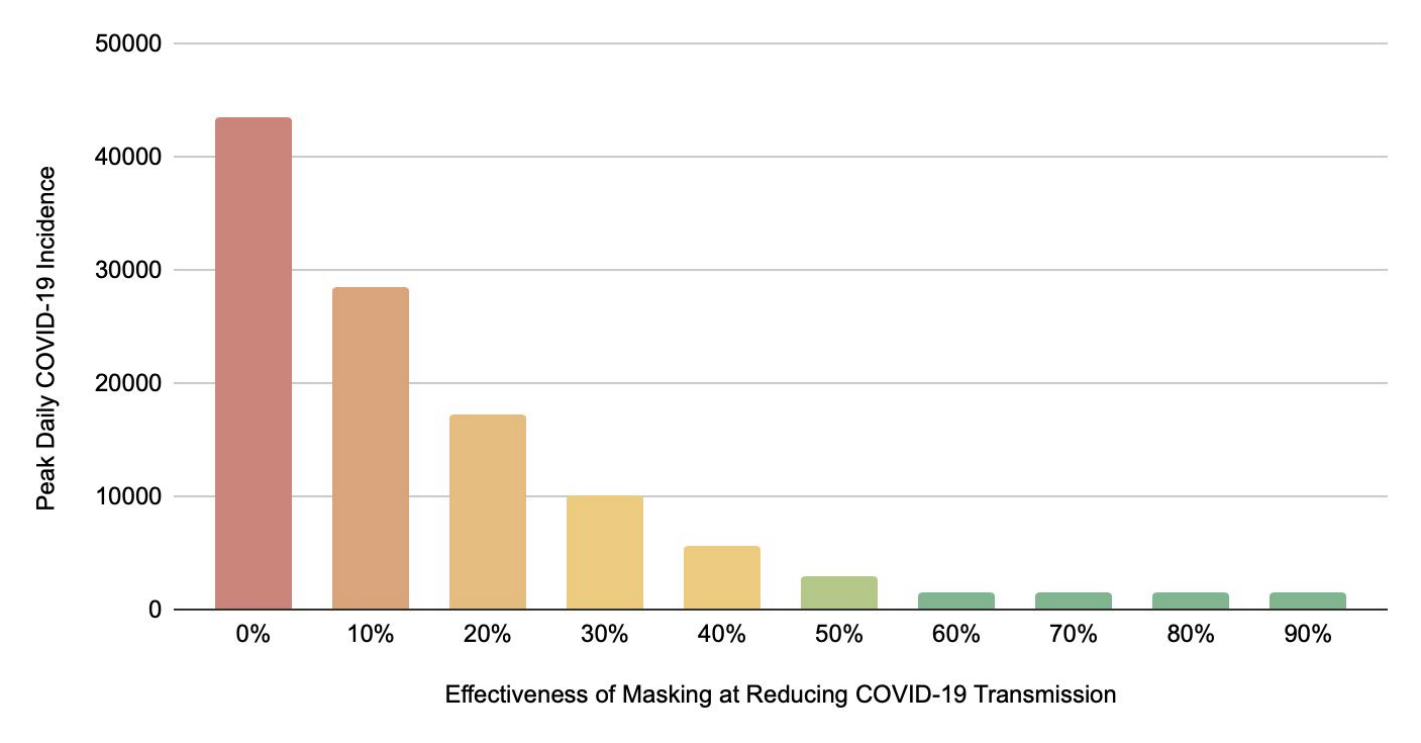
- Forecast:



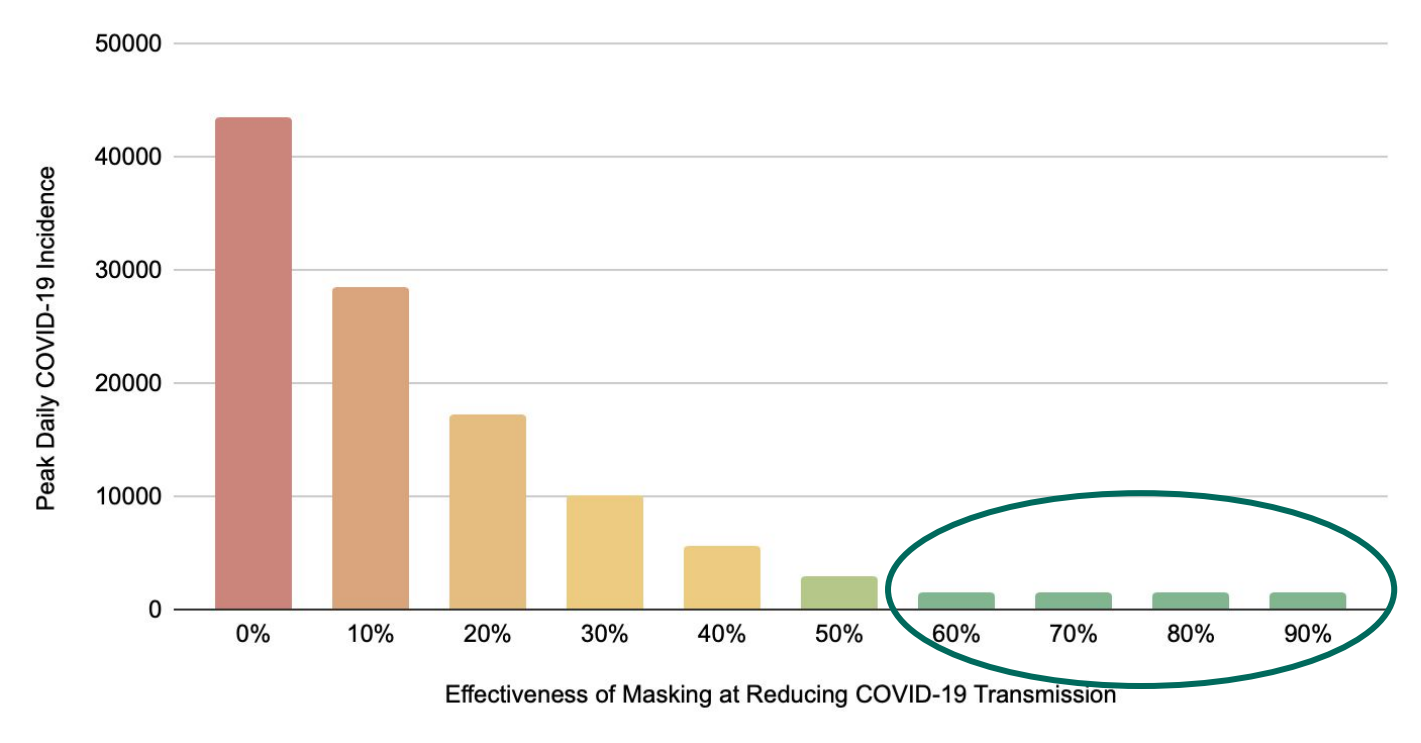
Model Diagnostics - Traceplot



Masking Decreases COVID-19 Incidence



Masking Decreases COVID-19 Incidence

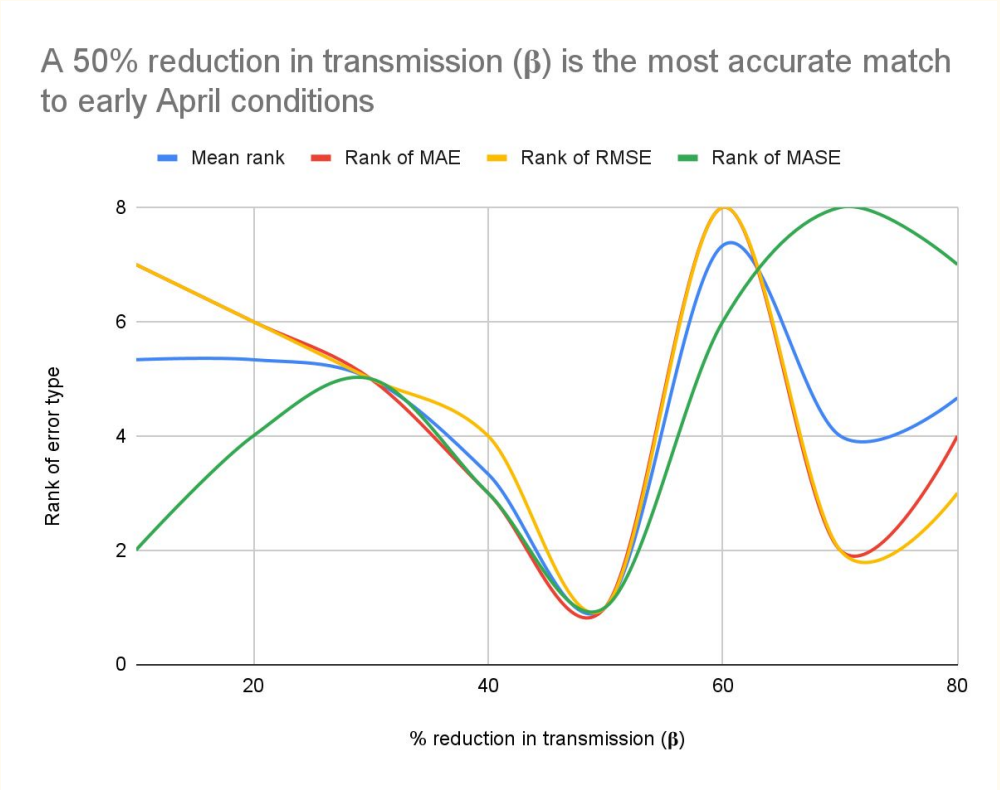


What actually happened during early April 2020?

Using data from April 1-15, 2020, we tested our model, incorporating a reduction in our **transmission parameter, β.**

We found that masking (and other public health measures) reduced **β** by 50%.

How do we know this? The model with a 50% reduction in **β** had the least error when tested against out-of-sample data from early April 2020.



Recommendations

-Apply what we learned to make better informed decisions

-Goal: lower hospitalizations, reduce spread

-Invest more time/energy on (inexpensive) effective protective methods

-Consider different stakeholders in future models

-Improved confidence in model with other data

Thank you!

Questions?

Appendix: Validation - April 2020

How do we measure **error**?

Mean absolute **error (MAE)**

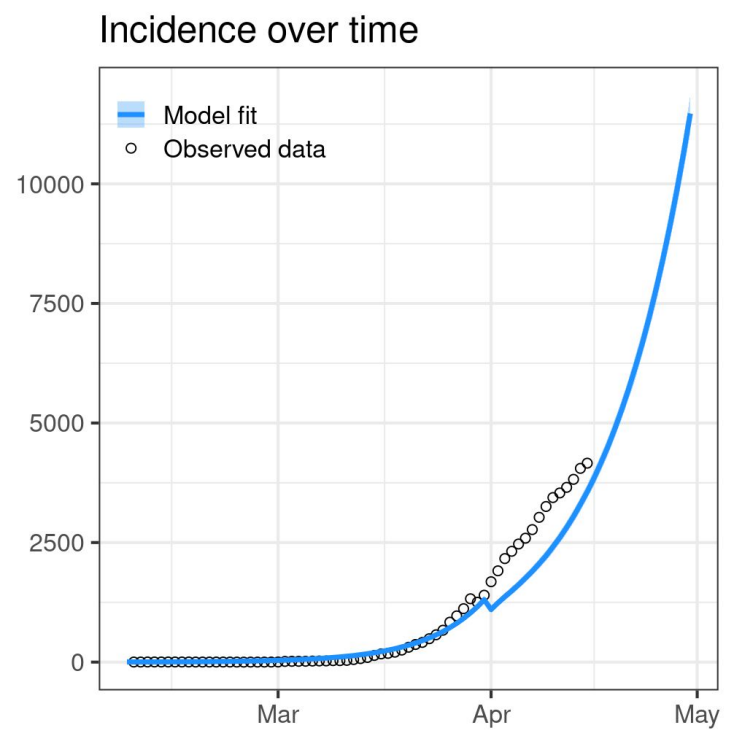
Root mean squared **error (RMSE)**

Mean absolute scaled **error (MASE)**: allows comparisons between time series of different absolute values. Mean absolute error scaled by the variation in the observed data.

$$Q = \frac{1}{N-1} \sum_{j=2}^{N} |y_j - y_{j-1}|.$$

$$\text{MASE} = \text{mean}(|q_j|) = \text{MAE}/Q.$$

Initial Forecast Does Not (Perfectly) Predict the Validation Data



Refined forecasts do alright!