Case Study: Masking & COVID-19

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Case Study Introduction
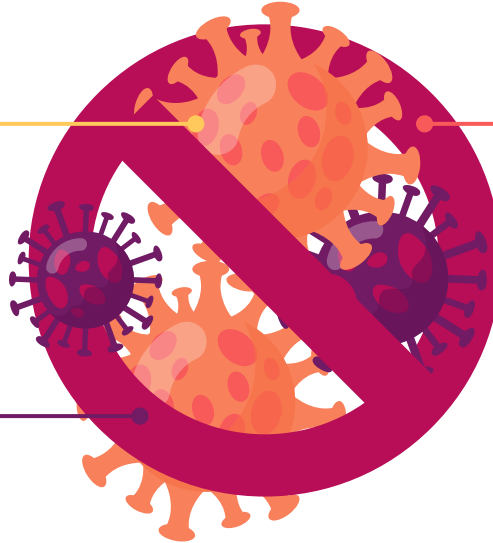
Fitting Data Timeline:
February to March 2020
(~60 days)

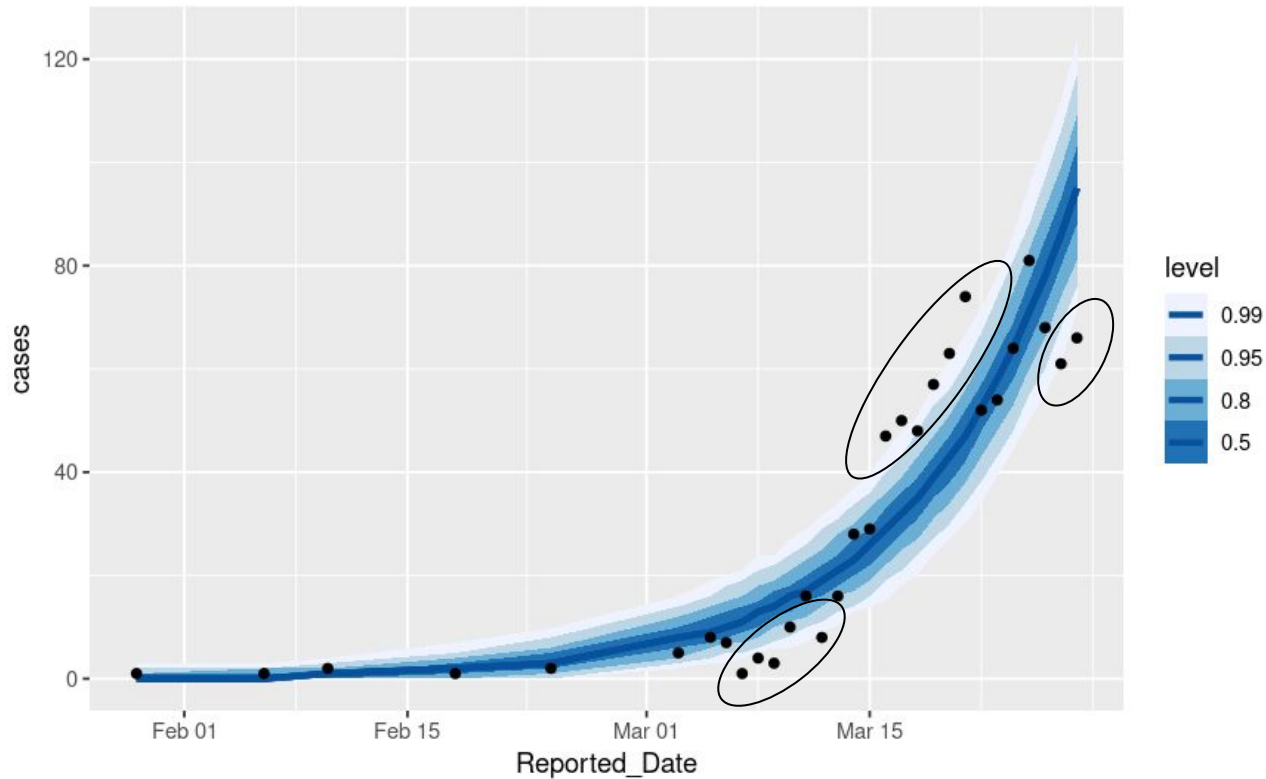**Projection Period:**

April 2020 (30 days)

Decision Maker's Request:

What impact could a mandatory mask policy have on projected case reports?
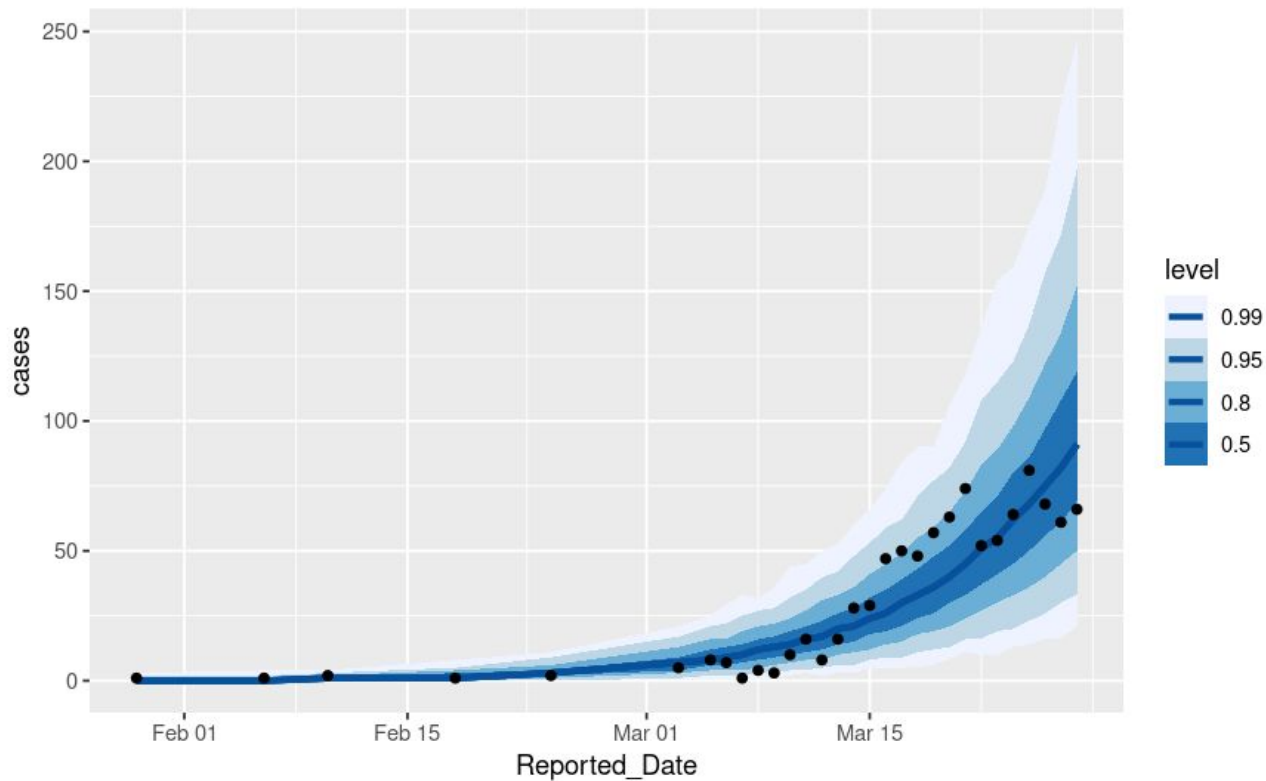
Original Model

- Compartmental model
- R0 → average number of people infected by one infected individual
  - Higher R0 = quicker spread of disease

Original Data Model (Poisson Distribution)

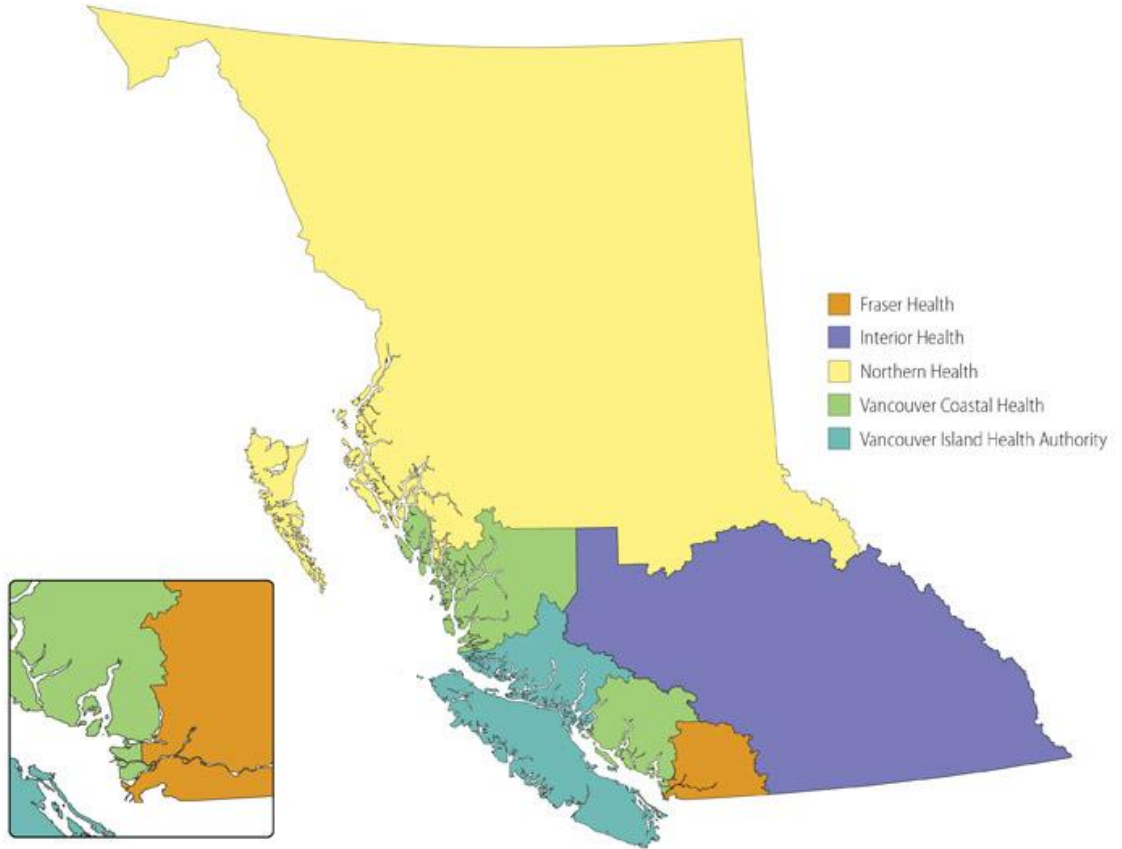# Adjusted Data Model (Negative-Binomial Distribution)

Regional Differences
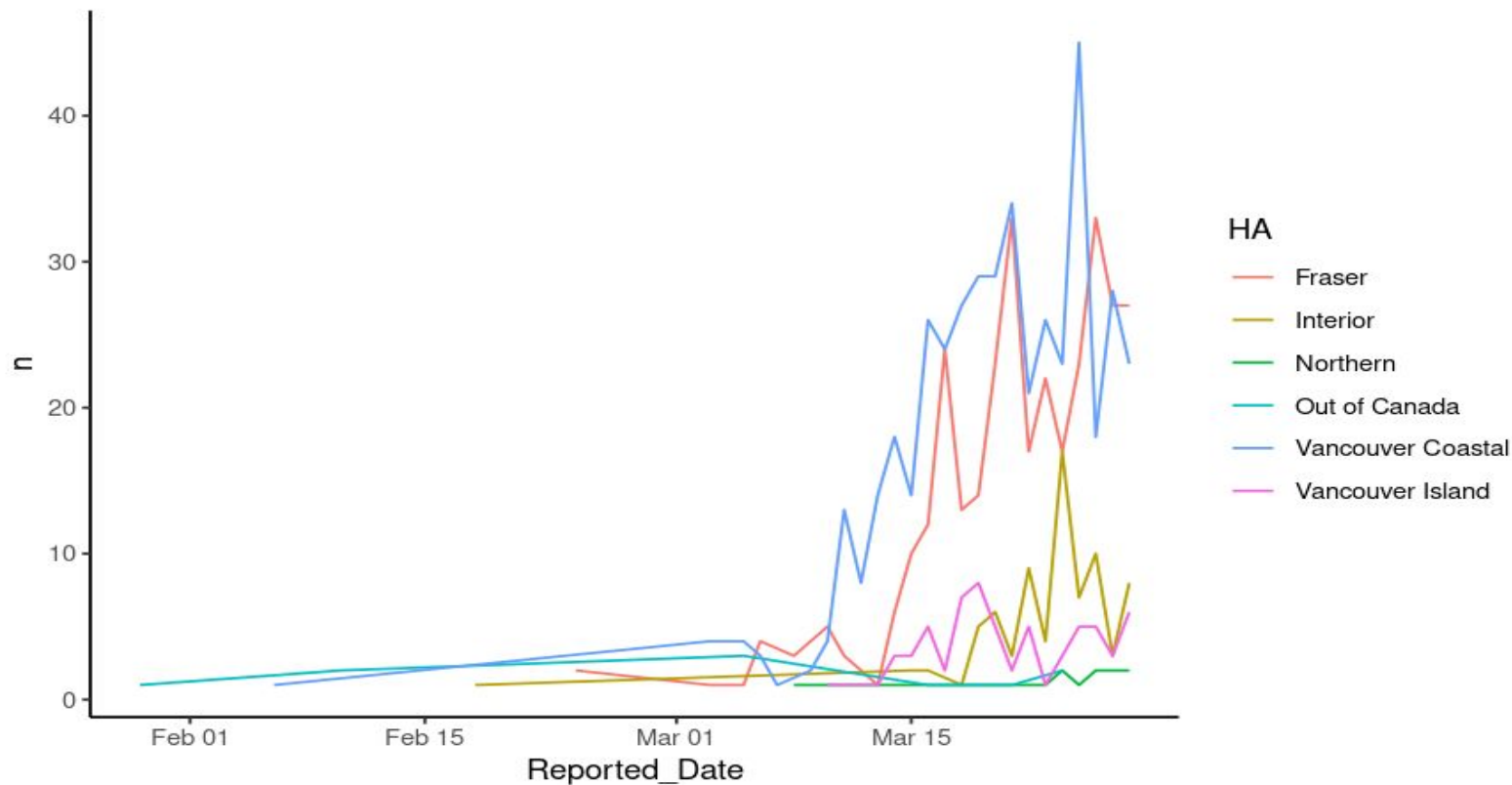
Population Size

Population Density

Environment

Prior Policies

Fraser Health
Interior Health
Northern Health
Vancouver Coastal Health
Vancouver Island Health Authority

(Health, 2022)

Regional Differences

Did the model converge?

```
$summary
               mean       se_mean          sd         2.5%         25%         50%         75%       97.5%      n_eff        Rhat
R0[1]      2.8720684  3.410567e-03  0.31451100  2.326746620  2.64243481  2.8549969  3.0732576  3.5431502   8503.908   0.9998339
R0[2]      3.1168442  5.646759e-03  0.51302385  2.191954396  2.75151026  3.0958679  3.4423784  4.1964712   8254.232   1.0000139
R0[3]      1.7073044  5.160523e-03  0.36860288  1.197835383  1.44002819  1.6377933  1.8991602  2.6064178   5101.877   1.0001059
R0[4]      2.6142014  2.364191e-03  0.21117817  2.265708090  2.46421607  2.5916513  2.7380653  3.0826775   7978.713   1.0004179
R0[5]      2.3672301  4.537797e-03  0.37416180  1.777917107  2.08779839  2.3213895  2.6012045  3.2063442   6798.745   1.0000281
i0[1]      0.5223965  4.391282e-03  0.40857875  0.078779433  0.23317431  0.4013650  0.6921819  1.6112855   8657.031   0.9998469
i0[2]      0.1089929  2.149054e-03  0.17643522  0.003584754  0.02101072  0.0501205  0.1214148  0.5688363   6740.250   1.0000445
i0[3]      0.8179504  7.684904e-03  0.71973173  0.032643331  0.26523838  0.6044460  1.1932808  2.5787488   8771.309   0.9998263
i0[4]      1.2797050  6.436317e-03  0.63589188  0.347868821  0.81105588  1.1807693  1.6387412  2.7856274   9760.940   1.0002846
i0[5]      0.5217486  5.274149e-03  0.49502649  0.035182016  0.16668137  0.3614534  0.7159991  1.8733054   8809.518   1.0000111
sample_frac 0.1971915  8.659782e-05  0.01023234  0.176823197  0.19041165  0.1972184  0.2040765  0.2173533  13961.634   0.9998666
```
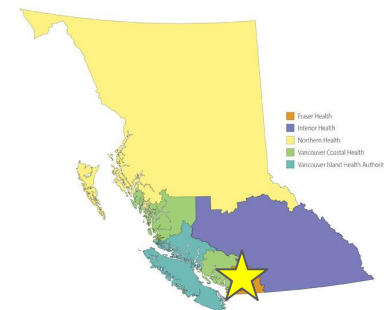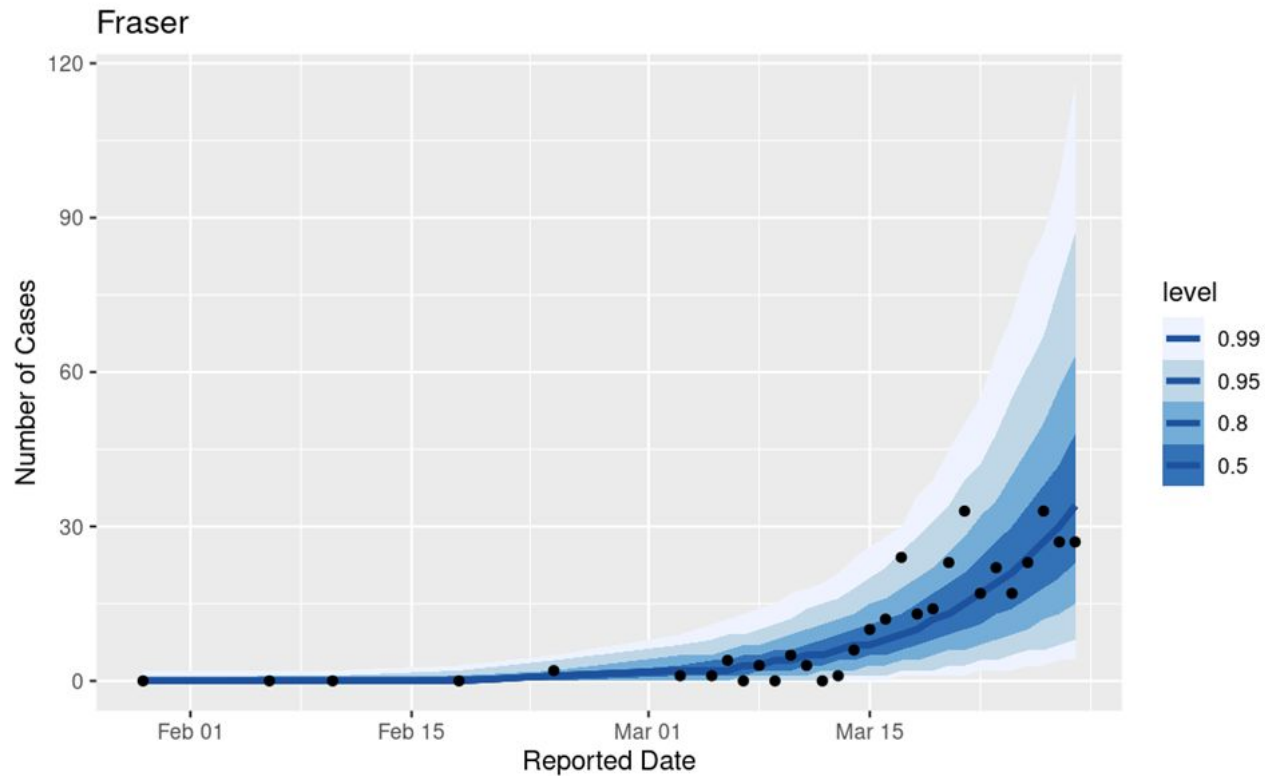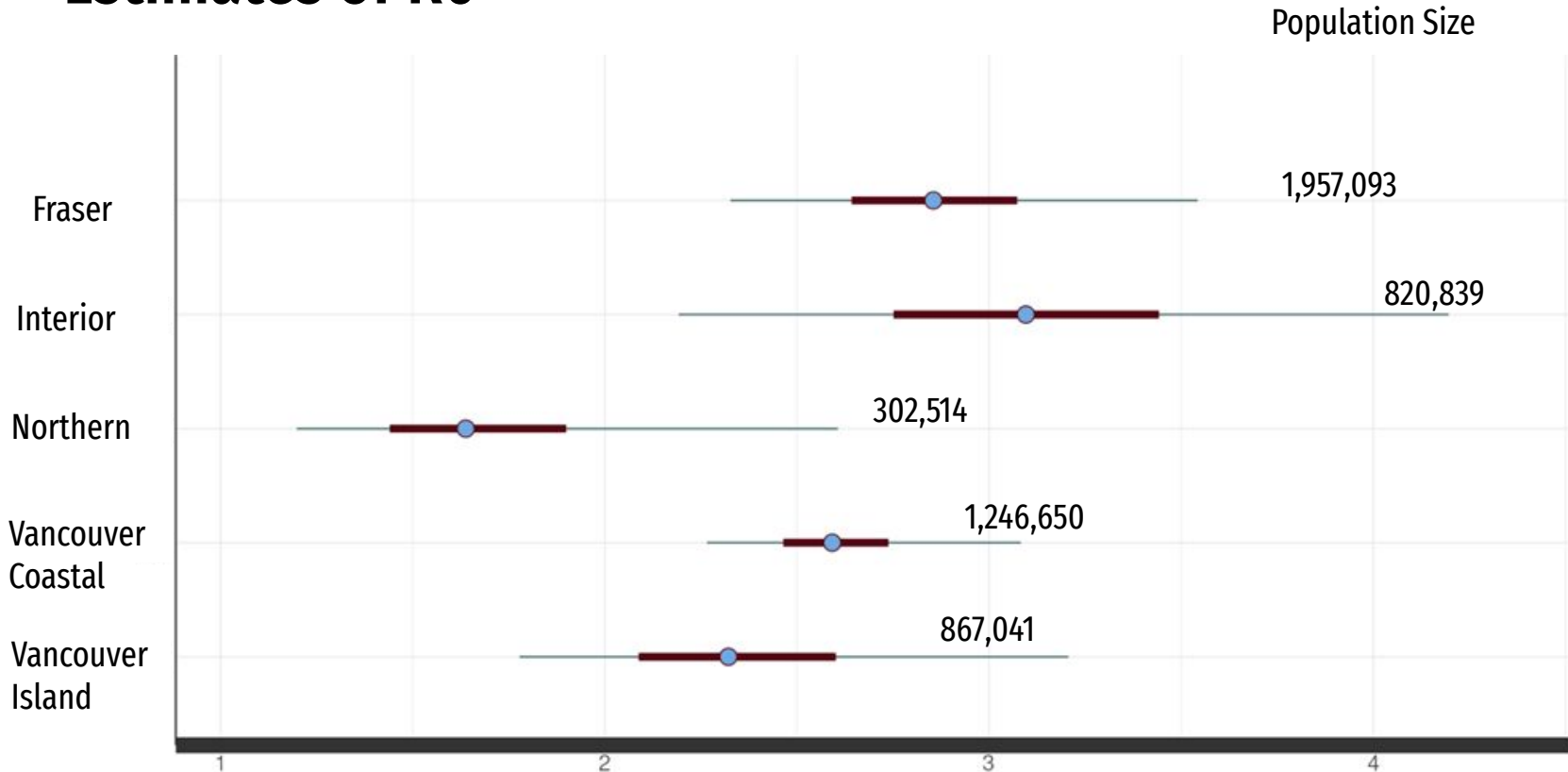
Rhat < 1.1 ✅

N_eff > 5000 ✅

Fitting New Model

Fraser

Estimates of R0

Population Size

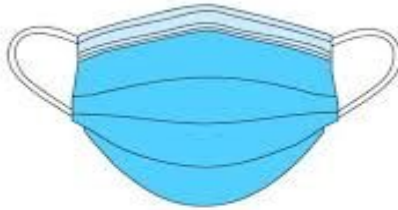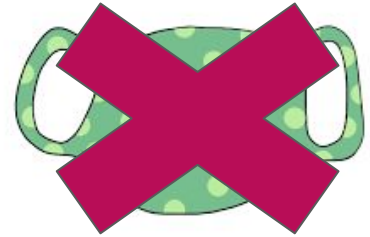| Region	Population Size
Fraser	1,957,093
Interior	820,839
Northern	302,514
Vancouver Coastal	1,246,650
Vancouver Island	867,041

Estimates of Initial Infections (i0)
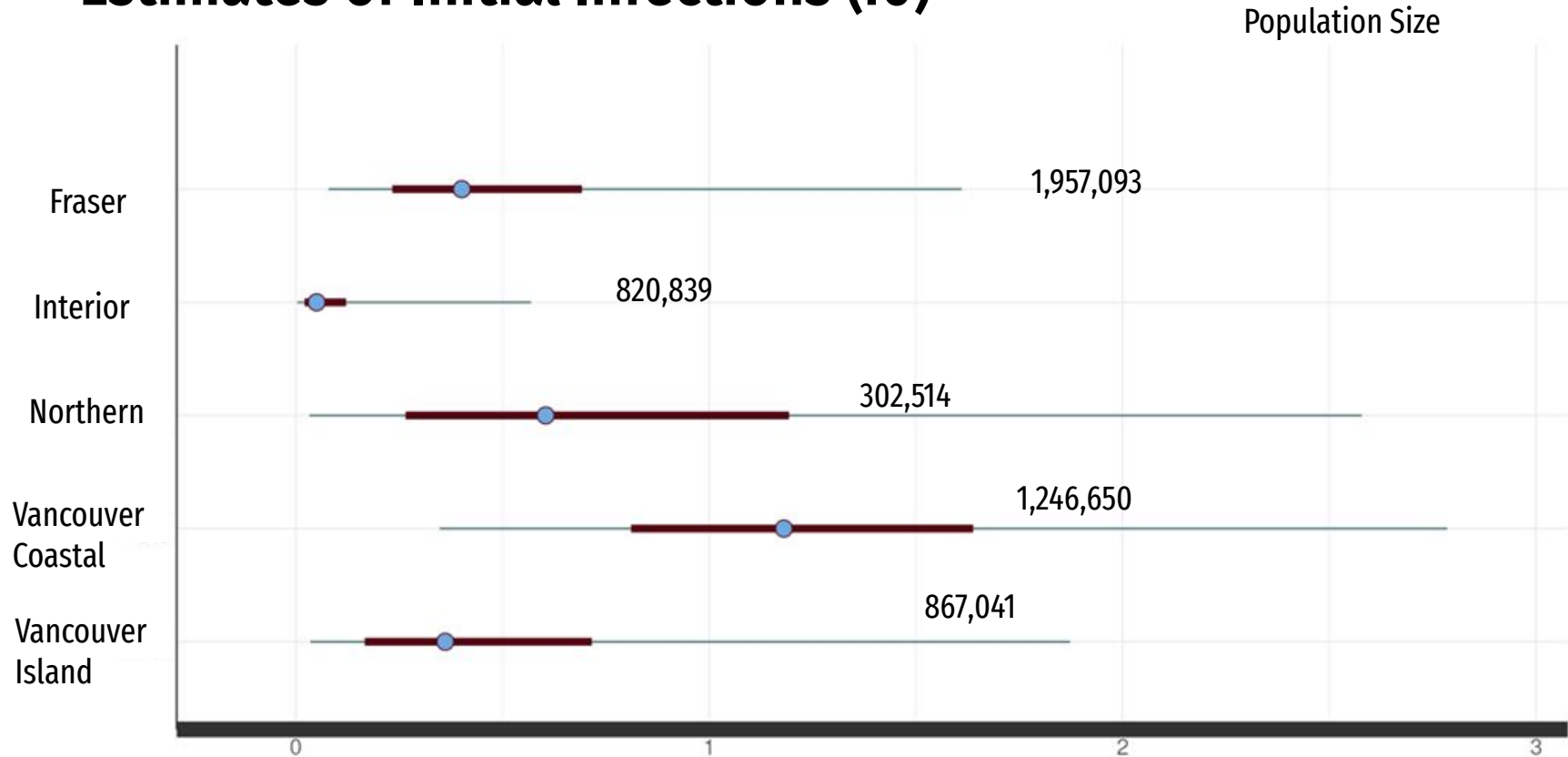
Mask Effectiveness

1

N95

~90% protective efficacy (Ueki et al., 2020).
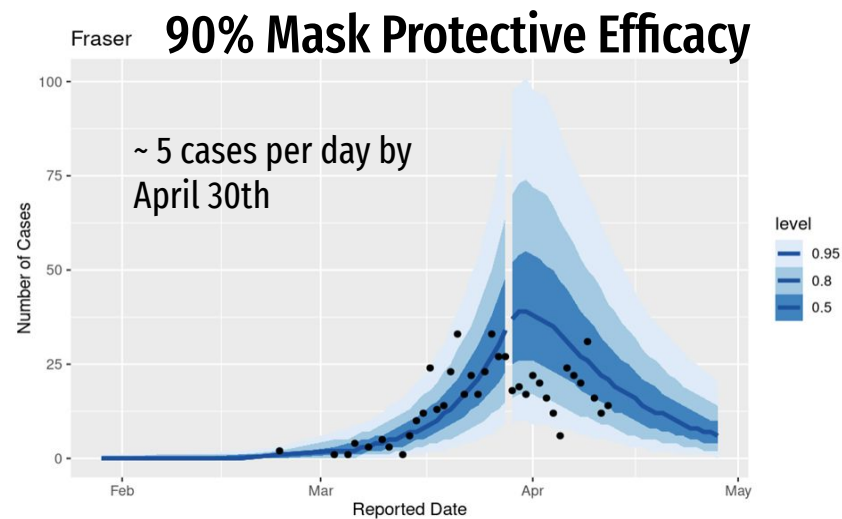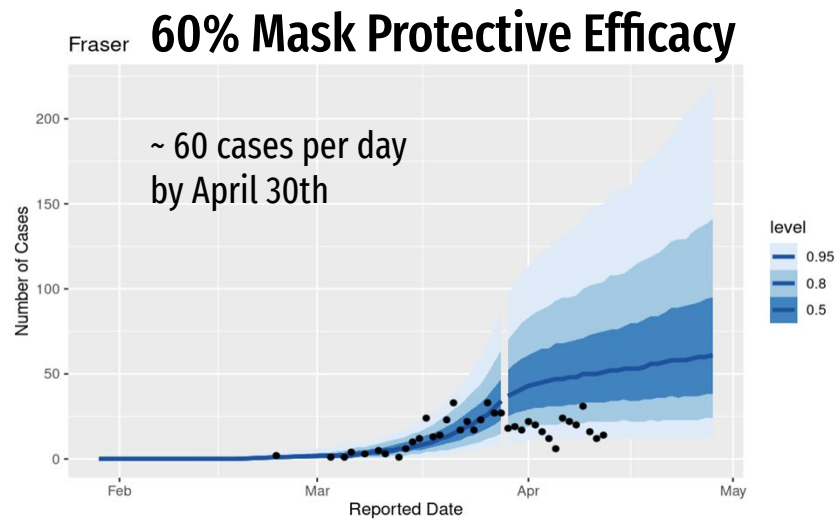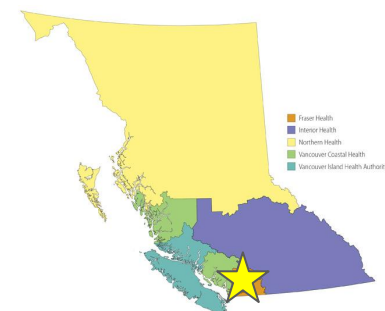
2

Surgical

~60% protective efficacy

3

No Mask

~0% protective efficacy
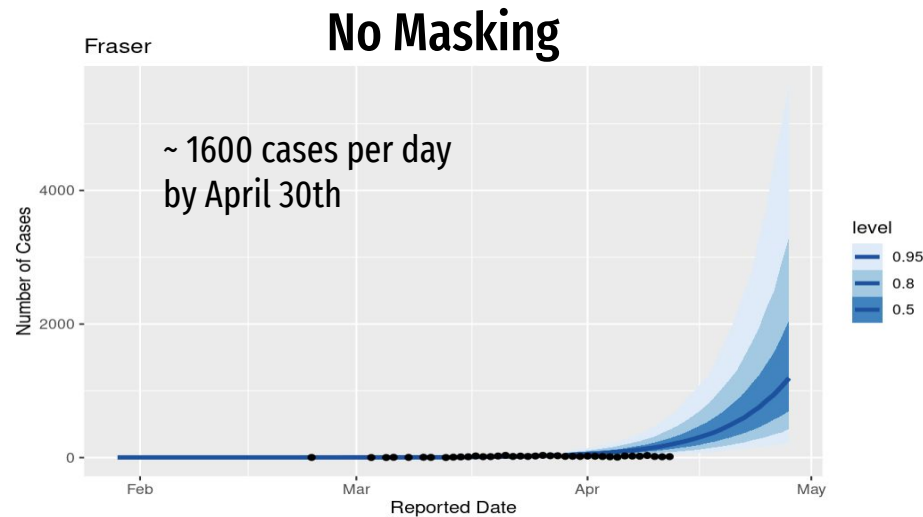
No Masking

Fraser

~ 1600 cases per day by April 30th

60% Mask Protective Efficacy

Fraser

~ 60 cases per day by April 30th

90% Mask Protective Efficacy

Fraser

~ 5 cases per day by April 30th

Policy Changes

Around March 20th

(CIHI, 2020)

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Behavioural Changes: Mobility

1 Retail & Recreational

Average decrease of 50%

2 Grocery & Pharmacy

Average decrease of 22%

3 Transit

Average decrease of 61%

4 Workplace
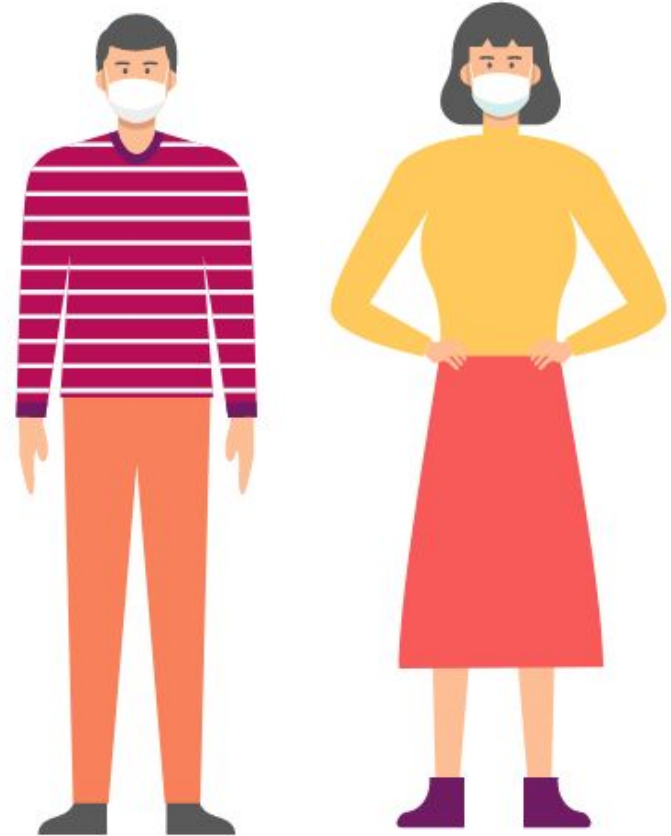
Average decrease of 54%
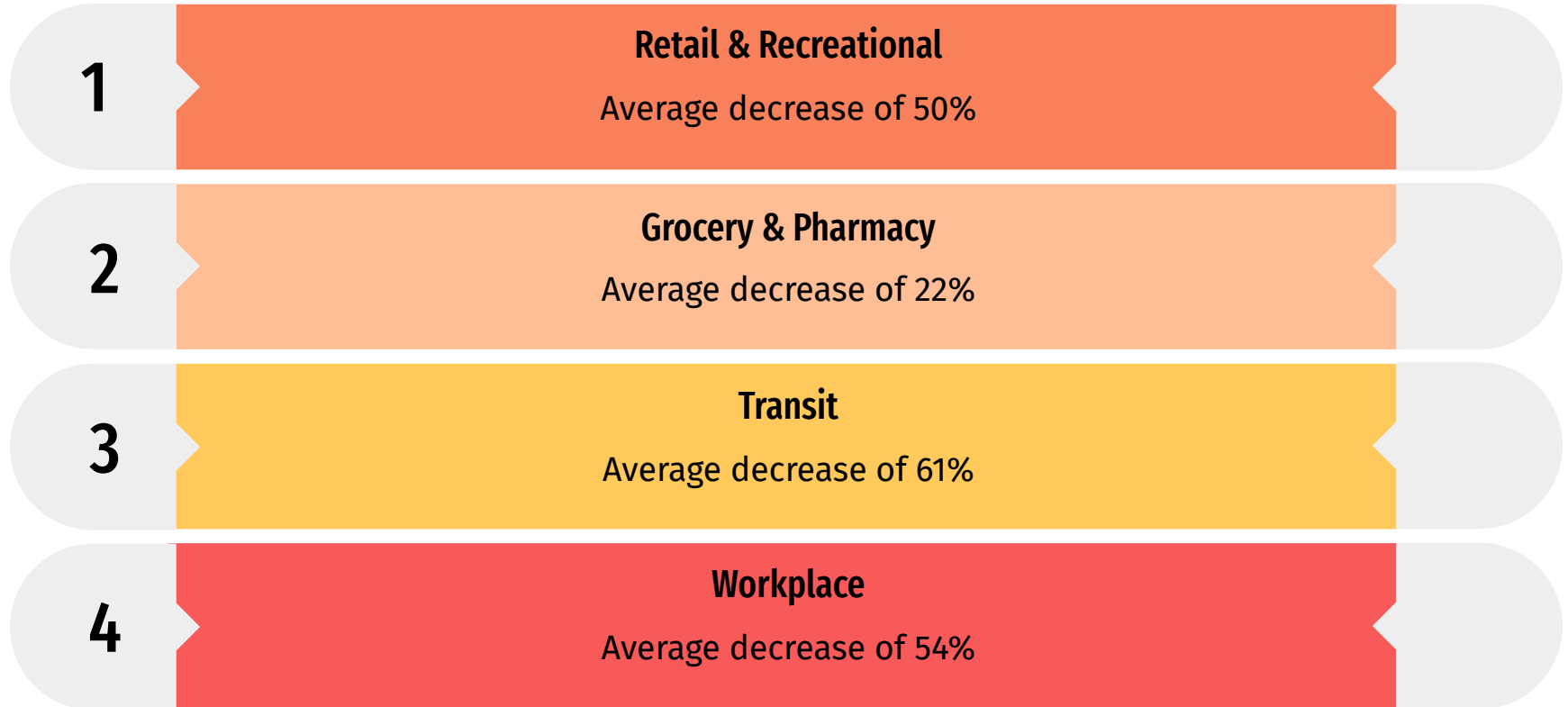
(Google, 2020)

Future Directions

- **Adding covariates**
  - Policy changes
  - Changes in mobility
  - Etc.
- **Account for age demographics**
  - Behaviour changes differ by age
- **Relax assumptions**
  - No movement between regions
  - Closed population
  - No reinfection
  - No regional variation in testing
  - Instantaneous policy implementation

Conclusion & Acknowledgements

Conclusion:

Our model suggests masking is an effective way to reduce the spread of Covid-19. Masks with the highest possible protective efficacy showed the greatest reduction in projected cases.

Fields Institute
Arranging and hosting the 2023 Forecasting for Decision Making short-course

Mike Irvine
For his guidance and development of the covidseir case study

References

CIHI. (2020). *Canadian covid-19 intervention timeline*. CIHI. https://www.cihi.ca/en/canadian-covid-19-intervention-timeline

Google. (2020). *Covid-19 community mobility reports - google*. Covid-19 Google Mobility Data.
https://www.google.com/covid19/mobility/

Health, M. of. (2022, April 14). *Regional Health Authorities*. Province of British Columbia.
https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/partners/health-authorities/regional-health-authorities

Interior Health. (n.d.). *Health Authority Profile - 2021 - interior health*. Interior Health: Data & Analytics Services.
https://www.interiorhealth.ca/sites/default/files/PDFS/interior-health-authority-profile.pdf

Stan-Dev. (n.d.). *Prior choice recommendations*. GitHub.
https://github.com/stan-dev/stan/wiki/Prior-Choice-Recommendations

Ueki, H., Furusawa, Y., Iwatsuki-Horimoto, K., Imai, M., Kabata, H., Nishimura, H., & Kawaoka, Y. (2020). Effectiveness of face masks in preventing airborne transmission of SARS-CoV-2. Msphere, 5(5)https://doi.org/10.1128/mSphere.00637-20
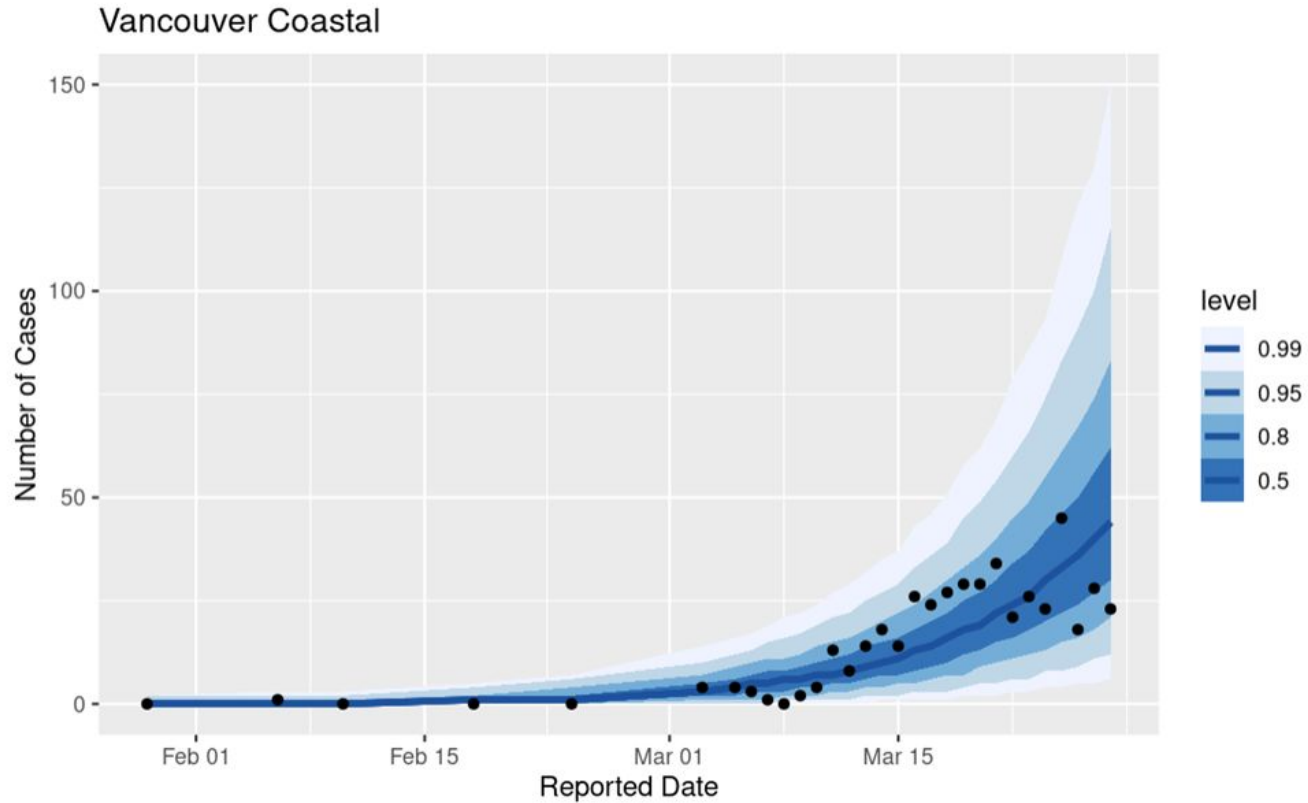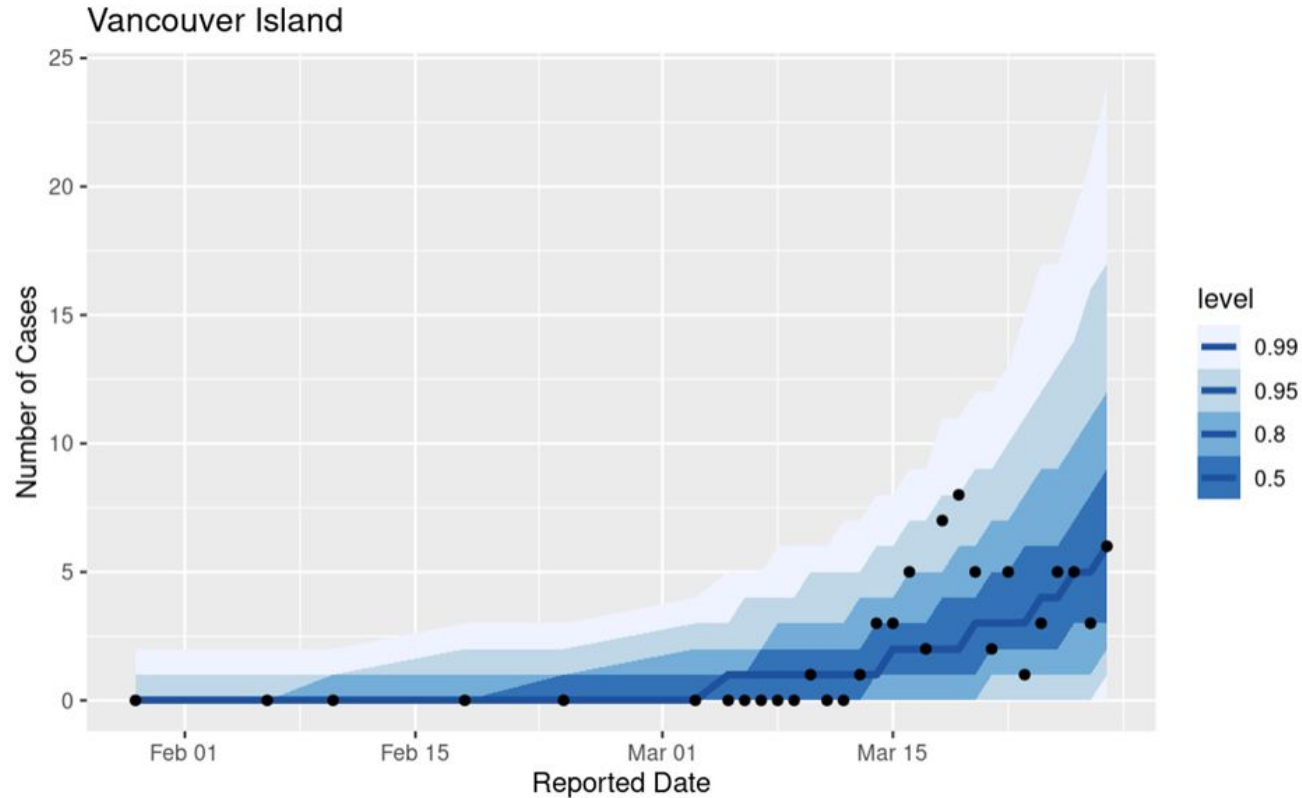
Fitting New Model (Interior)
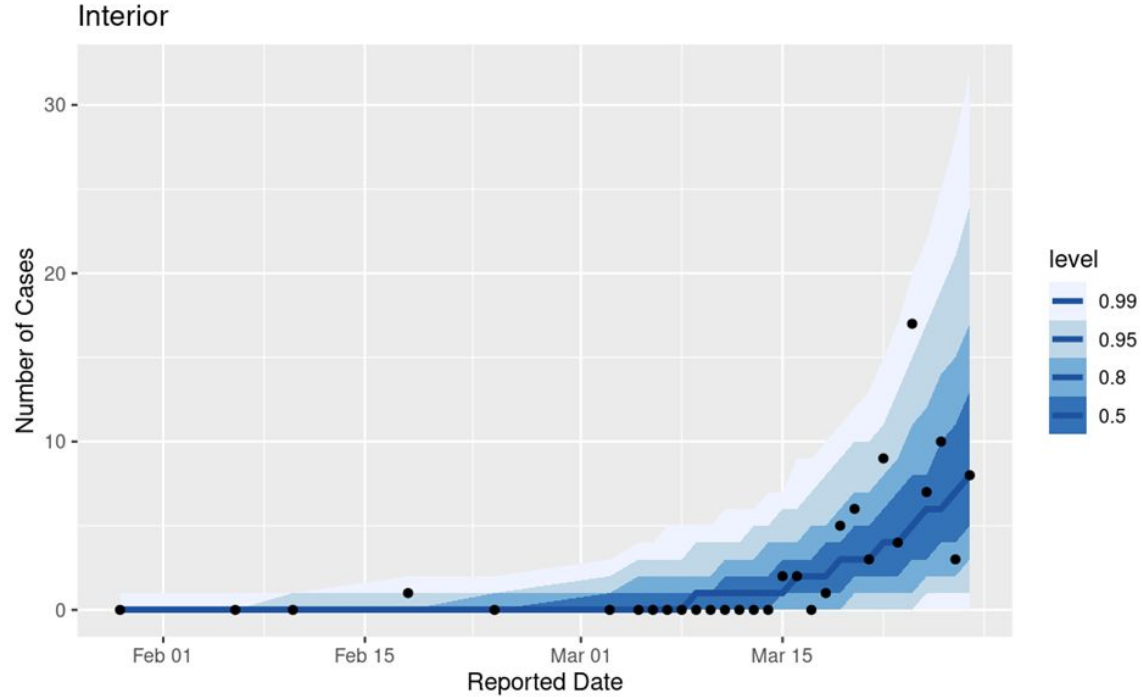
Fitting New Model (Northern)
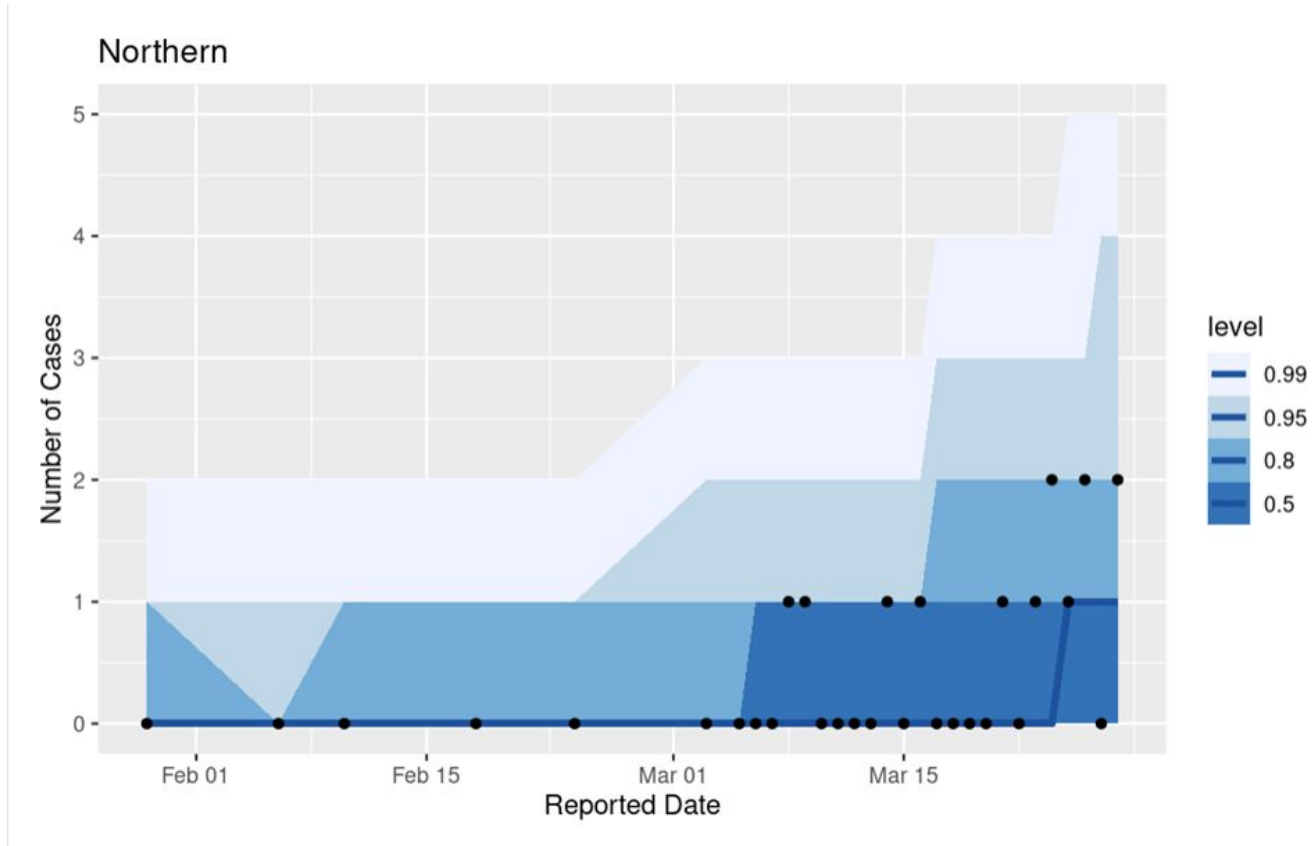
Fitting New Model (Vancouver Coastal)
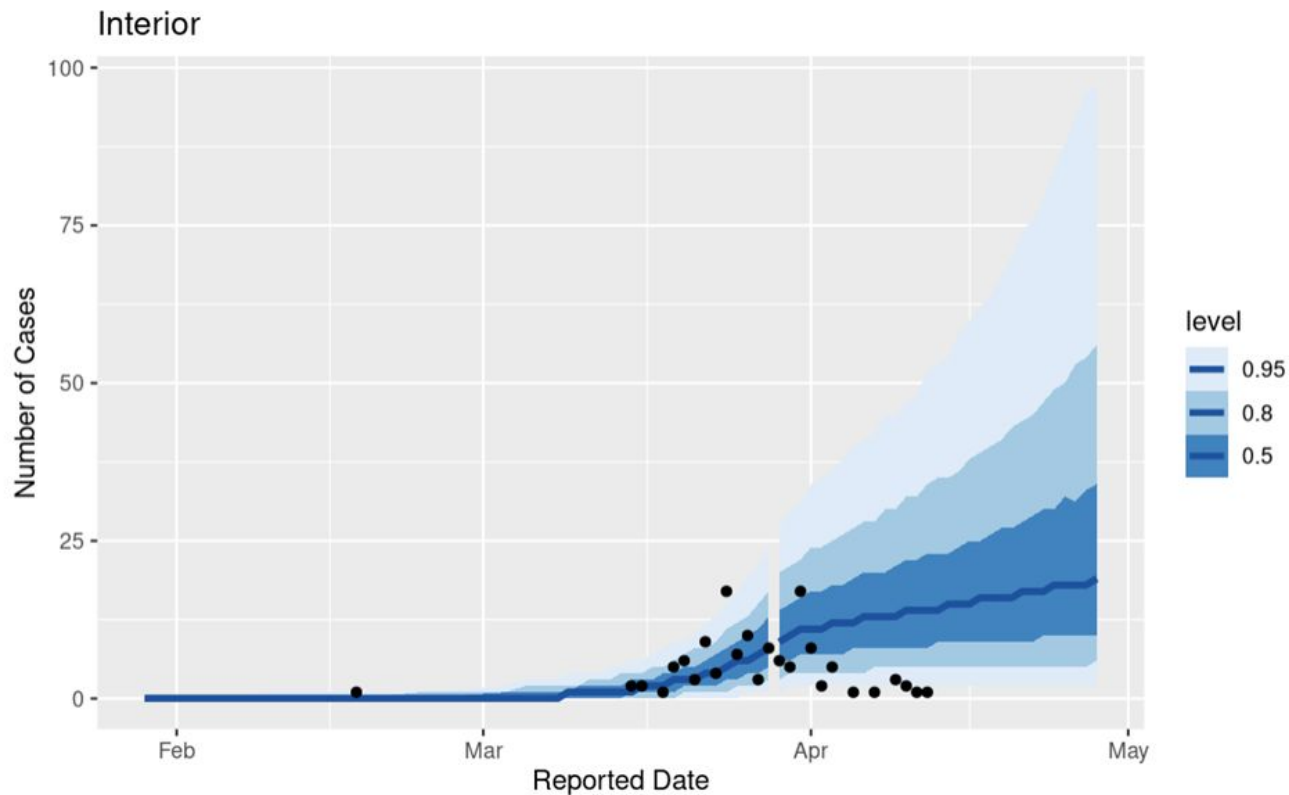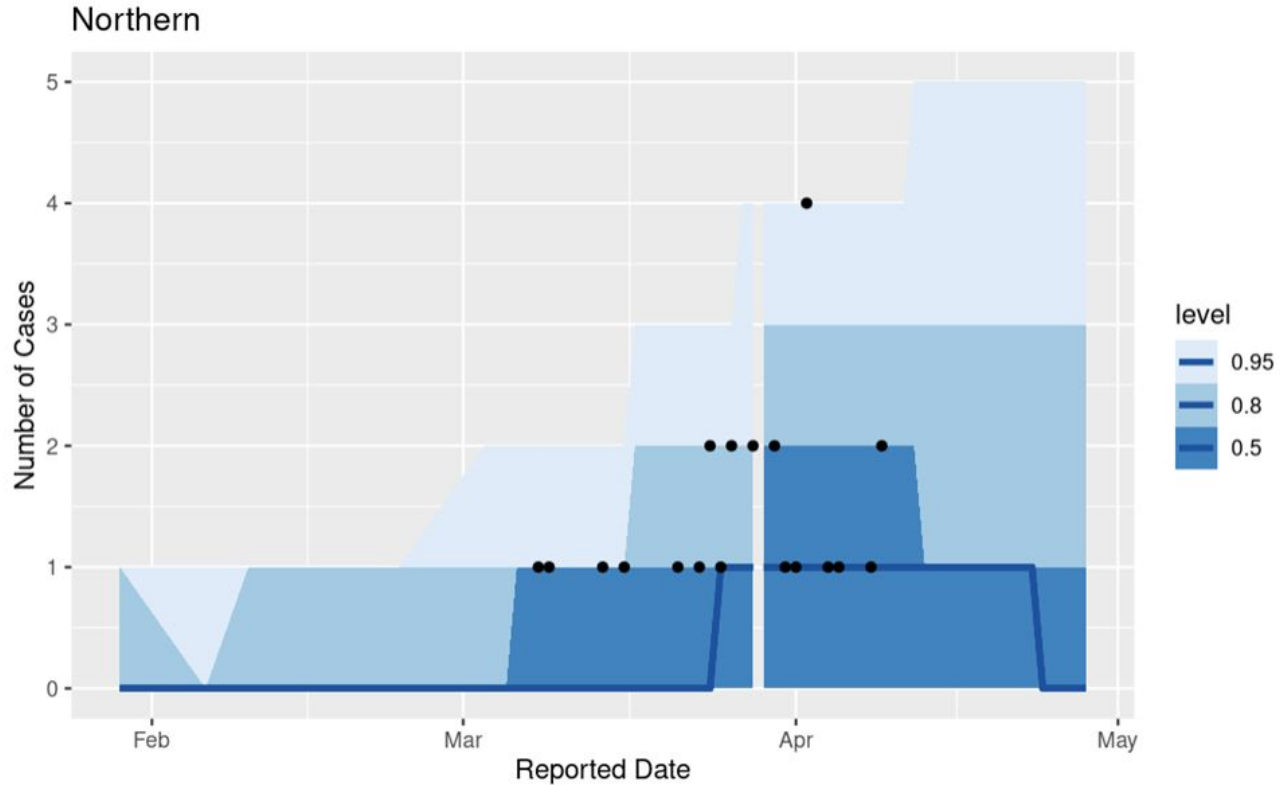

Vancouver Coastal

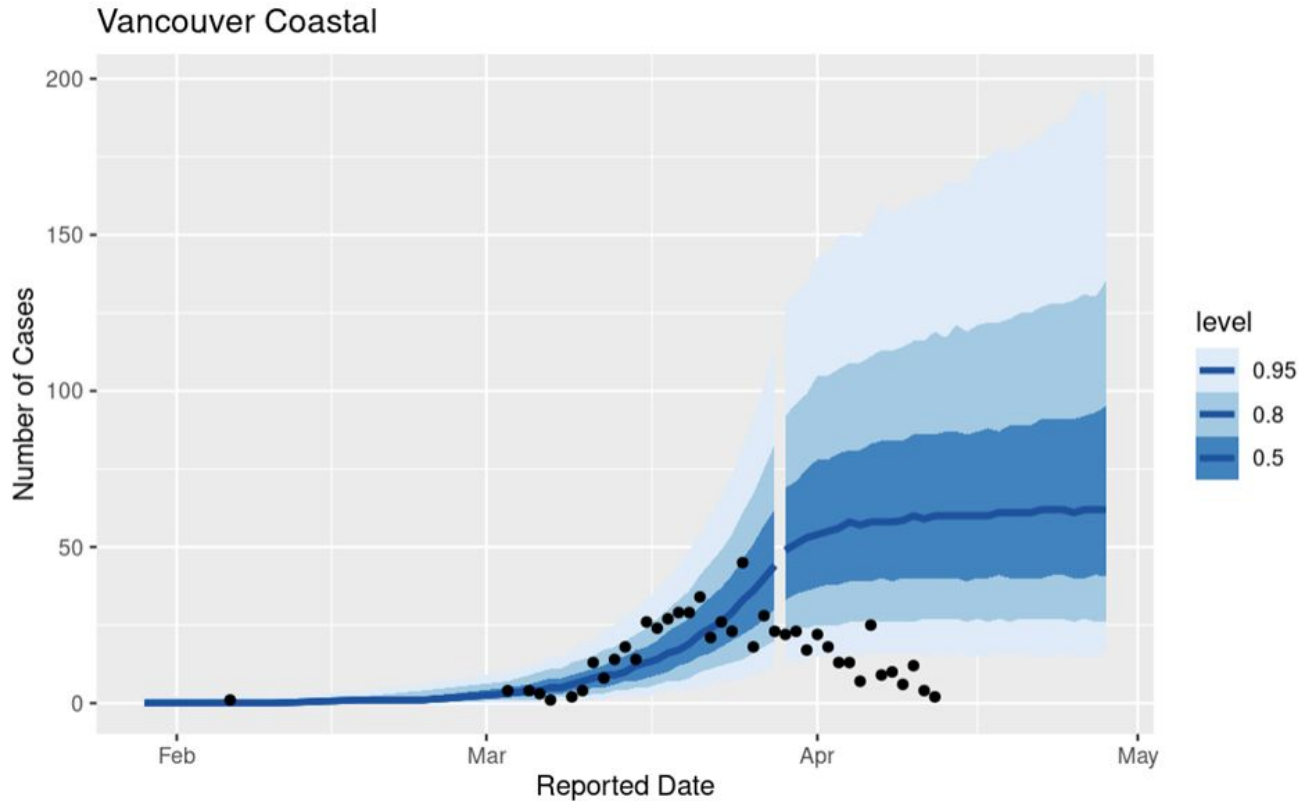# Fitting New Model (Vancouver Island)

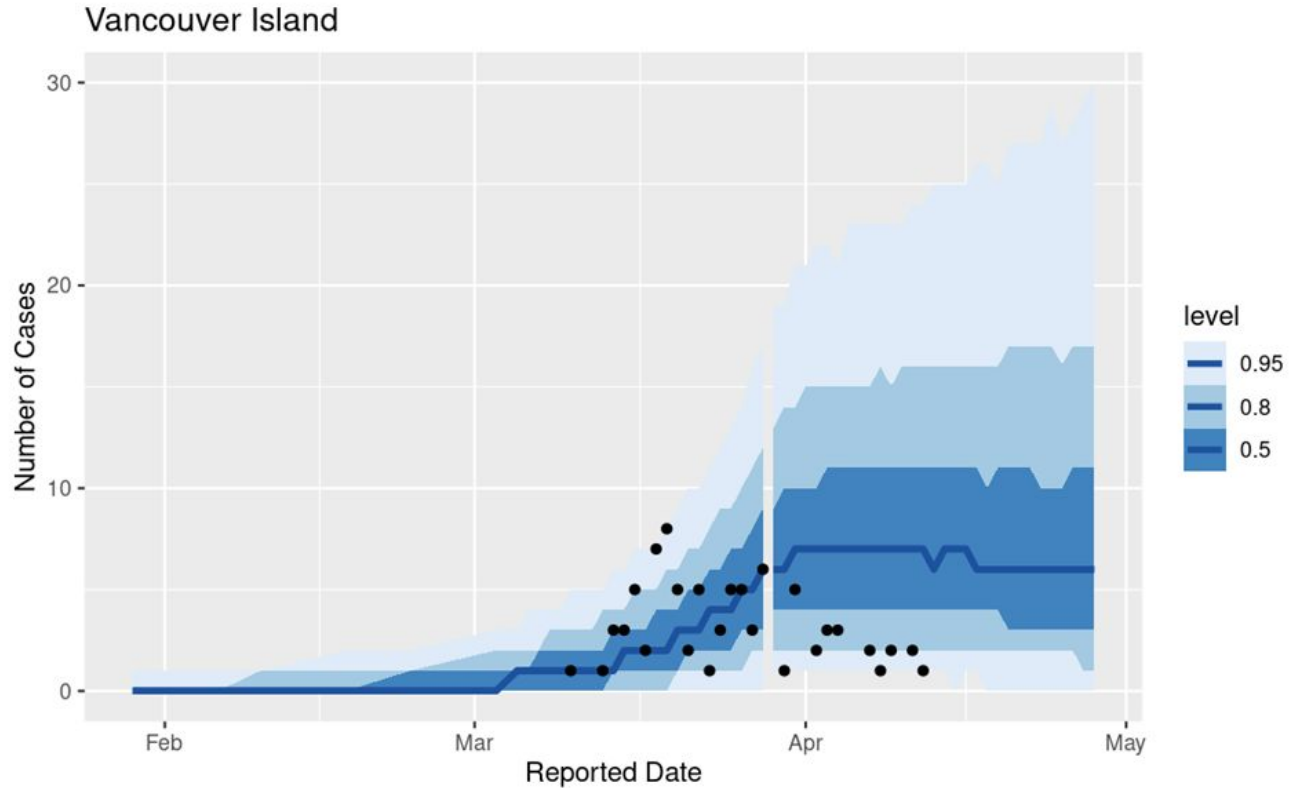# 60% Mask Efficiency Projection (Interior)

60% Mask Efficiency Projection (Northern)

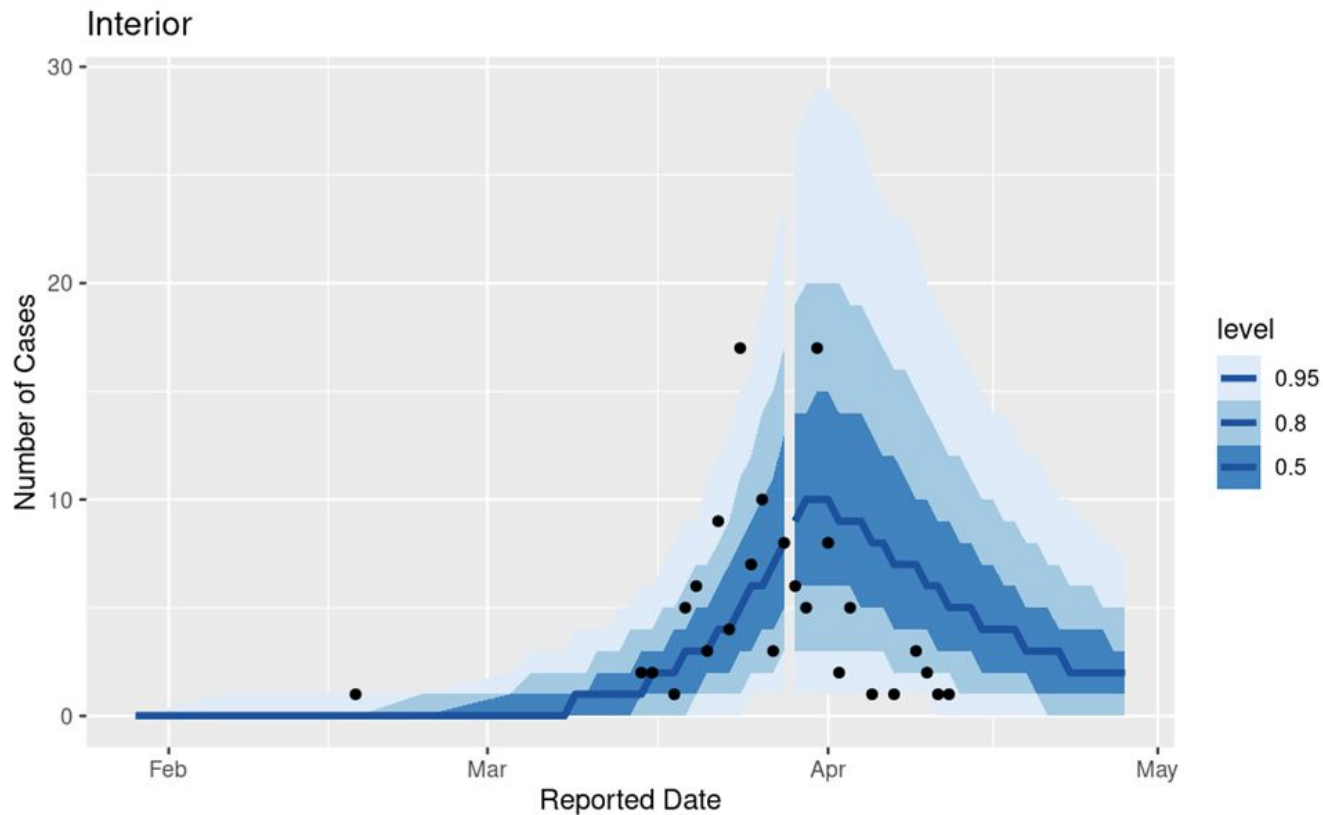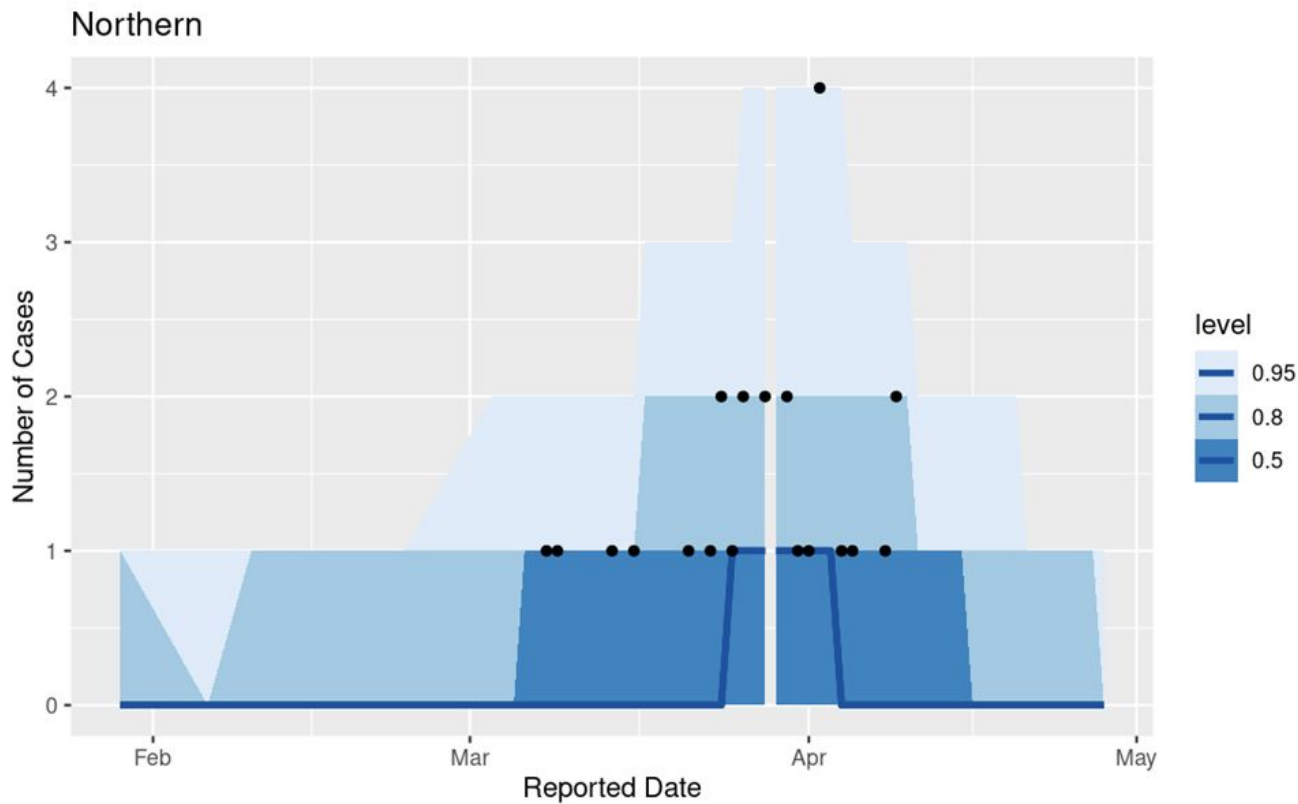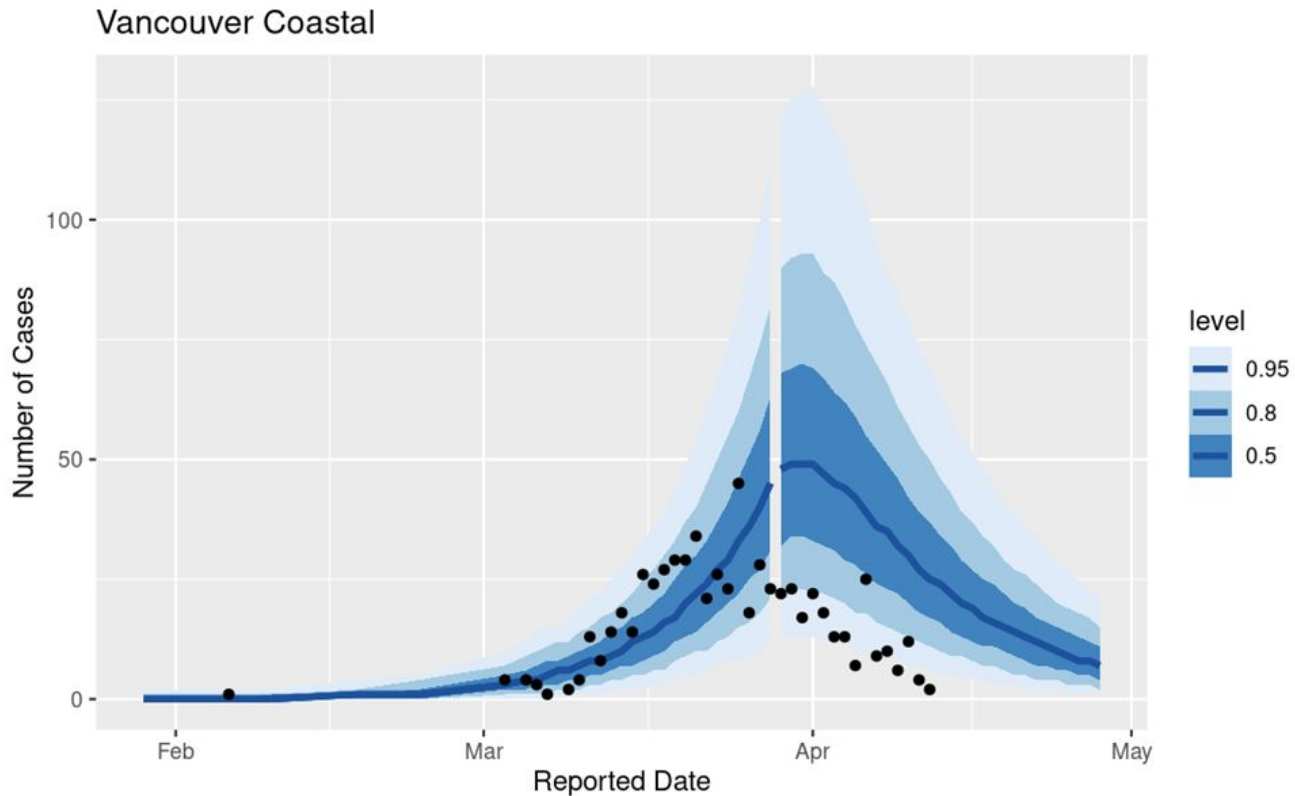# 60% Mask Efficiency Projection
(Vancouver Coastal)

60% Mask Efficiency Projection
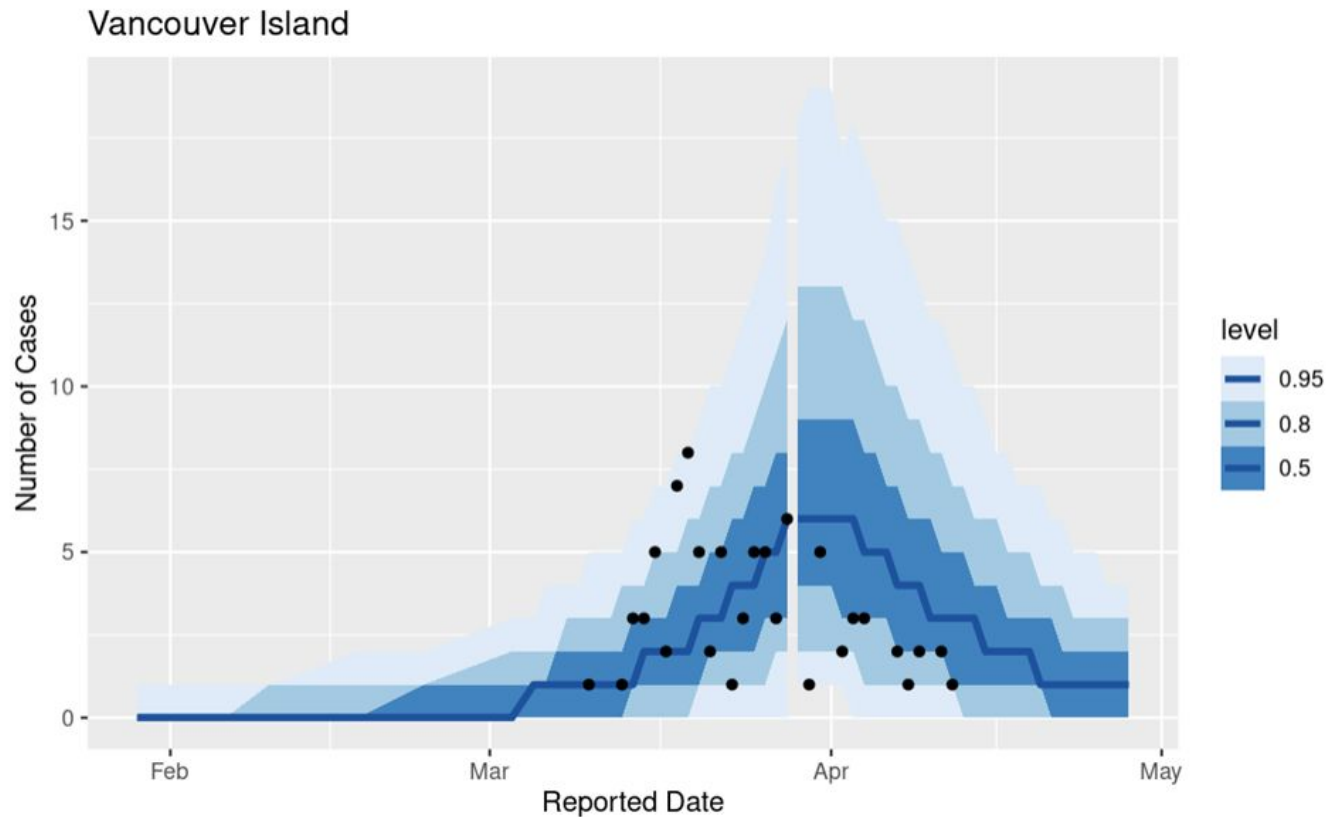## (Vancouver Island)

90% Mask Efficiency Projection
(Interior)

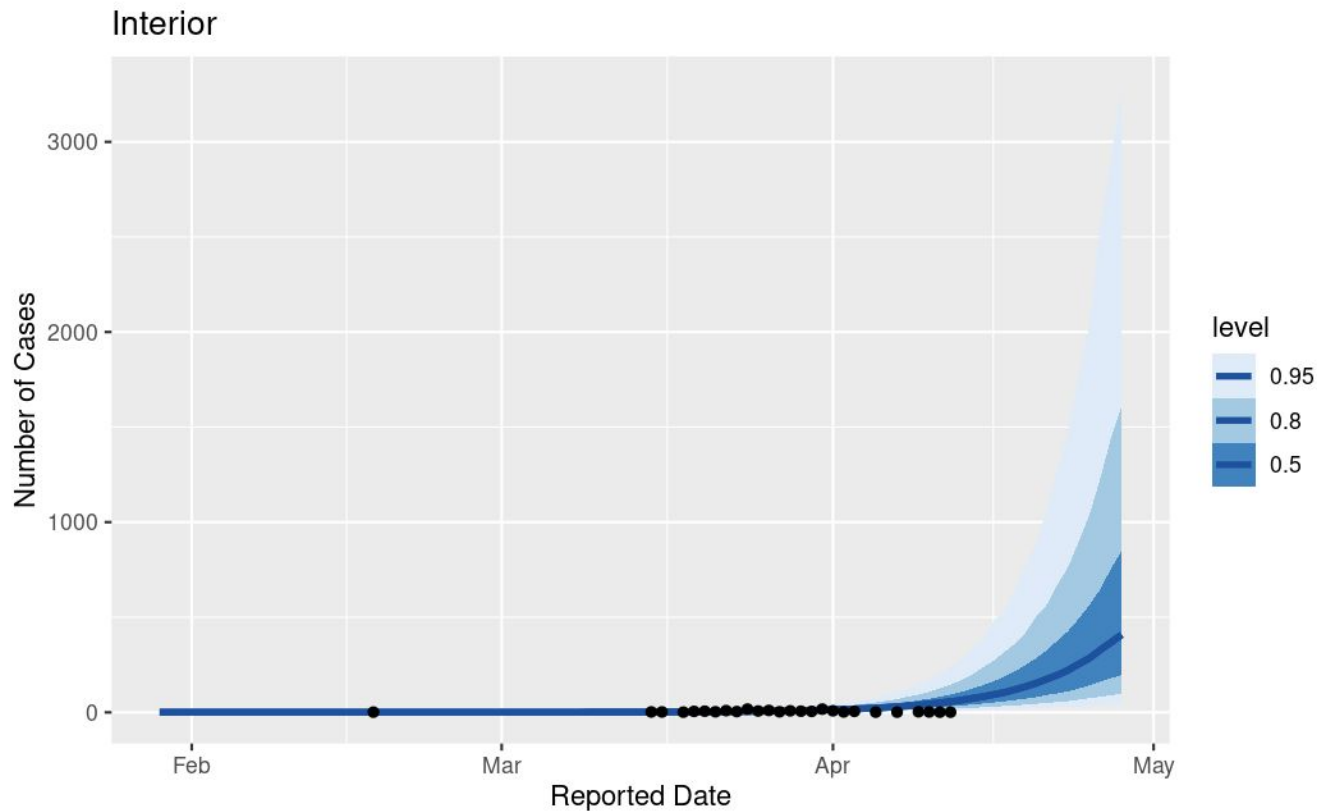# 90% Mask Efficiency Projection
(Northern)
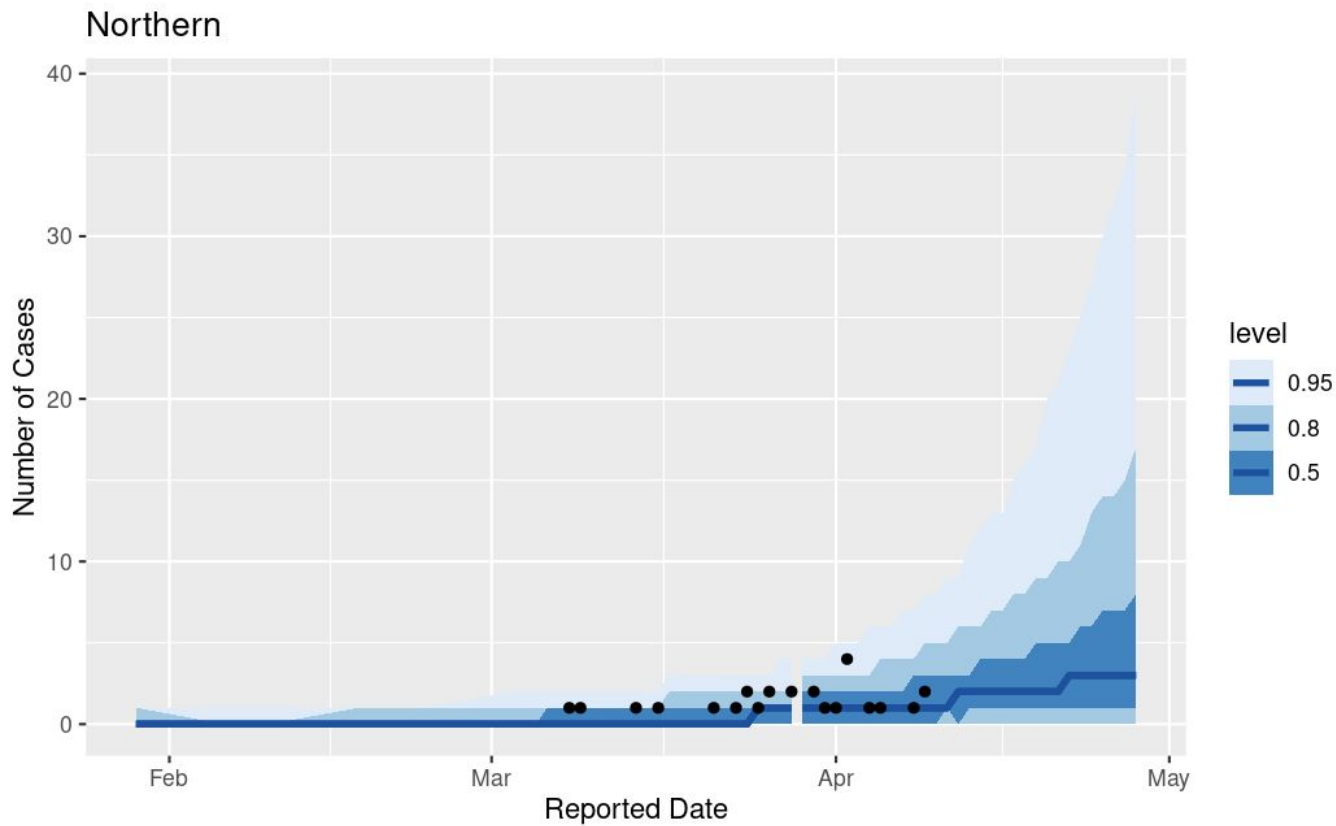
90% Mask Efficiency Projection
(Vancouver Coastal)

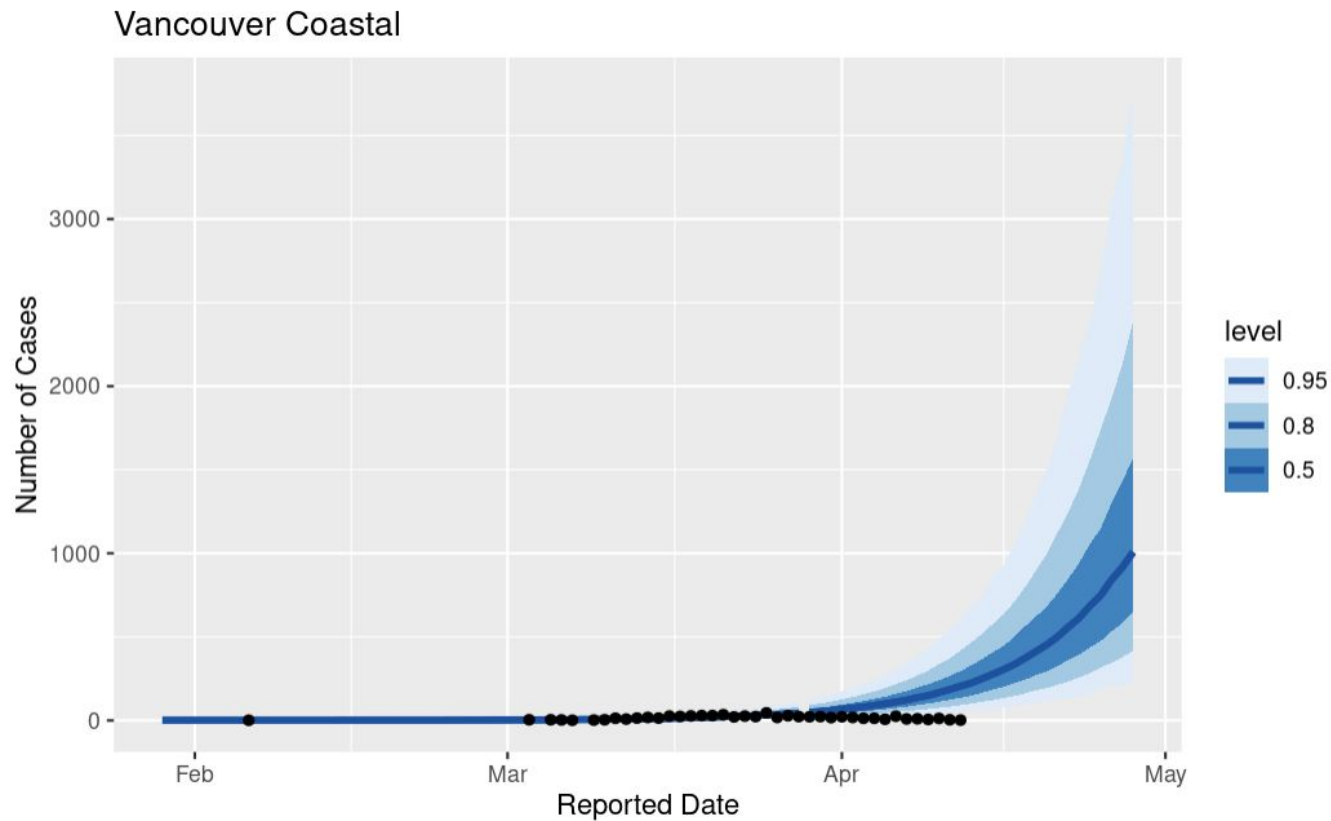# 90% Mask Efficiency Projection
(Vancouver Island)

No Mask Projection
(Interior)

No Mask Projection
(Northern)

No Mask Projection
(Vancouver Coastal)

No Mask Projection
(Vancouver Island)

Vancouver Island