

Considerations about R_t , the reproduction number

- The R_t is a measure of transmissibility - number of secondary cases caused by an infected individual.
- $R_t = \# \text{ contacts} \times \text{Pr}(\text{infection} \mid \text{contact}) \times \text{infectious period}$.
- Contact rates and transmissibility change over time, affecting the R_t . Hence, $R_{t,t}$ the instantaneous reproduction number.

Modelling

Branching Process - type models

- $D_t \sim \text{NegativeBinomial}(d_t, d_t + d_t^2/\psi)$, where D_t the daily observed deaths.
- $d_t = ifr_j \sum_{\tau=0}^{t-1} c_t \pi_{t-\tau}$, where c_t the true number of infected individuals at time τ and $\pi_{t-\tau}$ the infection to death distribution.
- ifr_j is the infection-to-fatality ratio at wave j .
- $c_t = S_t R_t \sum_{s=1}^{t-1} c_{t-s} w_s$, where $S_t = 1 - \frac{\sum_{s=1}^{t-1} c_s}{N}$ the shrinkage of R_t due to the reduction of susceptible individuals.
- w_s is the infectivity profile of an infected individual given by a probability distribution.
- We amend this model by inferring the location and magnitude of R_t changes.

IFR in Numbers

IFR	1st Wave Covid19	2nd Wave Covid19
United Kingdom	0.900 %	0.600 %
Greece	1.140 %	0.802 %

Table 1: Infection Fatality Ratios at the general population.

Bayesian Computation Methods

- Training of the model and Inference was performed using Bayesian methodology
- We used *PyStan*, a Python interface to *Stan* implementing the No-U-Turn sampler, a variant of Hamiltonian Monte Carlo.

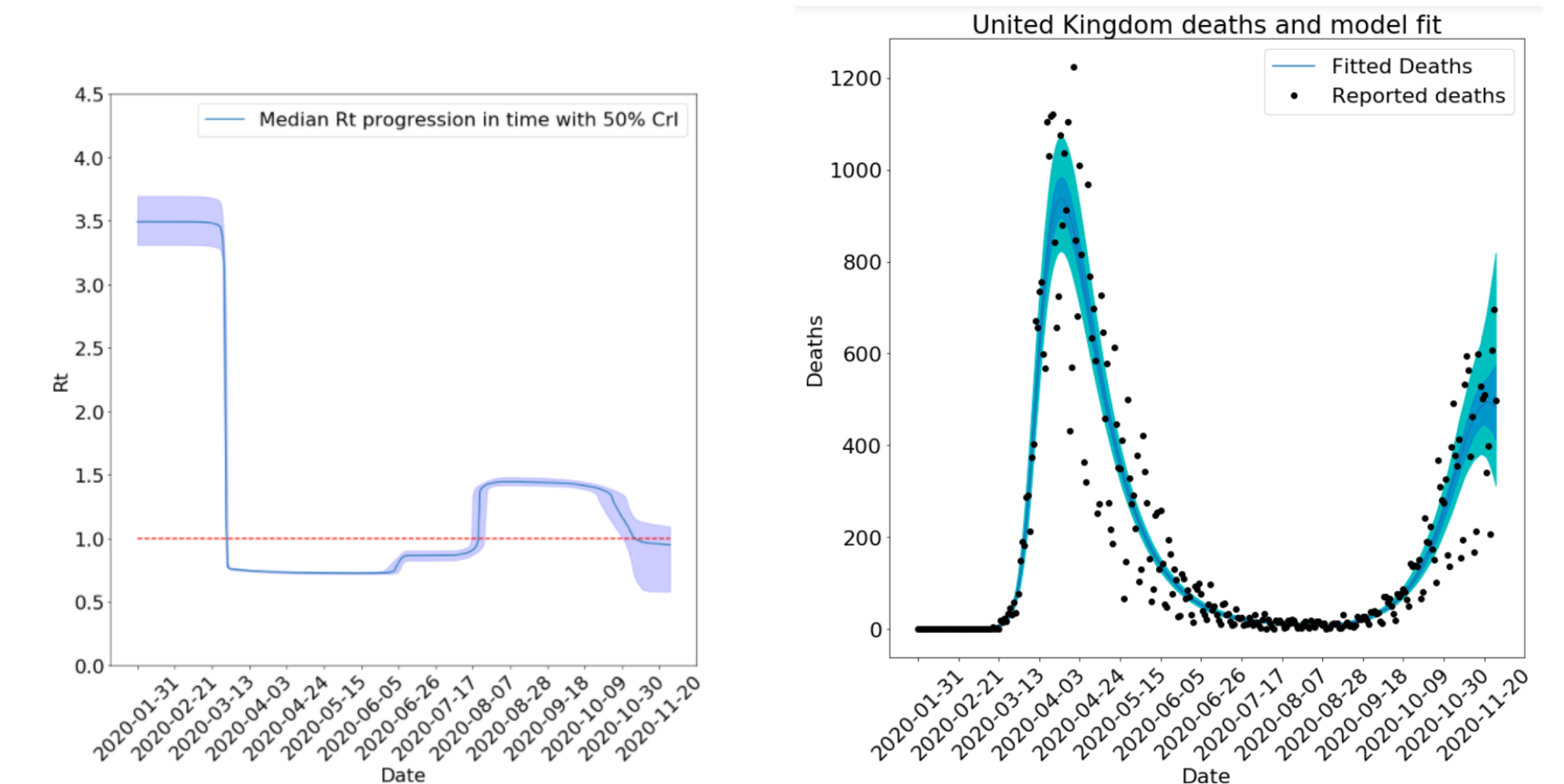
Antibody prevalence studies in UK and Greece

- In Greece a serosurvey of IgG antibodies against SARS-CoV-2 was performed during March and April 2020 with the inclusion of 6,586 leftover sera.
- In England REACT2 study was performed with the inclusion of 100,000 adults.
- Model's predictions about prevalence present small deviations in comparison to the serosurveys.

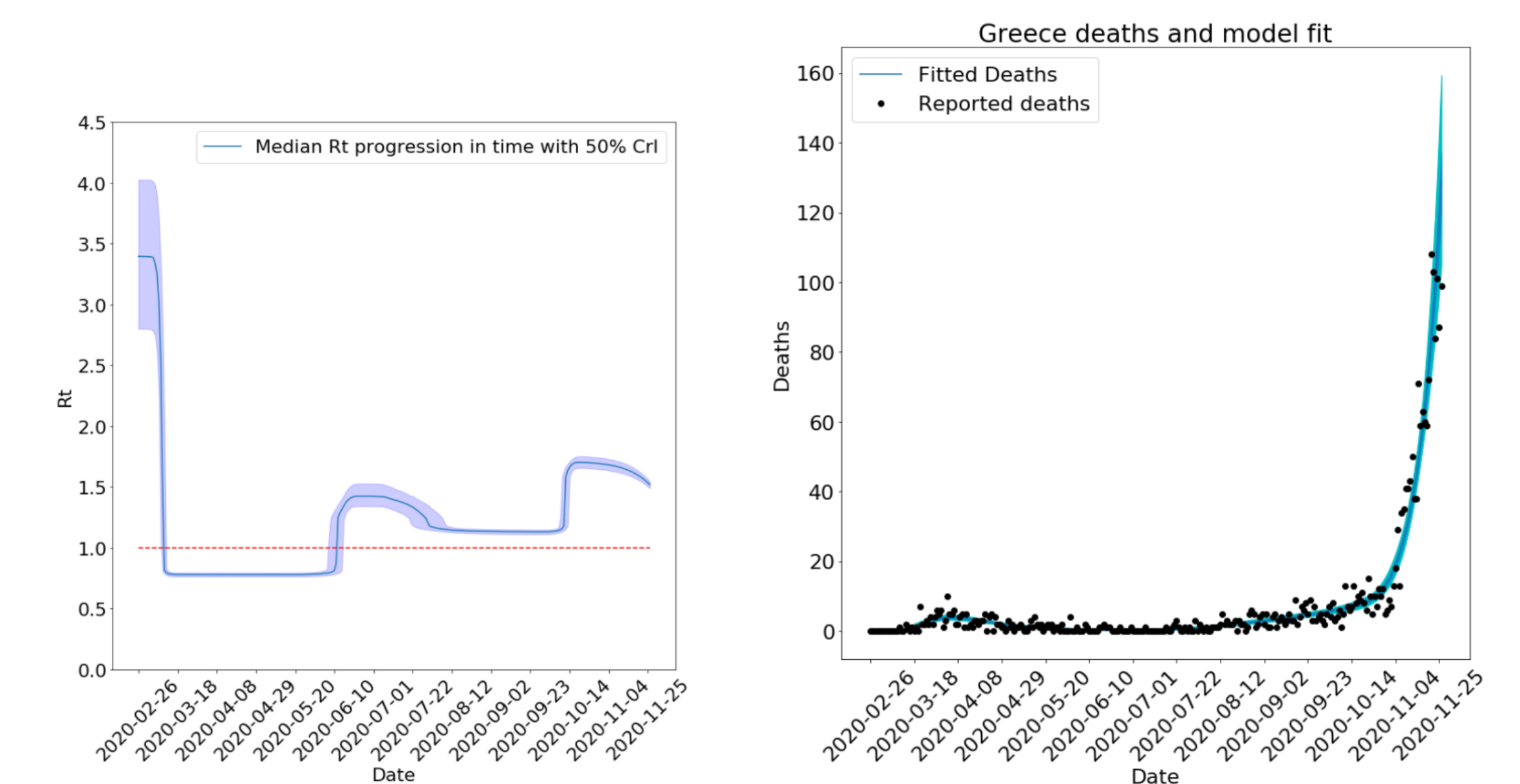
Prevalence (%)	Antibody Testing	Model based estimate
United Kingdom (June)	6.000 (5.700, 6.800)	7.037 (5.105, 10.226)
Greece (March)	0.020 (0, 0.250)	0.100 (0.063, 0.210)
Greece (April)	0.250 (0.020, 0.500)	0.135 (0.089, 0.248)

Table 2: Prevalence comparison between Antibody Testing and BP Model.

United Kingdom model fit 2020-11-26



Greece model fit until 2020-11-26



Future Work

- Inclusion of mobility data provided by *Google* and *Apple* to the model.
- Perform Prequential Analysis using proper-scoring rules.