On the complexity of Modelling the phases of SARS-CoV2 transmission

Barmpounakis Petros, Demiris Nikolaos

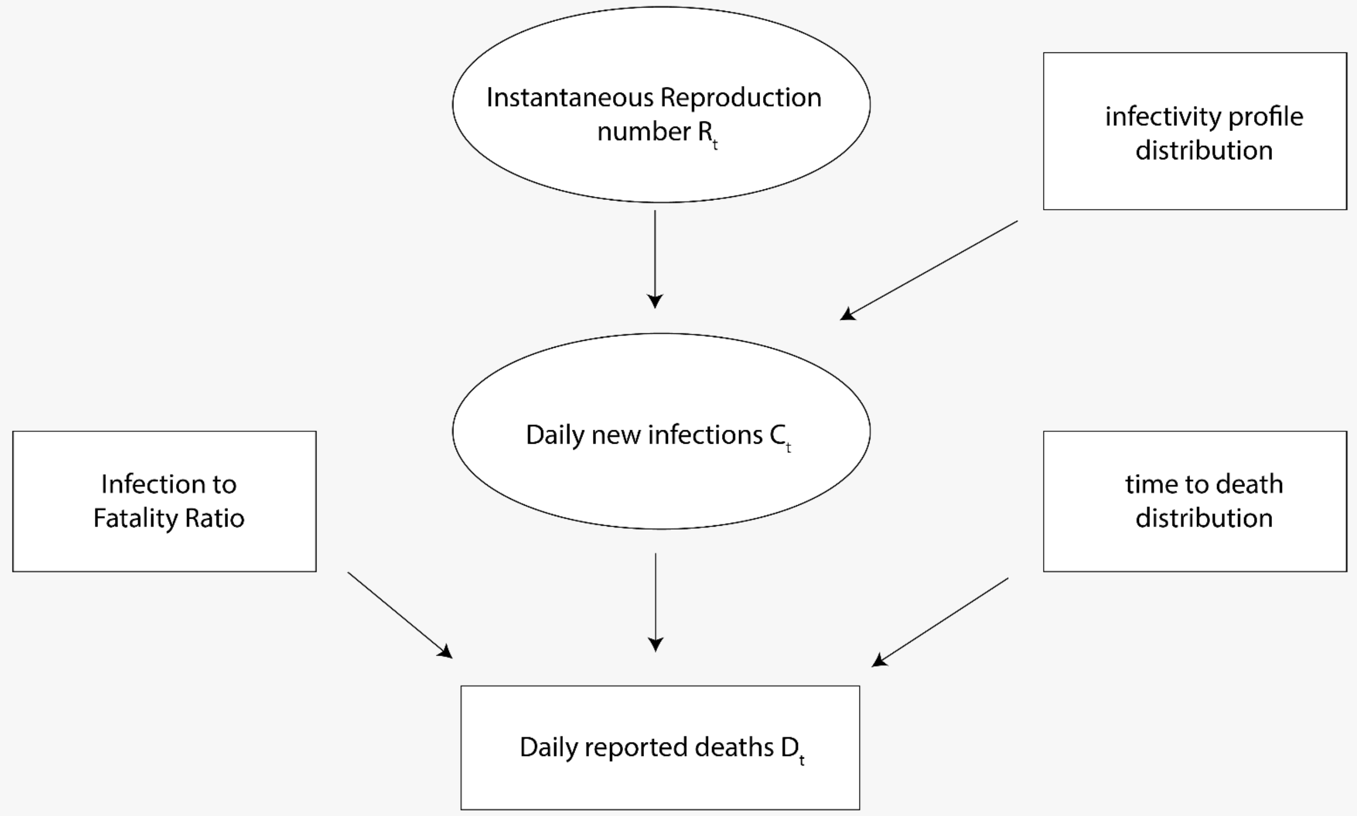
barmpounakis@aueb.gr

Athens University of Economics and Business,

Department of Statistics

WGMBC Autumn Session, Athens, Greece, 2021

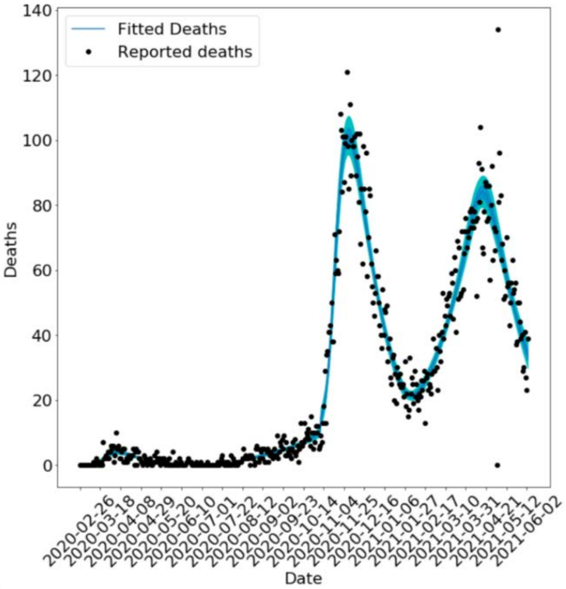
A graphical representation of the stochastic epidemic model

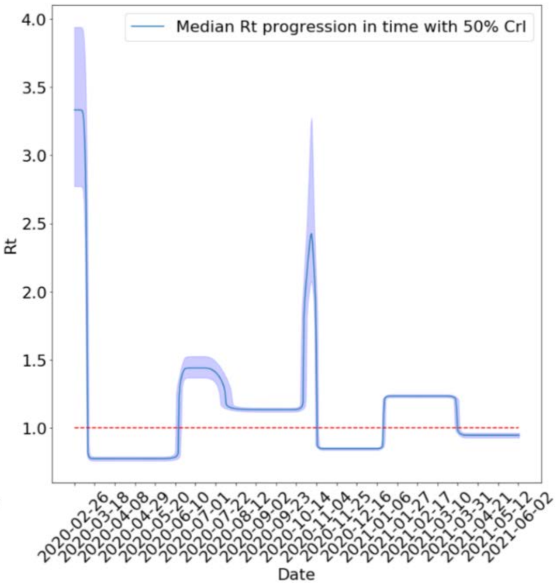


Some considerations about this model

- We consider that the true infection dynamics can be described by a hierarchical stochastic epidemic model with piece-wise constant reproduction number building on the work of Flaxman et al.
- The Flaxman et al. model was published in *Nature* on June 2020.
- The main source of criticism for this model was that the time of the changes of the R_t was a-priori defined.
- Also, it was assumed that all the NPIs had a positive effect on the transmissibility.
- We amend the transmission mechanism of the Flaxman model by inferring the location and magnitude of R_t changes using stochastic changepoints.

Greece model fit until 2021-06-03





Introduction of Bayesian non-parametrics into our framework (work in progress)

- In the previous framework the number of stochastic changepoints was a-priori selected and not learned from the data.
- We use Bayesian non-parametric methods in order to determine an appropriate model complexity directly from data in a fully Bayesian manner.
- Specifically, the stick-breaking construction of the Dirichlet process.
- The non-parametric nature of this model makes it an ideal candidate for modelling the phases of an epidemic where the distinct number of phases is unknown beforehand.

Some early promising results from simulations

- We simulate data from an epidemic for $t = 1, \dots, 150$.
- At time points $T_1 = 60$ and $T_2 = 100$ we have a change in transmissibility.

$$R_t = \begin{cases} 2.5 & t < T_1 \\ 0.95 & T_1 \leq t < T_2 \\ 0.7 & T_2 \leq t \end{cases}$$

variable	*mean*	*sd*	*95% Cr.I.*
R_1	2.50	0.0	(2.50, 2.50)
R_2	0.95	0.0	(0.95, 0.95)
R_3	0.70	0.0	(0.70, 0.70)
T_1	60.39	0.24	(60.10, 60.96)
T_2	100.59	0.21	(100.11, 100.90)

Table 1: Results were obtained using Hamiltonian Monte Carlo.

Thank you for your attention