Canovaccio

March 31, 2020

1 Model

To analyze policies, we set up a minimal compartimental model that assumes:

- Contact between infected I and susceptible S generates new infected at a rate β
- Infected are asymptomatic. After a time $\tau_I = \gamma^{-1}$ either recover with probability ϵ or show evident sympthoms (compartiment O ="observable") with probability $1 - \epsilon$
- O do not infect others, either because hospitalized or because they start a quarantine
- O recovers after a time h^{-1} (either because recovered or because dead... should say politely)

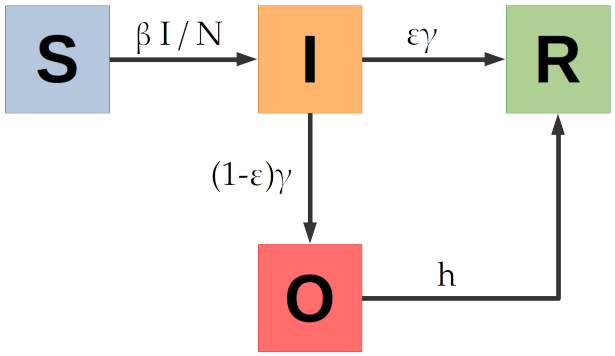

Figure 1: Compartimental model

The model, to take account for age classes, incorporates also contact patterns through a sociological matrix C that rescales the infectivity β; moreover, it also

considers the different age incidence of "observable" cases through a matrix Ξ that built up on ISS data.

2 Lockdown

We notice a strong lockdown effect from mobility data

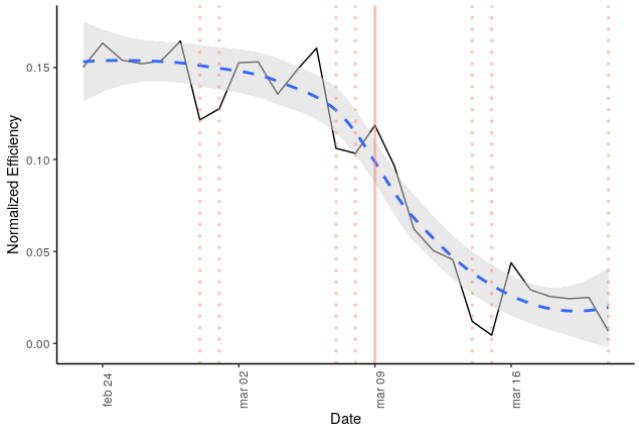

Figure 2: Mobility change

To fit our model over Italian data, i.e., we confront Y^{obs}, the reported cumulative number of Covid19 cases, with a fraction ω of the analogous quantity Y^{mod} predicted by our model. We observe a good stability of the fitted parameters (i.e. they change by few percent by varying ω in a range $[10\% \dots 100\%]$).

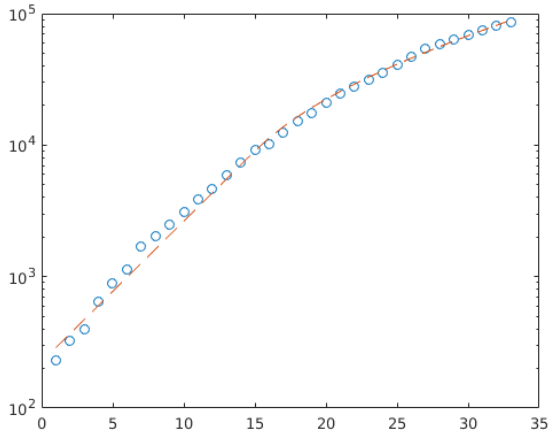

Figure 3: Comparison of the cumulative number of observed cases with our model. Parameters indicate a reduction of 50% in the number of contacts after the lockdown

To take account of a possible reduction of the virality due to reduced contacts, we consider two different values β^I, β^{II} before and after the lockdown. We find $\beta^I/\beta^{II} \sim 50\%$; such results indicate that , thanks to the reduction in mobility and the new social distance behaviours, such reduction correspond to a $\sim 50\%$ post-lockdown decrease in contacts. The number does not depend significantly on the fraction ω of serious cases we are observing.

3 Scenarios

The observed reproduction number in our model is $R_0 \sim 6$ and is again stable against varying the fraction ω of cases. Notice that in our model β (and hence R_0) depends also on the contact matrix C, i.e. on the structure of social interactions among age classes; as an example, the different patterns of contacts in Germany and in Italy could easily justify a growth of the epidemic twice faster in the second country.

We first consider what happens by stopping the lockdown after the peak of reported synthomatic people (i.e. ωO)

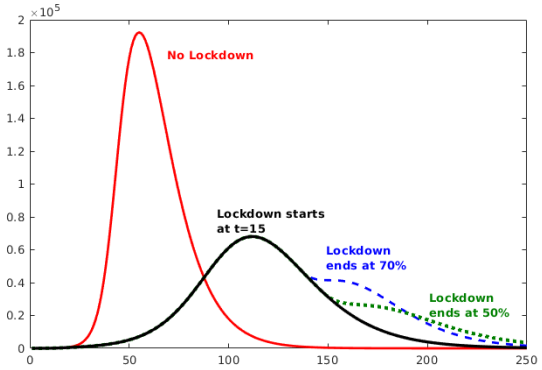

Figure 4: Comparison of the scenarios where the lockdown is relaxed after it is reached the 70% and the 50% of the reported cases peak

We notice that, contrary to the scenarios were exiting the lockdown would restart the epidemics and create a new peak, for our parameters exiting the lockdown prolongs the reporting of cases without putting under strain the national healthcare system (HERE WE ARE AVOIDING SPEAKING OF THE MORTALITY .... THAT COULD BE THE FOCUS OF THE PAPER: SCENARIOS FOR HEALH-CARE CAPACITY). This is due to the fact that, in our model and with our estimated parameters (remember $R_0 \sim 6$), the number of infected and recovered is much higher than what reported to the national healthcare system. Hence, lockdown does not happen in the early stages .

Notice that lockdown has two effects: lowering the peak – very important for avoiding the collapse pf the national healthcare system – but also moving the peak toward later times – extremely obnoxious for the economy of a country.

3.1 Early Lockdown

Here we show that early lockdown reduce the height of the peak without much moving it forward in time. However, ending the lockdown can make epidemic start again

3.2 Strong lockdown

Here we show that increasing the strength of the lockdown (i.e. reducing the social contacts) is much less effective than acting in early times; moreover, if moves the peak forward in time. It can be reasonable only for low productive part of the population

3.3 Effects on regions

Starting from the fact that different regions have different delays in the start of the epidemics (taking Lombardia as the earliest), we could analyze possible

scenarios according to the delay (i.e. can the end of the lockdown restart an epidemic in some regions?)

4 Some thoughts

Social matrices indicates that

- Young people $(0-19)$ are the most interconnected, with higher contacts rates. They are the ones that "dominate" R_0. Hence, most policies will be late if they don't act first with youngs. On the other hand, if teh infection is very quick and mostly asymptomatic, it is difficult to detect an epidemic before it has already spread too much
- Elderly people (60+) are the second most interconnected class. Since for Covid19 the incidence is also higher in their class, that's were it makes sense to enforce a stronger and longer lockdown

Thnks