Big Data Project

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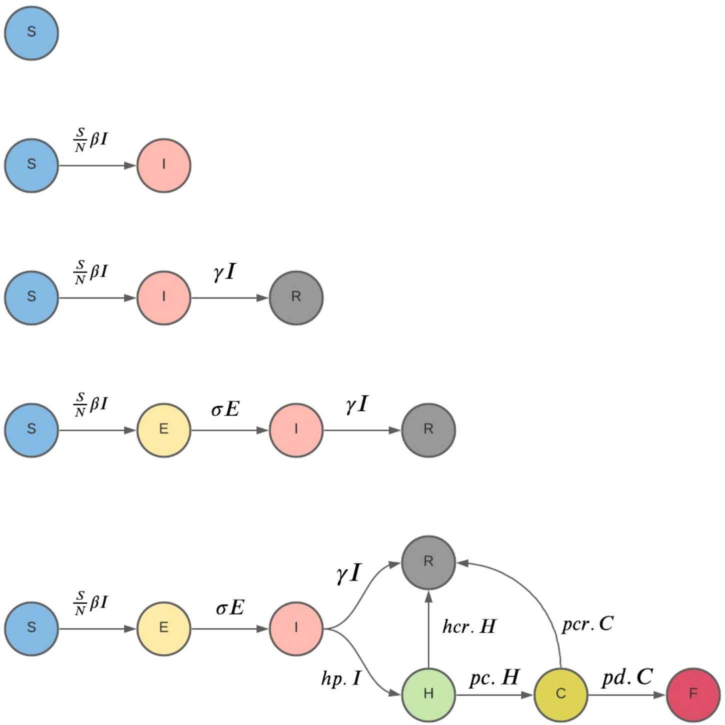
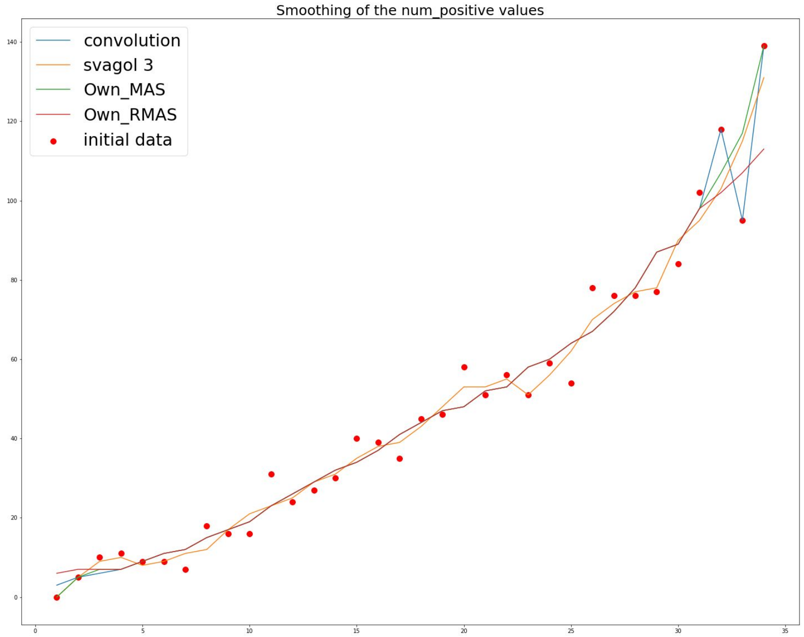
Covid-20 modelling: Beyond SIR model



- β = Contamination rate
- σ = Inverse of incubation time
- γ = Recovery rate
- hp = Hospitalization rate
- hcr = Recovery rate from hospital
- pc = Probability to fall in ICU
- pd = Probability to die in ICU
- pcr = Probability to recover from ICU

Fitting our model: Pre-processing

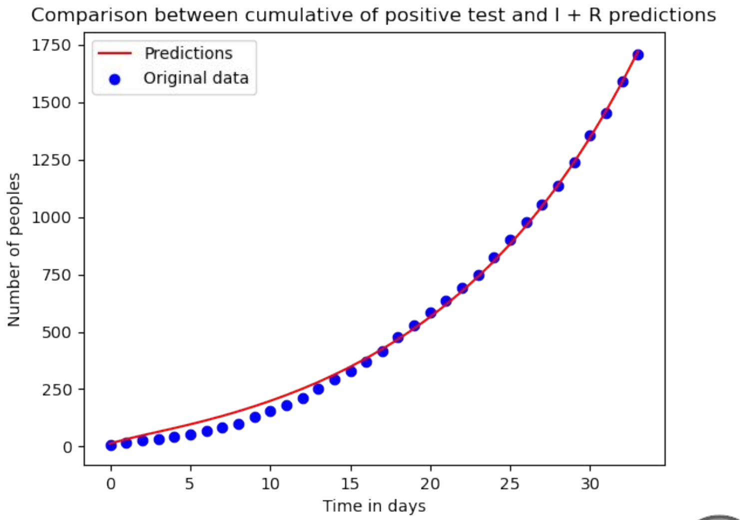


- We attempt to fit important patterns in our dataset while ignoring noise.
- Beginning of an epidemic, our data, especially from the early days, seem to be very unreliable.

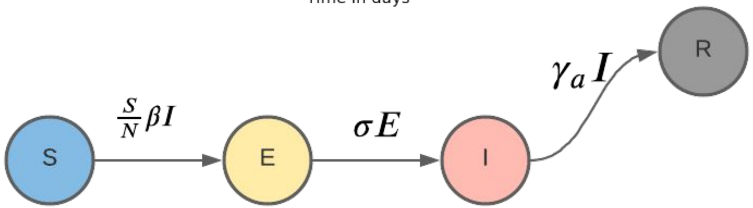
Moving average:
- Svagol filter
- Convolution
- Own_MAS : reducing window size
- Own_NRMAS : not reducing window size

[1] https://nl.mathworks.com/help/curvefit/smoothing-data.html
[2] https://docs.scipy.org/doc/scipy/reference/generated/scipy.signal.lfilter.html
[3] https://docs.scipy.org/doc/scipy/reference/generated/scipy.signal.savgol_filter.html

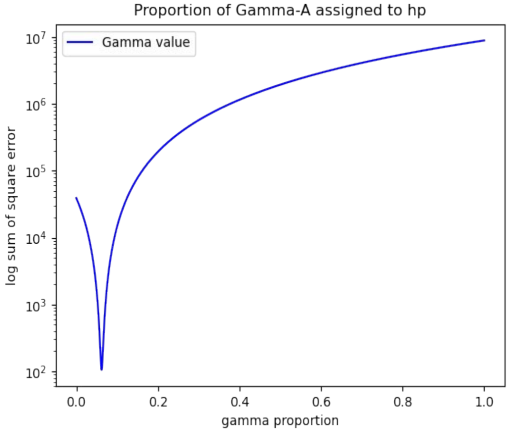
Fitting our model: Step 1

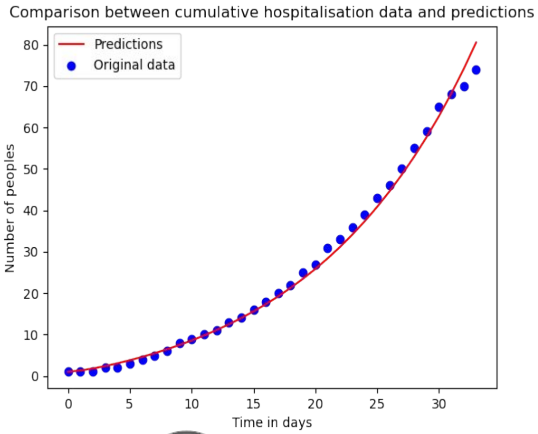


- $\beta = 0.38709$
- $\sigma = 0.35330$
- $\gamma = 0.22725$
- $hp = 0.0$
- $hcr = 0.0$
- $pc = 0.0$
- $pd = 0.0$
- $pcr = 0.0$



Fitting our model: Step 2





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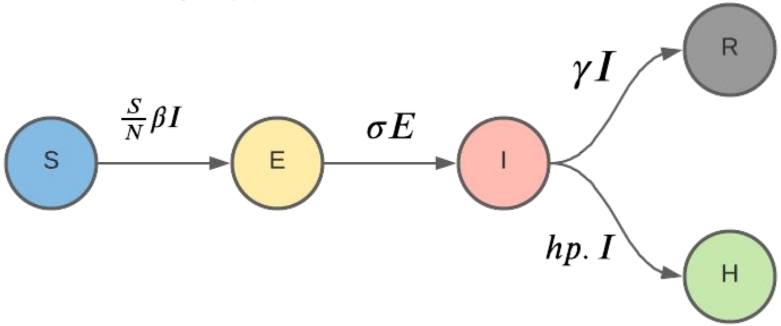
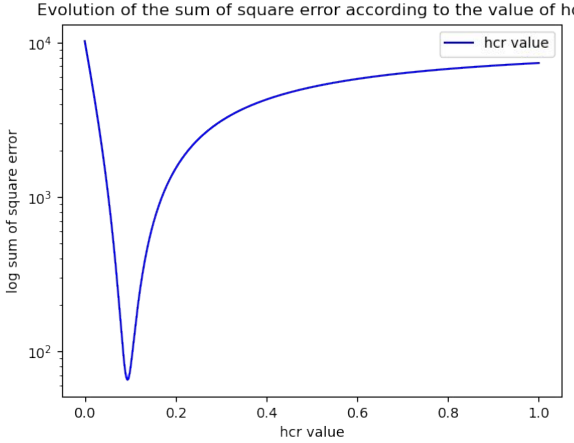
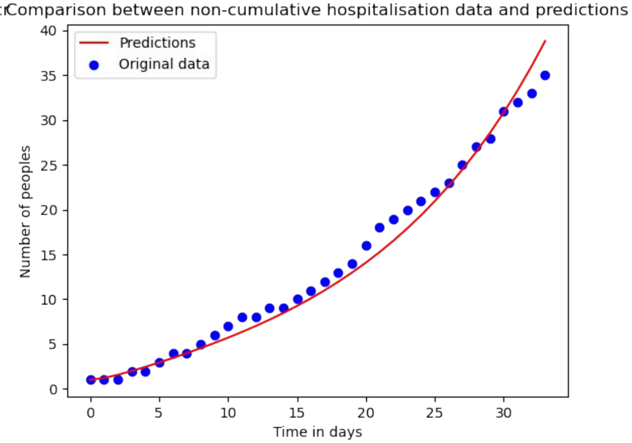


Fitting our model: Step 3





- $\beta = 0.38709$
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- $\gamma = 0.22725$
- $hp = 0.01503$
- $hcr = 0.05645$
- $pc = 0.0$
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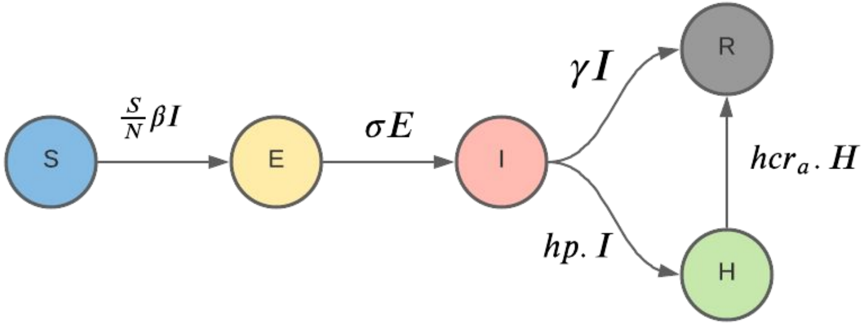
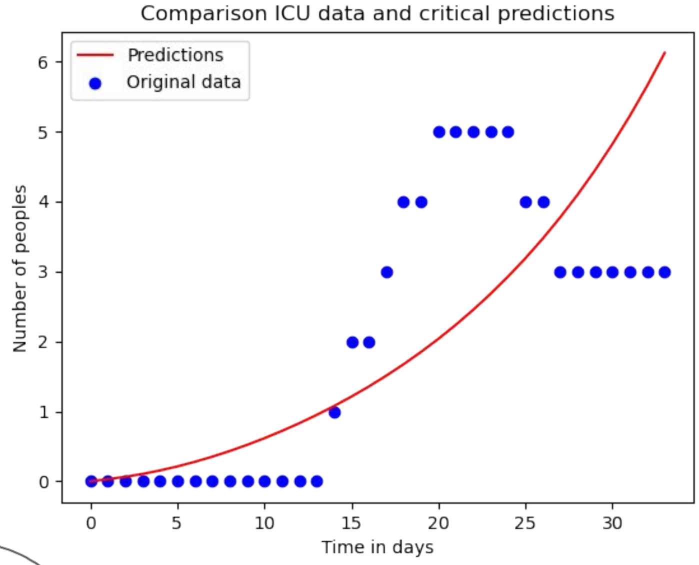
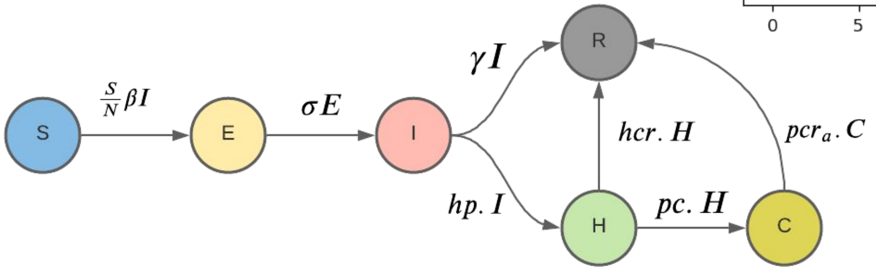
- $pcr = 0.0$



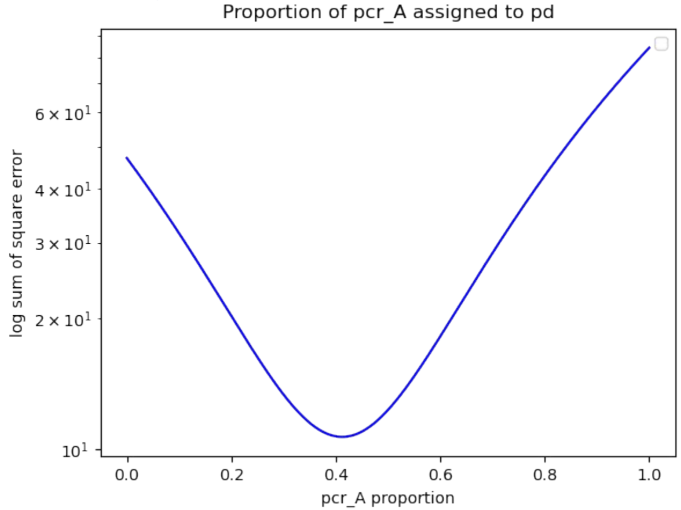
Fitting our model: Step 4

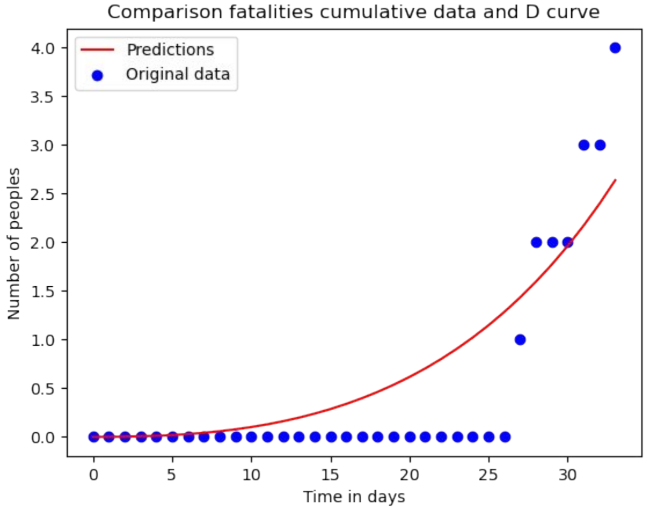


- $\beta = 0.38709$
- $\sigma = 0.35330$
- $\gamma = 0.22725$
- $hp = 0.01503$
- $hcr = 0.05645$
- $pc = 0.01503$
- $pd = 0.0$
- $pcr = 0.03093$



Fitting our model: Step 5





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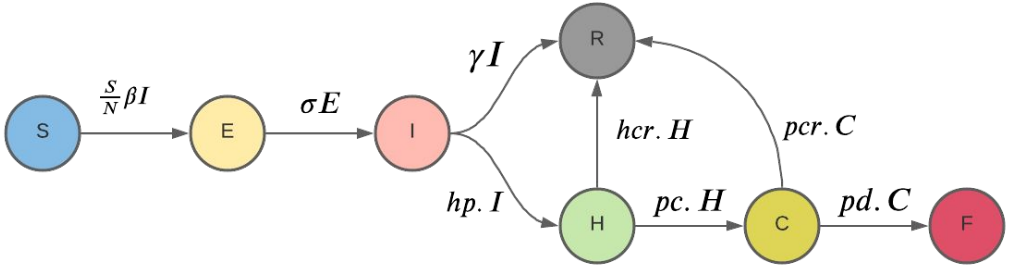

Parameters Interpretation

- $\beta = 0.38709$
- $\sigma = 0.35330$
- $\gamma = 0.22725$
- $hp = 0.01503$
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- $pc = 0.01503$
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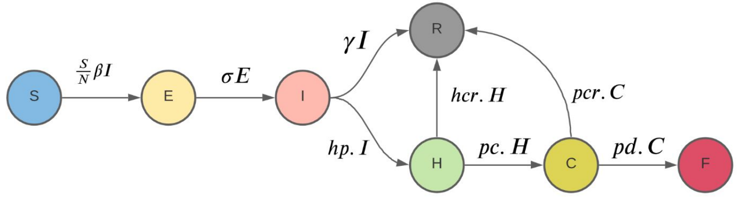
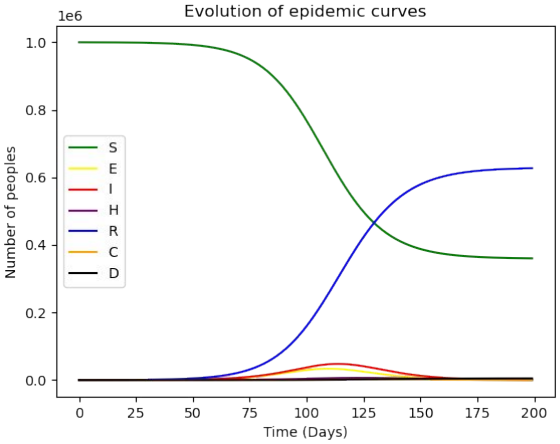
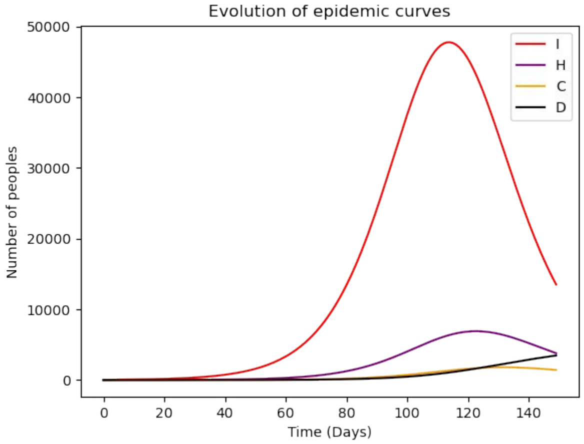
- $pcr = 0.03093$

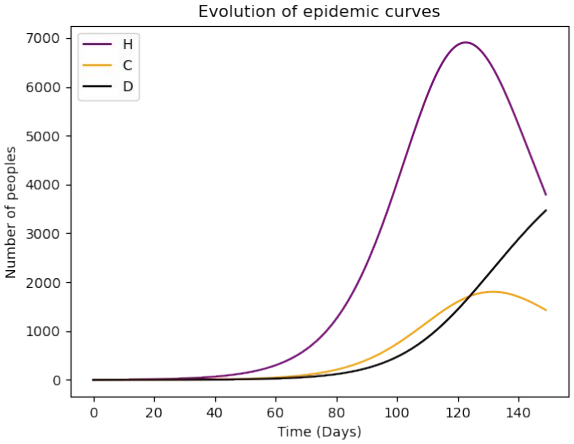
$$R_0 = \frac{\beta}{\gamma} = 1.7$$



Graph Interpretation

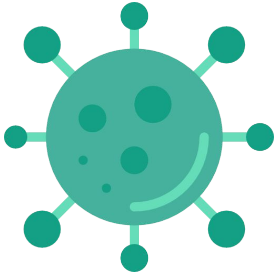






Visualisation

website



Improvements - What’s next?

- (what we think we are going to do for next review: “uncertainty”)
- Improvement of our prediction
- add the simulation of vaccination campaigns
- To train our model on different existing coronavirus databases

Thank you!

Optimizer

minimize(L-BFGS) algorithm:

- Derived from the Quasi-Newton methods (iterative)
- Minimize cost function over its unconstrained parameters
- Uses Wolf conditions to determine step
- Returns the values of optimal parameters if the algorithm converged
- Converge to a local minimum so we supposed a convex space

[1] https://en.wikipedia.org/wiki/Limited-memory_BFGS
[2] https://docs.scipy.org/doc/scipy/reference/generated/scipy.optimize.minimize.html

wolfe conditions

First condition: The first condition will allow us thanks to the beta 1 parameter to find an ideal step according to the beta value.

The second condition will allow us thanks to the beta 2 parameter to That characterizes a sufficient progress of the algorithm.