Mask Effectivity Using an SIR Model

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Modeling Question

“How effective do masks need to be to cut the peak number of infected persons by 50%?”

Importance

- Covid-19 has put a focus on daily public health interventions.
- We will demonstrate the importance of masks in everyday life.
- Our model runs under the assumption that everyone is wears a mask in real life - however, this is not the case.
- Researching masks and running a simulation based on real world data, proving the importance of using masks, will serve as another reason for people to mask up and slow the spread of real world infectious diseases

Background Info

- The infection rate of Covid-19 is around 1%
- The re-infection rate of Covid-19 is around 2.7%
- In real life, only a fraction of the population wears a mask

Assumptions

- Our alpha value (infectivity rate) is 1%
- Our beta value (recovery rate) is 25%
- Our gamma value (re-susceptibility rate) is 2%
- Everyone wears a mask
- Everyone will recover, and everyone will take the same time to recover
- Everyone susceptible is equally susceptible to be infected

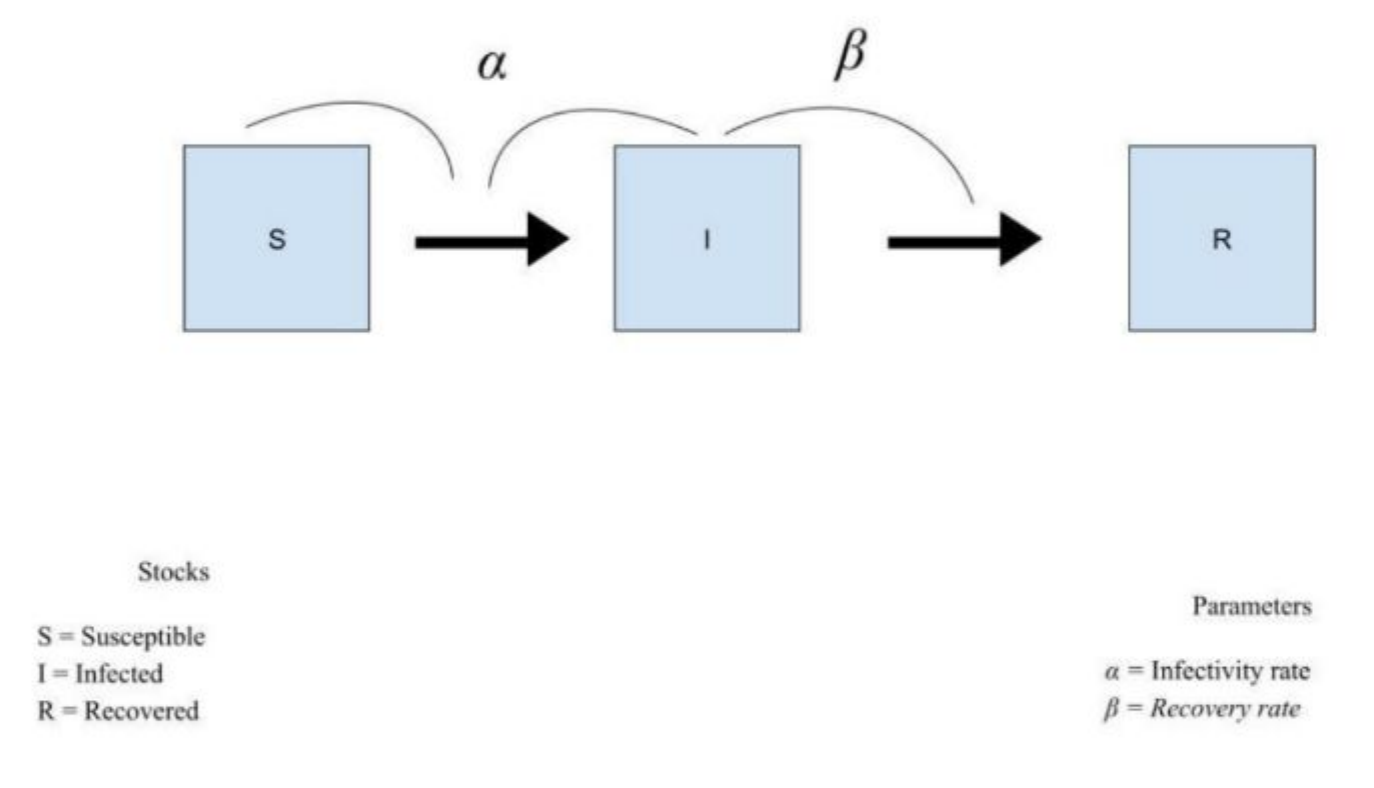
Model Methodology

Model 1 - This is the original SIR model that we looked at to adapt for our modeling question.

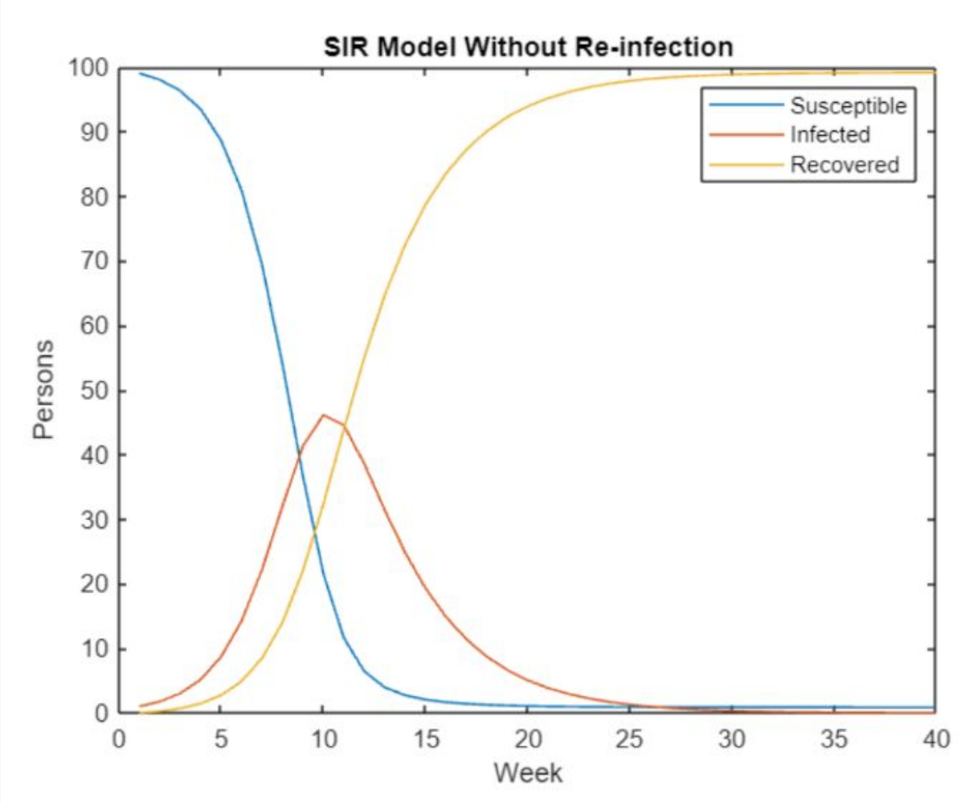
Model 2 - Our improved version of the SIR model that accounts for the re-infection of recovered persons. This is the model we will run our parameter sweep on.

Parameter Sweep - We will run a parameter sweep on mask effectiveness to find the minimum effectiveness to cut the peak number of infected persons by 50%.

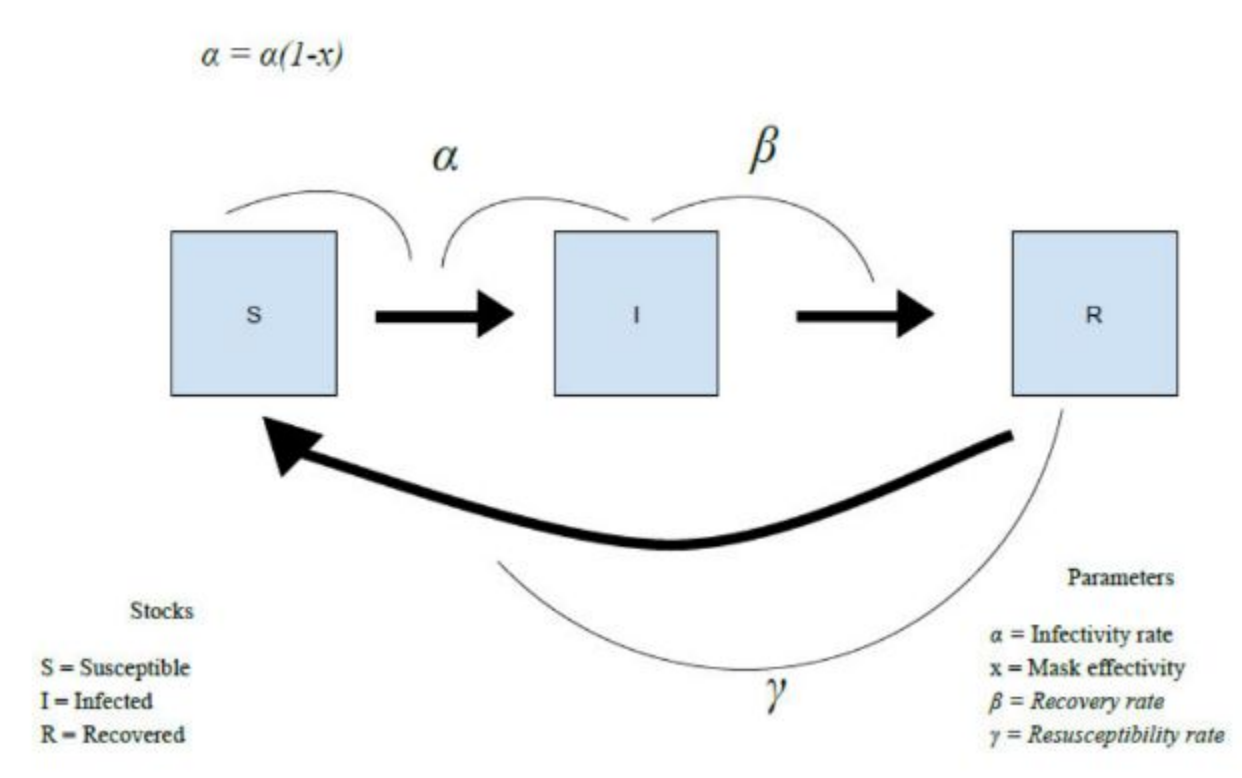
Stock and Flow Model 1



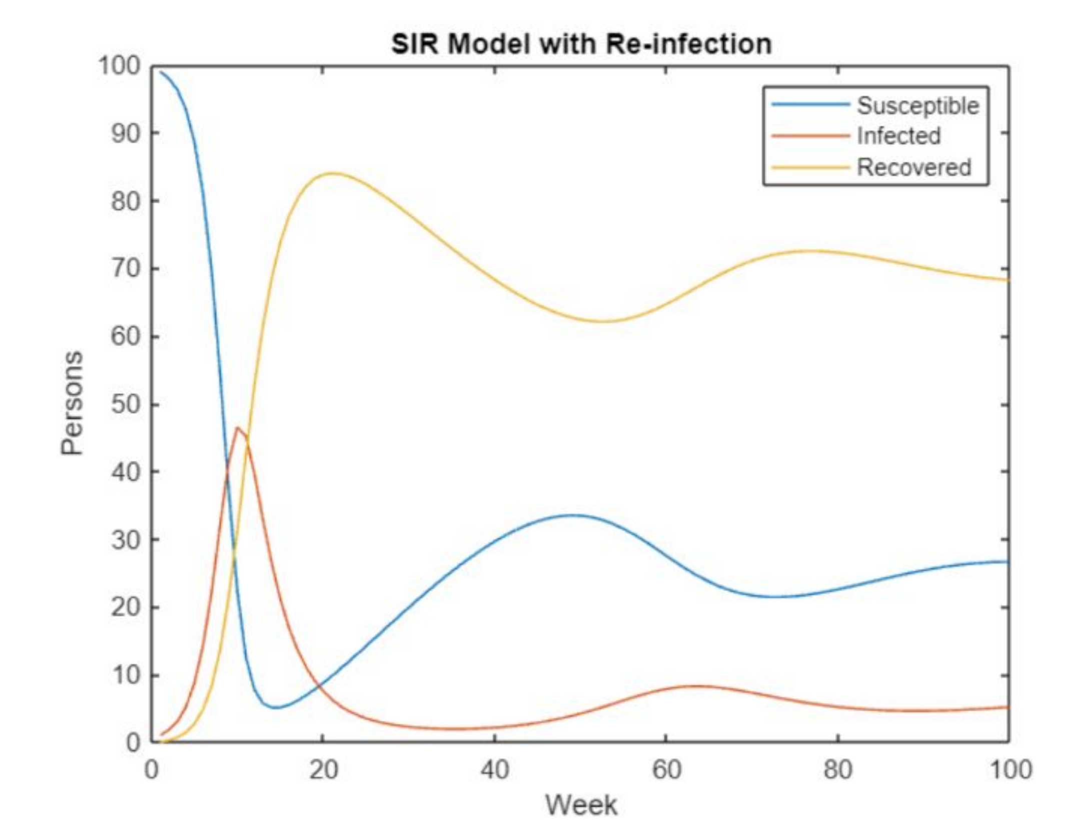
Model 1 Graph



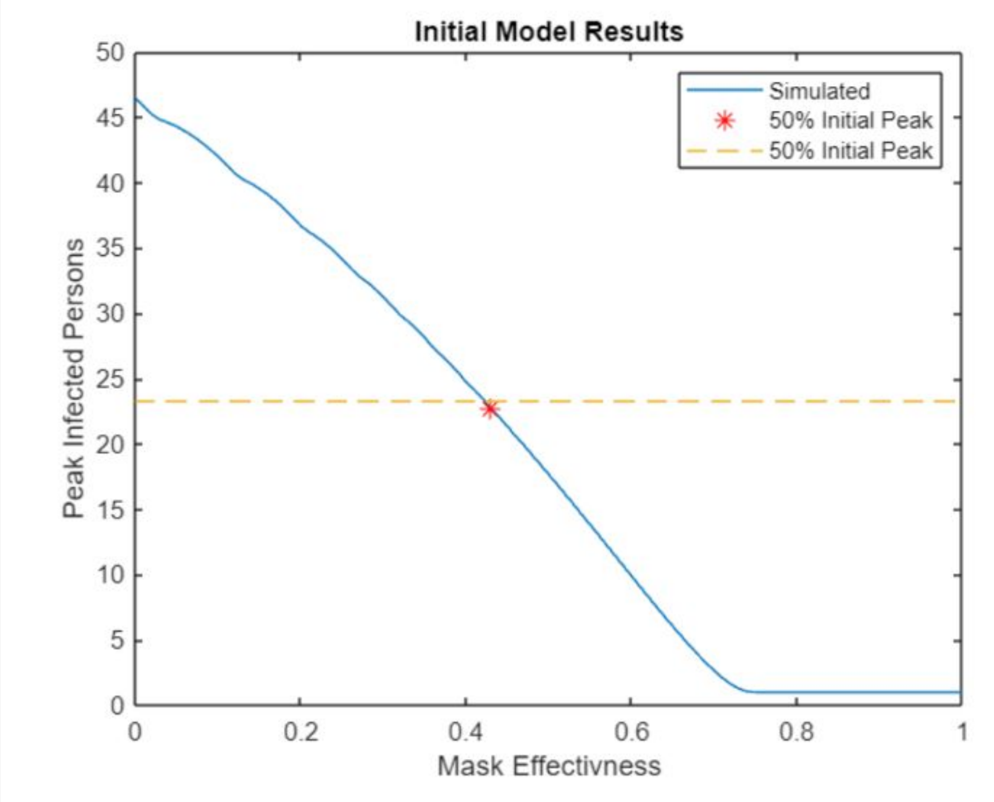
Stock and Flow Model 2



Model 2 Graph



Parameter Sweep
(Mask Effectivity v.s. Peak Infection)



Results

- Our model proves there is a negative correlation between peak number of infected persons and mask effectiveness
- As we used more effective masks, the peak number of infected persons decreased
- **In order to decrease the peak number of infected persons by 50%, our masks needed to be at least 43% effective.**
- However, since not everyone wears a mask in real life, masks will actually have to be more than 43% effective in order to truly cut the peak number of infected people in half


That's all Folks!

References

Eikenberry et al.:

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