

The SIRss Model of Epidemics

Definition and Difference from the SIR Model

The SIRss model is an extended version of the SIR model of epidemics. This updated model includes social stress, which describes how the general public responds to a large disease outbreak, with those who are susceptible to the disease being split into three separate categories:

- Susceptible and ignorant/uninformed
 - o People in this category either do not know of the disease that is spreading or do not care to take precautionary measures
- Susceptible and reasonably resistant
 - o People in this category are aware of the potential danger and take precautionary measures such as social distancing and sanitizing often
- Susceptible but exhausted
 - o People in this category are tired of being resistant to the disease, and are no longer taking precautionary measures

These three categories are labelled as S_{ign} , S_{res} , and S_{exh} , respectively.

People who are still susceptible to the disease (assuming full natural immunity once catching the disease) will shift from S_{ign} to S_{res} and then to S_{exh} , following a natural progression of learning about the disease to being worried about catching it, and then ultimately not caring about catching it. This is then followed by the person going back to their initial state of S_{ign} .

Since the SIRss model is simply an extended version of the SIR model, the transition of an individual from susceptible to infected is the same, with the only difference being that those who are currently resistant (S_{res}) will not become infected. The transition from infected to recovered remains the same, as a fraction of the infected will recover each day based on a rate derived from the average time spent being infected.

Additionally, the two figures provided by this implementation contain the cumulative total of cases (CC), which is equal to the number of infected plus the number of recovered at any given time. Taking the derivative of this (CC') will roughly graph the number of daily new cases, as shown in the second figure where CC' is graphed against the reported number of COVID cases provided by the csv file.

References

Paper providing the differential equations of the SIRss model and the variables used for the United States - https://www.researchgate.net/publication/352479773_Social_stress_drives_the_multi-wave_dynamics_of_COVID-19_outbreaks

Direct link to the file that the linked CSV file is derived from - <https://covid.ourworldindata.org/data/owid-covid-data.xlsx>