

## Modeling and Simulation, CS302

### Lab-5

In this lab we try to include some realistic effects in the SIR model and examine their role. The model has been extensively discussed in the lectures. No specific parameter value is being provided. You may refer to the book or the lecture slides for representative values of the parameters.

1. **(Modeling epidemics by SIR)** Implement the SIR model of Influenza and obtain Fig. 6.2.3 in the book.
  - (a) **(Role of  $R_0$ )** Assume that the basic reproduction number ( $R_0$ ) can be varied take a range of values of  $R_0$  and plot the variation of total infected with  $R_0$ . Comment on the observed behavior. Also look at how the time at which the number of infected reaches its maximum depend on  $R_0$ . Try to provide a numerical fit to your observation.
  - (b) **(Role of  $S_0$ )** As the number of initial susceptibles changes how does the total number of infected change. You may want to look at the fraction of total infected in the population.
  - (c) **(Role of vaccination)** Explore the vaccination effect by referring to questions 1, 2 and 3 under projects in the chapter from the book.
  - (d) Assuming that the vaccination is only partially effective and that the vaccinated individuals can become susceptible at a rate  $\mu^{-1}$ , discuss how the results in 1c will be influenced as a function of  $\mu$ .
  - (e) **(Role of lock down):** Lock down effects the rate at which contacts happen. Reduction in the number of contacts helps in reducing the spread rate. Assuming lock down effect to be constant explore its effect in a systematic way on the epidemic spread.
  - (f) If we want to include people behavior in the lock down model above one may argue that lock down does not lead to an immediate reduction in the number of contacts. Assuming the following function for lock down. Initially  $\beta$  is at a high value but slowly goes down to a lower value. It remains at the lower value for some time beyond which the unlock is initiated. When unlock is announced people behavior changes in the same way. In the initial stages people are cautious so  $\beta$  is at its lower value. In time other important factors take over and they start to venture out and become more relaxed.

This leads to an increase in  $\beta$ . Accommodate for these two effects in the model and discuss your findings.

- (g) Based on your analysis and the understanding developed provide suggestions to the policy makers for developing an effective strategy in the conclusion of your report.