Heterogeneous Risk Attitudes and Waves of Infection

Daisuke Fujii

The University of Tokyo

Abstract

The COVID-19 pandemic caused multiple waves of infection in many countries. The susceptible-infectious-removed (SIR) model, a workhorse model in epidemiology, cannot explain the waves of infection. We propose a simple extension of the SIR model, which we call a "VSIR" model, to explain infection waves with constant population. In the model, "vigilant" individuals (compartment V) take appropriate measures against virus such as staying at home, and hence, do not get infected. Susceptible individuals are less cautious about virus and exposed to the risk of infection. Depending on the size of susceptible population, a fraction of the vigilant lower their guard and become susceptible. When the virus spreads among the susceptible, it reaches "local" herd immunity and infection goes down. Nevertheless, the inflow from the vigilant to the susceptible generates the expansion of the susceptible population leading to the next wave of infection. This repeated process creates a finite number of infection waves. We provide analytical results of the VSIR model and characterize parameter conditions which give rise to waves of infection.