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SIR Infectious Disease Modelling with Vaccination

The new coronavirus attacked the world in 2019, causing harm to people's lives and society in multiple aspects. It is therefore of high importance to develop reliable mathematical models that would be able to predict the development of similar pandemics under different scenarios, including vaccination strategies, to help inform governments and health care systems and facilitate optimal policy making.

In this work, we study an SIR ("Susceptible-Infected-Recovered") epidemic model that considers the time evolution of the three respective groups of population. Transitions between Susceptible, Infected, and Recovered groups are usually defined by constant coefficients, such as infection and recovery rates. The novel aspect of our model is making the coefficients time-dependent. This allows a significantly larger freedom in building the models and predicting the outcomes under different scenarios. As an example we choose the model coefficients to reflect a situation when, at a certain time, a vaccine is introduced. In this situation, it is shown that under the same parameters, vaccination leads to a significantly faster transition to a recovered population.