Modeling epidemics: an introduction to the use of compartmental models for the simulation of epidemics in time and space.

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Abstract

The outbreak of COVID-19 in 2020 has led to a surge in interest of the mathematical modeling of epidemics. Many of the introduced models are so-called *compartmental models*, in which the total quantities characterizing a certain system may be decomposed into two (or more) species that are distributed into two (or more) homogeneous units called compartments. This short course will introduce the notion of a compartment model and the basics of their development. We will begin with the standard SIR (susceptible-infected-recovered) model, and gradually introduce more realistic models that account for factors such as age-structured populations, asymptomatic patients, and interventions such as lockdowns, mandatory mask-wearing etc. The course will also address how one may incorporate spatial variation via a partial differential equation (PDE) model or additional compartments in an ordinary differential equation (ODE) model. Some sample python code will be provided for numerical examples. The course is open to all students; however previous exposure to differential equations and basic programming concepts is recommended.