Mathematical modelling in epidemiology

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Mathematical models can provide insight into infectious disease dynamics and aid in epidemic control and public health policy design.

Infectious diseases are caused by pathogens, such as bacteria and viruses.

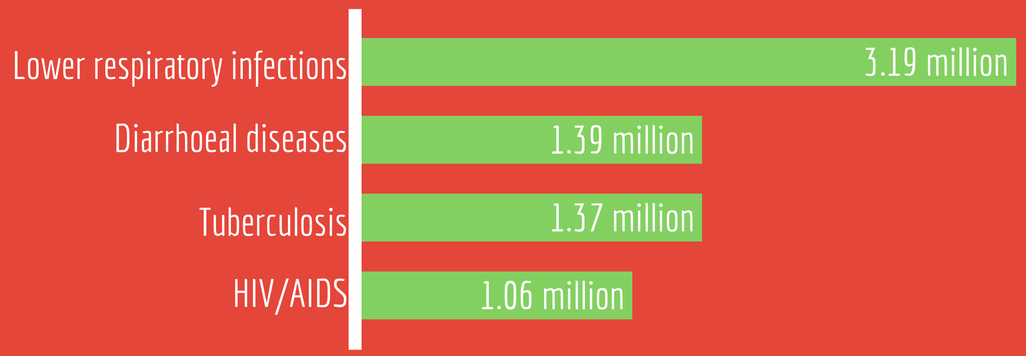
Pathogens are spread through physical contact, via contaminated food or water, or through the bites of infected animals.

New diseases can rapidly spread over long distances via the airline network.

Infectious diseases are the #2 leading cause of death worldwide

8.9 million, or 15% of total deaths

and affect the quality of life of billions more.



World Health Organisation global health estimates 2015 summary tables: global deaths by cause, age and sex, 2000-2015

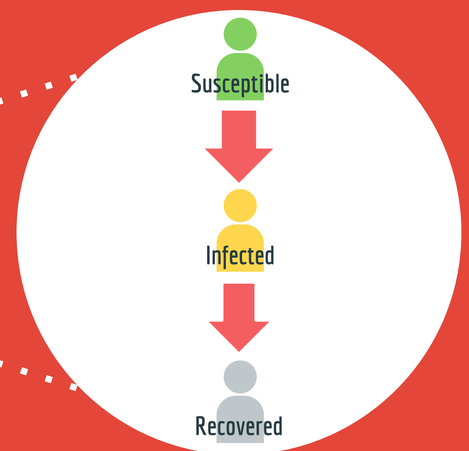
What can mathematical models tell us about infectious diseases?

- What's the chance of a new epidemic?
- How long will an epidemic last?
- How many people will be affected?
- How do epidemics affect each other?

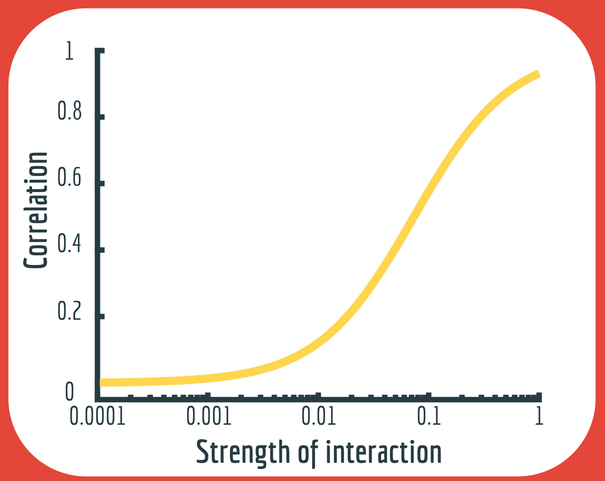
An epidemic model on two identical interacting populations

Interaction between populations represents temporary movement of individuals.

Population 1 — Population 2



What is the correlation between the number of infected individuals in each population? We can write down an equation for the correlation as a function of the strength of interaction between the populations.



So what? Can use results to:

- Predict how changes in mobility will affect future epidemics;
- Infer level of interaction from correlation between populations.

What next?
Generalise for more than two populations, non-identical populations and apply to data.