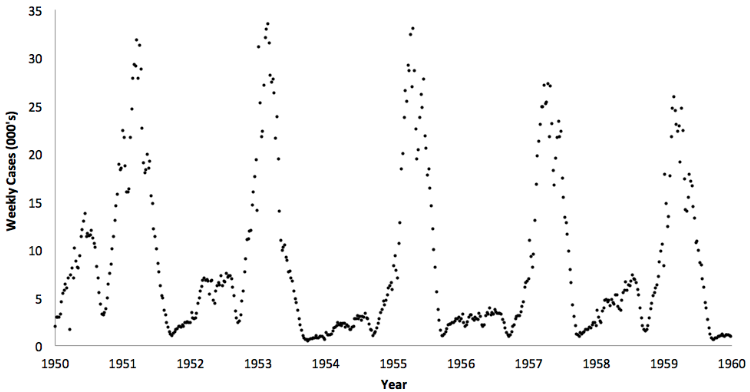
Dynamics of Infectious Diseases

Data

The recorded statistics on weekly cases of measles recorded in England and Wales 1950-60 (taken from a larger time series 1947-67). (see data file for full timeseries)



Model

The SIR model considers a population comprising of Susceptible, Infectious and Recovered members and comprises of two reactions.

Reaction	Rate
$S+I \rightarrow 2I$	β
$I \rightarrow R$	ν

Note the parameters here can be estimated using the following facts:
- ν is equal to 1/(average time infectious)
- $N\beta/\nu$ (also known as R_0) is equal to the average number of people a single infectious person would directly infect (if the population was all susceptible to the disease).

Suggested Investigation

- Describe the behaviour of the observed measles data. Discuss the various factors which might be important, and that affects the cases of measles more generally. Discuss what use this data could be to the medical profession.
- Research the population and birth rate (approximate value only) for England and Wales at this period. Comment on these numbers with respect to the number of measles cases.
- Estimate (either from research or a common sense guess!) values for ν and β.
- Set up a stoichiometry matrix and use it generate the differential equations to run the SIR model (see M1.2 Section 1.2 and M1.4 Section 2). Include all the diagram, matrices and derivation in your report.
- Run the model in MATLAB (using total population equal to pop of England and Wales in 1950's). Start by setting I to a small number (i.e. modelling introduction off measles into population) and with all the population initially susceptible.
- Explore how the initial levels of S and R affect the behaviour of the model?
- Add a third reaction R -> S with rate equal to the birth rate per member of population. This models replacement of old recovered (immune) individuals with susceptible newborns. Rerun the model with this case.
- Compare and contrast your model with the data and comment on how useful it is.