Lecture 8
Harpending
SIR Model

• Three kinds of people
  • S is number of susceptible
  • I is number of invectives
  • R is number of recovered
SIR model II

- Two constants
  - \( a \) = infection rate
  - \( b \) = recovery rate
- Mass action
  - New cases proportional to \( aS \)
  - Recovery proportional to \( bl \)
    - \( 1/l \) is infectious period
SIR III

- $dI/dt = aSI - bI$
- Consider a single infective
- Does number of cases increase?
  - If $aS - b > 0$, yes an epidemic occurs
  - If $aS - b < 0$, no, disease dies out
- Recent examples
  - Ebola
  - Measles
  - Whooping Cough in Utah
Bubonic plague

- zoonotic, vector borne infection: fleas-rodents
- “Black Death”
smallpox (Variola) virus

- airborne (inhaled droplets), fomites
- 12 day incubation (exposure to symptoms), 7-10 day infectious period
- V. major 20-60% death rate (~80% death rate in children)
Varicella zoster virus

- airborne via coughing and sneezing or from direct contact with rash
- 2-pronged reproductive strategy
  - appears as chicken pox in kids, reappears as shingles in adults
- infectious 1 to 5 days before rash appears, then 5 to 6 days till rash scab over
- 10 to 21 day incubation period (time from exposure to symptoms)
- SIR model?
treponema

- *T. pallidum* subspecies serologically indistinguishable
- venereal syphilis (*pallidum*) and pinta (*carateum*) more common in adults
- endemic syphilis (*endemicum*), yaws (*pertenue*) more common in children
- leaves skin lesions after long term exposure
- need evidence in New World, else Columbus exported it?
- Yaws
- childhood disease
- skin-to-skin transmission
- warm moist climates
- bone lesions appear after years of infection
parasitic infections

- malaria (P. falciparum, P. vivax, P. ovale, P. malariae): acute to long lasting
- Duffy blood group
- SCA
- tapeworms
- toxoplasmosis (zoonotic)
Mortality by tuberculosis in England and Wales

(re-drawn from T Mc Keown, 1976)
Mortality by smallpox in England and Wales

(re-drawn from T Mc Keown, 1976)
Mortality by scarlet fever in England and Wales

(re-drawn from T Mc Keown, 1976)

Death Rate (per thousand under 15)

Year

1880 1920 1960

Streptococcus identified

Sulphonamides

Antibiotics
Pertussis Vaccine Widespread Use In The Late 1940s

Deaths per 100,000
Measles Vaccine
Introduced 1963