Estimation and statistical considerations

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Overview

- Statistical background
- Study design issues

Prevalence vs incidence

- Cross sectional
  - Prevalence plus life tables
  - Sullivan's method
- Longitudinal – uses transitions
  - Incidence
  - Remission
  - Case fatality

Longitudinal methods

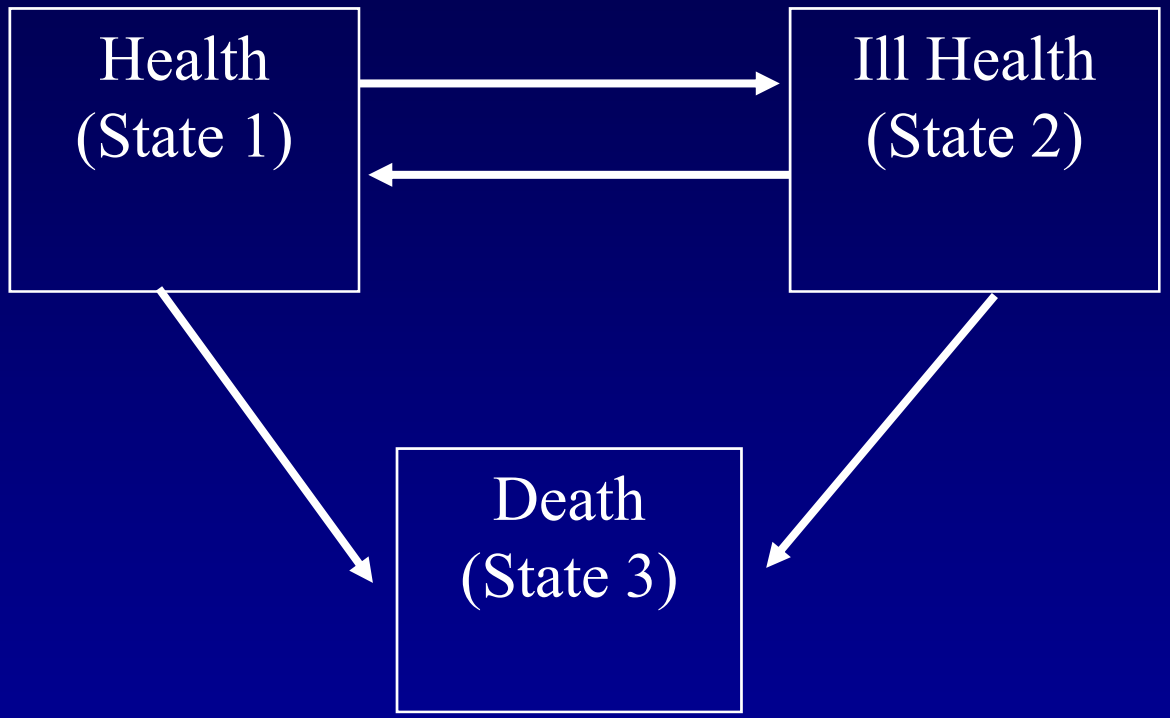
- Double decrement
  - Non-reversible processes only
- Multi-state methods
  - Multi-state life tables
  - Increment decrement life tables
  - Multi-state models
- Microsimulation

Multi-state models

- Model discrete state of health
- Discrete time
  - Small fixed intervals
  - Simplifies algebra
- Continuous time
  - Time dependent transition intensities

- Allows covariates

Multi state models



Modelling framework (discrete)

- Probability of being in state k at a longitudinal time point given you were in a state j initially
- Modelled using multivariate logistic model
- Regression smoothed transitions
- Markov assumption (history of process not important)

Modelling framework (discrete)

Individual i in state j at time x_i and state k after time h then

$$p_{jk} = \Pr(Y_{t+h} = k \mid Y_t = j)$$

$$\log\left(\frac{p_{jk}(x_i)}{p_{jJ}(x_i)}\right) = a_{jk} + b_{jk}x_i$$

Life expectancies (discrete)

$$e^{jk}_{z_0} = \sum_{y=1}^{\infty} P(X_{(x_i+h)} = k \mid X_{x_i} = j, z_0)$$

Life expectancy of state jk is the sum of the probability of transitions given covariates

$$e^{j}_{z_0} = \pi^{1}_{z_0} e^{j1}_{z_0} + \pi^{2}_{z_0} e^{j2}_{z_0}$$

Total life expectancy for each state j is the combination of the state based life expectancies weighted to the proportions of the population in each state

Continuous time

- Similar methodology, but intensities not probabilities modelled
- Covariates are modelled on intensities
- Matrix with transition probabilities for elapsed time t is given by exp(tQ)
- Hidden transitions are modelled
- Where **Q** is the transition intensity matrix

$$\begin{pmatrix} -\{q_{12}+q_{13}\} & q_{12} & q_{13} \\ q_{21} & -\{q_{21}+q_{23}\} & q_{23} \\ 0 & 0 & 0 \end{pmatrix}$$

- Integration used for life expectancies

Microsimulation

- Simulate trajectories from estimated coefficients (any multistate model)
- Creates life histories for individuals

Study design issues

- Longitudinal data
- States measured similarly at each stage
- Fixed or variable time intervals
- Irreversible or reversible
- Main limitation number of transitions
- Sampling method important for variance estimation

Considerations

- Time intervals
- Number of transitions
- Study design
  - Sampling scheme
  - Size of study
- Model assumptions