Modeling Individual Change over Time with Minimal Assumptions

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Overview

• Conventional models for change
• A semi-parametric alternative
• An example application

Conventional Models for Change

• Common change models for longitudinal data include latent curve models and multilevel models

• Typically, these models involve the specification of a function for the individual trajectories
  – Linear
  – Quadratic
  – Nonlinear

Problems with Conventional Approach

• WTF? (What’s the function?)
  – What if we don’t know the function?

• Each individual’s trajectory is described by the same function
  – Variation only in the function parameters, e.g., differences in the intercepts and slopes of a line
  – What if the same function isn’t a good model for everyone?

• More generally, we act as though the model is literally true when it is really an approximation
A Semi-Parametric Alternative

• Another approach might be to remove as many assumptions as possible from the model

• Rather than imposing a specific function on the individual trajectories, allow the functions(s) to emerge from the data

• One possibility: use a longitudinal latent profile analysis to identify functions inductively
  – allows for uncertainty in functional form by freely estimating shape of change profiles
  – Individuals can differ in functional form by belonging to different profiles or being ‘in between’ profiles
  – Uncertainty due to sampling variability can also be accounted for by resampling from distribution of parameter estimates

Example Application

• Data from Carolyn Halpern

• N = 141 males, age 18-25

• 6 repeated measures of cortisol, collected every 10 minutes during and after a dating interview

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Cortisol Reactivity

Longitudinal Latent Profiles
Probabilistic Class Membership

Class 1

Class 2

Class 3

Class 4
Advantages

- The model provides a semi-parametric depiction of heterogeneity in change over time without assumptions about functional form
- Does a reasonably good job of predicting individual trajectories
- Performance should improve with more data
  - With higher N, could support more classes, capturing finer structure and greater heterogeneity in trajectories
  - Not the case for misspecified parametric models

Limitations

- Not really continuous trajectories -- no function from which to interpolate or extrapolate from the observed data points
  - No generality beyond specific situation in this study
- Interpretation is hindered by lack of meaningful parameters
  - Particularly relevant when go on to evaluate the effects of predictors of individual change over time

Other Options to Consider

- Blended approach
  - Could impose theoretical functional form in primary class
  - Additional classes could capture deviations from this functional form
- Parametric model with uncertainty
  - Could have multiple classes characterized by different candidate functional forms
- Smoothing toward a functional form
  - Use a penalized estimation approach to smooth latent profiles toward a low-order polynomial function (Shedden & Zucker, 2008, Psychometrika)