

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

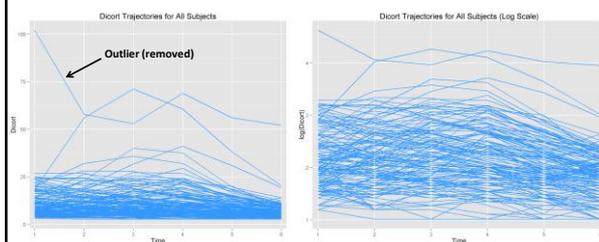
A Semi-Parametric Alternative

- 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 function(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

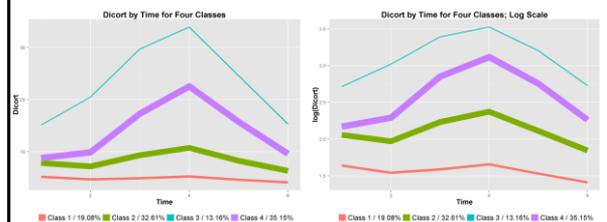
Example Application

- Data from Carolyn Halpern
 - Halpern, et al. (2002). Associations between stress reactivity and sexual and nonsexual risk taking in young adult human males. *Hormones and Behavior*, 42, 387-398.
- $N = 141$ males, age 18-25
- 6 repeated measures of cortisol, collected every 10 minutes during and after a dating interview

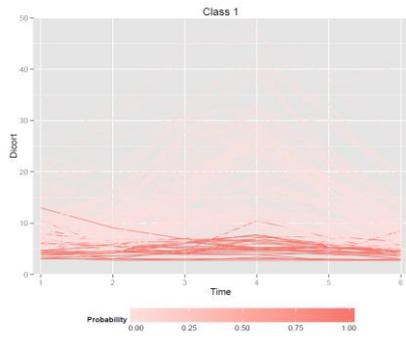
Cortisol Reactivity



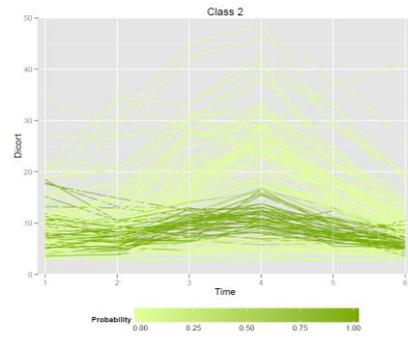
Longitudinal Latent Profiles



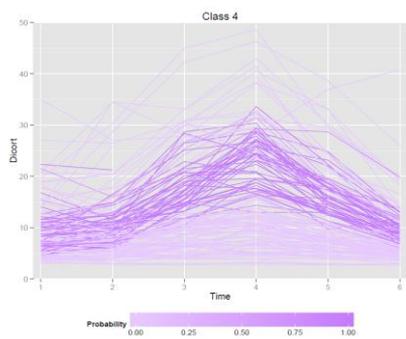
Probabilistic Class Membership



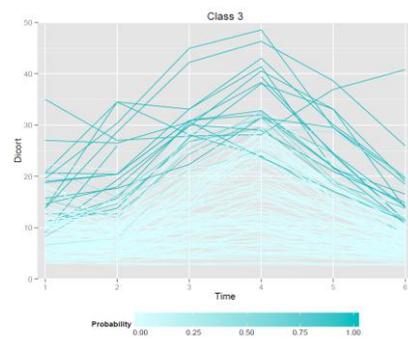
Probabilistic Class Membership

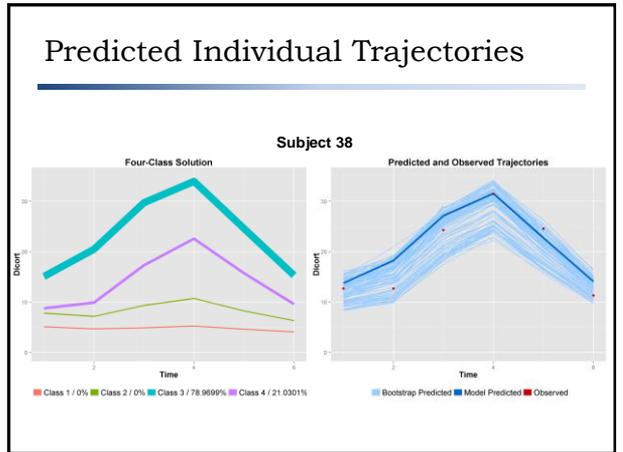
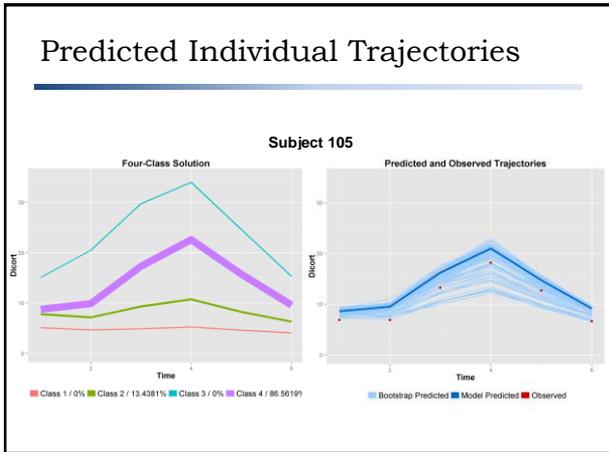
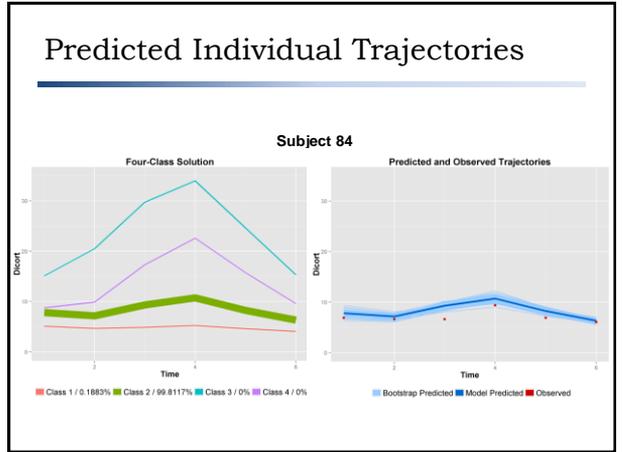
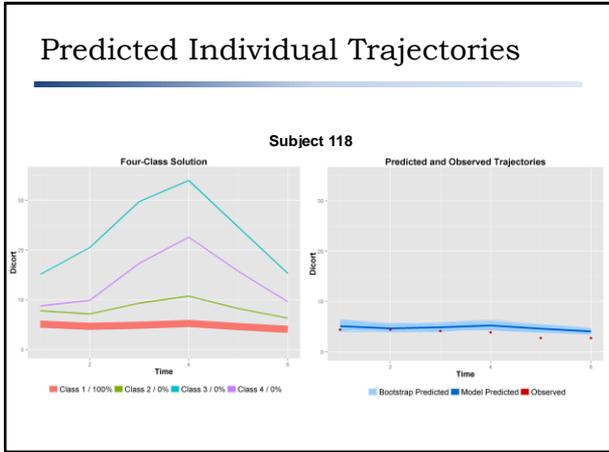


Probabilistic Class Membership



Probabilistic Class Membership





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*)