

## Using Growth Mixture Models to Examine Developmental Heterogeneity in Reading Achievement from 1<sup>st</sup> to 7<sup>th</sup> Grade

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## Outline

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- Theoretical Motivation
- Explication of Growth Mixture Models
- Empirical Example
- Conclusions

## Acknowledgements

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## Theoretical Motivation

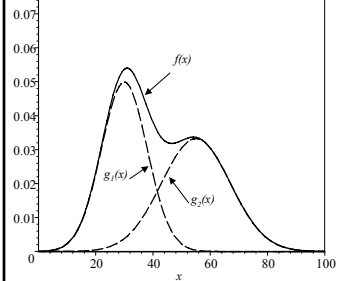
"There are gophers,  
there are chipmunks,  
but there are no gophmunks."  
(Meehl, 1994)



"...temporary versus persistent antisocial persons constitute...  
two qualitatively distinct categories of individuals, each in need  
of its own distinct theoretical explanation."  
(Moffitt, 1993)

## A Simple Mixture Problem

Two-Component (Class) Univariate Normal Mixture



Want to know:

- how many latent classes are there?
- what proportion of cases arises from each class?
- what are the means and variances of the class distributions?

## Explication of Growth Mixture Model

## Properties of Normal Mixtures

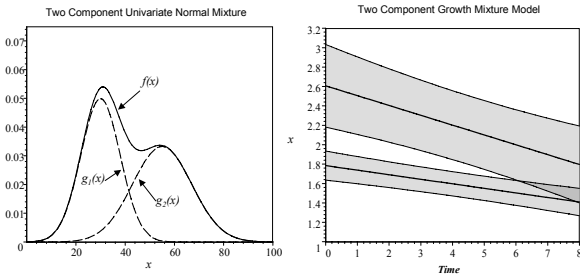
### Properties of Finite Normal Mixtures

- A finite mixture of normal distributions is necessarily non-normal (except under trivial circumstances)
- Non-normality does not necessarily imply a mixture of normals

### Pearson (1895, p. 394):

"The question may be raised, how are we to discriminate between a true curve of skew type and a compound curve [or mixture]."

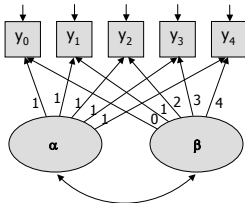
## From Univariate to Longitudinal



## Empirical Example

## Growth Mixture Models

- (1) Extend from a univariate to a multivariate mixture model
- (2) Each class distribution characterized by a mean vector and covariance matrix
- (3) The within-class mean vectors and covariance matrices are structured by a latent curve model



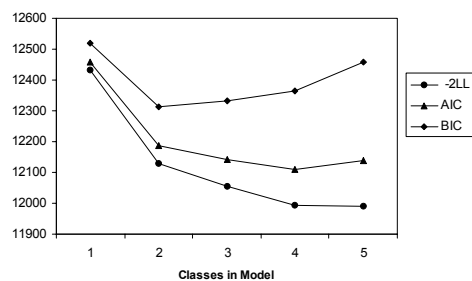
## Description of Example

- NLSY Child Sample
- Two cohorts of children
  - children in first grade in 1988 (1988 Cohort, N=548)
  - children in first grade in 1990 (1990 Cohort, N=439)
- Dependent Variable: Reading Recognition (PIAT)
- Up to 4 biennial assessments from first to seventh grade

## Modeling Goals

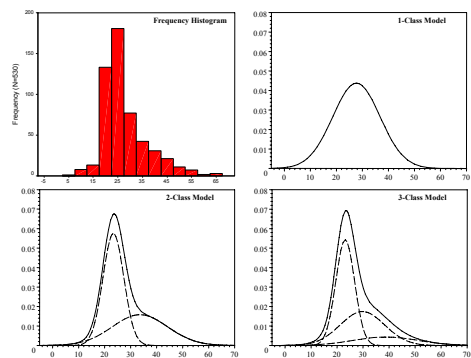
- (1) Determine optimal number of latent classes for 1988 Cohort
- (2) Evaluate growth mixture model results for 1988 Cohort
- (3) Replicate substantive results with 1990 Cohort
- (4) Draw conclusions with respect to possibly distinctive developmental pathways

## Assessing Number of Classes

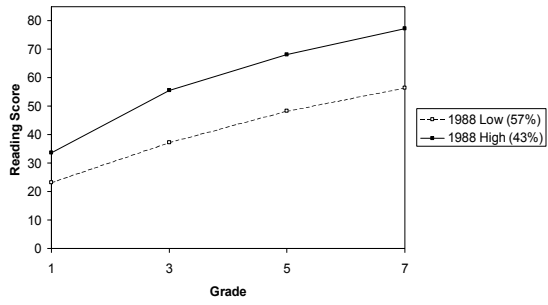


## 1988 Cohort Analyses

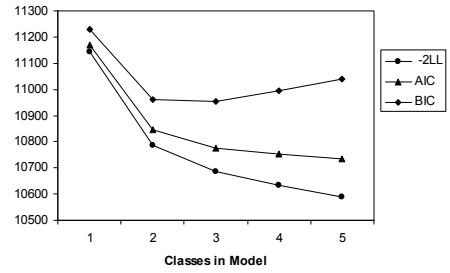
## Fit to First Grade Distribution



## Latent Trajectory Classes

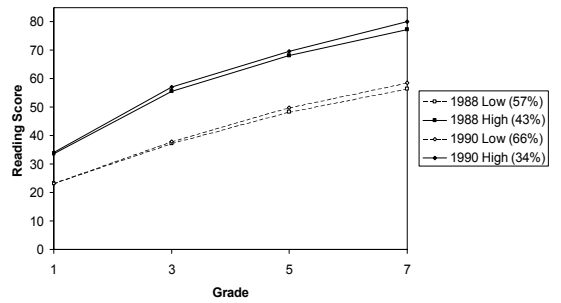


## Number of Classes - 1990 Cohort



## 1990 Cohort Replication Analyses

## Latent Trajectory Classes



## Inferences

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- (1) Degree of replication is impressive, especially given inductive nature of the methodology
- (2) Two trajectory classes appear optimal
- (3) Minority class has higher and more steeply increasing reading scores than majority class
- (4) Does this mean that there are two distinct developmental pathways in the population? NOT NECESSARILY

## Conclusions

## Threats to Inference of Heterogeneity

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- (1) Inference relies on the assumption that the observed non-normality in reading scores is due to the mixture of unobserved group distributions.
- (2) Other possible sources of non-normality for this data:
  - Use of percent correct scores (bounded by 0,100 and maybe not interval-level scale)
  - Data *not* obtained as a simple random sample.
  - More?
- (3) Latent trajectory classes may serve only to approximate non-normality due to these other sources

## Conclusions

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- Many theories posit the existence of population sub-groups with qualitatively distinct developmental pathways
- Growth mixture models offer a new opportunity to evaluate these theories
- A key assumption is that non-normality reflects the mixture of unobserved groups, and is not due to other sources
- Analyses on reading achievement point to both the promise of growth mixture models for identifying heterogeneity and the caution that must be exercised in interpreting their results.