Within-year Variance in Mathematics Growth Between Students, Teachers, and Schools

Daniel Anderson (daniela@uoregon.edu)
Behavioral Research and Teaching, University of Oregon

Abstract
Teachers and Schools both play important roles in students’ education. Yet, the unique contribution of each to students’ academic growth has rarely been explored. This study used a Bayesian estimator to parse variance in students’ within-year growth into student, classroom, and school factors in Grades 3–5. Three cohorts of students were modeled with a weakly informative prior, arrived upon through a training dataset. The distribution of classroom effects (proxy for teacher effects) between schools was also examined, as well as the persistence of teacher effects across years.

Method
Measure. Measure of Academic Progress (MAP), developed by Northwest Evaluation Association (NWEA, 2011).
• Computer adaptive test designed to measure growth
• Vertical scale
• Administered during the fall, winter, and spring of each year

Sample. Five years of data collected in each of Grades 3–5:
• Three contiguous cohorts
• Test sample
• Two noncontiguous cohorts in each grade
• Training sample

Analyses. Fully Bayesian multilevel growth model with weakly informative priors, fit with the MCMCglmm package (Hadfield, 2010) within the R statistical software (R Core Team, 2014).

Prior Specification
• Training dataset for each grade
• Simple OLS model fit for each student (Scores on Time)
• Variance components specified according to the inverse Wishart distribution, \( V \sim W^{-1}(c, \Psi) \) with \( c = 10, 5, \) and 3 for student, classroom, and school levels, respectively, and \( \Psi \) specified according to the variances among OLS intercepts and slopes.
• Fixed effects (non-informative): \( \text{Priors: } \sim N(0, 10^3 I) \)
• Residual

Results

Discussions

References