Layered Model

- Links past teachers to subsequent student outcomes
- Consider student score = overall mean + cumulative effects of previous and current teachers + random residual variation

Non-layered Model

- Links current teachers to student outcomes, so ignores effects of instruction in earlier years
- Student Score = overall mean + effects of current teachers + random residual variation

As long as the y’s are the same across time and share compatible meanings over time, the analysis is relatively straightforward.

Value-Added Modeling Techniques:

- Estimate contribution of educational factors to growth in achievement, while controlling for effect of non-educational factors
- Potential to identify characteristics of highly effective teachers
- Require a single developmental scale and quality longitudinal data

Value-added refers to growth in achievement above what is expected across time for a given student, expressed in the t’s:

\[ y_{sk} = \mu + S_k \]

Initial Score:

\[ y_{1k} = \mu + S_k + t_1 + e_{1k} \]

Value-Added Modeling Techniques:

- Estimate contribution of educational factors to growth in achievement, while controlling for effect of non-educational factors

Value-Added Modeling Techniques:

- Utilize incomplete student records for efficient use of available data
- Robust to omitted covariates (e.g. SES) in some instances
- Estimate “teacher effects”

What is Value-Added?

Test Scores

\[ S_k \]

\[ y_{sk} \]

\[ \mu \]

Year

0

1

What is a Layered Model?

Equal to average growth

Above average growth

Layered Model

- Teachers + random residual

Value-Added Models:

- Utilize incomplete student records for efficient use of available data
- Model relationships between multiple test scores on same student
- Robust to omitted covariates (e.g. SES) in some instances
- Estimate “teacher effects”

Current Challenge:

- Data available often do not meet the technical requirements of current VAM
- One common challenge occurs when available student achievement data come from multiple assessments over time.

\[ y_{sk} = \mu + S_k + t_1 + e_{1k} \]

\[ u_{1k} = f(\mu + S_k + t_1 + e_{1k}) \]

\[ w_{2k} = g(\mu + S_k + t_1 + e_{1k} + t_2 + e_{2k}) \]

- Need to somehow put y, u, w, etc. on the same scale to use the system of equations for estimating value added defined by the t’s
- Various methods have been proposed, e.g. z-scores and parallel processing.

Binning by quantile is another way currently being explored.

Binning By Quantile:

- Non-parametric alternative to z-scores
- Within a given year and grade, scores are ranked and divided into quantiles, e.g. deciles or quintiles
- “Expected” progress: same relative rank from year to year
- “Above expected” progress: movement up in relative rank

Y_{sk} = \mu + S_k + t_1 + e_{1k}

u_{1k} = f(\mu + S_k + t_1 + e_{1k})

w_{2k} = g(\mu + S_k + t_1 + e_{1k} + t_2 + e_{2k})

Binning Illustration

Year 1: Students sorted into quartiles based on achievement scores

Year 2: Students re-sorted into quartiles based on new achievement scores

Future Research:

- Explore number of bins and binning techniques
- Compare to other alternative methods
- Extend to analyze real data

References: