COMPUTING SCHOOL AND CLASSROOM EFFECTIVENESS INDICES

The Value-Added Model Implemented in Dallas Independent School District

The basic building blocks of School and Classroom Effective Indices are students' pre-test and post-test scores and student demographic variables. Using this information, School and Classroom Effective Indices are calculated in a two stage process.

Stage One: Create and estimate HLM model

The first stage is the calculation of students' value-added gains using residuals from a hierarchical linear regression model. In this stage students who are not continuously enrolled at a campus are filtered out of the dataset. This constraint of continuous enrollment was implemented to ensure that teachers had sufficient days of instruction with that student to make an impact on his or her education. Next, the remaining students' post-test scores are regressed against student level characteristics and student pre-test scores. The following hierarchical linear model (HLM) was developed to model the students' scores.

$$\mathrm{POST}_{\mathrm{ij}} = B_{0\mathrm{j}} + B_1\mathrm{PRE\_1}_{\mathrm{ij}} + B_2\mathrm{PRE\_2}_{\mathrm{ij}} + \sum_{k=1}^{10} \Lambda_{\mathrm{k}}\mathrm{X}_{\mathrm{kij}} + \delta_{\mathrm{ij}} ,$$

where $POST_{ij}$ is the current year's score and PRE_1_{ij} and PRE_2_{ij} are the previous year's scores for student *i* in school *j*. Student level covariates are X_{kij}, variable *k* for student *i* in school *j*:

$\mathrm{X}_{1\mathrm{ij}} =$ Limited English proficiency status (1 if LEP, 0 otherwise)

$\mathrm{X}_{2\mathrm{ij}} =$ Gender (1 if male, 0 if female)

$\mathrm{X}_{3\mathrm{ij}} =$ Free or reduced lunch status (1 if on Free or Reduced Lunch, 0 otherwise)

$\mathrm{X}_{4\mathrm{ij}} =$ Talented and gifted (1 if TAG, 0 otherwise)

$\mathrm{X}_{5\mathrm{ij}} =$ Special education (1 if SPED, 0 otherwise)

$\mathrm{X}_{6\mathrm{ij}} =$ Tract-level median family income

$\mathrm{X}_{7\mathrm{ij}} =$ Tract-level percentage of college-degreed adults

$\mathrm{X}_{8\mathrm{ij}} =$ Tract-level percentage of families above poverty level

The equation for student level covariates is:

$$\sum_{k=1}^{10} \Lambda_{k} X_{kij} = \Lambda_{1} X_{1ij} + \Lambda_{2} X_{2ij} + \Lambda_{3} X_{3ij} + \Lambda_{4} X_{4ij} + \Lambda_{5} X_{5ij} + \Lambda_{6} X_{6ij} + \Lambda_{7} X_{7ij} + \Lambda_{8} X_{8ij}$$

$$+ \Lambda_{9} X_{1ij} X_{2ij} + \Lambda_{10} X_{1ij} X_{3ij} + \Lambda_{11} X_{2ij} X_{3ij} + \Lambda_{12} X_{1ij} X_{2ij} X_{3ij}$$

where the interaction terms are:

Λ_9 = LEP x Gender interaction

Λ_{10} = LEP x Free/Reduced Lunch interaction

Λ_{11} = Gender x Free/Reduced Lunch interaction

Λ_{12} = LEP x Gender x Free/Reduced Lunch interaction

At the second level of the hierarchical linear model, B_{0j} is predicted using the following equation:

$$B_{0j} = \Gamma_{00} + u_{0j}$$

where

B_{0j} = Intercept of school j

Γ_{00} = Intercept of district

u_{0j} = School level residual of school j

The hierarchical linear regression is carried out for each type of post-test available by grade using all possible pre-test combinations. For example, for Grade 3, the above process is repeated for each English and Spanish *STAAR* Reading and Mathematics assessments using combinations of Grade 2 English and Spanish Norm-Referenced Language Arts and Mathematics as predictors. The next task is statistically choosing which prior-year assessments are the best possible predictors. For example, for predicting the outcome of English *STAAR* Mathematics in Grade 3, it could be determined that the previous year's Norm-Referenced Mathematics and Norm-Referenced Reading combined would be the best predictors.

The hierarchical linear model identifies the best linear model where the combined variance at level one, the student level, and level two, the school level, are minimized. This is achieved by modeling each student's gain within each school *j*. Thus, the model yields a linear regression line for each school.

School Effectiveness Indices are an end-product of this stage. u_{0j} measures the variation in the intercept of the school level regression line for school *j* to the overall regression line for the district. The School Effectiveness Index for school *j* is the reliability-adjusted estimate of u_{0j}, $\hat{u}^{*}_{0j}$. The reliability adjustment is a shrinkage adjustment in which $\hat{u}_{0j}$ is shrunk towards the overall district mean if its reliability is low.

Stage Two: Compute Classroom Effectiveness Indices

In this stage, value-added gains are computed for each student. The i^{th} student in schools j has a value-added gain of

$$\hat{\delta}_{ij} = \hat{u}^{*}_{0j} + \delta_{ij} .$$

When all HLM regressions are carried out for all courses and tests for all grades, each student will have a residualized gain, $\hat{\delta}$, for each test taken. For example, a Grade 3 student will have residualized gains for *STAAR* Reading and Mathematics, each Assessment of Course Performance (*ACP*) test taken, and Texas English Language Proficiency Assessment System (*TELPAS)* Reading. A high school student will have residualized gains for each *ACP* and *STAAR EOC* test taken and *TELPAS* Reading.

Value-added gains from Stage Two are appropriately grouped and aggregated with a reliability adjustment to arrive at Classroom Effectiveness Indices (CEIs). Student's gains are identified by test type and then are then assigned to the course scheduling group in which the student was enrolled. Course scheduling groups comprise courses that were evaluated with the same or related assessments or courses in which students receive the same instruction.

The test-level CEI for a teacher is the reliability adjusted mean value-added gain of students for the specified test. The reliability adjustment is a shrinkage adjustment that moves a teacher's CEI towards the mean of the unadjusted CEIs if the within-teacher variance is high compared to the variance of the unadjusted CEIs.

To compute the reliability-adjusted CEIs, first compute the unadjusted CEI for a teacher by aggregating the N value-added gain scores as follows:

$$CEI_t = \frac{1}{N_t} \sum_{S=1}^{N_t} \hat{\delta}_S .$$

Compute the variance of the value-added gain scores for teacher *t* as σ_t. After having computed unadjusted CEI and its variance for all teachers in the district, compute the mean and variance of these unadjusted CEIs as μ_C and σ_C. The reliability-adjusted CEI for teacher *t* is

$$CEI_t^R = \mu_C + (CEI_t - \mu_C) \frac{\sigma_C}{\left[\sigma_C + \sigma_t / N_t \right]}$$

where

$$\frac{\sigma_C}{\left[\sigma_C + \sigma_t / N_t \right]}$$

is the reliability of the CEI for teacher *t*. If the ratio σ_t / N_t is very small compared to σ_C, the reliability will tend to one and the teacher's reliability adjusted CEI will be very close to the unadjusted CEI. If the reliability is low, the reliability adjusted CEI will be shrunk towards μ_C, the mean of the unadjusted CEIs. The reliability-adjusted CEIs are all standardized to a mean of 50 and standard deviation of 10 in the final presentations.

For questions contact the Office of Institutional Research in the Evaluation and Assessment division of the Dallas Independent School District.

Phone: 972-925-6446

E-mail: oir@dallasisd.org

Internet: www.dallasisd.org/eval