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Technical Explanation of the Teacher Composite

Introduction

This document captures how the policy decisions by the Houston Independent School District (HISD) are implemented in the calculation of composites for teachers who instruct students in grades/subjects or courses assessed with the STAAR 3-8, Norm-referenced test (NRT), and STAAR EOC assessments.

The key policy decisions are:

- The teacher composite includes all subjects and grades that have value-added measures in the current year.
- The teacher composite weights equally each subject/grade/year (for STAAR 3-8/NRT) and each subject/year (for STAAR EOC).
- The teacher and school composites use the most appropriate and robust statistical approach possible in the calculation of the value-added estimate and associated standard error. As a result, these calculations are more sophisticated than the simple averaging of each separate STAAR 3-8/NRT subject/grade and STAAR EOC subject.

In HISD, each teacher who receives a value-added report for at least one grade/subject or course in the current year also receives a value-added report for a composite. The district uses this composite measure in ASPIRE as it represents the most appropriate and robust measure of progress for all of a teacher's students over the course of a school year.

The examples below illustrate the calculation of the teacher composite for three types of teachers:

- An educator who taught only grades/subjects assessed with STAAR assessments in Math and Reading in Grades 4-8; the gain model (also referred to as the multivariate response model, or MRM) is used to determine value-added measures for these grades and subjects
- An educator who taught only courses assessed with STAAR EOC, the NRT, STAAR Science in Grades 5 and 8, STAAR Social Studies in Grade 8, and/or STAAR Reading and Math in Grade 3; the predictive model (also referred to as the univariate response model, or URM) is used to determine value-added measures for these grades and subjects and courses
- An educator who taught a mix of grades/subjects and courses assessed with both STAAR 3-8, the NRT and STAAR EOC; both the gain and predictive models are used to determine value-added measures for these grades and subjects and courses

Example One

Mrs. Smith provided instruction to students who took either the STAAR Grade 8 Reading assessment or the STAAR Grade 8 Math assessment. She received two value-added reports in 2014, which are summarized below.

Year	Subject	Grade	Growth Measure	Standard Error
2014	Reading	8	0.19	3.80
2014	Math	8	1.95	1.00

Calculating the Growth Measure for the Composite:

Because value-added analysis for Grade 8 Reading and Math is completed with the gain model (MRM), the growth measures are in the same scale: normal curve equivalents (NCEs). For that reason, the growth measures can simply be averaged in this case. Mrs. Smith's growth measure is calculated as follows:

$$Composite\ Growth\ Measure = \frac{1}{2}Reading_8 + \frac{1}{2}Math_8 = \frac{1}{2}(0.19) + \frac{1}{2}(1.95) = 1.07$$

where $Reading_8$ represents the growth measure for Grade 8 Reading, and $Math_8$ represents the growth measure for Grade 8 Math.

Calculating the Standard Error for the Composite:

Before discussing the formula used to calculate the standard error for Mrs. Smith's composite, it is important to review the idea of independence between two variables, in this case, between her growth measures for Grade 8 Reading and Grade 8 Math. When evaluating two variables for statistical independence, one asks the question "are these two measures related in some way?"

Mrs. Smith's growth measures may, in fact, be related to each other. Because she provides instruction on both Reading and Math to some of the same students, her Reading and Math growth measures are not entirely independent because the students' progress in Reading may be related to their progress in Math.

The extent to which Mrs. Smith's growth measures are related can be captured in the covariance between them. The covariance is a measure of the relationship between the two that includes the correlation between the two measures. The formula for determining the covariance for Mrs. Smith's growth measures is:

$$Cov(Reading_8, Math_8) = Correlation(Reading_8, Math_8)\sqrt{Reading_8}\sqrt{Math_8}$$

The formula for determining the variance for Mrs. Smith's combined Grade 8 Math and Reading growth measures is:

$$Var\left(\frac{Reading_8 + Math_8}{2}\right) = \left(\frac{1}{2}\right)^2 Var(Reading_8) + \left(\frac{1}{2}\right)^2 Var(Math_8) + 2\left(\frac{1}{2}\right)^2 Cov(Reading_8, Math_8)$$

where *Var* represents the variance, or square of the standard error of that measure, and *Cov* represents the covariance between the two measures.

Now that the variance and covariance have been obtained, the standard error for the composite can be calculated by taking the square root of the variance. The formula for determining the standard error for Mrs. Smith's composite growth measure is:

$$Standard\ Error\ of\ Composite\ Growth\ Measure = \frac{1}{2}\sqrt{Var(Reading_8) + Var(Math_8) + 2Cov(Reading_8, Math_8)}$$

The position of the covariance in the formula above shows how the relationship between Mrs. Smith's two growth measures is taken into account. Because those measures may include the same students, the addition of the covariance produces a larger standard error than if it had not been added to the formula. This larger standard error is appropriate since having the same students is not as much

evidence as having completely separate students in each measure, and it provides her with additional protection against her value-added measure being artificially increased or decreased due to the connection between her Grade 8 Reading and Math growth measures.

To simplify the remaining calculations needed to determine Mrs. Smith's composite, assume that the standard error is 0.50.

Calculating the Teacher Gain Index for the Composite:

The teacher gain index for the composite is calculated using the same methods as the calculation of the teacher gain index for Mrs. Smith's separate Grade 8 Reading and Math reports. The formula for determining Mrs. Smith's composite is:

$$Teacher\ Gain\ Index\ for\ Composite = \left(\frac{Composite\ Growth\ Measure}{Standard\ Error\ for\ Composite\ Growth\ Measure}\right)$$

$$Teacher\ Gain\ Index\ for\ Composite = \left(\frac{1.07}{0.50}\right)$$

Mrs. Smith's composite teacher gain index is 2.14, which corresponds to an effectiveness level of most effective since it is greater than or equal to two.

Example Two

Mr. Brown provided instruction to students who took the STAAR EOC assessments in Biology and Algebra I. He received two value-added reports in 2014, which are summarized below.

Year	Subject	Growth Measure	Standard Error	Teacher Gain Index
2014	Algebra I	7.50	3.80	1.97
2014	Biology	2.30	1.00	2.30

Calculating the Index for the Composite:

Unlike in Example 1, Mr. Brown's individual growth measures for Algebra I and Biology are calculated with the predictive model (URM). This type of analysis uses student scale scores on assessments, not normal curve equivalents for student scores. As a result, the growth measures are not on the same scale. To combine them into a composite, a new index must be calculated by averaging the teacher gain indices for the applicable assessments. Mr. Brown's average index is calculated as follows:

$$Average\ Index = \frac{1}{2}AlgebraI + \frac{1}{2}Biology = \frac{1}{2}(1.97) + \frac{1}{2}(2.30) = 2.14$$

where $AlgebraI$ represents the teacher gain index for Algebra I, and $Biology$ represents the teacher gain index for Biology.

Calculating the Standard Error for the Composite:

To create the teacher gain indices in the table above, the growth measure for a subject in a specific year is divided by the standard error. The effect of this calculation is to standardize the growth measure so that they can be combined with other measures even when they are not on the same scale. This also causes the new index value to have a "standardized" standard error of one.

When these indices are then averaged together, the standard error of the resulting index is smaller than the standard error of 1 for each individual index. With more data included in average index calculation,

the certainty for the measure is higher than the certainty for any of the individual teacher gain indices. The formula for determining the standard error for Mr. Brown's average index is:

$$Standard\ Error\ of\ Average\ Index = \frac{1}{2}\sqrt{((1.00)^2 + (1.00)^2)} = \frac{1}{\sqrt{2}} = 0.71$$

Calculating the Teacher Gain Index for the Composite:

The teacher gain index for the composite is calculated using the same methods as the calculation of the teacher gain index for Mr. Brown's individual Algebra I and Biology reports. The formula for determining Mr. Brown's composite is:

$$Teacher\ Gain\ Index\ for\ Composite = \left(\frac{2.14}{0.71}\right)$$

$$Teacher\ Gain\ Index\ for\ Composite = 3.01$$

Mr. Brown's composite is 3.01, which corresponds to an effectiveness level of most effective.

Example Three

To fully explore how the composite is calculated for an educator teaching a mix of grades/subjects and courses assessed with both STAAR 3-8 and STAAR EOC, consider Ms. Martin, who taught Biology and Algebra I during the first semester of the 2013-14 school year. Prior to the start of the second semester, she transitioned to a position at a middle school and taught Grade 8 Reading and Math. While this teaching schedule may be a bit unusual, it provides a strong explanation as Ms. Martin's composite, essentially, is a combination of the two composites that were calculated in Examples One and Two.

Year	Composite	Assessments Included	Teacher Gain Index
2014	STAAR 3-8	Grade 8 Reading Grade 8 Math	2.14
2014	STAAR EOC	Biology Algebra I	3.01

Calculating the Index for the Composite:

The calculations to determine Ms. Martin's composite are very similar to the steps used in Example Two. First, a new index must be calculated by averaging the teacher gain indices for the STAAR 3-8 assessments and the STAAR EOC assessments. In this case, a simple average will suffice because there are two subjects included in the STAAR 3-8 composite and two included in the STAAR EOC composite. If there were more assessments included in one of the composites, the formula to average them would need to include weights.

$$Average\ Index = \frac{1}{2}STAAR3-8/Stanford + \frac{1}{2}STAAREOC = \frac{1}{2}(2.14) + \frac{1}{2}(3.01) = 2.58$$

where $STAAR3-8/Stanford$ represents the teacher gain index for the composite for Grade 8 Reading and Math, and $STAAREOC$ represents the teacher gain index for the composite for Biology and Algebra I.

Calculating the Standard Error for the Composite:

Like in Example Two, each teacher gain index has a standard error of 1.00.

The formula for determining the standard error for Mrs. Brown's average index is:

$$Standard\ Error\ of\ Average\ Index = \frac{1}{2}\sqrt{((1.00)^2 + (1.00)^2)} = 0.71$$

Calculating the Teacher Gain Index for the Composite:

As in Example Two, the formula for determining Mr. Brown's composite is:

$$Teacher\ Gain\ Index\ for\ Composite = \left(\frac{2.58}{0.71}\right)$$

$$Teacher\ Gain\ Index\ for\ Composite = 3.63$$

Ms. Martin's composite is 2.87, which corresponds to an effectiveness level of most effective.