

**A Comparison of Alternative Models for Estimating School Performance in Mathematics
and Reading/Language Arts in Four State Accountability Systems:**

Oregon Results

NCAASE Technical Report

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A Comparison of Alternative Models for Estimating School Performance in Mathematics and Reading/Language Arts in Four State Accountability Systems: Oregon Results

Background and Introduction

This technical report is one of a series of four technical reports that describe the results of a study comparing eight alternative models for estimating school academic achievement using data from the Arizona, North Carolina, Oregon, and Pennsylvania accountability systems. Our purpose was not to evaluate or examine the accountability systems in use by these states, but to evaluate a broader range of models commonly used for estimating school performance that are applied in many states and frequently reported in the school effectiveness research literature. This introduction briefly describes the study background and details the methods and procedures we used to estimate the eight school performance models and compare model results in all four states. The individual state technical reports including details on each state's accountability data, assessment instruments, and results are provided at: <http://www.ncaase.com/publications/tech-reports>.

Despite the central importance of analytic models used in evaluating teacher and school effects in modern accountability systems, there are relatively few studies of the reliability and validity of these high-stakes systems (see, for example, Goldschmidt, Choi, & Beaudoin, 2012). The results reported here examine eight models using operational state accountability data in mathematics and reading/language arts from the four participating states. We addressed four questions surrounding the use of analytic models for the evaluation of school performance:

1. Are estimates of school performance stable across successive cohorts of students?
2. How well do estimates of school performance correlate among models?
3. How do estimates of school performance correlate with variables describing the student composition of the school?
4. Do estimates of school performance vary from one model to another based on the school composition of students with disabilities (SWD)?

General Method Description

Sample

The sample from each state is described in each individual state technical report. In three of the four states, the sample consisted of all students who took the state's mathematics or reading/language arts general assessment in any one school year from 2007-08 through 2011-12, and whose records in each year were included in the state's calculation of Adequate Yearly Progress (AYP). Samples were separated into two grade level bands: a longitudinal elementary school sample (Grades 3 through 5) and a longitudinal middle school sample (Grades 6 through 8), each consisting of three cohorts (a) 2007/08 through 2009/2010; (b) 2008/09 through 2010/11; and (c) 2009/10 through 2011/12 (see research design schematic below). In Arizona, only one elementary and middle school cohort was used (2006/07 through 2008/09) due to changes in the Arizona testing program that occurred in 2010.

Instruments

The outcome measures for all analyses were the standardized mathematics and reading/language arts tests used for accountability in each state. In three of the states, the instruments used vertically linked developmental scales created using item response theory (IRT) methods. In Pennsylvania, the test was not vertically linked over grades preventing the estimation of some of the school performance models described in the next section. More detail about the Oregon test is contained in a later section of this report.

Research design indicating academic years and longitudinal cohorts studied:

Grade	Academic Year				
	2007/08	2008/09	2009/10	2010/11	2011/12
3	E1	E2	E3		
4		E1	E2	E3	
5			E1	E2	E3
6	M1	M2	M3		
7		M1	M2	M3	
8			M1	M2	M3

Note. E denotes an elementary school cohort, M denotes a middle school cohort. Only one elementary and one middle school cohort were available in the Arizona data.

School Performance Models

For all models, we estimated school performance in the last focal year (Grade 5 or 8) of the two grade level bands, as well as using prior years of achievement data as dictated by the particular model. We applied eight alternative analytic models of school performance to the mathematics and reading/language arts achievement data in elementary and middle school for each state. The eight school performance models were: Percent Proficient (PP), gain score (Gain), transition matrix (TM), student growth percentile (SGP), value-added model (VAM), and three Multilevel Linear Model (MLM) estimates: focal year intercept or status (MLM0), focal year growth rate (Grate), and average MLM growth rate across the three years (AvGrate).

Percent Proficient (PP). PP was the NCLB required metric used by the state that calculated the percentage of students in each school that met or exceeded state benchmarks for proficiency in either mathematics or reading/language arts in each grade.

Average Gain Score. Gain scores were calculated as the prior academic year (Grade 4 or Grade 7) scale score in mathematics or reading/language arts subtracted from the focal year scale score (Grade 5 or Grade 8):

$$\text{Gain}_i = \Delta_i = Y_{it} - Y_{i(t-1)} \quad (1)$$

where Y_{it} was the assessment outcome for student i at time t . Student gain scores were averaged for each school (labeled “Gain” below).

Transition Matrix (TM). School performance estimates were computed from a table of the state’s proficiency categories in the prior year crossed with the proficiency categories in the focal year (Grade 5 or Grade 8) which, in the case of five proficiency categories, created a transition matrix table of 25 cells. The percentage of students occurring in each of the cells was

entered and then a weighting scheme was applied to each cell and the products were summed to create a TM school performance index. The weighting scheme awarded one of three scores: (a) -1 was recorded if the student moved down one or more categories from the previous year, (b) 0 was recorded if the student stayed in the same category, and (c) +1 was recorded if the student moved up one or more categories from the previous year (see Tindal, Nese, & Stevens, 2017). The weighted values were averaged across all cells to create an overall school TM index.

Student Growth Percentiles (SGP). Student growth percentiles were computed at the student level using the approach described by Betebenner (2009). A student's SGP was calculated by taking the current year test score and regressing it on the two prior years of test scores. Betebenner's (2009) approach uses ordinal methods (quantile regression) as well as B-spline, cubic polynomial smoothing of the resulting normative distribution of conditional regression estimates. The analysis results in a relative rank for each student in a conditional distribution of those who had similar scores in previous years. We used the R package *SGP* (Betebenner, & Iwaarden, 2011) to compute student estimates based on the regression of the two prior years of test scores on the current year's test score and then we aggregated student SGP for each school to create a median SGP as each school's SGP performance estimate.

Value-added Models (VAM). This mixed effects approach examined performance gains over years and included indicators for student membership in a particular school. This model is known generally as the "layered model" because layers of equations are added with each year of schooling (Ballou, Sanders, and Wright, 2004). For example, the model for our case with students with three years of data would be specified as follows:

$$Y_{0ij} = b_0 + u_0 + e_0 \quad (2a)$$

$$Y_{1ij} = b_1 + u_0 + u_1 + e_1 \quad (2b)$$

$$Y_{2ij} = b_2 + u_0 + u_1 + u_2 + e_2, \quad (2c)$$

where Y_{tij} represents an assessment for student i at time t (grade) attending school j . The fixed mean for all students in the combination of grades and schools was μ_{tij} , while e_{tij} was the random deviation for student n from the mean, μ_{tij} . The layered model we used was limited to a maximum of three years and was applied separately to mathematics and reading/language arts.

Multilevel Linear Growth Model Initial Status, Focal Year Growth, and Average Growth (MLM0, MLM Growth Rate and MLM Average Growth Rate). We modeled student growth over the three elementary or three middle school grades with multilevel longitudinal analyses (Raudenbush & Bryk, 2002) using HLM 7.1 (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011) and full maximum likelihood estimation. The conditional models included a level-1 model that specified student mathematics or reading/language arts scores predicted by a quadratic function of time of measurement, a level-2 model composed of the prediction of level-1 model parameters as a function of student mean values, and a level-3 model composed of the prediction of level-2 parameters as a function of school mean parameter values. Time was centered on the focal year (Grade 5 or 8) for computation of MLM0 and MLM growth rate but was centered on the middle year (Grade 4 or 7) for computation of MLM average growth rate. We used a quadratic model based on previous findings (Bloom, Hill, Black, & Lipsey, 2008) as well as inspection of the data and statistical testing of alternative growth functions. Because only three time points were present, the model intercept and linear slope were random

parameters but the variance of the quadratic parameter was fixed (note the omission of a residual term in equation 4c below) to obtain a model solution. We used two different centering definitions to take into account the curvilinear nature of growth. Although centering in the last, focal year is most consistent with the definition of other models we examined, it likely underestimates the amount of growth that occurs over the three year period because of deceleration. We therefore also centered on the middle grade in the three year span to produce an average growth rate over the three years. The resulting MLM model equations were:

Level 1 (Time):

$$(Y_{tij}) = \pi_{0ij} + \pi_{1ij}(\text{time}_{tij}) + \pi_{2ij}(\text{time squared}_{tij}) + e_{tij} \quad (3)$$

Level 2 (Students):

$$\pi_{0ij} = \beta_{00j} + r_{0ij} \quad (4a)$$

$$\pi_{1ij} = \beta_{10j} + r_{1ij} \quad (4b)$$

$$\pi_{2ij} = \beta_{20j} \quad (4c)$$

Level 3 (Schools):

$$\beta_{00j} = \gamma_{000} + u_{00j} \quad (5a)$$

$$\beta_{10j} = \gamma_{100} + u_{10j} \quad (5b)$$

$$\beta_{20j} = \gamma_{200} + u_{20j} \quad (5c)$$

where Y_{tij} was the mathematics or reading/language arts scale score for student i at time t in school j , π_{0ij} was the initial status or intercept for student i at time 0 in school j , π_{1ij} was the linear rate of change, π_{2ij} was the quadratic curvature representing the acceleration or deceleration in each student's growth trajectory and e_{tij} was the residual for each student. At level-2, the level-1 parameters were modeled using mean parameter values across students (β_{k0j}) and at level-3, the level-2 parameters were modeled using mean parameter values across schools (γ_{k0j}).

Comparison of Model Estimates

We used several comparison criteria to evaluate the comparability and stability of school estimates across school performance models and across cohorts. In each state technical report we describe the results of our evaluation of school performance estimates. We examined: (a) correlations of model estimates for each school across the three cohorts, (b) correlations among school estimates from one model to another, (c) correlations among the school estimates and school composition variables (e.g., percent economically disadvantaged students in the school, percent minority students in the school), and (d) correlations of each model with the percentage of students with disabilities in the school.

Comparison of School Ranks Based on Model Estimates

Many states and districts create school ranks based on their accountability system results. To compare the alternative school performance models using this metric, we created school percentile ranks (from 1 to 99, with 99 being the highest performance) based on each of the eight school performance model estimates described above. In one of the only studies evaluating school performance models, Goldschmidt, Choi, and Beaudoin (2012) compared models using quintiles. They examined the percentage of times schools remained in the same quintile band based on one school performance model versus another. Similarly, Castellano and Ho (2013) compared SGP and conditional regression models by examining the percentage of times schools

remained within 1, 5 or 10 percentile ranks for each model. To maintain some comparability with each of these studies, we used three levels of similarity in school ranks, computing the percentage of schools within 5, 10, or 20 ranks of each other. We also computed the Spearman's correlation of school ranks from one cohort to another or from one school performance model to another. As a final comparison metric, we computed the root mean squared difference (RMSD) between school ranks based on each pair of cohorts or each pair of school performance models (see Castellano & Ho, 2013):

$$RMSD_{c,c} = \sqrt{\frac{\sum_{j=1}^j (Rank_{jc} - Rank_{jc})^2}{n}} \quad (6)$$

In equation 6, for a particular school performance model, the RMSD computes the difference ($Rank_{it}$) between each school's rank in one cohort (jt) versus the school's rank in a second cohort (ju), squaring the difference, summing across all schools, dividing by the number of schools, n , and taking the square root of the result.

$$RMSD_{mn} = \sqrt{\frac{\sum (Rank_{jm} - Rank_{jn})^2}{n}} \quad (7)$$

Similarly, in equation 7, the school ranks arising from alternative school performance models are compared in which $Rank_{jm}$ and $Rank_{jn}$ represent the rank of school j using school performance model m compared to that school's rank using school performance model n . As in equation 6, differences in ranks are then summed, squared, divided by the number of schools and taken to the $\frac{1}{2}$ power. The RMSD was a measure of similarity in school performance models where a lower value indicates a pair of models that rank schools most similarly.

Summary

We evaluated eight models for estimating school academic performance in mathematics and reading/language arts using operational state accountability data. In NC, OR, and PA, we examined stability in model estimates across three successive student cohorts in mathematics and reading/language arts in both elementary and middle school grades. In all four states, we also compared the estimates of school performance from one model to another to determine whether the models provided similar or different depictions of school performance, although several models could not be estimated in Pennsylvania because their state test did not use a vertically linked score scale. We then compared the degree to which model estimates correlated with variables that described the student composition of the school, a likely indication of construct irrelevant variance—ideally estimates of school performance should not be related to the student composition of the school. Last, we evaluated the school performance models in terms of the way they ranked schools, the stability of school ranks across cohorts, and the degree of agreement in school rankings from one school performance model to another. Detailed results of these analyses and comparisons follow for the state of Oregon.

Oregon Study Method

Sample

The initial Oregon sample consisted of all students that took the Oregon Assessment of Knowledge and Skills (OAKS) mathematics ($N = 483,502$) or reading/language arts ($N = 474,080$) general assessment in any one school year from 2007-08 through 2011-12, and whose records in each year were included in the state calculation of Adequate Yearly Progress (AYP). Students who did not follow the typical grade level sequence due to grade retention, acceleration, or dubious progressions were excluded from the sample; this included the transition from 2006/07 to 2007/08, so that no students present in 2007/08 had been retained or accelerated from the previous year.

The initial sample was separated into an elementary school sample (Grades 3 through 5) and a middle school sample (Grades 6 through 8), each consisting of three successive cohorts of students enrolled in school years: (a) 2007/08 through 2009/2010; (b) 2008/09 through 2010/11; and (c) 2009/10 through 2011/12. The initial elementary school sample for the mathematics test was 137,744 students. The initial middle school sample for the mathematics test was 136,535 students. The initial elementary school sample for the reading/language arts test was 137,535 students. The initial middle school sample for the reading/language arts test was 137,343 students. To create an analytic sample that was appropriate for our research questions, we only included students with valid test scores in all three years, schools that served all three grades (Grades 3 through 5 or 6 through 8) for a cohort, and schools with $N \geq 10$ students in each of the three cohorts in the final reference year of the three-year grade level band (i.e., Grade 5 for elementary grades 3 to 5 and Grade 8 for middle grades 6 to 8). Students and schools that did not meet these criteria were excluded from analyses. As is the case in most operational and research applications of these models, we made no attempt to account for student mobility in years prior to the focal year or to make any attributions of “school effects” based on how many years the student had been in the focal year school. Our concern in creating the analytic sample was to maximize the interpretation of comparisons of the models rather than to ensure complete representativeness of the samples. These inclusion rules were applied to ensure that there were no differences in the analytic samples for different school models so that comparisons of school models were a function only of differences in the models and not the composition of the sample analyzed. The final elementary school analytic sample for the mathematics test was 90,679 students (65.8% of the initial sample). The final middle school analytic sample for the mathematics test was 75,318 students (55.2%). The final elementary school analytic sample for the reading/language arts test was 89,627 students (65.2%). The final middle school analytic sample for the reading/language arts test was 75,193 students (54.7%).

Table 1 provides summary statistics describing the school-level analytical samples of Oregon elementary and middle school students in the three cohorts for mathematics and reading/language arts. Although variation existed from cohort to cohort in sample demographic characteristics, generally the composition of the samples was quite similar across the three cohorts and for mathematics and reading/language arts at each grade level band. From elementary to middle school cohorts, there were small but consistent decreases in the proportion of English learners (EL), economically disadvantaged students (EDS), racial/ethnic minority students (i.e., American Indian/Alaskan Native, Asian/Pacific Islander, Black/African American,

Hispanic, Multi-Ethnic, and Declined to report), and students with disabilities (SWD). At the elementary school level, almost 10% of the students were EL, almost 50% of the students were female, over 50% were EDS, approximately 33% were racial/ethnic minority students, and about 13% were SWD. It is also noteworthy that there was much greater school level variation—as indicated by the values of the standard deviations in parentheses—in EDS and racial/ethnic minority student school composition than other student characteristics. It should also be noted that when we refer to “school” composition, it references variables representing a particular cohort in each school in our analytic samples. Because we excluded students and schools to create our analytic samples, “total school” characteristics may differ slightly from the subsample characteristics reported here.

Table 1

Proportion and Standard Deviation (in parentheses) of Student Subgroups for the Oregon Analytical Samples by Content Area and Grade Level Band

		Cohort		
		1	2	3
Mathematics Elementary	EL	0.102 (0.136)	0.097 (0.129)	0.093 (0.120)
	Female	0.495 (0.093)	0.496 (0.086)	0.496 (0.078)
	EDS	0.514 (0.262)	0.523 (0.251)	0.543 (0.247)
	Ethnic Minority	0.323 (0.217)	0.332 (0.218)	0.343 (0.216)
	SWD	0.127 (0.065)	0.131 (0.068)	0.127 (0.063)
Reading/Language Arts Elementary	EL	0.093 (0.121)	0.096 (0.129)	0.093 (0.119)
	Female	0.497 (0.093)	0.497 (0.087)	0.497 (0.078)
	EDS	0.511 (0.262)	0.523 (0.251)	0.542 (0.247)
	Ethnic Minority	0.316 (0.211)	0.333 (0.218)	0.344 (0.216)
	SWD	0.123 (0.064)	0.127 (0.067)	0.123 (0.062)
Mathematics Middle	EL	0.056 (0.083)	0.048 (0.067)	0.034 (0.052)
	Female	0.496 (0.085)	0.499 (0.091)	0.494 (0.090)

Reading/Language Arts Middle	EDS	0.483 (0.237)	0.492 (0.228)	0.511 (0.227)
	Ethnic	0.307	0.321	0.330
	Minority	(0.229)	(0.220)	(0.219)
	SWD	0.116 (0.065)	0.113 (0.061)	0.116 (0.068)
	EL	0.056 (0.083)	0.047 (0.066)	0.033 (0.050)
	Female	0.495 (0.087)	0.500 (0.092)	0.494 (0.090)
	EDS	0.482 (0.238)	0.491 (0.228)	0.510 (0.227)
	Ethnic	0.307	0.319	0.330
	Minority	(0.229)	(0.220)	(0.218)
	SWD	0.115 (0.065)	0.111 (0.060)	0.114 (0.066)

Instrument

The outcome measures for all analyses were the standardized Oregon Assessment of Knowledge and Skills (OAKS; Oregon Department of Education [ODE], 2012a) mathematics and reading/language arts tests. The OAKS is a summative, computer-adaptive assessment based on the Oregon content standards (ODE, 2008). OAKS test specifications varied by grade and content area and were intended to measure the core content standards in the state curriculum (ODE, 2012a). The tests were administered under standardized conditions (ODE, 2012b). OAKS raw scores were converted to scale scores based on the number of items answered correctly while taking item difficulty into account using one parameter item response theory (IRT) methods and a vertical linking design over grades to create a developmental scale score (ODE, 2009).

Results and Discussion

This technical report is organized in three sections: Section A describes school performance model estimates, Section B describes school ranks, and the Appendices provide additional detailed results.

Section A: School Performance Estimates

Cohort stability. We first considered the stability of model estimates by computing the correlations among estimates across the three successive cohorts of students. It should be noted that cohort comparisons are both an indication of changes in the composition of students in the school from one academic year to another as well as any other temporal changes that occur from one year to another including changes in policy, practice, instruction, or other factors that impact student test scores. Table 2 shows the correlation of model estimates across cohorts for mathematics and reading/language arts in the elementary school and middle school samples. As can be seen in Table 2, correlations generally ranged only from small to moderate for the model

estimates (with the exception of the MLM0 estimates) indicating some substantial instability in school performance estimates across cohorts. Correlations between adjacent years in the first two columns (cohort 1 with 2 or 2 with 3) are generally somewhat higher than the comparisons across two years (cohort 1 with 3). Although there is also some variation from elementary to middle school or from mathematics to reading/language arts, trends in cohort stability were fairly

Table 2

Correlations of School Performance Model Estimates across Cohorts by Content Area and Grade Level Band

<u>Elementary Schools</u>						
Model	<u>Mathematics</u>			<u>Reading/Language Arts</u>		
	1 with 2	2 with 3	1 with 3	1 with 2	2 with 3	1 with 3
PP	0.593	0.630	0.529	0.655	0.667	0.593
MLM0	0.782	0.815	0.732	0.823	0.829	0.797
Gain	0.369	0.305	0.174	0.281	0.261	0.084
TM	0.319	0.267	0.139	0.208	0.093	0.115
SGP	0.416	0.432	0.237	0.364	0.279	0.204
VAM	0.443	0.468	0.275	0.396	0.312	0.215
Grate	0.325	0.241	0.145	0.211	0.123	0.113
AvGrate	0.432	0.523	0.261	0.420	0.397	0.272

<u>Middle Schools</u>						
Model	<u>Mathematics</u>			<u>Reading/Language Arts</u>		
	1 with 2	2 with 3	1 with 3	1 with 2	2 with 3	1 with 3
PP	0.713	0.670	0.586	0.674	0.668	0.672
MLM0	0.823	0.788	0.770	0.848	0.812	0.840
Gain	0.300	0.299	0.212	0.294	0.255	0.246
TM	0.321	0.259	0.205	0.131	-0.006	0.090
SGP	0.399	0.429	0.221	0.338	0.176	0.153
VAM	0.414	0.491	0.269	0.308	0.314	0.171
Grate	0.233	0.228	0.211	0.282	0.376	0.368

AvGrate	0.440	0.550	0.237	0.542	0.465	0.248
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similar across content area and grade level band. To facilitate interpretation of the cohort results, we also averaged correlations across the two content areas and grade levels (see Table 3). It can be seen that the correlations across cohorts were largest for the two status based school performance measures (PP and MLM0) and noticeably lower for all other models that used two or three years of data to estimate school performance. The two rightmost columns of Table 3 show the overall mean and standard deviation across the cohort comparisons for each school performance model. It can be seen that the greatest agreement over cohorts, content, and grade level was for the MLM0 estimates (MLM focal year intercepts), closely followed by the PP model estimates. All remaining multi-year performance models had much greater instability. The standard deviations of correlations across cohort comparisons shown in the rightmost column of Table 3 also show the least variability over cohorts for the status models and the greatest variability across cohort correlations for the Average Growth Rate (AvGrate) model followed by the SGP model.

Table 3

Average Correlations across Content Area and Grade Level Band and Overall Mean and Standard Deviation (SD) Across the Three Cohort Comparisons

Model	1 with 2	2 with 3	1 with 3	Mean	SD
PP	0.659	0.659	0.595	0.638	0.040
MLM0	0.819	0.811	0.785	0.805	0.026
Gain	0.311	0.280	0.179	0.257	0.071
TM	0.245	0.153	0.137	0.178	0.071
SGP	0.379	0.329	0.204	0.304	0.100
VAM	0.390	0.396	0.232	0.339	0.097
Grate	0.263	0.242	0.209	0.238	0.052
AvGrate	0.458	0.484	0.254	0.399	0.131
Mean	0.440	0.419	0.324	--	--

Comparison of models. We next computed the correlations of school performance estimates from one model to another within each of the three cohorts and then took the mean correlation across cohorts. Correlations of model estimates within each individual cohort are presented in Appendix A. Table 4 shows model correlations for mathematics and reading/language arts in the elementary school and middle school samples averaged over the three cohorts.

Table 4

Correlations of School Performance Estimates across Models by Content Area and Grade Level Band and Averaged over Content and Grade Band

Elementary School Mathematics

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	0.826	0.260	0.358	0.495	0.516	0.169	0.383
MLM0		0.276	0.316	0.55	0.592	0.179	0.426
Gain			0.894	0.849	0.872	0.960	0.573
TM				0.812	0.814	0.843	0.549
SGP					0.957	0.717	0.803
VAM						0.736	0.843
Grate							0.347

Elementary School Reading/Language Arts

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	0.844	-0.015	0.260	0.448	0.519	-0.013	-0.044
MLM0		-0.107	0.196	0.445	0.511	-0.120	-0.136
Gain			0.423	0.481	0.499	0.442	0.555
TM				0.709	0.716	0.672	0.406
SGP					0.913	0.535	0.587
VAM						0.576	0.629
Grate							0.274

Middle School Mathematics

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	0.785	0.456	0.572	0.513	0.508	0.431	0.381
MLM0		0.467	0.471	0.512	0.547	0.479	0.372
Gain			0.887	0.88	0.909	0.952	0.643
TM				0.811	0.809	0.836	0.577
SGP					0.948	0.762	0.840

VAM	0.803	0.884
Grate		0.448

Middle School Reading/Language Arts

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	0.853	-0.139	0.360	0.395	0.399	-0.308	-0.143
MLM0		-0.296	0.226	0.342	0.368	-0.438	-0.250
Gain			0.678	0.661	0.675	0.916	0.602
TM				0.732	0.719	0.527	0.384
SGP					0.897	0.437	0.598
VAM						0.499	0.682
Grate							0.452

Average over Content Area and Grade Level Band

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	0.827	0.141	0.388	0.463	0.486	0.070	0.144
MLM0		0.085	0.302	0.462	0.505	0.025	0.103
Gain			0.721	0.718	0.739	0.818	0.593
TM				0.766	0.765	0.720	0.479
SGP					0.929	0.613	0.707
VAM						0.654	0.760
Grate							0.380

As can be seen in Table 4, substantial variability was present in the degree to which school performance estimates for one model were related to other models and the correlations among models varied a good deal depending on content area and grade level band. For example, the correlation between the PP model and the Gain score model ranged from -.139 to +.456 and between MLM0 and MLM Grate ranged from -.438 to +.479. The least variation in model correlations across content area and grade level band was for the SGP and VAM models from +.897 to +.957.

As shown in the last panel of Table 4, on average across content area and grade level band, the highest correlations were among the SGP and VAM models (+.929), the PP and

MLM0 models (+.827), and the Gain score model with the Grate model (+.818). The lowest correlations were between the MLM intercept (MLM0) and MLM growth rate (Grate) models (+.025), the MLM0 model and the Gain model (+.085), and the MLM0 and the average growth rate (AvGrate) model (+.103). The average correlation of the two status models (PP, MLM0) with the remaining six multiyear models was only +.264. Average correlations among the six multiple year models ranged from +.479 to +.766 with one exception, the correlation of the Grate and AvGrate models was only +.380, with an average correlation among all six multiyear models of +.691.

We also examined the degree to which school performance model estimates were consistent from one content area to the other. Table 5 shows model estimate agreement across content areas in each cohort as well as the average across the three cohorts. As can be seen in Table 5, correlations were higher between content areas in elementary than middle school. On average, correlations for the two status models (PP and MLM0) were greater than +.70 and higher than average correlations for the other models that ranged from +.183 to +.578.

Table 5

Correlations of School Performance Model Estimates between Mathematics and Reading/Language Arts by Grade Level Band in each Cohort and Averaged over Cohorts

Model	Elementary Schools				Middle Schools			
	<u>Cohort</u>				<u>Cohort</u>			
	1	2	3	Mean	1	2	3	Mean
PP	0.772	0.753	0.761	0.762	0.725	0.720	0.702	0.716
MLM0	0.865	0.852	0.845	0.854	0.819	0.773	0.775	0.789
Gain	0.563	0.508	-0.122	0.316	0.261	0.326	0.281	0.289
TM	0.454	0.448	0.390	0.431	0.217	0.370	0.304	0.297
SGP	0.558	0.503	0.513	0.525	0.417	0.401	0.373	0.397
VAM	0.585	0.585	0.565	0.578	0.439	0.356	0.473	0.423
Grate	0.582	0.468	0.385	0.478	0.188	0.215	0.145	0.183
AvGrate	0.539	0.593	0.511	0.548	0.407	0.434	0.452	0.431

Relation with school composition variables. We computed the correlation of model estimates with school composition variables to determine whether estimates were related to the aggregated student characteristics in each school. Table 6 shows the correlations of model estimates with school composition variables for mathematics and reading/language arts in the elementary school and middle school samples. Correlations of model estimates with school composition variables within each individual cohort are presented in Appendix B.

The rightmost column of Table 6 shows the average correlation of each school performance model with the school composition variables across all school composition variables. As can be seen, correlations of the status models, PP and MLM0, were negative and noticeably higher than the correlations of the other school performance models with school

composition variables. On average across content and grade level band, the correlation of the school composition variables was -0.221 for the PP model and -0.225 for the MLM0 model. In contrast, the average correlations of the school composition variables with the remaining models were quite low ranging from -0.003 to +0.117. Thus there was relatively little relation of the multiyear models with school composition, but for the status models performance estimates were higher the fewer the number of students from protected groups present in the school and lower as the number of students from protected groups increased. No clear pattern was present for the relation between school size and model estimates.

Table 6

Correlations of Model Estimates with School Composition Variables by Content Area and Grade Level Band

Elementary School Mathematics

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.500	-0.328	-0.194	0.013	-0.319	0.147	-0.197
MLM0	-0.626	-0.339	-0.195	-0.012	-0.299	0.228	-0.207
Gain	-0.016	0.052	0.017	-0.003	0.021	0.099	0.028
TM	-0.058	0.031	-0.016	-0.006	-0.011	0.097	0.006
SGP	-0.158	-0.016	-0.036	-0.009	-0.028	0.171	-0.013
VAM	-0.180	-0.024	-0.052	0.006	-0.035	0.187	-0.016
Grate	-0.013	0.032	0.029	-0.006	-0.003	0.062	0.017
AvGrate	-0.020	0.090	-0.028	0.027	0.083	0.170	0.053

Elementary School Reading/Language Arts

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.600	-0.526	-0.204	0.002	-0.492	0.064	-0.293
MLM0	-0.725	-0.526	-0.189	0.001	-0.477	0.132	-0.297
Gain	0.158	0.184	0.076	-0.024	0.117	0.067	0.096
TM	-0.072	0.051	0.035	0.002	0.008	0.084	0.018
SGP	-0.210	-0.061	-0.041	-0.003	-0.105	0.110	-0.052
VAM	-0.259	-0.110	-0.059	0.009	-0.141	0.125	-0.072
Grate	0.142	0.130	0.054	0.023	0.090	0.005	0.074
AvGrate	0.237	0.285	0.057	-0.002	0.210	0.052	0.140

Middle School Mathematics

	EDS	EL	SWD	Female	Ethnic	School	Mean
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Model					Minority	Size		
PP	-0.329	-0.229	-0.267	0.051	-0.265	0.169	-0.145	
MLM0	-0.466	-0.232	-0.179	0.009	-0.184	0.236	-0.136	
Gain	-0.009	0.017	-0.070	0.030	0.056	0.140	0.027	
TM	-0.046	-0.001	-0.118	0.037	0.005	0.166	0.007	
SGP	0.005	0.045	-0.049	0.026	0.060	0.172	0.043	
VAM	0.006	0.045	-0.048	0.020	0.063	0.181	0.044	
Grate	-0.090	-0.045	-0.074	0.011	-0.001	0.138	-0.010	
AvGrate	0.134	0.128	0.001	0.020	0.113	0.150	0.091	

Middle School Reading/Language Arts

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.525	-0.444	-0.263	0.135	-0.481	0.088	-0.248
MLM0	-0.663	-0.459	-0.217	0.120	-0.456	0.109	-0.261
Gain	0.326	0.238	0.092	-0.026	0.226	0.031	0.148
TM	-0.021	0.001	-0.001	0.036	-0.028	0.112	0.017
SGP	-0.063	0.016	-0.035	0.056	-0.047	0.128	0.009
VAM	-0.058	0.002	-0.038	0.041	-0.058	0.121	0.002
Grate	0.365	0.256	0.126	-0.054	0.235	0.007	0.156
AvGrate	0.394	0.339	0.098	-0.039	0.258	0.057	0.185

Relation of Model Estimates to SWD School Composition. Because of the NCAASE emphasis on the performance and academic growth of SWD, we also focused more specifically on the relations between the percentage of SWD students served by a school and the school performance model estimates. Correlations of model estimates with SWD school composition within each individual cohort are presented in Appendix C. Table 7 shows the correlation of model estimates with the percentage of SWD in each school for mathematics and reading/language arts in the elementary school and middle school samples averaged over cohorts. As can be seen in the bottom row of Table 7, average school performance estimates based on the single-year, status models (PP and MLM0) had substantially higher correlations with school SWD composition than the other school performance models. With the PP and MLM0 models, school performance estimates were higher the lower the percentage of SWD students in the school and lower to the extent that the school served higher proportions of SWD.

Table 7

Average School Performance Model Estimates as a Function of the Percentage of SWD in the School by Content Area and Grade Level Band

Content Area and Grade Level Band	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
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Math Elementary	-0.194	-0.195	0.017	-0.016	-0.036	-0.052	0.029	-0.028
Math Middle	-0.204	-0.189	0.076	0.035	-0.041	-0.059	0.054	0.057
Reading/Language Arts Elementary	-0.267	-0.179	-0.070	-0.118	-0.049	-0.048	-0.074	0.001
Reading/Language Arts Middle	-0.263	-0.217	0.092	-0.001	-0.035	-0.038	0.126	0.098
Mean	-0.232	-0.195	0.029	-0.025	-0.040	-0.049	0.034	0.032

Summary of Section A. We evaluated eight alternative models for estimating school academic performance in mathematics and reading/language arts using operational Oregon state accountability data. We observed substantial variability in model estimates across three successive student cohorts in mathematics and reading/language arts in both elementary and middle school grades. Variability across cohorts was somewhat less for the two status models (PP and MLM0) than for the remaining models that used more than one year of data. We also compared the estimates of school performance from one model to another and found substantial disagreement across models. Generally, the status models based on a single year of data were more similar to each other and differed from the remaining models that examined more than one year of data. There was greater agreement among the models that used multiple years of data. We also compared school performance estimates in mathematics with those in reading/language arts. Again, agreement was greater across content areas for the status models than for the multiple year models. Comparison of model estimates with school composition variables showed that status models (PP and MLM0) had substantially higher correlations than the remaining school performance models with the student makeup of the school with lower estimates related to higher proportions of protected student subgroups in the school. Finally, we correlated school performance estimates with the percentage of SWD in each school. Ideally estimates of school performance should be unrelated to the student composition of the school, but as with the other school composition variables, we found that the status models were more highly correlated with SWD school composition and there were noticeably lower correlations of the multiyear model estimates with the percentage of SWD students in the school.

Section B: School Ranks Based on School Performance Estimates

The purpose of Section B of this technical report is to describe study results based on school ranks. In section A, we focused on the examination of school performance estimates that arose from the eight school performance models. In section B, we focus on the examination of school ranks based on those school performance estimates. The methods for analyzing school ranks, comparing school ranks across cohorts, and comparing school performance models using school ranks were described above in the General Methods section. Common practice for states and other jurisdictions is to rank schools as a method for evaluating academic performance. Therefore, using the estimates of school performance generated by the eight models described previously, we computed percentile ranks for each school. We then compared school ranks within each school performance model across the three cohorts used in the study. Next we compared the school ranks for each model to the ranks obtained from each of the other models. Finally we examined the relation between school ranks from each model with variables describing the student composition of each school. Three criteria were used to evaluate the

comparisons of school ranks: (a) the Spearman's correlation between school ranks, (b) the proximity of absolute school ranks, and (c) the root mean square difference (RMSD) in school ranks.

Comparison of cohorts. We first consider the stability of school ranks within each school performance model across the three successive cohorts of students in mathematics and reading/language arts in the elementary and middle school grades. We computed the Spearman's correlation of the school ranks from one cohort to the school ranks from each of the other two cohorts within each of the eight school performance models to determine the stability of school ranks. As mentioned in Section A, cohort comparisons are both an indication of changes in the composition of students in the school from one academic year to another as well as any other temporal changes that occur from one year to another including changes in policy, practice, instruction, or other factors that impact student test scores. Table 8 shows the correlation of school ranks across cohorts for mathematics and reading/language arts in the elementary school and middle school samples. As can be seen in Table 8, the correlations generally ranged from small to moderate indicating substantial variability in school ranks from one cohort to another. As would be expected, correlations between adjacent years in the first two columns (cohort 1 with 2 or 2 with 3) were generally somewhat higher than the comparison across two years (cohort 1 with 3). Although there was some variation, results were quite similar from elementary to middle school or from mathematics to reading/language arts.

Table 8

Spearman's Correlations of Model School Ranks for Each Pair of Cohorts by Content Area and Grade Level Band

Model	<u>Elementary Schools</u>					
	<u>Mathematics</u>			<u>Reading/Language Arts</u>		
	1 with 2	2 with 3	1 with 3	1 with 2	2 with 3	1 with 3
PP	0.620	0.613	0.529	0.658	0.659	0.609
MLM0	0.748	0.787	0.693	0.812	0.811	0.787
Gain	0.349	0.262	0.141	0.240	0.247	0.070
TM	0.315	0.255	0.117	0.173	0.116	0.102
SGP	0.406	0.409	0.217	0.354	0.282	0.193
VAM	0.428	0.450	0.235	0.388	0.324	0.215
Grate	0.297	0.195	0.124	0.195	0.120	0.120
AvGrate	0.419	0.512	0.242	0.424	0.384	0.248

<u>Middle Schools</u>						
	<u>Mathematics</u>			<u>Reading/Language Arts</u>		
Model	1 with 2	2 with 3	1 with 3	1 with 2	2 with 3	1 with 3
PP	0.675	0.635	0.511	0.707	0.686	0.684
MLM0	0.754	0.730	0.700	0.837	0.797	0.824
Gain	0.269	0.267	0.167	0.263	0.304	0.281
TM	0.306	0.222	0.171	0.096	0.121	0.086
SGP	0.373	0.418	0.197	0.323	0.243	0.162
VAM	0.402	0.452	0.238	0.295	0.301	0.158
Grate	0.230	0.207	0.169	0.272	0.370	0.373
AvGrate	0.442	0.512	0.201	0.516	0.456	0.261

To facilitate further interpretation, we averaged the results shown in Table 8 across content area and grade level band. As can be seen in Table 9, on average the greatest stability was for the two status models, PP and MLM0. Noticeably lower correlations occurred for the remaining school performance models, all of which were based on more than one year of data, with the least stability for the TM, Grate, and Gain models.

Table 9

Spearman's Correlations of Model School Ranks Averaged across Content Area and Grade Level Band and Overall Mean and Standard Deviation (SD) Across the Three Cohort Comparisons

Model	1 with 2	2 with 3	1 with 3	Mean	SD
PP	0.665	0.648	0.583	0.632	0.044
MLM0	0.788	0.781	0.751	0.773	0.027
Gain	0.280	0.270	0.165	0.238	0.071
TM	0.222	0.178	0.119	0.173	0.056
SGP	0.364	0.338	0.192	0.298	0.097
VAM	0.378	0.382	0.212	0.324	0.100
Grate	0.248	0.223	0.196	0.222	0.055
AvGrate	0.450	0.466	0.238	0.385	0.131

Our second criterion for comparing school ranks was to determine how much a school's rank changed from one cohort to another. Table 10 shows the proportion of schools that were within 5, 10, or 20 ranks in one cohort versus another for each school performance model in mathematics and reading/language arts at each grade level band. The last table entry for each school performance model shows the average differences in school ranks averaged over content area and grade level band. It can be seen that on average for the PP model, about one quarter of the schools differed by only 5 percentile ranks or less, slightly over 40% of schools differed by 10 ranks or less, and slightly more than 60% differed by 20 ranks or less. This also indicates that over a third of schools differed by more than 20 ranks from one cohort to another. The results for the MLM0 model showed slightly greater agreement in school ranks across cohorts. However, the level of agreement in school ranks across cohorts was noticeably lower for all of the remaining models that were based on two or more years of achievement data. For example, school ranks based on the remaining models (Gain, TM, SGP, VAM, Grate, and AvGrate) differed by more than 20 ranks for about 50% or more of the schools.

Table 10

Proportion of Elementary or Middle Schools Within 5, 10, or 20 Ranks of Each Other for each School Performance Model for each Pair of Cohorts in Mathematics and Reading/Language Arts

PP

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.229	0.380	0.642
	2 vs. 3	0.236	0.383	0.617
	1 vs. 3	0.228	0.376	0.589
Reading/Language Arts Elementary	1 vs. 2	0.267	0.437	0.652
	2 vs. 3	0.225	0.389	0.652
	1 vs. 3	0.219	0.387	0.629
Mathematics Middle	1 vs. 2	0.255	0.420	0.646
	2 vs. 3	0.272	0.399	0.638
	1 vs. 3	0.259	0.395	0.580
Reading/Language Arts Middle	1 vs. 2	0.284	0.453	0.741
	2 vs. 3	0.309	0.490	0.700
	1 vs. 3	0.259	0.465	0.695
Mean	1 vs. 2	0.259	0.422	0.670
	2 vs. 3	0.260	0.415	0.652
	1 vs. 3	0.241	0.406	0.623

MLM0

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.289	0.452	0.718
	2 vs. 3	0.309	0.512	0.752
	1 vs. 3	0.262	0.421	0.685
Reading Elementary	1 vs. 2	0.288	0.520	0.773
	2 vs. 3	0.325	0.525	0.783
	1 vs. 3	0.296	0.508	0.724
Mathematics Middle	1 vs. 2	0.292	0.481	0.691
	2 vs. 3	0.267	0.436	0.695
	1 vs. 3	0.272	0.440	0.671
Reading Middle	1 vs. 2	0.354	0.593	0.811
	2 vs. 3	0.374	0.539	0.790
	1 vs. 3	0.342	0.523	0.798
Mean	1 vs. 2	0.306	0.511	0.748
	2 vs. 3	0.319	0.503	0.755
	1 vs. 3	0.293	0.473	0.720

Gain

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.158	0.295	0.487
	2 vs. 3	0.144	0.261	0.467
	1 vs. 3	0.140	0.243	0.422
Reading Elementary	1 vs. 2	0.142	0.250	0.440
	2 vs. 3	0.171	0.283	0.447
	1 vs. 3	0.141	0.233	0.406
Mathematics Middle	1 vs. 2	0.165	0.284	0.453
	2 vs. 3	0.148	0.267	0.486
	1 vs. 3	0.119	0.235	0.412
Reading Middle	1 vs. 2	0.173	0.309	0.486

	2 vs. 3	0.173	0.292	0.498
	1 vs. 3	0.136	0.305	0.490
Mean	1 vs. 2	0.160	0.284	0.466
	2 vs. 3	0.159	0.276	0.475
	1 vs. 3	0.134	0.254	0.432

TM

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.155	0.276	0.500
	2 vs. 3	0.144	0.248	0.459
	1 vs. 3	0.127	0.249	0.452
Reading Elementary	1 vs. 2	0.131	0.233	0.445
	2 vs. 3	0.123	0.235	0.440
	1 vs. 3	0.118	0.212	0.394
Mathematics Middle	1 vs. 2	0.152	0.280	0.494
	2 vs. 3	0.165	0.276	0.490
	1 vs. 3	0.165	0.247	0.432
Reading Middle	1 vs. 2	0.128	0.243	0.432
	2 vs. 3	0.132	0.247	0.477
	1 vs. 3	0.128	0.235	0.383
Mean	1 vs. 2	0.142	0.258	0.468
	2 vs. 3	0.141	0.252	0.466
	1 vs. 3	0.134	0.236	0.415

SGP

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.168	0.285	0.495
	2 vs. 3	0.191	0.299	0.500
	1 vs. 3	0.150	0.256	0.446
Reading Elementary	1 vs. 2	0.179	0.278	0.490

	2 vs. 3	0.149	0.273	0.480
	1 vs. 3	0.151	0.243	0.424
Mathematics Middle	1 vs. 2	0.206	0.321	0.502
	2 vs. 3	0.156	0.313	0.568
	1 vs. 3	0.177	0.259	0.420
Reading Middle	1 vs. 2	0.169	0.305	0.481
	2 vs. 3	0.132	0.272	0.490
	1 vs. 3	0.119	0.276	0.395
Mean	1 vs. 2	0.180	0.297	0.492
	2 vs. 3	0.157	0.289	0.509
	1 vs. 3	0.149	0.258	0.421

VAM

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.172	0.305	0.508
	2 vs. 3	0.168	0.305	0.520
	1 vs. 3	0.147	0.243	0.444
Reading Elementary	1 vs. 2	0.159	0.262	0.498
	2 vs. 3	0.159	0.280	0.480
	1 vs. 3	0.131	0.230	0.419
Mathematics Middle	1 vs. 2	0.198	0.309	0.510
	2 vs. 3	0.218	0.325	0.510
	1 vs. 3	0.140	0.243	0.449
Reading Middle	1 vs. 2	0.169	0.276	0.469
	2 vs. 3	0.152	0.263	0.473
	1 vs. 3	0.169	0.251	0.395
Mean	1 vs. 2	0.174	0.288	0.496
	2 vs. 3	0.174	0.293	0.496
	1 vs. 3	0.147	0.242	0.427

Grate

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.168	0.272	0.467
	2 vs. 3	0.145	0.257	0.452
	1 vs. 3	0.117	0.231	0.394
Reading Elementary	1 vs. 2	0.139	0.255	0.442
	2 vs. 3	0.121	0.224	0.389
	1 vs. 3	0.137	0.240	0.417
Mathematics Middle	1 vs. 2	0.144	0.247	0.465
	2 vs. 3	0.169	0.280	0.420
	1 vs. 3	0.132	0.259	0.416
Reading Middle	1 vs. 2	0.181	0.296	0.502
	2 vs. 3	0.165	0.305	0.531
	1 vs. 3	0.152	0.313	0.473
Mean	1 vs. 2	0.158	0.268	0.469
	2 vs. 3	0.150	0.266	0.448
	1 vs. 3	0.134	0.261	0.425

AvGrate

	Cohort	r = 5	r = 10	r = 20
Mathematics Elementary	1 vs. 2	0.147	0.271	0.507
	2 vs. 3	0.173	0.325	0.561
	1 vs. 3	0.145	0.254	0.457
Reading Elementary	1 vs. 2	0.172	0.295	0.517
	2 vs. 3	0.137	0.265	0.470
	1 vs. 3	0.154	0.255	0.444
Mathematics Middle	1 vs. 2	0.169	0.313	0.490
	2 vs. 3	0.206	0.317	0.543
	1 vs. 3	0.115	0.222	0.370
Reading Middle	1 vs. 2	0.198	0.342	0.568
	2 vs. 3	0.165	0.296	0.539

	1 vs. 3	0.136	0.280	0.490
Mean	1 vs. 2	0.172	0.305	0.520
	2 vs. 3	0.170	0.301	0.528
	1 vs. 3	0.138	0.253	0.440

Our third criterion for comparing school ranks was to calculate the root mean square difference (RMSD) between cohorts or models as defined above in the General Method section. Table 11 shows the RMSD across pairs of cohorts by content area and grade level band for each of the eight school performance models and in the last two columns the mean and standard deviation (SD) across cohort comparisons. As can be seen in the table, the smallest differences in rank were for the MLM0 model, about 17 to 21 ranks on average, followed by the PP model. Average differences in school rank across cohorts for the remaining models ranged from about 31 to 38.

Table 11

RMSD in School Ranks for each Student Cohort for each School Performance Model by Content Area and Grade Level Band

Elementary School Mathematics

Model	1 with 2	2 with 3	1 with 3	Mean	SD
PP	24.884	25.134	27.684	25.901	1.549
MLM0	20.269	18.610	22.355	20.411	1.877
Gain	32.555	34.659	37.401	34.872	2.430
TM	33.382	34.818	37.929	35.376	2.324
SGP	31.076	31.011	35.696	32.594	2.686
VAM	30.527	29.940	35.304	31.924	2.942
Grate	33.823	36.204	37.772	35.933	1.988
AvGrate	30.753	28.179	35.139	31.357	3.519

Elementary School Reading/Language Arts

Model	1 with 2	2 with 3	1 with 3	Mean	SD
PP	23.598	23.592	25.257	24.149	0.960
MLM0	17.507	17.542	18.631	17.893	0.639
Gain	35.183	35.019	38.914	36.372	2.203
TM	36.703	37.928	38.240	37.624	0.812
SGP	32.430	34.189	36.250	34.290	1.912
VAM	31.568	33.183	35.764	33.505	2.116
Grate	36.207	37.847	37.852	37.302	0.948
AvGrate	30.618	31.678	35.001	32.432	2.287

Middle School Mathematics

Model	1 with 2	2 with 3	1 with 3	Mean	SD
PP	22.959	24.334	28.150	25.148	2.689
MLM0	19.945	20.889	22.024	20.953	1.041
Gain	34.406	34.469	36.731	35.202	1.325
TM	33.549	35.508	36.662	35.240	1.574
SGP	31.858	30.695	36.080	32.878	2.834
VAM	31.125	29.782	35.122	32.010	2.778
Grate	35.309	35.846	36.690	35.948	0.696
AvGrate	30.048	28.129	35.970	31.382	4.087

Middle School Reading/Language Arts

Model	1 with 2	2 with 3	1 with 3	Mean	SD
PP	21.787	22.540	22.604	22.310	0.454
MLM0	16.271	18.141	16.903	17.105	0.951
Gain	34.532	33.582	34.127	34.080	0.477
TM	38.265	37.749	38.471	38.162	0.372
SGP	33.096	35.016	36.844	34.985	1.874
VAM	33.787	33.661	36.927	34.792	1.851
Grate	34.337	31.956	31.883	32.725	1.396
AvGrate	28.016	29.695	34.590	30.767	3.416

Comparison of models. We next compared school ranks from one model to another within each of the three cohorts. Comparisons of school ranks within each individual cohort were computed and are presented in Appendix D. We averaged those results by taking the median absolute difference in school ranks over the three cohorts in mathematics and reading/language arts in the elementary and middle school grades. For each pair of school performance models, Table 12 shows the average percentage of schools that were within 5, 10, or 20 percentile ranks in one model versus the other. As can be seen in the table, the PP and MLM0 models ranked schools most similarly, over 50% of schools were within 10 ranks and over 80% were within 20 ranks for these two models. The level of agreement in school ranks was much lower when comparing either the PP or the MLM0 models with any of the other models that examined two or more years of achievement. Generally, either the PP or MLM0 model school rankings agreed with the multiyear models within 20 ranks in from about 40% to 60% of schools.

Agreement of the multiyear models with each other was greater with from about 50% to 90% of models ranking schools within 20 ranks of each other. Some of the lowest agreement in ranks occurred between the average MLM growth rate (AvGrate) rankings and other models, ranging from about 50% to about 70% of school within 20 ranks of each other.

Table 12

Proportion of Elementary or Middle Schools within 5, 10, or 20 Ranks of Each Other for each Pair of School Performance Models in Mathematics and Reading/Language Arts Averaged over Cohorts

Model Comparison:	r = 5	r = 10	r = 20
<u>PP vs. MLM0</u>			
Math Elementary	0.363	0.579	0.835
Reading/Language Arts Elementary	0.370	0.584	0.840
Math Middle	0.354	0.56	0.822
Reading/Language Arts Middle	0.406	0.645	0.875
Mean	0.373	0.592	0.843
<u>PP vs. Gain</u>			
Math Elementary	0.147	0.251	0.441
Reading/Language Arts Elementary	0.110	0.204	0.356
Math Middle	0.178	0.306	0.501
Reading/Language Arts Middle	0.097	0.180	0.326
Mean	0.133	0.235	0.406
<u>PP vs. TM</u>			
Math Elementary	0.160	0.276	0.471
Reading/Language Arts Elementary	0.134	0.244	0.455
Math Middle	0.217	0.357	0.583
Reading/Language Arts Middle	0.178	0.298	0.498
Mean	0.172	0.294	0.502
<u>PP vs. SGP</u>			
Math Elementary	0.184	0.305	0.545
Reading/Language Arts Elementary	0.169	0.309	0.524
Math Middle	0.202	0.339	0.540
Reading/Language Arts Middle	0.167	0.283	0.499
Mean	0.180	0.309	0.527
<u>PP vs. VAM</u>			

Math Elementary	0.183	0.32	0.554
Reading/Language Arts Elementary	0.193	0.332	0.558
Math Middle	0.193	0.325	0.534
Reading/Language Arts Middle	0.150	0.270	0.495
Mean	0.180	0.312	0.535

PP vs. Grate

Math Elementary	0.131	0.237	0.415
Reading/Language Arts Elementary	0.104	0.201	0.361
Math Middle	0.177	0.309	0.505
Reading/Language Arts Middle	0.081	0.143	0.289
Mean	0.123	0.222	0.392

PP vs. AvGrate

Math Elementary	0.158	0.281	0.502
Reading/Language Arts Elementary	0.100	0.188	0.357
Math Middle	0.180	0.307	0.487
Reading/Language Arts Middle	0.095	0.195	0.325
Mean	0.133	0.243	0.418

MLM0 vs. Gain

Math Elementary	0.145	0.262	0.463
Reading/Language Arts Elementary	0.098	0.185	0.348
Math Middle	0.171	0.320	0.527
Reading/Language Arts Middle	0.091	0.170	0.322
Mean	0.126	0.234	0.415

MLM0 vs. TM

Math Elementary	0.144	0.273	0.480
Reading/Language Arts Elementary	0.132	0.237	0.421
Math Middle	0.167	0.320	0.547
Reading/Language Arts Middle	0.151	0.267	0.447
Mean	0.148	0.274	0.474

MLM0 vs. SGP

Math Elementary	0.189	0.345	0.576
Reading/Language Arts Elementary	0.172	0.294	0.509
Math Middle	0.189	0.339	0.554
Reading/Language Arts Middle	0.166	0.270	0.508
Mean	0.179	0.312	0.537

MLM0 vs. VAM

Math Elementary	0.207	0.353	0.595
Reading/Language Arts Elementary	0.175	0.316	0.549
Math Middle	0.196	0.337	0.565
Reading/Language Arts Middle	0.141	0.278	0.514
Mean	0.180	0.321	0.556

MLM0 vs. Grate

Math Elementary	0.124	0.241	0.420
Reading/Language Arts Elementary	0.088	0.181	0.337
Math Middle	0.203	0.342	0.551
Reading/Language Arts Middle	0.082	0.152	0.288
Mean	0.124	0.229	0.399

MLM0 vs. AvGrate

Math Elementary	0.181	0.306	0.523
Reading/Language Arts Elementary	0.099	0.183	0.349
Math Middle	0.181	0.309	0.483
Reading/Language Arts Middle	0.104	0.182	0.332
Mean	0.141	0.245	0.422

Gain vs. TM

Math Elementary	0.404	0.631	0.875
Reading/Language Arts Elementary	0.215	0.361	0.588
Math Middle	0.421	0.636	0.866

Reading/Language Arts Middle	0.232	0.416	0.624
Mean	0.318	0.511	0.738

Gain vs. SGP

Math Elementary	0.357	0.552	0.812
Reading/Language Arts Elementary	0.206	0.341	0.552
Math Middle	0.394	0.616	0.846
Reading/Language Arts Middle	0.251	0.383	0.630
Mean	0.302	0.473	0.710

Gain vs. VAM

Math Elementary	0.356	0.585	0.836
Reading/Language Arts Elementary	0.192	0.334	0.566
Math Middle	0.439	0.649	0.883
Reading/Language Arts Middle	0.222	0.368	0.649
Mean	0.302	0.484	0.734

Gain vs. Grate

Math Elementary	0.583	0.823	0.98
Reading/Language Arts Elementary	0.334	0.524	0.715
Math Middle	0.553	0.816	0.971
Reading/Language Arts Middle	0.468	0.739	0.938
Mean	0.485	0.726	0.901

Gain vs. AvGrate

Math Elementary	0.211	0.371	0.597
Reading/Language Arts Elementary	0.198	0.358	0.571
Math Middle	0.265	0.399	0.626
Reading/Language Arts Middle	0.237	0.373	0.617
Mean	0.228	0.375	0.603

TM vs. SGP

Math Elementary	0.329	0.512	0.782
Reading/Language Arts Elementary	0.256	0.423	0.652

Math Middle	0.335	0.534	0.776
Reading/Language Arts Middle	0.314	0.464	0.716
Mean	0.308	0.483	0.732

TM vs. VAM

Math Elementary	0.327	0.520	0.783
Reading/Language Arts Elementary	0.246	0.401	0.662
Math Middle	0.333	0.538	0.791
Reading/Language Arts Middle	0.270	0.443	0.727
Mean	0.294	0.476	0.741

TM vs. Grate

Math Elementary	0.337	0.544	0.807
Reading/Language Arts Elementary	0.228	0.397	0.656
Math Middle	0.368	0.584	0.822
Reading/Language Arts Middle	0.203	0.347	0.553
Mean	0.284	0.468	0.710

TM vs. AvGrate

Math Elementary	0.201	0.356	0.575
Reading/Language Arts Elementary	0.166	0.292	0.487
Math Middle	0.225	0.383	0.597
Reading/Language Arts Middle	0.163	0.298	0.498
Mean	0.189	0.332	0.539

SGP vs. VAM

Math Elementary	0.575	0.822	0.974
Reading/Language Arts Elementary	0.430	0.679	0.907
Math Middle	0.598	0.833	0.974
Reading/Language Arts Middle	0.425	0.700	0.920
Mean	0.507	0.758	0.944

SGP vs. Grate

Math Elementary	0.256	0.439	0.678
Reading/Language Arts Elementary	0.188	0.329	0.552
Math Middle	0.316	0.464	0.723
Reading/Language Arts Middle	0.177	0.298	0.506
Mean	0.234	0.382	0.615

SGP vs. AvGrate

Math Elementary	0.317	0.526	0.770
Reading/Language Arts Elementary	0.216	0.360	0.582
Math Middle	0.337	0.556	0.807
Reading/Language Arts Middle	0.222	0.369	0.615
Mean	0.273	0.453	0.694

VAM vs. Grate

Math Elementary	0.267	0.440	0.689
Reading/Language Arts Elementary	0.210	0.355	0.573
Math Middle	0.311	0.497	0.745
Reading/Language Arts Middle	0.181	0.331	0.539
Mean	0.242	0.406	0.636

Grate vs. AvGrate

Math Elementary	0.169	0.288	0.501
Reading/Language Arts Elementary	0.138	0.256	0.438
Math Middle	0.204	0.329	0.517
Reading/Language Arts Middle	0.191	0.337	0.551
Mean	0.176	0.302	0.502

Our last criterion for comparing school ranks across cohorts was the RMSD between pairs of school performance model rankings. Appendix E shows the RMSD between pairs of school performance model rankings for each individual cohort. Table 13 shows the RMSD averaged over the three cohorts by content area and grade level band. The RMSD values reflect the same patterns of results for models as described previously. The greatest agreement in average ranks was between the PP and MLM0 models for which schools differed by about 16 ranks or less on average. Much larger differences (about 30 ranks or more on average) occurred between the PP and MLM0 versus the other school performance models. Agreement in school ranks between the remaining models was generally greater, in the range of 10 to 20 ranks on

average, although differences were somewhat larger between the AvGrate ranks and school ranks based on other models.

Table 13

Average across Cohorts of RMSD in School Ranks between School Performance Models by Content Area and Grade Level Band

Elementary School Mathematics

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	14.868	34.971	33.024	29.202	28.273	36.925	32.098
MLM0		34.243	33.067	27.245	26.140	36.416	30.701
Gain			13.260	15.971	14.623	7.943	26.889
TM				17.755	17.273	15.952	27.520
SGP					8.322	21.691	18.523
VAM						21.036	16.848
Grate							32.773

Elementary School Reading/Language Arts

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	14.712	41.170	34.889	30.196	28.243	40.873	41.440
MLM0		42.355	36.270	30.064	28.287	42.658	42.537
Gain			29.216	28.802	27.719	23.478	27.504
TM				22.765	22.238	23.411	31.715
SGP					11.868	28.201	26.374
VAM						27.033	25.169
Grate							34.942

Middle School Mathematics

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	16.219	30.145	26.924	28.58	28.258	30.096	32.242
MLM0		28.676	27.745	27.155	26.782	28.209	31.953
Gain			14.457	14.683	12.932	8.326	24.913

TM	18.225	17.644	15.777	26.607
SGP		8.330	20.216	16.257
VAM			19.246	14.308
Grate				30.695

Middle School Reading/Language Arts

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	13.470	43.525	33.005	31.943	31.717	46.231	43.532
MLM0		45.499	35.079	32.500	32.284	47.907	44.730
Gain			23.929	24.510	23.046	10.437	25.334
TM				21.508	20.289	27.575	31.313
SGP					11.374	30.572	25.692
VAM						29.257	23.367
Grate							30.083

We also evaluated the extent to which school ranks agreed from one content area to the other. Table 14 shows the Spearman's correlation of school ranks in mathematics with school ranks in reading/language arts by cohort and grade level band. The table also shows the mean correlation across cohorts at the two grade level bands. As can be seen in Table 14, on average correlations of school ranks across mathematics and reading/language arts in elementary schools ranged from +.301 to +.839 for the different school performance models. For middle schools, the average correlations ranged from +.160 to +.759. Correlations were higher for the two status models, and lower for the multiyear models at both grade level bands. Generally, correlations across content were lower for the other models. Average correlations at the middle school level were also consistently lower than for elementary schools for all models.

Table 14

Spearman's Correlations of School Performance Model Estimates across Mathematics and Reading/Language Arts by Cohort

Elementary Schools					Middle Schools			
Model	Cohort 1	Cohort 2	Cohort 3	Mean	Cohort 1	Cohort 2	Cohort 3	Mean
PP	0.781	0.755	0.755	0.764	0.716	0.693	0.659	0.689
MLM0	0.855	0.840	0.823	0.839	0.789	0.735	0.754	0.759
Gain	0.550	0.465	-0.112	0.301	0.243	0.282	0.232	0.252
TM	0.443	0.396	0.383	0.407	0.245	0.310	0.344	0.300
SGP	0.550	0.476	0.521	0.516	0.401	0.347	0.377	0.375

VAM	0.576	0.546	0.569	0.564	0.440	0.364	0.457	0.420
Grate	0.572	0.441	0.356	0.456	0.173	0.186	0.122	0.160
AvGrate	0.529	0.579	0.515	0.541	0.417	0.450	0.427	0.431

Table 15 shows the proportion of schools that shared similar ranks in mathematics as in reading/language arts for each school performance model by school level and averaged over grade level band. Similar to results previously described, Table 15 shows greater agreement for the PP and MLM0 models than the other school performance models with about 70% or more of the schools having ranks within 20 places across grade level bands. In contrast, there was substantially less agreement across the two content areas for the remaining, multiyear models with only approximately 50% of schools agreeing within 20 ranks for most models in either grade level band.

Table 15

Proportion of Elementary or Middle Schools within 5, 10, or 20 Ranks of Each Other in Mathematics versus Reading/Language Arts for each School Performance Model Averaged over Cohorts

Model Comparison	r = 5	r = 10	r = 20
<u>PP</u>			
Elementary	0.316	0.500	0.741
Middle	0.270	0.440	0.675
Mean	0.293	0.470	0.708
<u>MLM0</u>			
Elementary	0.339	0.547	0.805
Middle	0.287	0.473	0.741
Mean	0.313	0.510	0.773
<u>Gain</u>			
Elementary	0.144	0.276	0.493
Middle	0.150	0.278	0.481
Mean	0.147	0.277	0.487
<u>TM</u>			
Elementary	0.161	0.295	0.521
Middle	0.143	0.284	0.499
Mean	0.152	0.290	0.510
<u>SGP</u>			
Elementary	0.198	0.340	0.556
Middle	0.166	0.274	0.490
Mean	0.182	0.307	0.523

VAM

Elementary	0.197	0.351	0.573
Middle	0.162	0.292	0.495
Mean	0.180	0.322	0.534

Grate

Elementary	0.172	0.316	0.532
Middle	0.132	0.239	0.460
Mean	0.152	0.277	0.496

AvGrate

Elementary	0.190	0.339	0.564
Middle	0.176	0.291	0.538
Mean	0.183	0.315	0.551

Calculation of the RMSD in school ranks for mathematics versus reading/language arts by cohort and grade level band and averaged over cohorts showed similar results (see Table 16). The difference in school ranks averaged over cohorts for the PP and MLM0 models ranged from about 16 to 22. Average differences in rank across the two content areas were substantially greater for the remaining models ranging from 20 to 37 depending on model and grade level band.

Table 16

RMSD in School Ranks for Mathematics and Reading/Language Arts by Cohort and Grade Level Band and Overall Means and Standard Deviations (SD)

Model	Elementary Schools				Middle Schools			
	Cohort 1	Cohort 2	Cohort 3	Mean	Cohort 1	Cohort 2	Cohort 3	Mean
PP	18.842	19.929	19.925	19.565	21.421	22.277	23.507	22.402
MLM0	15.348	16.091	16.953	16.131	18.494	20.713	19.947	19.718
Gain	27.018	29.447	42.488	32.984	35.015	34.106	35.280	34.800
TM	30.044	31.282	31.667	30.998	34.945	33.477	32.626	33.683
SGP	27.007	29.155	27.882	28.015	31.148	32.517	31.749	31.805
VAM	26.227	27.137	26.445	26.603	30.117	32.090	29.670	30.626
Grate	26.340	30.094	32.333	29.589	36.600	36.302	37.713	36.872
AvGrate	27.646	26.131	28.034	27.270	30.718	29.842	30.472	30.344

Relation with school composition variables. We computed the correlation of school ranks based on each school performance model with school composition variables to determine whether estimates were related to the aggregated student characteristics in each school. Table 17 shows these correlations for mathematics and reading/language arts in the elementary school and middle school samples. Correlations of model estimates with school composition variables

within each individual cohort are presented in Appendix F. The rightmost column of Table 17 shows the correlation of each school performance model averaged over all of the school composition variables. As can be seen, correlations of the status models, PP and MLM0, ranged from -.153 to -.284 depending on content and grade level band and were noticeably higher than the correlations of the other school performance models with school composition variables, which ranged from -.010 to +.181 depending on content and grade level band.

Table 17

Spearman's Correlations of School Ranks with School Composition Variables by Content Area and Grade Level Band

Elementary School Mathematics

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.526	-0.323	-0.205	0.001	-0.282	0.123	-0.202
MLM0	-0.616	-0.301	-0.184	-0.009	-0.272	0.213	-0.195
Gain	-0.015	0.053	0.008	-0.003	0.022	0.114	0.030
TM	-0.053	0.020	-0.011	-0.011	-0.012	0.102	0.006
SGP	-0.159	-0.013	-0.039	-0.005	-0.014	0.172	-0.010
VAM	-0.183	-0.017	-0.053	0.013	-0.025	0.188	-0.013
Grate	-0.006	0.034	0.025	-0.011	-0.002	0.071	0.018
AvGrate	-0.029	0.086	-0.027	0.038	0.081	0.173	0.054

Elementary School Reading/Language Arts

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.610	-0.491	-0.201	0.002	-0.426	0.040	-0.281
MLM0	-0.722	-0.480	-0.181	-0.004	-0.437	0.123	-0.284
Gain	0.153	0.174	0.083	-0.027	0.134	0.060	0.096
TM	-0.085	0.031	0.039	-0.026	0.018	0.089	0.011
SGP	-0.225	-0.062	-0.043	0.001	-0.083	0.112	-0.050
VAM	-0.264	-0.095	-0.049	0.006	-0.110	0.126	-0.064
Grate	0.139	0.116	0.058	0.000	0.089	0.007	0.068
AvGrate	0.224	0.273	0.060	0.005	0.202	0.054	0.136

Middle School Mathematics

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.385	-0.211	-0.266	0.040	-0.213	0.119	-0.153

MLM0	-0.488	-0.149	-0.178	0.005	-0.141	0.203	-0.125
Gain	-0.034	0.045	-0.013	-0.013	0.058	0.147	0.032
TM	-0.094	0.008	-0.070	-0.010	0.004	0.158	-0.001
SGP	-0.015	0.085	-0.016	0.000	0.081	0.173	0.051
VAM	-0.011	0.074	-0.023	0.002	0.074	0.168	0.047
Grate	-0.112	-0.008	-0.037	-0.020	0.017	0.134	-0.004
AvGrate	0.119	0.134	0.002	0.019	0.112	0.130	0.086

Middle School Reading/Language Arts

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.559	-0.385	-0.272	0.133	-0.401	0.053	-0.239
MLM0	-0.687	-0.369	-0.241	0.108	-0.394	0.105	-0.246
Gain	0.338	0.227	0.136	-0.021	0.192	0.030	0.150
TM	-0.031	0.029	0.017	0.043	-0.002	0.137	0.032
SGP	-0.075	0.027	-0.021	0.051	-0.019	0.119	0.014
VAM	-0.055	0.034	-0.019	0.039	-0.030	0.103	0.012
Grate	0.381	0.238	0.165	-0.055	0.207	0.009	0.158
AvGrate	0.398	0.311	0.132	-0.022	0.227	0.038	0.181

Relation of school ranks with SWD school composition. We also specifically examined the relations between the percentage of SWD students served by a school and the school ranks based on the school performance model. Table 18 shows these correlations for mathematics and reading/language arts in the elementary school and middle school samples averaged over cohorts. Correlations of model estimates with SWD school composition within each individual cohort are presented in Appendix G. As can be seen in the bottom row of Table 18, on average, there was a substantially higher correlation of the status models (PP and MLM0) with school SWD composition than the other school performance models. With the PP and MLM0 models, school ranks were higher with lower percentages of SWD students in the school and school ranks were lower as schools served larger proportions of SWD. Little relation was present between school ranks based on the other models and SWD school composition.

Table 18

Average School Rank as a Function of the Percentage of SWD in the School by Model, Content Area, and Grade Level Band

Content Area and Grade Level Band	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
Math Elementary	-0.205	-0.184	0.008	-0.011	-0.039	-0.053	0.025	-0.027
Reading/Language Arts Elementary	-0.201	-0.181	0.083	0.039	-0.043	-0.049	0.058	0.060

Math Middle	-0.266	-0.178	-0.013	-0.070	-0.016	-0.023	-0.037	0.002
Reading/Language Arts Middle	-0.272	-0.241	0.136	0.017	-0.021	-0.019	0.165	0.132
Mean	-0.236	-0.196	0.054	-0.006	-0.030	-0.036	0.053	0.042

Summary of Section B. We evaluated the school ranks arising from eight alternative models for estimating school academic performance in mathematics and reading/language arts across three sequential cohorts of students. As with the school performance estimates described in Section A, substantial variability in school ranks was present across the three student cohorts regardless of content area or grade level band. Using any of our comparison criteria (Spearman's correlations, absolute difference in ranks, RMSD), there was somewhat less variability across cohorts for status models (PP and MLM0) than for the models that used more than one year of data. When we compared school ranks arising from one model to school ranks from other models, we found substantial disagreement across models. Generally, the PP and MLM0 status models were more similar to each other and both differed from the remaining models that examined more than one year of data. Comparison of model estimates to school composition variables showed that the status models (PP and MLM0) had substantially higher correlations than the remaining school performance models. Finally, we correlated school ranks arising from the eight performance models with the percentage of SWD in each school. As with the school performance model estimates, we found that the status models were more highly correlated with SWD school composition but there was little relation of the other model estimates with the percentage of SWD students in the school.

Conclusion

This technical report described the Oregon results of a large study examining eight alternative methods of estimating school performance. We represented school performance in two ways, the actual model estimates and school ranks based on model estimates. In addition to this Oregon report, there are additional reports describing results for the three other states (AZ, NC, PA) included in the study that are available at www.ncaase.com.

A number of general conclusions can be drawn from the results of the Oregon analyses. First, model representations of school performance over successive cohorts of students were very unstable, irrespective of whether representations were based on school performance model estimates or on school ranks. There was somewhat greater stability over cohorts for status models (PP, MLM0) than for the multiyear models. Nonetheless, even with the most stable model, MLM0, Spearman's correlations showed that less than two-thirds of the variance was common across cohorts, and over all the models, there was substantial instability over cohorts. These results were also reflected in the examination of differences in absolute or average (RMSD) differences in ranks over cohorts.

Our examination of the relations of the school performance models with each other produced similar results. Generally, there was agreement between the two status model estimates (PP and MLM0) that were based on a single year of data, but these two models did not agree with the remaining multiyear models. However, there was some substantial agreement of the multiyear models with each other with some variations. In general, the AvGrate model showed the least agreement with the other multiyear models.

We also examined the relation of school performance model estimates with variables describing the student composition of the schools. These results showed a pattern of results that differed between the status and the multiyear models. The two status models had substantially higher correlations with school composition variables than the multiyear models. This was also true in terms of the percentage of SWD students served by a school. The higher the percentage of SWD in the school, the lower the status model estimates of school performance.

Thus, the Oregon results showed consistent patterns of instability of estimates of school performance over successive cohorts of students, different estimates of school performance depending on the model chosen, especially for status versus multiyear models, and stronger relations of status models with the student composition of the school than multiyear models. Taken together, these results suggest the need for substantial caution in the way that school performance models are used and interpreted. Cohort instability suggests that rolling averages or some other mechanism is needed to provide more dependable depictions of school performance that are more stable over time. The substantial disagreement among the school performance models suggests that the choice of model matters a great deal. This choice should be made very carefully. A single model estimate of school performance may not be trustworthy and may need to be augmented by the results from additional models or metrics of school performance.

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Appendix A

Correlations among School Performance Model Estimates for Each Individual Cohort by Content Area and Grade Level Band.

Mathematics Elementary Schools

Cohort 1

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.805	0.150	0.295	0.465	0.473	0.049	0.254
MLM0			0.129	0.236	0.521	0.567	0.003	0.336
Gain				0.887	0.816	0.832	0.952	0.515
TM					0.792	0.796	0.827	0.496
SGP						0.956	0.659	0.756
VAM							0.665	0.800
Grate								0.253

Cohort 2

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.832	0.364	0.375	0.527	0.542	0.296	0.426
MLM0			0.372	0.313	0.546	0.584	0.321	0.421
Gain				0.901	0.892	0.916	0.970	0.691
TM					0.826	0.826	0.865	0.640
SGP						0.961	0.800	0.851
VAM							0.822	0.890
Grate								0.520

Cohort 3

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.842	0.268	0.405	0.494	0.534	0.161	0.469
MLM0			0.328	0.400	0.583	0.625	0.214	0.520
Gain				0.893	0.838	0.868	0.959	0.512

TM	0.817	0.820	0.838	0.511
SGP		0.955	0.692	0.803
VAM			0.719	0.840
Grate				0.267
AvGrate				

Mathematics Middle Schools

Cohort 1

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.770	0.360	0.530	0.435	0.421	0.306	0.287
MLM0			0.383	0.389	0.460	0.520	0.342	0.372
Gain				0.845	0.839	0.878	0.932	0.500
TM					0.719	0.705	0.781	0.366
SGP						0.931	0.671	0.780
VAM							0.723	0.833
Grate								0.229

Cohort 2

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.796	0.425	0.523	0.535	0.512	0.393	0.354
MLM0			0.378	0.409	0.481	0.500	0.388	0.287
Gain				0.889	0.897	0.913	0.957	0.669
TM					0.844	0.844	0.840	0.640
SGP						0.953	0.783	0.841
VAM							0.818	0.886
Grate								0.484

Cohort 3

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.790	0.583	0.662	0.568	0.591	0.594	0.502

MLM0	0.638	0.616	0.596	0.620	0.706	0.457
Gain		0.927	0.904	0.936	0.965	0.759
TM			0.870	0.877	0.887	0.726
SGP				0.962	0.832	0.901
VAM					0.868	0.932
Grate						0.630

Reading/Language Arts Elementary Schools

Cohort 1

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.828	-0.012	0.276	0.466	0.547	-0.152	-0.099
MLM0			-0.184	0.208	0.455	0.522	-0.302	-0.232
Gain				0.718	0.651	0.670	0.907	0.504
TM					0.722	0.721	0.593	0.345
SGP						0.917	0.409	0.501
VAM							0.435	0.529
Grate								0.213

Cohort 2

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.838	0.071	0.200	0.432	0.497	-0.008	0.023
MLM0			-0.028	0.124	0.441	0.509	-0.102	-0.037
Gain				0.769	0.727	0.766	0.931	0.534
TM					0.673	0.684	0.685	0.456
SGP						0.914	0.571	0.642
VAM							0.605	0.696
Grate								0.286

<u>Cohort 3</u>								
Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.865	-0.104	0.303	0.445	0.512	0.122	-0.055
MLM0			-0.108	0.254	0.438	0.502	0.044	-0.139
Gain				-0.219	0.065	0.060	-0.512	0.626
TM					0.732	0.743	0.738	0.418
SGP						0.909	0.624	0.618
VAM							0.689	0.662
Grate								0.322

Reading/Language Arts Middle Schools

Cohort 1

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.851	-0.197	0.383	0.390	0.347	-0.357	-0.192
MLM0			-0.352	0.227	0.324	0.291	-0.501	-0.321
Gain				0.624	0.646	0.690	0.916	0.616
TM					0.730	0.715	0.470	0.351
SGP						0.897	0.417	0.567
VAM							0.509	0.685
Grate								0.468

Cohort 2

Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.827	-0.106	0.342	0.401	0.392	-0.303	-0.248
MLM0			-0.329	0.146	0.291	0.349	-0.462	-0.381
Gain				0.706	0.647	0.649	0.891	0.549
TM					0.683	0.657	0.517	0.277
SGP						0.880	0.368	0.542

VAM							0.439	0.584
Grate								0.354
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<u>Cohort 3</u>								
Model	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP		0.880	-0.113	0.357	0.393	0.457	-0.262	0.010
MLM0			-0.208	0.306	0.412	0.462	-0.351	-0.048
Gain				0.705	0.689	0.686	0.942	0.642
TM					0.783	0.786	0.592	0.524
SGP						0.913	0.528	0.685
VAM							0.549	0.776
Grate								0.534
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Appendix B

Correlations of School Performance Model Estimates with School Composition Variables for each Individual Cohort by Content Area and Grade Level Band.

Mathematics Elementary Schools

Cohort 1

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.457	-0.333	-0.201	-0.017	-0.315	0.148
MLM0	-0.603	-0.348	-0.194	-0.058	-0.315	0.242
Gain	0.102	0.156	0.081	-0.022	0.099	0.164
TM	0.000	0.113	0.006	-0.015	0.043	0.174
SGP	-0.132	0.028	-0.033	-0.062	0.005	0.248
VAM	-0.156	0.020	-0.029	-0.033	-0.001	0.270
Grate	0.117	0.151	0.099	-0.009	0.076	0.110
AvGrate	0.025	0.141	-0.014	-0.010	0.149	0.223

Cohort 2

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.507	-0.319	-0.209	0.075	-0.291	0.181
MLM0	-0.636	-0.344	-0.223	0.025	-0.293	0.238
Gain	-0.039	0.080	0.019	0.023	0.027	0.093
TM	-0.001	0.108	-0.012	0.046	0.042	0.093
SGP	-0.122	0.026	-0.014	0.031	-0.001	0.142
VAM	-0.146	0.029	-0.041	0.045	0.000	0.170
Grate	-0.052	0.051	0.019	0.017	-0.005	0.063
AvGrate	0.006	0.128	-0.011	0.058	0.106	0.166

Cohort 3

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.536	-0.334	-0.172	-0.021	-0.351	0.111
MLM0	-0.638	-0.327	-0.167	-0.004	-0.288	0.203
Gain	-0.109	-0.080	-0.049	-0.009	-0.064	0.039
TM	-0.173	-0.126	-0.041	-0.049	-0.119	0.025
SGP	-0.219	-0.102	-0.060	0.003	-0.088	0.122
VAM	-0.239	-0.120	-0.086	0.005	-0.104	0.120
Grate	-0.104	-0.105	-0.031	-0.028	-0.080	0.013

AvGrate	-0.092	0.000	-0.058	0.033	-0.007	0.121
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Mathematics Middle Schools

Cohort 1

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.362	-0.198	-0.248	-0.013	-0.309	0.166
MLM0	-0.461	-0.189	-0.169	-0.078	-0.204	0.212
Gain	-0.050	0.116	-0.016	-0.021	0.112	0.156
TM	-0.076	0.117	-0.132	0.011	0.024	0.227
SGP	-0.005	0.130	0.039	-0.009	0.103	0.165
VAM	-0.031	0.118	0.024	-0.038	0.089	0.188
Grate	-0.109	0.055	-0.038	-0.054	0.068	0.135
AvGrate	0.101	0.154	0.089	-0.006	0.094	0.144

Cohort 2

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.331	-0.234	-0.275	0.084	-0.313	0.137
MLM0	-0.472	-0.258	-0.180	0.096	-0.210	0.221
Gain	0.039	-0.018	-0.058	0.032	-0.040	0.065
TM	-0.015	-0.055	-0.099	0.035	-0.084	0.090
SGP	0.011	0.008	-0.084	0.015	-0.046	0.128
VAM	0.024	0.023	-0.050	0.026	-0.006	0.143
Grate	-0.025	-0.082	-0.059	0.029	-0.081	0.049
AvGrate	0.166	0.157	0.009	-0.003	0.096	0.142

Cohort 3

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.296	-0.254	-0.278	0.082	-0.175	0.205
MLM0	-0.464	-0.249	-0.187	0.010	-0.137	0.275
Gain	-0.016	-0.047	-0.137	0.080	0.097	0.198
TM	-0.049	-0.064	-0.124	0.065	0.076	0.181
SGP	0.008	-0.003	-0.102	0.073	0.121	0.223
VAM	0.024	-0.005	-0.118	0.073	0.104	0.211
Grate	-0.137	-0.107	-0.126	0.057	0.009	0.229
AvGrate	0.133	0.072	-0.096	0.070	0.151	0.165

Reading/Language Arts Elementary SchoolsCohort 1

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.539	-0.530	-0.174	-0.035	-0.488	0.073
MLM0	-0.671	-0.511	-0.187	-0.025	-0.464	0.153
Gain	0.212	0.201	0.130	0.001	0.122	0.086
TM	-0.080	0.049	0.081	-0.033	-0.012	0.156
SGP	-0.187	-0.055	-0.021	0.001	-0.111	0.174
VAM	-0.265	-0.124	-0.034	-0.007	-0.176	0.187
Grate	0.251	0.198	0.136	0.023	0.123	0.061
AvGrate	0.253	0.320	0.065	0.006	0.232	0.044

Cohort 2

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.610	-0.506	-0.255	0.013	-0.472	0.078
MLM0	-0.747	-0.530	-0.240	0.013	-0.475	0.145
Gain	0.100	0.175	0.019	-0.002	0.110	0.054
TM	-0.045	0.101	0.025	-0.005	0.046	0.084
SGP	-0.227	-0.051	-0.083	-0.008	-0.097	0.127
VAM	-0.271	-0.077	-0.106	0.005	-0.116	0.151
Grate	0.119	0.152	0.035	0.000	0.101	0.004
AvGrate	0.184	0.272	0.026	-0.002	0.190	0.105

Cohort 3

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.651	-0.542	-0.184	0.029	-0.516	0.040
MLM0	-0.757	-0.537	-0.139	0.015	-0.492	0.099
Gain	0.163	0.175	0.079	-0.071	0.120	0.060
TM	-0.091	0.004	0.000	0.046	-0.010	0.011
SGP	-0.215	-0.078	-0.019	-0.002	-0.108	0.029
VAM	-0.239	-0.129	-0.037	0.027	-0.130	0.038
Grate	0.057	0.041	-0.009	0.046	0.047	-0.050
AvGrate	0.275	0.264	0.080	-0.010	0.209	0.008

Reading/Language Arts Middle SchoolsCohort 1

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.505	-0.412	-0.342	0.197	-0.496	0.104
MLM0	-0.628	-0.440	-0.253	0.109	-0.452	0.113
Gain	0.312	0.259	0.127	-0.006	0.197	0.017
TM	-0.005	0.031	-0.032	0.086	-0.082	0.103
SGP	-0.054	0.054	-0.041	0.065	-0.097	0.129
VAM	-0.017	0.055	-0.042	0.013	-0.058	0.138
Grate	0.369	0.290	0.163	-0.061	0.236	-0.005
AvGrate	0.412	0.360	0.102	-0.067	0.249	0.074

Cohort 2

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.501	-0.451	-0.197	0.135	-0.510	0.031
MLM0	-0.668	-0.498	-0.192	0.162	-0.483	0.079
Gain	0.359	0.280	0.083	-0.053	0.187	-0.023
TM	0.032	0.050	0.063	0.014	-0.032	0.042
SGP	-0.007	0.033	0.033	0.008	-0.036	0.093
VAM	-0.033	-0.002	-0.023	0.055	-0.087	0.064
Grate	0.369	0.257	0.102	-0.057	0.178	-0.058
AvGrate	0.483	0.403	0.133	-0.082	0.331	0.039

Cohort 3

Model	EDS	EL	SWD	Female	Minority	School Size
PP	-0.569	-0.468	-0.251	0.072	-0.438	0.129
MLM0	-0.693	-0.439	-0.205	0.087	-0.433	0.134
Gain	0.306	0.175	0.065	-0.018	0.294	0.099
TM	-0.090	-0.078	-0.033	0.007	0.031	0.191
SGP	-0.128	-0.038	-0.097	0.096	-0.009	0.163
VAM	-0.124	-0.048	-0.048	0.053	-0.028	0.162
Grate	0.357	0.219	0.113	-0.044	0.292	0.085
AvGrate	0.287	0.254	0.060	0.033	0.195	0.058

Appendix C

Correlations of School Performance Model Estimates with School Percentage SWD for each Individual Cohort by Content Area and Grade Level Band.

Mathematics Elementary Schools

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.201	-0.194	0.081	0.006	-0.033	-0.029	0.099	-0.014
2	-0.209	-0.223	0.019	-0.012	-0.014	-0.041	0.019	-0.011
3	-0.172	-0.167	-0.049	-0.041	-0.060	-0.086	-0.031	-0.058

Mathematics Middle Schools

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.248	-0.169	-0.016	-0.132	0.039	0.024	-0.038	0.089
2	-0.275	-0.180	-0.058	-0.099	-0.084	-0.050	-0.059	0.009
3	-0.278	-0.187	-0.137	-0.124	-0.102	-0.118	-0.126	-0.096

Reading/Language Arts Elementary Schools

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.174	-0.187	0.130	0.081	-0.021	-0.034	0.136	0.065
2	-0.255	-0.240	0.019	0.025	-0.083	-0.106	0.035	0.026
3	-0.184	-0.139	0.079	0.000	-0.019	-0.037	-0.009	0.080

Reading/Language Arts Middle Schools

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.342	-0.253	0.127	-0.032	-0.041	-0.042	0.163	0.102
2	-0.197	-0.192	0.083	0.063	0.033	-0.023	0.102	0.133
3	-0.251	-0.205	0.065	-0.033	-0.097	-0.048	0.113	0.060

Appendix D

Proportion of Elementary or Middle Schools within 5, 10, or 20 Ranks of Each Other for each Pair of School Performance Models in Mathematics and Reading/Language Arts by Cohort.

Model Comparison	Cohort 1			Cohort 2			Cohort 3		
	r = 5	r = 10	r = 20	r = 5	r = 10	r = 20	r = 5	r = 10	r = 20
<u>PP vs. MLM0</u>									
Math Elementary	0.315	0.536	0.835	0.401	0.594	0.838	0.373	0.606	0.832
Reading/Language Arts Elementary	0.366	0.563	0.823	0.341	0.581	0.834	0.404	0.609	0.863
Math Middle	0.370	0.560	0.819	0.342	0.605	0.844	0.350	0.514	0.802
Reading/Language Arts Middle	0.428	0.663	0.881	0.387	0.617	0.848	0.403	0.654	0.897
Mean	0.370	0.580	0.839	0.368	0.599	0.841	0.382	0.596	0.848
<u>PP vs. Gain</u>									
Math Elementary	0.149	0.236	0.421	0.150	0.276	0.472	0.144	0.243	0.431
Reading/Language Arts Elementary	0.109	0.199	0.359	0.121	0.209	0.371	0.101	0.204	0.338
Math Middle	0.119	0.243	0.428	0.206	0.333	0.490	0.210	0.342	0.584
Reading/Language Arts Middle	0.107	0.177	0.342	0.099	0.181	0.317	0.086	0.181	0.321
Mean	0.121	0.214	0.388	0.144	0.250	0.412	0.135	0.242	0.418
<u>PP vs. TM</u>									
Math Elementary	0.160	0.257	0.469	0.165	0.285	0.470	0.155	0.284	0.474
Reading/Language Arts Elementary	0.132	0.257	0.469	0.129	0.215	0.427	0.139	0.260	0.470

Math Middle	0.169	0.317	0.551	0.210	0.379	0.580	0.272	0.374	0.617
Reading/Language Arts Middle	0.144	0.300	0.481	0.181	0.276	0.490	0.210	0.317	0.523
Mean	0.151	0.283	0.492	0.171	0.289	0.492	0.194	0.309	0.521

PP vs. SGP

Math Elementary	0.178	0.305	0.525	0.205	0.309	0.548	0.168	0.302	0.561
Reading/Language Arts Elementary	0.180	0.315	0.538	0.137	0.275	0.492	0.189	0.338	0.543
Math Middle	0.177	0.296	0.502	0.214	0.362	0.551	0.214	0.358	0.568
Reading/Language Arts Middle	0.202	0.292	0.506	0.140	0.280	0.465	0.160	0.276	0.527
Mean	0.184	0.302	0.518	0.174	0.306	0.514	0.183	0.318	0.550

PP vs. VAM

Math Elementary	0.186	0.318	0.540	0.186	0.318	0.554	0.175	0.323	0.569
Reading/Language Arts Elementary	0.194	0.344	0.588	0.171	0.291	0.520	0.215	0.359	0.566
Math Middle	0.173	0.28	0.486	0.214	0.354	0.535	0.193	0.342	0.580
Reading/Language Arts Middle	0.160	0.288	0.481	0.128	0.23	0.510	0.160	0.292	0.494
Mean	0.178	0.308	0.524	0.175	0.298	0.530	0.186	0.329	0.552

PP vs. Grate

Math Elementary	0.132	0.231	0.388	0.137	0.256	0.460	0.124	0.223	0.396
Reading/Language Arts Elementary	0.089	0.174	0.333	0.096	0.199	0.351	0.127	0.232	0.399
Math Middle	0.107	0.226	0.449	0.181	0.305	0.473	0.243	0.395	0.593
Reading/Language Arts Middle	0.070	0.119	0.263	0.103	0.165	0.280	0.070	0.144	0.325

Mean	0.100	0.188	0.358	0.129	0.231	0.391	0.141	0.248	0.428
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PP vs. AvGrate

Math Elementary	0.167	0.269	0.485	0.153	0.285	0.518	0.153	0.289	0.503
Reading/Language Arts Elementary	0.086	0.180	0.373	0.114	0.202	0.348	0.099	0.182	0.349
Math Middle	0.152	0.288	0.453	0.189	0.321	0.481	0.198	0.313	0.527
Reading/Language Arts Middle	0.082	0.193	0.296	0.103	0.169	0.296	0.099	0.222	0.383
Mean	0.122	0.232	0.402	0.140	0.244	0.411	0.137	0.252	0.440

MLM0 vs. Gain

Math Elementary	0.119	0.243	0.436	0.162	0.287	0.482	0.153	0.257	0.472
Reading/Language Arts Elementary	0.083	0.161	0.321	0.099	0.169	0.343	0.113	0.227	0.381
Math Middle	0.152	0.284	0.457	0.144	0.309	0.502	0.218	0.366	0.621
Reading/Language Arts Middle	0.095	0.169	0.329	0.078	0.169	0.288	0.099	0.173	0.350
Mean	0.112	0.214	0.386	0.121	0.233	0.404	0.146	0.256	0.456

MLM0 vs. TM

Math Elementary	0.145	0.269	0.480	0.137	0.269	0.474	0.150	0.281	0.487
Reading/Language Arts Elementary	0.134	0.238	0.406	0.121	0.222	0.394	0.141	0.250	0.462
Math Middle	0.152	0.317	0.523	0.123	0.267	0.506	0.226	0.374	0.613
Reading/Language Arts Middle	0.107	0.235	0.416	0.152	0.251	0.420	0.193	0.317	0.506
Mean	0.134	0.265	0.456	0.133	0.252	0.448	0.178	0.306	0.517

<u>MLM0 vs. SGP</u>									
Math Elementary	0.188	0.342	0.569	0.191	0.343	0.571	0.186	0.350	0.587
Reading/Language Arts Elementary	0.184	0.311	0.538	0.164	0.278	0.464	0.169	0.291	0.525
Math Middle	0.165	0.300	0.527	0.173	0.337	0.560	0.23	0.379	0.576
Reading/Language Arts Middle	0.156	0.272	0.519	0.148	0.259	0.449	0.193	0.280	0.556
Mean	0.173	0.306	0.538	0.169	0.304	0.511	0.194	0.325	0.561

<u>MLM0 vs. VAM</u>									
Math Elementary	0.219	0.353	0.584	0.188	0.340	0.589	0.213	0.365	0.612
Reading/Language Arts Elementary	0.177	0.325	0.579	0.171	0.295	0.520	0.177	0.328	0.548
Math Middle	0.165	0.313	0.543	0.189	0.325	0.560	0.235	0.374	0.593
Reading/Language Arts Middle	0.152	0.251	0.498	0.111	0.267	0.514	0.160	0.317	0.531
Mean	0.178	0.310	0.551	0.165	0.307	0.546	0.196	0.346	0.571

<u>MLM0 vs. Grate</u>									
Math Elementary	0.116	0.210	0.381	0.135	0.284	0.472	0.120	0.229	0.408
Reading/Language Arts Elementary	0.075	0.149	0.298	0.089	0.180	0.315	0.099	0.214	0.397
Math Middle	0.160	0.284	0.457	0.156	0.292	0.506	0.292	0.449	0.691
Reading/Language Arts Middle	0.058	0.119	0.272	0.078	0.165	0.280	0.111	0.173	0.313
Mean	0.102	0.190	0.352	0.114	0.230	0.393	0.156	0.266	0.452

<u>MLM0 vs. AvGrate</u>									
Math Elementary	0.198	0.312	0.510	0.167	0.309	0.528	0.178	0.297	0.530

Reading/Language Arts Elementary	0.086	0.167	0.341	0.096	0.187	0.358	0.114	0.194	0.349
Math Middle	0.193	0.333	0.502	0.156	0.280	0.457	0.193	0.313	0.490
Reading/Language Arts Middle	0.095	0.165	0.300	0.099	0.173	0.296	0.119	0.210	0.399
Mean	0.143	0.244	0.413	0.130	0.237	0.410	0.151	0.254	0.442

Gain vs. TM

Math Elementary	0.403	0.614	0.866	0.404	0.642	0.884	0.406	0.639	0.875
Reading/Language Arts Elementary	0.272	0.439	0.697	0.281	0.464	0.738	0.091	0.180	0.329
Math Middle	0.395	0.597	0.831	0.387	0.613	0.848	0.481	0.700	0.918
Reading/Language Arts Middle	0.226	0.374	0.588	0.202	0.412	0.650	0.267	0.461	0.634
Mean	0.324	0.506	0.745	0.318	0.533	0.780	0.311	0.495	0.689

Gain vs. SGP

Math Elementary	0.315	0.490	0.777	0.429	0.639	0.865	0.327	0.526	0.795
Reading/Language Arts Elementary	0.250	0.401	0.594	0.228	0.389	0.647	0.141	0.233	0.416
Math Middle	0.329	0.560	0.798	0.383	0.613	0.844	0.469	0.675	0.897
Reading/Language Arts Middle	0.226	0.370	0.642	0.247	0.391	0.601	0.280	0.387	0.646
Mean	0.280	0.455	0.703	0.322	0.508	0.739	0.304	0.455	0.688

Gain vs. VAM

Math Elementary	0.292	0.523	0.795	0.436	0.670	0.893	0.340	0.561	0.818
Reading/Language Arts Elementary	0.220	0.376	0.616	0.243	0.399	0.666	0.113	0.228	0.417
Math Middle	0.395	0.630	0.848	0.416	0.609	0.868	0.506	0.708	0.934

Reading/Language Arts Middle	0.206	0.346	0.650	0.206	0.366	0.638	0.255	0.391	0.658
Mean	0.278	0.469	0.727	0.325	0.511	0.766	0.304	0.472	0.707
<u>Gain vs. Grate</u>									
Math Elementary	0.512	0.795	0.979	0.660	0.866	0.987	0.578	0.807	0.974
Reading/Language Arts Elementary	0.424	0.689	0.912	0.500	0.743	0.960	0.079	0.139	0.272
Math Middle	0.498	0.765	0.942	0.551	0.798	0.979	0.609	0.885	0.992
Reading/Language Arts Middle	0.424	0.704	0.938	0.436	0.704	0.901	0.543	0.811	0.975
Mean	0.464	0.738	0.943	0.537	0.778	0.957	0.452	0.661	0.803
<u>Gain vs. AvGrate</u>									
Math Elementary	0.200	0.351	0.558	0.241	0.432	0.677	0.193	0.328	0.556
Reading/Language Arts Elementary	0.204	0.353	0.545	0.175	0.318	0.551	0.215	0.404	0.616
Math Middle	0.226	0.366	0.556	0.272	0.362	0.617	0.296	0.469	0.704
Reading/Language Arts Middle	0.222	0.317	0.605	0.214	0.374	0.588	0.276	0.428	0.658
Mean	0.213	0.347	0.566	0.226	0.372	0.608	0.245	0.407	0.634
<u>TM vs. SGP</u>									
Math Elementary	0.315	0.485	0.774	0.363	0.533	0.789	0.309	0.517	0.784
Reading/Language Arts Elementary	0.240	0.424	0.639	0.247	0.394	0.619	0.281	0.452	0.697
Math Middle	0.235	0.444	0.712	0.379	0.584	0.782	0.391	0.572	0.835
Reading/Language Arts Middle	0.337	0.502	0.745	0.272	0.399	0.667	0.333	0.490	0.737
Mean	0.282	0.464	0.718	0.315	0.478	0.714	0.328	0.508	0.763

TM vs. VAM

Math Elementary	0.300	0.492	0.769	0.351	0.554	0.799	0.330	0.513	0.781
Reading/Language Arts Elementary	0.232	0.387	0.647	0.233	0.386	0.651	0.273	0.430	0.689
Math Middle	0.263	0.465	0.737	0.350	0.576	0.798	0.387	0.572	0.840
Reading/Language Arts Middle	0.259	0.449	0.733	0.235	0.383	0.675	0.317	0.498	0.774
Mean	0.264	0.448	0.722	0.292	0.475	0.731	0.327	0.503	0.771

TM vs. Grate

Math Elementary	0.317	0.526	0.792	0.360	0.554	0.838	0.335	0.551	0.790
Reading/Language Arts Elementary	0.215	0.373	0.613	0.212	0.396	0.671	0.257	0.422	0.684
Math Middle	0.309	0.547	0.790	0.337	0.523	0.802	0.457	0.683	0.872
Reading/Language Arts Middle	0.173	0.313	0.514	0.177	0.362	0.543	0.259	0.366	0.601
Mean	0.254	0.440	0.677	0.272	0.459	0.714	0.327	0.506	0.737

TM vs. AvGrate

Math Elementary	0.185	0.345	0.543	0.233	0.394	0.640	0.186	0.328	0.543
Reading/Language Arts Elementary	0.142	0.288	0.459	0.179	0.298	0.526	0.177	0.290	0.475
Math Middle	0.218	0.333	0.498	0.218	0.403	0.626	0.239	0.412	0.667
Reading/Language Arts Middle	0.160	0.272	0.514	0.123	0.276	0.444	0.206	0.346	0.535
Mean	0.176	0.310	0.504	0.188	0.343	0.559	0.202	0.344	0.555

<u>SGP vs. VAM</u>									
Math Elementary	0.583	0.830	0.972	0.579	0.828	0.969	0.564	0.807	0.980
Reading/Language Arts Elementary	0.417	0.671	0.921	0.444	0.685	0.897	0.429	0.682	0.904
Math Middle	0.564	0.794	0.959	0.609	0.856	0.984	0.621	0.848	0.979
Reading/Language Arts Middle	0.424	0.671	0.926	0.420	0.700	0.905	0.432	0.728	0.930
Mean	0.497	0.742	0.944	0.513	0.767	0.939	0.511	0.766	0.948

<u>SGP vs. Grate</u>									
Math Elementary	0.221	0.381	0.634	0.322	0.528	0.748	0.224	0.408	0.653
Reading/Language Arts Elementary	0.164	0.293	0.512	0.152	0.315	0.540	0.247	0.379	0.604
Math Middle	0.243	0.379	0.691	0.317	0.457	0.695	0.387	0.556	0.782
Reading/Language Arts Middle	0.177	0.292	0.502	0.144	0.276	0.490	0.210	0.325	0.527
Mean	0.201	0.336	0.585	0.234	0.394	0.618	0.267	0.417	0.642

<u>SGP vs. AvGrate</u>									
Math Elementary	0.282	0.487	0.731	0.337	0.589	0.818	0.333	0.502	0.761
Reading/Language Arts Elementary	0.185	0.316	0.543	0.224	0.374	0.593	0.238	0.389	0.611
Math Middle	0.296	0.477	0.745	0.329	0.560	0.802	0.387	0.630	0.872
Reading/Language Arts Middle	0.210	0.362	0.597	0.202	0.354	0.613	0.255	0.391	0.634
Mean	0.243	0.410	0.654	0.273	0.469	0.706	0.303	0.478	0.720

<u>VAM vs. Grate</u>									
Math Elementary	0.215	0.373	0.624	0.332	0.531	0.771	0.254	0.416	0.672

Reading/Language Arts Elementary	0.172	0.316	0.512	0.209	0.353	0.581	0.248	0.396	0.627
Math Middle	0.263	0.440	0.712	0.296	0.469	0.708	0.374	0.580	0.815
Reading/Language Arts Middle	0.177	0.325	0.514	0.193	0.321	0.523	0.173	0.346	0.580
Mean	0.207	0.364	0.590	0.258	0.418	0.646	0.262	0.434	0.674

Grate vs. AvGrate

Math Elementary	0.150	0.267	0.459	0.219	0.338	0.586	0.137	0.257	0.459
Reading/Language Arts Elementary	0.136	0.253	0.430	0.139	0.260	0.434	0.139	0.255	0.449
Math Middle	0.169	0.296	0.461	0.214	0.300	0.490	0.230	0.391	0.601
Reading/Language Arts Middle	0.202	0.333	0.568	0.181	0.288	0.486	0.189	0.391	0.601
Mean	0.164	0.287	0.480	0.188	0.296	0.499	0.174	0.324	0.528

Appendix E

RMSD in School Ranks for Pairs of School Performance Models for each Individual Cohort by Content Area and Grade Level Band.

Elementary School Mathematics: Cohort 1

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	15.770	37.362	34.105	29.798	29.045	39.441	34.357
MLM0		37.581	34.712	28.086	27.087	40.005	32.912
Gain			13.586	17.328	16.493	8.491	28.533
TM				18.316	17.633	16.537	29.001
SGP					8.358	23.251	20.655
VAM						22.979	19.137
Grate							34.628

Elementary School Mathematics: Cohort 2

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	14.395	32.726	33.384	28.644	27.823	34.156	31.510
MLM0		31.685	33.452	27.287	26.152	33.020	30.914
Gain			12.974	13.846	12.127	6.928	23.014
TM				17.736	17.345	14.738	24.819
SGP					8.376	18.687	16.332
VAM						17.860	14.033
Grate							28.523

Elementary School Mathematics: Cohort 3

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	14.438	34.826	31.582	29.163	27.95	37.177	30.428
MLM0		33.463	31.036	26.362	25.182	36.223	28.276
Gain			13.221	16.738	15.247	8.409	29.121
TM				17.213	16.842	16.581	28.739
SGP					8.232	23.134	18.582

VAM	22.268	17.376
Grate		35.168

Elementary School Reading/Language Arts: Cohort 1

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	15.540	41.213	34.408	29.400	27.321	43.555	42.161
MLM0		43.497	35.963	29.225	27.463	45.584	43.963
Gain			22.777	25.344	24.121	11.436	29.191
TM				22.777	22.356	25.866	33.432
SGP					11.359	31.683	28.953
VAM						30.928	28.344
Grate							36.431

Elementary School Reading/Language Arts: Cohort 2

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	15.237	39.573	36.531	31.045	29.042	40.759	40.435
MLM0		41.291	38.112	30.641	28.763	42.498	40.938
Gain			20.322	21.984	20.109	9.431	28.105
TM				23.757	23.045	22.685	30.209
SGP					12.271	26.996	24.897
VAM						25.955	23.274
Grate							34.614

Elementary School Reading/Language Arts: Cohort 3

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	13.361	42.724	33.727	30.142	28.365	38.305	41.723
MLM0		42.277	34.736	30.326	28.634	39.893	42.711
Gain			44.548	39.077	38.925	49.566	25.217
TM				21.761	21.312	21.682	31.506
SGP					11.974	25.923	25.274
VAM						24.214	23.890
Grate							33.782

Middle School Mathematics: Cohort 1

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	15.945	33.532	29.275	31.237	31.078	33.991	34.467
MLM0		31.716	30.267	28.905	28.418	32.702	32.596
Gain			15.570	17.226	15.180	9.810	29.276
TM				21.650	20.802	16.673	31.588
SGP					9.639	24.035	18.819
VAM						22.930	16.925
Grate							35.983

Middle School Mathematics: Cohort 2

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	15.635	30.273	27.086	27.474	27.691	30.347	33.333
MLM0		30.719	29.502	27.656	27.321	30.368	33.654
Gain			15.684	13.993	12.869	8.252	24.499
TM				17.324	17.193	17.646	25.730
SGP					7.731	19.772	16.862
VAM						18.960	14.753
Grate							30.439

Middle School Mathematics: Cohort 3

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	17.076	26.629	24.410	27.029	26.004	25.949	28.927
MLM0		23.594	23.467	24.903	24.606	21.557	29.608
Gain			12.116	12.830	10.747	6.916	20.965
TM				15.701	14.937	13.012	22.505
SGP					7.620	16.842	13.090
VAM						15.846	11.246
Grate							25.664

Middle School Reading/Language Arts: Cohort 1

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	13.241	43.882	32.089	32.422	33.161	46.984	44.585
MLM0		46.167	35.268	33.305	34.104	49.012	45.698
Gain			24.977	24.299	22.190	11.217	25.328
TM				20.479	20.045	29.293	31.687
SGP					11.441	30.771	26.530
VAM						29.010	23.190
Grate							30.048

Middle School Reading/Language Arts: Cohort 2

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	15.000	44.032	34.833	32.958	32.319	46.304	45.287
MLM0		46.575	37.457	34.303	33.357	48.333	47.229
Gain			23.159	25.486	24.178	11.342	26.658
TM				24.126	22.259	26.615	33.678
SGP					11.744	32.150	26.751
VAM						30.725	26.232
Grate							32.473

Middle School Reading/Language Arts: Cohort 3

Model	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
PP	12.169	42.661	32.093	30.448	29.671	45.404	40.724
MLM0		43.755	32.510	29.891	29.391	46.377	41.262
Gain			23.650	23.746	22.771	8.753	24.015
TM				19.919	18.565	26.819	28.573
SGP					10.938	28.795	23.796
VAM						28.036	20.678
Grate							27.729

Appendix F

Correlations of School Ranks with School Composition Variables by Content Area and Grade Level Band for each Individual Cohort.

Elementary School Mathematics: Cohort 1

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.490	-0.351	-0.212	-0.025	-0.273	0.124	-0.204
MLM0	-0.599	-0.325	-0.185	-0.045	-0.282	0.224	-0.202
Gain	0.105	0.164	0.066	-0.022	0.098	0.181	0.099
TM	-0.001	0.107	0.004	-0.033	0.042	0.185	0.051
SGP	-0.135	0.030	-0.025	-0.044	0.017	0.248	0.015
VAM	-0.153	0.029	-0.029	-0.023	0.008	0.265	0.016
Grate	0.126	0.154	0.089	-0.018	0.076	0.132	0.093
AvGrate	0.013	0.139	-0.008	0.001	0.134	0.223	0.084

Elementary School Mathematics: Cohort 2

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.548	-0.338	-0.213	0.045	-0.270	0.142	-0.197
MLM0	-0.626	-0.315	-0.198	0.033	-0.271	0.219	-0.193
Gain	-0.042	0.054	0.015	0.036	0.033	0.116	0.035
TM	0.002	0.056	0.003	0.047	0.029	0.088	0.038
SGP	-0.122	0.011	-0.014	0.035	0.016	0.144	0.012
VAM	-0.147	0.010	-0.034	0.059	0.015	0.168	0.012
Grate	-0.057	0.022	0.017	0.024	-0.003	0.076	0.013
AvGrate	0.003	0.104	-0.007	0.073	0.103	0.158	0.072

Elementary School Mathematics: Cohort 3

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.539	-0.280	-0.191	-0.018	-0.303	0.103	-0.205
MLM0	-0.622	-0.262	-0.169	-0.016	-0.262	0.195	-0.189
Gain	-0.109	-0.058	-0.057	-0.021	-0.067	0.046	-0.044
TM	-0.160	-0.104	-0.039	-0.046	-0.108	0.034	-0.070
SGP	-0.220	-0.079	-0.077	-0.007	-0.074	0.123	-0.056
VAM	-0.248	-0.090	-0.097	0.004	-0.097	0.129	-0.066
Grate	-0.087	-0.073	-0.031	-0.038	-0.079	0.005	-0.050
AvGrate	-0.104	0.015	-0.066	0.039	0.005	0.139	0.005

Elementary School Reading/Language Arts: Cohort 1

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.555	-0.510	-0.181	-0.034	-0.424	0.028	-0.279
MLM0	-0.681	-0.475	-0.178	-0.029	-0.418	0.136	-0.274
Gain	0.222	0.183	0.120	-0.029	0.154	0.091	0.124
TM	-0.092	0.030	0.076	-0.085	0.043	0.156	0.021
SGP	-0.224	-0.069	-0.032	0.005	-0.079	0.183	-0.036
VAM	-0.279	-0.120	-0.035	-0.016	-0.119	0.195	-0.062
Grate	0.252	0.157	0.146	-0.017	0.131	0.052	0.120
AvGrate	0.234	0.311	0.055	-0.002	0.233	0.053	0.147

Elementary School Reading/Language Arts: Cohort 2

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.626	-0.488	-0.248	0.012	-0.414	0.052	-0.285
MLM0	-0.741	-0.495	-0.225	0.015	-0.440	0.134	-0.292

Gain	0.097	0.180	0.041	-0.013	0.124	0.036	0.078
TM	-0.056	0.082	0.032	-0.004	0.059	0.085	0.033
SGP	-0.233	-0.051	-0.079	-0.001	-0.066	0.108	-0.054
VAM	-0.268	-0.066	-0.083	0.012	-0.089	0.123	-0.062
Grate	0.098	0.138	0.048	-0.013	0.094	-0.003	0.060
AvGrate	0.187	0.266	0.045	0.013	0.184	0.093	0.131

Elementary School Reading/Language Arts: Cohort 3

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.648	-0.476	-0.173	0.029	-0.440	0.041	-0.278
MLM0	-0.745	-0.470	-0.141	0.002	-0.452	0.097	-0.285
Gain	0.141	0.159	0.088	-0.040	0.123	0.054	0.088
TM	-0.107	-0.019	0.008	0.010	-0.049	0.026	-0.022
SGP	-0.218	-0.066	-0.019	-0.002	-0.102	0.047	-0.060
VAM	-0.246	-0.099	-0.028	0.022	-0.121	0.061	-0.068
Grate	0.066	0.053	-0.021	0.031	0.042	-0.028	0.024
AvGrate	0.252	0.243	0.080	0.003	0.188	0.017	0.130

Middle School Mathematics: Cohort 1

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.438	-0.154	-0.242	-0.055	-0.262	0.135	-0.169
MLM0	-0.495	-0.065	-0.162	-0.101	-0.167	0.208	-0.130
Gain	-0.058	0.128	0.048	-0.078	0.163	0.176	0.063
TM	-0.091	0.092	-0.031	-0.076	0.084	0.186	0.027
SGP	-0.015	0.185	0.067	-0.044	0.163	0.180	0.089
VAM	-0.026	0.170	0.053	-0.054	0.143	0.191	0.080
Grate	-0.123	0.063	0.010	-0.094	0.113	0.148	0.020

AvGrate	0.093	0.180	0.066	-0.006	0.130	0.109	0.095
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Middle School Mathematics: Cohort 2

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.377	-0.266	-0.301	0.106	-0.255	0.081	-0.169
MLM0	-0.481	-0.197	-0.177	0.121	-0.174	0.167	-0.124
Gain	0.056	0.028	0.000	0.007	-0.031	0.045	0.018
TM	-0.038	-0.025	-0.081	0.022	-0.085	0.100	-0.018
SGP	0.021	0.043	-0.048	0.025	-0.008	0.105	0.023
VAM	0.027	0.044	-0.033	0.039	0.001	0.105	0.030
Grate	-0.026	-0.026	-0.016	0.006	-0.066	0.029	-0.016
AvGrate	0.171	0.158	0.006	0.039	0.080	0.123	0.096

Middle School Mathematics: Cohort 3

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.340	-0.214	-0.254	0.071	-0.121	0.140	-0.120
MLM0	-0.487	-0.187	-0.194	-0.007	-0.083	0.235	-0.120
Gain	-0.100	-0.023	-0.085	0.030	0.044	0.218	0.014
TM	-0.152	-0.041	-0.097	0.023	0.014	0.190	-0.010
SGP	-0.050	0.026	-0.066	0.017	0.089	0.235	0.042
VAM	-0.033	0.008	-0.088	0.021	0.078	0.208	0.032
Grate	-0.189	-0.061	-0.106	0.026	0.002	0.225	-0.017
AvGrate	0.093	0.065	-0.067	0.025	0.125	0.157	0.066

Middle School Reading/Language Arts: Cohort 1

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.558	-0.350	-0.318	0.165	-0.398	0.090	-0.228
MLM0	-0.673	-0.318	-0.289	0.085	-0.386	0.128	-0.242
Gain	0.327	0.166	0.113	0.002	0.184	-0.005	0.131
TM	-0.023	0.013	-0.045	0.076	-0.045	0.106	0.014
SGP	-0.059	0.033	-0.031	0.046	-0.017	0.103	0.012
VAM	-0.021	0.052	-0.034	0.010	-0.018	0.096	0.014
Grate	0.390	0.192	0.163	-0.039	0.227	-0.010	0.154
AvGrate	0.412	0.314	0.112	-0.038	0.242	0.044	0.181

Middle School Reading/Language Arts: Cohort 2

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.526	-0.446	-0.221	0.204	-0.447	-0.003	-0.240
MLM0	-0.682	-0.434	-0.185	0.188	-0.440	0.084	-0.245
Gain	0.395	0.259	0.133	-0.050	0.161	-0.021	0.146
TM	0.052	0.058	0.062	0.048	-0.013	0.053	0.043
SGP	-0.013	0.017	0.015	0.043	-0.031	0.085	0.019
VAM	-0.028	0.014	-0.012	0.071	-0.079	0.049	0.002
Grate	0.395	0.245	0.139	-0.081	0.139	-0.052	0.131
AvGrate	0.469	0.332	0.148	-0.051	0.268	0.011	0.196

Middle School Reading/Language Arts: Cohort 3

Model	EDS	EL	SWD	Female	Ethnic Minority	School Size	Mean
PP	-0.594	-0.360	-0.275	0.032	-0.358	0.071	-0.247
MLM0	-0.705	-0.354	-0.249	0.051	-0.357	0.104	-0.252

Gain	0.292	0.257	0.163	-0.014	0.230	0.117	0.174
TM	-0.123	0.016	0.034	0.006	0.053	0.251	0.040
SGP	-0.153	0.030	-0.047	0.064	-0.009	0.168	0.009
VAM	-0.117	0.037	-0.009	0.037	0.007	0.165	0.020
Grate	0.358	0.276	0.194	-0.044	0.255	0.089	0.188
AvGrate	0.313	0.288	0.135	0.023	0.171	0.059	0.165

Appendix G

Correlations of School Performance Model Estimates with School Percentage SWD for each Individual Cohort by Content Area and Grade Level Band.

Elementary School Mathematics

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.212	-0.185	0.066	0.004	-0.025	-0.029	0.089	-0.008
2	-0.213	-0.198	0.015	0.003	-0.014	-0.034	0.017	-0.007
3	-0.191	-0.169	-0.057	-0.039	-0.077	-0.097	-0.031	-0.066

Elementary School Reading/Language Arts

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.181	-0.178	0.120	0.076	-0.032	-0.035	0.146	0.055
2	-0.248	-0.225	0.041	0.032	-0.079	-0.083	0.048	0.045
3	-0.173	-0.141	0.088	0.008	-0.019	-0.028	-0.021	0.080

Middle School Mathematics

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.242	-0.162	0.048	-0.031	0.067	0.053	0.010	0.066
2	-0.301	-0.177	0.000	-0.081	-0.048	-0.033	-0.016	0.006
3	-0.254	-0.194	-0.085	-0.097	-0.066	-0.088	-0.106	-0.067

Middle School Reading/Language Arts

Cohort	PP	MLM0	Gain	TM	SGP	VAM	Grate	AvGrate
1	-0.318	-0.289	0.113	-0.045	-0.031	-0.034	0.163	0.112
2	-0.221	-0.185	0.133	0.062	0.015	-0.012	0.139	0.148
3	-0.275	-0.249	0.163	0.034	-0.047	-0.009	0.194	0.135