Demonstration Skip Year SGP Analyses
A Historical Comparison of the 2019 SGP Results

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Executive Summary

DRAFT REPORT - DO NOT CITE!

The COVID-19 pandemic is having far-reaching effects on all facets of our lives. The impact on education included school closures in Spring 2020 and a 2020-2021 academic school year mixing remote and in-person instruction that is looking quite different from pre-pandemic times. Demonstration, like all states, is currently grappling with uncertainty regarding the summative spring assessments and accountability systems built from the results. Student academic growth is a significant component of Demonstration's accountability system and the lack of Spring 2020 results has necessitated an investigation into alternatives to the annual student academic growth calculations normally conducted.

This report summarizes findings of using skip-year growth as a substitute for the typical annual (i.e., one-year) student growth calculation. To pursue this investigation, historical Demonstration Student Assessment Program (DEMO) data in Mathematics and Reading was used to compare the SGPs derived from skip-year analyses (i.e., 2017 to 2019) versus sequential-year (non-skip, or one-year) analyses (i.e., 2018 to 2019). Comparisons between skip-year and sequential-year growth are examined at both the individual student level as well as the school level.

At the individual student level there is, not surprisingly, a very high correlation (~ 0.8) between skip-year SGPs and one-year SGPs (when the student has both). A very high correlation, however, does not preclude the existence of large differences for a substantial number of students. This is the case for more than 25 percent of students whose skip-year and one-year SGP differences exceed 20 in magnitude.

At the school level there is, again not surprisingly, a very high correlation (~ 0.87) between skip-year mean SGPs and one-year SGPs. However, the high correlation does mask approximately 10 percent of the schools whose mean SGP differs by 9 or more. The majority of schools demonstrating these large differences are elementary schools because 4^{th} grade SGPs can only be calculated using a sequential-year analysis given the available prior test scores. Thus, for those elementary schools, substantially different numbers of students are used to calculate the mean/median. As school performance ratings are comprised of other quantities besides student growth, the overall impact on school ratings may be muted.

As spring 2021 approaches and state summative assessments are scheduled to be given in Demonstration, the historical growth analyses discussed in this report support several recommendations:

- Historical analyses contained in this report do not unequivocally support or reject the use of skip-year student growth in lieu of one-year student growth for state accountability calculations at the school level. There is a high correlation between skip-year and sequential SGP results. However, there are a non-trivial number of cases where the differences are large enough to result in differing conclusions about student academic learning at a school.
- Historical analyses contained in this report are done under much better educational circumstances than currently exist. We think that the difficulty of current circumstances adds to skepticism for using skip-year student growth in lieu of one-year student growth. Based upon current evidence, the best stance is to assume that skip-year growth is *not* a valid substitute for one-year growth in 2021 *unless* 2021

skip-year growth analyses align well with historical skip-year analyses. Given current disruptions to student education due to COVID-19 in Fall 2021, it is unclear how well these analyses will align.

- Even with analyses that align well in 2021, it is not clear whether business-as-usual accountability is politically tenable. The issue of summative testing in 2021 is only partly technical in nature. There is a large pragmatic, non-technical, component to consider.
- Skip-year growth is extremely valuable to calculate even if not used for traditional accountability. Skip-year growth can be used to conduct investigations about the overall and differential impact of COVID-19 on the education of students. This has the potential to inform policy discussions about myriad of COVID-19 related issues including, for example, which modes of education best served students during the crisis.

1 Background

The COVID-19 pandemic is having far-reaching effects on all facets of our lives. The impact on education included school closures in Spring 2020 and a 2020-2021 academic school year mixing remote and in-person instruction that is already looking quite different from pre-pandemic times. Demonstration, like all states, is currently grappling with uncertainty regarding the summative spring assessments and accountability systems built from the results. Student academic growth is a significant component of Demonstration's accountability system and the lack of Spring 2020 results has necessitated an investigation into alternatives to the annual student academic growth calculations normally conducted.

The most prominent alternative to the standard one-year (sequential) student academic growth SGP utilized by Demonstration is to calculate a two-year (skip-year) student academic growth SGP from 2019 to 2021. The first question to such a proposal is, "Can you do that?" The answer is easy in one sense and not so easy in another.

- In terms of performing the actual calculation, it is no more difficult to calculate skip-year growth than one-year growth. In fact, skip-year growth is often calculated in states where there is a gap in grade level testing (e.g., grade 8 to 10 growth when there is no grade 9 test) or where students take an end-of-course test and the most recent previous score is from two years prior.
- Even though it is possible to calculate skip-year growth, it is not clear that it can be used in lieu of one-year growth for state accountability reporting.

Due to the uncertainty of instruction, testing, and accountability in the coming year, the best that any state can do at this point in time is to examine historical data in anticipation of different situations that might arise in 2021. This report is part of the due diligence being conducted by the Student Growth Percentiles Package (the SGP Package) in preparation for Spring 2021.

2 Data

Demonstration has extensive historical state summative assessment data from the Demonstration Student Assessment Program (DEMO) in Mathematics and Reading for grades 3 to 10 to examine how skip-year growth and one-year growth are related. To do so we calculated skip-year growth for 2019 (using 2016 to 2017 as priors). These skip-year growth quantities were then compared to one-year growth at the individual level and, when aggregated by school, at the school level.

Table 1 provides frequencies and proportions associated with student skip-year and one-year SGP counts by year, content area, and grade. An important aspect of Table 1 is that there are no 4^{th} grade skip-year SGPs because no prior score exists with which to calculate growth since there is no exam administered two grades prior. The absence of SGPs for an entire grade level has a significant impact on comparisons done at the elementary school level. Since one-year growth summaries (mean or median) usually include the 4^{th} grade SGPs, one-year to skip-year comparisons for elementary schools are not well aligned (using all growth data) since different grades are included. We discuss this issue later and provide supplemental analyses at the school

level that include only grades and content areas that could have both one-year and skip-year SGPs calculated.

Table 1: Sequential and skip-year SGP counts and percentages for 2019 by content area and grade

			Sequential		**Skip Year**	
Content Area	Grade	Total Students	Count	Percent	Count	Percent
Mathematics	4	4,562	4,048	88.7	– –	– –
	5	4,636	4,170	89.9	3,803	82.0
	6	4,584	4,034	88.0	3,707	80.9
	7	4,526	4,046	89.4	3,673	81.2
	8	4,529	4,073	89.9	3,686	81.4
	9	5,217	4,199	80.5	3,928	75.3
	10	4,809	4,199	87.3	3,653	76.0
Reading	4	4,550	3,845	84.5	– –	– –
	5	4,631	4,157	89.8	3,607	77.9
	6	4,581	4,024	87.8	3,688	80.5
	7	4,526	4,036	89.2	3,665	81.0
	8	4,525	4,062	89.8	3,680	81.3
	9	5,214	4,186	80.3	3,910	75.0
	10	4,787	4,187	87.5	3,641	76.1

In general, there are fewer students with a skip-year SGP (prior test score from two years ago) than a one-year SGP. For all grades and content areas for which *both* skip-year and one-year SGPs can exist, 77.7% of students have both a one-year and skip-year SGP, while 9.6% of students have a one-year SGP but no skip-year SGP. Only 1.2% of students have a skip-year SGP but not a one-year SGP. And 11.5% of students have neither.

Overall, these counts indicate there is no evidence of systematic under-representation that would compromise the representativeness of the student population used for skip-year growth calculations. For 2021, additional columns should be added to Table 1 indicating counts and percentages of students with skip-year growth. Any values differing dramatically from the 2019 skip-year counts would undermine claims about the representativeness of the 2021 growth calculations. In the next section we investigate the results more thoroughly to determine whether skip-year growth can be used in lieu of one-year growth.

3 Analyses and Results

Analyses were conducted for grades 4 to 10 for one-year SGPs and in grades 5 to 10 for skip-year SGPs in Mathematics and Reading for the 2019 DEMO administration. All analyses were

conducted using the R Software Environment (R Core Team, 2020) in conjunction with the SGP package (Betebenner, VanIwaarden, Domingue, & Shang, 2020). Source code associated with one-year analyses is available at this link and source code associated with skip-year analyses is available at this link.

Both sets of analyses are considered "standard" and resulted in no warnings or errors during calculation. In general, both one-year and skip-year SGP analyses yielded excellent data fit. This is consistent with the excellent fit of analyses run previously in Demonstration. Goodness of fit plots for relevant 2019 one-year and skip-year analyses are provided in Appendix A. Because growth percentiles are uniformly distributed, mean, median and standard deviation for one-year and skip-year SGPs are virtually identical. In the following we present results comparing one-year and skip-year SGPs at the individual level followed by results at the school level.

3.1 Individual Level Results

One-year (sequential) and skip-year SGPs quantify growth for students across different time spans. For sequential SGPs, the time span is a single year (possibly more depending on the availability of additional priors). For skip-year SGPs the time span is, at a minimum, two years. In general one would not communicate that a skip-year SGP is the same as a one-year SGP because they quantify something over a different time span.

However, as the Demonstration data analyses show, the two quantities are very similar. Correlations between one-year SGP and skip-year SGP shown in Table 2 by content area and grade range from 0.71 to 0.86. This indicates that although the quantities are for different time spans, students showing high or low growth across one of the time spans often showed a similar trend across the other time span.

The mean and standard deviation of SGPs at the individual level is similar for both sets of calculations, as shown in Table 2. The table also provides the correlation between the current (2019) and most recent prior (2018 and 2017 respectively) scale scores used in the growth calculations. Good model fit begins with a strong positive relationship between prior and current achievement, which suggests that growth is detectable and modeling it is reasonable to begin with. Although a decrease in this correlation is expected over time, the relationship is still strong in the data used for the skip-year analysis. All results presented in Table 2 are consistent with those found in all other states examined thus far.

Table 2: Sequential and skip-year SGP correlation, and SGP mean/standard deviation and test score correlations by content area and grade.

			Sequential			Skip Year		
Content Area	Grade	SGP Corr	Mean	SD	Score Corr	Mean	SD	Score Corr
Mathematics	4	– –	49.9	28.9	0.79	– –	– –	– –
	5	0.76	50.1	28.9	0.84	49.9	28.9	0.75
	6	0.80	49.7	28.8	0.85	50.0	28.9	0.79
	7	0.71	50.3	28.9	0.89	50.2	28.7	0.81
	8	0.78	49.8	28.9	0.90	50.1	29.0	0.86
	9	0.80	49.7	28.9	0.90	50.1	29.1	0.88
	10	0.80	50.2	29.0	0.90	50.0	28.9	0.88
Reading	4	– –	49.9	28.8	0.77	– –	– –	– –
	5	0.80	49.8	28.8	0.83	49.9	28.9	0.76
	6	0.82	49.7	28.8	0.85	50.0	28.5	0.81
	7	0.83	49.9	28.9	0.83	50.3	28.8	0.79
	8	0.82	49.8	29.0	0.87	50.0	28.9	0.85
	9	0.83	49.5	28.9	0.86	49.9	29.0	0.84
	10	0.86	49.4	28.9	0.84	49.9	29.0	0.81

High correlations imply that the results demonstrate a strong linear relationship but do not imply that the results are identical or interchangeable. For students with both skip-year and one-year SGPs, 80 percent showed differences of less than 23 percentile points between calculation methodologies across grades and contents, while 20 percent of students showed differences of 23 or more. The results are not surprising as a substantial number of students show wide test score fluctuations over time. Dropping the most recent score from growth calculations when each year's scores differ greatly will lead to highly discrepant SGPs.

Lastly, we examined whether there are systematic differences in student achievement for students with one-year SGPs but no skip-year SGPs (i.e., those who do not have a prior from two-years earlier). Recall that students without a skip-year SGP are a small minority comprising approximately 8 percent of the population in each grade and content area. In general, students without skip-year SGPs were slightly lower achieving (z-score approximately -0.11 versus a z-score of 0.0 for all students) but displayed similar one-year growth (i.e., mean SGP = 49.77) in comparison to students with both one year and skip-year growth. It is unclear, based upon the data provided, whether there are systematic reasons for these students to not have a skip-year SGP (e.g., highly transient).

At the individual student level, reporting skip-year student growth in lieu of one-year student growth could misrepresent what skip-year growth actually quantifies (growth over two years instead of a single year). The investigation carried out with historical Demonstration data suggests there is a close relationship between the two growth quantities, and 2021 skip-year growth could be used to draw inferences about what one-year growth would have been if

students had tested in 2020. In addition to being the most relevant and accessible proxy for one-year growth available, skip-year growth can serve many valuable investigative purposes as well.

3.2 School Level Results

Of most interest to states for reporting and accountability purposes is how well skip-year growth and one-year growth compare when aggregated to the school level. Aggregating SGPs is usually accomplished by taking the median or mean of the SGPs for the students attending a school for a given year and content area. One critical difference of skip-year growth from one-year growth is the absence of SGPs for 4^{th} grade students. A school serving 4^{th} graders would have growth for those students when using one-year growth but not with skip-year growth. Elementary schools comprising grades K-5 or K-6 would have less than 70-75% of the total student growth measures that they would have had with one-year growth when using skip-year growth.

Although the *total* impact on school growth is important in determining the best path forward for the state's accountability decisions, including 4^{th} grade growth in *only* one-year analyses leads to additional school level disparities beyond those resulting from the use of different analytic methods. The results are thus summarized in two ways:

1. Aggregates were calculated using all available skip-year and one-year growth scores.
2. Aggregates were calculated including only grades/content areas for which *both* skip-year and one-year growth could be calculated.

The first method includes all available growth scores (either skip-year or one-year) and calculates the mean and standard deviation from those. This method includes 4^{th} grade one-year SGPs for schools but those same schools would not have skip-year growth for those students. The second method filters students to only those in grades/content areas in which growth could be calculated in both analyses. This method omits 4^{th} graders since they do not have a skip-year SGP.

Table 3 shows basic descriptive statistics for school level growth and prior achievement. Unlike SGPs at the individual level, when aggregating to the group level (e.g., school) the correlation between aggregate prior student achievement and aggregate growth is rarely zero. The correlation between prior student achievement and growth at the school level is compelling because it indicates whether students attending schools serving higher achieving students grow faster (on average) than those students attending schools serving lower achieving students. When using sequential-year data, school level results across states typically show a correlation between mean prior achievement and mean SGP between 0.1 and 0.3 (although higher numbers have been observed in some states). This indicates that, on average, students attending schools serving lower achieving students tend to demonstrate less exemplary growth than those attending schools serving higher achieving students. This relationship is a critical component to assessing the comparability between sequential and skip-year analysis results.

Mean and standard deviations of the school mean SGPs (MSGPs) are provided for additional context and comparison. All statistics in Table 3 are restricted to schools with at least 10 students, and the measure of prior achievement used is the mean prior *standardized* scale score.

Table 3: School level mean and standard deviation of MSGPs, and correlation of MSGPs with mean prior achievement

		Sequential			**Skip Year**		
Filter	Content Area	Mean	SD	Corr	Mean	SD	Corr
All Students	Mathematics	49.3	9.1	0.50	49.0	13.5	0.32
	Reading	49.1	7.4	0.43	48.7	10.0	0.42
Skip-Year Subset	Mathematics	49.1	11.5	0.38	49.0	13.5	0.32
	Reading	49.0	8.2	0.34	48.7	10.0	0.42

3.2.1 School mean SGP correlations

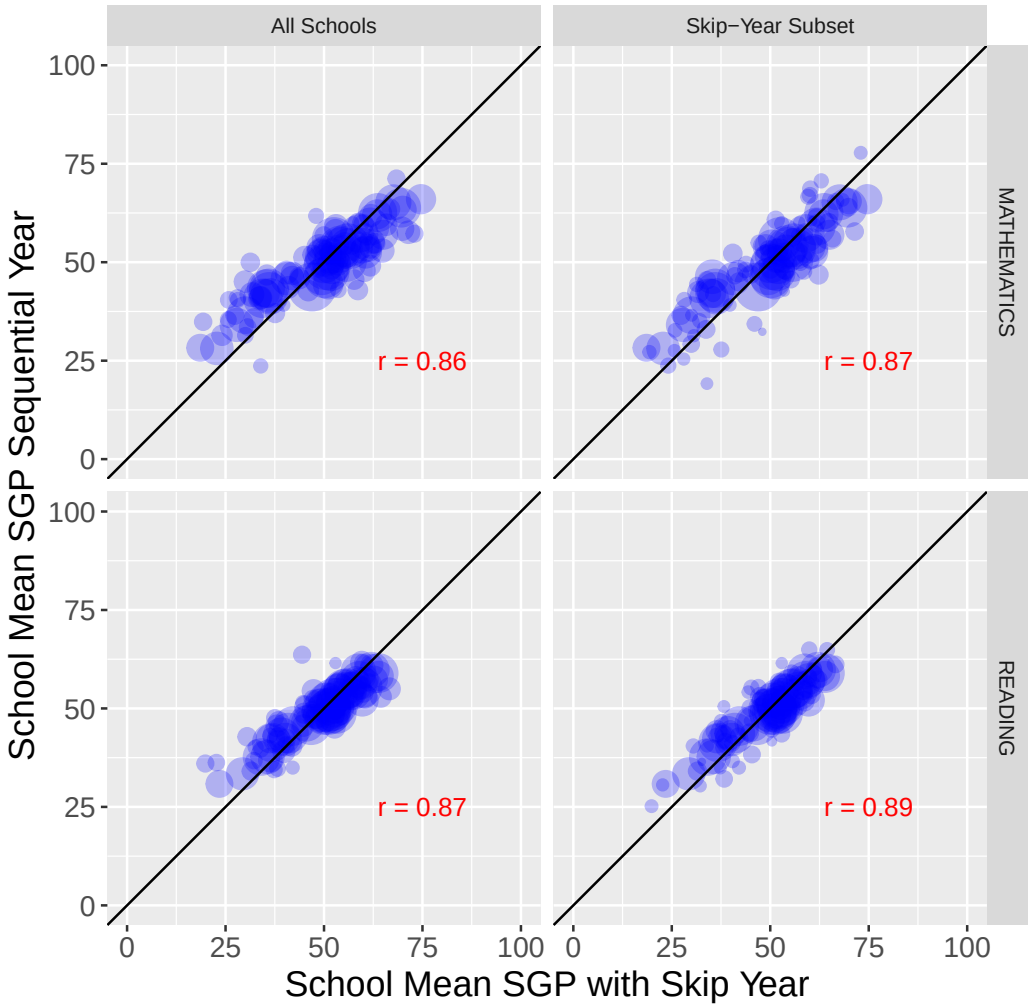
Like with individual results, correlations at the school level between one-year and skip-year mean SGPs are very high. Table 4 reports the correlations (restricted to schools with 10 or more students) which approach 0.9 based upon approximately 150 Demonstration schools. The results demonstrate that schools with high mean one-year SGPs predominantly have high mean skip-year SGPs and vice-versa. Though not reported, similarly high correlations are observed within schools at the grade level, as well as at the district level.

Table 4: School level correlations between mean SGPs with unfiltered and filtered students

Content Area	All Students	Skip-Year Subset
Mathematics	0.86	0.87
Reading	0.87	0.89

Figure 1 visualizes the relationship between school level MSGP and prior achievement by content area and student inclusion filter. Bubble sizes are representative of school size, and the black diagonal line represents perfect correlation (i.e. no difference).

Figure 1: Sequential- and skip-year mean SGP by content area and student filter



3.2.2 School mean SGP differences

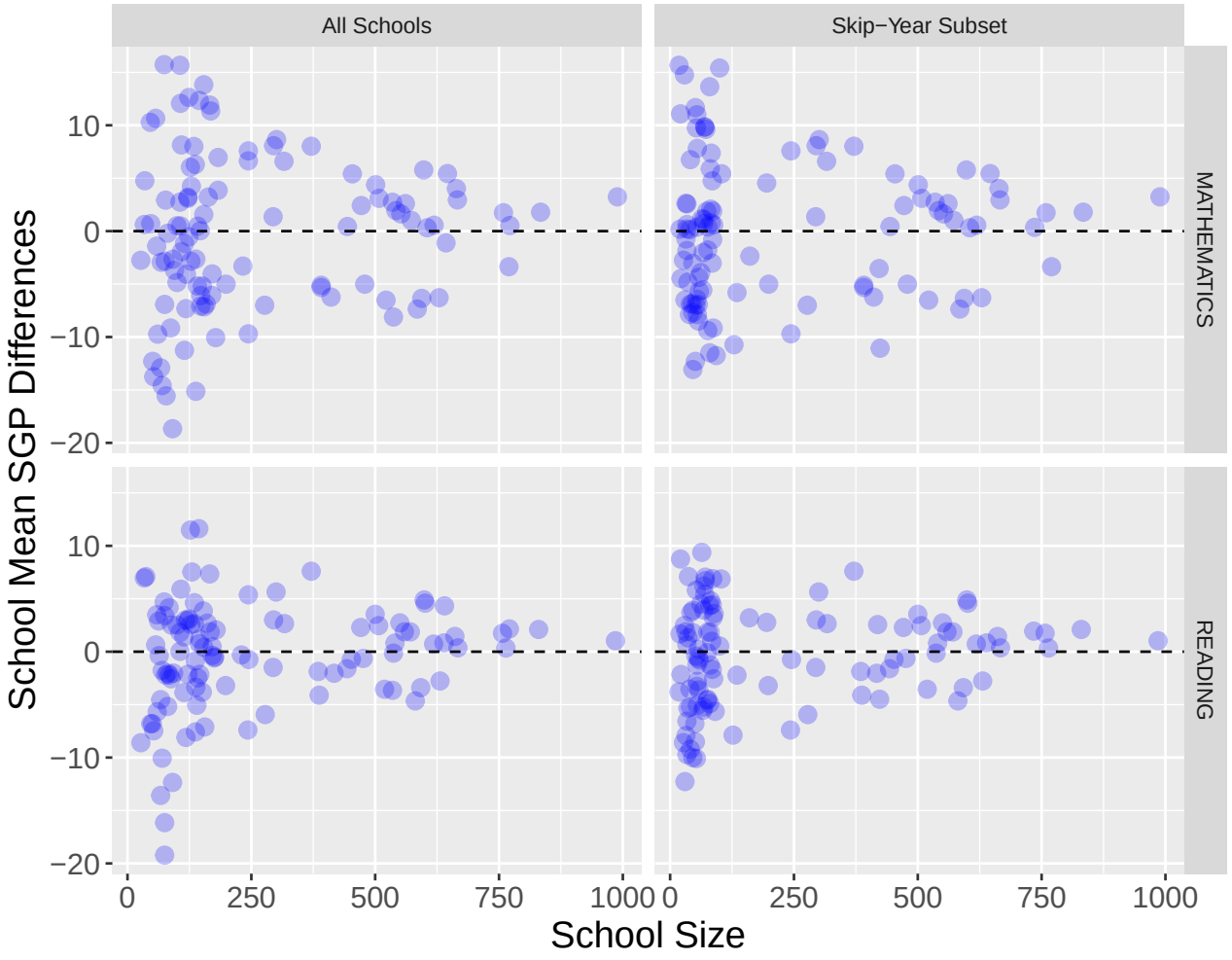
Like at the individual level, a high correlation does not imply the quantities are identical or interchangeable. Absolute differences between one-year mean and skip-year mean SGPs were calculated for schools to provide the average difference for the state by content area. Table 5 reports these average differences for all students and the subset of grades for which both skip-year and one-year SGPs were calculated. On average the differences are small. However, as the 95^{th} percentile shows, 5 percent of schools report differences in mean skip-year and one-year SGPs of approximately 14 in Mathematics and 11 in Reading when all students are included. Differences of more than 5 are associated with a small effect size, and are more likely to impact the accountability sub-indicator ratings that contribute to the larger school rating. Overall, the differences are middling, neither insignificant nor egregious.

Table 5: School level skip-year to one-year median and 95th percentile absolute differences

Filter	Content Area	Median Difference	95%ile Difference
All Students	Mathematics	5.11	14.36
	Reading	2.72	11.06
Skip-Year Subset	Mathematics	5.11	12.13
	Reading	3.27	9.08

School size is one driver of the differences in one- and skip-year mean SGPs to consider. Figure 2 illustrates the relationship between school level MSGP observed (*not absolute*) differences and school size, disaggregated by content area and student inclusion filter. In these plots, MSGP differences are defined as **skip-year MSGP *minus* one-year MSGP**; therefore positive numbers can be interpreted as showing an increase in schools' MSGP when using skip-year calculations, and vice-versa.

Figure 2: Mean SGP differences by content area and student inclusion filter



School level differences like student level differences were, on average, minor. However, numerous schools showed one-year/skip-year differences that were not minor and could possibly lead to a different accountability determination. Further analysis should include re-running 2019 accountability calculations to determine what impact using skip-year growth in place of one-year growth has on school performance framework ratings. Such results could be added to this report if made available or done in cooperation with the Center for Assessment.

3.3 Demographic Subgroup Results

Issues around opportunity to learn can be investigated using growth gap comparisons for relevant demographic subgroups. The following subsections examine differences in the 2019 results for three demographic groups: economically disadvantaged students (as indicated by free/reduced-price lunch eligibility status), English language learners, and students with disabilities (as indicated by having an individualized education program - IEP). All demographic summaries include only students who *could* have received a skip-year SGP (i.e. the "skip-year subset") unless otherwise indicated.

Investigations of (differential) impact on student achievement and growth for already at-risk student populations will be critical to help ameliorate impacts of the disruption to education from the COVID-19 pandemic.

3.3.1 Economically Disadvantaged Students

Table 6 provides the frequencies and proportions of students that had a sequential and/or skip-year SGP calculated in 2019, disaggregated by those identified as economically disadvantaged students (eligible for free/reduced lunch, or FRL), or not, and content area. As the results show, there is not a considerable difference between the two groups' growth calculation rates under either analysis.

Table 6: Sequential and skip-year SGP counts and percentages by content area and FRL status

			Sequential		**Skip Year**	
Content Area	FRL Status	Total Students	Count	Percent	Count	Percent
Mathematics	No	19,263	16,889	87.7	15,292	79.4
	Yes	9,038	7,832	86.7	7,158	79.2
Reading	No	19,232	16,848	87.6	15,235	79.2
	Yes	9,032	7,804	86.4	6,956	77.0

Table 7 provides the correlations between sequential and skip-year SGP estimates for FRL/non-FRL students that had both a sequential and skip-year SGP calculated in 2019, as well as the means and standard deviations for these values. The results show there is not a considerable difference *within* the two groups' growth under either analysis. The two growth measures are highly correlated and have similar distributional qualities within each group by content area. However, it is important to note the growth gap *between* the FRL/non-FRL groups in both ELA and Mathematics. This gap is approximately 7-10 points, on average, for FRL students for the sequential SGP estimates, and increases to roughly 11-15 points using the skip-year estimates.

Table 7: Sequential and skip-year SGP correlation and mean/standard deviation by content area and FRL status

			Sequential		**Skip Year**	
Content Area	FRL Status	SGP Correlation	Mean	SD	Mean	SD
Mathematics	No	0.76	53.0	28.6	54.7	28.1
	Yes	0.77	43.4	28.4	40.1	28.1
Reading	No	0.83	51.9	28.7	53.5	28.4
	Yes	0.82	44.8	28.7	42.4	28.3

Table 8 provides the correlations between school level sequential and skip-year MSGP estimates and the schools' percentage of FRL students. As with the school level summary results in the previous section, these summaries are provided for both 1) all students (including 4^{th} graders) and 2) for the subset of students that have both a sequential and skip-year SGP calculated in 2019. The results show a negative relationship (correlation) between typical school growth and the school percentage of FRL students. That is, the schools with larger FRL populations tend to demonstrate lower academic growth.

Table 8: School level correlations between mean SGPs and percent FRL by student inclusion filter

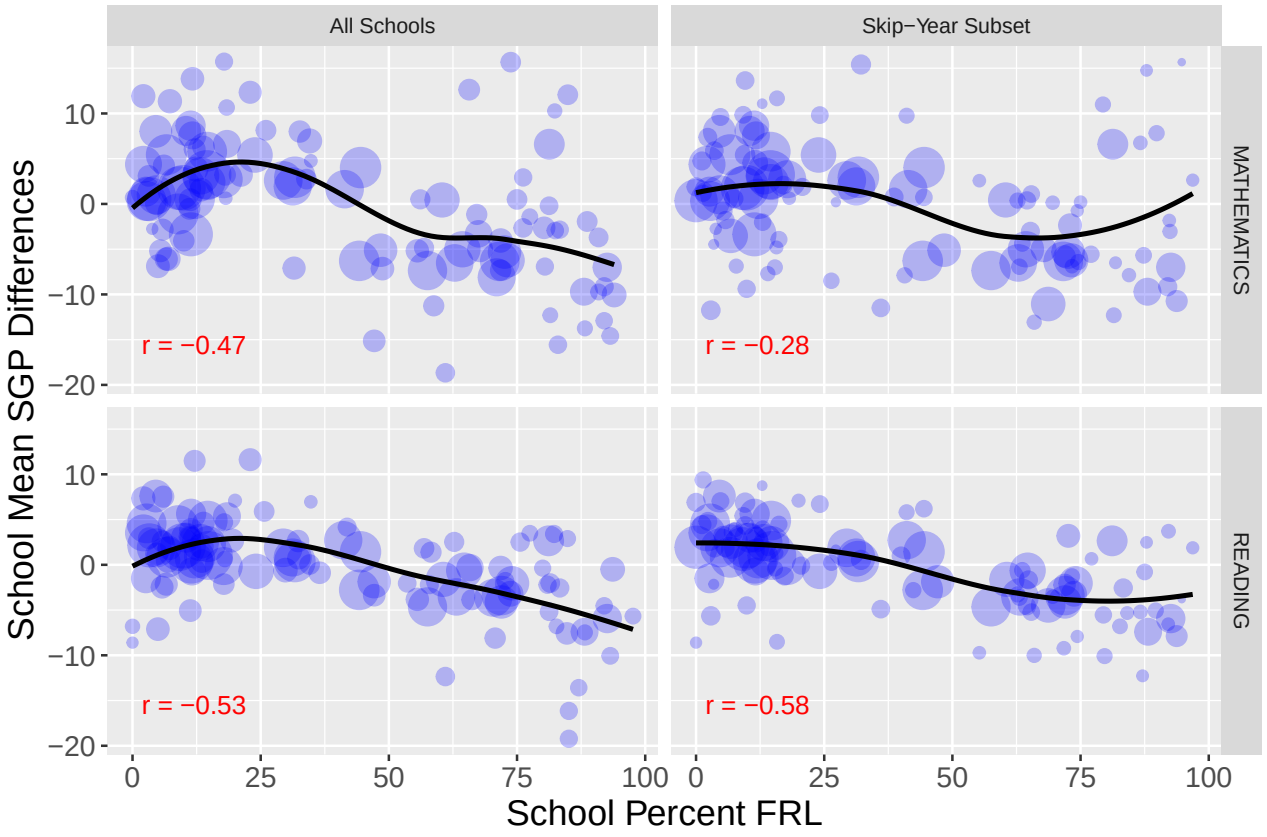
Filter	Content Area	Sequential	Skip Year
All Students	Mathematics	-0.54	-0.62
	Reading	-0.57	-0.69
Skip-Year Subset	Mathematics	-0.58	-0.63
	Reading	-0.51	-0.69

Figure 3 is a visual representation of school level MSGP differences as a function of school FRL population size by content area and student inclusion filter. MSGP differences are defined as **skip-year MSGP *minus* one-year MSGP**, and therefore positive numbers can be interpreted as showing an increase in schools' MSGP when using skip-year calculations, and vice-versa. Bubble sizes are representative of school size, and the black line is a LOESS smoothing curve that depicts the moving average MSGP difference relative to the percent FRL.

This plot shows a slight negative relationship between the MSGP difference and FRL population size. This suggests that, on average, schools with higher FRL populations have lower

difference values (i.e. schools with larger FRL populations may be slightly more likely to be negatively impacted with the use of skip-year analysis).

Figure 3: Mean SGP difference by percent FRL by content area and student inclusion filter



3.3.2 English Language Learners

Table 9 provides the frequencies and proportions of students that had a sequential and/or skip-year SGP calculated in 2019, disaggregated by those identified as English language learners (ELL), or not, and content area. As the results show, there is not a considerable difference between the two groups' growth calculation rates under either analysis. However, roughly 10% fewer students receive a SGP calculation under the skip-year approach.

Table 9: Sequential and skip-year SGP counts and percentages by content area and ELL status

			Sequential		**Skip Year**	
Content Area	ELL Status	Total Students	Count	Percent	Count	Percent
Mathematics	No	25,341	22,061	87.1	19,968	78.8
	Yes	2,960	2,660	89.9	2,482	83.9
Reading	No	25,316	22,015	87.0	19,916	78.7
	Yes	2,948	2,637	89.5	2,275	77.2

Table 10 provides the correlations between sequential and skip-year SGP estimates for ELL/non-ELL students that had both a sequential and skip-year SGP calculated in 2019, as well as the means and standard deviations for these values. The two growth measures are highly correlated and have similar distributional qualities within each group by content area. There is a slight difference *within* the ELL group's growth calculation between the sequential and skip-year analyses. This results in increasing the otherwise modest growth gap between ELL and non-ELL students in Mathematics between the sequential and skip-year analyses.

Table 10: Sequential and skip-year SGP correlation and mean/standard deviation by content area and ELL status

			Sequential		**Skip Year**	
Content Area	ELL Status	SGP Correlation	Mean	SD	Mean	SD
Mathematics	No	0.77	50.3	28.9	50.5	28.8
	Yes	0.79	47.2	28.9	46.3	29.3
Reading	No	0.83	49.6	29.0	50.1	28.9
	Yes	0.84	50.3	28.3	49.2	28.7

Table 11 provides the correlations between school level sequential and skip-year MSGP estimates and the schools' percentage of ELL students. As with the school level summary results in the previous section, these summaries are provided for both 1) all students (including 4^{th} graders) and 2) for the subset of students that have both a sequential and skip-year SGP calculated in 2019. As the results show, the relationship (correlation) between mean growth and the school percentage of ELL students is moderately negative.

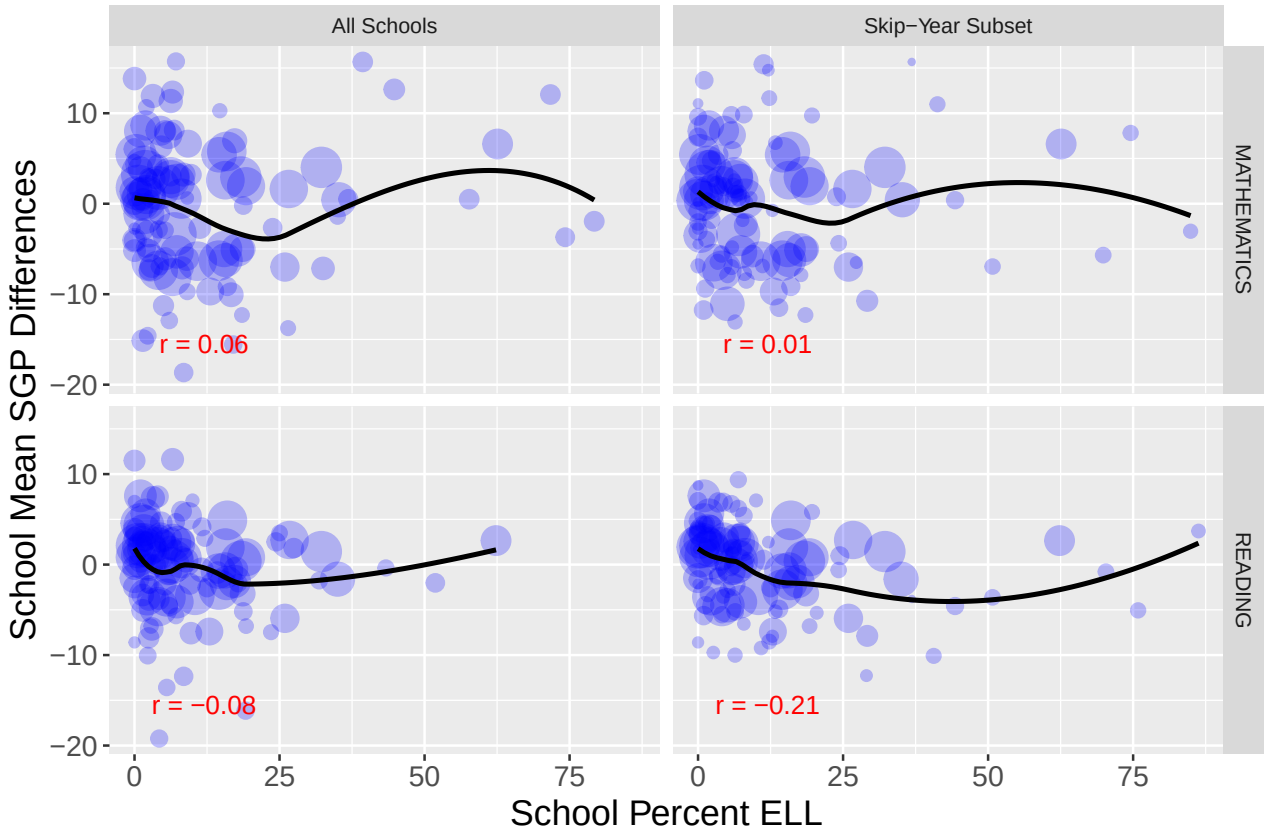
Table 11: School level correlations between mean SGPs and percent ELL by student inclusion filter

Filter	Content Area	Sequential	Skip Year
All Students	Mathematics	-0.23	-0.12
	Reading	-0.18	-0.18
Skip-Year Subset	Mathematics	-0.17	-0.15
	Reading	-0.07	-0.15

Figure 4 is a visual representation of school level MSGP differences as a function of school ELL population size by content area and student inclusion filter. MSGP differences are defined as **skip-year MSGP *minus* one-year MSGP**, and therefore positive numbers can be interpreted as showing an increase in schools' MSGP when using skip-year calculations, and vice-versa. Bubble sizes are representative of school size, and the black line is a LOESS smoothing curve that depicts the moving average MSGP difference relative to the percent ELL.

This plot shows a slightly negative relationship between the MSGP difference and ELL population size for the skip-year subset, particularly in Reading. This suggests that, on average, schools with higher ELL populations have lower difference values in Reading (i.e. schools with larger ELL populations are slightly more likely to be negatively impacted with the use of skip-year analysis, although this impact appears to modest).

Figure 4: Mean SGP difference by percent ELL by content area and student inclusion filter



3.3.3 Students with Disabilities

Table 12 provides the frequencies and proportions of students that had a sequential and/or skip-year SGP calculated in 2019, disaggregated by those identified as students with disabilities (or SWD, indicated as having an IEP), or not, and content area. As the results show, there is not a considerable difference between the two groups' growth calculation rates under either analysis, although students with disabilities (SWD) do receive SGP estimates at slightly lower rate than those without.

Table 12: Sequential and skip-year SGP counts and percentages by content area and SWD status

			Sequential		Skip Year	
Content Area	SWD Status	Total Students	Count	Percent	Count	Percent
Mathematics	No	26,348	23,077	87.6	20,968	79.6
	Yes	1,953	1,644	84.2	1,482	75.9
Reading	No	26,301	23,014	87.5	20,728	78.8
	Yes	1,963	1,638	83.4	1,463	74.5

Table 13 provides the correlations between sequential and skip-year SGP estimates for SWD/non-SWD students that had both a sequential and skip-year SGP calculated in 2019, as well as the means and standard deviations for these values. The results show that the two growth measures are highly correlated and have similar distributional qualities within each group by content area. There is a slight difference *within* the SWD group's MSGPs between the sequential and skip-year analyses. Specifically, this group's typical growth in both ELA and Mathematics are 1-3 points lower using the skip-year analysis, thus increasing the existing growth gap between SWD and non-SWD populations. The gap is 7 points, on average, for the sequential SGP estimates, and increases slightly to approximately 9 points using the skip-year estimates.

Table 13: Sequential and skip-year SGP correlation and mean/standard deviation by content area and SWD status

			Sequential		Skip Year	
Content Area	SWD Status	SGP Correlation	Mean	SD	Mean	SD
Mathematics	No	0.77	50.4	28.8	50.6	28.8
	Yes	0.81	44.2	29.9	41.5	29.8
Reading	No	0.83	50.2	28.8	50.6	28.7
	Yes	0.80	42.6	29.0	41.3	29.2

Table 14 provides the correlations between school level sequential and skip-year MSGP estimates and the schools' percentage of SWD students. As with the school level summary results in the previous section, these summaries are provided for both 1) all students (including 4^{th} graders) and 2) for the subset of students that have both a sequential and skip-year SGP calcu-

lated in 2019. As the results show, a negative relationship (correlation) exists between typical school growth and the school SWD percentage. That is, the schools with larger populations of students with disabilities tend to demonstrate lower academic growth.

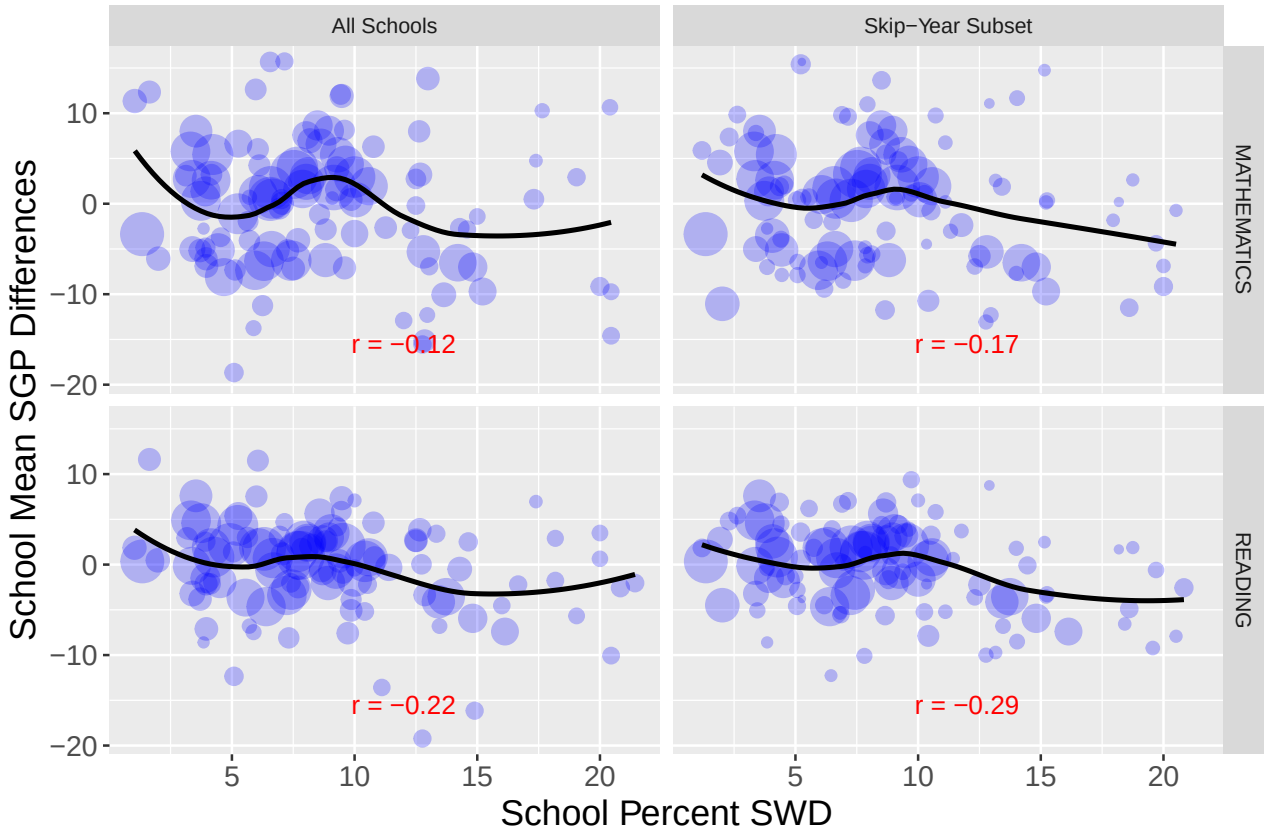
Table 14: School level correlations between mean SGPs and percent SWD by student inclusion filter

Filter	Content Area	Sequential	Skip Year
All Students	Mathematics	-0.32	-0.29
	Reading	-0.32	-0.35
Skip-Year Subset	Mathematics	-0.37	-0.40
	Reading	-0.41	-0.48

Figure 5 is a visual representation of school level MSGP differences as a function of school SWD population size by content area and student inclusion filter. MSGP differences are defined as **skip-year MSGP *minus* one-year MSGP**, and therefore positive numbers can be interpreted as showing an increase in schools' MSGP when using skip-year calculations, and vice-versa. Bubble sizes are representative of school size, and the black line is a LOESS smoothing curve that depicts the moving average MSGP difference relative to the percent SWD.

The plots show slight negative relationships between MSGP difference and SWD population size for the skip-year subset. This suggests that, on average, schools with higher SWD populations have lower difference values (i.e. schools with larger SWD populations are slightly more likely to be negatively impacted with the use of skip-year analysis). Note that the range of school percent SWD is restricted to 0 to 25%.

Figure 5: Mean SGP difference by percent SWD by content area and student inclusion filter



4 Summary

The analyses conducted in this report investigate whether skip-year SGPs can be used in place of the standard one-year SGPs. The report discussed four potential issues:

- Are the students with skip-year SGPs systematically different than those with one-year SGPs?
- Are the one-year SGPs systematically different than the skip-year SGPs at the individual level?
- Are the one-year SGPs systematically different than the skip-year SGPs when aggregated to the school level?
- Are the one-year SGPs systematically different than the skip-year SGPs for different demographic subgroups?

No significant systematic differences were found for any of these questions. This is not to say there were not differences worth considering for a minority of students and schools. The results produced by these analyses do not disqualify the use of skip-year growth in lieu of one-year growth. However, they do not unequivocally qualify their use either. Since the results here are generated from historical data derived under "usual" educational circumstances and the current circumstances are far from usual, it is likely that spring 2021 skip-year data will exhibit greater deviations than what is reported here. Until confirmation is available that 2021 skip-year deviations are no larger than they were historically, it is not possible to assure the usability of skip-year growth for business-as-usual accountability.

Beyond the technical characteristics of skip-year growth lie numerous practical and political considerations for its use in both state and federal accountability. As Demonstration approaches 2021, any decisions related to student testing and accountability will require some technical consideration, but much more practical and political calculation to determine the best course of action going forward.

Assuming testing does occur in some form in 2021, it is highly recommended that growth be calculated regardless of whether it is used for accountability. There are numerous, valuable inquiries that can be addressed with skip-year SGPs available including:

- What was the overall impact on student learning in the state of Demonstration due to COVID-19?
- What demographic subgroups fared best and which demographic subgroups fared most poorly in terms of learning during the COVID-19 pandemic?
- Are there COVID-19 related instructional approaches that led to greater student learning than others? If so, what were they and how much more learning were they associated with?

Critical to the investigation of COVID-19 related learning loss will be accurate data on COVID-19 related education programs and student participation over time. Collecting these data would allow the Student Growth Percentiles Package to leverage student growth data and inform stakeholders about the impacts of the COVID-19 pandemic on student educational outcomes.

References

Betebenner, D. W., VanIwaarden, A., Domingue, B., & Shang, Y. (2020). *SGP: Student growth percentiles & percentile growth trajectories.* Retrieved from sgp.io

R Core Team. (2020). *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing. Retrieved from http://www.R-project.org

Appendix A - Goodness of Fit Plots

A goodness of fit plot is produced for each unique analysis run in 2019. All fit plots will contain at least four panels. Each panel is a different depiction of the distribution of the Student Growth Percentiles (SGPs) calculated in that analysis relative to the students' prior or current achievement (i.e. the test scores used as the independent and dependent variables in the model).

The top panel is a mosaic plot that shows the percentage of students that fall into each prior proficiency level, and the location of the 10^{th} through 90^{th} deciles of the SGP distribution represented as dashed white lines (with the exception of the solid white line for the median/50^{th} percentile). Ideally the median SGP will be at or near 50 for all prior achievement level groups. The top panel is excluded when students' prior achievement level data is unavailable.

The "Ceiling/Floor Effects Test" panel helps identify problems in SGP estimation at the Highest and Lowest Obtainable/Observed Scale Scores (HOSS and LOSS). The table of values shows whether the current year scores at both extremes yield expected SGP values. The expectation is that the majority of SGPs for students scoring at or near the LOSS will be low (preferably less than 5 and not higher than 20), and that SGPs for students scoring at or near the HOSS will be high (preferably higher than 95 and not less than 80). Because few students may score *exactly* at the HOSS/LOSS, the top/bottom 50 students are selected and any student scoring within their range of scores are selected for inclusion in these tables. Consequently, there may be a range of scores at the HOSS/LOSS rather than a single score, and there may be more than 50 students included in the HOSS/LOSS row if the 50 students at the extremes only contain the single HOSS/LOSS score.

The "Student Growth Percentile Range" panel at bottom left shows the empirical distribution of SGPs given prior scale score deciles in the form of a 10 by 10 cell grid. Percentages of student growth percentiles between the 10^{th}, 20^{th}, 30^{th}, 40^{th}, 50^{th}, 60^{th}, 70^{th}, 80^{th}, and 90^{th} percentiles were calculated based upon the empirical decile of the cohort's prior year scaled score distribution[1]. Deviations from perfect fit are indicated by red and blue shading. The further above 10 the darker the red, and the further below 10 the darker the blue.

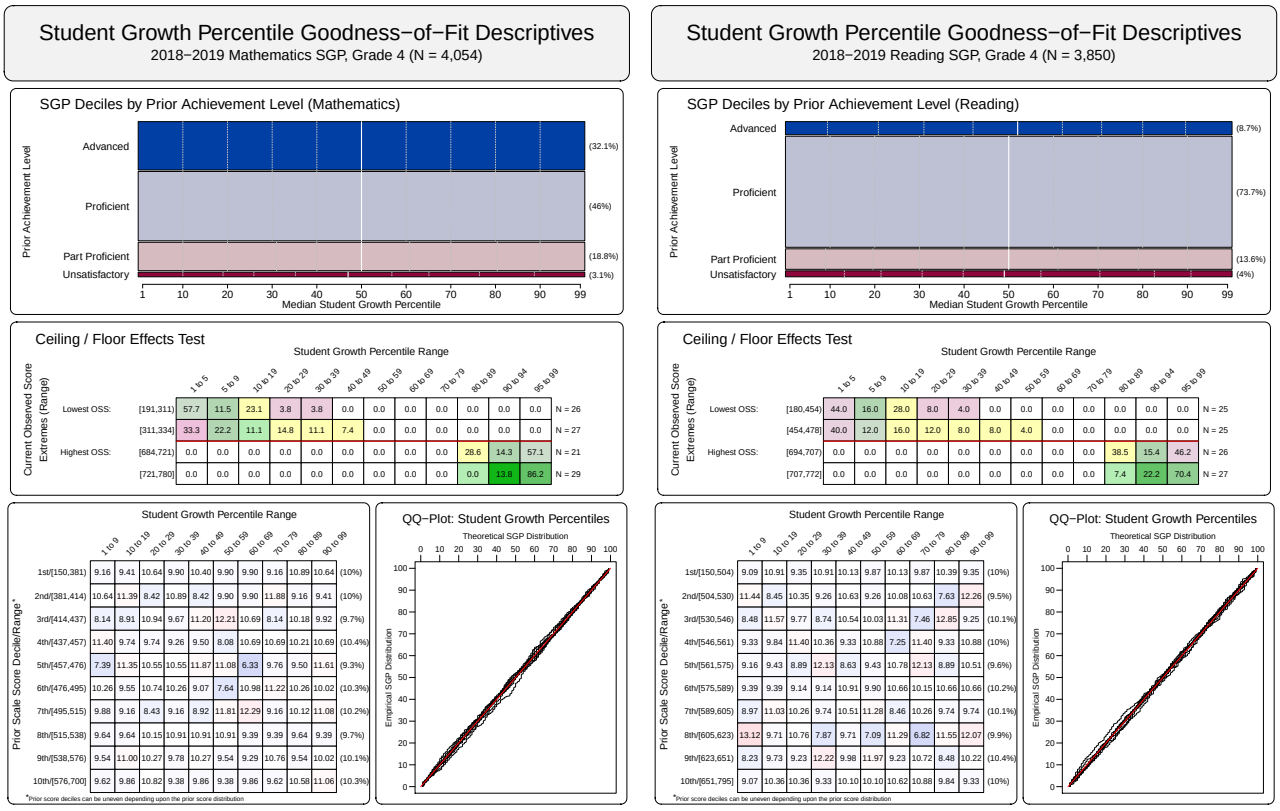
The bottom right panel of each plot is a Q-Q plot which compares the observed distribution of SGPs with the theoretical (uniform) distribution. An ideal plot here will show black step function lines that do not deviate from the ideal, red line which traces the 45 degree angle of perfect fit.

The following sections provide the fit plots for the sequential and skip year analyses. The first section provides the 4^{th} grade Mathematics and Reading plots for the 2019 sequential analyses only. These provide context for what a single prior one-year analysis looks like for Demonstration. The subsequent sections provides the fit plots from both sequential and skip-year analyses for Mathematics And Reading. In these two content area specific sections, the grade level analysis plots are presented with each grade in a row; sequential analyses are in the left column and skip-year analyses are in the right column.

[1]The total students in each analysis varies depending on grade and subject, and prior score deciles are based only on scores for students used in the SGP calculations.

A.1 Sequential Analyses Only

Figure A1: Sequential growth goodness of fit plots for 4^{th} grade Mathematics and Reading (no skip-year analyses)



A.2 Mathematics

Figure A2: Sequential (left) and skip-year (right) fit plots for Math (grades 5 - 6)

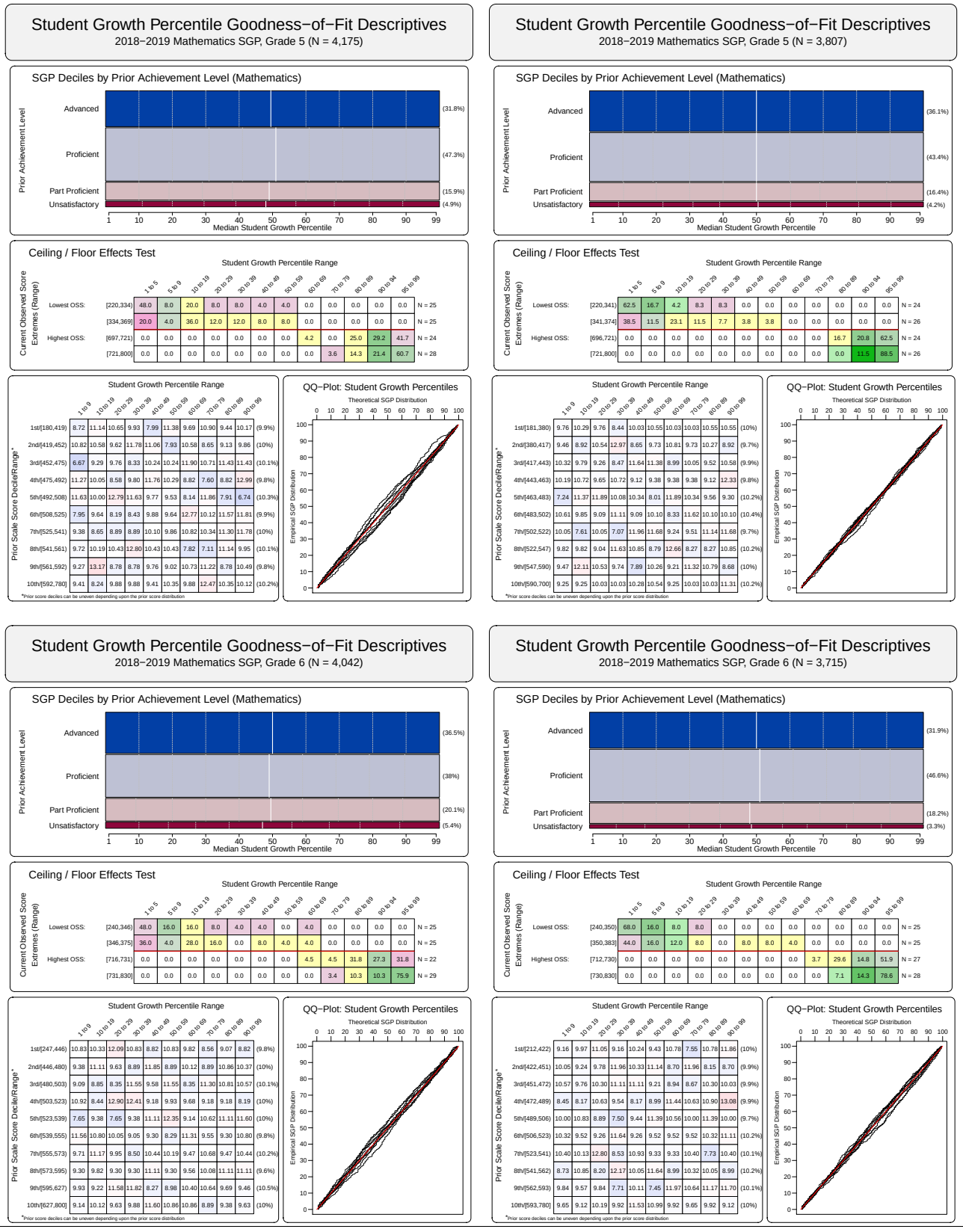


Figure A3: Sequential (left) and skip-year (right) fit plots for Math (grades 7 - 8)

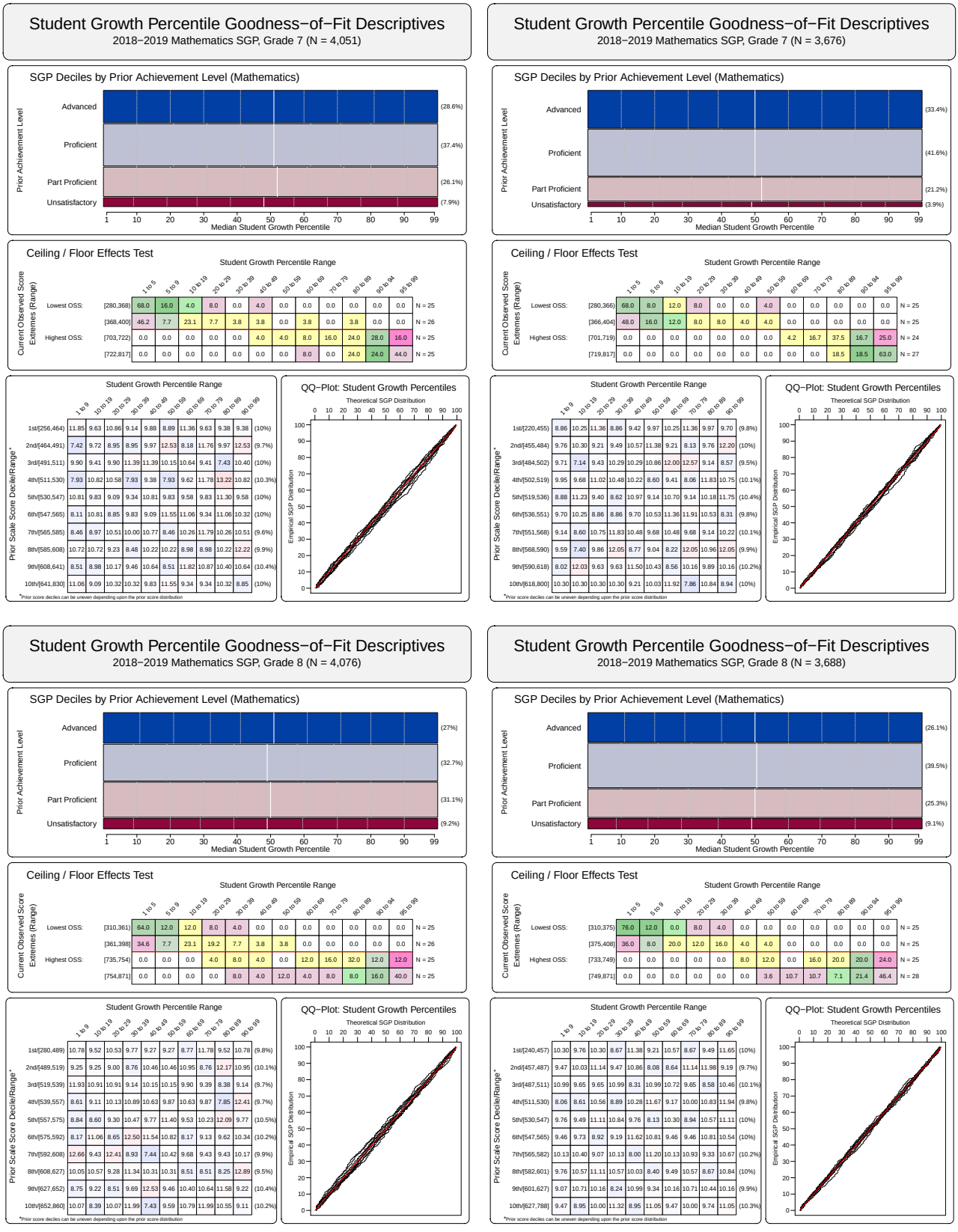
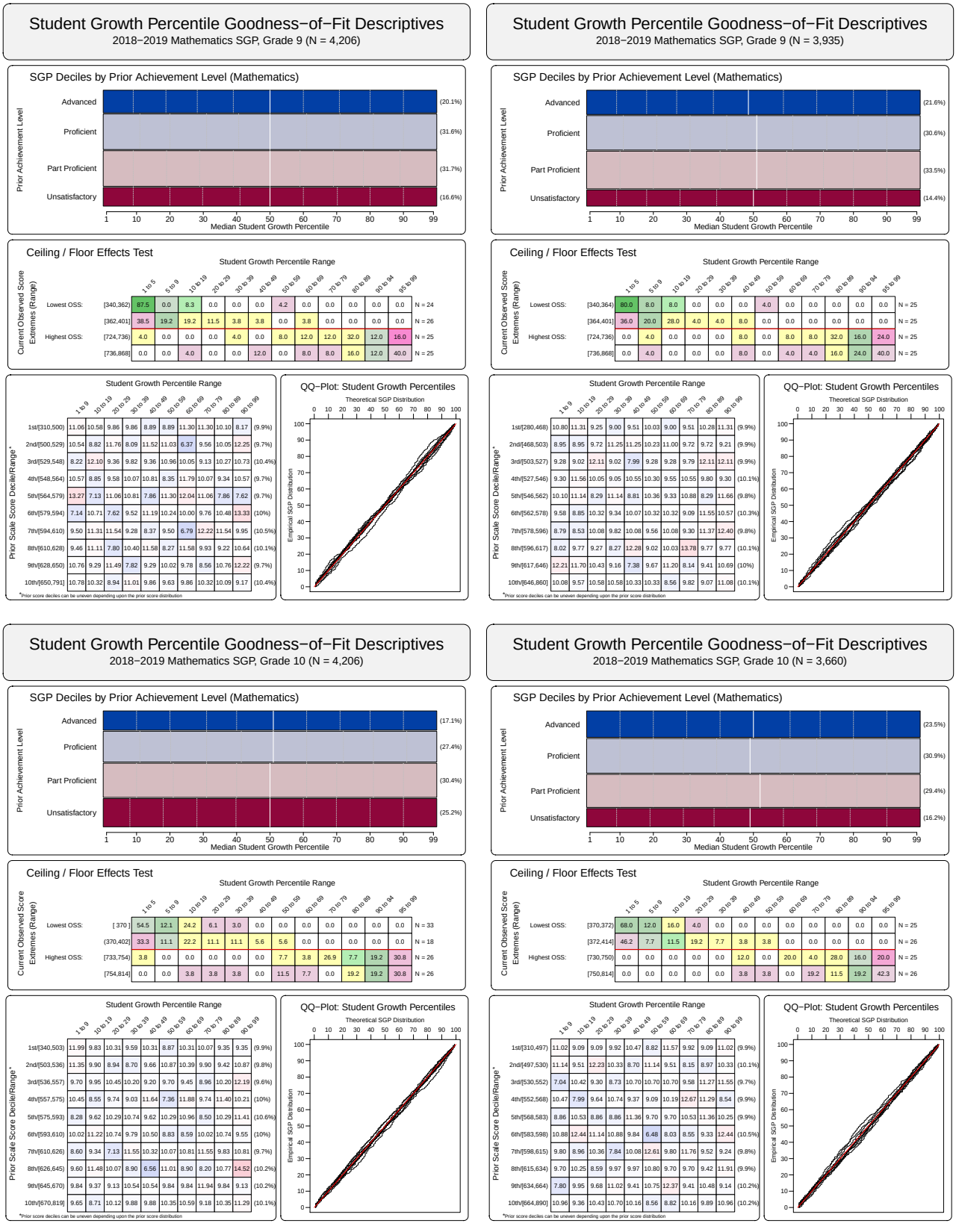


Figure A4: Sequential (left) and skip-year (right) fit plots for Math (grades 9 - 10)



A.3 Reading

Figure A5: Sequential (left) and skip-year (right) fit plots for Reading (grades 5 - 6)

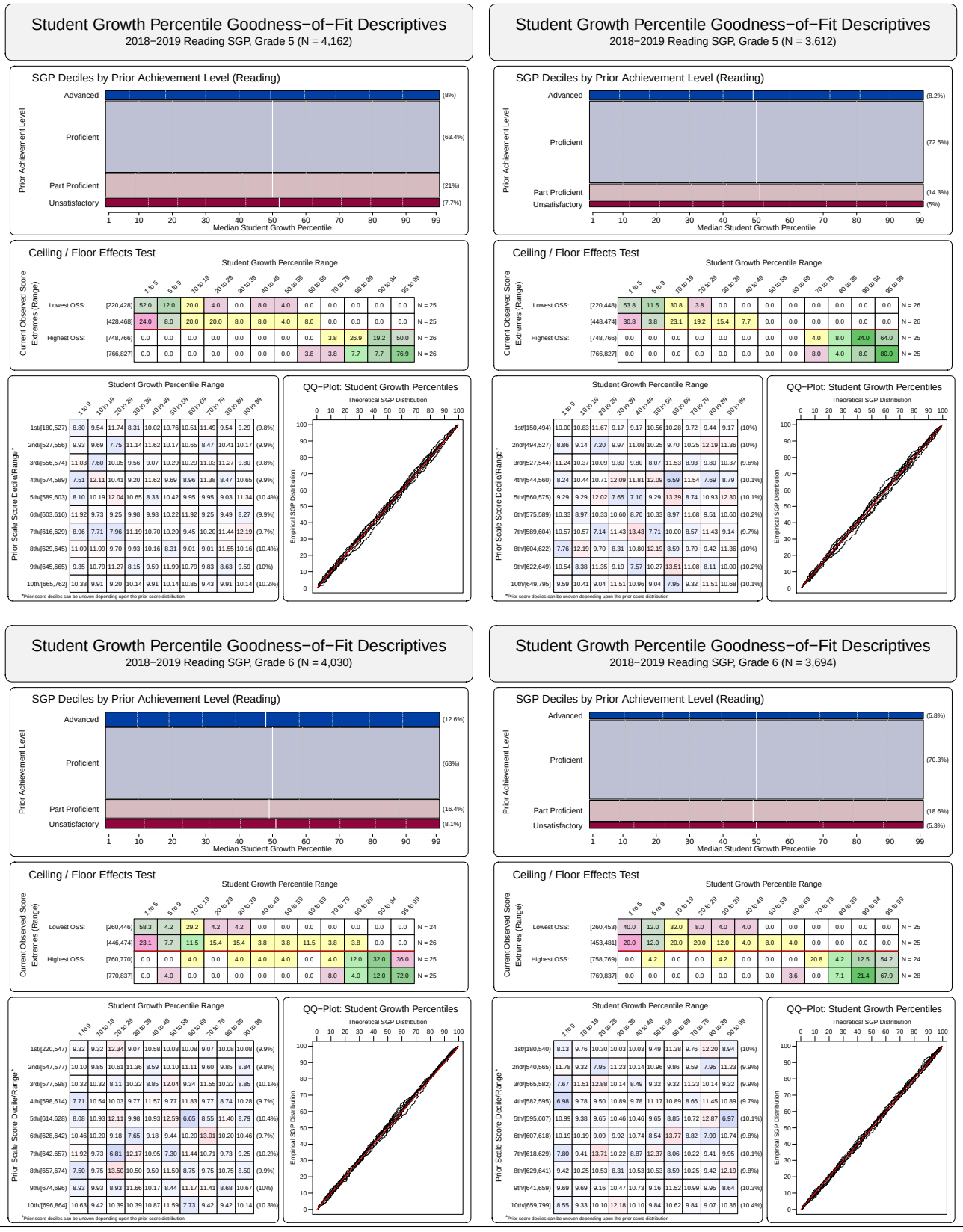


Figure A6: Sequential (left) and skip-year (right) fit plots for Reading (grades 7 - 8)

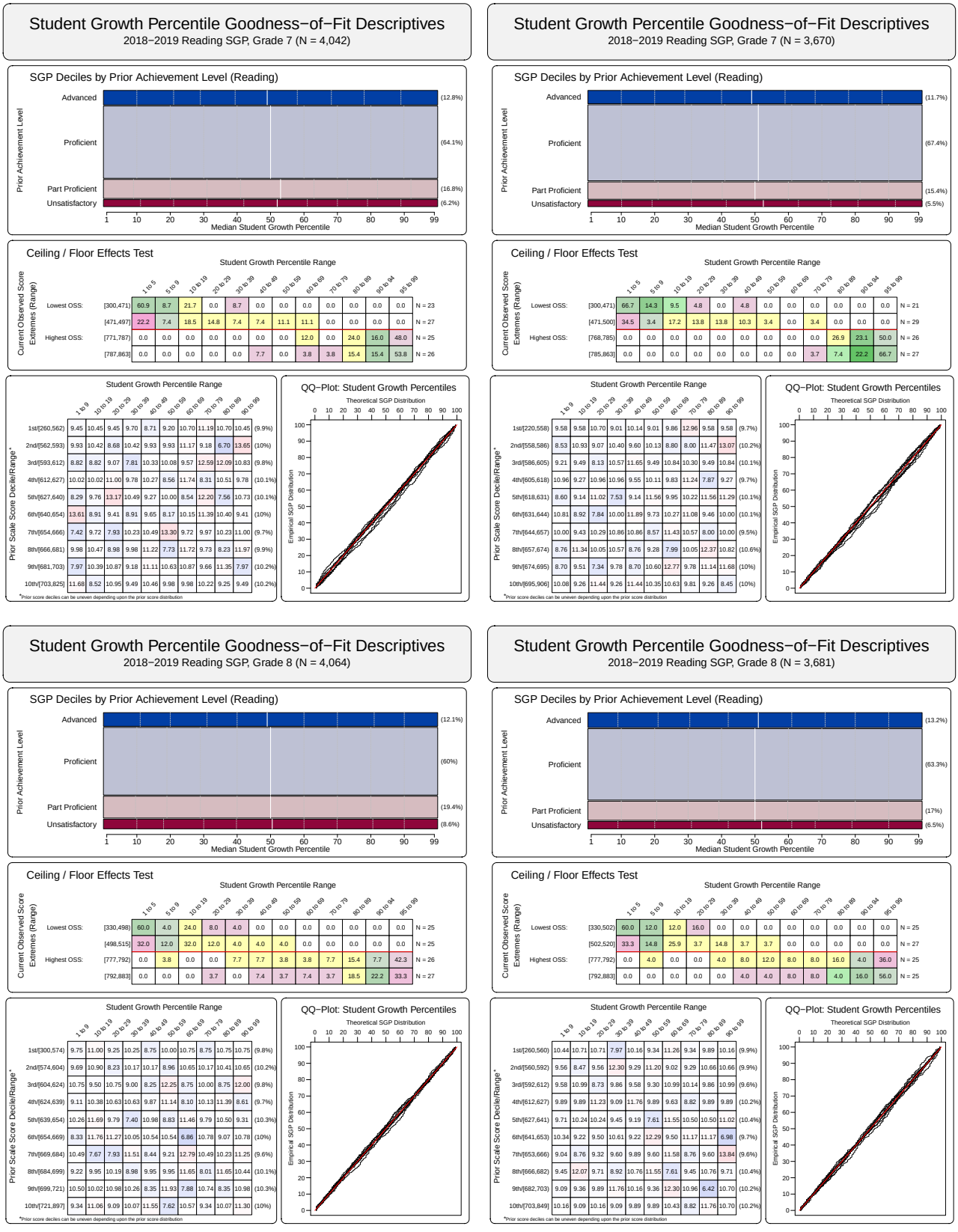


Figure A7: Sequential (left) and skip-year (right) fit plots for Reading (grades 9 - 10)