

# Appendix A to the 2015 Utah Growth Model Report

## Utah Student Growth Model Fit Plots

October 2015

# 1 Student Growth Percentile Fit Plots

A goodness of fit plot is produced for each unique analysis run in 2015. Each analysis is defined by the grade and content area for the grade-level analyses and the unique course progression sequences for the end of course test (EOCT) subjects.

Most fit plot contains four panels. When the prior scale score is unavailable the top panel will be excluded. Usually unavailability is due to the use of equated SGP estimation in an assessment program transition year or an End of Course Test (EOCT) analyses that use a prior course progression that is not a subset of the most typical (i.e. “canonical”) course progression. Prior scale score and prior proficiency data is required in the top panel as it displays a mosaic plot that shows the percentage of students that fall into each proficiency level, and the location of the 10<sup>th</sup> through 90<sup>th</sup> quantiles of the Student Growth Percentile (SGP) distribution represented as dashed white lines (with the exception of the solid white line for the median/50<sup>th</sup> percentile). Ideally this plot will show that the median percentile is at or near 50 for all prior achievement level groups.

The middle panel contains a “Ceiling/Floor Effects Test”, which is a relatively recent addition to the goodness of fit plots. It is intended to help identify potential problems in SGP estimation at the Highest and Lowest Obtainable (or Observed) Scale Scores (HOSS and LOSS). Issues can occur here where, when ceiling or floor effects are present in both the current and prior year(s) scores, it may be relatively typical for extremely high/low achieving students to consistently score at or near the HOSS/LOSS. As a result, the SGPs for students scoring at the HOSS/LOSS will be unexpectedly low/high. That is, for example, if a sufficient number of students maintain performance at the HOSS over time, this performance will be estimated to typical, and therefore SGP estimates will reflect typical growth (e.g. 50th percentile). In some cases these extreme score values or small deviations from them might even yield low growth estimates. Although these score patterns can legitimately be estimated as a low growth percentiles because they represent rather typical growth, it is potentially an unfair description of their growth performance (and by proxy teacher, school or district performance or “value added”) caused by an artifact of the inability of the assessment to adequately measure student performance at extreme ability levels.

The table of values here shows whether the current year scale scores at both extremes yield the expected SGPs<sup>1</sup>. 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 10), and that SGPs for students scoring at or near the HOSS will be high (preferably higher than 95 and not less than 90). Because few students may score *exactly* at the HOSS/LOSS<sup>2</sup>, 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<sup>3</sup>, 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<sup>4</sup>. In either case, a more

<sup>1</sup>Note that the prior year scale scores are not represented here, but are critical in the SGP calculation of all students

<sup>2</sup>This is particularly true when IRT Theta ( $\theta$ ) estimates are used rather than scaled scores, which often apply artificial LOSS/HOSS cut points.

<sup>3</sup>This can make the interpretation of the SGP distribution somewhat harder because score not directly at the extremes do not necessarily preclude maximum SGP estimates.

<sup>4</sup>This also leads to potential difficulties in interpretation because with a higher number of students comes a

fine grained analysis of the relationship between score histories and SGPs and the associated potential for ceiling or floor effects in the models/model estimates may be necessary. These plots are meant to serve more as a “canary in the coal mine” than as a detailed indicator.

The bottom left panel 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<sup>th</sup>, 20<sup>th</sup>, 30<sup>th</sup>, 40<sup>th</sup>, 50<sup>th</sup>, 60<sup>th</sup>, 70<sup>th</sup>, 80<sup>th</sup>, and 90<sup>th</sup> percentiles were calculated based upon the empirical decile of the cohort’s prior year scaled score distribution<sup>5</sup>. 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. A more detailed discussion about the reasons for and implications of model misfit for the various SGP analysis types can be found in the “Goodness of Fit” section of the 2015 Utah Student Growth Model report.

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 greatly from the ideal, red line which traces the 45 degree angle of perfect fit.

## 2 SAGE Grade-Level Fit Plots

### 2.1 ELA

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greater distribution of prior scale scores and therefore a greater distribution of the expected SGPs

<sup>5</sup>The total students in each for the analyses varies depending on grade and subject.

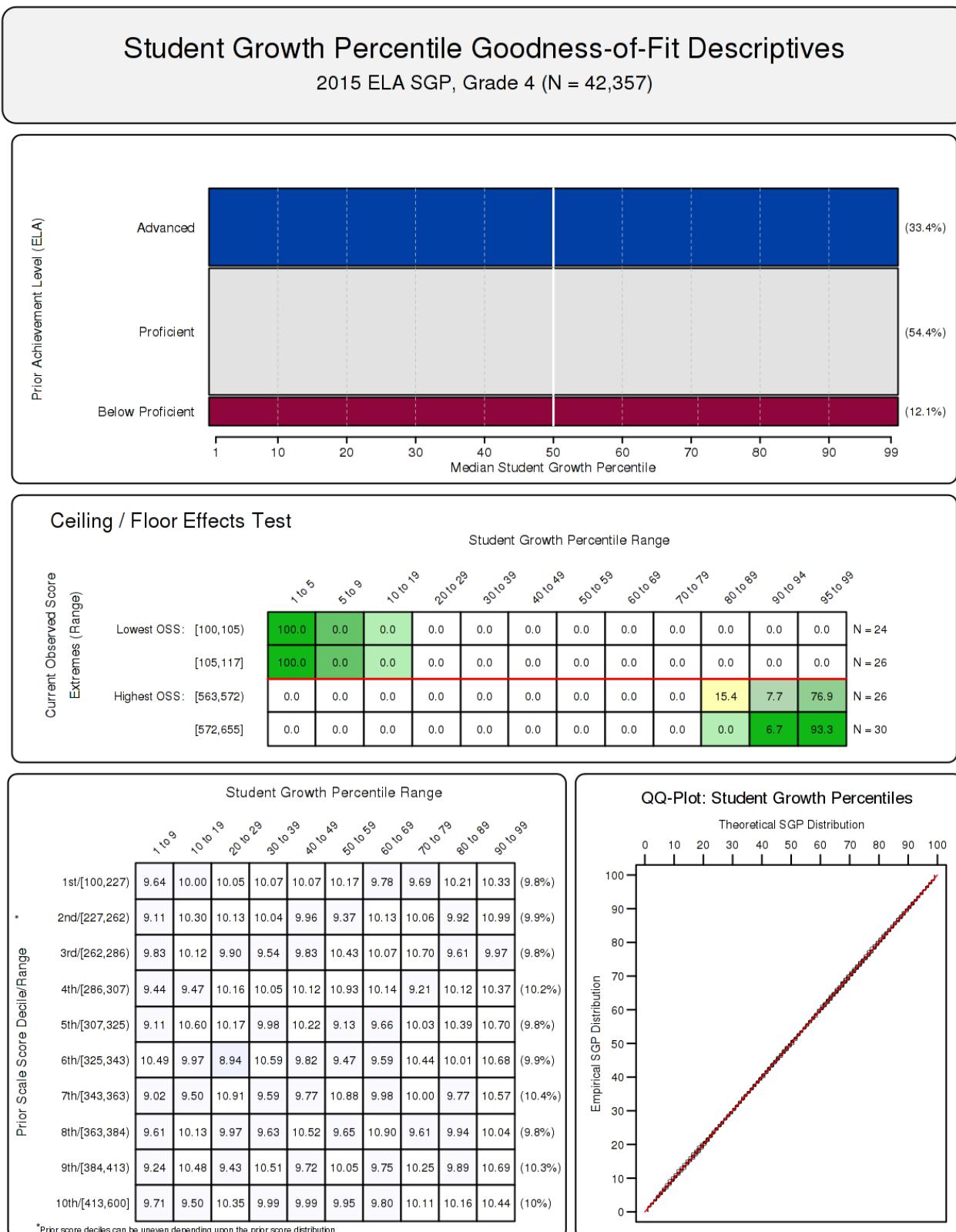


Figure 1: Goodness of Fit Plot for Grade 4 ELA, 2015.

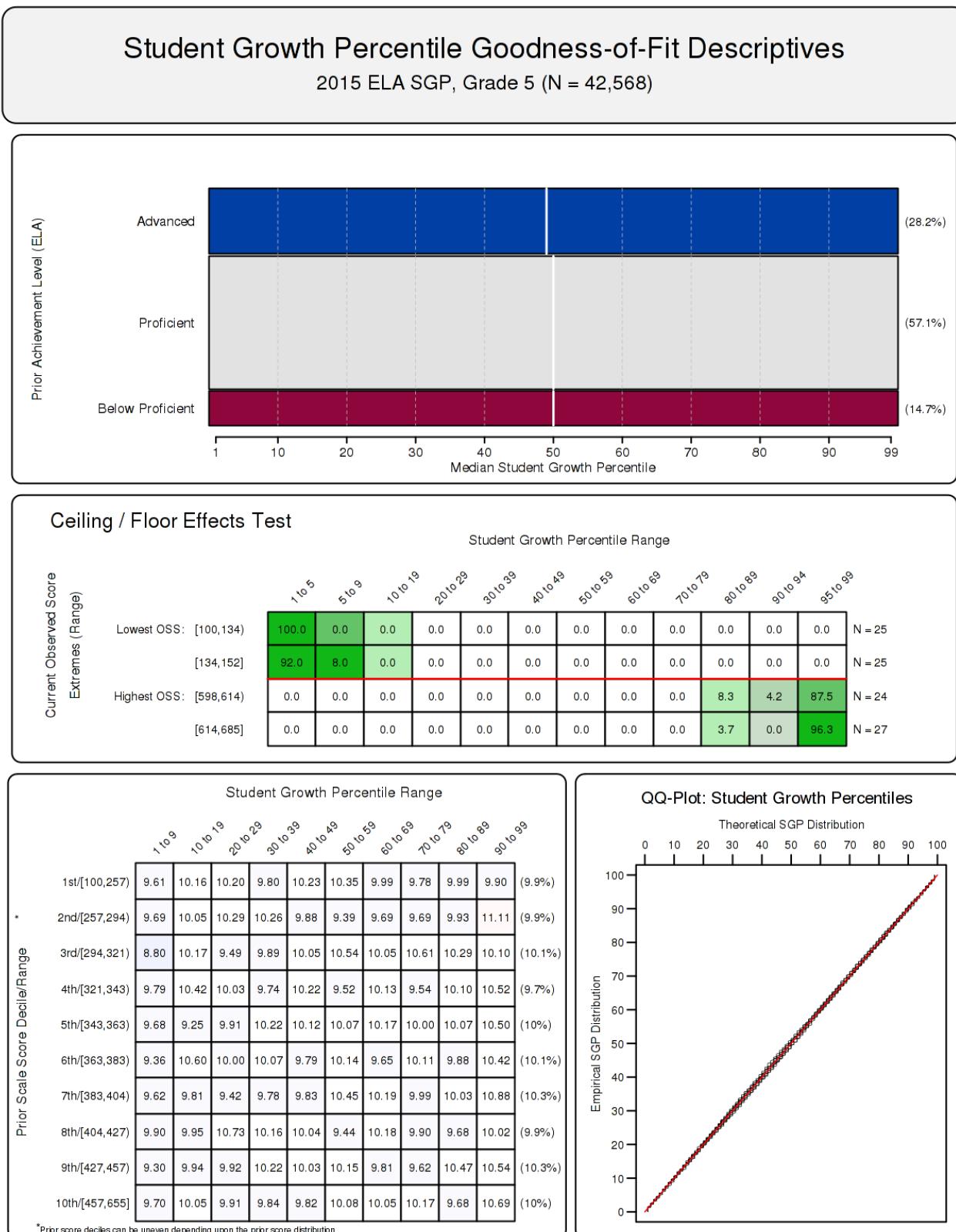


Figure 2: Goodness of Fit Plot for Grade 5 ELA, 2015.

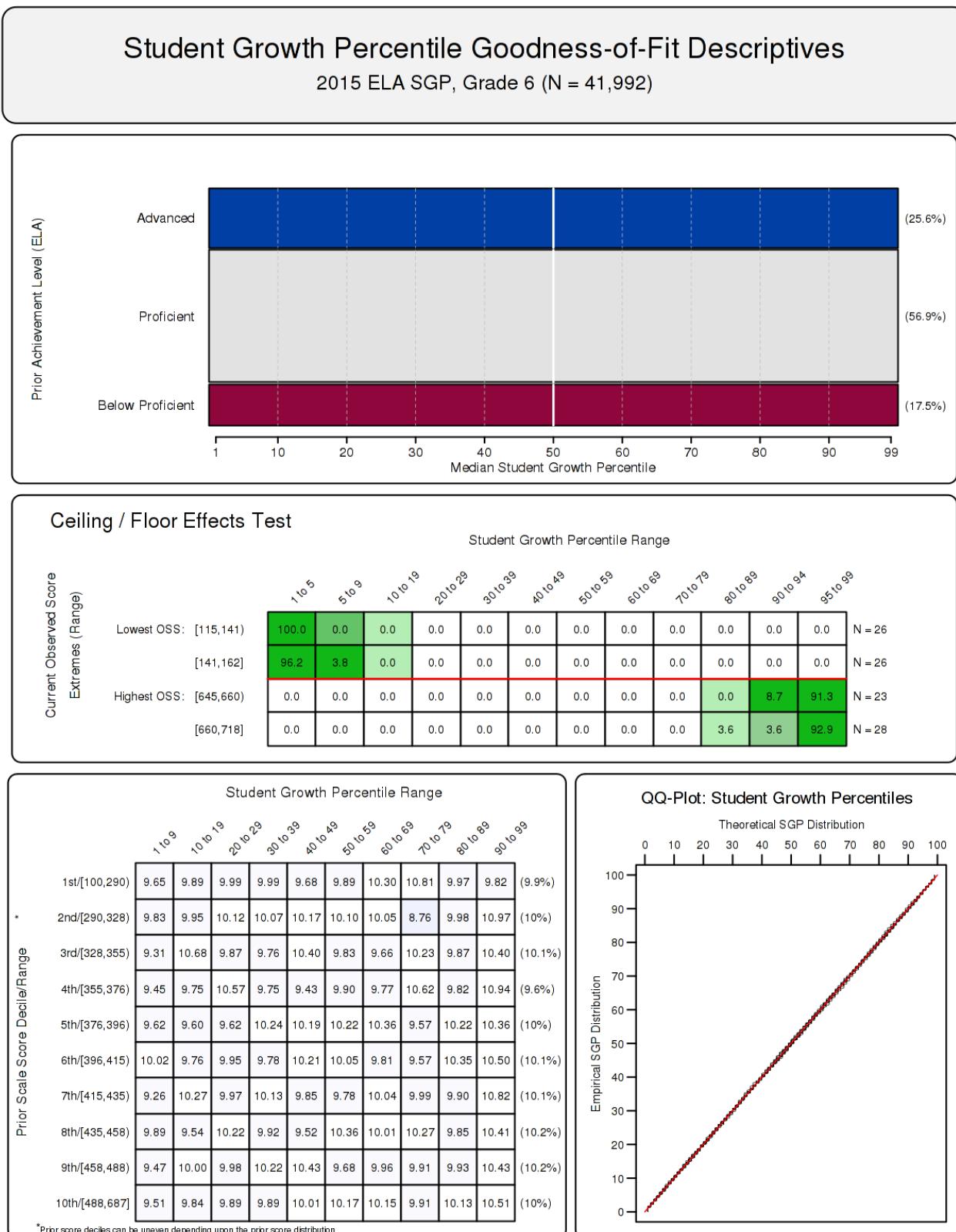


Figure 3: Goodness of Fit Plot for Grade 4 ELA, 2015.

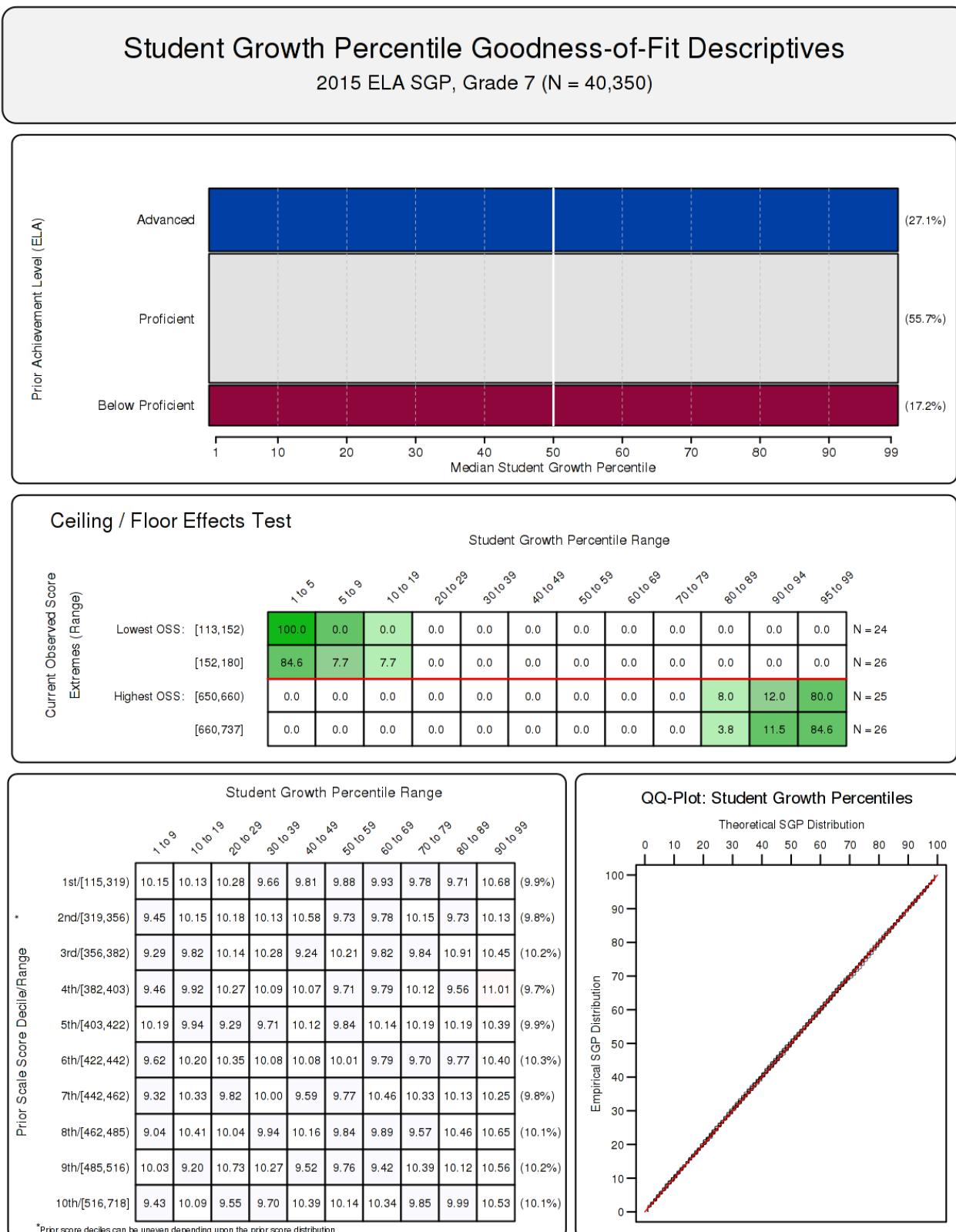


Figure 4: Goodness of Fit Plot for Grade 7 ELA, 2015.

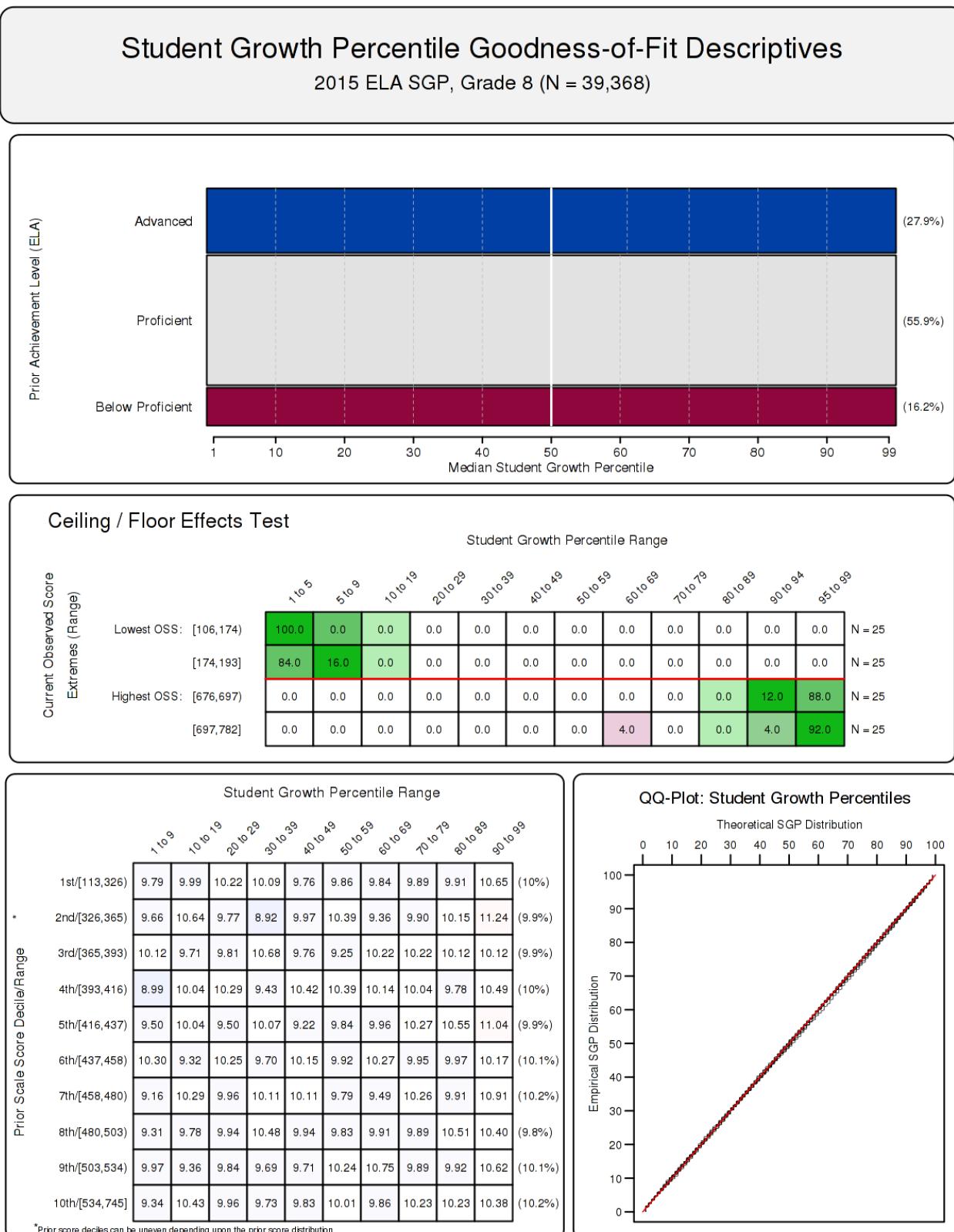


Figure 5: Goodness of Fit Plot for Grade 8 ELA, 2015.

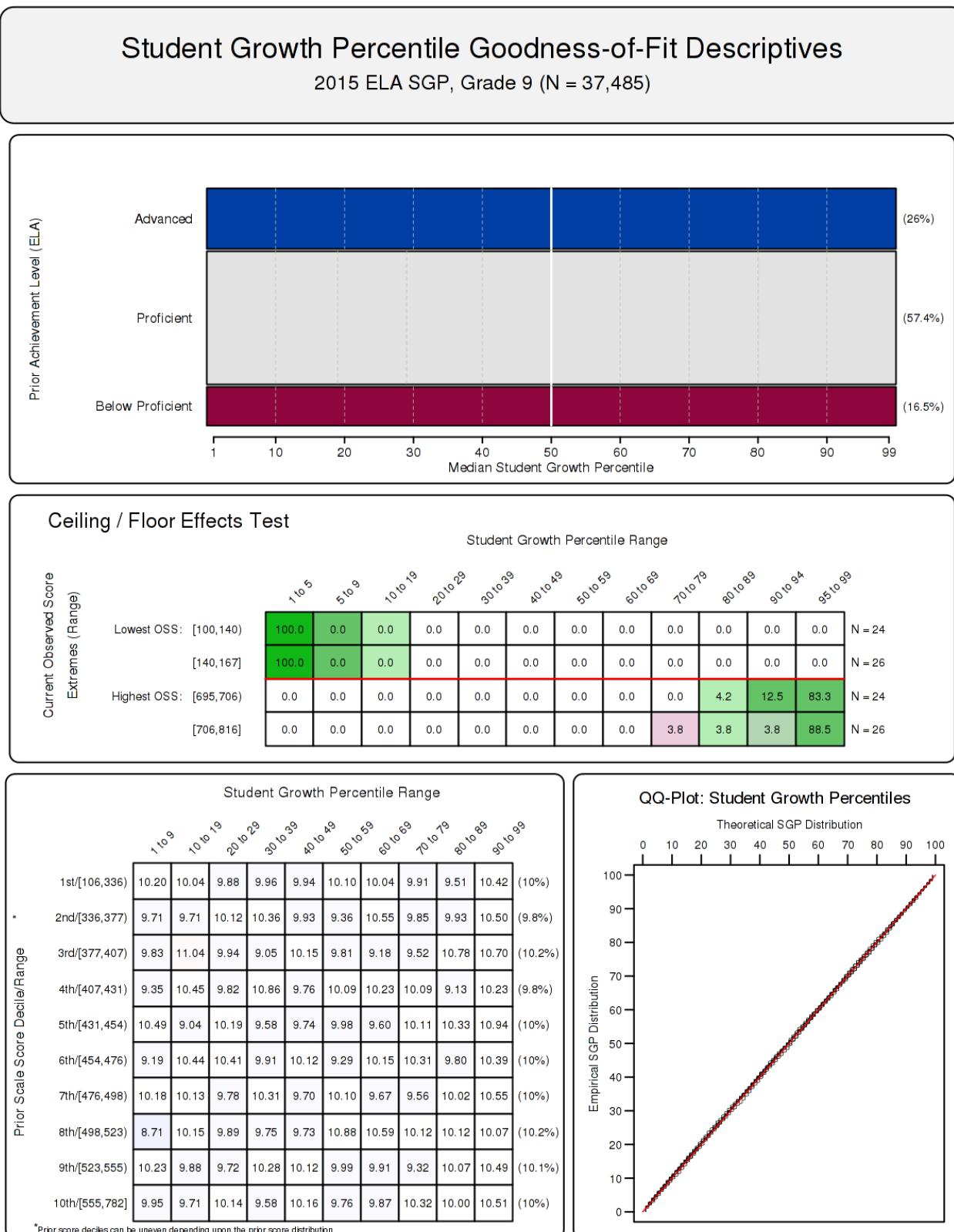


Figure 6: Goodness of Fit Plot for Grade 9 ELA, 2015.

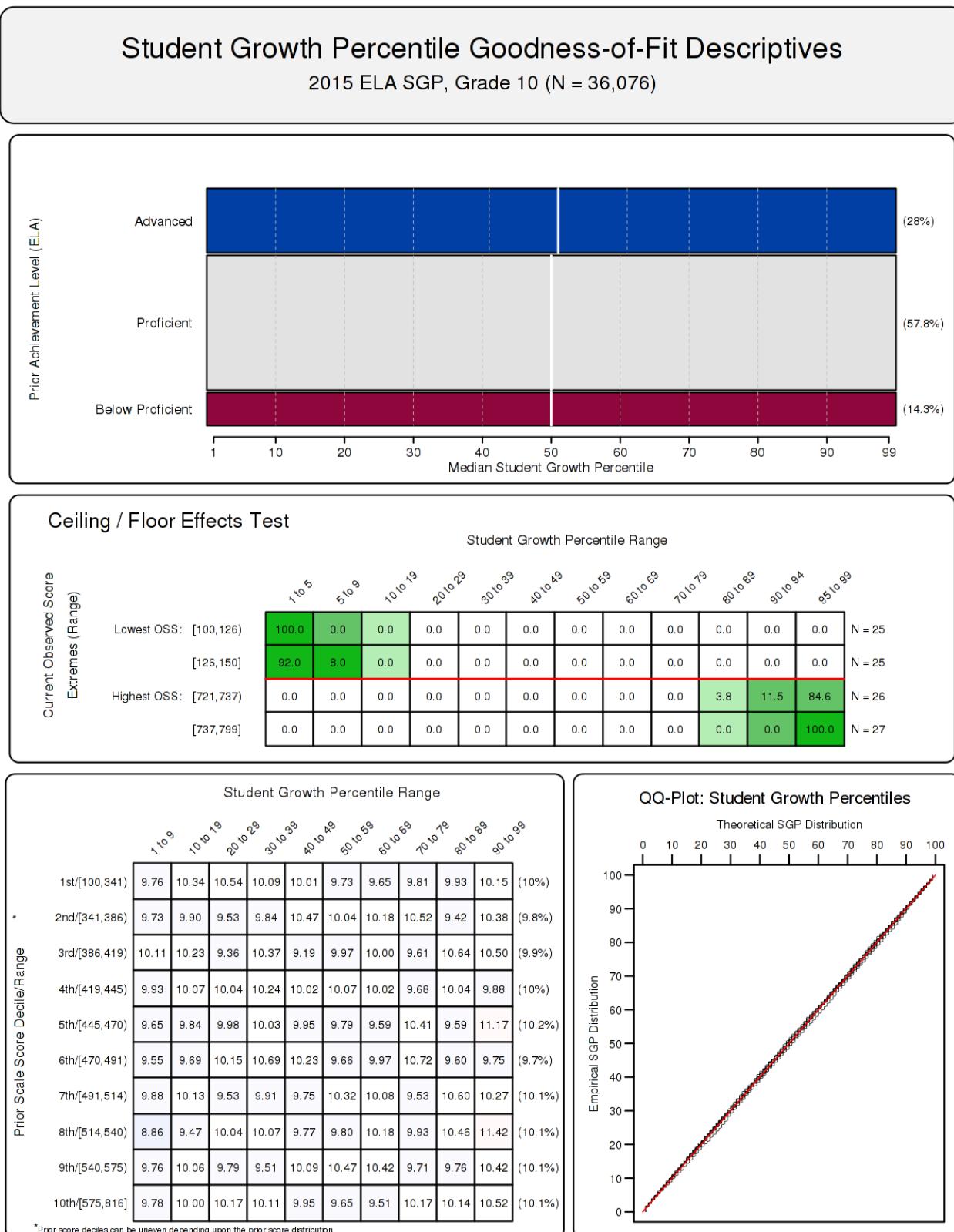


Figure 7: Goodness of Fit Plot for Grade 10 ELA, 2015.

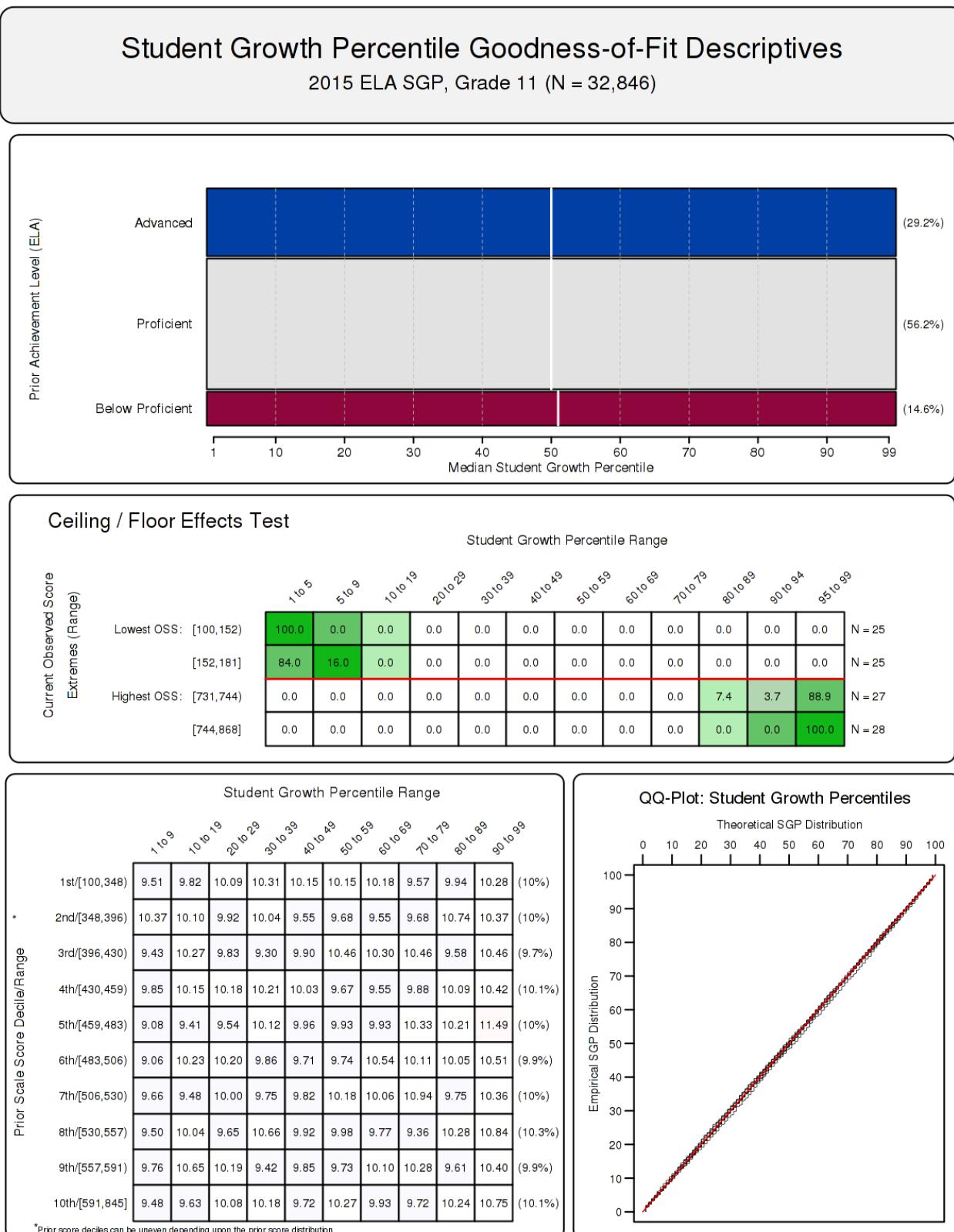


Figure 8: Goodness of Fit Plot for Grade 11 ELA, 2015.

## 2.2 Mathematics

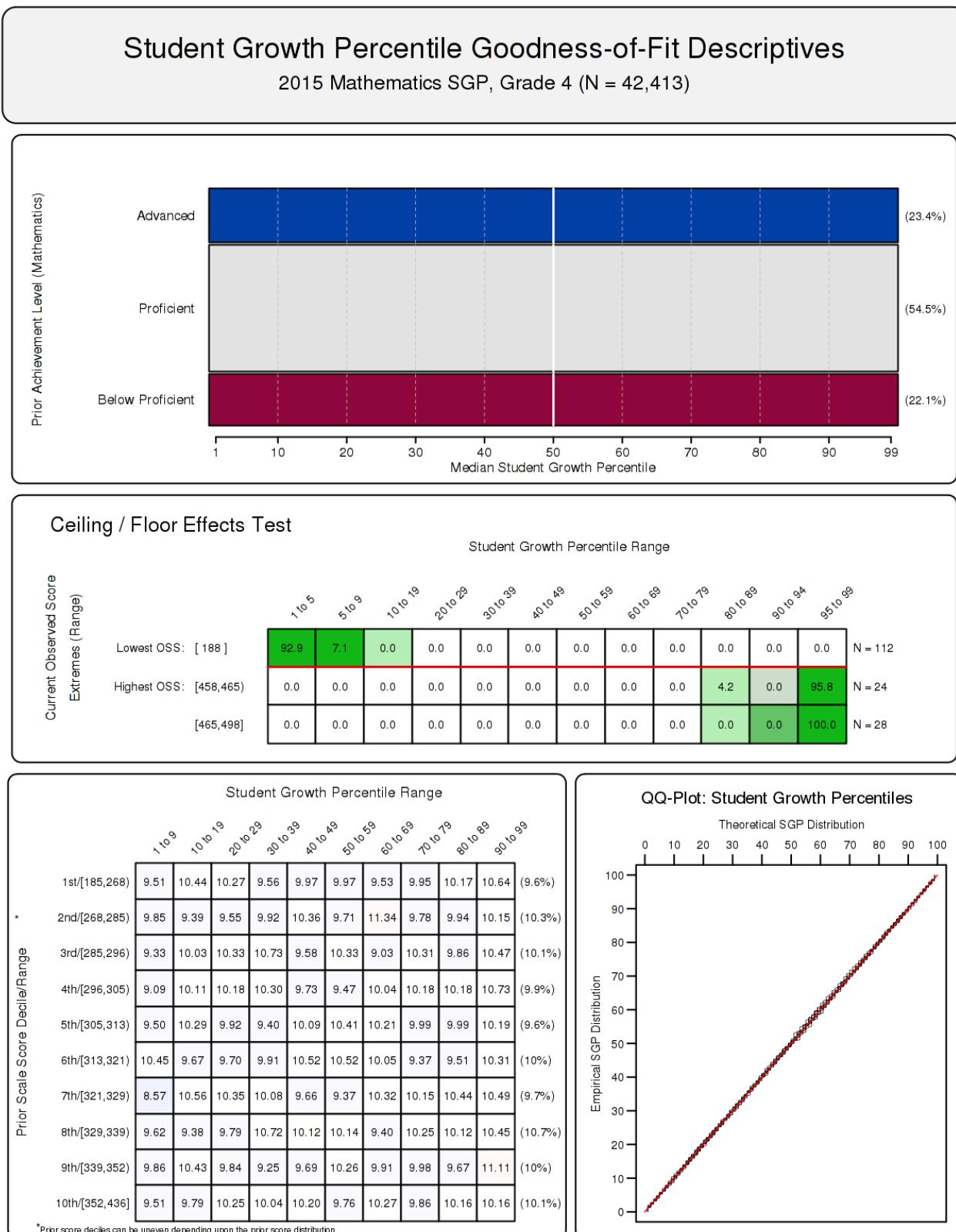


Figure 9: Goodness of Fit Plot for Grade 4 Mathematics, 2015.

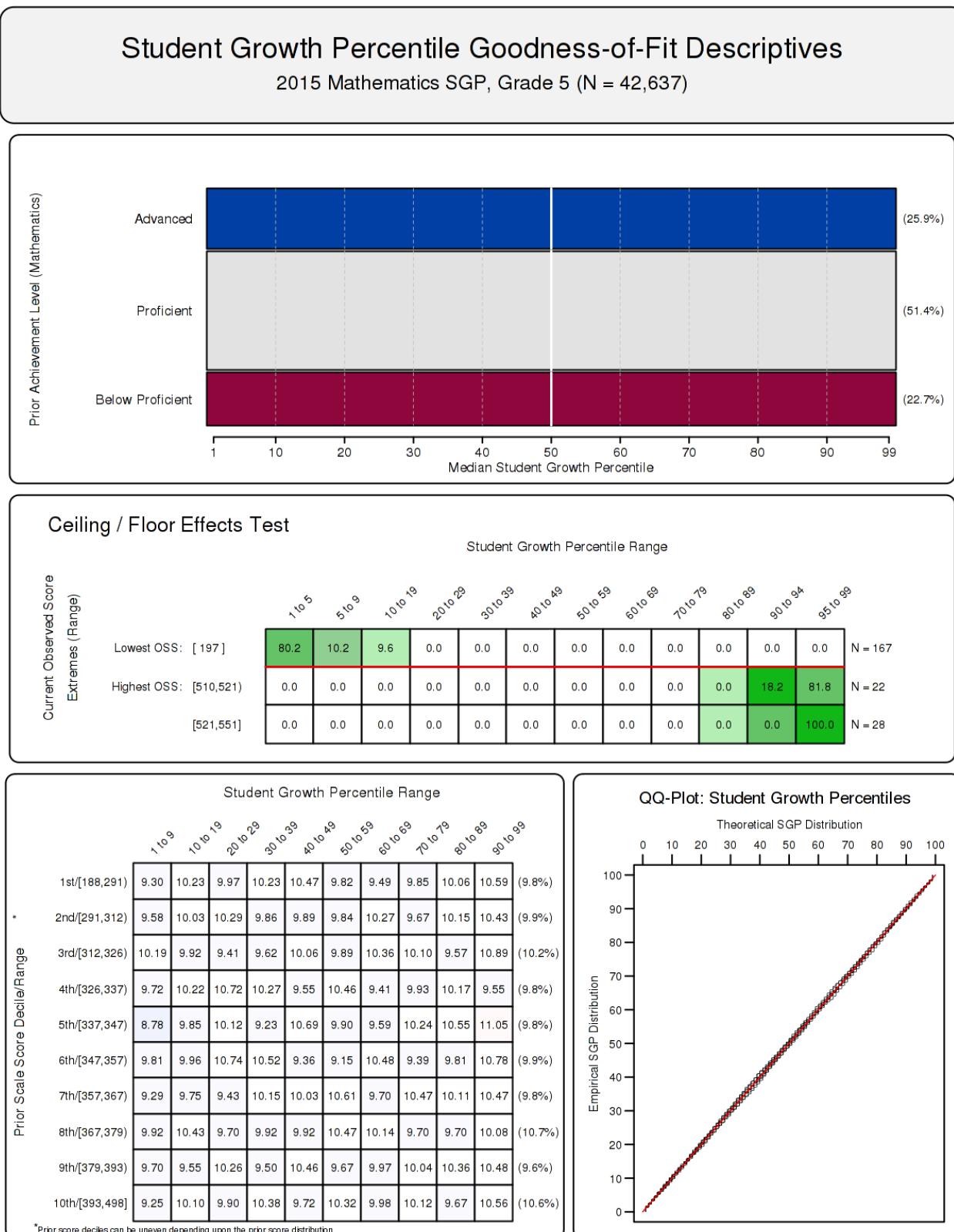


Figure 10: Goodness of Fit Plot for Grade 5 Mathematics, 2015.

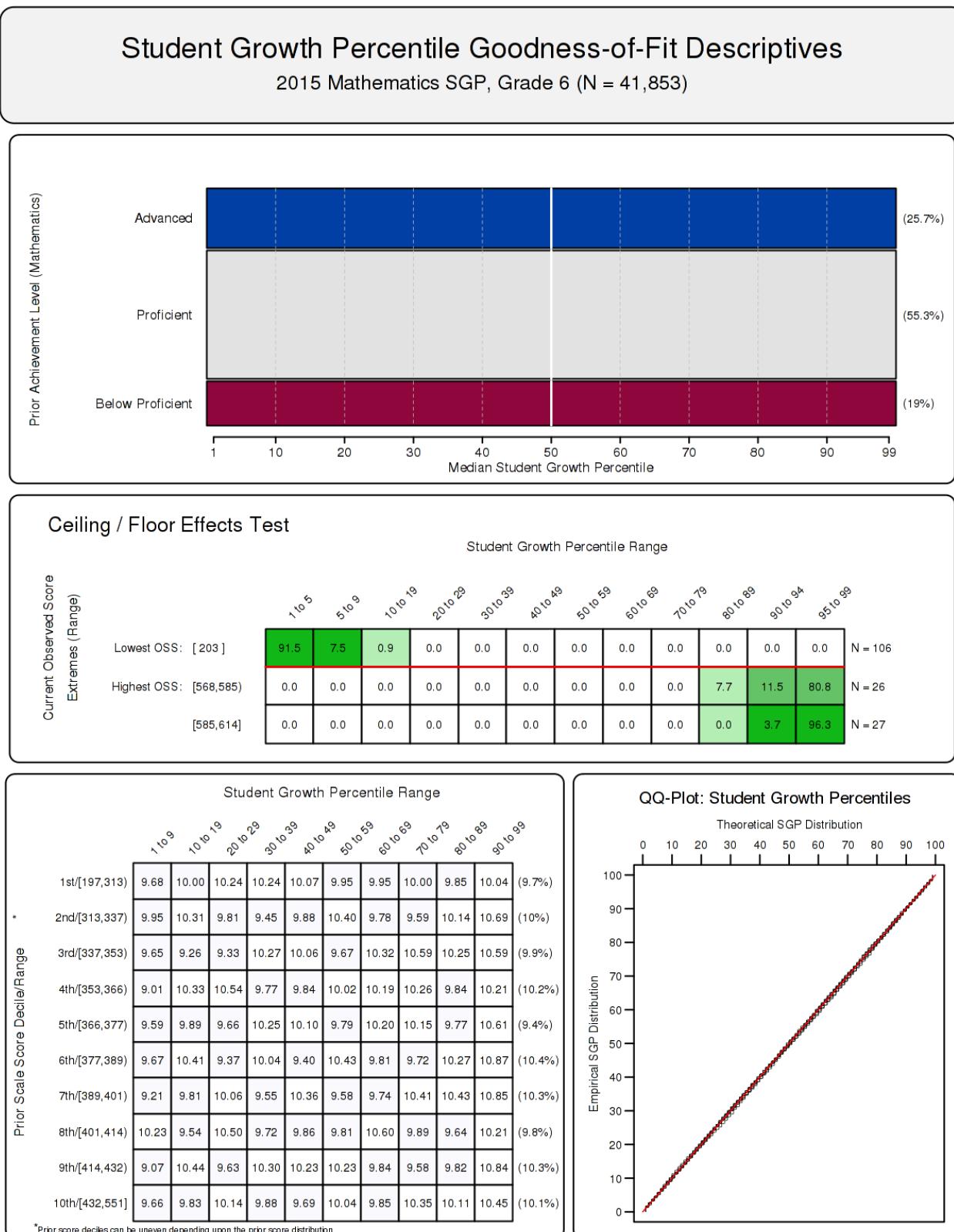


Figure 11: Goodness of Fit Plot for Grade 6 Mathematics, 2015.

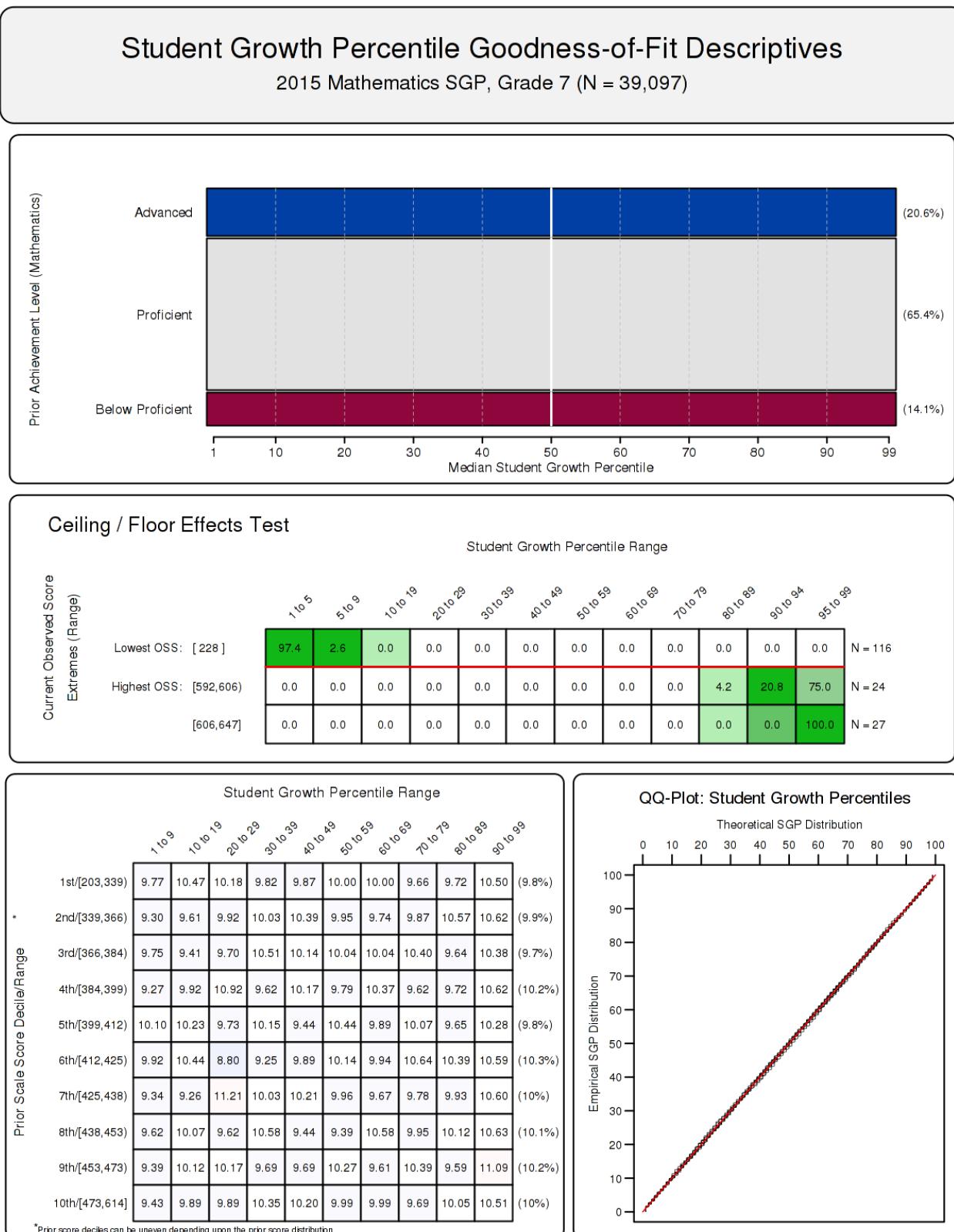


Figure 12: Goodness of Fit Plot for Grade 7 Mathematics, 2015.

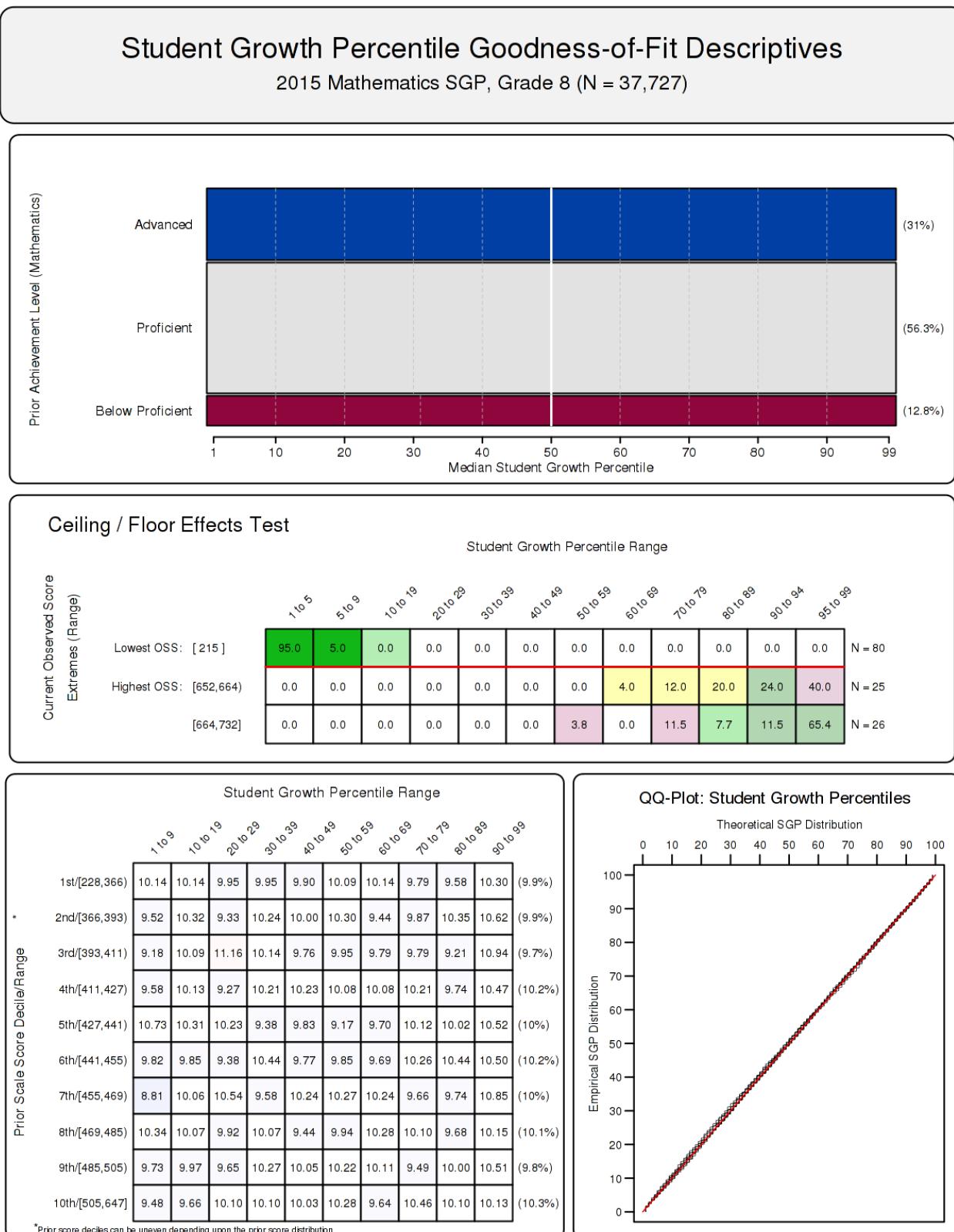


Figure 13: Goodness of Fit Plot for Grade 8 Mathematics, 2015.

## 2.3 Science

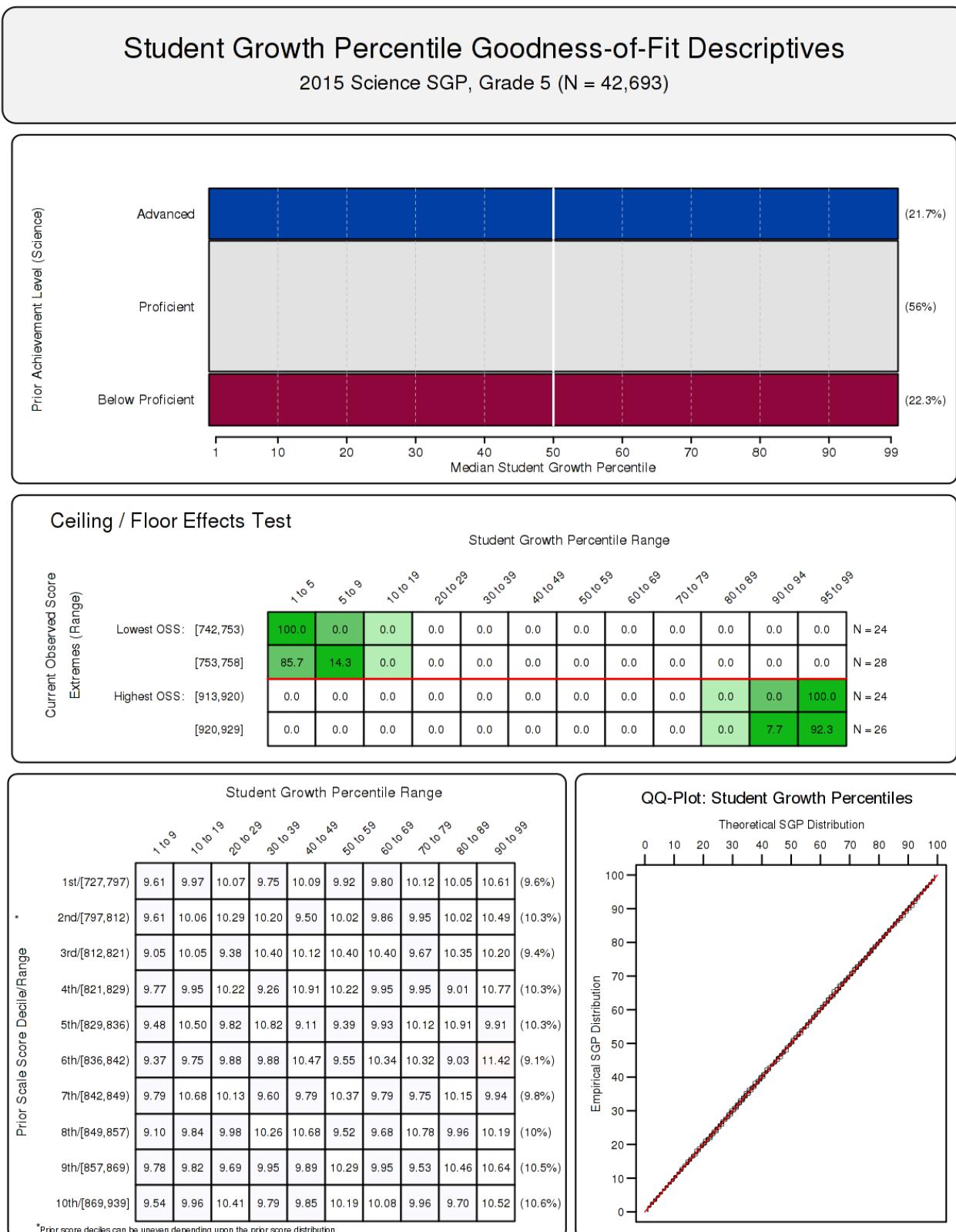
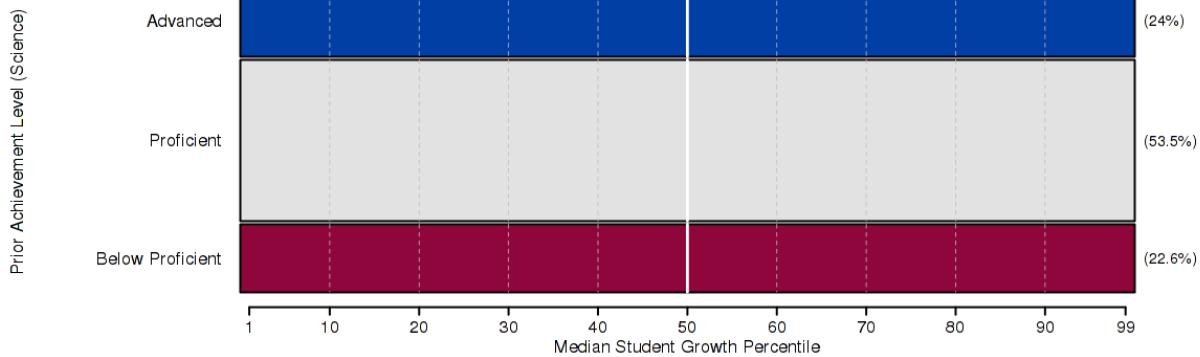


Figure 14: Goodness of Fit Plot for Grade 5 Science, 2015.

## Student Growth Percentile Goodness-of-Fit Descriptives

2015 Science SGP, Grade 6 (N = 42,124)



### Ceiling / Floor Effects Test

Student Growth Percentile Range

Current Observed Score Extremes (Range)	Student Growth Percentile Range												N = 26
	1 to 5	5 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 94	95 to 99	
Lowest OSS: [694,714] [714,724]	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 26
Highest OSS: [959,973] [973,975]	88.5	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 26
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	96.0	N = 25
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	92.3		N = 26

Student Growth Percentile Range

Prior Scale Score Decile/Range	Student Growth Percentile Range										(9.6%)
	1 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99	
1st/[742,804]	9.65	9.83	9.98	10.42	10.02	10.12	9.90	9.83	9.75	10.50	(9.6%)
2nd/[804,816]	9.91	9.91	9.74	9.33	10.00	9.69	10.48	10.29	10.29	10.34	(9.9%)
3rd/[816,824]	9.00	10.42	10.49	10.16	9.99	10.32	10.01	9.31	9.71	10.59	(9.4%)
4th/[824,831]	9.83	9.90	9.38	9.78	10.23	10.32	9.78	10.08	10.46	10.25	(10.1%)
5th/[831,837]	9.38	9.91	10.52	10.11	9.64	10.14	10.06	10.24	9.41	10.59	(9.4%)
6th/[837,844]	9.35	10.54	9.45	9.88	9.74	9.26	10.36	9.84	10.58	10.99	(11.5%)
7th/[844,850]	9.67	9.85	10.31	10.44	10.62	9.47	9.91	9.50	9.75	10.47	(9.3%)
8th/[850,858]	9.25	9.39	10.17	9.88	9.59	11.45	9.72	10.71	9.84	9.99	(10.6%)
9th/[858,868]	9.92	10.51	9.72	9.49	9.92	9.57	10.81	9.72	10.11	10.24	(9.5%)
10th/[868,929]	9.22	9.89	9.98	10.20	10.24	9.86	9.62	9.91	10.20	10.89	(10.7%)

\*Prior score deciles can be uneven depending upon the prior score distribution

### QQ-Plot: Student Growth Percentiles

Theoretical SGP Distribution

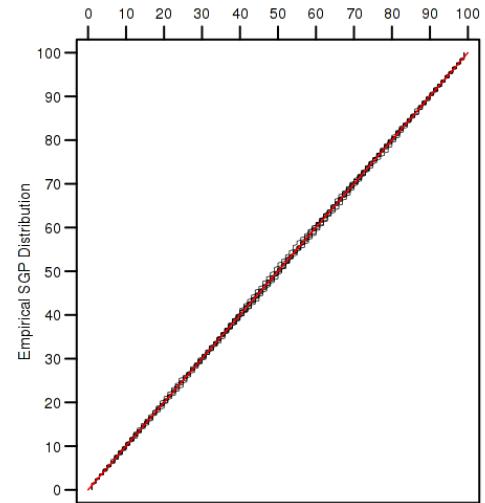


Figure 15: Goodness of Fit Plot for Grade 6 Science, 2015.

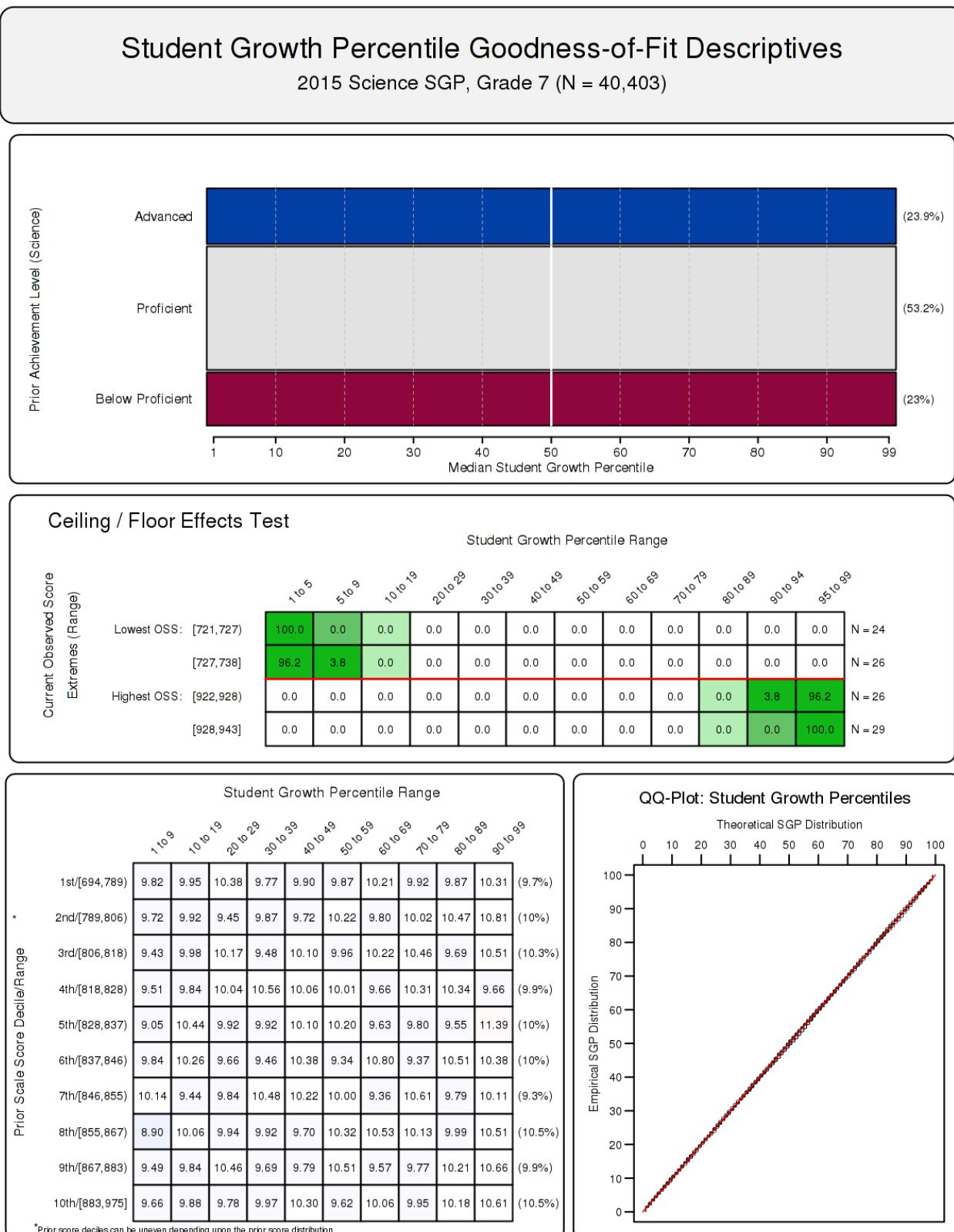
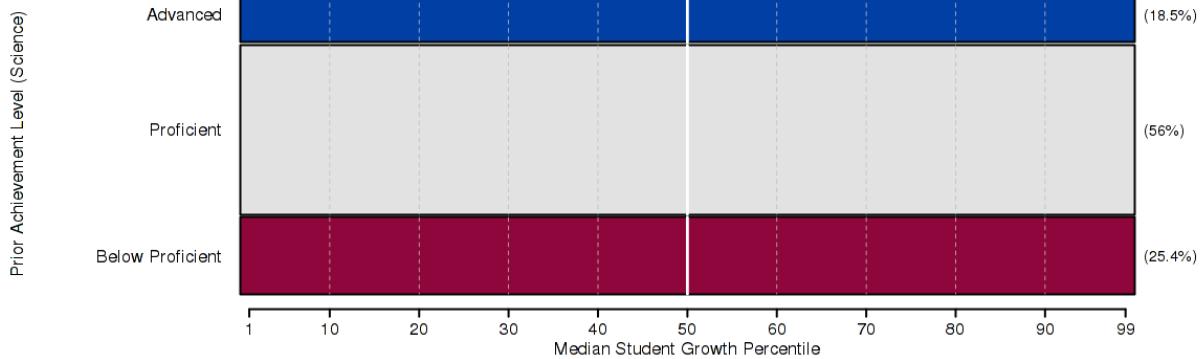


Figure 16: Goodness of Fit Plot for Grade 7 Science, 2015.

## Student Growth Percentile Goodness-of-Fit Descriptives

2015 Science SGP, Grade 8 (N = 36,241)



### Ceiling / Floor Effects Test

Student Growth Percentile Range

Current Observed Score Extremes (Range)	Student Growth Percentile Range												N = 26
	1 to 5	5 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 94	95 to 99	
Lowest OSS: [729,745]	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 26
[745,754]	92.3	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 26
Highest OSS: [927,932]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	N = 27
[932,942]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	N = 28

Student Growth Percentile Range

Prior Scale Score Decile/Range	Student Growth Percentile Range												(9.5%)
	1 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99	90 to 99	90 to 99	
1st/[721,795]	10.03	10.44	10.18	10.15	10.18	9.40	9.43	9.86	10.12	10.21			
2nd/[795,810]	9.25	10.18	9.69	10.24	9.94	9.99	9.96	10.65	9.72	10.38			
3rd/[810,820]	10.37	9.94	9.19	9.40	10.72	10.89	10.13	8.89	9.70	10.75			
4th/[820,828]	9.32	9.21	10.61	10.84	9.18	9.49	9.88	10.08	10.81	10.59			
5th/[828,835]	9.35	10.37	10.14	9.61	10.05	10.40	9.70	10.08	9.88	10.43			
6th/[835,842]	9.21	9.74	10.22	9.88	10.02	9.46	10.30	10.25	9.94	10.98			
7th/[842,850]	9.84	9.92	9.71	9.74	10.18	9.61	10.18	10.42	10.23	10.16			
8th/[850,858]	9.78	10.38	10.15	9.92	9.57	10.33	9.63	9.49	9.43	11.31			
9th/[858,870]	9.23	9.30	9.51	10.29	10.36	10.31	10.11	10.44	9.87	10.57			
10th/[870,943]	9.66	10.17	10.14	10.12	9.93	9.66	9.85	9.82	10.12	10.52			

\*Prior score deciles can be uneven depending upon the prior score distribution

### QQ-Plot: Student Growth Percentiles

Theoretical SGP Distribution

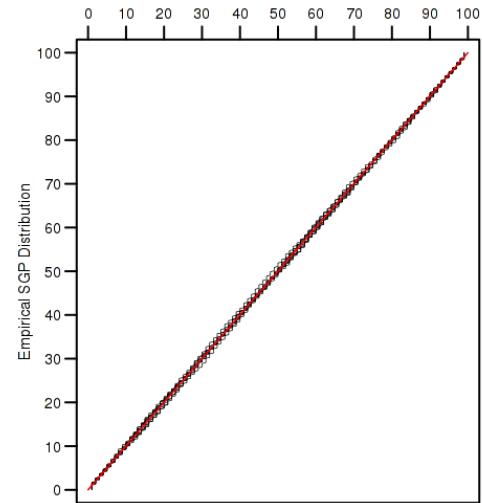


Figure 17: Goodness of Fit Plot for Grade 8 Science, 2015.

### 3 SAGE EOCT Fit Plots

#### 3.1 Earth Science

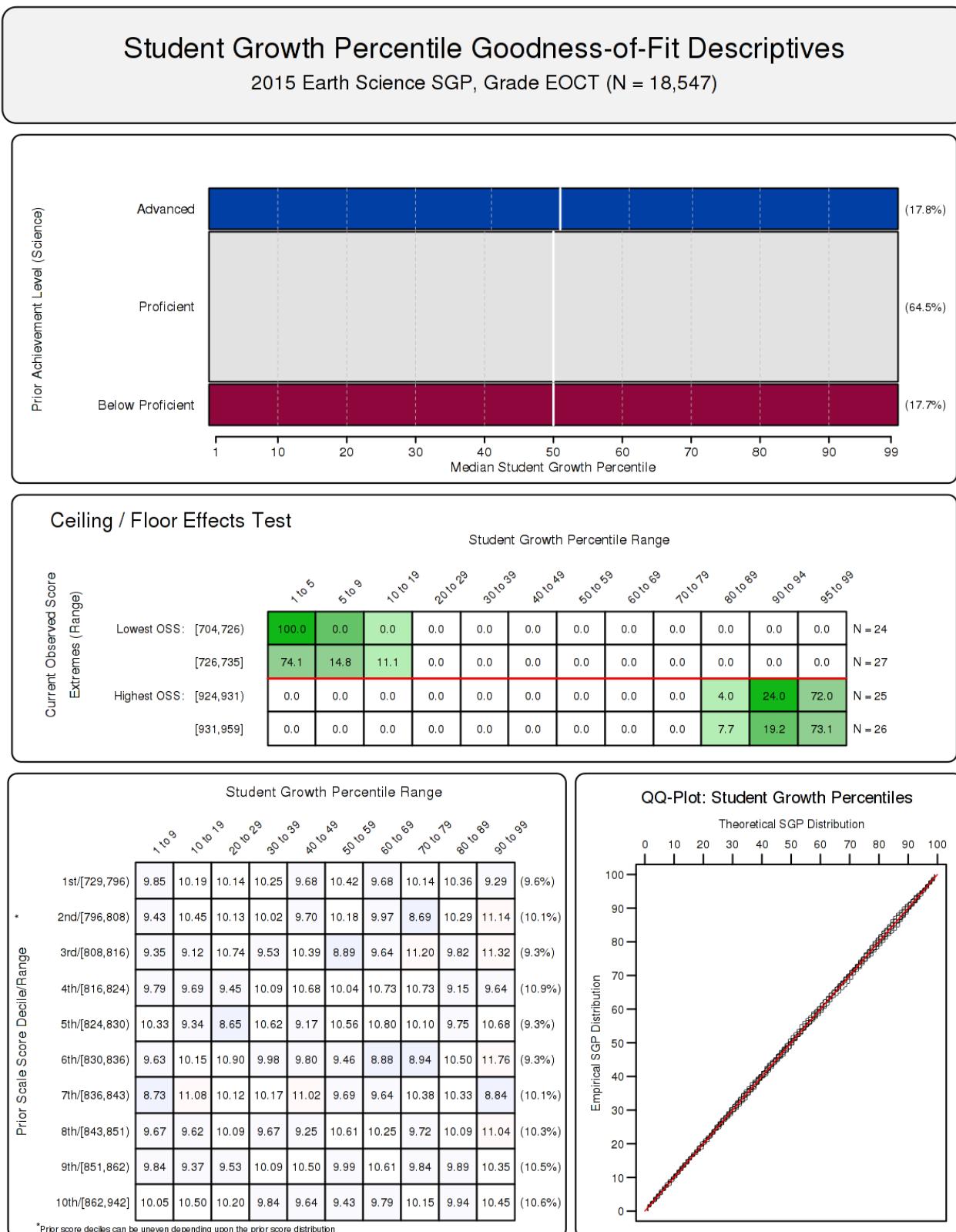


Figure 18: Goodness of Fit Plot for 2015 Earth Science (Priors - 2014 Science Grade 8, 2013 Science Grade 7, 2012 Science Grade 6, 2011 Science Grade 5, 2010 Science Grade 4)

## 3.2 Biology

### 3.2.1 Earth Science as Imediate Prior

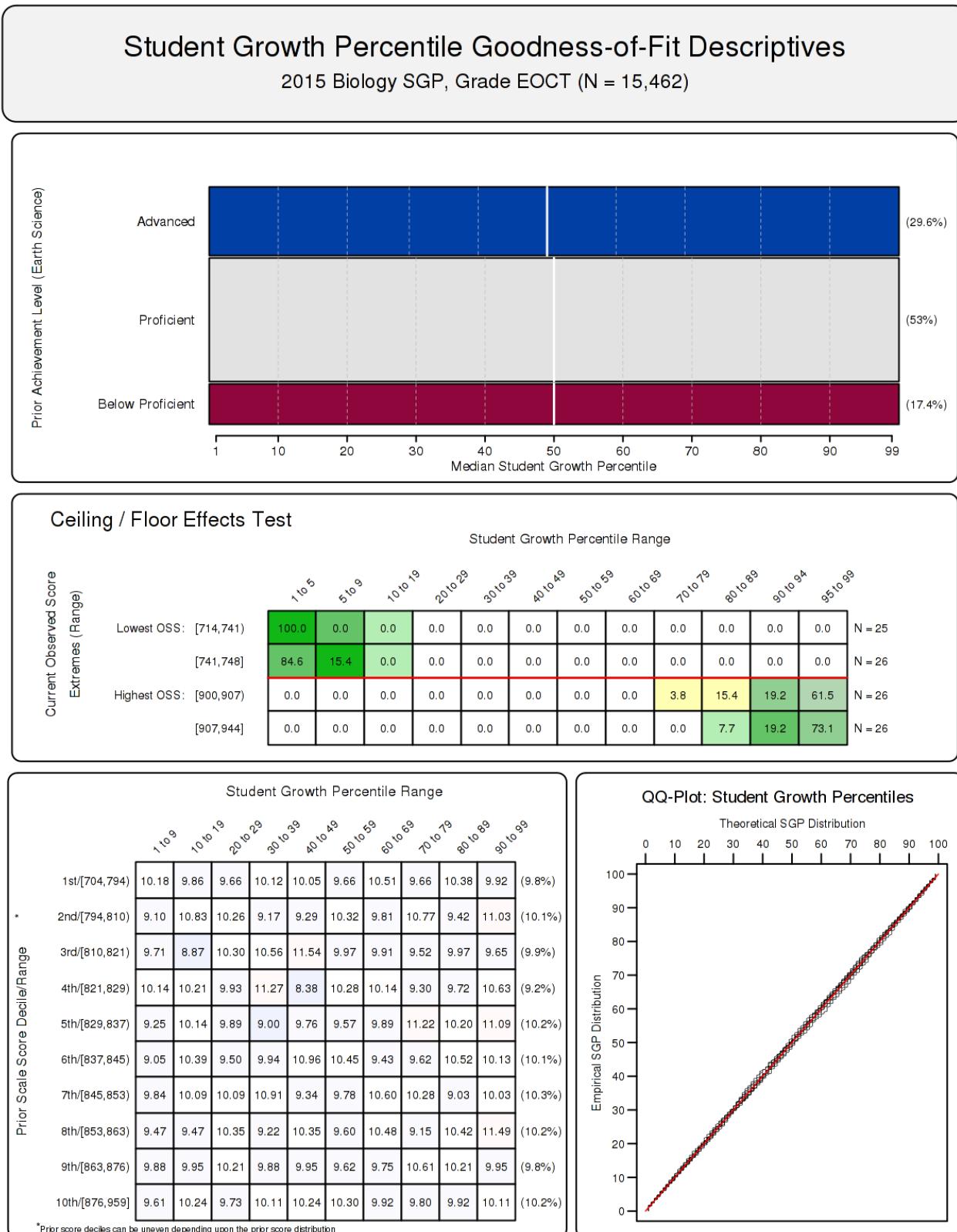


Figure 19: Goodness of Fit Plot for 2015 Biology (Priors - 2014 Earth Science, 2013 Science Grade 8, 2012 Science Grade 7, 2011 Science Grade 6, 2010 Science Grade 5)

### 3.2.2 Grade 8 Science as Immediate Prior

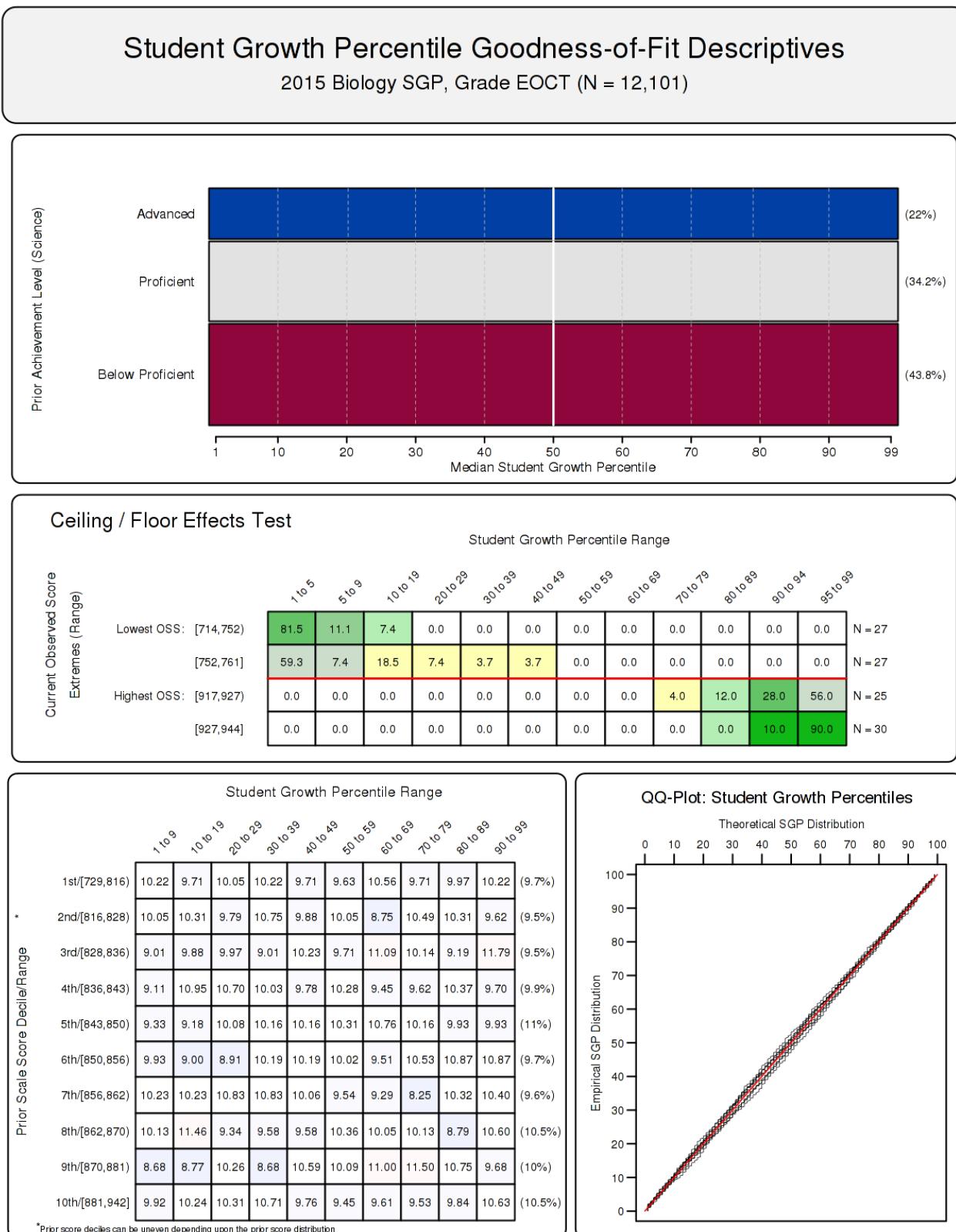


Figure 20: Goodness of Fit Plot for 2015 Biology (Priors - 2014 Science Grade 8, 2013 Science Grade 7, 2012 Science Grade 6, 2011 Science Grade 5, 2010 Science Grade 4)

### 3.3 Chemistry

#### 3.3.1 Biology as Immediate Prior, Grade 8 Science Secondary

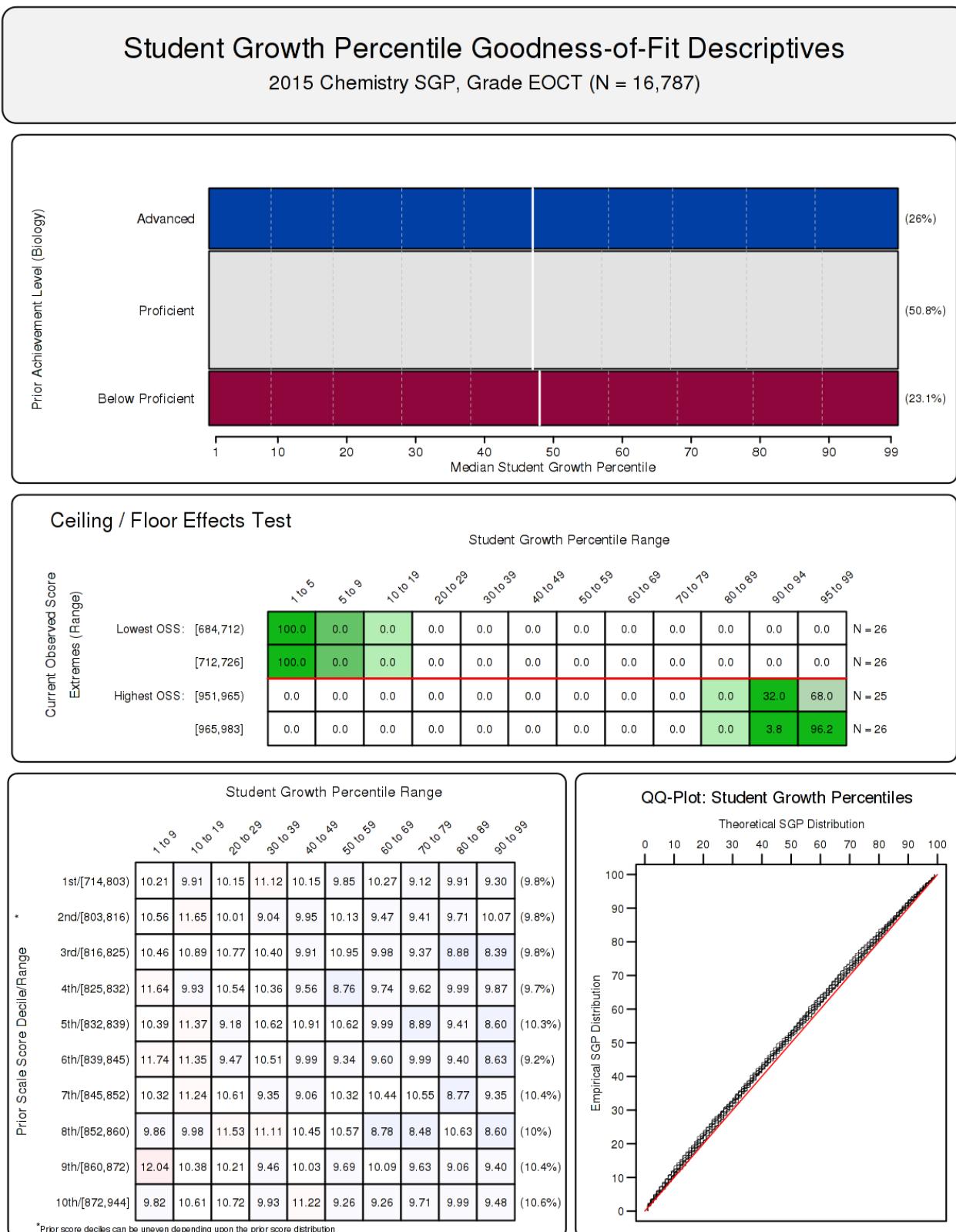


Figure 21: Goodness of Fit Plot for 2015 Chemistry (Priors - 2014 Biology, 2013 Science Grade 8, 2012 Science Grade 7, 2011 Science Grade 6, 2010 Science Grade 5)

### 3.3.2 Biology as Immediate Prior, Earth Science Secondary

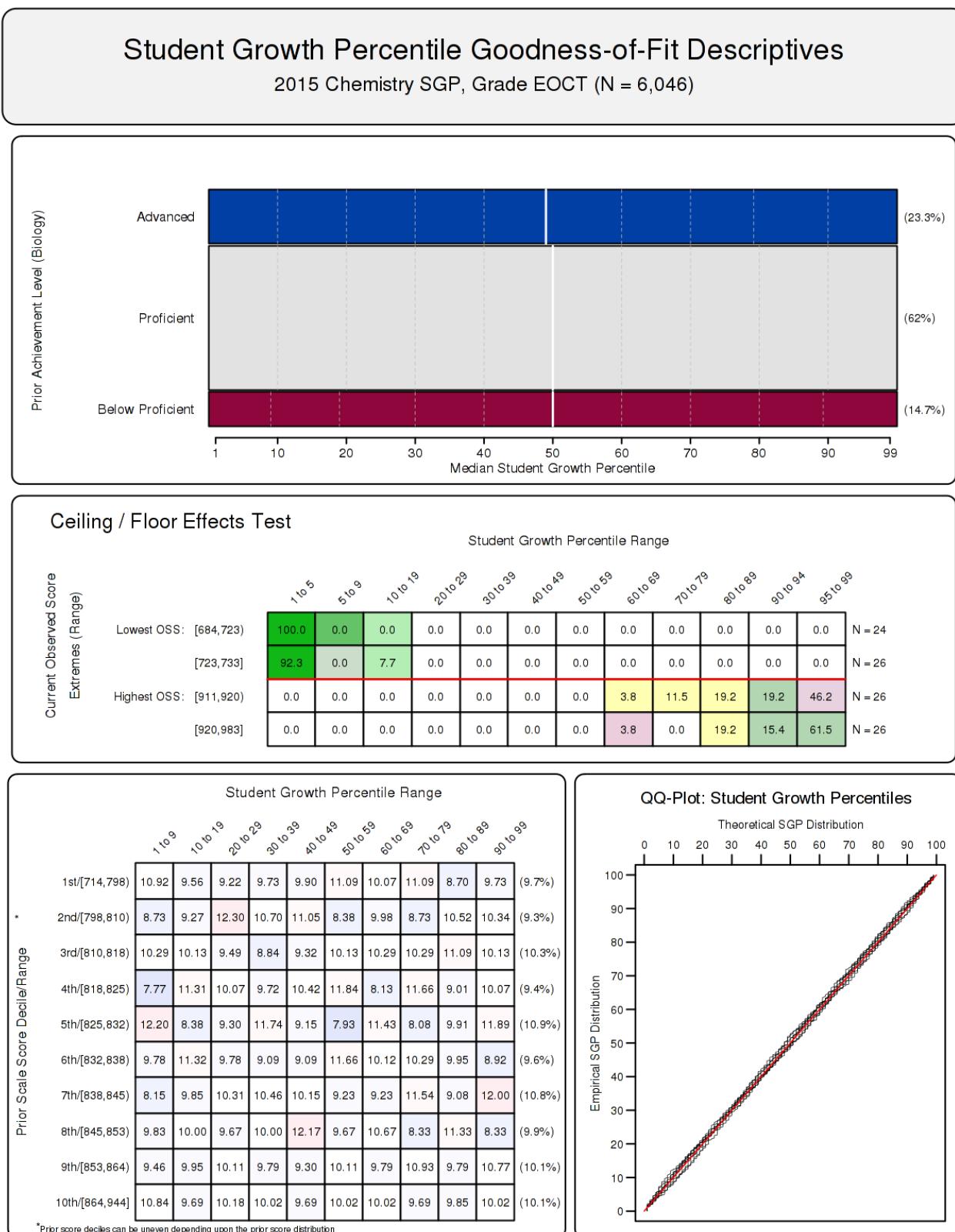


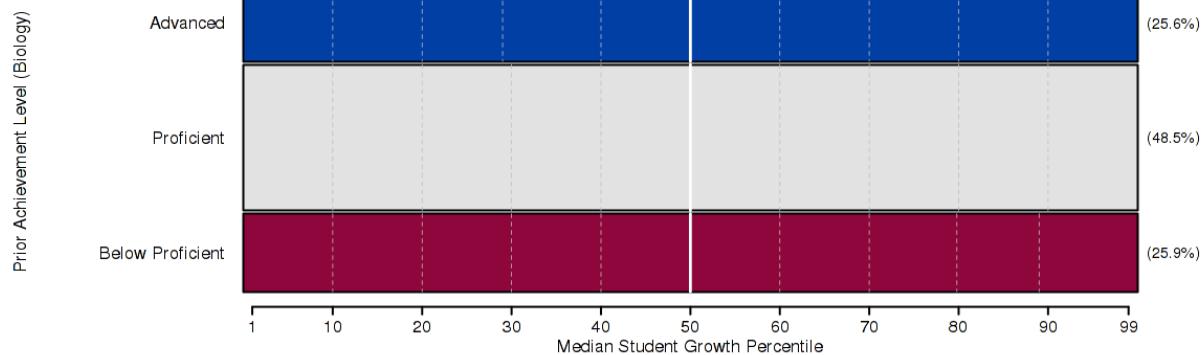
Figure 22: Goodness of Fit Plot for 2015 Chemistry (Priors - 2014 Biology, 2013 Earth Science, 2012 Science Grade 8, 2011 Science Grade 7, 2010 Science Grade 6)

### 3.4 Physics

#### 3.4.1 Biology as Imediate Prior

### Student Growth Percentile Goodness-of-Fit Descriptives

2015 Physics SGP, Grade EOCT (N = 6,258)



### Ceiling / Floor Effects Test

Student Growth Percentile Range

Current Observed Score Extremes (Range)	Student Growth Percentile Range												N = 25
	1 to 5	5 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 94	95 to 99	
Lowest OSS: [683, 711]	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 25
[711, 724]	70.4	14.8	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 27
Highest OSS: [929, 938]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	30.4	65.2	N = 23
[938, 985]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	11.1	81.5	N = 27

Student Growth Percentile Range

Prior Scale Score Decile Range	Student Growth Percentile Range												(9.8%)
	1 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99	95 to 99	99 to 100	
1st/[714,802]	9.82	10.15	10.47	9.98	9.49	10.47	10.31	9.82	9.00	10.47	9.82	9.82	
2nd/[802,817]	8.81	9.95	9.30	10.28	10.77	8.97	11.26	9.30	11.09	10.28	9.81	9.81	
3rd/[817,826]	9.51	9.85	10.53	9.51	8.83	11.21	8.32	11.54	10.53	10.19	9.51	9.51	
4th/[826,834]	9.94	9.49	10.69	10.39	9.34	9.34	10.39	10.69	8.58	11.14	9.94	9.94	
5th/[834,840]	9.52	10.77	8.44	9.34	13.64	9.69	9.69	7.36	11.31	10.23	9.52	9.52	
6th/[840,847]	9.42	11.06	9.87	11.96	7.77	10.01	9.42	10.01	10.91	9.57	9.42	9.42	
7th/[847,854]	10.39	8.04	11.06	8.38	10.39	9.55	11.06	11.56	9.05	10.55	10.39	10.39	
8th/[854,863]	9.16	11.37	9.16	9.60	9.90	11.23	9.90	8.57	10.19	10.93	9.16	9.16	
9th/[863,874]	10.08	8.24	10.08	10.84	10.38	9.77	9.62	11.76	8.85	10.38	10.08	10.08	
10th/[874,944]	8.95	11.34	10.38	9.42	9.90	9.58	10.22	9.42	10.70	10.06	8.95	8.95	

\*Prior score deciles can be uneven depending upon the prior score distribution

### QQ-Plot: Student Growth Percentiles

Theoretical SGP Distribution

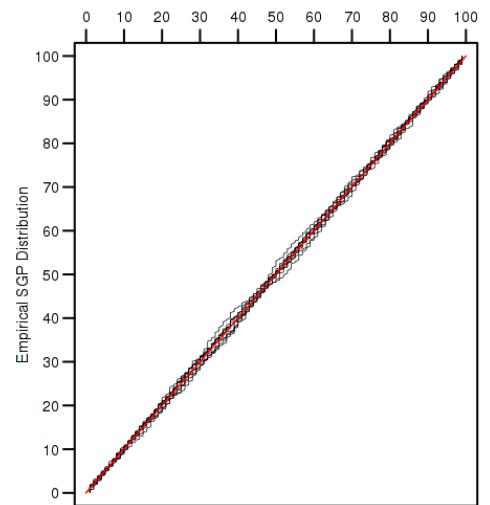
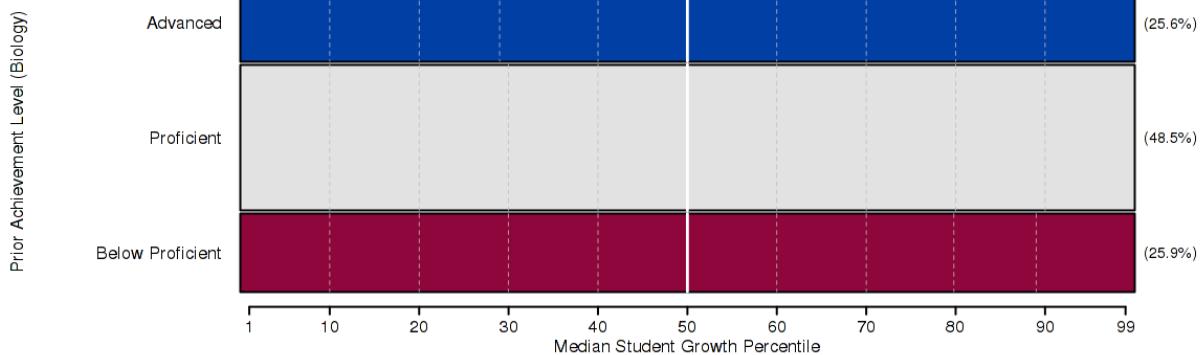


Figure 23: Goodness of Fit Plot for 2015 Physics (Priors - 2014 Biology, 2013 Earth Science, 2012 Science, 2011 Science, 2010 Science)

### Student Growth Percentile Goodness-of-Fit Descriptives

2015 Physics SGP, Grade EOCT (N = 6,258)



### Ceiling / Floor Effects Test

Student Growth Percentile Range

Current Observed Score Extremes (Range)	Student Growth Percentile Range												N = 25
	1 to 5	5 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 94	95 to 99	
Lowest OSS: [683, 711]	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 25
[711, 724]	70.4	14.8	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N = 27
Highest OSS: [929, 938]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	30.4	65.2	N = 23
[938, 985]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	11.1	81.5	N = 27

Student Growth Percentile Range

Prior Scale Score Decile/Range	Student Growth Percentile Range												(9.8%)
	1 to 5	5 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99		
1st/[714, 802]	9.82	10.15	10.47	9.98	9.49	10.47	10.31	9.82	9.00	10.47			
2nd/[802, 817]	8.81	9.95	9.30	10.28	10.77	8.97	11.26	9.30	11.09	10.28			
3rd/[817, 826]	9.51	9.85	10.53	9.51	8.83	11.21	8.32	11.54	10.53	10.19			
4th/[826, 834]	9.94	9.49	10.69	10.39	9.34	9.34	10.39	10.69	8.58	11.14			
5th/[834, 840]	9.52	10.77	8.44	9.34	13.64	9.69	9.69	7.36	11.31	10.23			
6th/[840, 847]	9.42	11.06	9.87	11.96	7.77	10.01	9.42	10.01	10.91	9.57			
7th/[847, 854]	10.39	8.04	11.06	8.38	10.39	9.55	11.06	11.56	9.05	10.55			
8th/[854, 863]	9.16	11.37	9.16	9.60	9.90	11.23	9.90	8.57	10.19	10.93			
9th/[863, 874]	10.08	8.24	10.08	10.84	10.38	9.77	9.62	11.76	8.85	10.38			
10th/[874, 944]	8.95	11.34	10.38	9.42	9.90	9.58	10.22	9.42	10.70	10.06			

\*Prior score deciles can be uneven depending upon the prior score distribution

### QQ-Plot: Student Growth Percentiles

Theoretical SGP Distribution

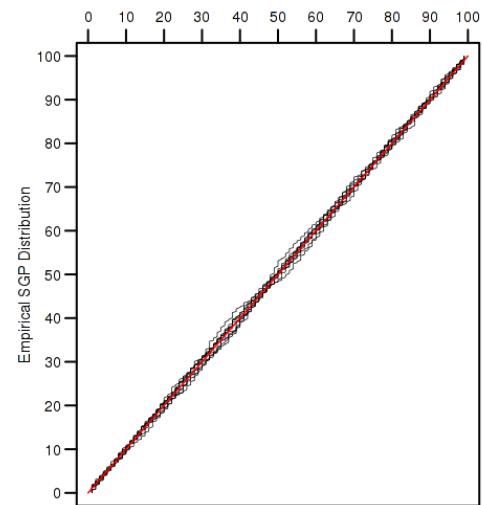


Figure 24: Goodness of Fit Plot for 2015 Physics (Priors - 2014 Biology, 2013 Science, 2012 Science, 2011 Science, 2010 Science)

### 3.4.2 Chemistry as Imediate Prior

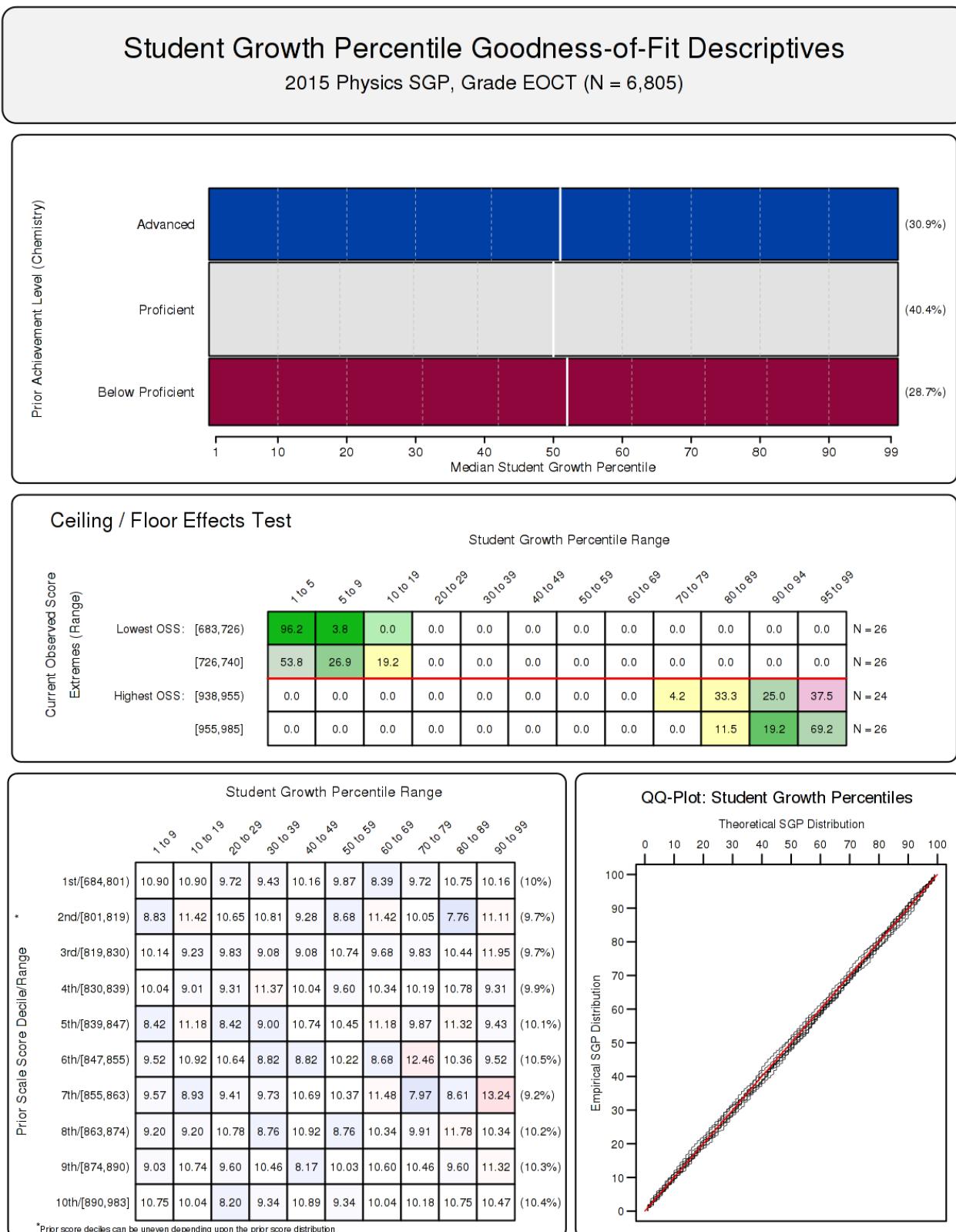


Figure 25: Goodness of Fit Plot for 2015 Physics (Priors - 2014 Chemistry, 2013 Biology, 2012 Earth Science, 2011 Science, 2010 Science)

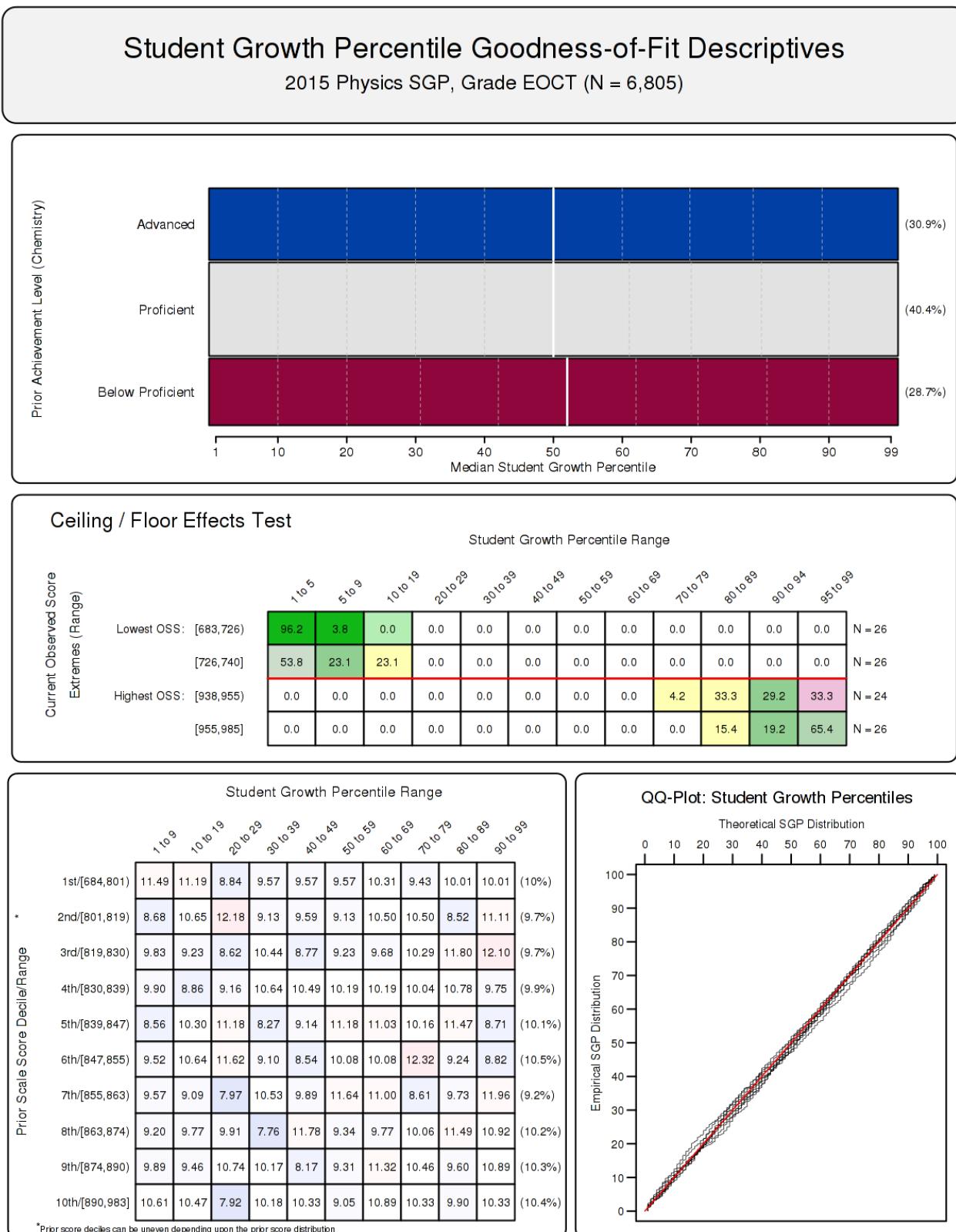


Figure 26: Goodness of Fit Plot for 2015 Physics (Priors - 2014 Chemistry, 2013 Biology, 2012 Science Grade 8, 2011 Science 7, 2010 Science 6)

### 3.5 Secondary Math I

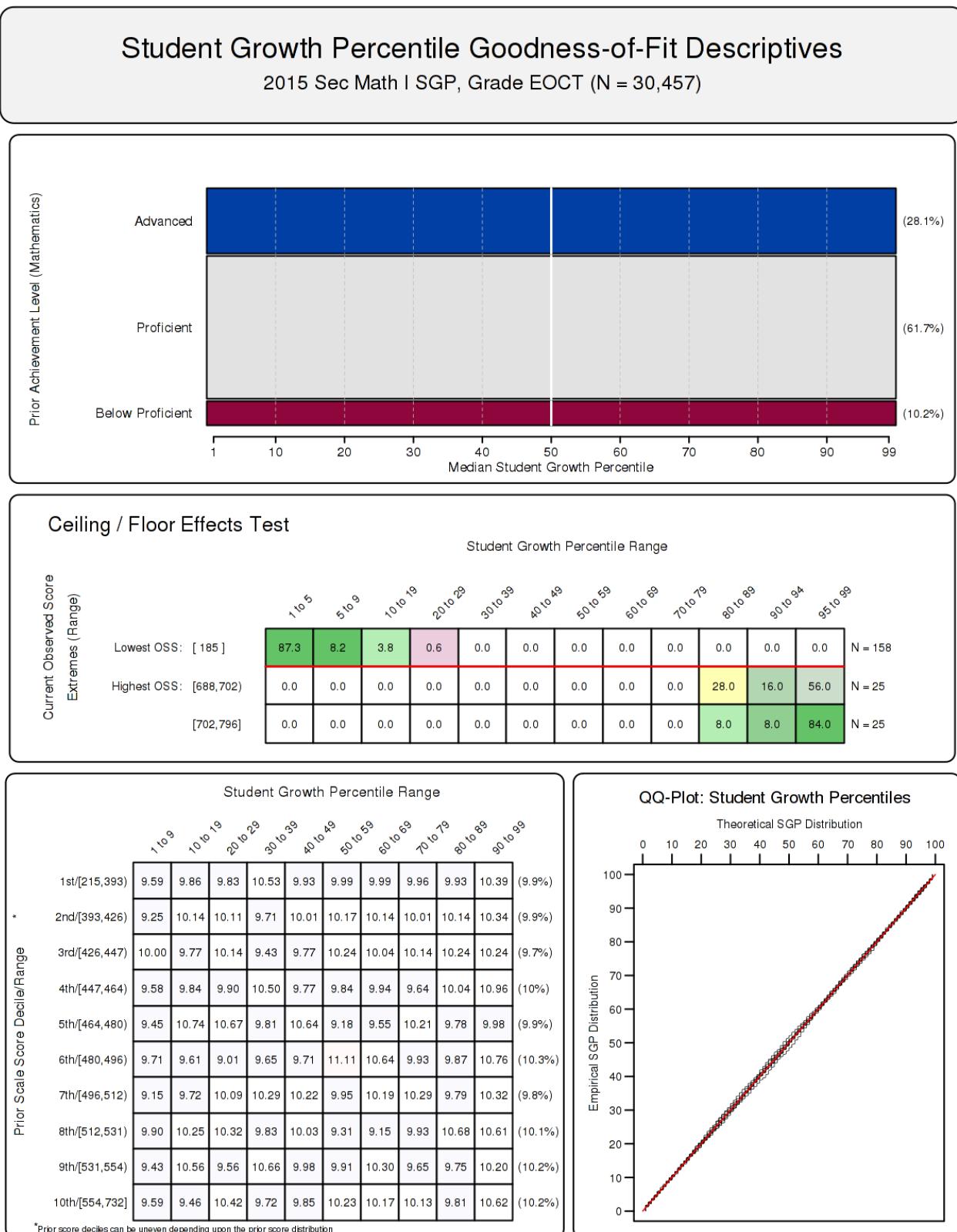


Figure 27: Goodness of Fit Plot for 2015 Secondary Math I (Priors - 2014 Math 8, 2013 Math Grade 7, 2012 Math Grade 6, 2011 Math Grade 5, 2010 Math Grade 4)

### 3.6 Secondary Math II

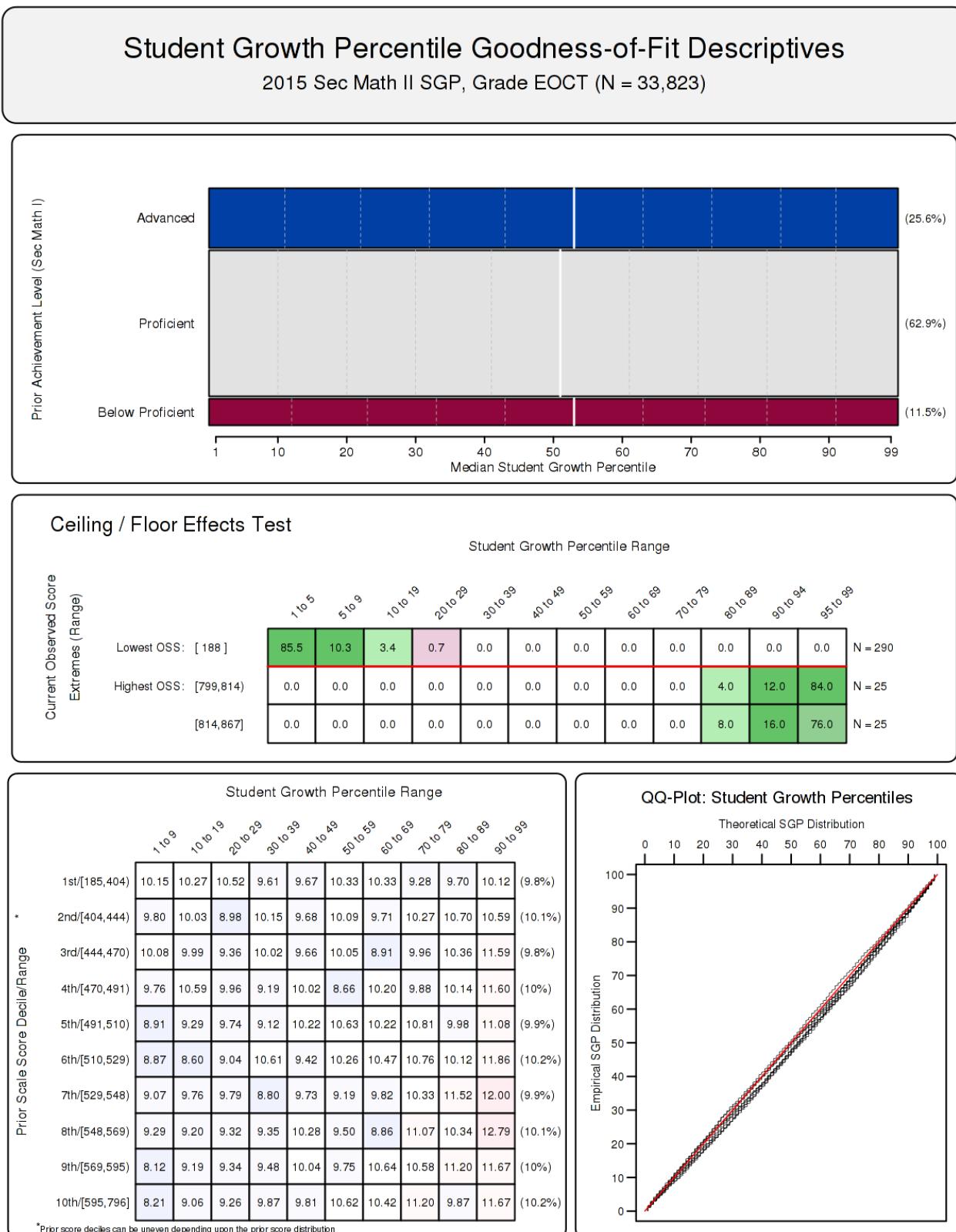


Figure 28: Goodness of Fit Plot for 2015 Secondary Math II (Priors - 2014 Sec Math I, 2013 Pre Algebra, 2012 Math Grade 7, 2011 Math Grade 6, 2010 Math Grade 5)

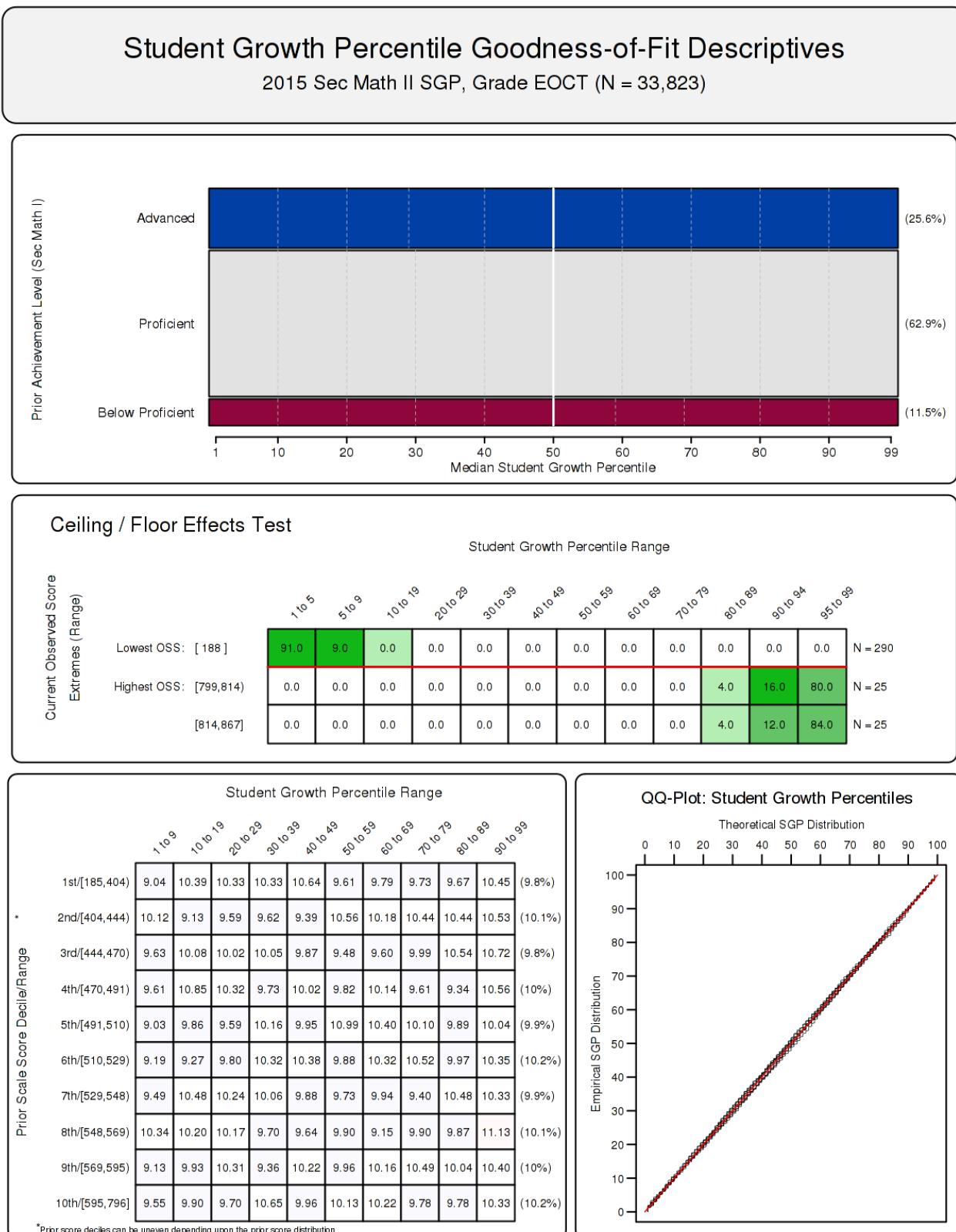


Figure 29: Goodness of Fit Plot for 2015 Secondary Math II (Priors - 2014 Sec Math I)

### 3.7 Secondary Math III

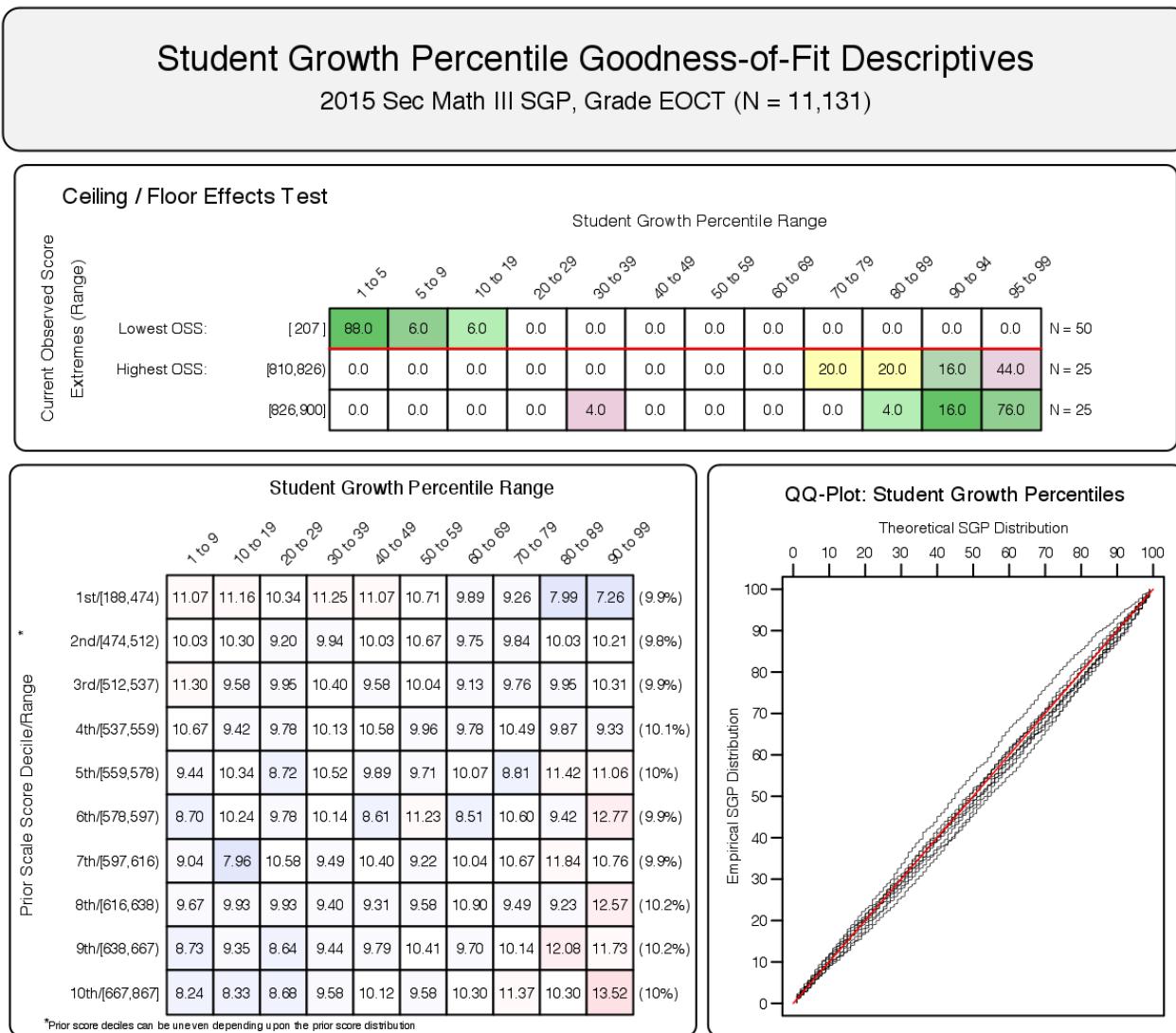


Figure 30: Goodness of Fit Plot for 2015 Secondary Math III (Priors - 2014 Sec Math II, 2012 Algebra I)