



Idaho Percentile Results for Mathematics and Reading, NAEP 2007-2017, Grades 4 & 8, All Students

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Learning Point Associates (2009) suggests three school performance measures that can provide valuable support for program evaluation and accountability systems. The three statistics are averages (i.e., means), percentiles, and effect sizes. This paper illustrates how a traditional normative statistic using NAEP scale scores -- percentiles -- provides us with useful descriptions of our student's achievement.

Idaho participates in the National Assessments of Educational Assessment (NAEP), which reports mathematics and reading scale score results for grades 4 and 8 in odd-numbered years (2013, 2015, 2017, etc.). Percentiles provide performance information across the student's distribution of scale scores for each subject-grade. This enables us to look at the change in five points over time. The five percentiles (i.e., scale scores) are:

- *90th percentile*: High score, at or above 90% of the scale scores
- *75th percentile*: High Average score, at or above 75% of the scale scores
- *50th percentile*: Average score for Grade Level, at or above 50% of the scores
- *25th percentile*: Low Average score, at or above 25% of the scale scores
- *10th percentile*: Low score, at or above 10% of the scale scores

In addition, the 75th and 25th percentiles define the middle half of students who took the test. The 50th percentile is the middle half of students in the box, and the middle of all students.

Percentiles enable an across-the-board look at student achievement (i.e., at the High, High Average, Average for Grade Level, Low Average, and Low performing students) and at how the scale scores at each percentile have changed over time.

Boxplots and line graphs, which provide graphic displays of Idaho's NAEP percentiles from 2007 to 2017, are in Appendix A (page 6).

Change in Idaho Percentiles

Each time NAEP releases its mathematics and reading results for grade 4 and grade 8, one particular outcome typically emerges for national conversation (usually a problem rather than a success). In 2017, the focus has been about how gaps had grown between High achieving students (90th percentile) and Low achieving students (10th percentile)

from 2015 to 2017. In 2015, the nation's conversation focused on the drop of mathematics scores to unacceptable levels from 2013 to 2015.

The 2015 to 2017 change in each percentile's scale scores ("points") for NAEP mathematics and reading are displayed in Table 1. Each point in Table 1 is calculated as the difference between the 2017 and 2015 percentiles (i.e., the 2017 scale score minus the 2015 scale score). If the 2017 percentile is higher than the 2015 percentile, the point(s) are positive. If the 2017 percentile is the same as the 2015 percentile, the points are zero or none. If the 2017 percentile is lower than the 2015, the point(s) are negative.

The NAEP Data Explorer (NDE) provided percentiles for each grade/subject. The NDE also conducted a statistical test of the change or difference for each the 2015 and 2017 grade/subject percentiles.

Table 1 Change in scale score for each grade/percentile on the NAEP mathematics and reading assessments between 2015 and 2017.

Idaho's Change in NAEP Percentiles from 2015 to 2017					
Percentile	Mathematics		Reading		Percentile Descriptor
	Grade 4	Grade 8	Grade 4	Grade 8	
90th	1	7*	2	0	High
75th	1	3	2	0	High Average
50th	2	0	2	1	Average
25th	2	-2	0	1	Low Average
10th	1	-5	-2	2	Low

* Statistically significant at the .05 level of probability.

Narratives about Table 1 (2015-2017):

- The only statistical significant change in NAEP percentiles between the 2015 and 2017 assessments was the 90th percentile in eighth grade mathematics.

In 2017, the national focus has been about how gaps had grown between the High achieving students (90th percentile) and Low achieving students (10th percentile) from 2015 to 2017.

- In NAEP 2017 fourth grade mathematics, the High student and the Low student both gained one (+1) point, so Idaho did not see a change in the "gap" in fourth grade mathematics.
- In NAEP 2017 eighth grade mathematics, the High student gained seven (+7) points while the Low students lost five (-5) points, so Idaho saw a significant increase in the "gap" in eighth grade mathematics.

- In NAEP 2017 fourth grade reading, the High student gained two (+2) points while the Low student gained two (+2) points, so Idaho saw an increase in the “gap” in fourth grade reading.
- In NAEP 2017 eighth grade reading, the High student had no change (0) points, while the Low student lost two (-2) points, so Idaho saw a decrease in the “gap” in eighth grade reading.

The author suggested only a few narratives related to Table 1. Many more are possible. The intent was that the reader is invited take the opportunity to review Table 1 and write narratives for findings of personal and specific interest to the reader. The reader may also want to review the extensive information in the 2007 through 2017 percentile boxplots and line graphs in Appendix A (page 6) for further narratives related to your special interest(s).

Table 2 Change in scale score for each grade/percentile on the NAEP mathematics and reading assessments between 2013 and 2015.

Idaho's Change in NAEP Percentiles from 2013 to 2015					
Percentile	Mathematics		Reading		Percentile Descriptor
	Grade 4	Grade 8	Grade 4	Grade 8	
90th	-1	-3	2	-2	High
75th	0	-2	2	-1	High Average
50th	-2	-3	2	0	Average
25th	-4	-2	2	-1	Low Average
10th	-4	-4*	3	-2	Low

* Statistically significant at the .05 level of probability.

Narratives about Table 2 (2013 to 2015):

- The only statistically significant change in NAEP percentiles between the 2013 and 2015 assessments was the 10th percentile in eighth grade mathematics.

In 2015, the nation’s conversation focused on a general drop in NAEP mathematics scores to unacceptable levels from 2013 to 2015.

- In NAEP 2015 eighth grade mathematics, all five percentiles lost points, one of which was statistically significant. {A significant decline in mathematics performance.}
- In NAEP 2015 fourth grade mathematics, four percentiles lost points, but one percentile had no change. {A decline in mathematics performance.}
- In NAEP 2015 eighth grade reading, four percentiles lost points, but one percentile had no change. {A decline in reading performance.}
- In NAEP 2015 fourth grade reading, all five percentiles gained one or more points. {An improvement in reading performance.}

The reader may also want to review the extensive information available in the 2007 through 2017 percentile boxplots and line graphs in Appendix A (page 6) to prepare further narratives related to the reader's special interests.

The Value of Percentiles

Each year Idaho administers and scores the Idaho Standards Achievement Tests (ISAT). Unfortunately, the state has published little to no ISAT results other than Idaho's "percent below basic, basic, proficient, and advanced" for public access. NAEP and ISAT both report out scale scores and achievement levels (percent above cut-score). The percent above cut-score metric as reported by NAEP and ISAT are problematic, especially when looking at achievement trends.

The National Academies of Sciences, Engineering, and Medicine (2017) conducted a congressionally mandated evaluation of the NAEP achievement levels – *Basic*, *Proficient* and *Advanced* (i.e., NAEP's percent above cut-score metric) – to determine whether the achievement levels are reasonable, reliable, valid, and informative to the public, and to recommend ways that the use of achievement levels can be improved. The National Academies' report notes:

“One of the most common and unwarranted inferences using achievement level percentages involves assessing the amount of progress students have made over time, particularly by population groups. For instance, news reports often focus not only on how students are doing at a particular time, but the extent to which the percentage of students scoring Proficient or above has (or has not) improved over successive NAEP years. When these comparisons are based on the scale scores, they provide useful information. When they are based on the “percentage Proficient or above” metric and used to compare progress across groups, they can be misleading. A report by Holland on this issue focused on misinterpretations associated with using the “percent above a cut score” metric. Although this metric is widely used for NAEP [also for ISAT and IRI], there are serious limitations to the inferences that the percent above cut score metric can support, particularly when evaluating trends over time, gaps among groups, or trends in gaps....” [Emphasis added.] (p. 208).

The National Academies' evaluation team did not determine that NAEP achievement levels are reasonable, reliable, valid, and informative to the public. The National Center for Education Statistics' (2018) website acknowledges the problem, "The achievement levels shall be used on a trial basis until the Commissioner for Education Statistics determines, as a result of an evaluation under subsection (f), that such levels are reasonable, valid, and informative to the public." The Commissioner of Education Statistics has not yet accomplished this task (nor as of yet has any other test publisher).

The percentiles surveyed in this paper are scale scores from NAEP 2009 through 2017. NAEP percentiles can provide useful trend information that is preferred over trend information based on NAEP achievement percentages.

The author's hope is that this brief introduction to percentiles might increase awareness that by using NAEP or ISAT percentiles we might well learn and understand more about

the status of our students' achievement in the knowledge and skills in mathematics, reading, and English language arts.

References

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Comments and questions regarding this paper are welcome.

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Appendix A

Overview of Boxplots [Page 7]

Figure A1. [Page 8]

NAEP Mathematics, Grade 4, 2007 to 2017. Idaho scale scores for 10th, 25th, 50th, 75th, and 90th percentiles displayed in boxplot and line graph formats.

Figure A2. [Page 9]

NAEP Mathematics, Grade 8, 2007 to 2017. Idaho scale scores for the 10th, 25th, 50th, 75th, and 90th percentiles displayed in boxplot and line graph formats.

Figure A3. [Page 10]

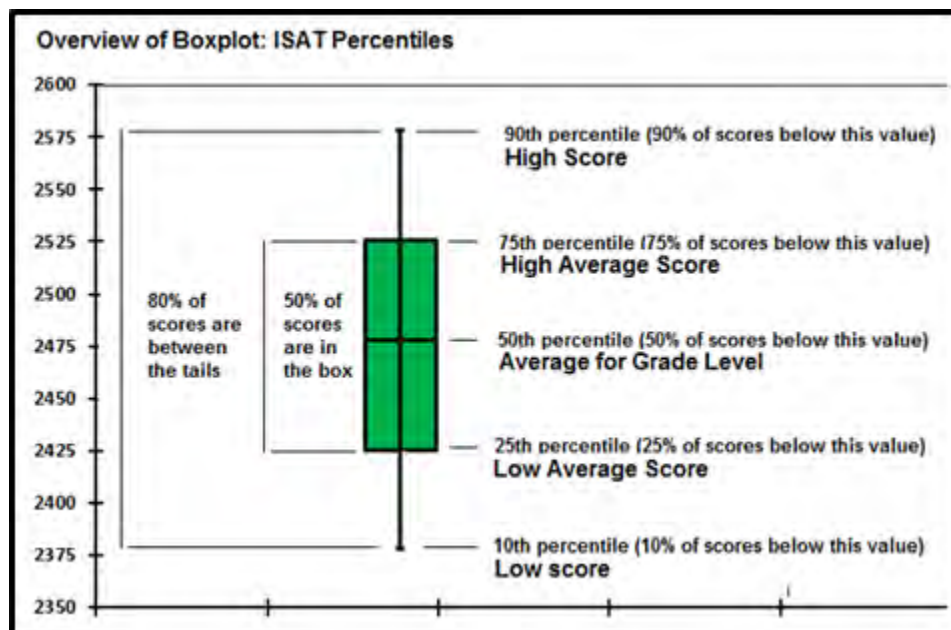
NAEP Reading, Grade 4, 2007 to 2017. Idaho scale scores for the 10th, 25th, 50th, 75th, and 90th percentiles displayed in boxplot and line graph formats.

Figure A4. [Page 11]

NAEP Reading, Grade 8, 2007 to 2017. Idaho scale scores for the 10th, 25th, 50th, 75th, and 90th percentiles displayed in boxplot and line graph formats.

Overview of Boxplots

Performance trends being with the third data point and are refined with each additional data point. The author selected *two kinds of graphs for displaying trends at the 10th, 25th, 50th, 75th and 90th percentiles over time for each grade-subject: boxplots and line charts*. Line charts are often used to report student test results and are generally understood by administrators, teachers and parents. Boxplots, on the other hand, are not commonly used to report student test results so a brief overview may be in order for some readers.



The boxplot permits the reader to follow the academic progress of the middle half of students (i.e., from high average and average for grade level to low average) without losing track of the high and low students. While it does not provide the reader with exact scores for the five percentiles, the boxplot can illustrate a trend. The reader, however, will find exact scale scores for the high, high average, average, low average, and low percentiles displayed in the line graphs.

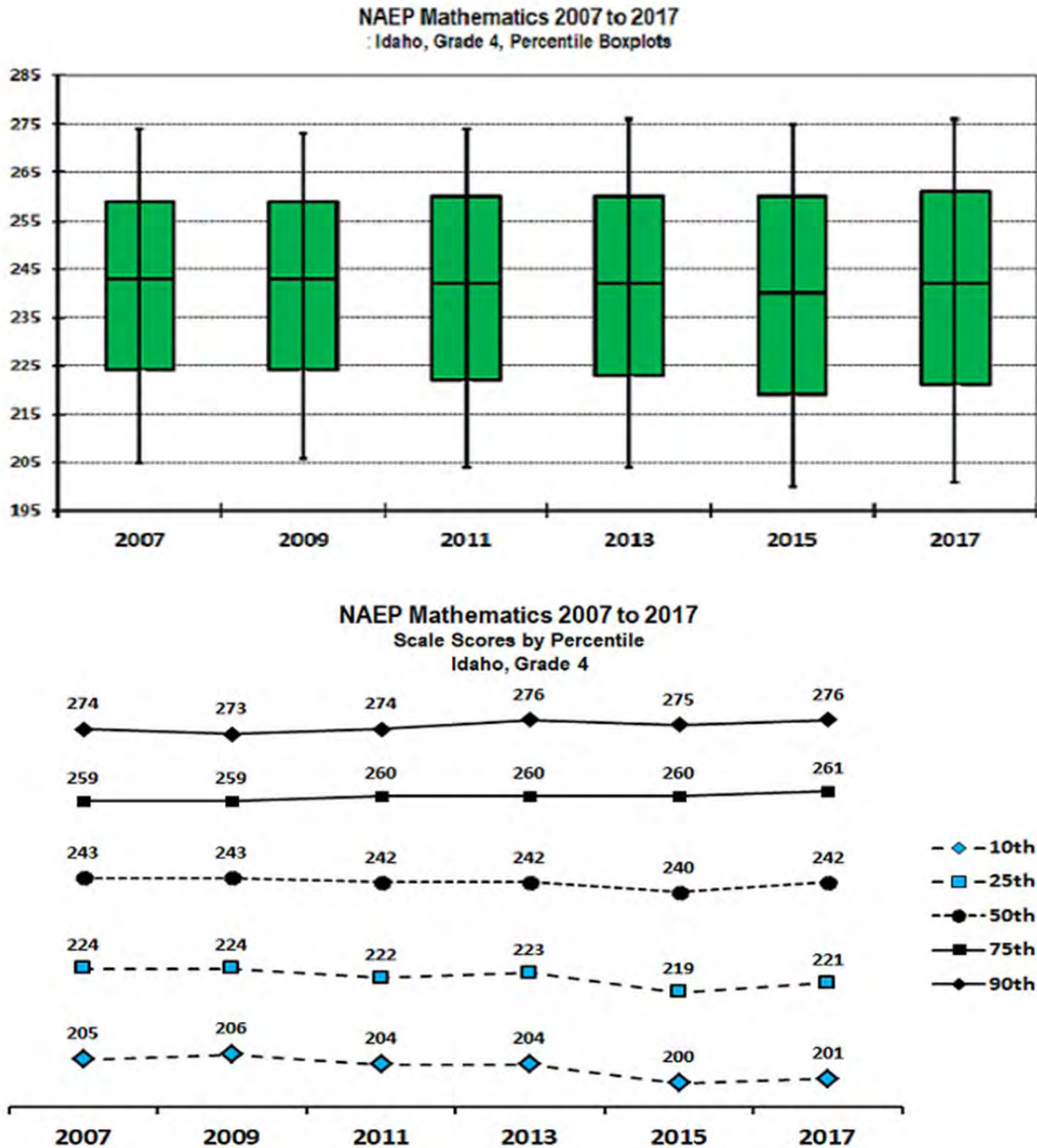


Figure A1. NAEP mathematics, grade 4, 2007 to 2017. Idaho scale scores for the 10th, 25th, 50th, 75th, and 90th percentiles presented in boxplot and line graph formats.

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2007, 2009, 2011, 2013, 2015, and 2017, Mathematics Assessments.

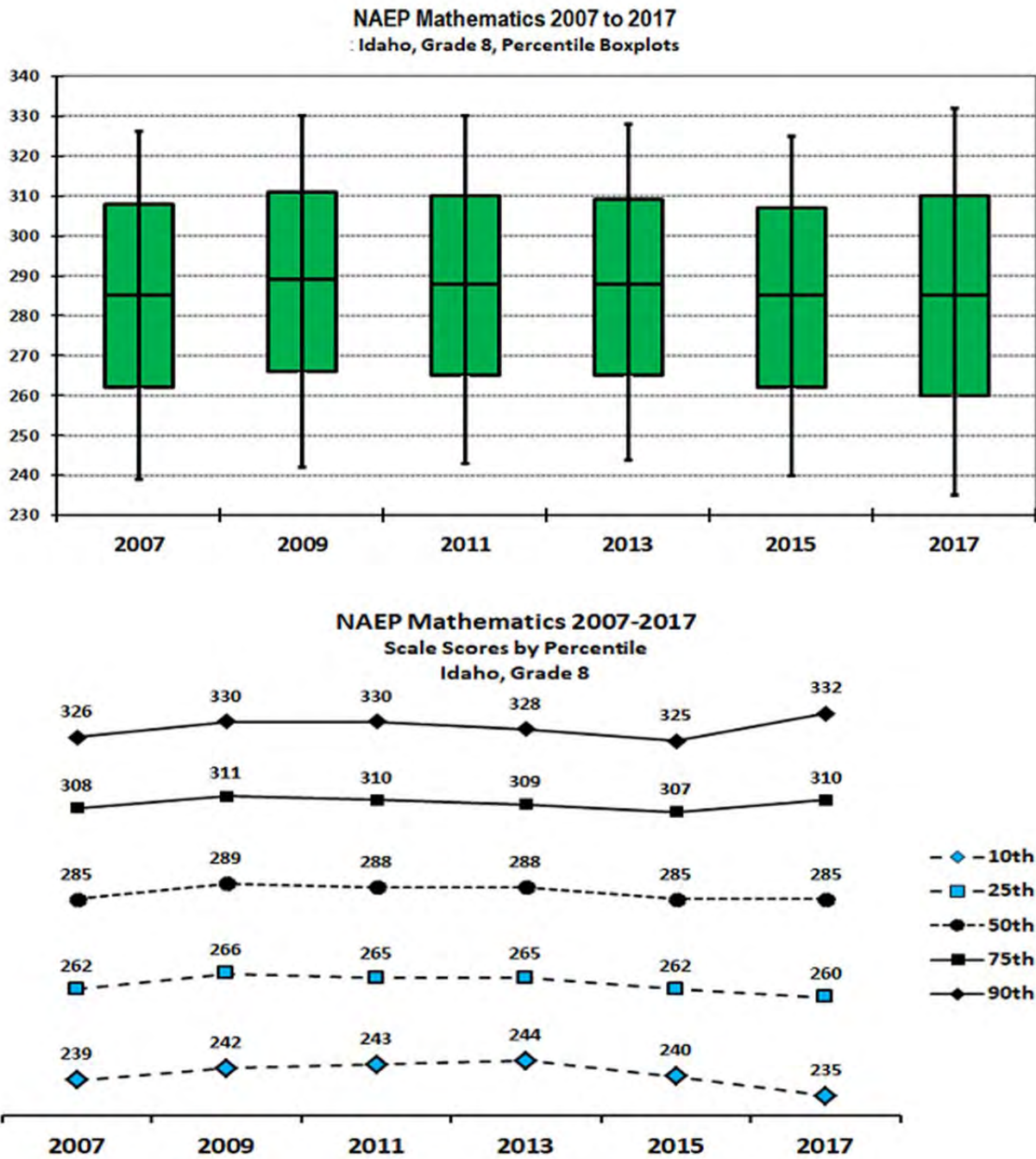


Figure A2. NAEP mathematics, grade 8, 2007 to 2017. Idaho scale scores for the 10th, 25th, 50th, 75th, and 90th percentiles presented in boxplot and line graph formats.

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2007, 2009, 2011, 2013, 2015, and 2017, Mathematics Assessments.

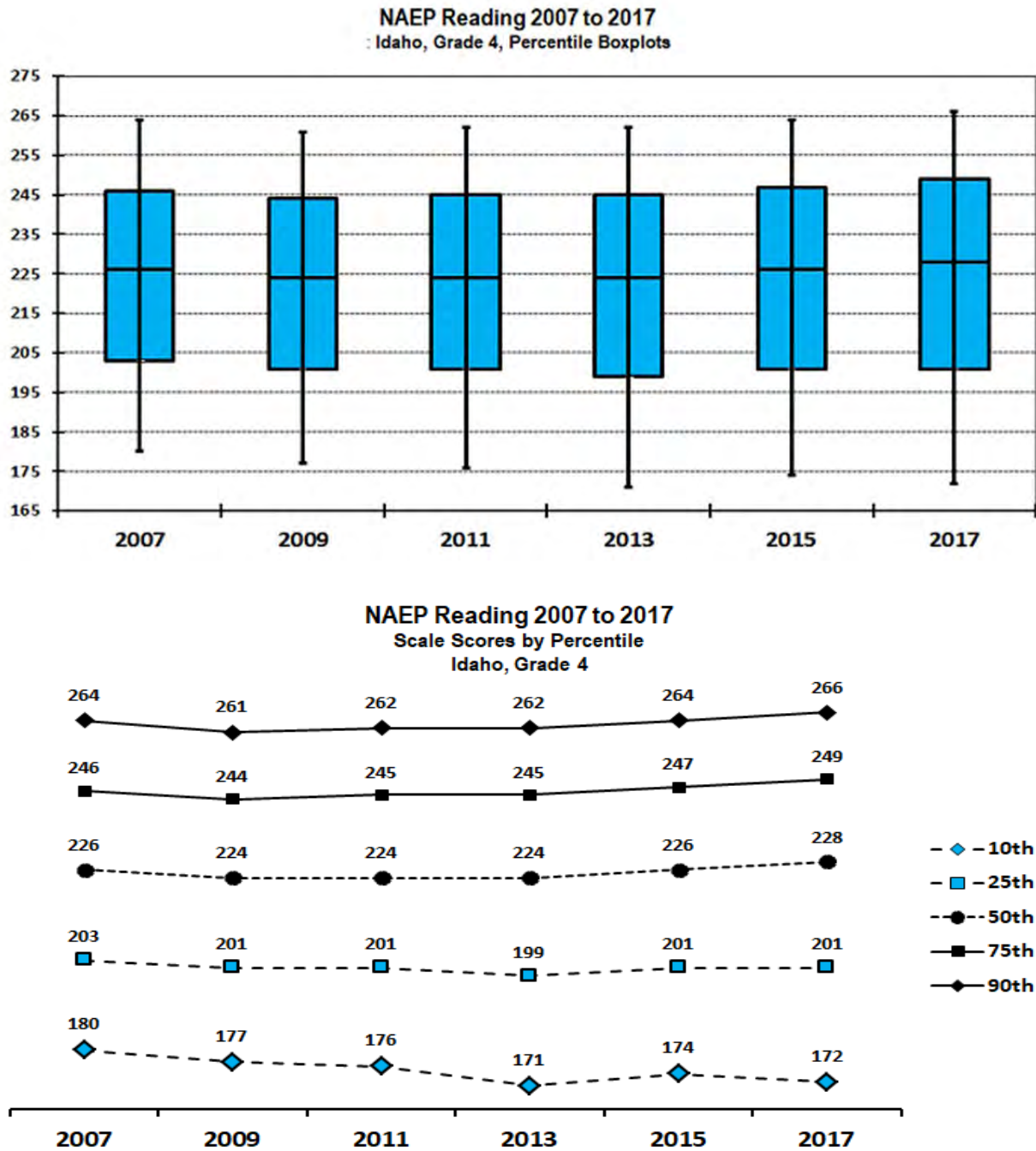


Figure A3. NAEP reading, grade 4, 2007 to 2017. Idaho scale scores for the 10th, 25th, 50th, 75th, and 90th percentiles presented in boxplot and line graph formats.

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2007, 2009, 2011, 2013, 2015, and 2017, Reading Assessments.

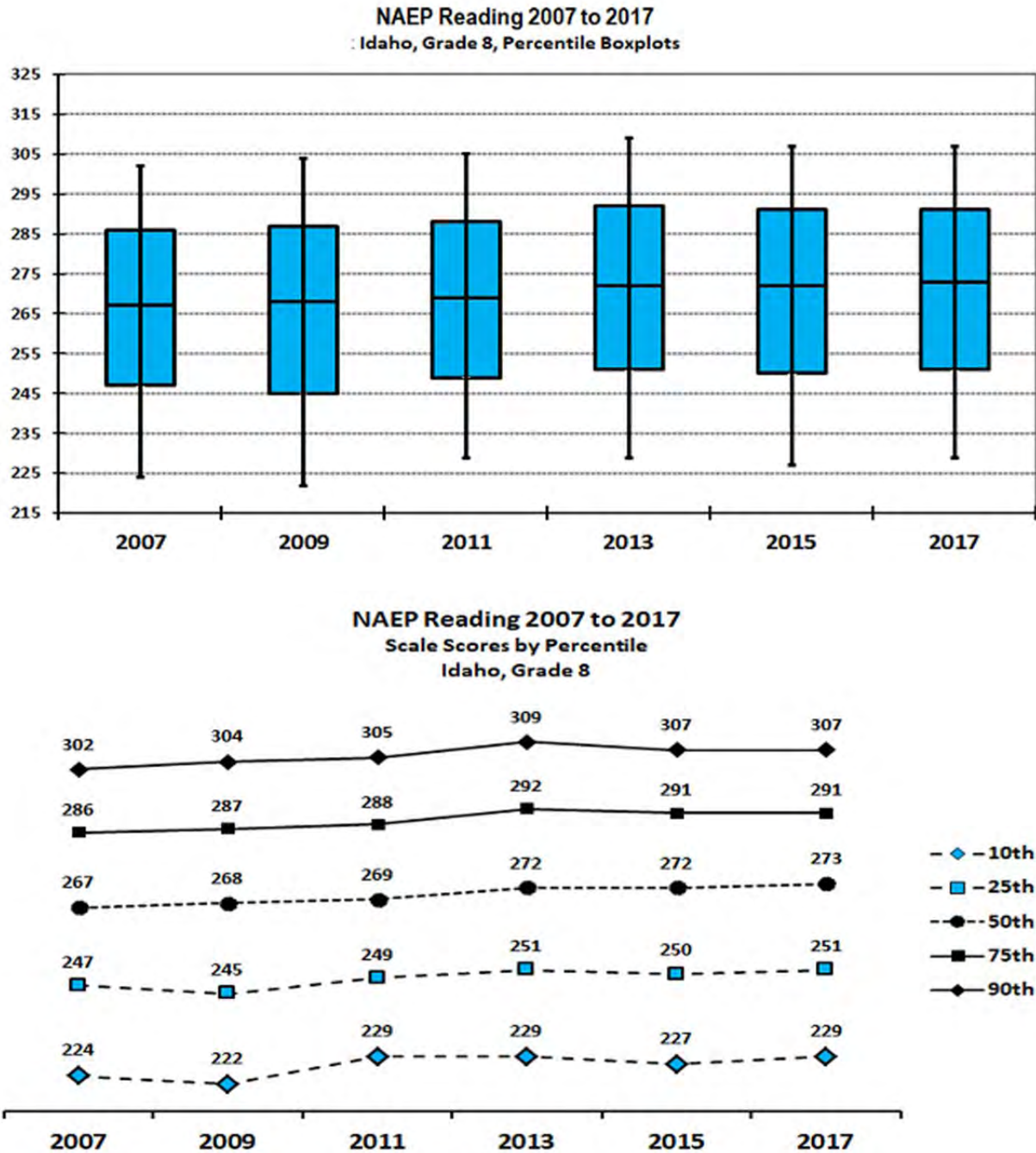


Figure A3. NAEP reading, grade 8, 2007 to 2017. Idaho scale scores for the 10th, 25th, 50th, 75th, and 90th percentiles presented in boxplot and line graph formats.

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2007, 2009, 2011, 2013, 2015, and 2017, Reading Assessments.