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Discussion of Standard & Poor's Presentation Entitled "Comparing State Performance under NCLB: Issues and Opportunities for Using NAEP"

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Introduction

My preparation for today's discussion has been primarily a review of the report entitled *Leveling the Playing Field 2005: Identifying Outperforming and Underperforming States on the NAEP in Demographic Context*. (Standard & Poor's School Evaluation Services, 2005). All references to "the report" hereafter will be references to this publication.

Before stating my concerns about the Standard & Poor's study, let me gratefully acknowledge that the report was free of three mistakes in analyzing and reporting NAEP 2005 results that have appeared again and again in publications issued by foundations, institutes and other research organizations, and in newspaper columns and reports.

- ✓ The report did not denigrate NAEP's At or Above *Basic* as a "dumbing-down" statistic whose primary use is to enable dishonest public educators to escape the accountability measures of the *No Child Left Behind Act*.
- ✓ The report did not resort to point-by-point comparison of performance scores on NAEP and the state assessments.

- ✓ The report did not rank order the states based solely on their average scores or percentage scores.

The literature does recommend that NAEP's Percent At or Above *Basic* as the appropriate statistic when using NAEP to confirm state testing APY results (Mosquin and Chromy, 2004). It also cautions against point-by-point analyses of NAEP versus state performance scores (Ad Hoc Committee, 2002), and against ranking the states on their NAEP average scores (Stoneberg, 2005).

I sincerely appreciate Standard & Poor's (1) recognition that NAEP data cannot be understood sans a consideration of the demographic characteristics of students that produced them, and (2) venture to introduce more sophisticated statistical methodology into the analysis of NAEP data. Nonetheless, my concerns fall primarily in these two areas.

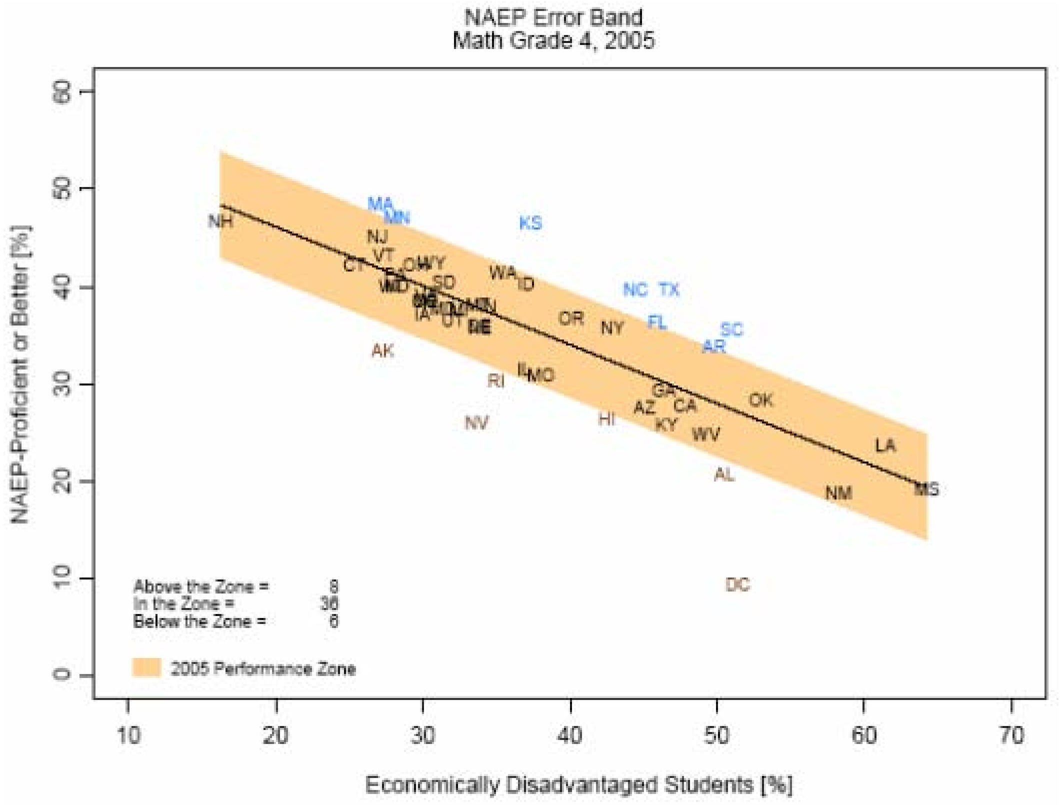
Statistical Methodology

The linear regression model assumes that all data used to construct the model and all data input to the model are accurate. Data accuracy has been defined as "conformity between a recorded data value and the corresponding actual data value" (Klein and Rossin, 1999). Standard & Poor's implementation of the linear regression model did not meet this data accuracy assumption. There are problems both with the student performance scores and with the percentages of economically disadvantaged students used in the analyses.

Student Performance Scores

The report describes the linear regression method, which illustrated in Figure 1 using the grade 4 mathematics analysis, with this language:

Figure 1. Depiction of Standard & Poor's linear regression method used to predict a state's performance from the percentage of its economically disadvantaged students.



> "Standard & Poor's method involves plotting statewide NAEP performance against economically disadvantaged enrollment, and then creating a regression line (representing the expected performance) that runs through the scatter plot. *To account for the statistical uncertainty associated with test measurement error, an "error band" of plus or minus one standard deviation of the residuals is drawn around the regression line to determine the statistically expected zone of statewide performance.* The resulting analysis, which can be depicted graphically, reveals which states perform as statistically expected, which states exceed these expectations (i.e., perform above the error band), and which states fall below statistical expectations (i.e., perform below the error band)." [Emphasis added.]

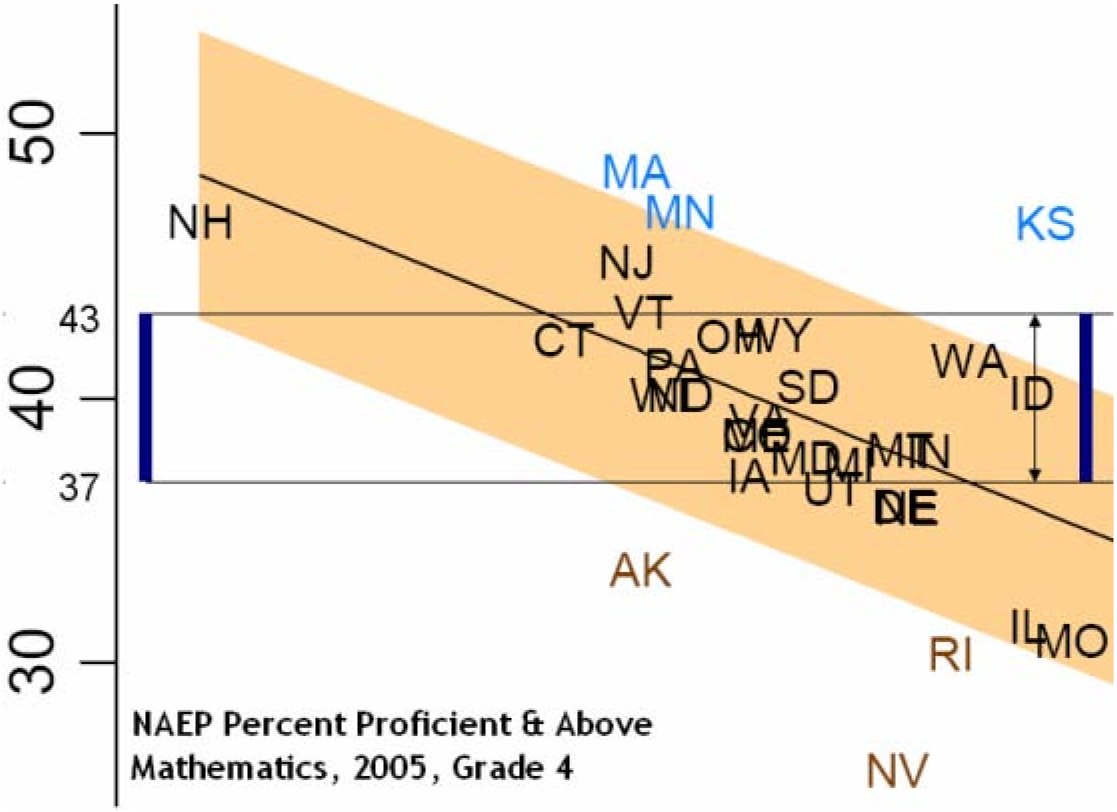
It must be duly noted that the linear regression model really does not account for "test measurement error" as claimed. Consider:

- ✓ The "error band" is actually related to the correlation between the two variables selected for a regression analysis -- the higher the correlation, the smaller the error band (Runyon & Haber, 1971). Two variables of low correlation would produce an "error band" even if the variables were free of test measurement error.
- ✓ The "error band" definitely does not account for the uncertainty in the data associated with sampling. This uncertainty makes up the major portion of what NAEP reports as the "standard error."

NAEP reports out both an estimated score and its standard error. Let's continue using the percentage of students scoring At or Above *Proficient* on the grade 4 NAEP 2005 mathematics test as an example. NAEP estimated that 40 percent of Idaho's students were At or Above *Proficient*, with a standard error of 1.6 percent. The formula **Estimate ± (1.96 x Standard Error)** defines a 95 percent confidence interval for a NAEP estimate. Figure 2 illustrates the 95 percent confidence interval for Idaho's estimate of 40, which is about 37 to 43 (rounding to whole numbers). In short, we can be 95 percent sure that the percentage of Idaho's grade 4 students scoring At or Above *Proficient* on the NAEP 2005 mathematics test was somewhere between 37 percent and 43 percent.

It is apparent in Figure 2 that the linear regression did not *"account for the statistical uncertainty associated with test measurement error."* It simply ignored it. The model cannot account for it. Perhaps Standard & Poor's should seek a statistical model that is more appropriate for analyzing NAEP data.

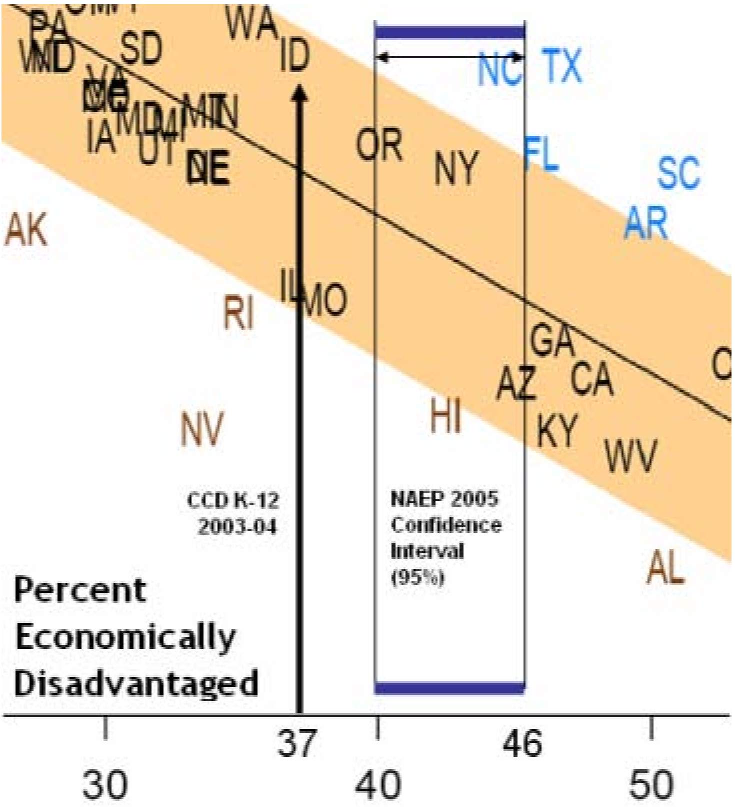
Figure 2. Confidence interval (95%) for the percentage of Idaho students estimated At or Above *Proficient* on the NAEP 2005 mathematics test, grade 4.



Economically Disadvantaged Students

NAEP collected demographic information for all students that took part in the assessment, including their eligibility for free or reduced price meals under the National School Lunch Program. This enabled NAEP to use data from one student sample to estimate both a state's performance score and its percentage of disadvantaged students. Indeed, NAEP estimated that 43 percent of Idaho's grade 4 students in 2005 were economically disadvantaged, with a standard error of 1.5 percent. Upon calculating the 95% confidence interval, as depicted in Figure 3,

Figure 3. The 2003-04 percentage of economically disadvantaged K-12 students in Idaho from the Common Core of Data, and the confidence interval (95%) for the percentage of economically disadvantaged grade 4 students in Idaho estimated from the NAEP 2005 mathematics test.



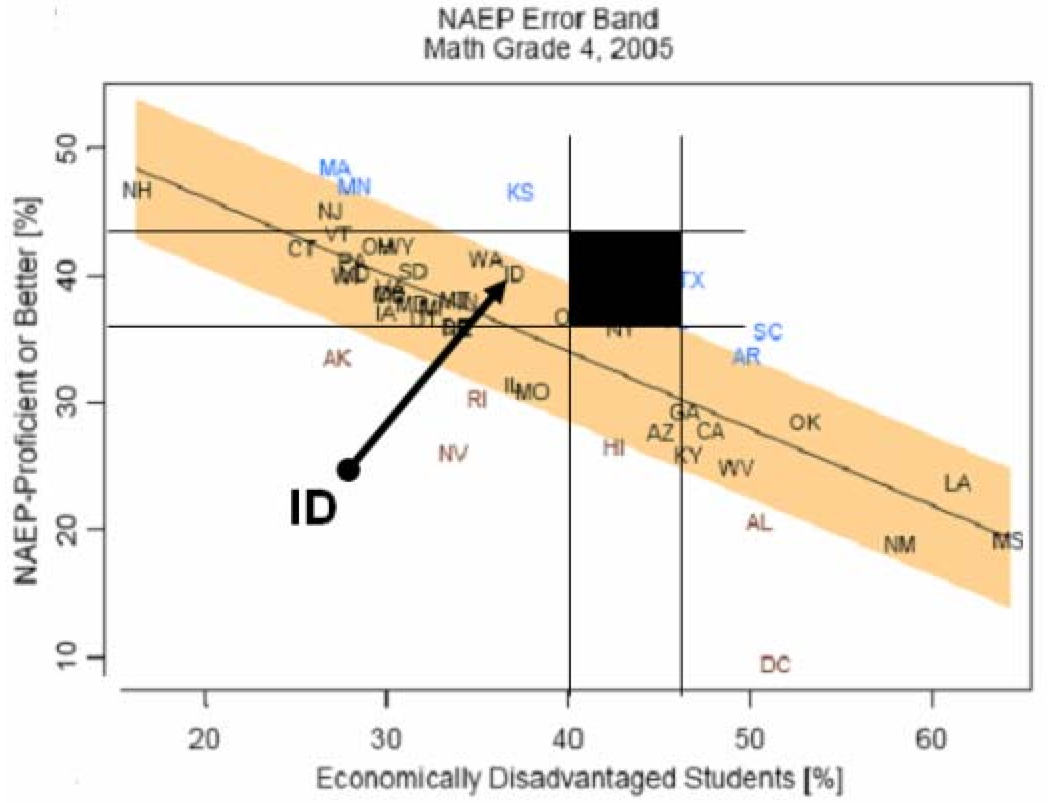
we can be 95 percent sure that the percentage of Idaho's grade 4 students who were economically disadvantaged in 2005 was between 40 and 46 percent.

Ignoring grade 4 estimates from the 2005 assessment, Standard & Poor's decided to use 2003-04 percentages of economically disadvantaged students in grades K-12 listed in the Common Core of Data. As Figure 3 shows, the 2003-04 CCD percentage for Idaho students across K-12 (37) did not even fall within the confidence interval of NAEP's 2005 estimated percentage for Idaho grade 4 students (40 to 46). A state's percentage of students in the National School Lunch

Program across grades K-12 is typically lower than in grade 4 and higher than in grade 8. Thus, this decision detracted from data accuracy at both grade levels, just in different directions.

The intersection of the NAEP confidence intervals for the percentages of students At or Above *Proficient* and economically disadvantaged are plotted on Figure 4. The value for the grade 4 mathematics analysis that the report used for Idaho is also plotted. It might be reasonably expected that the “actual” value for

Figure 4. Intersection of NAEP 2005 confidence intervals (95%) for percentage of Idaho students At or Above *Proficient* in grade 4 mathematics and percentage of economically disadvantaged students, and the “corresponding” value point used by Standard & Poor’s to represent Idaho.



Idaho would fall somewhere inside the intersection, but the value Standard & Poor's selected for Idaho falls clearly outside the intersection. Inaccurate data!

What Is the Research Question?

Standard & Poor's intent was to identify the states that were above or below "statistical expectations," i.e., being above or below the "error band." The Standard & Poor's model assures that, absent impact of outliers, about 16 percent of the states will fall above the "error band," about 68 percent will fall within the "error band," and about 16 percent will fall below the "error band."

The two variables that Standard & Poor's "defined" for use in the linear regression analysis on grade 4 mathematics, i.e.,

► percentage of **all K-12** students **eligible for NSLP** in **2003-04**, and the
► percentage of **all fourth graders** **At or Above NAEP *Proficient*** in **2005**,

do show a -0.77 correlation over the 50 states, but did it make sense to use them in a linear regression analysis? Why proceed using data from different groups of students and from different years, which were collected without regard for sampling error? How can analyses using confused and inaccurate data be interpreted? Even with inaccurate data, absent influence from outliers, by design eight states were likely to have "exceeded statistical expectations" for grade 4 mathematics. My problem is I have no idea from reading the report (or from listening to the presentation) how to word a research question about grade 4 mathematics that this analysis might answer. "Statistical expectations" for what? Maybe you comment on this?

Comparing State Performance Using NAEP, Another Way

Linear regression is an unsuitable statistical method for analyzing NAEP data, but appropriate statistical methods are available. The National Center for Education Statistics (NCES), for example, has developed, and made available to the public, an on-line tool known as the "NAEP Data Explorer" (NDE). Its URL is

http://nces.ed.gov/nationsreportcard/nde/

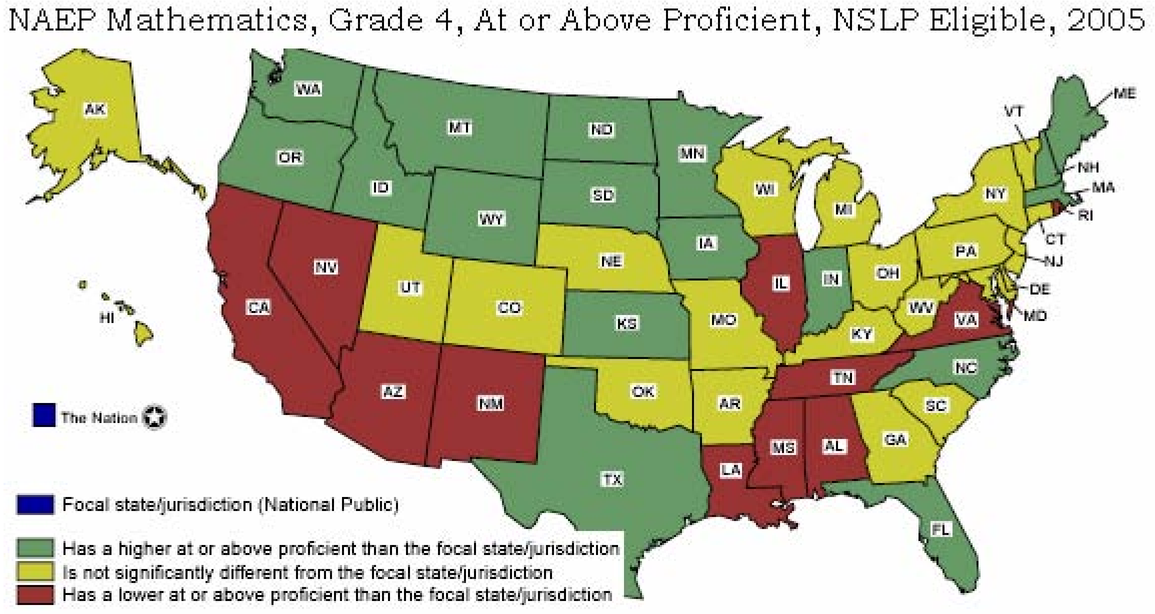
The NDE runs pair-wide t-tests, one test for each state against the nation. To maintain a family probability level of .05, the NDE applies the Benjamini-Hochberg False Discovery Rate.

Before going to the NDE, one should start the analysis by forming a research question, such as:

> How did the percentage of economically disadvantaged grade-4 students in each state who scored At or Above *Proficient* on the 2005 math assessment compare to the percentage of economically disadvantaged grade-4 students who scored At or Above *Proficient* in the nation as a whole?

The NDE will select the data needed to answer the question perform the statistical analyses, and report the results. To answer the research question here, the NDE will calculate for the nation and for each state two statistics: the percent of students At or Above *Proficient* with its standard error. Only data generated by students who qualify for free or reduced price meals under the National School Lunch Program are used for the national and state calculations. The NDE then uses these statistics to run 50 pair-wide t-tests followed by a correction to preserve the family probability level of .05. Finally, the NDE prepares a map (see Figure 5) painting the states into one of three categories: significantly higher than

Figure 5. Map from "NAEP Data Explorer" showing how the percentage of economically disadvantaged students in each state scoring At or Above *Proficient* on the grade 4 mathematics test in 2005 compared to the percentage of economically disadvantaged students scoring At or Above *Proficient* nationwide.


NAEP Mathematics, Grade 4, At or Above Proficient, NSLP Eligible, 2005

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WA
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OK
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GA
MS
AL
LA
TX
FL
🟦 The Nation ✪
🟦 Focal state/jurisdiction (National Public)
🟩 Has a higher at or above proficient than the focal state/jurisdiction
🟨 Is not significantly different from the focal state/jurisdiction
🟥 Has a lower at or above proficient than the focal state/jurisdiction

the nation (green), not significantly different from the nation (yellow), and significantly lower than the nation (red). If no state distinguished itself from the nation as a whole, either positively or negatively, then all states would be painted yellow. There is no statistical requirement that a given percentage of the states fall either above or below the nation.

Figure 1 (Standard & Poor's) and Figure 5 (National Center for Education Statistics) both seek to control for economic disadvantage when examining how states compared on the NAEP 2005 mathematics test in grade 4. The results, however, are not always the same. Two examples. Figure 1 plots Arkansas and North Carolina over performing statistical expectations," but Figure 5 paints them as not significantly different from the nation. Figure 1 plots Alaska and Hawaii as under performing “statistical expectations,” but Figure 5 paints them as not significantly different from the nation.

NCLB, and At or Above NAEP *Basic*

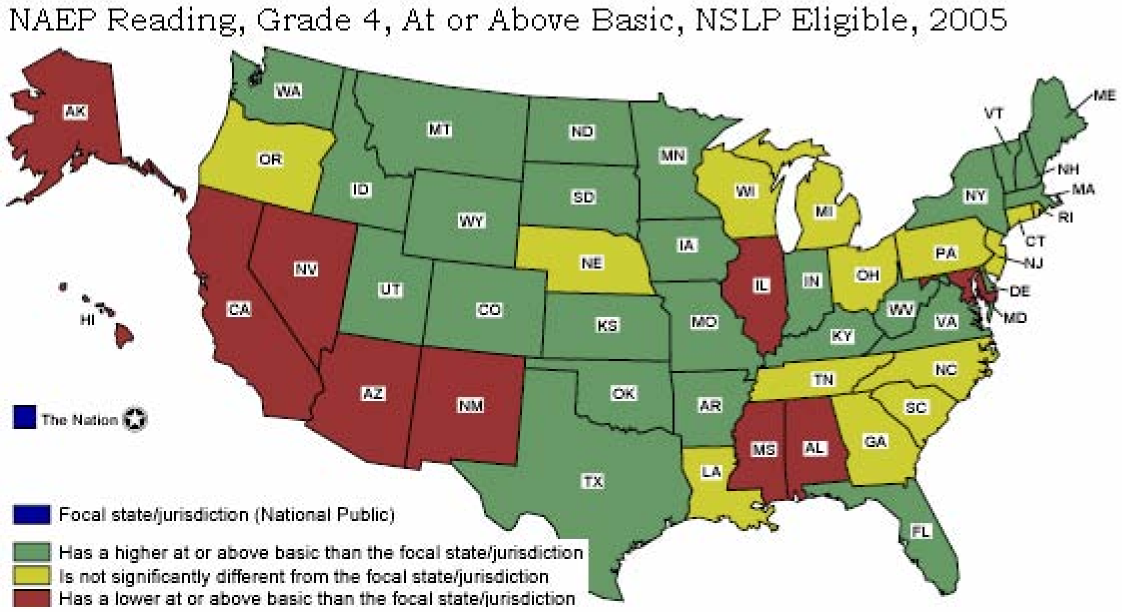
The discussion thus far as focused on NAEP’s At or Above *Proficient* performance level, but NCLB isn’t about NAEP *Proficient*. NCLB is about Adequate Yearly Progress (AYP), and NAEP At or Above *Basic* is the appropriate statistic when using NAEP to confirm state testing AYP results.

Figure 6 (reading) and 7 (mathematics) display the NDE maps showing the percentage of economically disadvantaged grade-4 students in each state who scored At or Above *Basic* on the 2005 NAEP assessments compared to their counterparts nationwide.

Figure 8 (reading) and 9 (mathematics) display the NDE maps showing the percentage of economically disadvantaged grade-8 students in each state who scored At or Above *Basic* on the 2005 NAEP assessments compared to their counterparts nationwide.

We’ll move through these slides without comment. Find your state on each slide; you’ll know immediately how well your economically disadvantaged students are doing.

Figure 6. Percentage of economically disadvantaged grade-4 students in each state who scored At or Above *Basic* on the 2005 reading assessment compared to their counterparts nationwide


NAEP Reading, Grade 4, At or Above Basic, NSLP Eligible, 2005
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NC
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NY
VT
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NH
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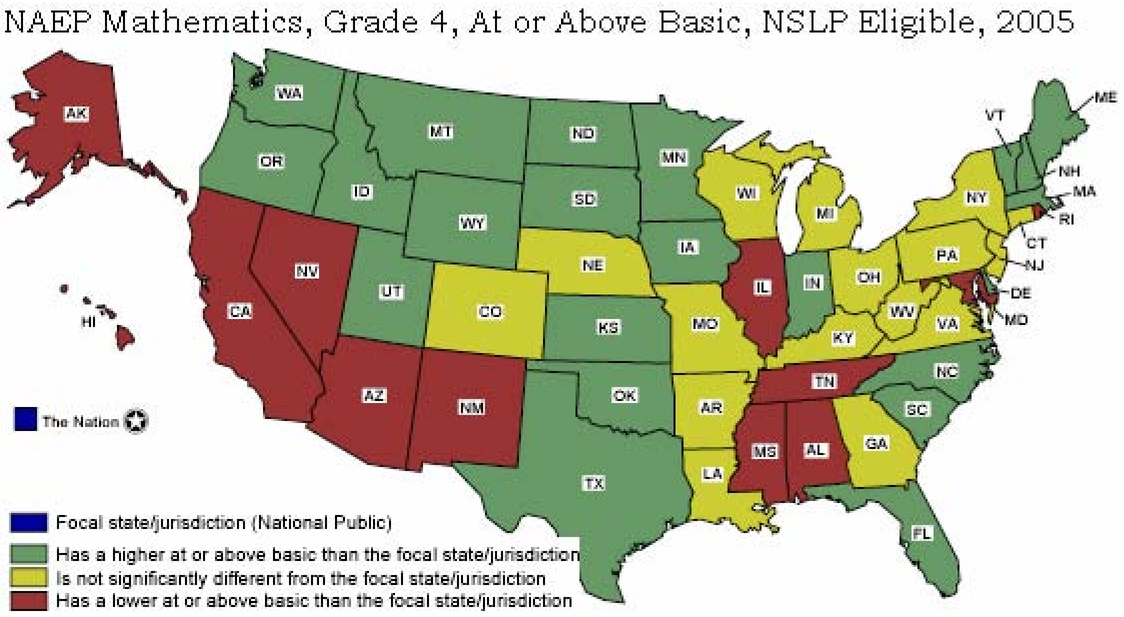
RI
CT
NJ
DE
MD
The Nation
Focal state/jurisdiction (National Public)
Has a higher at or above basic than the focal state/jurisdiction
Is not significantly different from the focal state/jurisdiction
Has a lower at or above basic than the focal state/jurisdiction

Figure 7. Percentage of economically disadvantaged grade-4 students in each state who scored At or Above *Basic* on the 2005 mathematics assessment compared to their counterparts nationwide.


NAEP Mathematics, Grade 4, At or Above Basic, NSLP Eligible, 2005
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AL
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GA
FL
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NC
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CT
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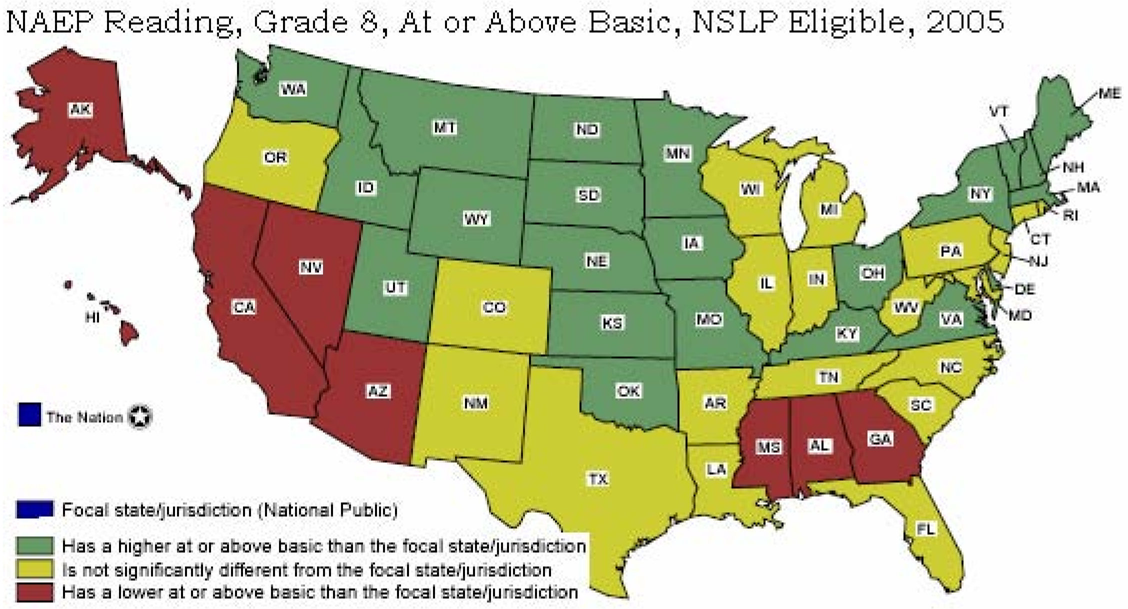
DE
MD
The Nation
Focal state/jurisdiction (National Public)
Has a higher at or above basic than the focal state/jurisdiction
Is not significantly different from the focal state/jurisdiction
Has a lower at or above basic than the focal state/jurisdiction

Figure 8. Percentage of economically disadvantaged grade-8 students in each state who scored At or Above *Basic* on the 2005 reading assessment compared to their counterparts nationwide.


NAEP Reading, Grade 8, At or Above Basic, NSLP Eligible, 2005
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IL
MI
IN
OH
KY
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SC
NC
VA
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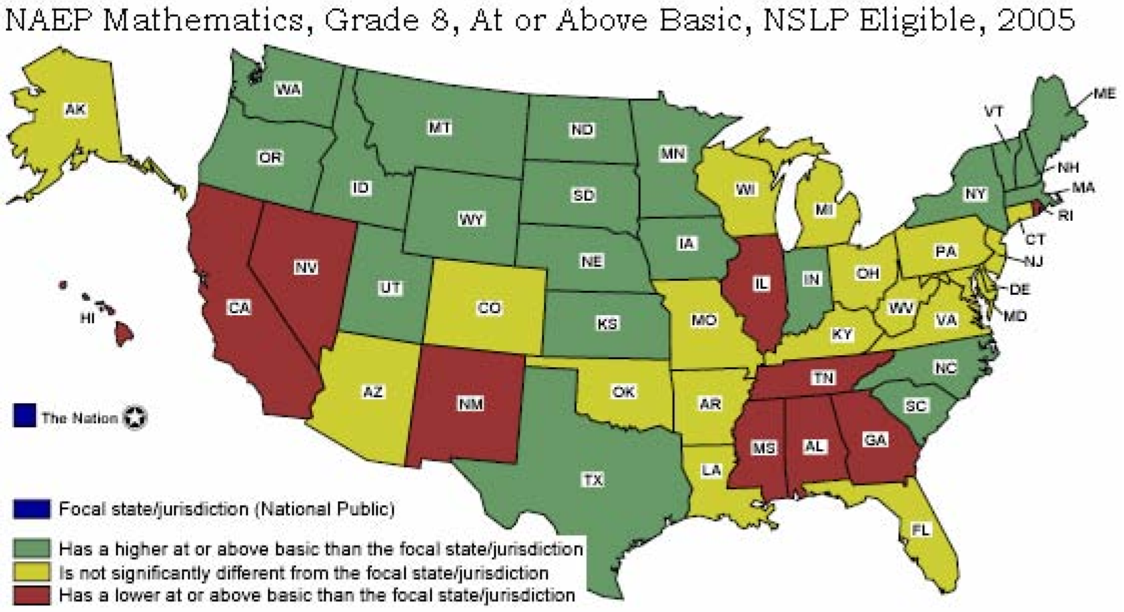
NY
VT
ME
NH
MA
RI
CT
NJ
DE
MD
The Nation
Focal state/jurisdiction (National Public)
Has a higher at or above basic than the focal state/jurisdiction
Is not significantly different from the focal state/jurisdiction
Has a lower at or above basic than the focal state/jurisdiction

Figure 9. Percentage of economically disadvantaged grade-8 students in each state who scored At or Above *Basic* on the 2005 mathematics assessment compared to their counterparts nationwide.


NAEP Mathematics, Grade 8, At or Above Basic, NSLP Eligible, 2005
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NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MI
IN
OH
KY
TN
MS
AL
GA
FL
SC
NC
VA
WV
PA
NY
VT
ME
NH
MA
RI
CT
NJ
DE
MD
The Nation
Focal state/jurisdiction (National Public)
Has a higher at or above basic than the focal state/jurisdiction
Is not significantly different from the focal state/jurisdiction
Has a lower at or above basic than the focal state/jurisdiction

Final Words

The statistical methodology available through the NAEP Data Explorer is preferred over the linear regression model. Standard & Poor's should consider using the NAEP Data Explorer for its future analyses or at least consider identifying and using a methodology that can appropriately deal with the uncertainty in the NAEP data due to the use of samples.

Today we looked at controlling for poverty on only one level. This is helpful, but it's not enough. It's likely that poor White students, poor Hispanic students, poor African-American Students, poor Asians and poor Native Americans, each as a member of a distinct cultural group, may made use of their educational experience differently, even when they sit side-by-side in the same classroom. If we really want to understand how the performance of economically disadvantaged students looks from state to state, or within a state, it is necessary to look at least at two levels of demographics. In this way, we'll be able to get the information that we want, and that we need.

# # #

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