AN INTRODUCTION TO THE 2012 NATIONAL SURVEY OF SCIENCE AND MATHEMATICS EDUCATION BRIEFING BOOK

This document provides an introduction to the *2012 National Survey of Science and Mathematics Education (NSSME) Briefing Book*.[1] It includes an overview of the organization and contents of the Briefing Book, as well as information on how to accurately communicate findings from the 2012 NSSME.

The *2012 National Survey of Science and Mathematics Education Briefing Book* was prepared with support from the National Science Foundation under grant number DRL-1008228. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Organization of the Briefing Book

The Briefing Book consists of slides showing results from the 2012 NSSME, which can be drawn upon for creating presentations about K–12 science and mathematics education. It follows the structure of the *Report of the 2012 National Survey of Science and Mathematics Education*,[2] and consists of 13 sets of PowerPoint slides. The first set of slides describes the study design, instruments, and response rates. It also includes an "acknowledgement" slide that should be included in any presentation utilizing Briefing Book slides. The remaining sets of slides correspond to chapters 2–7 of the 2012 NSSME report, with two sets of slides for each chapter (one for science and one for mathematics).

Within each chapter, slides are organized by topic area. For example, within the Chapter 2 slides on Teacher Background, there are slides with findings about teacher demographics, teacher content background, and teacher preparedness. The first slide in each topic area is an overview containing information intended to help users understand and accurately communicate the findings in the presentation slides. Each overview slide shows the original data table from the report used to create the presentation slides, with standard errors of the estimates shown in parentheses.[3] Each overview slide also includes several pieces of information in the "notes" field:

- The page on which the table appears in the report;

[1] Horizon Research, Inc. (2014). *2012 National survey of science and mathematics education briefing book.* Chapel Hill, NC: Horizon Research, Inc.

[2] Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). *Report of the 2012 national survey of science and mathematics education.* Chapel Hill, NC: Horizon Research, Inc.

[3] Standard errors represent the uncertainty in an estimate; the true value of a parameter is 95 percent likely to fall ±1.96 times the standard error.

- An indication of whether the table shows data from individual survey items, composite variables,[4] or other variables derived from the survey data;
- The original questionnaire items the table is based on; and
- The text from the report that was written about the data in the table.

The overview slides are not intended for presentation. They are followed by presentation slides representing the data in chart format. (Note, several tables in the report contain both science and mathematics data. The science slides show only the science portion of those tables, and the mathematics slides show only the mathematics portion.)

Most of the slides in the Briefing Book show data disaggregated by grade ranges (elementary, middle and high). When possible, results for all three grade ranges are represented on a single chart. Some slides show data disaggregated by "equity factors":

- Prior achievement level of students in the class;
- Percentage of students in the class from race/ethnic groups historically underrepresented in STEM (HUS);
- Percentage of students in the school eligible for free/reduced-price lunch (FRL);
- School size;
- Community type (i.e., rural, suburban, urban); and
- Region of the country (i.e., Midwest, Northeast, South, West).

For school size and FRL, each school was classified into one of four quartiles within groups of schools serving the same grades (e.g., schools with grades K–5, schools with grades 6–8). Similarly, each randomly selected class was classified into one of the four categories based on the proportion of students identified as HUS, regardless of grade level.

Accurately Communicating Findings

Because of the complexity of the 2012 NSSME sample design and analysis, there are a number of issues that should be considered when presenting findings:

- The 2012 NSSME sample design involved clustering and stratification of schools and teachers. Consequently, weighting the data in analysis is necessary to reflect different probabilities of selection. Weighting is also used to adjust for non-response of sampled schools and teachers. The use of weights in the analysis allows the results to be considered nationally representative; thus, when sharing results from the study it is appropriate to talk about schools, teachers, and classes in the nation.

  It is actually *incorrect* to talk about results referring to schools, teachers, and classes "in the sample." For example, teachers of chemistry and physics were sampled at a higher rate than other science teachers to allow for reporting of findings for these groups, and

[4] Sets of related questionnaire items were combined to create several composite variables related to key constructs. Composite variables, which are more reliable than individual survey items, were computed to have a minimum possible value of 0 and a maximum possible value of 100; higher composite scores indicate more of the construct being measure by the composite.

make up a larger portion of the sample than they would if simple random sampling was used. The use of weights in analysis adjusts for this overrepresentation.

- It is important to pay attention to figure and axis titles in the Briefing Book as some slides refer to schools, some to teachers, and some to classes. In addition, because of the sample design, you cannot interchange "classes" and "teachers."

- In the Briefing Book, almost all figures are on a 0–100 scale. This decision was made to avoid magnifying small differences in the data. Exceptions are when the bars are supposed to add to 100.

- Although some results point to differences among groups (e.g., by grade level), it will be important to consider whether a finding is educationally significant as well as statistically significant. Small significant differences may not be worth discussing.

- If the "difference" (e.g., between findings or groups) is not statistically significant, it would not be appropriate to describe it as a difference; the apparent difference could be due to sampling error. Unfortunately, there is not a simple way for you to test for statistical significance. There are three options you can use for making this determination:

    1. Look in the 2012 NSSME report; if we wrote about a difference in a report, that difference was tested and is statistically significant.

    2. You can approximate whether two numbers are statistically different by adding the standard errors and comparing that to the difference between the two numbers. If the difference is greater than the sum of standard errors, it is likely statistically significant.

       For example, suppose you wanted to know if the highest-poverty schools were less likely to have science teachers with college degrees in their discipline than the lowest-poverty schools. The data are shown in Table 2.6:

Table 2.6
Secondary Teachers with a Degree in Discipline,
by Proportion of Students Eligible for Free/Reduced-Price Lunch

	Percent of Teachers			
	Lowest Quartile	Second Quartile	Third Quartile	Highest Quartile
Science Teachers	68 (3.1)	57 (3.3)	62 (3.7)	58 (3.9)

Using this approximation method, you would first add the standard errors:

$$3.1 + 3.9 = 7.0$$

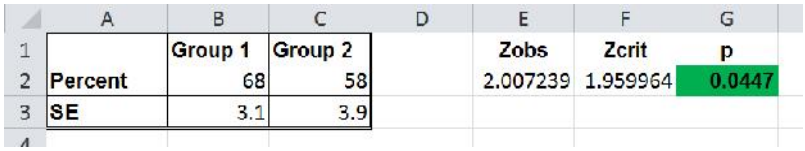
You would then compute the difference in the percentages:

68 – 58 = 10

Lastly, compare the difference in the percentages to the sum of the standard errors. Because the difference is greater than the sum of the standard errors, the difference is likely statistically significant. (Note, the greater the difference between the difference in percentages and the sum of the standard errors, the more likely the difference is actually statistically significant.)

3. If you want to be somewhat more precise, and put in a little more effort, you can use an Excel spreadsheet calculator for comparing percentages (this calculator was not intended to be used with means).

   For example, entering the data from the previous example into the calculator indicates that the p-value for this comparison is 0.0447:



	A	B	C	D	E	F	G
1		Group 1	Group 2		Zobs	Zcrit	p
2	Percent	68	58		2.007239	1.959964	0.0447
3	SE	3.1	3.9				

   Because the p-value is less than 0.05 (the typical level used for significance testing), you could say that the difference between the highest- and lowest-poverty schools is statistically significant. (Note, the calculator shows the p-value in green if the difference is statistically significant and red if it is not.)