Applied Research Methods

A guide to calculating district expenditure-to-performance ratios using publicly available data

Sarah Ryan
Heather J. Lavigne
Jacqueline S. Zweig
Pamela J. Buffington
Education Development Center, Inc.

In collaboration with the Northeast Rural Districts Research Alliance

ies NATIONAL CENTER FOR EDUCATION EVALUATION AND REGIONAL ASSISTANCE

Institute of Education Sciences
U.S. Department of Education

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Regional Educational Laboratory
At Education Development Center, Inc.

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Summary

During the 2012/13 school year 35 states provided less funding for education than they had prior to the U.S. economic recession of 2007–09 (Leachman, Albares, Masterson, & Wallace, 2016; Levin et al., 2012; Oliff, Mai, & Leachman, 2012). As a result, districts across the country are seeking ways to increase efficiency—the maximization of education outcomes for a given quantity of inputs (Houck, Rolle, & He, 2010). One proxy for district efficiency is an expenditure-to-performance ratio—for example, the ratio of per pupil expenditures to student academic performance.

This guide shows how states and districts can use publicly available data on district expenditures and student academic performance to calculate six district-level expenditure-to-performance ratios. The guide is based on a separate Regional Educational Laboratory (REL) Northeast & Islands project (Lavigne, Ryan, Zweig, & Buffington, in press) conducted for the Northeast Rural Districts Research Alliance and uses state department of education data from one state in the REL Northeast & Islands Region as an example.

This guide also shows states and districts how to rank districts on each of the ratios to examine how a district's perceived efficiency varies depending on which expenditure-to-performance ratio is considered. As the example presented in the guide indicates, the perceived efficiency of a district relative to other districts in the state can vary widely across the six ratios. For example, 4 of the 10 highest ranked districts on ratio A, a ratio of total per pupil expenditures to median student growth percentile in math, were ranked in the bottom half of the distribution on at least one of the other five ratios.

Practitioners and policymakers can use the information in this guide to consider how districts in a state, particularly districts with similar characteristics, are using specific types of resources (expenditures) to produce particular student outcomes (performance). However, local and state stakeholders must carefully consider which measure of performance they are most interested in (for example, growth on standardized achievement assessments, school attendance, or high school graduation rates), as well as which kinds of expenditures they are most interested in.

Contents

Why this guide?

Practitioners and policymakers need to identify effective ways of improving education while delivering the greatest benefits relative to the resources invested. Average state education budgets have decreased since the U.S. economic recession of 2007–09 (Leachman et al., 2016; Levin et al., 2012; Oliff, Mai, & Leachman, 2012). School districts across the country are thus seeking ways to increase efficiency—the maximization of education outcomes for a given quantity of inputs (Houck et al., 2010; see box 1 for definitions of key terms used in the guide).

One proxy for district efficiency is an expenditure-to-performance ratio—for example, a ratio of per pupil expenditures to student academic performance.[1] Expenditure-to-performance ratios are increasingly being used to rank districts on efficiency (see, for example, Boser, 2014). The simultaneous consideration of district expenditures and student academic performance has also been used to estimate potential savings through school district consolidation, an issue of particular importance for small and rural districts (Jimerson, 2007; Rooney & Augenblick, 2009).

This guide shows state and local education agencies and other researchers how to use data that are frequently publicly available on state department of education websites to calculate six district-level expenditure-to-performance ratios. The guide also shows how these stakeholders can rank districts on each of the ratios to examine how a district's perceived efficiency varies depending on which expenditure-to-performance ratio is considered. The guide is based on a recent Regional Educational Laboratory (REL) Northeast & Islands project (Lavigne et al., in press) conducted for the Northeast Rural Districts Research Alliance and uses state department of education data from one state in the REL Northeast & Islands Region as an example.

This guide shows state and local education agencies and other researchers how to use data that are frequently publicly available on state department of education websites to calculate six district-level expenditure-to-performance ratios

The six expenditure-to-performance ratios illustrate that prioritizing certain measures of expenditures and performance over others can lead to different conclusions about efficiency. The six ratios were calculated using three measures of per pupil expenditures and two measures of student performance and were based on 2012/13 data from 98 districts serving grades K–12. Only K–12 districts were included because expenditures for districts that serve K–8 students are expected to differ from expenditures for districts that serve K–12 students (Silvernail, Sloan, Paul, Johnson, & Stump, 2014). All data used to calculate the six ratios were publicly available from the example state's department of education website.

Box 1. Key terms

Efficiency

Efficiency. The maximization of education outcomes for a given quantity of inputs.

Enrollment

Enrollment. An average of the headcount of students living within district boundaries on October 1 and April 1.

Measures of expenditures

Constructed per pupil expenditures. Total spending on 7 of the 11 expenditure categories reported by districts in the example state in 2012/13, divided by student enrollment. This

(continued)

Box 1. Key terms *(continued)*

measure includes spending on regular instruction, other instruction (including summer school and extracurricular instruction), student and staff support, system administration, school administration, operations and maintenance, and other expenditures and excludes spending on transportation, special education instruction, career and technical education instruction, and debt services and other commitments. This measure acknowledges interest among Regional Educational Laboratory Northeast & Islands Region stakeholders in creating an expenditure-to-performance ratio that excludes expenditures that vary widely across districts—and particularly across districts in different locales (for example, rural and urban).

Instructional per pupil expenditures. Total spending on 4 of the 11 expenditure categories reported by districts in the example state in 2012/13, divided by student enrollment. This measure includes spending on regular instruction, special education instruction, career and technical education instruction, and other instruction (including summer school and extracurricular instruction) and excludes spending on student and staff support, system administration, school administration, transportation, operations and maintenance, debt services and other commitments, and other expenditures.

Total per pupil expenditures. Total spending on all 11 expenditure categories reported by districts in the example state in 2012/13, divided by student enrollment. The 11 expenditure categories are regular instruction, special education instruction, career and technical education instruction, other instruction (including summer school and extracurricular instruction), student and staff support, system administration, school administration, transportation, operations and maintenance, debt services and other commitments, and other expenditures.

Measures of performance

Median student growth percentile in math. A summary of the median student growth rate in math in the district relative to the median student growth rate in math in the state. For example, a median student growth percentile of 60 indicates that the performance of the median student in the district grew as much as or more than that of 60 percent of his or her peers in the state who had similar assessment score histories. Median student growth percentile is not an equal interval variable.

Percentage of students scoring proficient or above in math. The percentage of a district's students scoring proficient or above on the state standardized achievement assessment in math. Students are assigned to one of four proficiency categories (below basic, basic, proficient, or advanced) based on their assessment score.

State standardized achievement assessment. A statewide assessment used to measure students' academic knowledge and skills relative to the grade-level expectations for the state.

Source: Definitions based on Houck et al. (2010) and the example state's department of education website.

Example calculation of district expenditure-to-performance ratios

Estimating district expenditure-to-performance ratios involves three steps:
- Identifying appropriate data on expenditures.
- Identifying appropriate data on performance.
- Calculating a ratio by dividing a measure of expenditures by a measure of performance.

Step 1: Identifying appropriate data on expenditures

Identifying appropriate data on expenditures involves determining the resources that a district reports spending for various purposes and ensuring that this information is reported in the same way across districts. In this guide, data on 11 expenditure categories reported by districts in the example state were used. These expenditure categories capture many of the resources that a district spends to operate its schools.

Data on district expenditures are from the example state's department of education website, which reports the following 11 categories of expenditures: regular instruction, special education instruction, career and technical education instruction, other instruction (including summer school and extracurricular instruction), student and staff support, system administration, school administration, transportation, operations and maintenance, debt services and other commitments, and other expenditures.[2] Per pupil expenditures were calculated on the basis of student enrollment.

Three measures of expenditures were calculated on the basis of the 11 expenditure categories reported by districts in the example state (see box 1):

- *Total per pupil expenditures*. The sum of expenditures across all 11 categories divided by student enrollment.
- *Instructional per pupil expenditures*. The sum of expenditures directly related to instruction (regular instruction, special education instruction, career and technical education instruction, and other instruction) divided by student enrollment.
- *Constructed per pupil expenditures*. Total expenditures minus expenditures related to special education instruction, transportation, and debt service divided by student enrollment. This measure acknowledges interest among REL Northeast & Islands Region stakeholders in creating an expenditure-to-performance ratio that excludes expenditures that vary widely across districts—particularly across districts in different locales (for example, rural and urban).

Although three measures of expenditures are illustrated in this guide, district and state leaders can use a subset of these measures or develop an alternative measure of expenditures that is more applicable to local interests and needs

Although these three measures of expenditures are illustrated in this guide, district and state leaders can use a subset of these measures or develop an alternative measure of expenditures that is more applicable to local interests and needs.

District and state leaders may consider the following issues when identifying measures of expenditures:

- *Does the state context suggest that particular types of expenditures are more appropriate to use in calculating expenditure-to-performance ratios when the goal is to compare districts?* Some expenditures vary more widely by district size and type—for example, those for special education instruction and transportation (Silvernail, 2006; Terman & Behrman, 1997). In particular, if the goal is to understand how districts use resources to influence student outcomes, ratios based on instructional expenditures—over which districts tend to have greater discretion—may be more appropriate for comparing districts on efficiency (Ladd, Chalk, & Hansen, 1999).
- *Are measures of per pupil expenditures based on the most accurate or appropriate district enrollment data?* In some states a sizable share of students live within the boundaries of one district but attend school in a different district. Thus some states report two enrollment counts: enrollment based on district of residence and enrollment based on district of attendance. When applicable, stakeholders should

consider calculating expenditure-to-performance ratios using both enrollment counts to explore whether conclusions about district efficiency vary depending on the enrollment count used.

- *Per pupil expenditures do not reflect all the costs incurred in operating a school district.* Complete measurement of all district costs, including costs that are not captured through measures of per pupil expenditures, would require a cost analysis. That involves calculating all the costs, both tangible (for example, for personnel and physical facilities) and intangible (for example, opportunity costs incurred when using resources for one purpose rather than for another purpose), that are required to carry out a particular program or combination of programs (Levin et al., 2012). The example state in this guide had publicly available data on district expenditures, which reflect district-reported spending but do not reflect all the resources required to operate a school district (Baker, 2009). If the goal is to document all resources required to operate a school district, stakeholders should consult the literature on cost analysis (for example, Levin et al., 2012).

Step 2: Identifying appropriate data on performance

Stakeholders from the example state recommended using data on performance that align with measures of student performance commonly used for accountability in the REL Northeast & Islands Region. On the basis of this input, two measures of student performance were used (see box 1):

- *Median student growth percentile in math.* A summary of the median student growth rate in math for students in grades 4–8 in the district relative to that of all students in the state. For example, a median student growth percentile of 60 indicates that the performance of the median student in the district grew as much as or more than that of 60 percent of his or her peers in the state who had similar test score histories in math. This measure is based on student performance over two consecutive years and reported beginning in grade 4.
- *Percentage of students scoring proficient or above in math.* The number of students in grades 3–8 in the district scoring proficient or above on the end-of-year math assessment divided by the total number of students who took the math assessment.

Both measures were obtained from the example state's department of education website and capture student performance on the state standardized achievement assessment in 2012/13. Math performance on the state assessment was used, but either reading or math performance (or a composite of the two) could be used, depending on the state context and questions of interest.

Districts and state leaders may consider the following questions when identifying measures of performance:

- *Does the state context suggest that a particular student performance outcome is most appropriate for comparisons across districts?* For example, some states use student proficiency as the basis for consequential decisions related to practice and policy, while other states base such decisions on measures of student growth. It is important to consider that point-in-time proficiency measures reflect other external influences (beyond-school influences, such as family or community poverty and peer influences) to a greater extent than growth measures do. Districts with a larger proportion of affluent households may thus appear to produce proficiency for

Stakeholders from the example state recommended using data on performance that align with measures of student performance commonly used for accountability in the REL Northeast & Islands Region

lower cost (Dynarski, Schwab, & Zampelli, 1989). Growth measures more fully account for the accumulated effects of beyond-school factors because factors influencing current performance are likely to have influenced performance on the previous assessment as well (Hanushek, Rivkin, & Taylor, 1996).[3] Expenditure-to-performance ratios that focus on growth may therefore more accurately reflect how efficiently districts produce achievement, beyond the accumulated influence of other factors such as families and peers.

Step 3: Calculating a ratio by dividing a measure of expenditures by a measure of performance

To calculate an expenditure-to-performance ratio, the data on expenditures and performance must be combined into a single dataset. In the data for the example state, the district identification number was used as a unique identifier to merge the data files. After the file that included data on per pupil expenditures for each district was merged with the file that included student performance for each district, the master dataset was examined for missing data. Districts that did not have data on expenditures or performance were removed from the sample because a ratio could not be calculated without both pieces of information. Similarly, districts that did not have data for a particular measure of expenditures or performance were removed from the sample for those ratios. The characteristics of districts removed from the sample because of missing data were also examined. See appendix A for the steps involved in calculating descriptive statistics and response frequencies using IBM SPSS Statistics (version 19).

Expenditure-to-performance ratios do not indicate a cause-and-effect relationship; rather, they can show how conclusions about the relative efficiency of districts may shift as a function of the expenditure and performance measures used

The proxy measure of district efficiency considered here is a ratio of the measure of expenditures (defined for a given time period, such as a specific year) to the measure of performance, expressed in the units of the measure of performance:

$$\text{Expenditure-to-performance ratio} = \frac{\textit{Measure of expenditures}}{\textit{Measure of performance}}.$$

To examine how prioritizing certain measures of expenditures and performance over others can lead to different conclusions about efficiency, six expenditure-to-performance ratios were calculated for each district (table 1). Expenditure and performance data from one of the districts in the sample, referred to in this guide as the example district, are used to illustrate how the six ratios were calculated. See appendix B for the steps involved in calculating one of these ratios (expenditure-to-performance ratio A) using IBM SPSS Statistics (version 19).

The final column in table 1 presents the six expenditure-to-performance ratios calculated for the example district. Thus for ratio A every $284.25 in total per pupil expenditures is associated with a 1 percentile point increase in the median student growth percentile in math. However, the ratios do not indicate a cause-and-effect relationship; they provide a basis on which to compare how conclusions about the relative efficiency of districts within a state may shift as a function of the measures of expenditures and performance used to calculate the ratios. Subsequent analyses might focus on which district characteristics (such as locale, enrollment, and percentage of students eligible for the federal school lunch program) are most strongly associated with variability in the expenditure-to-performance ratios.

Table 1. Calculation of six expenditure-to-performance ratios in the example district, 2012/13

Ratio label	Expenditure measure	Performance measure	Formula	Calculation	Calculated ratio
A	Total per pupil expenditures (dollars)	Median student growth percentile in math	$\dfrac{\text{Total per pupil expenditures (dollars)}}{\text{Median student growth percentile in math}}$	$\dfrac{\$14{,}781}{\text{52nd percentile}}$	$284.25
B	Total per pupil expenditures (dollars)	Percentage of students scoring proficient or above in math	$\dfrac{\text{Total per pupil expenditures (dollars)}}{\text{Percentage of students scoring proficient or above in math}}$	$\dfrac{\$14{,}781}{\text{80 percent}}$	$184.76
C	Instructional per pupil expenditures (dollars)	Median student growth percentile in math	$\dfrac{\text{Instructional per pupil expenditures (dollars)}}{\text{Median student growth percentile in math}}$	$\dfrac{\$6{,}724}{\text{52nd percentile}}$	$129.31
D	Instructional per pupil expenditures (dollars)	Percentage of students scoring proficient or above in math	$\dfrac{\text{Instructional per pupil expenditures (dollars)}}{\text{Percentage of students scoring proficient or above in math}}$	$\dfrac{\$6{,}724}{\text{80 percent}}$	$84.05
E	Constructed per pupil expenditures (dollars)	Median student growth percentile in math	$\dfrac{\text{Constructed per pupil expenditures (dollars)}}{\text{Median student growth percentile in math}}$	$\dfrac{\$10{,}518}{\text{52nd percentile}}$	$202.27
F	Constructed per pupil expenditures (dollars)	Percentage of students scoring proficient or above in math	$\dfrac{\text{Constructed per pupil expenditures (dollars)}}{\text{Percentage of students scoring proficient or above in math}}$	$\dfrac{\$10{,}518}{\text{80 percent}}$	$131.48

Source: Authors' analysis of 2012/13 data from the example state's department of education website.

States and disricts can also consider whether the measure of performance used to calculate expenditure-to-performance ratios influences districts' ranks more than the measure of expenditures. In the REL Northeast & Islands project on which this report is based (Lavigne et al., in press), correlations between the six ratios ranged from .47 to .93, and correlations were weakest among ratios based on the same measure of expenditures but different measures of performance. This suggests that the difference in a district's rank may be greater when comparing expenditure-to-performance ratios that use different measures of performance. However, these results are based on K–12 districts from one state and should be confirmed by replicating the findings with data from other states.

The difference in a district's rank may be greater when comparing expenditure-to-performance ratios that use different measures of performance

Example ranking of districts on each expenditure-to-performance ratio

Once expenditure-to-performance ratios have been calculated, districts can be ranked on each of the six ratios. For each ratio the highest ranked district (rank of 1) is considered the most efficient because a smaller value implies that fewer dollars are spent for a unit gain in student performance. By ranking districts on each of the six ratios, practitioners and policymakers can examine how a given district's perceived efficiency varies depending on the measures of expenditures and performance used to calculate each ratio. For example, among the 98 districts in the sample, the example district's rank ranged from the 5th most efficient (on ratio D) to the 87th most efficient (ratio E; table 2). See appendix C for the steps involved in ranking districts on expenditure-to-performance ratio A using IBM SPSS Statistics (version 19).

Table 2. Rank on each of six expenditure-to-performance ratios in the example district, 2012/13

District	Ratio A	Ratio B	Ratio C	Ratio D	Ratio E	Ratio F
Example district	82	46	34	5	87	51

Source: Authors' analysis of 2012/13 data from the example state's department of education website.

Table 3. Rank on each of six expenditure-to-performance ratios for the 10 highest ranked districts on ratio A in the example state in the Regional Educational Laboratory Northeast & Islands Region, 2012/13

Ratio A	Ratio B	Ratio C	Ratio D	Ratio E	Ratio F
1	24	1	4	3	52
2	4	7	8	4	8
3	12	11	20	5	16
4	52	3	28	1	26
5	11	6	6	2	2
6	45	8	38	13	50
7	6	24	24	14	11
8	37	13	34	12	30
9	70	18	64	20	70
10	18	9	13	26	32

Note: The first column indicates the 10 districts ranked highest on ratio A. Subsequent columns indicate each district's rank on ratios B–F.

Source: Authors' analysis of 2012/13 data from the example state's department of education website.

In the sample of 98 districts from the example state in the REL Northeast & Islands Region, only 4.1 percent of districts had the same rank on both ratio A (total per pupil expenditures/median student growth percentile in math) and ratio B (total per pupil expenditures/percentage of students scoring proficient or above in math). An example of how district ranks varied depending on the ratios used is provided in table 3 for the 10 districts ranked highest on ratio A. For example, the highest ranked district on ratio A also appears among the 10 highest ranked districts on ratios C, D, and E but not on ratios B and F. Eight of the 10 highest ranked districts on ratio A were among the 10 highest ranked districts on at least one other ratio. But 9 of the 10 highest ranked districts on ratio A were ranked outside the highest 10 on one or more other ratios. And 4 of the 10 highest ranked districts on ratio A were ranked in the bottom half of the distribution on at least one other ratio. This suggests that conclusions about the relative efficiency across districts within a state will likely vary considerably depending on which measures of expenditures and performance are used in calculating the ratio.

Implications for practitioners and policymakers

While sophisticated statistical models of education efficiency exist, practitioners and policymakers often seek simple, straightforward proxies for efficiency (Seiler et al., 2013). This guide provides a set of steps that practitioners and policymakers can use to calculate six expenditure-to-performance ratios and describes how to rank districts on each ratio.

The example presented here is based on data from one state in the REL Northeast & Islands Region, and the analyses should be replicated with data from other states. However, the results discussed here suggest implications for practitioners and policymakers interested in exploring information related to district efficiency. Because each ratio provides different information, local and state stakeholders should carefully consider the measure of performance that they are most interested in (for example, growth on standardized achievement assessments, school attendance, or high school graduation rates), as well as which kinds of expenditures they are most interested in.

Expenditure-to-performance ratios based on total per pupil expenditures provide information on how districts use all reported expenditures to produce the outcome of interest and are often of primary interest to policymakers and taxpayers. These ratios may be misleading if apparent differences in efficiency actually reflect substantial contextual differences across districts rather than differences in how efficiently districts spend resources (Guthrie, 2006; Seiler et al., 2013). And while total per pupil expenditures include all 11 expenditure categories reported by districts in the state, districts likely face costs that are not reported or that are difficult or impossible to measure empirically. Such costs are not reflected in any of the measures of expenditures in this guide.

Expenditure-to-performance ratios based on instructional per pupil expenditures provide some information on how districts use instructional expenditures to produce the outcome of interest. Variability across districts in some types of expenditures may primarily reflect differences in district characteristics (Wan et al., 2012), while ratios based on instructional expenditures may provide a stronger signal on how districts deploy resources over which they have greater discretion, beyond differences in district characteristics (Ladd et al., 1999).[4] For example, although school districts in the United States spend the largest share of their funding on instruction, districts may also have more discretion over how they spend instructional funding than they do over, for instance, spending on transportation (Becker, 2005).

Expenditure-to-performance ratios based on constructed per pupil expenditures provide some information on how districts use expenditures that practitioners perceive to be less variable across districts in different locales (for example, rural and urban).[5] For example, expenditures on transportation and special education instruction tend to be higher in rural districts than in urban or suburban districts (Killeen & Sipple, 2000; Silvernail, 2006; Terman & Behrman, 1997).

The guide also describes how to rank districts on each ratio and how to compare district ranks on two or more ratios. These data can be analyzed in three ways.

By ranking districts on each expenditure-to-performance ratio, practitioners and policymakers can explore how conclusions about the relative efficiency of districts within a state vary depending on how efficiency is calculated. For instance, other research demonstrates that district-level variability in some types of expenditures reflects primarily differences in district characteristics (Wan et al., 2012). Although district expenditure-to-performance ratios can provide useful information, all ranks are subject to data issues that can limit their reliability and validity. For example, misreporting or inconsistent reporting of expenditures, which are used as a proxy for costs, can influence the reliability and validity of efficiency estimates calculated on the basis of publicly available data (see Seiler et al., 2013), as can substantial variation in the cost of living in different areas of a state.

Expenditure-to-performance ratios based on instructional per pupil expenditures provide information on how districts use instructional expenditures to produce the outcome of interest; ratios based on constructed per pupil expenditures provide information on how districts use expenditures that practitioners perceive to be less variable across districts

On the basis of the results of the ranking analysis, practitioners and policymakers could more closely investigate the characteristics of districts that appear to be highly efficient across all ratios. More in-depth research, such as additional statistical analyses, interviews, or site visits, could help practitioners and policymakers better understand the characteristics of highly efficient districts and their strategies for resource use. Similarly, stakeholders could more closely investigate circumstances in districts whose rankings vary dramatically across the different ratios in order to better understand the sources of the variability.

Given evidence that districts and states should consider the role of various district characteristics when comparing districts on proxy measures of efficiency such as expenditure-to-performance ratios (Guthrie, 2006; Seiler et al., 2013), the ranking process will be most appropriate for and most useful to practitioners and policymakers when used to draw comparisons across similar districts. For example, departments of education and other organizations in numerous states have created benchmarking systems that allow practitioners and policymakers to make comparisons on one or more outcomes of interest among a set of similar districts.[6] Such benchmarking systems could be used to compare ranks on the different ratios across demographically similar districts, providing information on which districts appear to be using different categories of expenditures most efficiently. However, stakeholders interested in carrying out this kind of analysis are reminded that the number of districts in the sample will constrain the number of characteristics across which districts can be compared.[7]

Finally, interest in district efficiency is often associated with high-stakes decisionmaking—for example, about school closure or district consolidation or about continued funding for specific education and extracurricular programs. Particularly when high-stakes decisions are under consideration, it is important to remember that an expenditure-to-performance ratio is one descriptive proxy of how efficiently districts use resources.[8] The limitations of basing high-stakes decisions only on descriptive expenditure-to-performance ratios are clear after noting that the perceived efficiency of a district can vary substantially depending on which measures of expenditures and performance are considered. Results should always be considered in conjunction with other information that is unlikely to be captured in the measures of expenditures and performance used to calculate the ratios presented in this guide.

When high-stakes decisions are under consideration, expenditure-to-performance ratios should always be considered in conjunction with other information that the expenditure and performance measures are unlikely to capture

Appendix A. Steps involved in calculating descriptive statistics and response frequencies using IBM SPSS Statistics

This appendix describes the steps involved in calculating descriptive statistics and response frequencies, including the amount of missing data, using IBM SPSS Statistics (version 19), the statistical software package used most frequently by districts in the Regional Educational Laboratory Northeast & Islands Region (O'Dwyer & Parker, 2014). Descriptive statistics and response frequencies can be calculated using any common statistical (for example, R, SAS, Stata) or spreadsheet (for example, Microsoft Excel) program. The SPSS syntax language can also be used to calculate descriptive statistics and response frequencies (instead of using the point-and-click menus); the syntax for this example is included at the end of the appendix.

Step 1: Select the Descriptive Statistics option under Analyze. From the Descriptive Statistics submenu, select Frequencies.
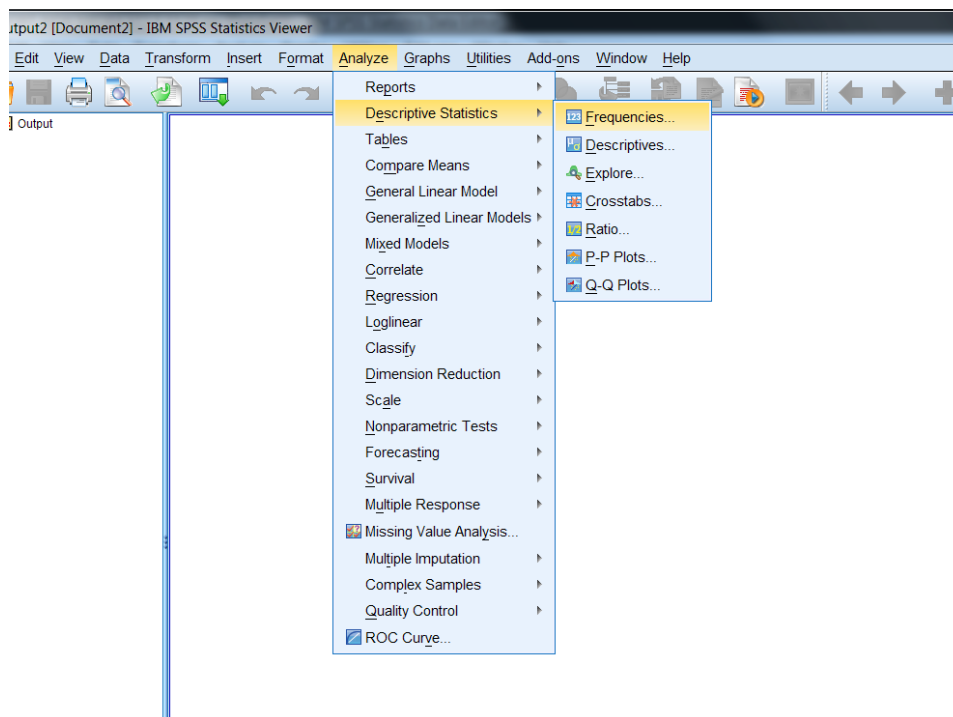
Step 2: In the Frequencies dialog box, highlight the measures of expenditures (in this example, TotalExpenditures, InstructionalExpenditures, and ConstructedExpenditures) and the measures of performance (in this example, MedianStudentGrowth and Percent-Proficient). Click on the arrow button between the two columns to move the measures to the Variable(s) window.
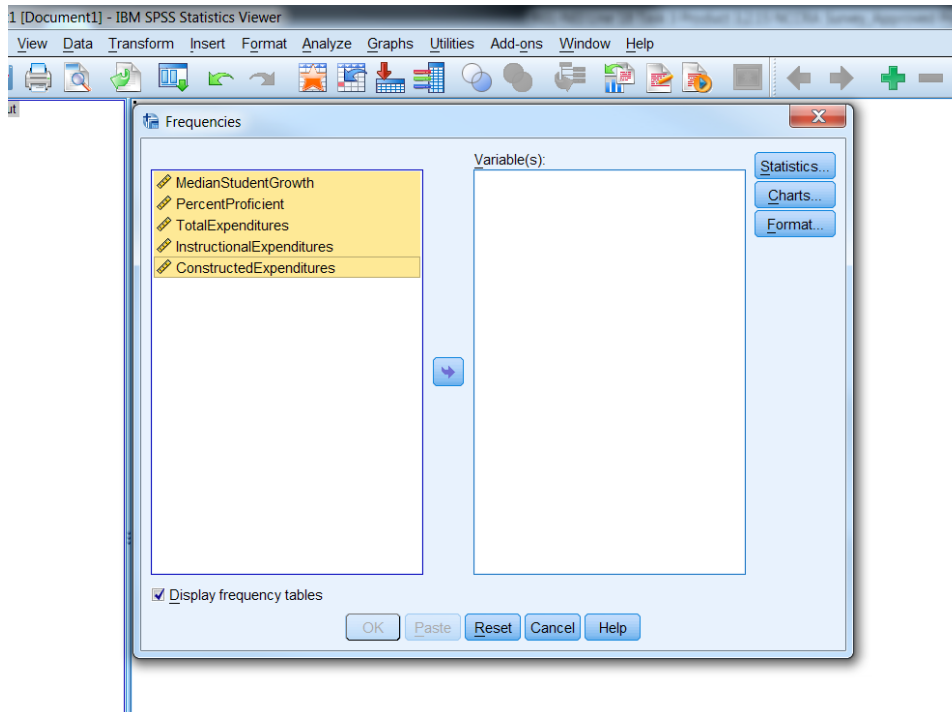

Step 3: After moving the measures of expenditures and performance to the Variables window, click on the Statistics tab in the upper right-hand corner of the dialog box.
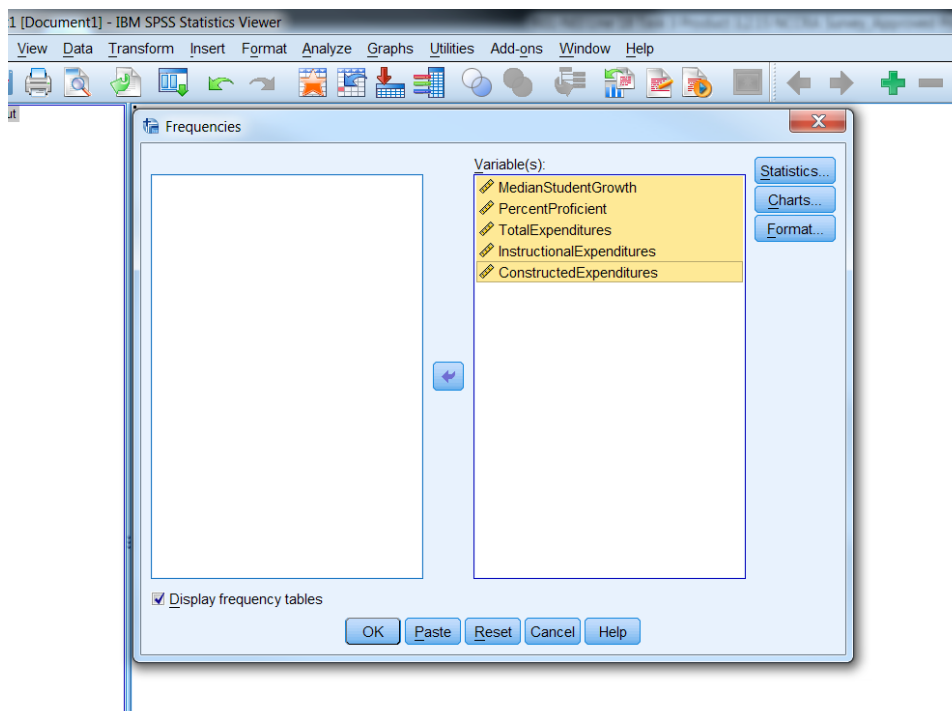
Step 4: A new dialog box will appear, providing options for various descriptive statistics that can be calculated for the data. Researchers typically examine and describe data using measures of central tendency and measures of dispersion. Six commonly reported statistics include the mean, median, standard deviation, minimum, maximum, and range. The mean represents the average of a set of values, and the median represents the middle value (for example, the middle value in a set after arranging the values in increasing order). The standard deviation, which is the square root of the variance, represents the extent to which a set of values spread out from the average (mean). The minimum and the maximum are, respectively, the lowest and highest observed values. The range represents the spread between the minimum and the maximum values.

After selecting these descriptive statistics, click Continue to return to the main Frequencies dialog box.
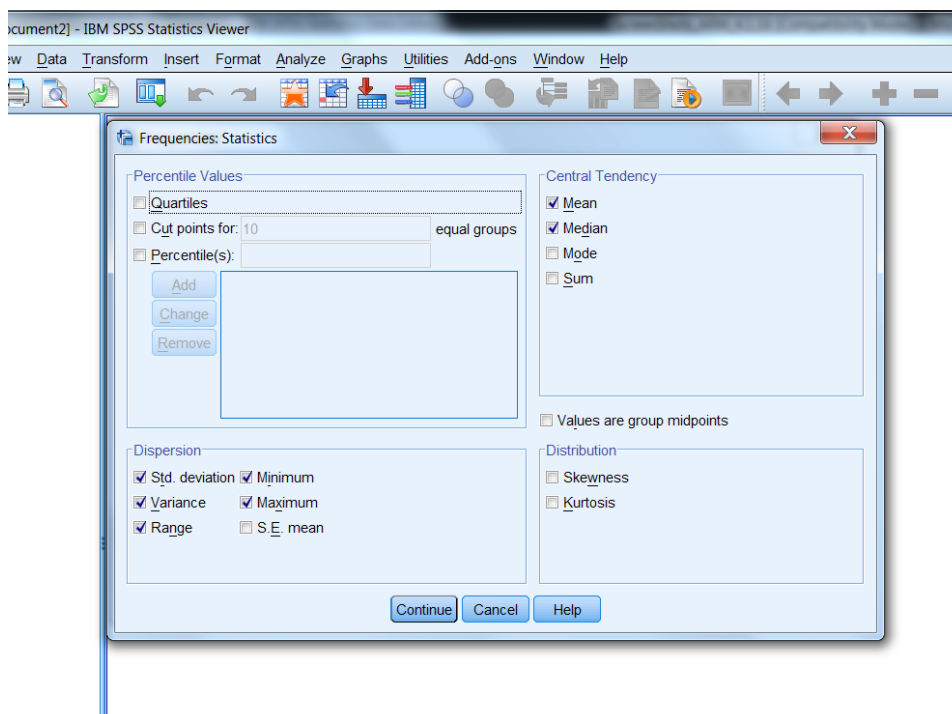
Step 5: Check to make sure that the Display frequency tables option in the bottom left corner of the dialog box has been checked. Click OK.
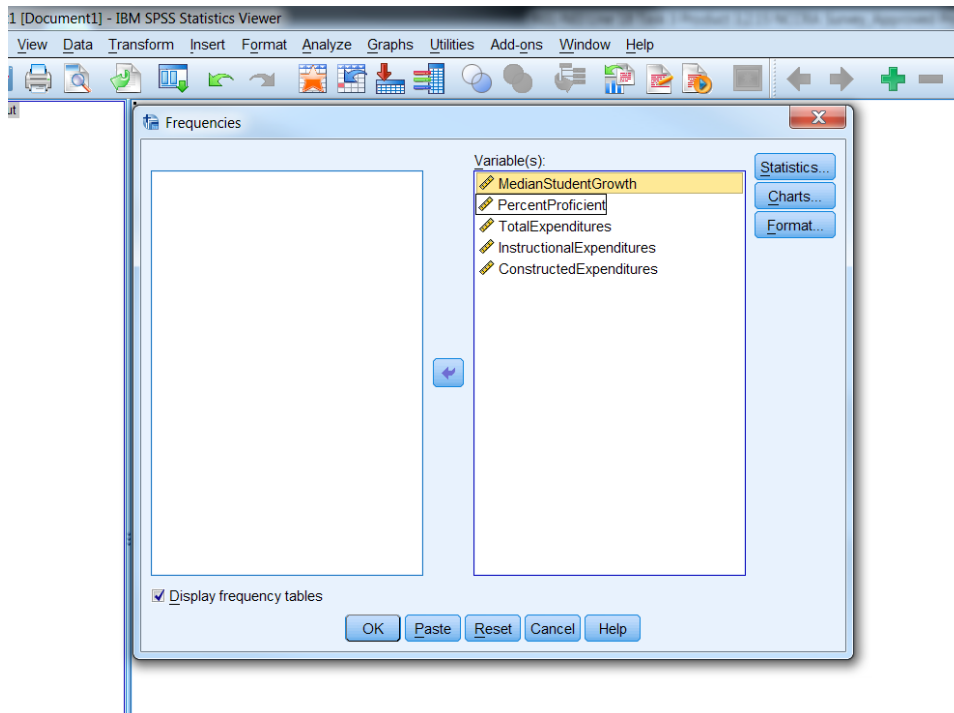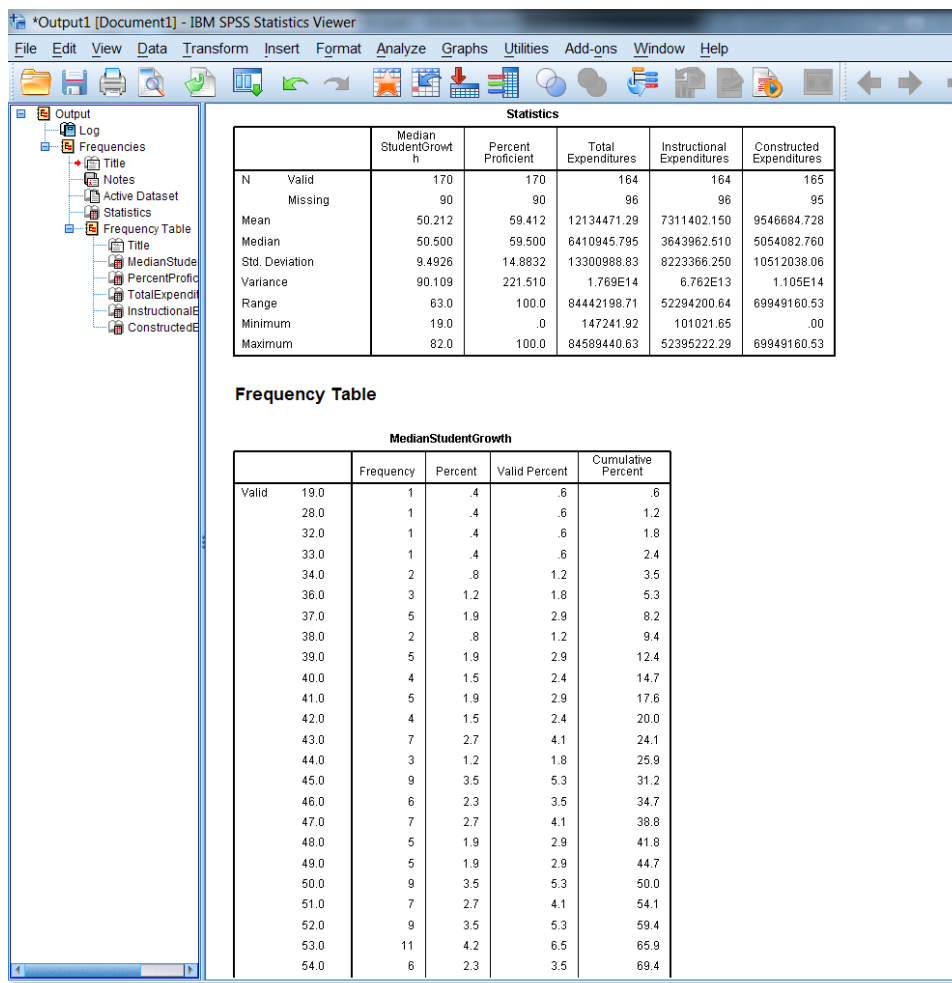

The following SPSS command syntax can also be used to calculate descriptive statistics and to examine response frequencies.

```
FREQUENCIES VARIABLES=MedianStudentGrowth PercentProficient TotalExpenditures
  InstructionalExpenditures ConstructedExpenditures
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN
  /ORDER=ANALYSIS.
```

Step 6: Examine the output. The commands in steps 1–5 will produce a table that includes a count of valid and missing cases (here, districts) as well as the statistics described in step 4. In the current example 96 districts (36.9 percent of all districts in the state) were missing data on one or more variables used to calculate the six expenditure-to-performance ratios.

A frequency table will also be produced for each variable in the analysis. The frequency table for MedianStudentGrowth is included here (some rows have been removed for demonstration purposes). The table indicates the number of districts with complete data (n = 170) for the variable and the number of cases with missing data for the variable (n = 90). Only the 98 K–12 districts out of the subset of 164 districts with complete data on all variables of interest were used in the examples in this guide. This ensures that all comparisons are between districts that educate students at all grade levels.

Statistics

		Median StudentGrowth	Percent Proficient	Total Expenditures	Instructional Expenditures	Constructed Expenditures
N	Valid	170	170	164	164	165
	Missing	90	90	96	96	95
Mean		50.212	59.412	12134471.29	7311402.150	9546684.728
Median		50.500	59.500	6410945.795	3643962.510	5054082.760
Std. Deviation		9.4926	14.8832	13300988.83	8223366.250	10512038.06
Variance		90.109	221.510	1.769E14	6.762E13	1.105E14
Range		63.0	100.0	84442198.71	52294200.64	69949160.53
Minimum		19.0	.0	147241.92	101021.65	.00
Maximum		82.0	100.0	84589440.63	52395222.29	69949160.53

Frequency Table

MedianStudentGrowth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	19.0	1	.4	.6	.6
	28.0	1	.4	.6	1.2
	32.0	1	.4	.6	1.8
	33.0	1	.4	.6	2.4
	34.0	2	.8	1.2	3.5
	36.0	3	1.2	1.8	5.3
	37.0	5	1.9	2.9	8.2
	38.0	2	.8	1.2	9.4
	39.0	5	1.9	2.9	12.4
	40.0	4	1.5	2.4	14.7
	41.0	5	1.9	2.9	17.6
	42.0	4	1.5	2.4	20.0
	43.0	7	2.7	4.1	24.1
	44.0	3	1.2	1.8	25.9
	45.0	9	3.5	5.3	31.2
	46.0	6	2.3	3.5	34.7
	47.0	7	2.7	4.1	38.8
	48.0	5	1.9	2.9	41.8
	49.0	5	1.9	2.9	44.7
	50.0	9	3.5	5.3	50.0
	51.0	7	2.7	4.1	54.1
	52.0	9	3.5	5.3	59.4
	53.0	11	4.2	6.5	65.9
	54.0	6	2.3	3.5	69.4

# Appendix B. Steps involved in calculating expenditure-to-performance ratio A using IBM SPSS Statistics

This appendix describes the steps to calculating expenditure-to-performance ratio A (total expenditure/median student growth percentile in math; see table 1 in the main text) using IBM SPSS Statistics (version 19), the statistical software package used most frequently by districts in the Regional Educational Laboratory Northeast & Islands Region (O'Dwyer & Parker, 2014). Expenditure-to-performance ratios can be calculated using any common statistical (for example, R, SAS, Stata) or spreadsheet (for example, Microsoft Excel) program.

The same steps would be used to calculate the other expenditure-to-performance ratios. For each calculation the measure of expenditures or the measure of performance would change in accordance with the ratio being calculated. The SPSS syntax language can also be used to calculate the expenditure-to-performance ratios (instead of using the point-and-click menus); the syntax for this example is included at the end of the appendix.
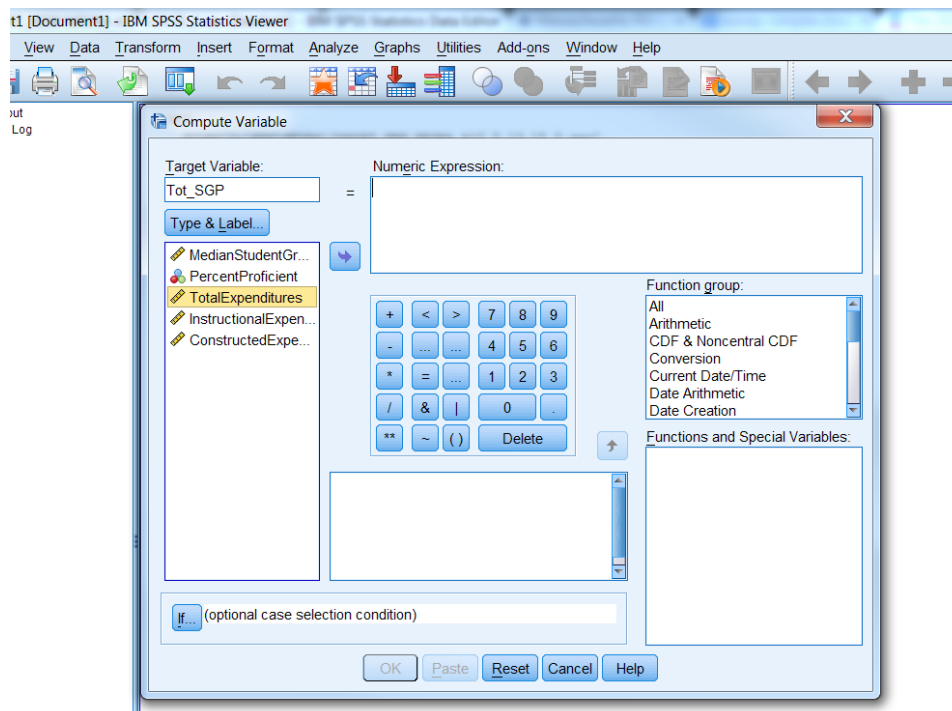
Step 1: Select the Compute Variable option under Transform.
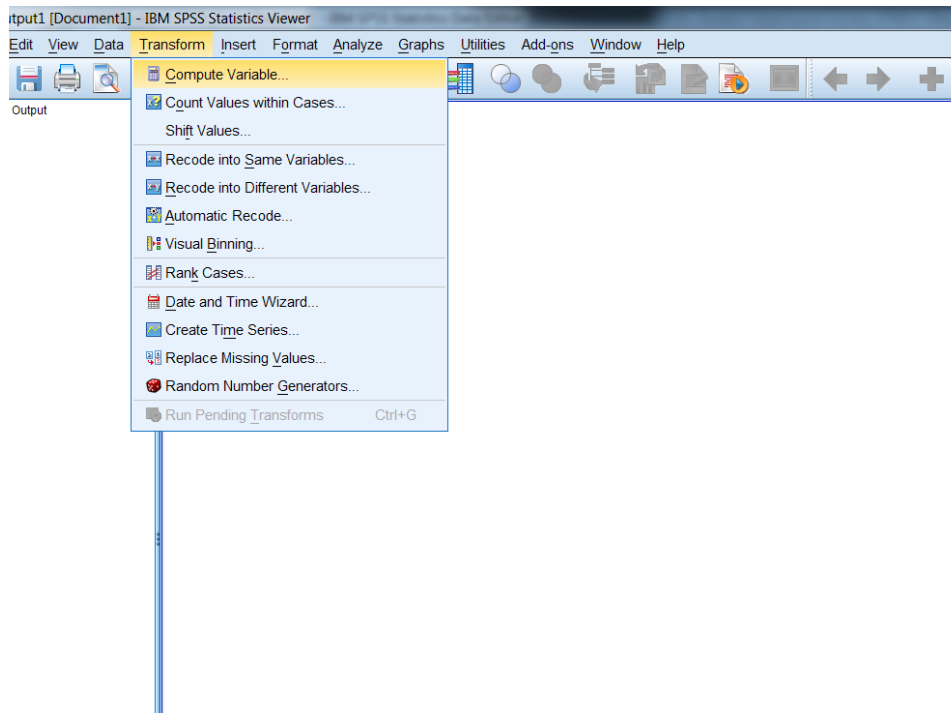
Step 2: Assign a name to the Target Variable (the ratio being calculated).
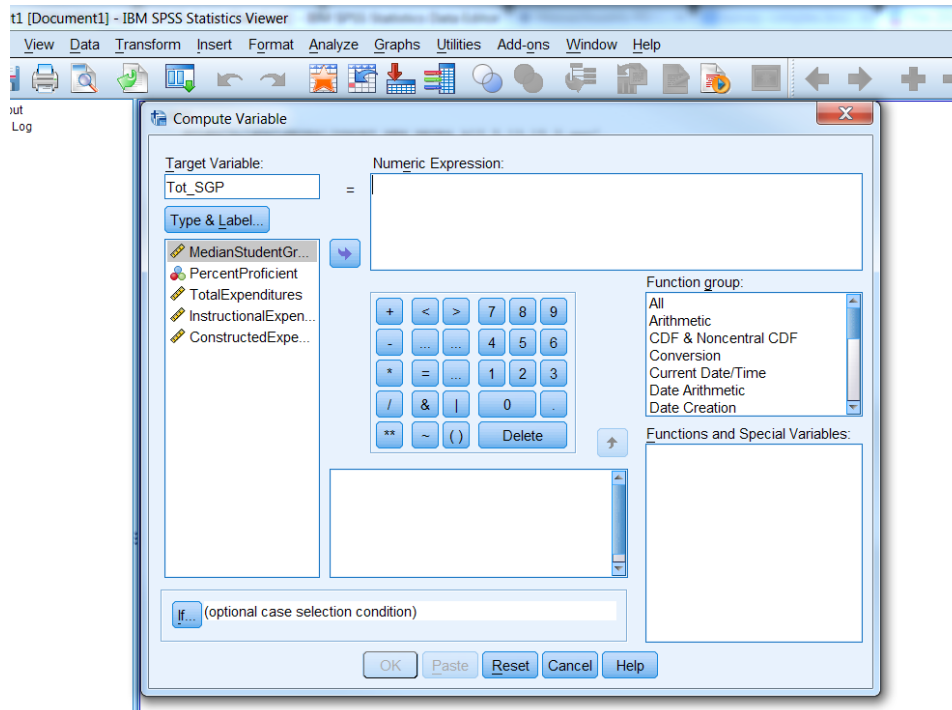
Step 3: Click on the numerator (TotalExpenditures) variable in the list of variables and then move this variable to the Numeric Expression window by clicking on the arrow button.

Step 4: Click on the division symbol ("/") in the function menu. Then highlight the denominator (MedianStudentGrowth) variable in the list of variables and then move this variable to the Numeric Expression window by clicking on the arrow button. Click OK and return to the Data View window to confirm that the new variable, the expenditure-to-performance ratio named "Tot_SGP," appears as a new variable (a new column) in the dataset.
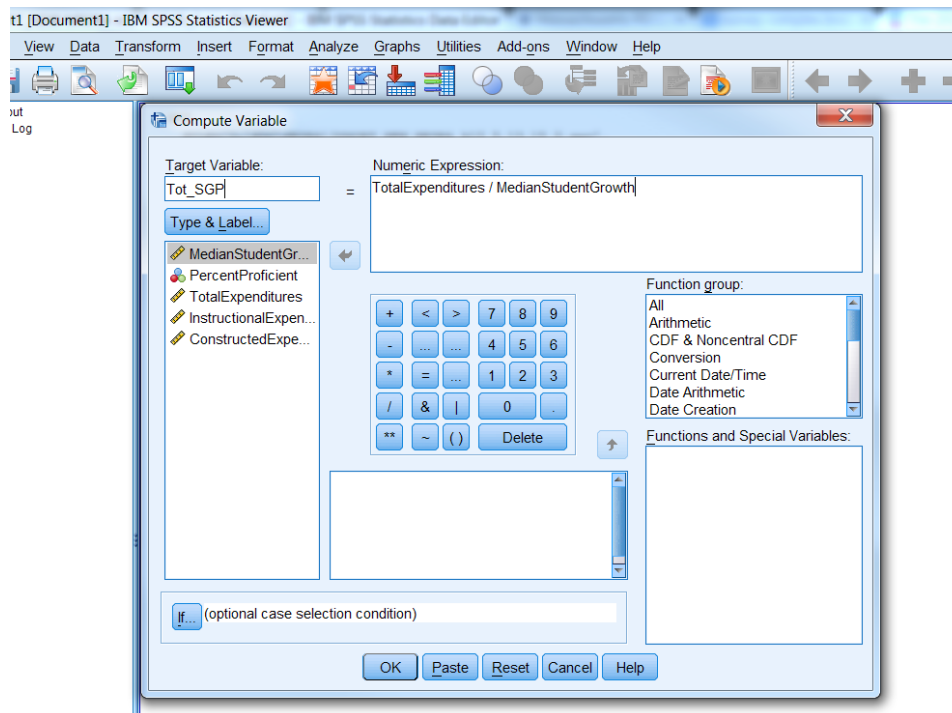
This four-step process produced the following SPSS command syntax. Steps 1–4 should be repeated to calculate each of the other five expenditure-to-performance ratios.

```
COMPUTE Tot _ SGP= TotalExpenditures / MedianStudentGrowth.
   EXECUTE.
```

This appendix describes the steps to ranking districts on expenditure-to-performance ratio A (total expenditure/median student growth percentile in math; see table 1 in the main text) using IBM SPSS Statistics (version 19), the statistical software package used most frequently by districts in the Regional Educational Laboratory Northeast & Islands Region (O'Dwyer & Parker, 2014). Ranking can be made using any common statistical (for example, R, SAS, Stata) or spreadsheet (for example, Microsoft Excel) program.

Steps 1–8 describe how to compare each district's rank on one expenditure-to-performance ratio to its rank on another ratio. SPSS syntax language can also be used to compare district ranks (instead of using the point-and-click menus); the syntax for this example is included at the end of the appendix.

Step 1: Select the Rank Cases option under Transform.
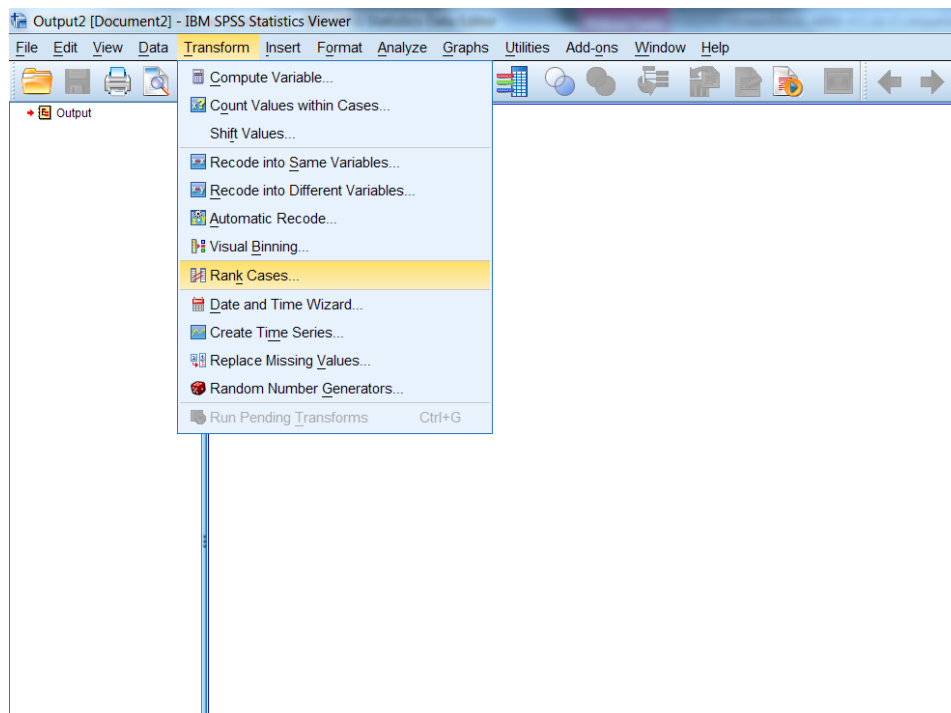
Step 2: Highlight the expenditure-to-performance ratio variable (Tot_SGP; this is the variable name for expenditure-to-performance ratio A) and click on the arrow button to move this variable to the Variable(s) window. Confirm that the Smallest value is selected within the box labeled "Assign Rank 1 to." Click OK.
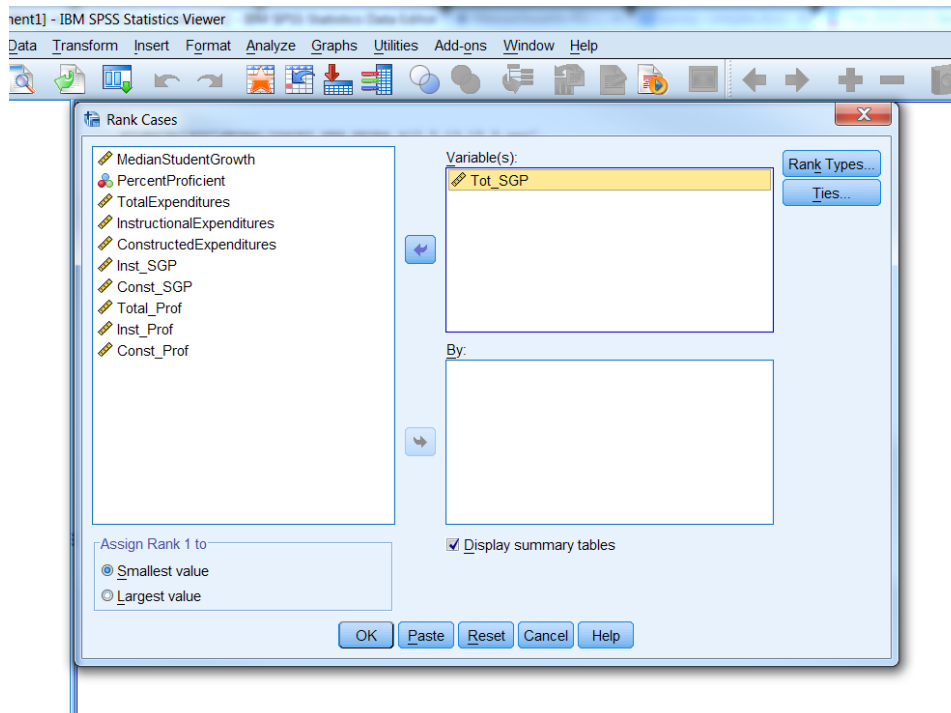
Step 3: Repeat step 2 for expenditure-to-performance ratio B (Total_Prof), which is the ratio that also uses total expenditure in the numerator but uses the district percentage of students scoring proficient or above in the denominator.
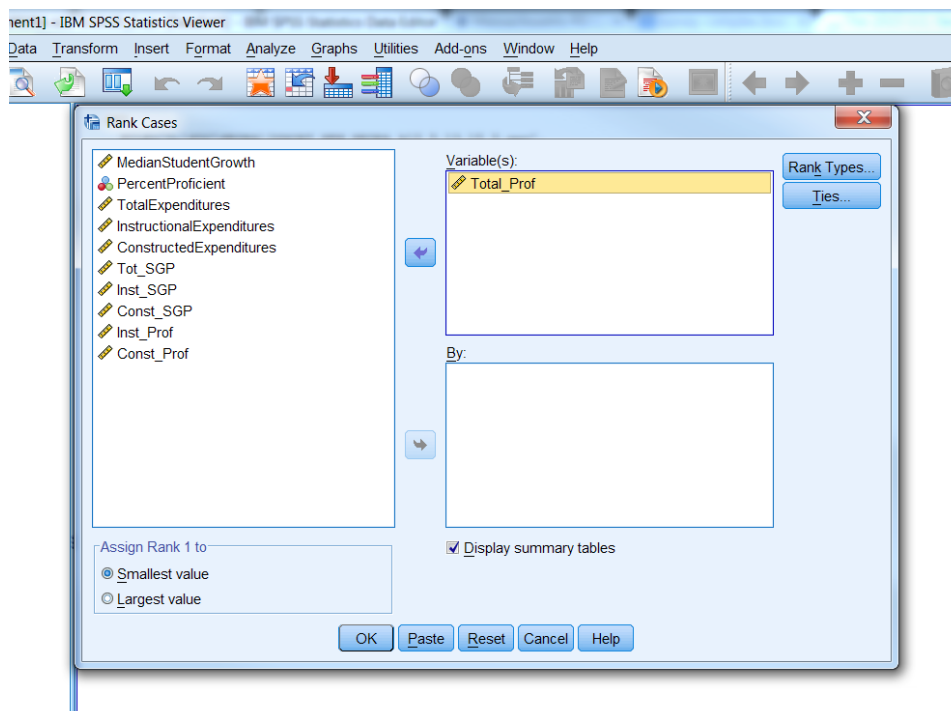
Step 4: Confirm that the new variables, "RTot_SGP" and "RTotal_P," now exist in the dataset by returning to the Data View window.

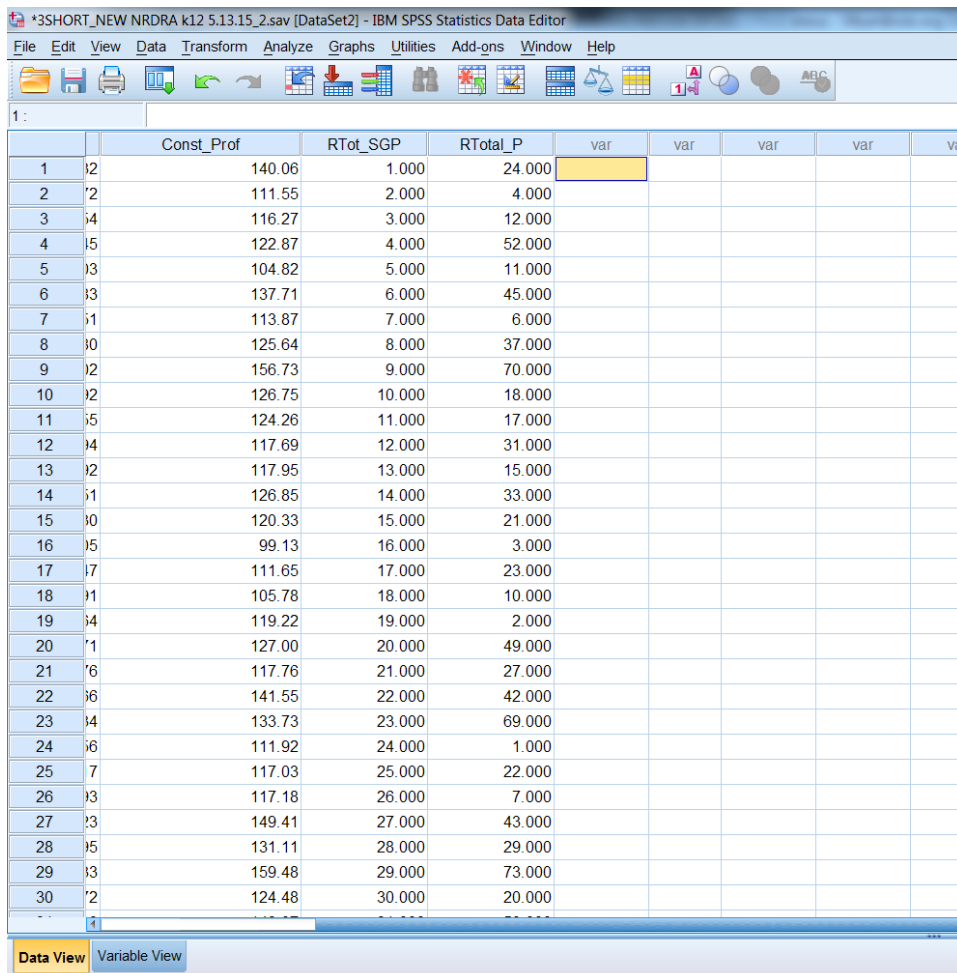|	Inst_Prof	Const_Prof	RTot_SGP	RTotal_P	var	var	var
1	247.97	271.33	95.000	97.000			
2	637.28	931.00	98.000	98.000			
3	107.29	130.33	68.000	41.000			
4	135.59	163.39	77.000	76.000			
5	174.02	214.93	93.000	87.000			
6	169.75	219.13	97.000	90.000			
7	126.75	150.84	75.000	56.000			
8	126.15	151.40	58.000	64.000			
9	96.98	157.90	60.000	47.000			
10	126.06	155.46	71.000	62.000			
11	131.07	209.89	94.000	94.000			
12	109.70	132.58	64.000	40.000			
13	124.73	155.04	66.000	59.000			
14	98.16	131.58	72.000	35.000			
15	98.30	134.17	73.000	34.000			
16	92.56	111.92	24.000	1.000			
17	111.01	127.43	87.000	44.000			
18	108.82	137.03	88.000	53.000			
19	105.07	130.50	46.000	26.000			
20	75.57	107.75	50.000	5.000			
21	140.33	187.00	83.000	84.000			
22	160.49	193.47	84.000	86.000			
23	90.92	114.13	62.000	9.000			
24	149.10	193.83	86.000	91.000			
25	107.51	126.85	14.000	33.000			
26	111.73	154.35	41.000	57.000			
27	132.78	165.61	74.000	82.000			
28	128.71	160.48	85.000	72.000			
29	107.49	133.44	90.000	39.000			
30	124.94	149.81	91.000	77.000			

Step 5: Now sort cases by their rank on expenditure-to-performance ratio A, or by the variable "RTot_SGP." Start by selecting the Sort Cases option under Data.
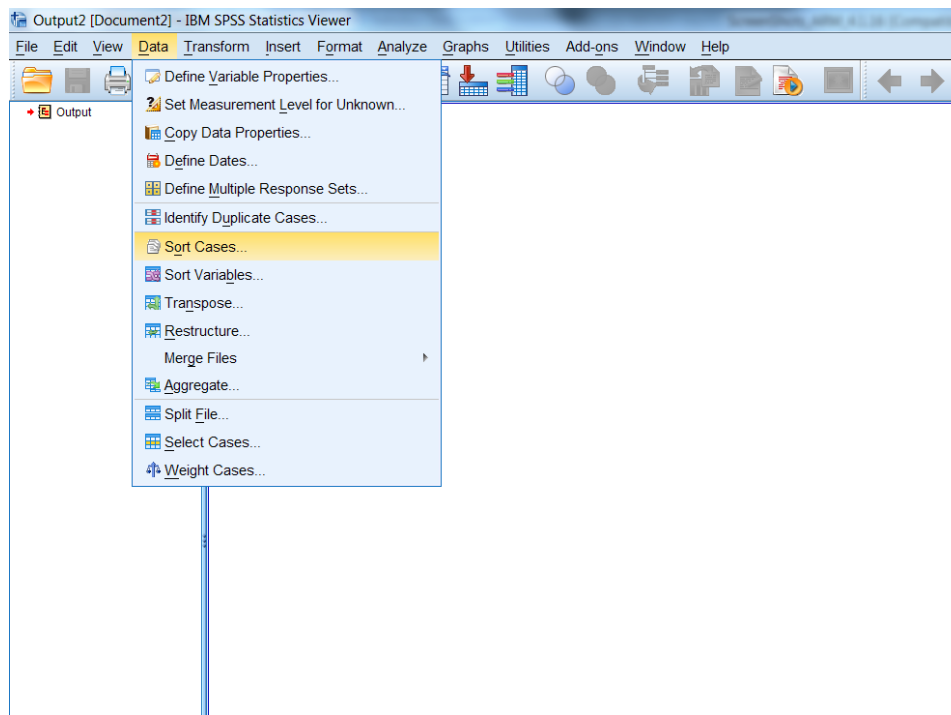
Step 6: Highlight the new variable (RTot_SGP) that provides each district's rank on ratio A and click on the arrow button to move this variable to the Sort by window. Confirm that the Sort Order is Ascending and then click OK.
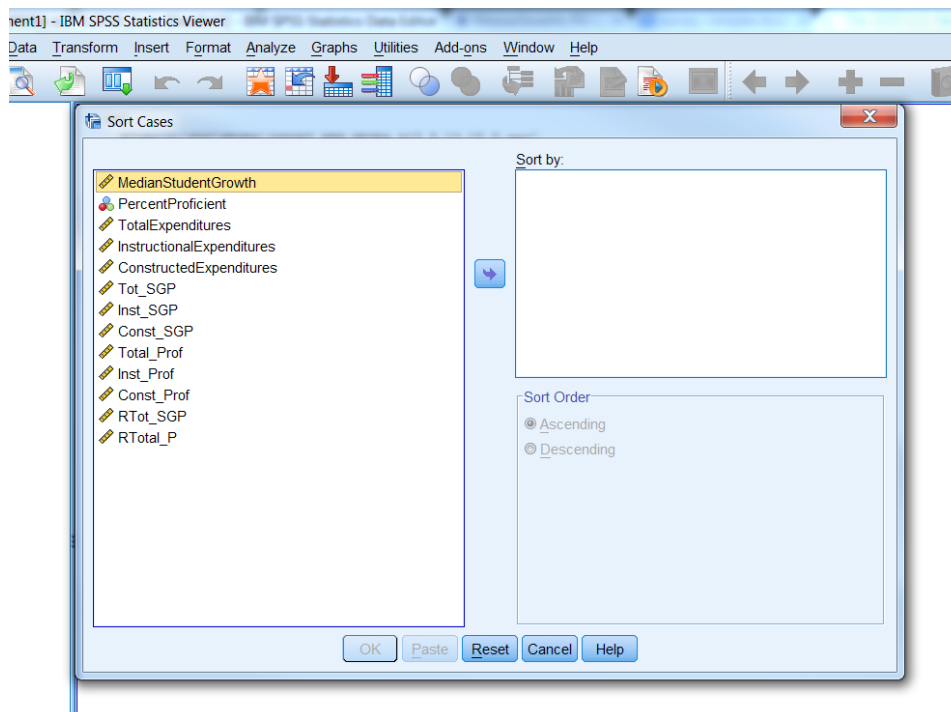
Step 7: Return to the Data View window and confirm that the districts in the dataset have been reordered, from smallest to largest, according to the variable "RTot SGP," which includes each district's rank on expenditure-to-performance ratio A.

		Const_Prof	RTot_SGP	RTotal_P	var	var	var	var	va
1	2	140.06	1.000	24.000					
2	'2	111.55	2.000	4.000					
3	54	116.27	3.000	12.000					
4	15	122.87	4.000	52.000					
5	03	104.82	5.000	11.000					
6	33	137.71	6.000	45.000					
7	51	113.87	7.000	6.000					
8	30	125.64	8.000	37.000					
9	02	156.73	9.000	70.000					
10	02	126.75	10.000	18.000					
11	55	124.26	11.000	17.000					
12	04	117.69	12.000	31.000					
13	02	117.95	13.000	15.000					
14	51	126.85	14.000	33.000					
15	30	120.33	15.000	21.000					
16	05	99.13	16.000	3.000					
17	17	111.65	17.000	23.000					
18	01	105.78	18.000	10.000					
19	54	119.22	19.000	2.000					
20	'1	127.00	20.000	49.000					
21	'6	117.76	21.000	27.000					
22	56	141.55	22.000	42.000					
23	54	133.73	23.000	69.000					
24	56	111.92	24.000	1.000					
25	7	117.03	25.000	22.000					
26	03	117.18	26.000	7.000					
27	23	149.41	27.000	43.000					
28	05	131.11	28.000	29.000					
29	03	159.48	29.000	73.000					
30	'2	124.48	30.000	20.000					

The following SPSS command syntax can also be used to rank districts on expenditure-to-performance ratios A and B and then sort cases according to their rank on ratio A (or the variable "RTot_SGP").

```
RANK VARIABLES=Tot _ SGP
  /RANK
  /PRINT=YES
  /TIES=MEAN.

RANK VARIABLES=Total _ P
  /RANK
  /PRINT=YES
  /TIES=MEAN.

SORT CASES BY RTot _ SGP.
```

Step 8: Next, create a new variable based on the comparison of each district's rank on expenditure-to-performance ratio B to its rank on ratio A. To do so, enter the following SPSS syntax into the SPSS Syntax window. This syntax yields a value of 1 for the new "Comp_Rank" variable if a district's rank on expenditure-to-performance ratio B (the variable "RTotal_P") is a larger value than its rank on ratio A (the variable "RTot_SGP"). A larger value rank on expenditure-to-performance ratio B relative to ratio A would mean that the district appeared less efficient on ratio B. In other words, a district with a rank of 50 (larger value) appears less efficient than a district with a rank of 20. If a district's rank on expenditure-to-performance ratio B is a smaller value than its rank on ratio A, "Comp_Rank" is assigned a value of 2. A smaller value rank on expenditure-to-performance ratio B relative to ratio A would mean that the district appeared more efficient on ratio B. Finally, if a district's rank is the same on expenditure-to-performance ratios A and B, "Comp_Rank" is assigned a value of 0.

To run this syntax in SPSS, highlight all lines of syntax and hit "Enter" on the keyboard (or click the green "execute" triangle in the command bar to run this syntax).
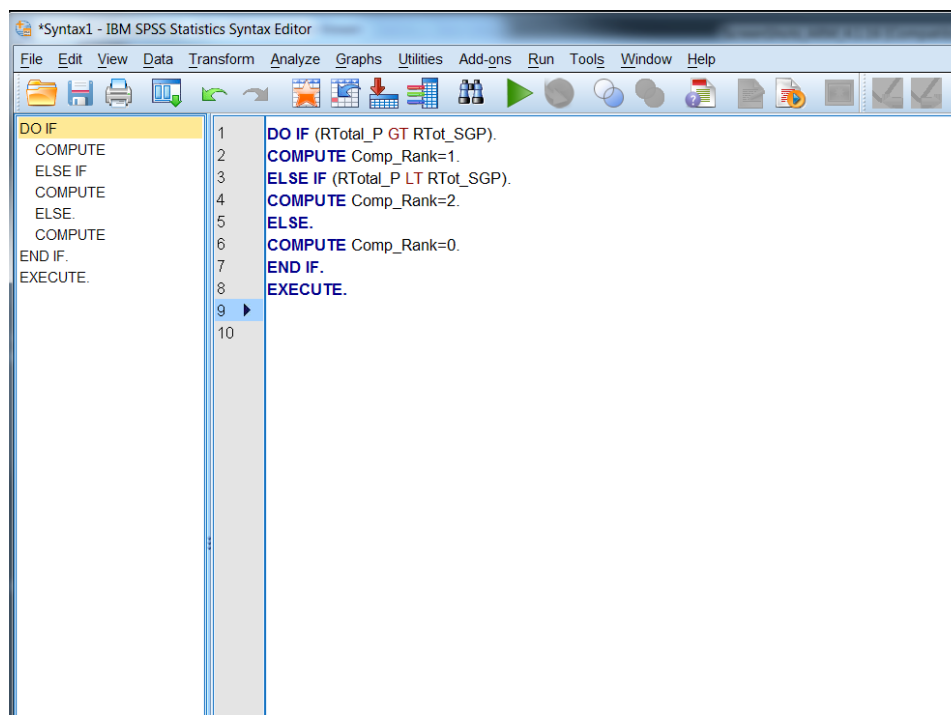
Step 9: Confirm that the new variable, "Comp_Rank" now exists in the dataset by returning to the Data View window.

	Const_Prof	RTot_SGP	RTotal_P	Comp_Rank	var	var	var	va
1	140.06	1.000	24.000	1.00				
2	111.55	2.000	4.000	1.00				
3	116.27	3.000	12.000	1.00				
4	122.87	4.000	52.000	1.00				
5	104.82	5.000	11.000	1.00				
6	137.71	6.000	45.000	1.00				
7	113.87	7.000	6.000	2.00				
8	125.64	8.000	37.000	1.00				
9	156.73	9.000	70.000	1.00				
10	126.75	10.000	18.000	1.00				
11	124.26	11.000	17.000	1.00				
12	117.69	12.000	31.000	1.00				
13	117.95	13.000	15.000	1.00				
14	126.85	14.000	33.000	1.00				
15	120.33	15.000	21.000	1.00				
16	99.13	16.000	3.000	2.00				
17	111.65	17.000	23.000	1.00				
18	105.78	18.000	10.000	2.00				
19	119.22	19.000	2.000	2.00				
20	127.00	20.000	49.000	1.00				
21	117.76	21.000	27.000	1.00				
22	141.55	22.000	42.000	1.00				
23	133.73	23.000	69.000	1.00				
24	111.92	24.000	1.000	2.00				
25	117.03	25.000	22.000	2.00				
26	117.18	26.000	7.000	2.00				
27	149.41	27.000	43.000	1.00				
28	131.11	28.000	29.000	1.00				
29	159.48	29.000	73.000	1.00				
30	124.48	30.000	20.000	2.00				

Data View Variable View

Step 10: Determine the number and percentage of districts that had a larger value, smaller value, or same value rank on expenditure-to-performance ratio B relative to their rank on ratio A. To do so, select Descriptive Statistics and then Frequencies from the Analyze menu.
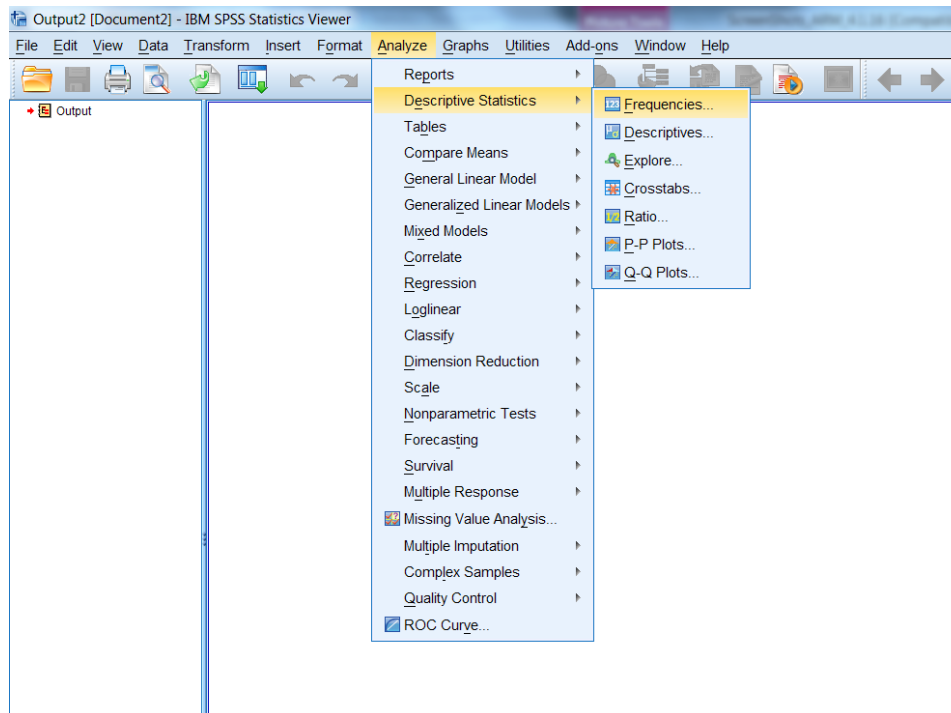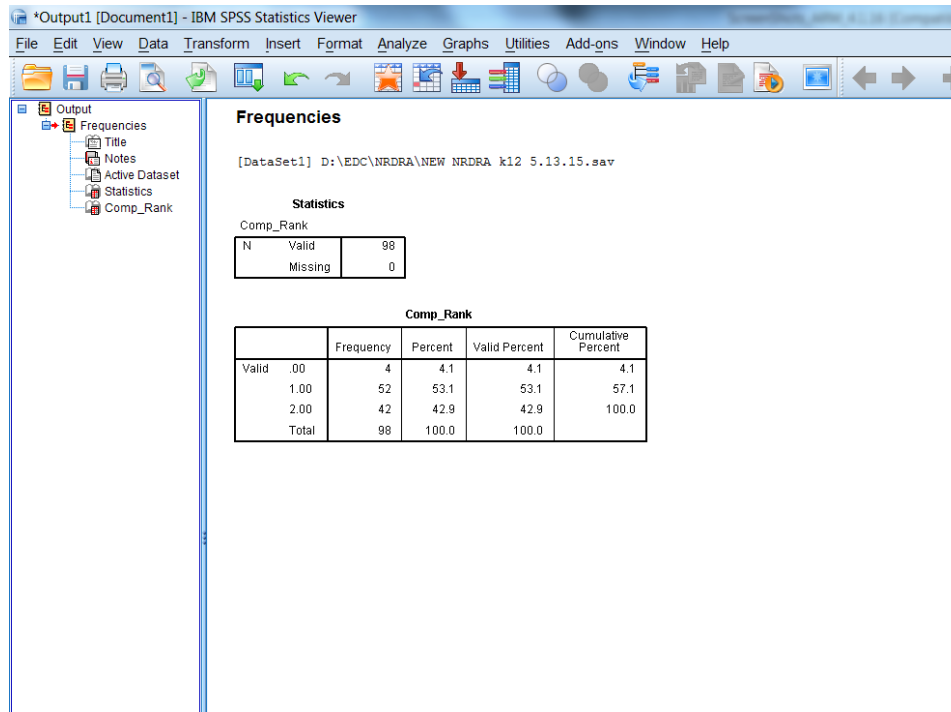
Step 11: Find the new variable "Comp_Rank" in the list of variables and use the arrow button to move this to the Variable(s) window. Click OK.
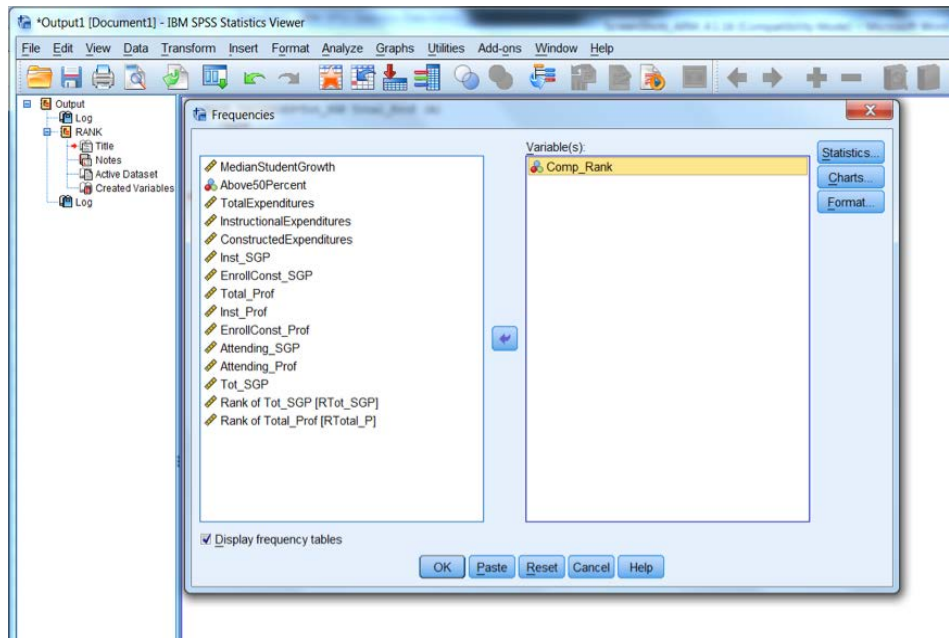
The following SPSS command syntax can also be used to determine the number and percentage of districts that had a larger value, smaller value, or same value rank on expenditure-to-performance ratio B relative to their rank on ratio A.

```
FREQUENCIES VARIABLES=Comp _ Rank
   /ORDER=ANALYSIS.
```

Step 12: View the output. In this example, relative to their ranks on expenditure-to-performance ratio A, 4.1 percent of districts stayed the same on their rank on ratio B. Slightly more than half of districts (53.1 percent) had a larger value rank (appeared less efficient) on expenditure-to-performance ratio B relative to ratio A, while 42.9 percent had a smaller value rank (appeared more efficient).

Notes

1. In the education literature, measures of efficiency are sometimes referred to as measures of cost-effectiveness. For example, Government Finance Officers Association (2015) refers to "a district's total spending in pursuit of a given outcome (e.g., reading proficiency) divided by the number of proficient students" as a measure of cost-effectiveness. However, cost-effectiveness analysis, which is used to assess which among two or more interventions shows the highest effectiveness relative to cost, typically requires accounting for all costs, both tangible (such as materials and staff salaries) and intangible (such as parent volunteer hours and donations) involved in each intervention (Levin & Belfield, 2015). Cost-effectiveness analysis also requires a causal estimate of each intervention's impact on the outcome of interest, as opposed to a descriptive outcome measure. The expenditure-to-performance ratios presented in this guide do not reflect any causal association between district spending and student performance.

2. In many states, public school district expenditure data are publicly available from the state department of education. District expenditure data are also available from the National Center for Education Statistics Common Core of Data. Annual expenditure data may be available from states before these data are available through the Common Core of Data. In the example state in this guide, expenditure data were available for 2012/13 from the state department of education. At the time this guide was published, the most recent school year for which expenditure data were available from the Common Core of Data was 2010/11.

3. While measures based on growth more fully account for beyond-school factors that are generally fixed over time (for example, student gender or district locale), time-varying factors (for example, district poverty rate or community unemployment rate) could still be confounding growth measures and should be considered when interpreting them.

4. District characteristics such as locale, student need, and enrollment fully accounted for differences in administration, student support, and transportation expenditures across Minnesota districts but could not fully explain differences in instructional expenditures (Wan et al., 2012).

5. This acknowledges interest among REL Northeast & Islands Region stakeholders in calculating an expenditure-to-performance ratio that excludes expenditures that they perceive to be most variable across districts in different locales. Other stakeholders can determine whether this ratio is applicable in their context.

6. For example, Connecticut creates district reference groups, or a set of similar districts for each district in the state, on the basis of family and district characteristics. At the school level the New York State Center for Rural Schools creates benchmark schools, or a set of similar schools for most schools in the state, on the basis of school characteristics.

7. For example, the REL Northeast & Islands project on which this guide is based (Lavigne et al., in press) considered three district characteristics: locale, enrollment, and poverty rate. However, with five locale categories, four enrollment categories, and three poverty rate categories, there are 60 unique category combinations. With 98 districts in the sample, sorting districts across all 60 possible combinations could result in such a small number of districts per combination that it would be difficult to draw meaningful conclusions about the relationship between district efficiency and district characteristics.

8. A comprehensive evaluation of efficiency in education requires sophisticated statistical models; for a treatment of the subject, see Lockheed & Hanushek (1994).

References

Baker, B. D. (2009). *Private schooling in the U.S.: Expenditures, supply, and policy implications*. Boulder, CO, and Tempe, AZ: Education and the Public Interest Center & Education Policy Research Unit. http://eric.ed.gov/?id=ED507357

Becker, S. (2005). *Education finance: More money or different spending choices. What factors make a difference?* Saint Paul, MN: Education Evolving.

Boser, U. (2014). *Return on educational investment: A district-by-district evaluation of U.S. educational productivity*. Washington, DC: Center for American Progress. http://eric.ed.gov/?id=ED535853

Dynarski, M., Schwab, R., & Zampelli, E. (1989). Local characteristics and public production: The case of education. *Journal of Urban Economics, 26*(1), 250–263.

Government Finance Officers Association. (2015). *Best practices in school district budgeting*. Retrieved May 23, 2015, from http://www.gfoa.org/best-practices-school-district-budgeting.

Guthrie, J. W. (2006). Modern education finance: How it differs from the 'old' and the analytic and data challenges it implies. *Education Finance and Policy, 1*(1), 3–16. http://eric.ed.gov/?id=EJ902819

Hanushek, E. A., Rivkin, S., & Taylor, L. (1996). Aggregation and the estimated effects of school. *The Review of Economics and Statistics, 78*(4), 611–627.

Houck, E. A., Rolle, R. A., & He, J. (2010). Examining school district efficiency in Georgia. *Journal of Education Finance, 34*(4), 331–357. http://eric.ed.gov/?id=EJ886337

Jimerson, L. (2007). *Slow motion: Traveling by school bus in consolidated districts in West Virginia*. Arlington, VA: The Rural School and Community Trust. http://eric.ed.gov/?id=ED499440

Killeen, K., & Sipple, J. (2000). *School consolidation and transportation policy: An empirical and institutional analysis*. Arlington, VA: Rural School and Community Trust. http://eric.ed.gov/?id=ED447979

Ladd, H. F., Chalk, R., & Hansen, J. F. (1999). *Equity and advocacy in education finance*. Washington, DC: National Academies Press. Retrieved June 1, 2015, from http://www.nap.edu/catalog/6166.html.

Lavigne, H. J., Ryan, S., Zweig, J. S., & Buffington, P. J. (in press). *Exploring district-level expenditure-to-performance ratios* (REL 2017–267). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northeast & Islands.

Leachman, M., Albares, N., Masterson, K., & Wallace, M. (2016). *Most states have cut school funding, and some continue cutting*. Washington, DC: Center on Budget and

Policy Priorities. Retrieved June 14, 2016, from http://www.cbpp.org/sites/default/files/atoms/files/12–10–15sfp.pdf.

Levin, H. M., & Belfield, C. (2015). Guiding the development and use of cost-effectiveness analysis in education. *Journal of Research on Educational Effectiveness*, 8(3), 400–418. http://eric.ed.gov/?id=EJ1068556

Levin, H. M., Belfield, C., Hollands, F., Bowden, A. B., Cheng, H., Shand, R., et al. (2012). *Cost-effectiveness analysis of interventions that improve high school completion*. New York, NY: Columbia University, Teachers College, Center for Benefit-Cost Studies of Education. Retrieved December 14, 2014, from http://newyorkfed.org/research/education_seminar_series/IESHighSchoolCompletion.pdf.

Lockheed, M. E., & Hanushek, E. (1994). *Concepts of educational efficiency and effectiveness.* (Working Paper No. 24). Washington, DC: World Bank. Retrieved February 4, 2015, from http://documents.worldbank.org/curated/en/1994/03/698554/concepts-educational-efficiency-effectiveness.

O'Dwyer, L. M., & Parker, C. E. (2014). *A primer for analyzing nested data: multilevel modeling in SPSS using an example from a REL study* (REL 2015–046). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northeast & Islands. http://eric.ed.gov/?id=ED551064.

Oliff, P., Mai, C., & Leachman, M. (2012). *New school year brings more cuts in state funding for schools.* Washington, DC: Center on Budget and Policy Priorities. Retrieved June 14, 2016, from http://www.cbpp.org/research/new-school-year-brings-more-cuts-in-state-funding-for-schools.

Rooney, K., & Augenblick, J. (2009). *An exploration of district consolidation.* Denver, CO: Augenblick, Palaich and Associates.

Seiler, M. F., Ewalt, J. G., Jones, J. T., Landy, B., Olds, S., & Young, P. (2013). *Indicators of efficiency and effectiveness in elementary and secondary education spending.* (Research Report No. 338). Frankfort, KY: Legislative Research Commission, Office of Education Accountability.

Silvernail, D. L. (2006). *Preliminary analysis: The cost and characteristics of Maine's higher performing public schools.* Report Prepared for Joint Standing Committee on Education and Cultural Affairs. Augusta, ME: Maine State Legislature. http://eric.ed.gov/?id=ED509476

Silvernail, D. L., Sloan, J. E., Paul, C. R., Johnson, A. F., & Stump, E. K. (2014). *The relationships between school poverty and student achievement in Maine.* Orono, ME: Maine Education Policy Research Institute. Retrieved April 29, 2015, from http://usm.maine.edu/sites/default/files/cepare/poverty_achievement_Web.pdf.

Terman, D. L., & Behrman, R. E. (1997). Financing schools: Analysis and recommendations? *The Future of Children, 7*(3), 4–23. Retrieved June 15, 2015, from https://www.princeton.edu/futureofchildren/publications/docs/07_03_Analysis.pdf.

Wan, Y., Norbury, H., Molefe, A. C., Gerdeman, R. D., Meyers, C. V., & Burke, M. (2012). *Differences in spending in school districts across geographic locales in Minnesota* (REL 2012–124). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest. http://eric.ed.gov/?id=ED532662

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