

INFORMATION WORKS!

*Technical Brief on the Statistical Model Used in the
2002 Rhode Island School and District Reports
(School Year 2000-2001)*

By

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We acknowledge Lynda Hurditch, Education Specialist, NCPE, for her editorial comments.

INFORMATION WORKS!

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Across the nation, politicians, educators, and parents have become deeply concerned with finding ways to measure the effectiveness of schools and school systems. There is statewide agreement in Rhode Island that all students need to attain high standards of achievement in mathematics, reading, writing, health as well as other school subjects. To ensure that there is a measurable progress in the core subjects, the State administers the New Standards Reference Examinations developed by Harcourt Educational Measurement and state-developed tests in writing and health. The proficiency results are reported to the general public through an annual publication called *Information Works!*

1. PURPOSE

The main purpose of *Information Works!* is to present an overview of the school in five basic categories: past and present academic achievement, demographics, school specific highlights, selected school indicators, and a summary of the financial breakdown for the school. The goal is to provide school-related content that would enhance public understanding of the school and the widely varying circumstances within which the school, its staff and students operate. The ultimate goal of *Information Works!* and the School Accountability for Learning and Teaching (SALT) is to assist each school in its efforts to improve student achievement by providing measures that focus on getting all students to the desired level of *proficiency*. *Information Works!* summarizes and presents in a concise manner much of the information that schools need when developing their strategic planning and school improvement initiatives.

2. MOTIVATION

Politicians and educators have struggled with the idea of developing useful yardsticks for school effectiveness that were honest, accurate and easy to comprehend. The initial stages of this effort often ignored the varying degree to which the social and political factors affected schools in various districts. Schools were frequently measured by a small set of benchmarks that often had no universal applicability. In other words, benchmarks were being used to rank order districts and schools as if the schools were competing on a level playing field. The rank-ordering yardstick by itself is not sensitive to differences in a school's environment, its practices, or to its achievement results that are not part of the formal state assessment program. To help alleviate some of the problems in viewing raw achievement results, the researchers at the Rhode Island Department of Education (RIDE) and the National Center on Public Education and Social Policy (NCPE) at the University of RI have devised a statistical model that attempts to address some of the differences in school composition. The remainder of this document is devoted primarily to the understanding of the statistical model – one of the key components of *Information Works!*

3. ACHIEVEMENT: A THREE-SIDED VIEW

Information Works! provides a three-sided view of student achievement in the individual school reports. The views are presented in Field 1: Achievement Results, Field 2: The Statistical Model, and Field 4: Three Year Breakdown of Achievement Results. This portrayal leads to a much richer and deeper understanding of how an individual school is helping its students attain the required level of proficiency. A detailed discussion for each of the fields follows.

3.1 Field 1: Achievement Results

Field 1 or “Achievement Results” as shown below in Figure 1, presents the percentage of eligible students at each performance level on the school assessments. Figure 1 also shows the percentage of students that met or exceeded the standard when LEP Level 1 and the students eligible for Alternate Assessment were included (shown by the triangle below the bars).

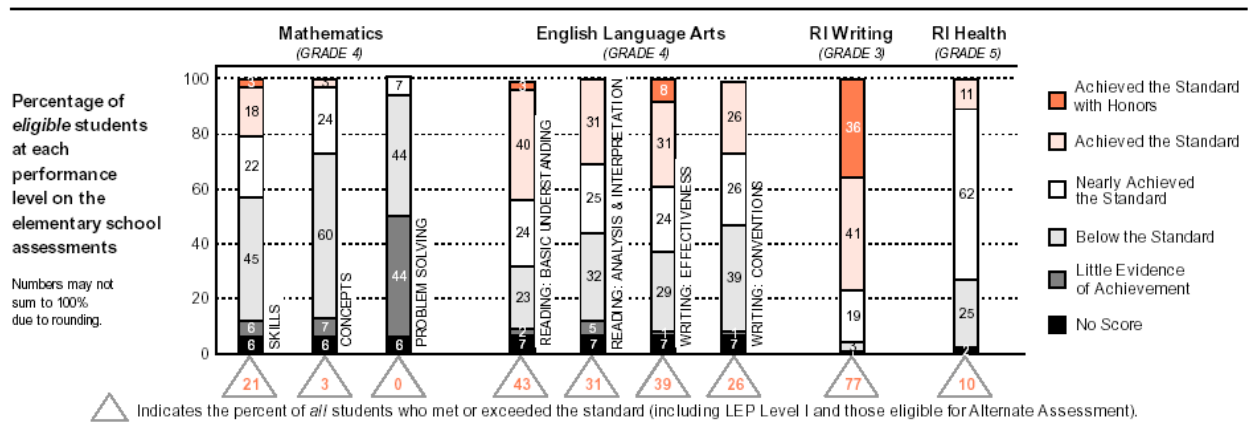


Figure 1: Sample of the Achievement Results as presented in Infoworks!

3.2 Field 2: The Statistical Model

Field 2, as shown below in Figure 2, presents a school’s achievement results on various state tests in a manner different from, but complementary to, the reporting of assessment scores as shown in Field 1. Field 2, is the outcome of research conducted at RIDE & NCPE. The researchers studied the current literature¹ on performance indicators of school effects in an attempt to identify an *effective* school. This year’s model is based on data sources that are readily available. The researchers report on the percentage of eligible students who have met or exceeded the standard (shown in Figure 2 as the Actual Range) compared to the percentage of similar students statewide (shown in Figure 2 as the Sample Range). Field 2, thus demonstrates how an individual school is performing while taking into account other socioeconomic factors of students compared to similar schools statewide. The researchers call this group of similar schools a “virtual school.” It is assumed that as schools improve and as the statistical model is refined, the “virtual school” will also change. Over time, the virtual school model hopes to provide an additional measure by which the state can target investments of both money and human resources to improve schools.

¹ J. Douglas Williams, *Monitoring School Performance: A Guide for Educators*. Philadelphia: Falmer Press, 1992; Center for Educational Research and Innovation, *Measuring the Quality of Schools*. Paris, France: Organization for Economic Co-operation and Development, 1995; Center for Educational Research and Innovation, *Measuring What Students Learn*. Paris, France: Organization for Economic Co-operation and Development, 1995; Sandra Black, “Measuring the value of better schools,” *Economic Policy Review*, 4(1): 87-94, 1998.

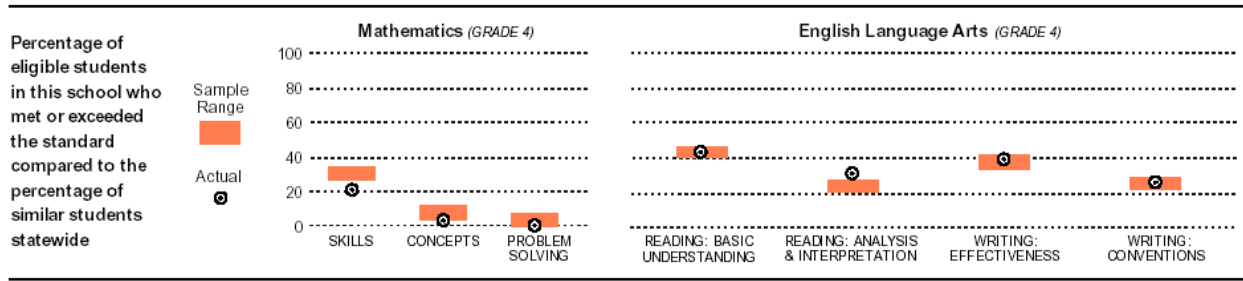


Figure 2: Sample of the RI Statistical Model as presented in Infoworks!

3.3 Field 4: Three-Year Breakdown of the Achievement Results

Field 4 presents a three-year breakdown of the achievement results. The achievement results are viewed against four basic categories for the elementary school and three categories for the middle, and high schools. The common categories are: ethnicity, gender, and special programs. The elementary schools have one additional category for poverty/non poverty. In Infoworks! this chart is commonly referred to as the *disaggregation* chart.

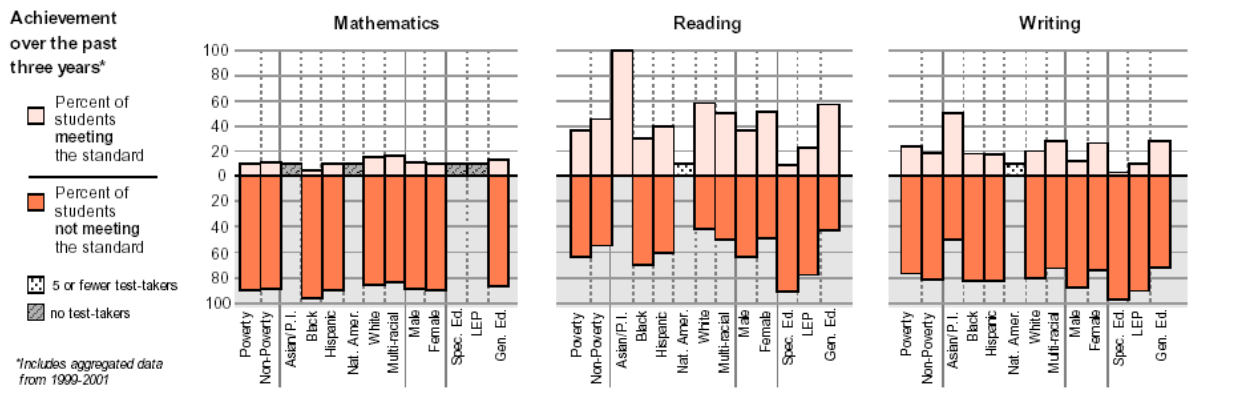


Figure 3: Elementary School Disaggregates for the Three-Year Achievement Results

4. PREDICTORS OF STUDENT ACHIEVEMENT

Studies² show that family background characteristics are closely related to student achievement. Schools with less economically privileged students, for example, almost always have lower achievement scores. This trend is also evident in Rhode Island. When Rhode Island ranks their state test results, the results closely mirror the socioeconomic status (SES) of the district. Thus, high-income districts have higher number of students meeting or exceeding the standards than low-income districts. Changes in many other characteristics (variables) have also been shown by research studies to correlate closely to student achievement. These variables include:

1. Prior achievement or aptitude
2. Participation in free or reduced lunch programs
3. Minority status
4. Educational level of the mother
5. Father's occupation
6. Family income
7. Number of siblings
8. Students receiving special services (e.g., special education, bilingual or ESL education).

Additionally, other macro-economic variables such as school settings (urban, rural, suburban), per pupil expenditure, policies and practices within schools or school districts, and community characteristics (for example, job market, tax support, etc.) also seem to affect student achievement³.

² Cf. Daniel Koretz, "Indicators of educational achievement," In Indicators of Children's Well-Being, Eds. Robert M. Hauser, Brett V. Brown, William R. Prosser. New York: Russell Sage Foundation, 1997, pp. 208-234; Stephen P. Klein et al., "Gender and racial/ethnic differences on performance assessments in science," Educational Evaluation and Policy Analysis, 19(2): 83-98, 1997; Bonnie L. Halpern-Felsher et al., "Neighborhood and family factors predicting educational risk and attainment in African American and white children and adolescents," in Neighborhood Poverty: Context and Consequences for Children, Eds. Jeanne Brooks-Gunn, Greg J. Duncan, J. Lawrence Aber. New York: Russell Sage Foundation, 1997, Volume 1, pp. 146-173; Jeanne-Brooks Gunn, Greg J. Duncan, "The effects of poverty on children," Children and Poverty, 7(2): 55-71, 1997.

³ David Kaplan, Pamela R. Elliott, "A model-based approach to validating education indicators using multilevel structural equation modeling," Journal of Educational and Behavioral Statistics, 22(3): 323-347, 1997; Garrett K. Mandeville, "The South Carolina experience with incentives," In Midwest Approaches to School Reform, Eds. Thomas A. Downes, William A. Testa. Chicago: Federal Reserve Bank of Chicago, 1994, pp. 69-91; Robert D. Felner et al., "The impact of school reform for the middle years: Longitudinal study of a network engaged in Turning Points-based comprehensive school transformation," Phi Delta Kappan, 78(7): 528-532, 541-550, 1997.

5. THE RHODE ISLAND MODEL ⁴

Statisticians over the years have built increasingly sophisticated models to relate the various factors presented above. One of the most powerful of these methods is hierarchical linear modeling (HLM). When applied to schools, HLM considers characteristics of a school as well as the characteristics of individual students. Researchers at NCPE attempted to use HLM but ultimately rejected it as an approach because the sets of schools that look similar to each other are too small to yield reliable results. The NCPE research team thus used hierarchical regression analysis, which is a specialized form of multivariate analysis.⁵

5.1 The Outcome (Dependent) Variable

The outcome variable, or the variable to predict, is the student's academic achievement in each subject area across different grade levels. Researchers employed a separate hierarchical regression model for each subtest in each subject area (Mathematics, and English Language Arts) in each of the tested grade levels (grades 4, 8, and 10). The percentages of students who achieved proficiency or were above the proficiency level were computed and used as the outcome (dependent) variable.

5.2 The Explanatory (Independent) Variables

Five explanatory variables known to relate statistically to student achievement on state tests are collected annually from Rhode Island schools and districts. These variables are:

1. The percentage of students within a school eligible for free or reduced lunch
2. The percentage of minority students (i.e., non-white) within a school
3. The percentage of students whose most educated parent has at least some college education
4. The percentage of students in a school enrolled in ESL or bilingual education programs
5. The percentage of students within a school receiving services under special education law

⁴ Details on the statistical terminology used in the Rhode Island Model are presented in Appendix A.

⁵ For further information consult George A. Marcoulides, Scott L. Hershberger, Multivariate Statistical Methods: A First Course. Mahwah, NJ: Lawrence Erlbaum Associates, 1997; J. Scott Long, Regression Models for Categorical and Limited Dependent Variables, Thousand Oaks, CA: SAGE Publications, 1997; and one of the classics in the field, Jacob Cohen, Patricia Cohen, Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. Hillsdale, NJ: Lawrence Erlbaum Associates, 2nd ed., 1983. A good general discussion of modeling is David W. Britt, A Conceptual Introduction to Modeling: Qualitative and Quantitative Perspectives. Mahwah, NJ: Lawrence Erlbaum Associates, 1997.

Because of the small number of schools in Rhode Island, comparisons were made among all schools in the state for the given grade level rather than at a district level. Research has shown that some or all of these variables may be highly correlated. (See Table 2: Correlation Analysis). The researchers at NCPE have thus created a Poverty Index variable that will be used as an explanatory variable. The creation of the Poverty Index is discussed in Section 5.3.2.

5.3 A Glimpse Into The Rhode Island Data

A descriptive analysis for the Rhode Island data is presented in Table 1. Table 2 presents the correlation results between the set of explanatory variables. Table 3 presents the correlation results between the response variable and the set of explanatory variables. Table 4 presents the results of the hierarchical regression analysis.

5.3.1 Descriptive Analysis

Table 1 shows the descriptive statistics for the seven response variables (assessment subtests) and the five explanatory variables that will be investigated in the development of the RI school model. Specifically, the information shows the minimum and maximum value for the variable (range), mean (arithmetic average), and standard deviation (a measure of dispersion in the variable).

Analyzing the information in Table 1, we find that among the five explanatory variables the highest variability (standard deviation) exists in the percentage of minority and free/reduced lunch students enrolled in a particular grade. The lowest variability in grade 4 and 8 exists in the percentage of students in special education programs. However, in grade 10 the lowest variability is the percentage of students enrolled in LEP. When analyzing the seven response variables, that the highest variability changes by grade. The only thing consistent is that the highest variability exists in one of the subtest for ELA. Also from Table 1, it is evident that, in general, the percentage of students that meet or exceed the standards decreases by grade level. That is, there are fewer students that meet or exceed the standards in Grade 10 than in Grade 4, as evidenced by the decreasing mean (Mean Column).

5.3.2 Creating the Poverty Index Variable

The three explanatory variables that are highly correlated across all grades are: % Eligible for Subsidized Lunch, % Minority Students, and % With at Least One Parent Who Had Some College Education (See Table 2). The variables were said to exhibit *multicollinearity*. In other words, when one variable shifted, the others also shifted in similar manner. The correlations between the % Eligible for Subsidized Lunch and % Minority Students, for example, was greater than 0.84 across all three tested grade levels. One of the remedies for multicollinearity is to group variables in blocks. Therefore, the researchers computed an equally weighted average of the following three variables: % Eligible for Subsidized Lunch, % Minority Students, and % Parents with at least some college education. The first two variables and the last variable point in different directions, i.e., high % free or reduced lunch and high % of minorities indicate greater poverty, whereas a high % of students whose most educated parent has some college education indicates less poverty. Therefore, one variable was reversed when computing the combined Poverty Index. A low value within the Poverty Index indicates greater poverty in a school and a high value indicates lower poverty.

5.3.3 Correlation Analysis

The Statistical Model presented, shows a very high correlation between achievement on selected state tests and most of the explanatory variables. This is presented in Table 3. The only exception is the variable that measures the percentage of students in special education programs. For this variable, most of the correlations are not significant at the 95% confidence level.

5.3.4 Hierarchical Regression Analysis

After careful study of the correlation tables, a hierarchical regression analysis was performed. The results are presented in Table 4. The first variable to be entered in the model is Poverty Index. We then added in the variable that measured the percentage of students in LEP programs. The variable that measures the percentage of students in the special education programs was entered next into the regression. (For a quick overview on Hierarchical Regression see

Appendix A7.3). In the Rhode Island Statistical Model, we used the *Poverty Index* first because it accounts for the most variation in student achievement among the three variables. Research with several Hierarchical Models suggested that the next most important variable was % *Students in LEP*. The residual variance was picked up by % *Students in Special Education* programs. The researchers are aware that some students within a school receive both types of services and would be “counted” twice in this model. Students with multiple learning needs require more support, which in turn factors into the cumulative effects of multiple challenges.

Table 4, presents the results from the hierarchical regression. Across all grade levels, the Poverty Index variable explained most of the variation in student achievement. Schools with more economically disadvantaged students have lower student achievement across all subject areas and grades. The residual variation (variation not explained by the Poverty Index) is then explained in part by students in LEP programs and students receiving special education services. These two variables rarely have significant effects on student achievement as indicated in Table 4. The last column of Table 4, represents the proportion of variance (r-square) in student achievement scores that were “statistically” explained by the set of explanatory variables. The model, for example, explains 70.2% of the variance in Reading: Basic Understanding for Grade 4, 69.7% for Grade 8, and 63.8% for Grade 10.

6. PREDICTING INDIVIDUAL SCHOOL PERFORMANCE

The hierarchical regression models were used to create expected achievement scores. The information for each school is presented on *Field 2: The Statistical Model*. These expected scores, based on school context derived from the entire set of state achievement tests in school year 2000-2001, provide us with guidelines about what we can statistically expect for individual school performance. Standard errors were computed in addition to the specific point estimates for the expected scores. The point estimates combined with the errors generated a band within which we would expect individual school performance to lie. The band, shown in Figure 2 as the sample range, shows the 95% confidence interval for the predicted score. The larger the width of the confidence band the less likely the school is in representing a typical Rhode Island school. Conversely, the narrower the band the more representative the school.

APPENDIX A: STATISTICAL DEFINITIONS

The following few sections describe some general statistical terminology that is important for understanding the analysis presented in this Technical Brief especially in Section 5.

A1. Definition of a Variable

A variable is a data / questionnaire item on which individual responses (observations) are obtained. Variables are categorized into two major categories.

- Response Variable: Is a variable whose outcome is being studied.
- Explanatory Variable: A variable that can explain the causal changes in the response variable.

A2. Descriptive Statistics

Descriptive Statistics is the collection, organization, analysis, and presentation of data. Table 1 presents some of the descriptive measures for the variables that will be used in *Field 2: The Statistical Model*. In column one, the table presents the number of valid observations (N) for each of the variables. The next column shows the minimum value for that variable in the data set. The third column shows the maximum value for the variable. The fourth column shows the arithmetic mean for the variable. Arithmetic mean is often called the average value. The last column shows the standard deviation for the variable. Standard deviation provides a statistical measure for dispersion around the mean. For example, Figure A1 shows the dispersion around the mean of three sample schools. The innermost curve corresponds to smallest dispersion (low standard deviation) around the mean the outermost curve corresponds to the most variability (high standard deviation).

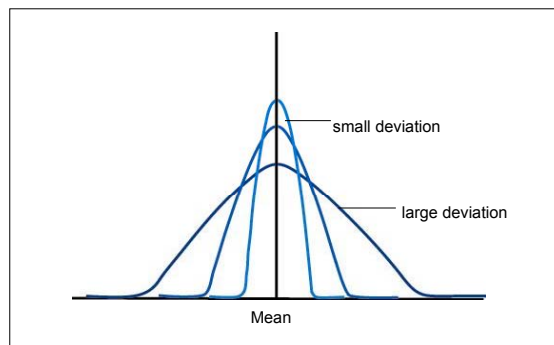


Figure A1: Example of Deviations Around the Mean

A3. Correlation

Researchers find it convenient to have a single number to measure the strength of the relationship between two variables and to have that number be independent of the units used to make the measurement. The correlation between the response variables and the explanatory variables is shown in Table 2. The reader thus has a better idea of the predictive ability of a single explanatory variable on the response variable. Table 3, on the other hand, shows the interactions of the explanatory variable amongst themselves. The higher the absolute value of the correlation, the greater the relationship between the two variables. A correlation of zero indicates that there is no positive or negative relationship between the two variables. A positive correlation value indicates that the variables increase together (Figure A2 shows a line with an upward slope – bottom left to top right). A negative correlation indicates that as one variable increases the other decreases (Figure A3 shows a line with a downward slope – top left to bottom right). A correlation of ± 1 (or 100%) indicates that there is a perfect linear relationship between the two variables. Correlations of ± 1 would be extremely strong relationships. These correlations are rarely observed when exploring relationships between different variables.

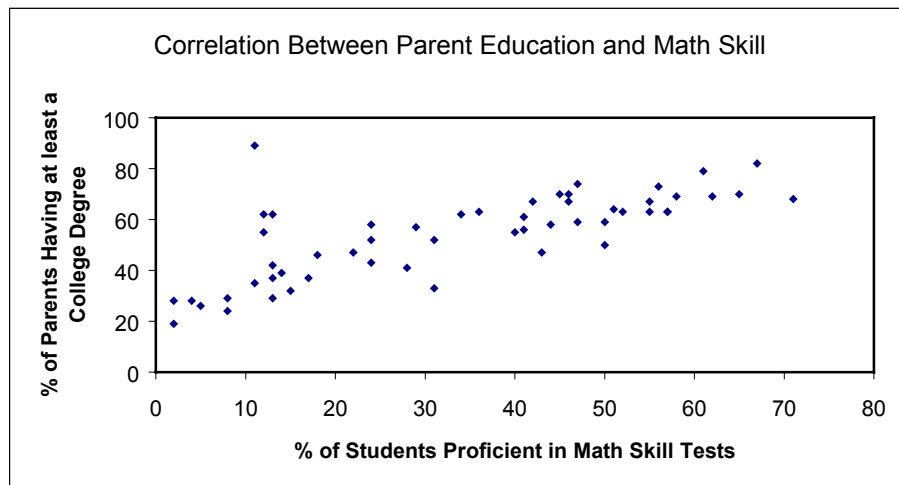


Figure A2: Example of Positive Correlation between Two Variables

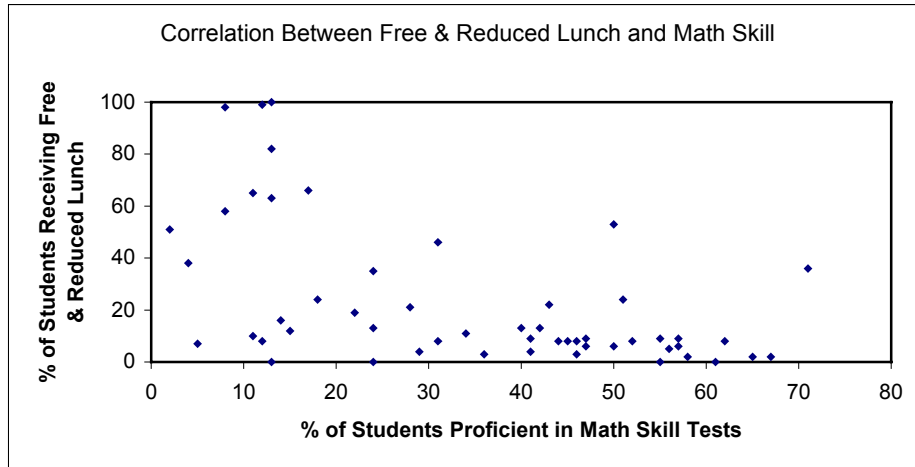


Figure A3: Example of Negative Correlation between Two Variables

A4. Correlation vs. Causation

Most statisticians know that “*Correlation does not imply causation.*” That is, even if two variables are related or correlated, they may not have any causal relationship between them. In other words, changes in one variable may not be directly caused by the independent operation of the other variable. One variable may fluctuate in relation to the other due to chance (coincidence) or both may be strongly affected by one or more *confounding*⁶ variables. Other possible reasons include both variables changing over time or when it is unclear whether there was causation or a contribution effect. In the absence of any other evidence, data from an observational study cannot be used to establish causation. However, a causal connection probably does exist if we can establish that: 1) there is a reasonable explanation of cause and effect, 2) the connection happens under varying conditions, and 3) potential confounding variables are ruled out. In the statistical model it is our intention to present the significant causal connection between a set of explanatory variables and a response variable.

⁶ Confounding occurs when more than one variable affects the response variable and the effects of the variables cannot be distinguished from each other.

A5. Statistical Significance

Researchers want to know and be able to say with some degree of confidence whether any relationships they have found between various types of data are different from relationships they would find solely due to chance. A measure for the degree of confidence we have in a statistical relationship is called the *confidence level*. A confidence level of 95% and above is considered to have *statistical significance*. In other words, most researchers are willing to state that a relationship is statistically significant if the possibility of observing that relationship in the sample purely due to chance is less than 5%.

For interpretational reasons, statisticians generally present a *confidence interval* of a prediction. A *confidence interval* is the statistical lower and upper bound within which the predicted value will occur 95% of the time. 95% is the value of the confidence level. In *Information Works!* this *confidence interval* is represented as a band (sample range) on Field 2 of the school report. In essence, a school should expect the actual achievement score (presented as a heavy solid line) for a particular sub-test to fall within the band. If the actual achievement score is above or below the band it is assumed that the school achieved those results purely by chance. Of course, if the school consistently performs above or below the band in multiple years and/or in more than one test, this school requires further study. It is increasingly likely if the results hold over multiple years that the results obtained are not due solely to chance (i.e., random fluctuations) but represent “real” under or over achievement as compared to what was expected from the model.

A6. Simple Linear Regression

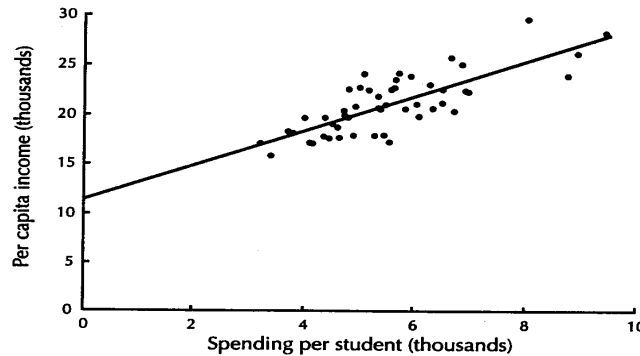


Figure A4: Regression Line

As mentioned in Section A3, the correlation coefficient measures the degree of linear relationship between two variables. However, it does not describe the exact linear association between a response variable (y) and the explanatory variable (x); that role is played by regression analysis. Regression analysis helps us to determine whether a specific relationship exists between x and y thereby allowing one to use x to predict y .

Figure A4⁷, shows the causal relationship of *Spending per Student* (X) on the *Per Capita Income* (Y). The original data is represented by dots. The line, often termed as the *regression line*, is obtained via the principles of Least Squares. As we know, given two points we can draw one line. Given, infinite points we can draw infinite lines. Thus, the problem of finding the *best* line through a set of points was solved using the Least Squares principle. The Least Square principle minimizes the deviations from the actual data points to a hypothetical line. This is shown in Figure A5⁸. The formula that defines the *regression line* is termed the *regression equation* and explained next.

⁷ Reproduced from *Statistics: The Easy Way*, Douglas Downing, Jeffrey Clark, Barron's Educational Series Inc., Hauppauge, NY, 1997, p.256.

⁸ Reproduced from *Statistics: The Easy Way*, Douglas Downing, Jeffrey Clark, Barron's Educational Series Inc., Hauppauge, NY, 1997, p.259.

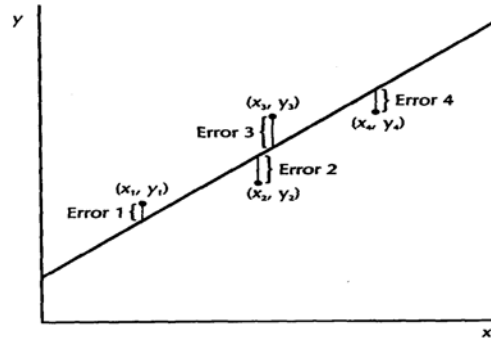


Figure A5: Regression Line with Deviations

A simple linear regression equation is written as: $y = a + bx$, where y represents the values on the vertical axis (per capita income in our example); x represents the values on the horizontal axis (spending per student in our example); and a and b are parameters (values) obtained from the least squares solution. The intercept or a is the intersection point of the regression line with the vertical axis. The slope or b determines if there is a positive or negative relationship between x & y . A positive slope, indicated by a positive value for b , shows that for every unit increase in x the response variable y has an increase of b units. Conversely, a negative value of b indicates that for every unit increase in x , y decreases by b units.

A7. Multivariate Analysis

The section above presented an overview of how one explanatory variable can predict the outcome of one response variable. However, in most daily scenarios it is unlikely that one explanatory variable is all one needs to build an effective model. The study of multiple explanatory variables interacting simultaneously to produce the outcome on one or many response variables is termed Multivariate Analysis. For the purposes of this Technical Brief, we will only address models with one response variable and more than one explanatory variables. The Rhode Island Statistical Model is based on one such technique -- Hierarchical Regression. As is shown in the following sections Hierarchical Regression is a variation of two other forms of analysis that we did not use: Multiple Regression and Stepwise Regression. A brief discussion on each of the three techniques follows.

A7.1 Multiple Regression

In a multiple regression model, sets of explanatory variables called independent variables jointly predict the outcome of the response variable or the dependent variable. All of the independent variables are specified simultaneously in the regression equation and the solution is obtained through a technique called Least Squares. The assumption is that all (n) independent variables (x_i) together are necessary to explain the variation in the dependent variable (y). The regression equation is written as:

$$y = a + b_1x_1 + b_2x_2 + \dots + b_nx_n$$

Once again, a and b_i are parameters obtained from the least squares solution. The intercept or a is often termed as the constant term. Each b_i determines if there is a positive or negative relationship between a given x_i and y . A positive slope, indicated by a positive value for b_i , shows that for every unit increase in x_i the response variable y has an increase of b_i units. A negative slope indicated by a negative b_i value shows that for every unit increase in x_i the response variable decreases by b_i units.

A7.2 Stepwise Regression

In stepwise regression, the researcher assumes that the independent variables (x_i) are correlated. The researcher simultaneously specifies all of the variables in the regression equation just like in the Multiple Regression Model. However, the Stepwise procedure will systematically add variables that make a significant contribution to the explanation of the variation in y . The Stepwise procedure will also eliminate variables that are not significant from the equation. Thus, the final predication equation will have fewer independent variables. Stepwise regression does not address the economic or model building requirements. It simply adds and removes variables based on mathematical criteria.

A7.3 Hierarchical Regression

In hierarchical regression, the approach used in the RI model, a core set of m independent variables ($m < n$) form the basis of the regression equation. In essence these are forced into the model. The other variables are introduced one at a time in the model to see the incremental gain. Thus the order in which the variables are entered is important. The variable that explains the

most variance is the better predictor of the variance in the dependent variable. For example⁹, if we know that IQ, age, and parents' income predict a student's ability to do math, we would like to investigate if Test A or Test B is the better predictor of a student's test score. This model can be solved by hierarchical regression by first adding all known factors – IQ, Age, and Parent's income -- into the model. Next we add the performance on Test A and Test B in every possible combination. The sample results is presented below:

| STEPS FOR MODEL 1 | R2 CHANGE | STEPS FOR MODEL 2 | R2 CHANGE |
|----------------------------|-----------|-----------------------------|-----------|
| 1. Age, IQ, Parents Income | 68% | 1. Age, IQ, Parent's Income | 68% |
| 2. Test A | 18% | 2. Test B | 6% |
| 3. Test B | 4% | 3. Test A | 16% |

Table A1: Predicting Math Performance Using Hierarchical Regression

In this example, Test A accounts for more unique variation in math scores 18% or 16% compared to Test B which accounts for only 4% or 6% of the variation in math scores. Test A is thus considered to be a better predictor of math scores and should be selected in the model.

⁹ Example obtained from <http://www.bath.ac.uk/~pssiw/stats/week4ohp/sld012.htm>

APPENDIX B: TABLES

Table 1: Descriptive Statistics for Key Variables Used in the Model

| | | N | Minimum | Maximum | Mean | Std. Deviation |
|------------------------------------|------------------------------------|----------|----------------|----------------|-------------|-----------------------|
| Grade 4 | Skills | 193 | 0.00 | 100.00 | 59.90 | 20.71 |
| | Concepts | 193 | 0.00 | 100.00 | 33.82 | 20.15 |
| | Problem Solving | 193 | 0.00 | 100.00 | 22.31 | 16.11 |
| | Reading: Basic Understanding | 193 | 0.00 | 100.00 | 71.96 | 19.04 |
| | Reading: Analysis & Interpretation | 193 | 0.00 | 100.00 | 58.55 | 21.67 |
| | Writing: Conventions | 193 | 0.00 | 100.00 | 53.85 | 19.33 |
| | Writing: Effectiveness | 193 | 0.00 | 100.00 | 61.33 | 18.94 |
| | % Eligible for subsidized lunch | 193 | 1.00 | 100.00 | 38.44 | 29.84 |
| | % Minority Students | 193 | 0.00 | 97.83 | 24.34 | 29.37 |
| | % Students in Special Education | 193 | 0.00 | 43.00 | 18.21 | 4.66 |
| | % Students in LEP | 193 | 0.00 | 68.00 | 7.60 | 12.95 |
| | % Parent Education | 193 | 2.00 | 100.00 | 43.40 | 19.59 |
| | Grade 8 | Skills | 57 | 4.00 | 73.00 | 41.72 |
| Concepts | | 57 | 0.00 | 61.00 | 19.53 | 15.65 |
| Problem Solving | | 57 | 0.00 | 75.00 | 24.96 | 18.65 |
| Reading: Basic Understanding | | 57 | 0.00 | 83.00 | 50.18 | 19.59 |
| Reading: Analysis & Interpretation | | 57 | 0.00 | 53.00 | 24.42 | 14.81 |
| Writing: Conventions | | 57 | 0.00 | 83.00 | 45.12 | 18.06 |
| Writing: Effectiveness | | 57 | 7.00 | 83.00 | 49.81 | 20.36 |
| % Eligible for subsidized lunch | | 58 | 4.00 | 90.00 | 34.78 | 28.99 |
| % Minority Students | | 58 | 0.00 | 93.60 | 24.29 | 31.10 |
| % Students in Special Education | | 58 | 0.00 | 30.00 | 18.05 | 5.75 |
| % Students in LEP | | 58 | 0.00 | 37.00 | 4.03 | 7.71 |
| % Parent Education | | 58 | 0.00 | 86.00 | 53.57 | 18.87 |
| Grade 10 | | Skills | 55 | 0.00 | 76.00 | 34.71 |
| | Concepts | 55 | 0.00 | 55.00 | 19.04 | 15.36 |
| | Problem Solving | 55 | 0.00 | 51.00 | 17.04 | 13.58 |
| | Reading: Basic Understanding | 55 | 0.00 | 69.00 | 34.33 | 17.63 |
| | Reading: Analysis & Interpretation | 55 | 0.00 | 67.00 | 28.95 | 18.69 |
| | Writing: Conventions | 55 | 0.00 | 87.00 | 51.56 | 21.78 |
| | Writing: Effectiveness | 55 | 0.00 | 55.00 | 21.85 | 15.88 |
| | % Eligible for subsidized lunch | 56 | 0.00 | 91.00 | 23.88 | 23.85 |
| | % Minority Students | 56 | 0.61 | 91.92 | 25.41 | 30.06 |
| | % Students in Special Education | 56 | 0.00 | 97.00 | 13.98 | 13.08 |
| | % Students in LEP | 56 | 0.00 | 25.00 | 2.63 | 5.17 |
| | % Parent Education | 55 | 7.00 | 87.00 | 55.42 | 17.82 |

Table 2: Correlation between Explanatory Variables

| | Explanatory Variables | % Eligible for Subsidized Lunch | % Minority Students | % Students in Special Education | % Students in LEP | Poverty Index | % Students Whose Parents Having at least some College Education |
|-----------------|---|--|----------------------------|--|--------------------------|----------------------|--|
| Grade 4 | % Eligible for subsidized lunch | 1.000 | | | | | |
| | % Minority Students | 0.920** | 1.000 | | | | |
| | % Students in Special Education | 0.060 | -0.073 | 1.000 | | | |
| | % Students in LEP | 0.760** | 0.839** | -0.039 | 1.000 | | |
| | Poverty Index | 0.972** | 0.944** | 0.042 | 0.805** | 1.000 | |
| | % Students whose Parents Have At least some a College Education | -0.679** | -0.578** | -0.172* | -0.550** | -0.787** | 1.000 |
| Grade 8 | % Eligible for subsidized lunch | 1.000 | | | | | |
| | % Minority Students | 0.915** | 1.000 | | | | |
| | % Students in Special Education | 0.113 | 0.114 | 1.000 | | | |
| | % Students in LEP | 0.639** | 0.655** | 0.261* | 1.000 | | |
| | Poverty Index | 0.971** | 0.957** | 0.087 | 0.670** | 1.000 | |
| | % Students whose Parents Have At least some a College Education | -0.757** | -0.692** | -0.145 | -0.558** | -0.844** | 1.000 |
| Grade 10 | % Eligible for subsidized lunch | 1.000 | | | | | |
| | % Minority Students | 0.848** | 1.000 | | | | |
| | % Students in Special Education | 0.100 | 0.176 | 1.000 | | | |
| | % Students in LEP | 0.620** | 0.626** | -0.036 | 1.000 | | |
| | Poverty Index | 0.928** | 0.960** | 0.209 | 0.644** | 1.000 | |
| | % Students whose Parents Have At least some a College Education | -0.702** | -0.752** | -0.327* | -0.518** | -0.860** | 1.000 |

** Significant at the 99% confidence level

** Significant at the 95% confidence level

Table 3: Correlation Coefficients of Student Characteristics to Student Achievement

| | | % Eligible for Free & Reduced Lunch | % Minority Students | % Students in Special Education | % Students in LEP | % Students whose Parents Have At Least Some College Education |
|----------|------------------------------------|-------------------------------------|---------------------|---------------------------------|-------------------|---|
| Grade 4 | Skills | -0.811** | -0.743** | -0.034 | -0.601** | 0.650** |
| | Concepts | -0.730** | -0.644** | -0.065 | -0.521** | 0.632** |
| | Problem Solving | -0.612** | -0.534** | -0.122 | -0.453** | 0.593** |
| | Reading: Basic Understanding | -0.819** | -0.775** | -0.014 | -0.662** | 0.674** |
| | Reading: Analysis & Interpretation | -0.849** | -0.780** | -0.085 | -0.675** | 0.722** |
| | Writing: Conventions | -0.792** | -0.703** | -0.074 | -0.593** | 0.695** |
| | Writing: Effectiveness | -0.693** | -0.637** | -0.011 | -0.503** | 0.588** |
| Grade 8 | Skills | -0.823** | -0.794** | -0.238 | -0.598** | 0.823** |
| | Concepts | -0.20** | -0.637** | -0.334* | -0.512** | 0.765** |
| | Problem Solving | -0.711** | -0.649** | -0.368** | -0.520** | 0.765** |
| | Reading: Basic Understanding | -0.813** | -0.746** | -0.070 | -0.585** | 0.864** |
| | Reading: Analysis & Interpretation | -0.838** | -0.761** | -0.102 | -0.548** | 0.871** |
| | Writing: Conventions | -0.778** | -0.708** | -0.062 | -0.509** | 0.845** |
| | Writing: Effectiveness | -0.799** | -0.776** | -0.159 | -0.527** | 0.836** |
| Grade 10 | Skills | -0.683** | -0.719** | -0.204 | -0.449** | 0.892** |
| | Concepts | -0.652** | -0.660** | -0.131 | -0.426** | 0.864** |
| | Problem Solving | -0.651** | -0.675** | 0.112 | -0.418** | 0.891** |
| | Reading: Basic Understanding | -0.665** | -0.691** | -0.239 | -0.432** | 0.891** |
| | Reading: Analysis & Interpretation | -0.675** | -0.700** | -0.168 | -0.428** | 0.898** |
| | Writing: Conventions | -0.618** | -0.701** | 0.302 | -0.396** | 0.899** |
| | Writing: Effectiveness | -0.601** | -0.618** | 0.159 | -0.330** | 0.831** |

* Significant at the 90% confidence level

** Significant at the 95% confidence level

Table 4: Regression Results

| | | CONSTANT | PROVERTY INDEX | % LEP | % SPECIAL EDUCATION | R-SQUARE (%) |
|------------------------------------|------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Grade 4 | Skills | 89.292** (3.778) | -0.810** (0.061) | 0.251** (0.113) | -0.005 (0.187) | 67.1% |
| | Concepts | 62.885** (4.274) | -0.748** (0.069) | 0.307** (0.128) | -0.088 (0.212) | 55.6% |
| | Problem Solving | 46.152** (3.921) | -0.497** (0.063) | 0.176 (0.118) | -0.297 (0.194) | 61.5% |
| | Reading: Basic Understanding | 97.168** (3.305) | -0.688** (0.053) | 0.057 (0.099) | -0.096 (0.164) | 70.2% |
| | Reading: Analysis & Interpretation | 94.102** (3.443) | -0.813** (0.056) | 0.084 (0.103) | -0.211 (0.170) | 75.1% |
| | Writing: Conventions | 83.814** (3.627) | -0.736** (0.059) | 0.214** (0.109) | -0.126 (0.180) | 65.2% |
| | Writing: Effectiveness | 83.784** (4.215) | -0.678** (0.068) | 0.281** (0.126) | 0.132 (0.209) | 51.1% |
| | Grade 8 | Skills | 77.391** (5.479) | -0.707** (0.079) | 0.018 (0.262) | -0.601** (0.263) |
| Concepts | | 49.457** (5.103) | -0.469** (0.074) | 0.121 (0.244) | 0.769** (0.245) | 60.5% |
| Problem Solving | | 62.593** (5.908) | -0.557** (0.086) | 0.144 (0.282) | -1.027** (0.283) | 62.7% |
| Reading: Basic Understanding | | 71.950** (5.593) | -0.632** (0.081) | -0.128 (0.267) | 0.053 (0.268) | 69.7% |
| Reading: Analysis & Interpretation | | 44.267** (4.009) | -0.529** (0.058) | 0.109 (0.191) | -0.095 (0.192) | 72.8% |
| Writing: Conventions | | 65.970** (5.609) | -0.608** (0.081) | 0.124 (0.268) | 0.000 (0.269) | 64.2% |
| Writing: Effectiveness | | 81.084** (5.701) | -0.731** (0.083) | 0.259 (0.272) | -0.367 (0.273) | 70.9% |
| Grade 10 | | Skills | 59.493** (3.222) | -0.809** (0.102) | 0.458 (0.427) | -0.038 (0.132) |
| | Concepts | 35.875** (2.661) | -0.590** (0.084) | 0.375 (0.353) | -0.051 (0.109) | 59.3% |
| | Problem Solving | 32.055** (2.271) | -0.547** (0.072) | 0.423 (0.301) | 0.076 (0.093) | 62.1% |
| | Reading: Basic Understanding | 55.741** (2.881) | -0.674** (0.091) | 0.385 (0.382) | -0.088 (0.118) | 63.8% |
| | Reading: Analysis & Interpretation | 50.972** (2.993) | -0.759** (0.095) | 0.556 (0.397) | -0.025 (0.123) | 65.3% |
| | Writing: Conventions | 79.072** (3.540) | -0.830** (0.112) | 0.608 (0.470) | -0.212 (0.145) | 64.2% |
| | Writing: Effectiveness | 39.179** (2.906) | -0.624** (0.092) | 0.716 (0.386) | 0.029 (0.119) | 54.7% |

** Significant at the 95% confidence level
Standard Deviations are in parentheses