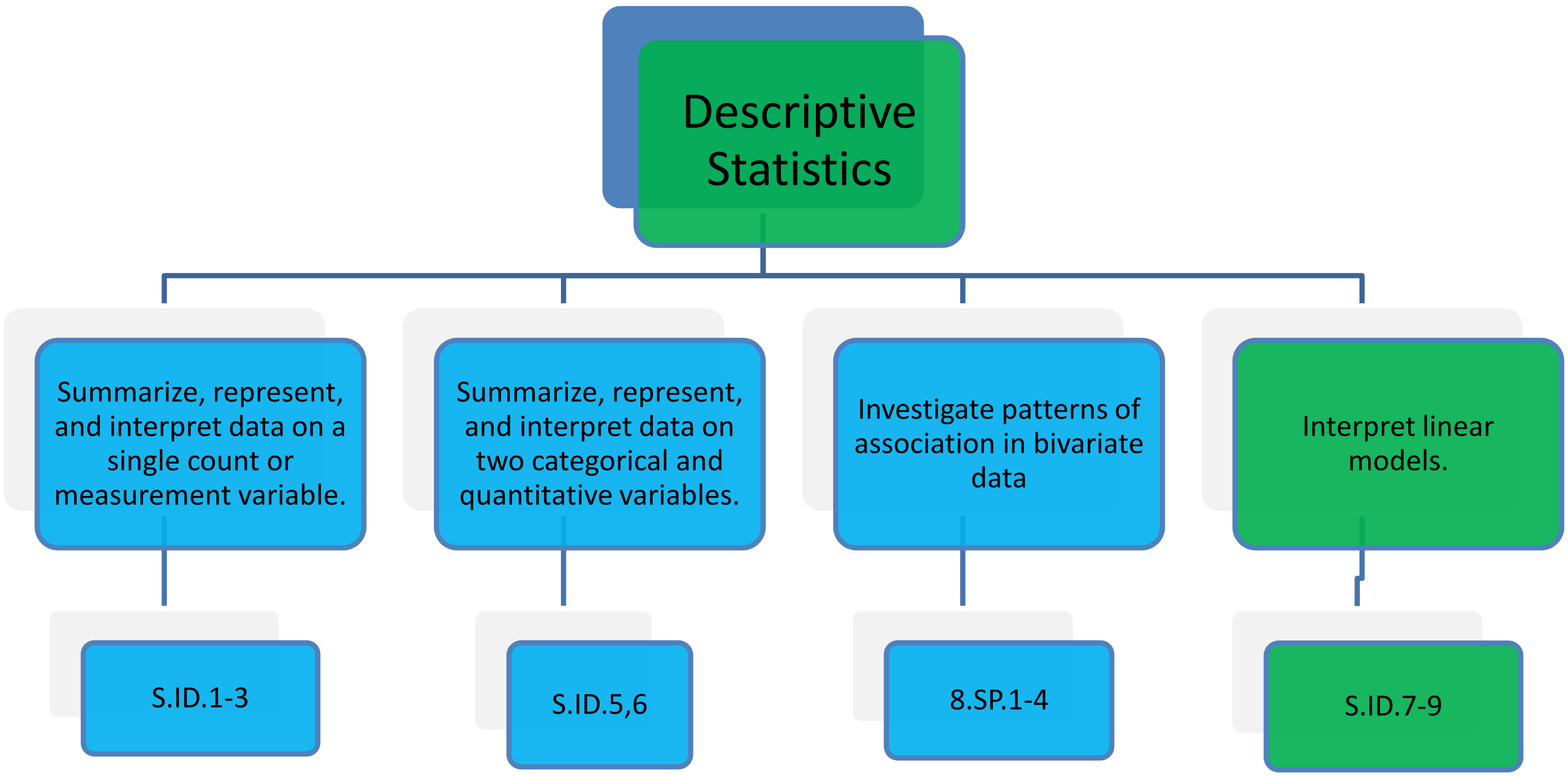
Accelerated Algebra 1

Unit 3



S-ID.7-9: Modeling and interpreting linear Models

Key: Major Clusters; Additional / Supporting Clusters

Accelerated Algebra 1 – UNIT 3
Descriptive Statistics

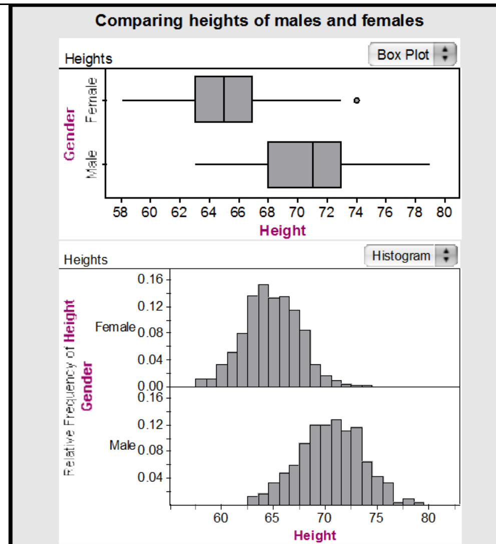
Critical Area: Experience with descriptive statistics began as early as Grade 6. Students were expected to display numerical data and summarize it using measures of center and variability. By the end of middle school they were creating scatterplots and recognizing linear trends in data. This unit builds upon that prior experience, providing students with more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

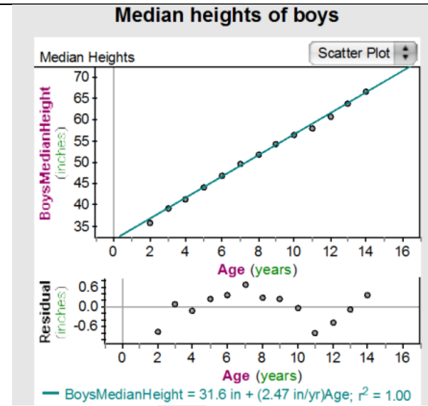
CLUSTERS	COMMON CORE STATE STANDARDS
Summarize, represent, and interpret data on a single count or measurement variable. *In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.*	S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
Summarize, represent, and interpret data on two categorical and quantitative variables. *Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals.* *S.ID.6b should be focused on linear models, but may be used to preview quadratic functions in Unit 5 of this course.*	S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.* b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association.
Investigate patterns of association in bivariate data. *While this content is likely subsumed by S.I.D. 6-9, it could be used for scaffolding instruction to the more sophisticated content found there.*	8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association and nonlinear association. 8.SP.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the

CLUSTERS	COMMON CORE STATE STANDARDS
	model fit by judging the closeness of the data points to the line. 8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height. 8.SP.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two way table. Construct and interpret a two way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?
Interpret linear models. *Build on students' work with linear relationships in eighth grade and introduce the correlation coefficient. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9.*	S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. S.ID.9 Distinguish between correlation and causation.
MATHEMATICS PRACTICES	**LEARNING PROGRESSIONS**
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the arguments of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.	CDE Progress to Algebra K-8 www.cde.ca.gov/be/cc/cd/documents/updateditem12catt3.doc

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
• Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. • Students will be introduced to the correlation coefficient. The focus is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. • The important distinction between a statistical relationship and a cause-and-effect relationship is studied. • Students take a deeper look at bivariate data, using their knowledge of proportions to describe categorical associations and using their knowledge of functions to fit models to quantitative data.	How would you analysis bivariate data using your knowledge of proportions? How would you describe categorical associations and use your knowledge of functions to fit models to quantitative data? How would you interpret the parameters of a linear model in the context of data that it represents? How can you compute correlation coefficients using technology and interpret the value of the coefficient?	Association Bivariate data Box plots Categorical association Causation Correlation coefficient Dot plots Histogram Intercept (constant term) Linear model Line of best fit Mean, Median Outlier Quantitative variables Scatter plot Slope (rate of change)

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
Materials: **California Revised Mathematics Framework:** http://www.cde.ca.gov/be/cc/cd/draftmathfwchapters.asp. **NCTM Illuminations** • Line of Best Fit http://illuminations.nctm.org/ActivityDetail.aspx?ID=146 • Linear Regression http://illuminations.nctm.org/ActivityDetail.aspx?ID=82 **Illustrative Mathematics** http://www.illustrativemathematics.org/illustrations/942 **Mathematics Assessment Project – MARS Tasks**	Use graphs such as the one below to show two ways of comparing height data for males and females in the 20-29 age group. Both involve plotting the data or data summaries (box plots or histograms) on the same scale, resulting in what are called parallel (or side-by-side) box plots and parallel histograms (S-ID.1). The parallel histograms show the distributions of heights to be mound shaped and fairly symmetrical (approximately normal) in shape. The data can be described using the mean and standard deviation. Have students sketch each distribution and answer questions about it just from knowledge of these three facts (shape, center, and spread). They also observe that the two measures of center, median and mean, tend to be close to each other for symmetric distributions.	SBAC - http://www.smarterbalanced.org/ Thermometer Crickets http://www.smarterbalanced.org/wordpress/wp-content/uploads/2012/09/performance-tasks/crickets.pdf PARCC - http://parcconline.org/samples/mathematics/grade-6-slider-ruler

Representing Data Using Box Plots – S.ID. 5, 6 a- c: http://map.mathshell.org/materials/download.php?fileid=1243 Representing Data 1: Using Frequency Graphs – S.ID 1-3: http://map.mathshell.org/materials/download.php?fileid=1230 Statistics Online Computational Resource (SOCR) http://www.socr.ucla.edu/	 *Heights of U.S. males and females in the 20–29 age group.* Source: *U.S. Census Bureau, Statistical Abstract of the United States: 2009*, Table 201. Have students learn how to take a careful look at scatter plots, as sometimes the "obvious" pattern does not tell the whole story, and can even be misleading. The graphs show the median heights of growing boys through the ages 2 to 14. The line (least squares regression line) with slope 2.47 inches per year of growth looks to be a perfect fit (S-ID.6c). But, the residuals, the differences between the corresponding coordinates on the least squares line and the actual data values for each age, reveal additional information.	



LANGUAGE GOALS

Students will analysis bivariate data using your knowledge of proportions and explain their findings.

Students will describe categorical associations and use their knowledge of functions to fit models to quantitative data.

Students will interpret the parameters of a linear model in the context of data that it represents.

Students will compute correlation coefficients using technology and interpret the value of the coefficient.

PERFORMANCE TASKS

ILLUSTRIVE MATHEMATICS

- Haircut Costs – S.ID.1, 2, 3 : http://www.illustrativemathematics.org/illustrations/942
- Speed Trap – S.ID.1, 2, 3: http://www.illustrativemathematics.org/illustrations/1027
- Coffee and Crime – S.ID.6-9: http://www.illustrativemathematics.org/illustrations/1307
- Olympic Men's 100-meter dash – S.ID.6a, 7: http://www.illustrativemathematics.org/illustrations/1554
- Used Subaru Foresters I – S.ID.6: http://www.illustrativemathematics.org/illustrations/941
- Texting and Grades II – S.ID.7 : http://www.illustrativemathematics.org/illustrations/1028

MARS Tasks:

- Representing Data 1: Using Frequency Graphs – S.ID 1-3: http://map.mathshell.org/materials/download.php?fileid=1230
- Representing Data Using Box Plots – S.ID. 5, 6 a- c: http://map.mathshell.org/materials/download.php?fileid=1243
- Interpreting Statistics: A Case of Muddying the Waters – S.ID 7-8 http://map.mathshell.org/materials/download.php?fileid=686
- Devising a Measure for Correlation – S.ID : http://map.mathshell.org/materials/download.php?fileid=1234

NCTM Illuminations Lessons

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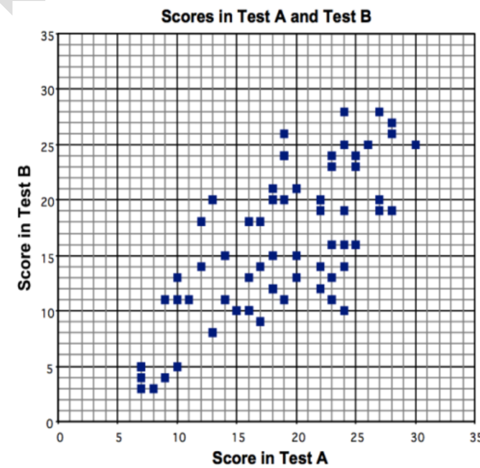
<tr><td colspan="3">DIFFERENTIATION📖</td></tr>
<tr><td>FRONT LOADING</td><td>ACCELERATION</td><td>INTERVENTION</td></tr>
<tr><td>• Use graphs of experiences that are familiar to students to increase accessibility and supports understanding and interpretation of proportional relationship. Students are expected to both sketch and interpret graphs including scatter plot.
• Students create an equation with given information from a table, graph, or problem situation.
• Engage students in interpreting slope and intercept using real world applications (e.g. bivariate data).</td><td>Students will explore how the residuals, the differences between the corresponding coordinates on the least squares line and the actual data values for each age, reveal additional information.
Students should be able to sketch each distribution and answer questions about it just from knowledge of these three facts (shape, center, and spread).

Have students design an experiment (project) where they would collect data from different sources, make a scatter plot of the data, draw a line of best fit modeling the data. From the plot, students would write the regression coefficient and the residual to explain the strength of the association.</td><td>Have the students work in groups to generate data from the internet, such as the CST scores and other data. Have them construct a table based on the pattern and then graph the values and explain the relationship observed on the graph (association).
Example: Certain students took two different tests (Test A and Test B). In the scatter diagram, each square represents one student and shows the scores that student got in the two tests.


Draw a line of best fit on the scatter diagram and answer some questions regarding the data.</td></tr>
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[1] **Major Clusters – area of intensive focus where students need fluent understanding and application of the core concepts.**

[2] **Supporting/Additional Clusters – designed to support and strengthen areas of major emphasis/expose students to other subjects.**

References:

1. National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common Core State Standards (Mathematics)*. Washington D.C.: National Governors Association Center for Best Practices, Council of Chief State School Officers.

2. McCallum, W., Zimba, J., Daro, P. (2011, December 26 Draft). *Progressions for the Common Core State Standards in Mathematics*. Cathy Kessel (Ed.). Retrieved from http://ime.math.arizona.edu/progressions/#committee.
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