Unit 8: Bivariate Data

Cluster: Investigate patterns of association in bivariate data.

Nevada Academic Content Standard	What does this standard mean that a student will know and be able to do? (adapted from North Carolina *8th Grade Standards, Unpacked Content*)
8.SP.A.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.1** Bivariate data refers to two-variable data, one to be graphed on the *x*-axis and the other on the *y*-axis. Students represent numerical data on a scatter plot, to examine relationships between variables. They analyze scatter plots to determine if the relationship is linear (positive, negative association or no association) or nonlinear. Students can use tools such as those at the National Center for Educational Statistics to create a graph or generate data sets. (http://nces.ed.gov/nceskids/createagraph/default.aspx) Data can be expressed in years. In these situations it is helpful for the years to be "converted" to 0, 1, 2, etc. For example, the years of 1960, 1970, and 1980 could be represented as 0 (for 1960), 10 (for 1970) and 20 (for 1980). *Example 1:* Data for 10 students' Math and Science scores are provided in the chart. Describe the association between the Math and Science scores. *Solution:* This data has a positive association. *Example 2:* Data for 10 students' Math scores and the distance they live from school are provided in the table below. Describe the association between the Math scores and the distance they live from school. *Solution:* There is no association between the math score and the distance a student lives from school. *Example 3:* The chart below lists the life expectancy in years for people in the United States every five years from 1970 to 2005. What would you expect the life expectancy of a person in the United States to be in 2010, 2015, and 2020 based upon this data? Explain how you determined your values. *Solution:* There is a positive association.

Student	1	2	3	4	5	6	7	8	9	10
Math	64	50	85	34	56	24	72	63	42	93
Science	68	70	83	33	60	27	74	63	40	96

Student	1	2	3	4	5	6	7	8	9	10
Math	64	50	85	34	56	24	72	63	42	93
Distance from School (miles)	0.5	1.8	1	2.3	3.4	0.2	2.5	1.6	0.8	2.5

Date	1970	1975	1980	1985	1990	1995	2000	2005
Life Expectancy (in years)	70.8	72.6	737	74.7	75.4	75.8	76.8	77.4

8.SP.A.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 model fit by judging the closeness of the data points to the line.

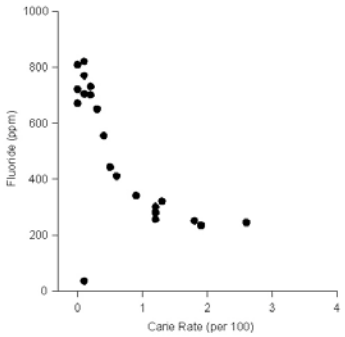
8.SP.A.3

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.*

Students recognize that points may be away from the other points (outliers) and have an effect on the linear model.

NOTE: Use of the formula to identify outliers is **not** expected at this level.

Students recognize that not all data will have a linear association. Some associations will be non-linear as in the example.



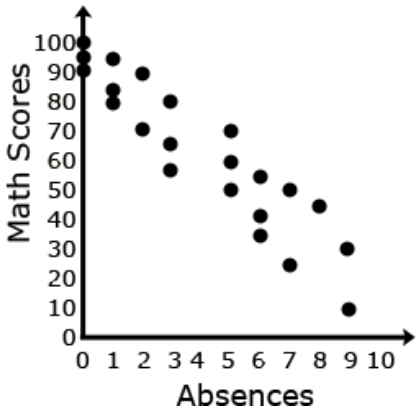
8.SP.2 Students understand that a straight line can represent a scatter plot with linear association. The most appropriate linear model is the line that comes closest to most data points. The use of linear regression is not expected. If there is a linear relationship, students draw a linear model. Given a linear model, students write an equation.

8.SP.3 Linear models can be represented with a linear equation. Students interpret the slope and *y*-intercept of the line in the context of the problem.

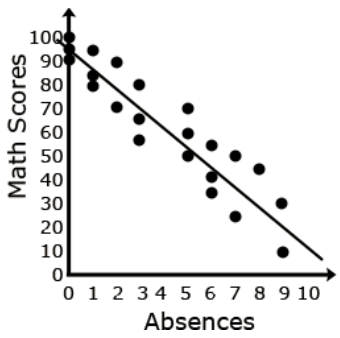
Example 1:

1. Given data from students' math scores and absences, make a scatterplot.

Absences	Math Scores
3	65
5	50
1	95
1	85
3	80
6	34
5	70
3	56
0	100
7	24
8	45
2	71
9	30
0	95
6	55
6	42
2	90
0	92
5	60
7	50
9	10
1	80



2. Draw a linear model paying attention to the closeness of the data points on either side of the line.



8.SP.A.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?*

3. From the linear model, determine an approximate linear equation that models the given data
(about y = $-\frac{25}{3}x + 95$)

4. Students should recognize that 95 represents the *y*-intercept and $-\frac{25}{3}$ represents the slope of the line. In the context of the problem, the *y*-intercept represents the math score a student with 0 absences could expect. The slope indicates that the math scores decreased 25 points for every 3 absences.

5. Students can use this linear model to solve problems. For example, through substitution, they can use the equation to determine that a student with 4 absences should expect to receive a math score of about 62. They can then compare this value to their line.

8.SP.4 Students understand that a two-way table provides a way to organize data between two categorical variables. Data for both categories needs to be collected from each subject. Students calculate the relative frequencies to describe associations.

Example 1:
Twenty-five students were surveyed and asked if they received an allowance and if they did chores. The table below summarizes their responses.

	Receive Allowance	No Allowance	Totals
Do Chores	15	5	20
Do Not Do Chores	3	2	5

Of the students who do chores, what percent do not receive an allowance?

Solution: 5 of the 20 students who do chores do not receive an allowance, which is 25%

Approximate Time Frame: *2 - 3 weeks*

Terms:

- ✓ Bivariate
- ✓ Categorical data
- ✓ Cluster
- ✓ Data
- ✓ Extrapolation
- ✓ Frequency
- ✓ Initial value
- ✓ Interpolation
- ✓ Line of best fit
- ✓ Trend line
- ✓ Linear association
- ✓ Negative association/correlation
- ✓ Numerical data
- ✓ Outlier
- ✓ Positive association/correlation
- ✓ Qualitative data
- ✓ Quantitative data
- ✓ Rate of change
- ✓ Relative frequency
- ✓ Scatter plot
- ✓ Trend line
- ✓ Two-way table
- ✓ Univariate

Resources

MGH – McGraw Hill, Glencoe Math (2015)
ML – McDougal Littell, Pre-Algebra Book; Larson, 2005
EX – Explorations in Core Math (Holt McDougal)
NY – *Engage* New York
LZ – Learn Zillion Website
MAP – Math Assessment Project (MARS)

	Suggested Topics for Lessons	***Suggested Resources***
8.SP.A.1	**Qualitative vs Quantitative Data** **Categorical vs Numerical Data** **Construct and interpret scatter plots** SBAC Evidence: ➢ The student interprets patterns of association between two quantities in a scatter plot (clustering in reference to the line of best fit, positive or negative association, linear association, nonlinear association, and the effect of outliers)…	➢ Powerpoints: http://www.sophia.org/packets/bivariate-data-two-variables--2 ➢ NY Regents Prep: *Qualitative vs Quantitative Data* ➢ ABS Educ Serv*: What's the Difference between Numerical & Categorical Data?* ➢ MGH 9-1 Inquiry Lab: *Scatter Plots* (page 663) ➢ MGH 9-1 Lesson 1: *Scatter Plots* (page 665) ➢ ML 1.8 *Making a Scatter Plot* (page 48) ➢ EX 9-1 *Scatter Plots* (page 339) ➢ NY Module 6 Lesson 6: *Scatter Plots* ➢ NY Module 6 Lesson 7: *Patterns in Scatter Plots* ➢ LZ Video Lesson: *Construct a scatter plot* ➢ Virtual Nerd Video Lesson: *What's a scatter plot?* ➢ LZ Video Lesson: *Interpret a scatter plot by identifying clusters and outliers* ➢ LZ Video Lesson: *Interpret and distinguish linear and non-linear scatter plots* ➢ LZ Video Lesson: *Describe patterns in scatterplots* ➢ Virtual Nerd Video: *How do you use a scatter plot to find a positive correlation* ➢ Virtual Nerd Video: *How do you use a scatter plot to find a negative correlation* ➢ Virtual Nerd Video Lesson: *How do you use a scatter plot to find no correlation* ➢ LZ Video Lesson: *Compare linear and non-linear functions* ➢ Illustrative Math Task: *Hand span and height* ➢ Illustrative Math Task: *Texting and Grades* ➢ Virginia: *Play a Game to Gather Data to Construct a Scatter Plot*
8.SP.A.2	**Informally identify line of best fit**	➢ MGH 9-2 Inquiry Lab: *Lines of Best Fit* (page 675) ➢ ML 8.6 *Approximating a Best-Fitting Line* (page 421) ➢ EX 9-1 *Scatter Plots* (page 341) ➢ NY Module 6 Lesson 8: *Informally Fitting a Line* ➢ LZ Video Lesson: *Construct a line of best fit* ➢ LZ Video Lesson: *Interpret association in lines of best fit* ➢ LZ Video Lesson: *Determine the type of association in a scatter plot* ➢ LZ Video Lesson: *Draw a line of best fit* ➢ LZ Video Lesson: *Fit a linear function to a scatterplot* ➢ LZ Video Lesson: *Interpret association in lines of best fit* ➢ LZ Video L: *Determine the strength of an association by comparing scatterplots* ➢ LZ Video Lesson: *Use bivariate measurement to make a prediction*
8.SP.A.3	**Find an equation for line of best fit** **Solve problems (make**	➢ MGH 9-2 Lesson 2: *Lines of Best Fit* (pg 677) ➢ EX 9-2 *Linear Best Fit Models* (page 345) ➢ NY Module 6 Lesson 9: *Determining the Equation of a Line Fit to Data* ➢ NY Module 6 Lesson 10: *Linear Models*

	predictions) in context of bivariate measurement data SBAC Evidence: ➢ ….and interprets the slope and *y*-intercept in terms of the context. ➢ The student identifies the slope (rate of change) and intercept (initial value) of a line suggested by examining bivariate measurement data in a scatter plot.	➢ NY Module 6 Lesson 11: *Using Linear Models in a Data Context* ➢ LZ Video Lesson: *Interpret the slope of a line of best fit* ➢ LZ Video Lesson: *Interpret the y-intercept of a line of best fit* ➢ LZ Video Lesson: *Write an equation for line of best fit* ➢ LZ Video Lesson: *Use the equation of a line of best fit to make predictions* ➢ LZ Video: *Interpret scatter plots by calculating rate of change on a graph* ➢ LZ Video Lesson: *Find y-intercept to interpret scatter plots* ➢ LZ Video Lesson: *Calculate y-intercept using slope-intercept equation* ➢ LZ Video Lesson: *Calculate unobserved values using line of best fit equation* ➢ MAP Task: *Bird's Eggs* ➢ MAP Task: *Scatter Diagram* ➢ NCTM Illuminations: *Exploring Linear Data* ➢ Illustrative Math: *US Airports*
8.SP.A.4	**Construct and interpret two-way tables** SBAC Evidence: ➢ The student constructs and interprets a two-way table summarizing data on two categorical variables collected from the same subjects.	➢ MGH 9-3 Lesson 3: *Two-Way Tables* (pg 689) ➢ EX Ext *Patterns in Two-Way Tables* (page 351) ➢ NY Module 6 Lesson 13: *Summarizing Bivariate Categorical Data in a Two-Way Table* ➢ NY Module 6 Lesson 14: *Association Between Categorical Variables* ➢ LZ Video Lesson: *Identify bivariate categorical data by reading a two-way table* ➢ LZ Video Lesson: *Construct a two-way table from a list* ➢ LZ Video Lesson: *Construct a two-way table by interpreting a Venn diagram* ➢ Illustrative Math Task: *Music and Sports* ➢ Illustrative Math Task: *What's Your Favorite Subject?* ➢ MARS Formative Assessment Lesson: *Testing a New Product*