

Unit 5 Scatterplots and Trend Lines

4 Weeks

Algebra I Model Curriculum

Agenda & Presenters

▶ Agenda

- ▶ Unit 5 Overview
- ▶ Investigation and Assessment Exploration
- ▶ Summary and Closing

▶ Presenters

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Unit Content

- ▶ Investigation 1: Univariate Data (3 days)
- ▶ Investigation 2: Introduction to Scatterplots and Trend Lines (2 days)
- ▶ Investigation 3: Technology and Linear Regression (2 days)
- ▶ Investigation 4: Explorations of Data Sets (4 days)
- ▶ Investigation 5: Exploring the Influence of Outliers on Trend Lines (2 days)
- ▶ Investigation 6: Piecewise Functions (3 days)
- ▶ Performance Task: Linearity is in the Air – Can You Find It? (2 days)
- ▶ End-Unit Review and Test (2 days)

What Students Need to Know

- ▶ Measures of central tendencies and spread (IQR, standard deviation, range)
- ▶ Dot plots, histograms, and box plots
- ▶ Scatter plots, trend lines
- ▶ Correlation coefficient
- ▶ Outliers
- ▶ Piecewise functions (Scatter plots with multiple lines of fit)



What Students Need to Be Able to Do

- ▶ Find measures of central tendency (mean, median, and mode) and of dispersion (range and IQR).
- ▶ Create a histogram, dot plot or bar graph.
- ▶ Use a graphing calculator or computer program (such as excel) to find and analyze statistical data (including standard deviation).
- ▶ Create a scatter plot by hand and draw the trend line.
- ▶ Use a graphing calculator to graph a scatter plot, using an appropriate window, and to find a linear regression line.
- ▶ Interpret the correlation coefficient for a linear model.
- ▶ Distinguish between correlation and causation.
- ▶ Understand the effects of outliers.
- ▶ Write the equations for piecewise functions.

Investigation 1: Univariate Data

(3 days)

- ▶ Students define and find measures of central tendency and dispersion. They will create a box and whiskers plot to display the 5-number summary. They will identify outliers.
- ▶ Activities are designed for whole-class, small group, and paired discussions.



Investigation 2: Introduction to Scatterplots and Trend Lines (3 days)

- ▶ Students will create scatterplots and fit trend lines to the data. They will then find the equation of the trend line and use it to interpolate and extrapolate.
- ▶ Activities are designed for whole group and paired discussions.



Investigation 3: Technology and Linear Regression (2 days)

- ▶ Students will compare the equation of the trend line they found by hand calculations with the equation found on the graphing calculator.
- ▶ Students will interpret the meaning of the correlation coefficient and will then explore the difference between correlation and causation.
- ▶ Activities are designed for paired exploration.

Investigation 4: Exploration of Data Sets (4 days)

- ▶ Students will gather/generate data to put in a scatterplot and then fit a regression line to the data. They will then find the equation of the regression line to interpolate and extrapolate.
- ▶ Activities are designed for students to collect or find data and use the knowledge they have from the previous two investigations to make predictions.
- ▶ These activities are for small groups or pairs of students.

Investigation 5: Exploring the Influence of Outliers on Trend Lines (2 days)

- ▶ Students will identify outliers and describe the influence outliers have on the slope, y-intercept and correlation coefficient for a linear regression equation.
- ▶ Students will describe the effect outliers have on the conclusions drawn from an analysis of data that include outliers.
- ▶ Activities are designed for whole group, small group and paired discussions.

Investigation 6: Piecewise Functions

(2 days)

- ▶ Students will write the piecewise function for a given graph and be able to determine the appropriate domain for each section of the graph.
- ▶ Students will create a story that describes the piecewise graph.
- ▶ Activities are designed for independent work.



Performance Task: Linearity is in the Air – Can You Find It? (3 days)

- ▶ Students will choose two variables that interest them and they believe are correlated. (There are 15 model topics that can be provided.)
- ▶ Students will collect data through an experiment/survey or by researching online.
- ▶ Students will then report on their findings in a unique way (poster, blog, animation, PowerPoint, Prezi, or voicethread) that incorporates what they have learned in this unit.

End-Unit Review and Test

(2 days)

- ▶ Students will calculate the measures of central tendency, IQR, and standard deviation. They will also create a box-and-whiskers plot to display the 5-number summary.
- ▶ Students will have a choice to use a graphing calculator or to calculate by hand to determine the equation for the regression line. They will then have to interpolate and extrapolate.
- ▶ Students will write a piecewise function and be able to evaluate for specific data points.
- ▶ Students will interpret the contextual meaning shown in the graph of a piecewise function.



Essential Questions

By the end of this unit, students will be able to answer the following essential questions:

- ▶ How do we make predictions and informed decisions based on current numerical information?
- ▶ What are the advantages and disadvantages of analyzing data by hand versus using technology?
- ▶ What is the potential impact of making a decision from data that contains one or more outliers?



Investigation Exploration

- ▶ Participants will break into four groups. Each group will participate in a couple of the following workshops (20-25 minutes each):
 - ▶ **Workshop 1:** Univariate Data (Investigation 1)
 - ▶ **Workshop 2:** Scatterplots with and without Technology (Investigations 2 & 3)
 - ▶ **Workshop 3:** Outliers (Investigation 5)
 - ▶ **Workshop 4:** Piecewise Functions (Investigation 6)
- ▶ Then participants will regroup, at least one person from each workshop, and discuss the objectives for the activity they completed and their thoughts about it.

Investigation Exploration

- ▶ Investigation 4: Explorations and Data Sets – presentation of the objectives for the 4 days
 - ▶ **Days 1 & 2:** Students follow structured experiments that apply scatterplots to real-world topics
 - ▶ **Day 3:** Students will create the own experiment that involves exercise and heart rate
 - ▶ **Day 4:** Students research data online that relates the population of a state to the number of elected officials
- ▶ Participants will view *Forensic Anthropology* PowerPoint and then complete the Forensics activity

Assessment Plan

Investigation 1: Scatter Plots and Trend Lines

- ▶ **Exit Slip 5.1** has students make a frequency table and a histogram
- ▶ **Exit Slip 5.2** has students find the five number summary and construct a box and whiskers plot.
- ▶ **Journal Entry** asks students to describe the difference between the median number and the mean of a data set and to describe what happens when numbers are added or removed from the set.

Assessment Plan

Investigation 2: Introduction to Scatterplots and Trend Lines

- ▶ **Exit Slip 5.2** asks students to interpret a trend line and identify the strength and direction of the correlation.
- ▶ **Journal Entry** asks students to describe the difference between interpolation and extrapolation, including which they believe to be more accurate and which they believe to be more useful.

Assessment Plan

Investigation 3: Technology and Linear Regression

- ▶ **Exit Slip 5.3** asks students to match graphs with correlation coefficients.
- ▶ **Journal Entry** asks students to write how they determine the difference between correlation and causation and asks students to provide an example of two variables that demonstrate each.

Assessment Plan

Investigation 4: Explorations of Data Sets

- ▶ **Exit Slip 5.4** asks students to reflect on what they have learned so far in this unit.
- ▶ **Journal Entry** asks students to look back and revise one of the last three journal entries they wrote. Suggestions include writing a clearer explanation or drawing a picture to better express current knowledge.

Assessment Plan

Investigation 5: Exploring the Influence of Outliers on Trend Lines

- ▶ **Exit Slip 5.5** asks students to make a prediction from a data set and use their judgment whether to include an outlier.
- ▶ **Journal Entry** asks students to describe how they determine if something is an outlier and suggests the use of examples from class.

Assessment Plan

Investigation 6: Piecewise Functions

- ▶ **Exit Slip 5.6** asks students to find a rule for a piecewise function from its graph.
- ▶ **Journal Entry** asks students to reflect on their participation in class today and respond to some writing prompts. There is an alternative prompt which asks students to describe how confident they feel about their knowledge of piecewise functions.

Common Core Content Standards (priority standards are in bold)

- ▶ **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 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.*
- ▶ **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.**

Common Core Content Standards (priority standards are in bold)

- ▶ **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).**
- ▶ **S-ID 6.** Represent data on two quantitative variables on a scatterplot, 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.**
 - c. Fit a linear function for a scatter plot that suggests a linear association.
- ▶ **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.



Common Core Standards for Mathematical Practice (bold standards to be emphasized)

- ▶ *Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*
- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively
- 3. Construct viable arguments and critique the reasoning 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.

Reflection in informal groups

- ▶ Write down 2 questions you have about today's activities.
- ▶ Turn to the partner on one side of you and take turns asking your first question. See if you can answer each other's questions.
- ▶ Turn to the partner on the other side of you and take turns asking your second question.
- ▶ (This can be done by having students form an inner and an outer circle and having them ask a question of someone on the other circle, then rotating the circle(s). This is called a *fishbowl*.)