



Candies and Caddies

Linear Regression



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Published by K20 Center

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Grade Level	8th – 9th Grade	Time Frame	125 minutes
Subject	Mathematics	Duration	3 class periods
Course	Algebra 1		

Essential Question

How can we find and describe the shape of data?

Summary

In this lesson, students will explore the properties of linear and nonlinear relationships by examining tables, graphs, and descriptions. They will then calculate the linear regression model for a set of data and evaluate the reliability of the model by interpreting the correlation coefficient.

Snapshot

Engage

Students think through potential payment options and select which one they would prefer.

Explore

Students create graphs from given data and use their calculators to find the linear regression equation, assessing for fit.

Explain

Students develop their own meaning of the variables from the linear regression model and use patterns to identify linear and nonlinear trends through guided exploratory notes.

Extend

Students complete two experiments and then analyze their data to find the line of best fit and interpret the correlation coefficient.

Evaluate

Students reflect on their original answers of the potential payment options from the beginning of the lesson and modify or justify as needed.

Standards

ACT College and Career Readiness Standards - Mathematics (6-12)

S506: Recognize that when a statistical model is used, model values typically differ from actual values

Oklahoma Academic Standards Mathematics (Algebra 1)

A1.F.2.1: Distinguish between linear and nonlinear (including exponential) functions. Understand that linear functions grow by equal intervals (arithmetic) and that exponential functions grow by equal factors over equal intervals (geometric).

A1.D.1.3: Make predictions based upon the linear regression, and use the correlation coefficient to assess the reliability of those predictions using graphing technology.

Attachments

- [Calculator Guide—Candies and Caddies - Spanish.pdf](#)
- [Calculator Guide—Candies and Caddies.pdf](#)
- [Data Exploration—Candies and Caddies - Spanish.docx](#)
- [Data Exploration—Candies and Caddies - Spanish.pdf](#)
- [Data Exploration—Candies and Caddies.docx](#)
- [Data Exploration—Candies and Caddies.pdf](#)
- [Experimental Drop—Candies and Caddies - Spanish.docx](#)
- [Experimental Drop—Candies and Caddies - Spanish.pdf](#)
- [Experimental Drop—Candies and Caddies.docx](#)
- [Experimental Drop—Candies and Caddies.pdf](#)
- [Guided Notes Correlation Coefficient \(Model Notes\)—Candies and Caddies.docx](#)
- [Guided Notes Correlation Coefficient \(Model Notes\)—Candies and Caddies.pdf](#)
- [Guided Notes Correlation Coefficient—Candies and Caddies - Spanish.docx](#)
- [Guided Notes Correlation Coefficient—Candies and Caddies - Spanish.pdf](#)
- [Guided Notes Correlation Coefficient—Candies and Caddies.docx](#)
- [Guided Notes Correlation Coefficient—Candies and Caddies.pdf](#)
- [Guided Notes Trends \(Model Notes\)—Candies and Caddies.docx](#)
- [Guided Notes Trends \(Model Notes\)—Candies and Caddies.pdf](#)
- [Guided Notes Trends—Candies and Caddies - Spanish.docx](#)
- [Guided Notes Trends—Candies and Caddies - Spanish.pdf](#)
- [Guided Notes Trends—Candies and Caddies.docx](#)
- [Guided Notes Trends—Candies and Caddies.pdf](#)
- [Lesson Slides—Candies and Caddies.pptx](#)
- [Pay Day—Candies and Caddies - Spanish.docx](#)
- [Pay Day—Candies and Caddies - Spanish.pdf](#)
- [Pay Day—Candies and Caddies.docx](#)
- [Pay Day—Candies and Caddies.pdf](#)

Materials

- Lesson Slides (attached)
- Pay Day handout (attached; one-half page per student; print one-sided)
- Data Exploration handout (attached; one per student; print two-sided)
- Calculator Guide handout (attached; one per student; print one-sided)
- Guided Notes Correlation Coefficient handout (attached; for half the class; print two-sided)
- Guided Notes Correlation Coefficient (Model Notes) document (attached)
- Guided Notes Trends handout (attached; for the other half of class; print two-sided)
- Guided Notes Trends (Model Notes) document (attached)
- Experimental Drop handout (attached; one per student; print two-sided)

- Meter sticks (one per group)
- Golf balls (one per group)
- Candy (ten pieces per group)
- TI-84 Plus CE graphing calculator (one per student)
- Desmos Studio calculator or other graphing calculator (optional)

5 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Briefly introduce the essential question on **slide 3**. Move to **slide 4** to identify the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Teacher's Note: Guiding the Activity

During this phase of the lesson, students are given a scenario (below) where they are asked to select between two payment options. Do not share which payment option yields the best return. At this point in the lesson, you want to see what students think. After the lesson, students will use their new knowledge to develop a more informed decision.

Introduce the class to the [Preflections](#) strategy. Give each student a half-page of the attached **Pay Day** handout and display **slide 5**. Read the prompt from their handout aloud as they follow along:

"You got a new short-term job! Your employer gives you two options for how you will receive payment. In the first option, you will receive \$10,000 every day for a month (30 days). With the second option, you will receive \$0.01 on the first day, but each day, the amount will double (the first five days you would get \$0.01, \$0.02, \$0.04, \$0.08, \$0.16)."

Have students circle the payment option they would prefer in the Preflection section of the table on their handout and then write their reasoning.

Once students are done, collect these responses with the plan to redistribute them during the Evaluate phase of this lesson.

35 minutes

Explore

Graphing Calculator Options:

During this phase of the lesson, students will use a graphing calculator to find the linear regression model for the given set of data. The attached **Calculator Guide** provides directions for the TI-84 Plus CE graphing calculator. If your students are using a different calculator, be sure to provide the steps for how to use that specific calculator.

If your students do not have a graphing calculator, consider using the [Desmos Studio](#) graphing calculator.

Have students get into groups of 2–3. Distribute the attached **Data Exploration** and **Calculator Guide** handouts to each student. Instruct students to get a graphing calculator. The guide will walk students through the steps of how to find the line of best fit using the linear regression functionality of their calculator.

Display **slide 6** and preview the activity. Explain to students that for each of the two given data sets, they need to:

- Plot the given data on their handout.
- Input the data into their graphing calculator.
- Use their calculator to find the line of best fit.
- Use that information to sketch the line of best fit on their handout.

Remind students that even though they are working in small groups, they are required to independently record their work and reasoning. Give students approximately 20–25 minutes to complete this task for the two datasets. Use the hidden **slide 7** to check a , b , and r -values for the given datasets.

Teacher's Note: Guiding the Activity

As students work, intervene as little as possible. This is the Explore phase, so there will be time later in the lesson to resolve any misconceptions.

Have students return to their seats and display **slide 8**. Facilitate a discussion using the questions on the slide:

- What trends did you notice in the data?
- Do you think the linear equation you found was an accurate representation of the data?
- What do you think the r -value is for?
- What might explain the relationship between:
 - income and obesity?
 - days and zombies?

Sample Student Responses:

- I noticed that in one of the sets, the data made a straight line but in the other, it didn't.
- For the first one I think a linear equation was good, but not for the second one.
- The r -value might explain how straight of a line the points are in.
- Answers will vary for these, the point is to extend student thinking and knowledge application beyond the classroom.
 - Ex: As income increases, obesity decreases. This might be because people with more money can buy healthier food and gym memberships. As days increased, the number of zombies in town also increased. This makes sense because zombies make more zombies, so as time goes on, there will be a lot more zombies.

40 minutes

Explain

Teacher's Note: Activity Preparation

During the following activity, half of the students will be using the attached **Guided Notes Correlation Coefficient** handout, the other half will be using the attached **Guided Notes Trends** handout. The information on the first page of these files is the biggest difference, while the information on the second page of these files is the same, just in a different sequence.

Students with the Guided Notes Correlation Coefficient handout are comparing a table of data, a scatter plot, and the linear regression results from a graphing calculator and then formalizing their findings. Students with the Guided Notes Trends handout are finding a pattern in the change in y -values from the given tables, and then formalizing their findings.

Distribute a copy of the **Guided Notes Correlation Coefficient** handout to half of the students and a copy of the **Guided Notes Trends** handout to the other half of the students. Display **slide 9** and have students with the same handout form small groups of 2–3 to work on the handout together. Introduce the [jigsaw](#) strategy to the students and explain that they are responsible for learning the information on the front side of their handout and will need to explain it to a classmate who has a different handout. Emphasize that all students within each small group need to work together to make sure their partners understand all of the information, as they are each expected to be able to individually explain what they learned.

Students with the Guided Notes Correlation Coefficient handout will be comparing tables, scatter plots, and linear regression models to determine the significance of the variables from the given linear regression model results, including the correlation coefficient, r . When groups have completed the directions and recorded their observations on the front of the handout, they should formalize their findings by filling out the top four bullet points on the back of their handout.

Students with the Guided Notes Trends handout will be analyzing the rates of change from tables of data, where some of the data form a linear trend and some of the data is nonlinear (specifically, exponential). When groups have completed the directions and recorded their observations on the front of the handout, they should formalize their findings by filling out the top four bullet points on the back of their handout.

Give students approximately 15 minutes to observe and formalize their observations, and then move to **slide 10**. Ask students to form groups of 3–4. Each group should contain students who worked on both the Guided Notes Correlation Coefficient handout and the Guided Notes Trends handout. Give groups around 15 minutes to explain their findings to each other. Emphasize to students the importance of explaining what they learned and helping their peers understand the reasoning behind the conclusions they drew, rather than allowing their peers to simply copy their notes.

Teacher's Note: Guiding the Activity

Students may be tempted to simply allow their groupmates to copy the answers onto their own paper. Preempt this by explaining to students that when they teach and help their partners, they are helping their peers (and themselves) better understand the ideas and answering questions. Copying, while it may be quicker, keeps groupmates from learning and growing.

After groups have had a chance to share and learn from each other, come together as a whole class. Transition through **slides 11–12** and summarize the information, ensuring students understand the meaning of the variables in the linear regression model and how to determine the difference between the change in linear and exponential data.

Transition through **slides 13–19** and have the students work through the example problem at the bottom of the handout. Depending on your students' needs and level of understanding, this may be completed through a whole class discussion, small group work, or individually.

35 minutes

Extend

Give each student a copy of the attached **Experimental Drop** handout. All students will be doing both experiments, but half will complete the Ball Drop experiment first, while the other half completes the Candy drop experiment first. Have students find a partner or assign partners. Then direct half of the pairs to begin the Ball Drop experiment and the other half to begin the Candy drop experiment. Display **slide 20**. Have students gather their materials:

- For the Ball Drop experiment, each pair will need a meter stick, a golf ball, and a calculator.
- For the Candy Drop experiment, each pair will need 20 pieces of candy and a calculator.

Give the students around 10 minutes to complete the experiment, record their results on their handout, and answer the questions. Here, students are asked to use their calculator to find the linear regression model and then identify and interpret the correlation coefficient.

Sample Student Response:

The line of best fit for the Ball Drop data was a fairly good fit for the data, while the line of best fit for the Candy Drop data was not very good. I don't think the candy experiment data was linear.

Move to **slide 21** and have pairs now conduct the other experiment.

After another 10 minutes, bring the class together and lead a discussion about their findings. Consider using the questions on **slide 22** as talking points:

- Which data was linear?
- Which data was nonlinear?
- Did anyone get an r -value of 1 for their regression models?
- Why do you think different groups got different results?

10 minutes

Evaluate

Return each student's **Pay Day** handout from the Engage phase of the lesson and display **slide 23**. Ask students to reflect on what they learned during the lesson and use their knowledge to evaluate their original payment choice. Have students indicate their payment option preference on their handout, and if their mind changed (from the beginning of the lesson), have students write what made them change their mind.

Optional Activity:

As an optional extension activity, ask students to calculate how much money they would receive on each payment option. Then ask them to predict how much money they would receive in a 31-day month.

Resources

- K20 Center. (n.d.). Desmos Studio. Tech Tools. <https://learn.k20center.ou.edu/tech-tool/2356>
- K20 Center. (n.d.). Jigsaw. Strategies. <https://learn.k20center.ou.edu/strategy/179>
- K20 Center. (n.d.). Preflections. Strategies. <https://learn.k20center.ou.edu/strategy/191>