

- **Pathway:** Agribusiness
- **Lesson:** ABR C1–8: Property Value and Appraisal
- **Common Core State Standards for Mathematics:** 9-12.S-ID.6, 7
 - Domain:** Interpreting Categorical and Quantitative Data S-ID
 - Cluster:** Summarize, represent, and interpret data on two categorical and quantitative variables.
 - Standard:** 6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
 - Standard:** 6c. Fit a linear function for a scatter plot that suggests a linear association.
 - Standard:** 7. Interpret the slope (rate of change) and intercept (constant term) of a linear model in the context of the data.
- **Student Objective:** Students will create scatter plots of property value data and use a line of best fit to estimate land value.

BACKGROUND KNOWLEDGE for Teachers and Students

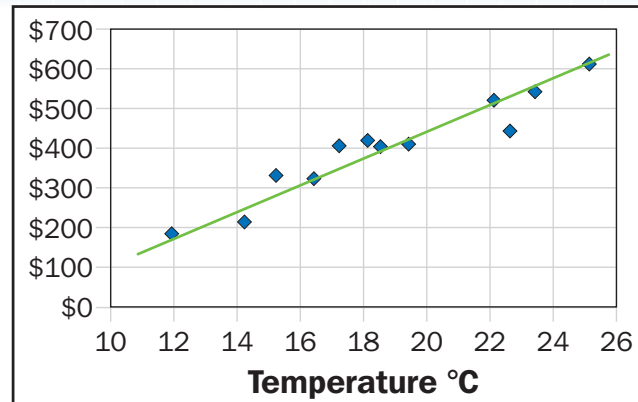
➤ **Math Concepts:**

Data representing two related quantities can be written as ordered pairs and graphed as points on a graph. When the data points are graphed on a coordinate plane, the result is called a *scatter plot*. Once the data is graphed, it is helpful to determine if there is a trend in the data. If the points appear to be in a linear pattern, we can draw a *line of fit* to represent the trend in the data. The exact placement of the best-fit line can be calculated, but for this activity it will suffice to estimate the placement of the line of fit.

Example: The points on this scatter plot represent temperatures (in Celsius) and the corresponding amount of ice cream sales at a local shop (in dollars). The line of fit has been drawn to represent the trend in the data.

The full example can be found here:

<http://www.mathsisfun.com/data/scatter-xy-plots.html>



One important point on the line of fit is the y-intercept. The y-intercept of a line is where the line crosses the y-axis (vertical axis). The x-coordinate of this point is always zero.

This video from Virtual Nerd shows how to draw a line of fit on a scatter plot:

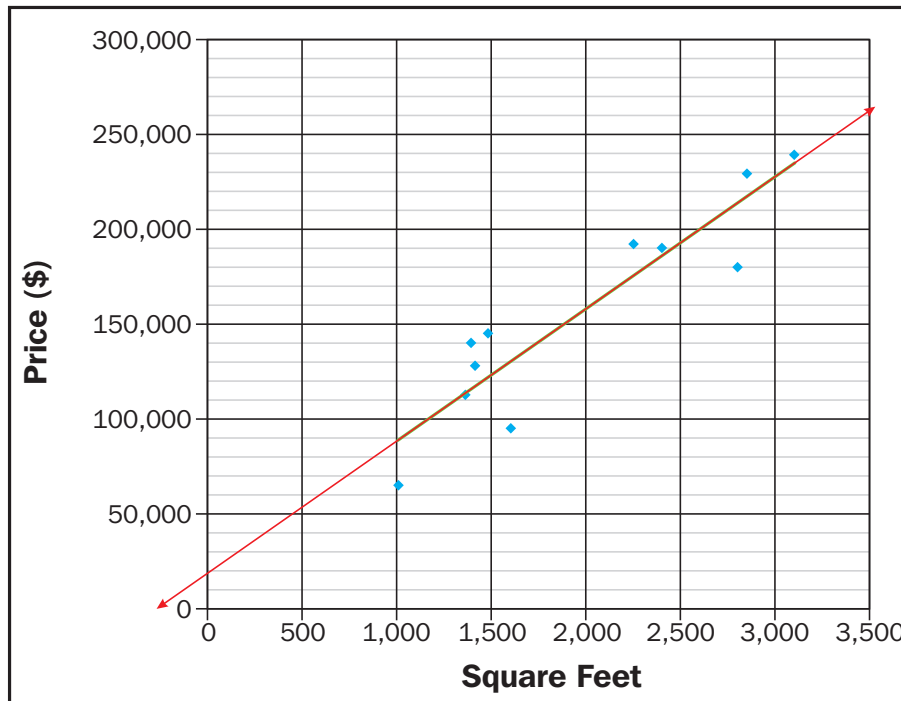
<http://www.virtualnerd.com/algebra-2/linear-equations-functions/line-of-fit-scatter-plot.php>

➤ **Agriculture Concepts:**

The value of agricultural land is largely based on the cash flow generated by the use of the land for growing crops or raising livestock. Farmland values tend to increase over time because of inflation. Appraisers determine the value of agricultural land by comparing the property to nearby property that has sold recently, calculating the value based on discounted cash flows, or by considering the highest and best use for the property by assessing the land for a use other than agriculture.

Guided Practice Exercises: ANSWER KEY

1. (The line is not drawn until question 3.)



2. As the square footage increases, the price increases. (This is called a *positive correlation*.) The points seem to be in a linear pattern.
3. See graph above.
4. Student estimations may vary. The exact y-intercept is \$19,332.
5. The y-intercept corresponds to the point on the graph (0, 19,332). This means when the square footage is 0, the price is \$19,332. Zero square feet would indicate there is no home built on the land, so the land itself is worth \$19,332. (The average lot size for the data was 1 acre, so this is a value of \$19,332 per acre.)
6. Residential land
7. a. Student answers may vary. Sample answer:
The total value as agricultural land is $\$7,800 \times 40 = \$312,000$.
The total value as residential land is $\$19,332 \times 40 = \$773,280$.
Jason can get more money selling the land to the developer than it is worth as agricultural land.

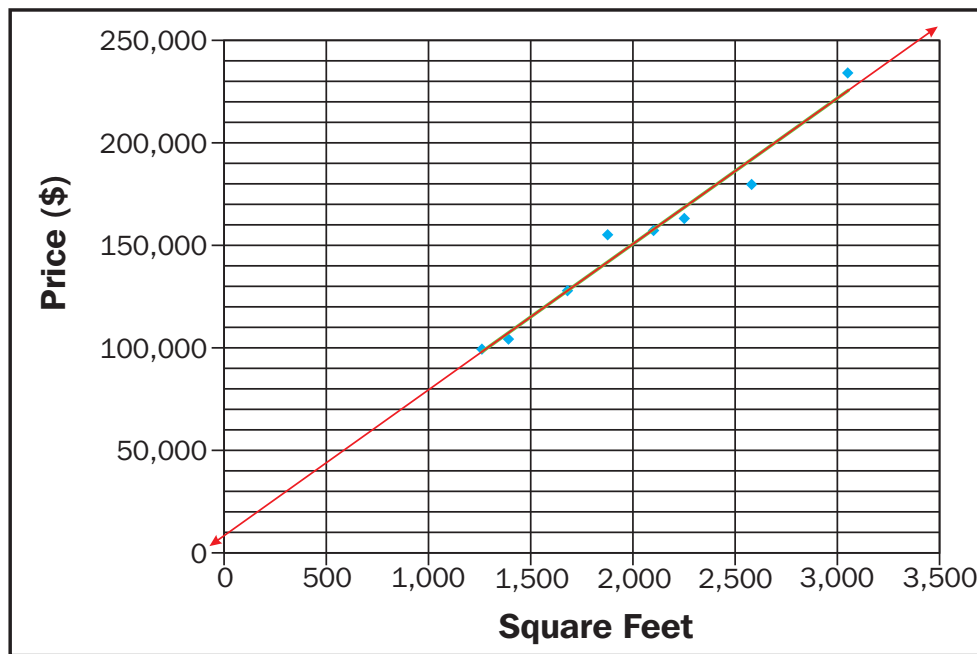
b. Student answers may vary. Sample answer:

Small communities often want to protect and preserve their agricultural land for agricultural purposes. Although Jason could make a lot of money by selling the land to the developer, he may choose to continue farming the land to support local agricultural pursuits.

8. Answers will vary.

Independent Practice Exercises: ANSWER KEY

1. (The line is not drawn until question 5.)



2. The points fall in a linear pattern. As the square footage increases, the price increases, so it is a positive correlation.

3.

Square Feet	Price	Value of house	Value of land
1,875	\$154,900	$1,875 \times \$71 =$ \$133,125	$\$154,900 - \$133,125$ = \$21,775
2,250	\$162,900	\$159,750	\$3,150
1,260	\$99,000	\$89,460	\$9,540
1,390	\$103,900	\$98,690	\$5,210
2,580	\$179,500	\$183,180	-\$3,680*
3,050	\$234,000	\$216,550	\$17,450
2,100	\$157,000	\$149,100	\$7,900
1,680	\$127,500	\$119,280	\$8,220

*The negative land value for the fifth home must indicate that this home's value is less than the \$71 average we are using. To get a true average of land value, we should still use this negative value along with the others to get our approximation in question 4.

4. $21,775 + 3,150 + 9,540 + 5,210 + -3,680 + 17,450 + 7,900 + 8,220 = 69,565$

$69,565/8 = \$8,695.63$ per 1-acre lot

5. The line drawn should cross the y-axis (vertical axis) around \$8,695. Yes, this estimate seems reasonable, because we can draw a line of fit with this y-intercept that also closely models the points on the graph.
6. Agricultural land—the monetary value is higher (\$11,200 per acre compared to \$8,695 per acre). Also, the fertile farmland surrounding Redwood is part of the identity of the community, and the use of the land for farming would be valued by the community.
7. Student answers may vary.

Guided Practice Exercises:

Jason owns and farms 40 acres of farmland on the edge of Oakville, a small rural community. He estimates the value of his farmland to be \$7,800 per acre, based on the amount of crops he can produce on the land. However, Oakville is a growing community, and a developer is interested in purchasing the 40-acre section of land to build a new subdivision. Before making a decision, Jason wants to determine the value of the land if it were used for residential purposes. This will help Jason decide whether to sell the land and, if he does, help him negotiate a fair price with the developer.

To estimate the value of residential land in Oakville, Jason gathers data from 11 homes that have sold recently in the area. He knows that the price of a home is a function of the size of the home (in square feet) as well as the size of the lot it is on. The data he gathered is below. The average lot size for these homes was 1 acre.

Square Feet	Price
2,250	\$192,000
1,360	\$112,500
1,600	\$94,900
1,390	\$139,900
2,800	\$179,900
1,412	\$127,900
2,850	\$229,000
3,100	\$239,000
2,400	\$189,900
1,480	\$144,900
1,006	\$65,000

1. Create a scatter plot of the data with square feet on the x-axis and price on the y-axis.

2. Describe the relationship between the square footage of the home and the price of the home.

3. Draw a line of fit on your scatter plot to model the trend in the data.
4. Extend your line so that it crosses the y-axis. Estimate the y-intercept of the line of fit. Label this value with correct units.

Independent Practice Exercises:

The farmland surrounding the town of Redwood is well known for producing high yields. Kevin owns and farms 40 acres of this fertile farmland near the edge of town, and based on the yields he can produce on this section of land, he estimates it to be worth about \$11,200 per acre. A developer is looking to purchase land near Redwood to build a new subdivision and approaches Kevin about purchasing this 40-acre section.

Kevin wants to know the value of residential land in Redwood, so he gathers data on eight homes that have sold recently. The average lot size for these homes was 1 acre.

Square Feet	Price
1,875	\$154,900
2,250	\$162,900
1,260	\$99,000
1,390	\$103,900
2,580	\$179,500
3,050	\$234,000
2,100	\$157,000
1,680	\$127,500

1. Draw a scatter plot of the data Kevin gathered. Put square feet on the x-axis and price on the y-axis.

2. Describe the relationship between square feet and price. Does the data appear to be in a linear pattern?

3. Before estimating where the line of fit should be placed, Kevin decides to calculate an approximate value of the land. He does some research and finds that homes in his area can be built for about \$71 per square foot. Use this information to complete the table below, which shows how much of the cost for each home is for the house itself and how much is for the land.

Square Feet	Price	Value of House	Value of Land
1,875	\$154,900		
2,250	\$162,900		
1,260	\$99,000		
1,390	\$103,900		
2,580	\$179,500		
3,050	\$234,000		
2,100	\$157,000		
1,680	\$127,500		

4. Average the land values to obtain an approximate value for 1 acre of residential land. (To find the average, add the numbers and divide by 8.)

