LESSON MAKER PRO

Patterns That Predict

Use graphing technology to fit models and test predictions.

HIGH SCHOOL · MM.D3D.B.15

MM.D3D.B.15 "Use regression with statistical graphing technology to determine an equation that best fits a set of bivariate data, including nonlinear patterns. a. Create a scatter plot with a sufficient number of data points to predict a pattern. b..."

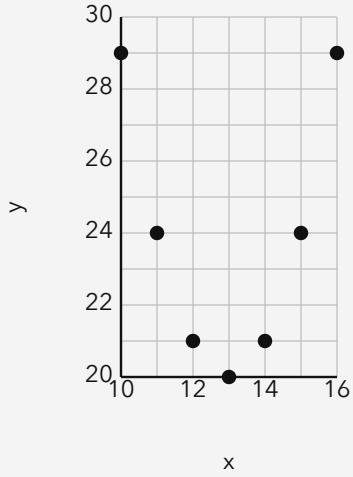
NAME _____ DATE _____

CHOOSE A MODEL

Use a graphing calculator or app with regression tools. Enter the data, create a scatter plot, and fit linear and quadratic models. Compare their residual sums of squares (RSS) and plotted shapes. Predict from a suitable model, but question extrapolation beyond the data.

WORKED EXAMPLE

Use the scatter plot and the technology results to choose a model and predict y when x = 17. Linear regression: y = 24, RSS = 84. Quadratic regression: $y = (x - 13)^2 + 20$, RSS = 0.

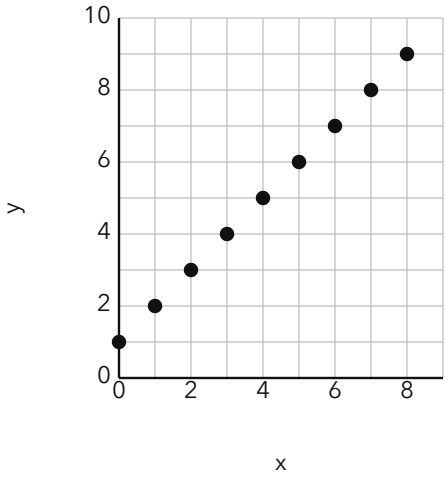


1. The points curve downward and then upward, so a quadratic model follows their shape.
2. The quadratic model also has the smaller RSS: 0 instead of 84.
3. Substitute 17: $y = (17 - 13)^2 + 20 = 36$.

Answer: Choose $y = (x - 13)^2 + 20$. The predicted value is 36.

PRACTICE Problems 1–2

1 Enter the plotted data in graphing technology and create a scatter plot. Perform linear regression; report the equation and RSS. Describe the relationship and predict y at x = 9.

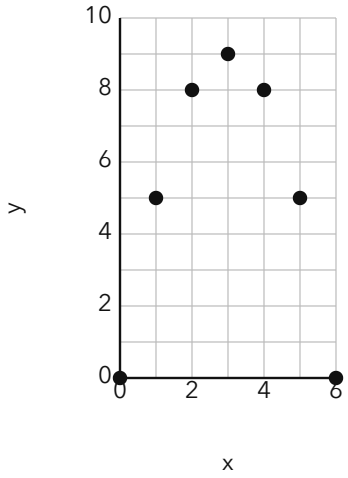


ANSWER _____

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2 Enter the plotted data in graphing technology. Fit linear and quadratic regressions; report both equations and RSS values. Which model follows the shape better, and where is its maximum?



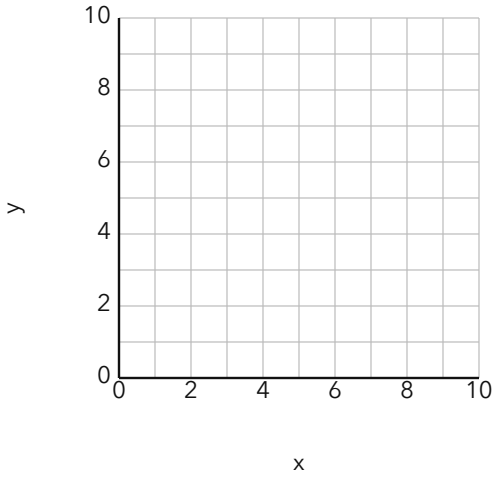
ANSWER _____

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PRACTICE Problems 3–4

3 Enter (0,10), (1,9), (2,8), (3,7), (4,6), (5,5), (6,4), (7,3), (8,2), (9,1) in graphing technology. Create a scatter plot and fit a linear regression. Sketch the plot here, report the equation and RSS, and predict y at x = 10.

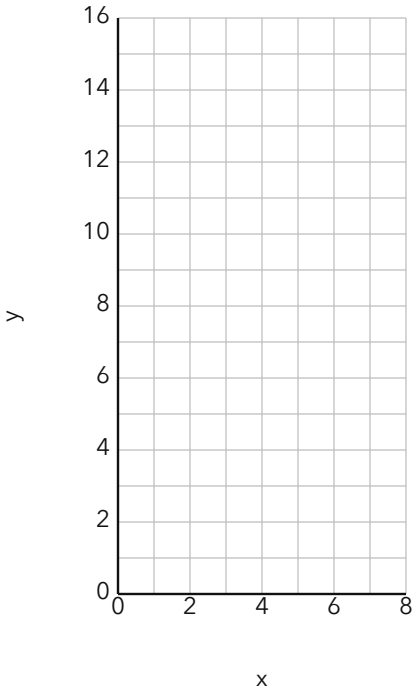


ANSWER _____

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4 Enter (0,9), (1,4), (2,1), (3,0), (4,1), (5,4), (6,9), (7,16) in graphing technology. Create and sketch a scatter plot. Fit a quadratic regression; report its equation, minimum, and predicted y at x = 8.



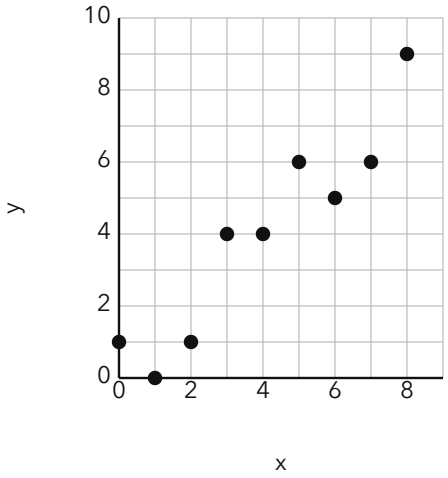
ANSWER _____

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PRACTICE Problems 5–6

5 Enter the plotted data in graphing technology and fit a linear regression. Report the equation and RSS, then predict y at x = 9. Explain why that prediction is uncertain.

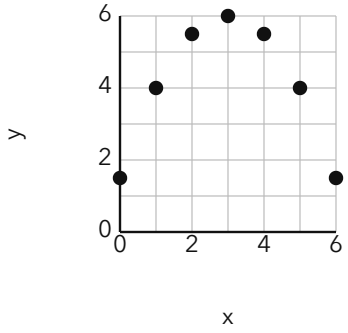


ANSWER _____

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6 Enter the plotted data in graphing technology. Fit linear and quadratic regressions and compare their equations and RSS values. Choose the model that follows the shape and predict y at x = 5.



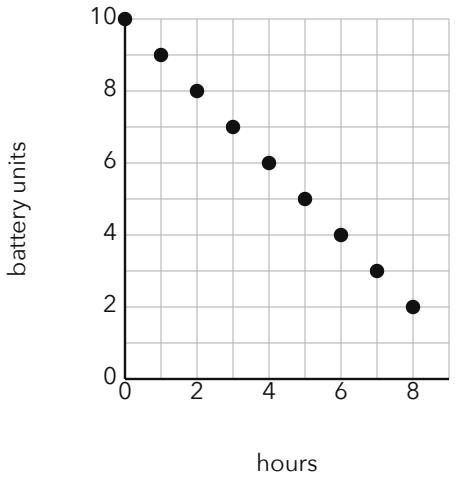
ANSWER _____

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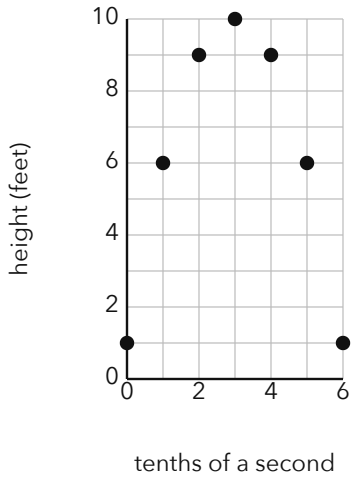
APPLY IT Show your work

1 A student tracks a phone's battery after x hours. Each y unit on the plot represents 10% battery. The technology reports linear regression y = 10 - x with RSS = 0. Predict the battery percentage after 9 hours, and describe the pattern of change.



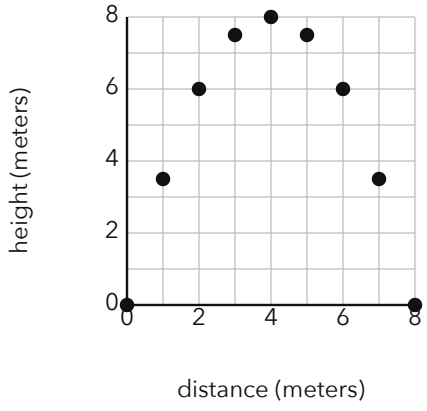
ANSWER _____

2 A soccer ball's height y, in feet, is measured x tenths of a second after it is kicked. The technology reports quadratic regression y = 10 - $(x - 3)^2$ with RSS = 0. Predict its height after 0.4 second, and state its greatest height and when it occurs.



ANSWER _____

CHALLENGE One step up



The plot shows a skate ramp's height y, in meters, at horizontal distance x, in meters. Technology results are linear regression y = 14/3, RSS = 77, and quadratic regression y = 8 - $(x - 4)^2/2$, RSS = 0. Choose the better model. What does it predict at x = 9, and why should you reject that prediction as a height above the ground?

WORK SPACE AND ANSWER

Patterns That Predict

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Enter the plotted data in graphing technology and create a scatter plot. Perform linear regression; report the equation and RSS. Describe the relationship and predict y at x = 9.	**y = x + 1, RSS = 0. The relationship is increasing and linear; predicted y = 10 at x = 9.**
2	Enter the plotted data in graphing technology. Fit linear and quadratic regressions; report both equations and RSS values. Which model follows the shape better, and where is its maximum?	**Linear: y = 5, RSS = 84. Quadratic: y = 9 - (x - 3)², RSS = 0. The quadratic follows the curve and has maximum y = 9 at x = 3.**
3	Enter (0,10), (1,9), (2,8), (3,7), (4,6), (5,5), (6,4), (7,3), (8,2), (9,1) in graphing technology. Create a scatter plot and fit a linear regression. Sketch the plot here, report the equation and RSS, and predict y at x = 10.	**y = 10 - x, RSS = 0. The plot decreases linearly through the supplied points; predicted y = 0 at x = 10.**
4	Enter (0,9), (1,4), (2,1), (3,0), (4,1), (5,4), (6,9), (7,16) in graphing technology. Create and sketch a scatter plot. Fit a quadratic regression; report its equation, minimum, and predicted y at x = 8.	**y = (x - 3)², equivalent to y = x² - 6x + 9. The plot has minimum 0 at x = 3; predicted y = 25 at x = 8.**
5	Enter the plotted data in graphing technology and fit a linear regression. Report the equation and RSS, then predict y at x = 9. Explain why that prediction is uncertain.	**y = x, RSS = 8; predicted y = 9. The points vary around the line, and x = 9 lies beyond the observed range, so the prediction is uncertain.**
6	Enter the plotted data in graphing technology. Fit linear and quadratic regressions and compare their equations and RSS values. Choose the model that follows the shape and predict y at x = 5.	**Linear: y = 4, RSS = 21. Quadratic: y = 6 - (x - 3)²/2, RSS = 0. Choose the quadratic; predicted y = 4 at x = 5.**

PART 2 · APPLY IT

1. **10% battery; the battery decreases linearly.** At x = 9, the model gives y = 1 battery unit, or 10%. The line drops by one unit each hour.
2. **After 0.4 second, the predicted height is 9 feet. The greatest height is 10 feet at 0.3 second.** Because x counts tenths of a second, substitute x = 4 to get 9. The quadratic reaches its maximum of 10 at x = 3.

CHALLENGE

Choose y = 8 - (x - 4)²/2. At x = 9, it predicts -4.5 meters. Reject this extrapolation because a height above the ground cannot be negative.

Required materials: graphing calculator or regression app. Students must enter data, create scatter plots, and run regressions themselves. Accept equivalent expanded equations and rounding near zero RSS. RSS is the sum of squared vertical residuals, not R^2; software may label it SSE. Exact synthetic patterns do not guarantee real-world predictions.