LESSON MAKER PRO

Data, Models, and Reliability

Collect data, fit models, and judge predictions with technology.

HIGH SCHOOL · A2.D.1

A2.D.1 "Display, describe, and compare data. For linear and nonlinear relationships, make predictions and assess the reliability of those predictions..."

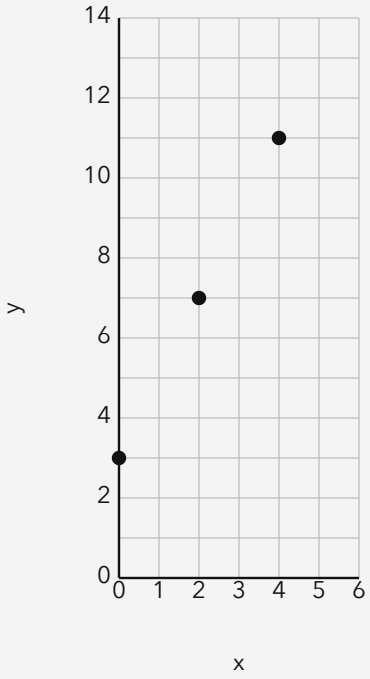
NAME _____ **DATE** _____

CHOOSE AND CHECK A MODEL

Use graphing technology to display data, calculate statistics, and fit linear, quadratic or exponential models. Check the scatter plot before choosing a model. The correlation coefficient r describes linear association, not causation; a large absolute r does not guarantee an extrapolation. Normal models use a mean and standard deviation.

WORKED EXAMPLE

Use the plotted points to write a linear model. Then predict y when x = 3.



1. From (0, 3) to (2, 7), m = (7 - 3)/(2 - 0) = 2.
2. At x = 0, y = 3, so b = 3.
3. The model is y = 2x + 3.
4. When x = 3, y = 2(3) + 3 = 9.

Answer: y = 2x + 3; predicted y = 9

PRACTICE Problems 1–2

1 Treat these eight values as the whole population. Use technology to find the mean and population standard deviation; explain what each describes.

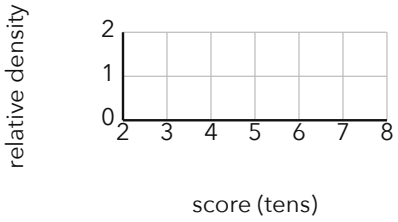
POPULATION VALUES

Observation	Value
1	2
2	4
3	4
4	4
5	5
6	5
7	7
8	9

ANSWER _____

_____

2 A normal model has mean 50 and standard deviation 10. Sketch its bell curve, label the mean and one, two and three standard deviations on each side. About what percent lies from 40 to 60?



ANSWER _____

_____

PRACTICE Problems 3–4

3 Use technology to create a scatter plot and fit a linear regression. Report its equation and r to three decimals. Predict y at x = 6, and explain why this prediction needs caution.

MEASURED PAIRS

x	y
0	1
1	2
2	2
3	4
4	5

ANSWER _____

_____

_____

4 Use technology to scatter-plot these synthetic pairs and fit linear and quadratic models. Which follows the pattern? Report that equation and predict y at x=5. Explain why perfect fit here does not guarantee future data.

SYNTHETIC PAIRS

x	y
0	1
1	2
2	5
3	10
4	17

ANSWER _____

_____

_____

PRACTICE Problems 5–6

5 Use technology to scatter-plot these synthetic pairs and fit an exponential regression. Report its equation and predict y at x=5. Describe the repeated multiplicative change.

SYNTHETIC GROWTH

x	y
0	2
1	4
2	8
3	16
4	32

ANSWER _____

6 Measure length and width in centimeters of six leaves of varied lengths. Record pairs here. Use technology to scatter-plot, fit a linear regression, and report r. Explain a risk in predicting for a much longer leaf. If all lengths match, collect varied lengths; if widths are constant, report r undefined.

ANSWER _____

APPLY IT Show your work

1 Two hypothetical studies relate practice time to scores. Study A reports r=0.95, Study B r=0.35. Both observed 1–5 hours. Which has stronger linear association? Does either result prove practice caused the scores or justify a prediction at 20 hours?

WORK SPACE

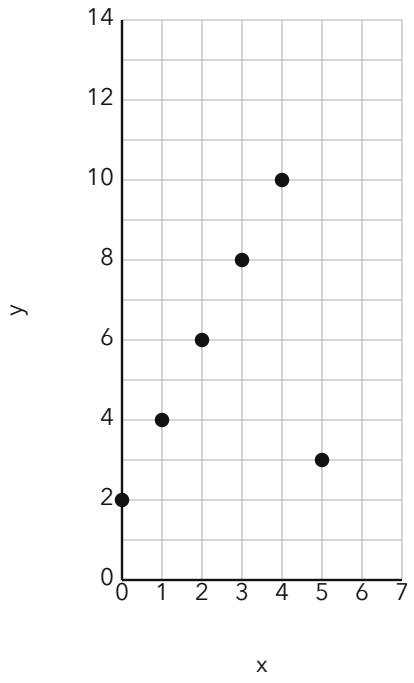
ANSWER _____

2 A normal model for a score has mean 100 and standard deviation 15. About what percent falls from 85 to 115? Give an interval containing about 95% under this model.

WORK SPACE

ANSWER _____

CHALLENGE One step up



Use technology to fit a linear regression to all six points and report r. Compare it with the fit after omitting (5,3); predict y at x=6 with both. Explain why deleting that point merely to improve r is unjustified.

WORK SPACE AND ANSWER

Data, Models, and Reliability

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Treat these eight values as the whole population. Use technology to find the mean and population standard deviation; explain what each describes.	**Mean = 5; population standard deviation = 2. The mean gives the center, and the standard deviation measures spread around it. Population variance is 4.**
2	A normal model has mean 50 and standard deviation 10. Sketch its bell curve, label the mean and one, two and three standard deviations on each side. About what percent lies from 40 to 60?	**Symmetric bell centered at 50, with labels 20,30,40,50,60,70,80. About 68% lies between 40 and 60. Vertical height is schematic.**
3	Use technology to create a scatter plot and fit a linear regression. Report its equation and r to three decimals. Predict y at x = 6, and explain why this prediction needs caution.	**y = x + 0.8; r ≈ 0.962; predicted y = 6.8. The linear association is strong, but x=6 is outside the observed 0–4 range and the points do not fit exactly.**
4	Use technology to scatter-plot these synthetic pairs and fit linear and quadratic models. Which follows the pattern? Report that equation and predict y at x=5. Explain why perfect fit here does not guarantee future data.	**The quadratic $y=x^2+1$ follows the curve exactly and predicts 26. A perfect fit to these constructed points does not establish that new observations will follow it.**
5	Use technology to scatter-plot these synthetic pairs and fit an exponential regression. Report its equation and predict y at x=5. Describe the repeated multiplicative change.	**$y=2(2^x)$, so predicted y=64. Each increase of one in x doubles y.**
6	Measure length and width in centimeters of six leaves of varied lengths. Record pairs here. Use technology to scatter-plot, fit a linear regression, and report r. Explain a risk in predicting for a much longer leaf. If all lengths match, collect varied lengths; if widths are constant, report r undefined.	**Answers vary. Check six measured pairs with varied lengths, a labeled scatter plot, a regression equation and r computed from the pairs. If widths are constant, r is undefined, not zero. Interpretation must match the data; species differences, scatter or extrapolation may weaken predictions.**

PART 2 · APPLY IT

1. **A has stronger linear association. Neither correlation alone proves causation, and both 20-hour predictions extrapolate far beyond observed data.** Compare absolute r values, then distinguish association from causation and interpolation from extrapolation.
2. **About 68% from 85 to 115; about 95% from 70 to 130.** The first interval is mean ±1 standard deviation; the second is mean ±2 standard deviations, using the empirical rule for a normal model.

CHALLENGE

All six: y≈0.714x+3.714, r≈0.434, predicted y≈8. Without (5,3): y=2x+2, r=1, predicted y=14. Investigate the observation and its context; a poor fit alone is not evidence that valid data should be discarded.

Materials: graphing calculator or regression app, ruler and six leaves. Use population standard deviation in item 1; distinguish it from sample standard deviation. Check actual student data and technology output in item 6. Normal-model percentages use the approximate 68–95–99.7 rule. r measures linear association; examine the plot for nonlinear patterns.