Name ______________________________ Date ________

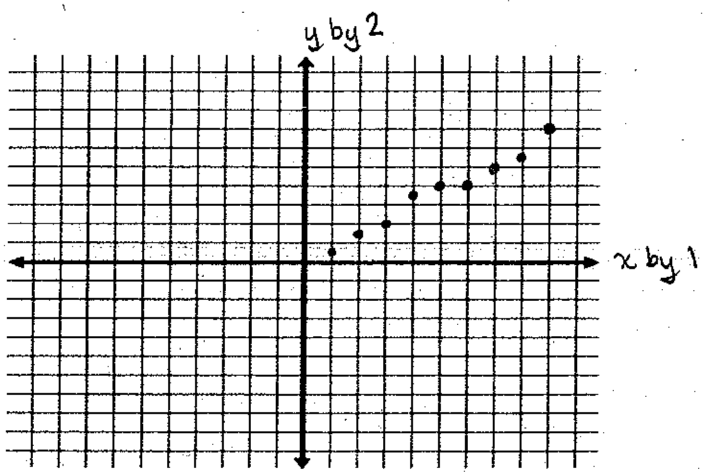
4.5 Practice

In Exercises 1, use residuals to determine whether the model is a good fit for the data in the table. Explain.

1. $y = -4x + 27$

$-12+27=15$
$-16+27=11$

	x	1	2	3	4	5	6	7	8	9
data	y	24	22	19	18	15	11	9	6	5
model	y	23	19	15	11	7	3	-1	-5	-9
residuals		1	3	4	7	8	8	10	11	14



The model is not a good fit for the data. The residuals are large and increase as x increases. So there is a pattern to the residuals and they are not evenly distributed about the x-axis. This indicates that a linear model is a good fit.

In Exercise 2 use a graphing calculator if you have access to one (use DESMOS if you have access to the internet) to find an equation of the line of best fit for the data. Identify and interpret the correlation coefficient.

2. Line of best fit:

$y = 1.8x - 8$

x	1	2	3	4	5	6	7	8	9
y	−7	−4	−1	0	0	1	4	7	9

The correlation coefficient: $r \approx .976$

The correlation coefficient is close to 1 meaning there is a strong positive correlation between x and y.

3. The table shows the number of people x in a room and the temperature in the room in degrees Fahrenheit, y.

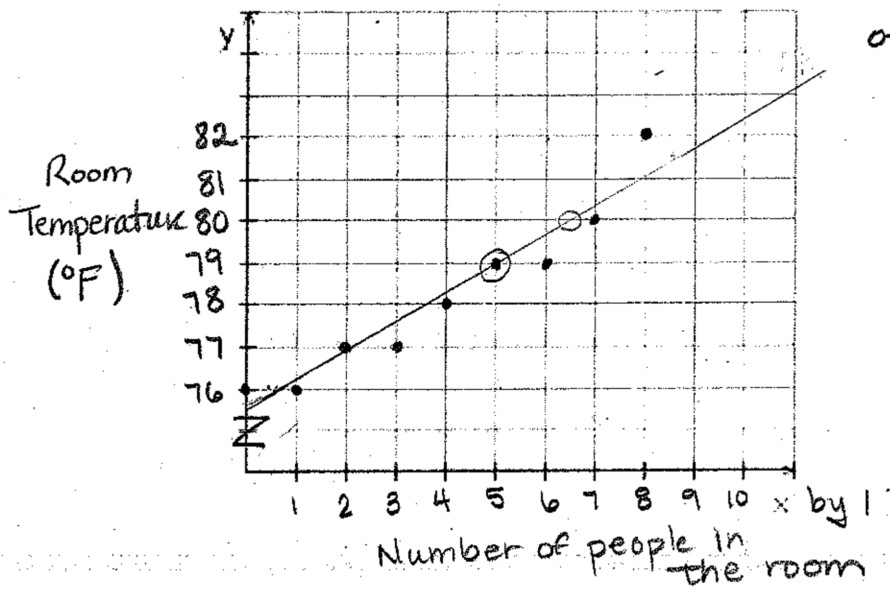
x	0	1	2	3	4	5	6	7	8
y	76	76	77	77	78	79	79	80	82

$8-0=8$

$82-76=6$

a. Draw a scatter plot. Be sure to label the axes, determine scale and title the graph.

Temperature as a Function of People in the Room



$82-76=6$

$(5,79)$

$(6.5,80)$

b. Draw a line of fit. Choose two points on the line and find the equation of the line of fit. (You are NOT finding the line of best fit).

$m = \frac{80-79}{6.5-5} = \frac{1}{1.5} = \frac{2}{3}$

$y-79 = \frac{2}{3}(x-5)$

$y-79 = \frac{2}{3}x - \frac{10}{3}$

$+\frac{237}{3} \qquad + \frac{237}{3}$

$\boxed{y = \frac{2}{3}x + \frac{227}{3}}$ OR $\boxed{y = .67x + 75.67}$

c. Interpret the slope and y-intercept of the line of fit.

The slope predicts that an increase of 3 people to the room will raise the temperature of the room by 2°F. This is the same as saying that each additional person, raises the temperature of the room by $\frac{2}{3}$°F. The model predicts that when no one is in the room, the temperature will be 75.67°F.

d. Approximate the temperature when 15 people are in the room. Is this extrapolation or interpolation?

$y = \frac{2}{3}(15) + \frac{227}{3}$

$y = \frac{30}{3} + \frac{227}{3}$

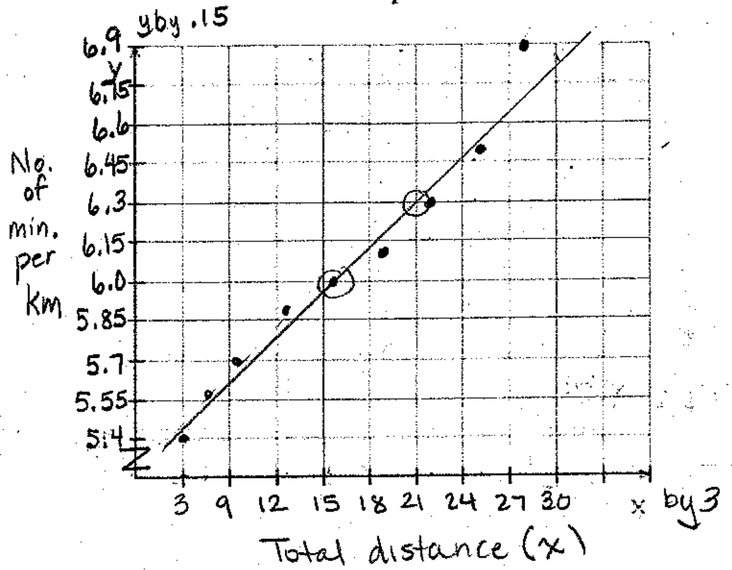
$y = \frac{257}{3} = 85\frac{2}{3}$

The model predicts that the temperature of the room will be $85\frac{2}{3}$° F when there are 15 people in the room. This is extrapolation.

4. The table shows the average number of minutes y per kilometer for runners and the total distance of a running race, x (in kilometers).

x	3.1	6.2	9.3	12.4	15.5	18.6	21.7	24.8	27.9	total race distanc
y	5.4	5.6	5.7	5.9	6.0	6.1	6.3	6.5	6.9	minutes/km

a. Draw a scatter plot. Be sure to label the axes, determine scale and title the graph.



$6.9 - 5.4 = 1.5$

$\frac{1.5}{10} = .15$

b. Draw a line of fit. Choose two points on the line and find the equation of the line of fit. (You are NOT finding the line of best fit).

$(15.5, 6)(21, 6.3)$

$m = \frac{6.3 - 6}{21 - 15.5} = \frac{.3}{5.5} = \frac{3}{55}$

$y - 6 = \frac{3}{55}(x - 15.5)$

$y - 6 = \frac{3}{55}\left(x - \frac{31}{2}\right)$

$y - 6 = \frac{3}{55}x - \frac{93}{110}$

$\boxed{y = \frac{3}{55}x + \frac{567}{110}}$

or

$\boxed{y = .055x + 5.155}$

c. Interpret the slope and y-intercept of the line of fit.

The slope predicts that for every mile added to the race, .055 minutes (about 3 seconds) is added to the time to run one kilometer. The y-intercept doesn't make sense in this context but says that if a race has no length then it will take a runner about 5 minutes to run a kilometer

d. Approximate the average number of minutes per kilometer when the distance of a race is 31 kilometers. Is this extrapolation or interpolation?

$y = \frac{3}{55}(31) + \frac{567}{110}$

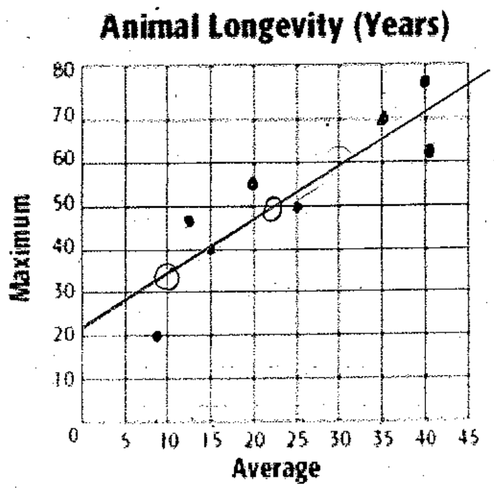
$y \approx 6.85$ minutes

The model predicts that if the race is 31 km, runners will take an average of 6.85 minutes to run a kilometer. This is extrapolation.

5. The table shows the average and maximum longevity of various animals in captivity.

Longevity (years)								
Avg.	12	25	15	8	35	40	41	20
Max.	47	50	40	20	70	77	61	54

a. Draw a scatter plot and determine, what relationship, if any, exists in the data.



(10, 35)
(22, 50)

$m = \frac{50-35}{22-10} = \frac{15}{12} = \frac{5}{4}$

1.6

$y - 50 = \frac{5}{4}(x - 22)$

$y - 50 = \frac{5}{4}x - \frac{55}{2}$

$+\frac{100}{2} \qquad +\frac{100}{2}$

$\boxed{y = \frac{5}{4}x + \frac{45}{2}} \Longleftrightarrow \boxed{y = 1.25x + 22.5}$

b. Draw a line of fit for the scatter plot, and write the slope-intercept form of an equation for the line of fit.

(see above)

c. Predict the maximum longevity for an animal with an average longevity of 33 years. Is this an example of Extrapolation or Interpolation?

$y = 1.25(33) + 22.5$

$y = 63.75$

The model predicts the maximum longevity of an animal with an average longevity of 33 years is about $63\frac{3}{4}$ years.

This is an example of interpolation.

In exercises 6, 7, 8, and 9, tell whether a correlation is likely in the situation. If so, tell whether there is a causal relationship. Explain your reasoning.

6. the amount of time spent talking on a cell phone and the remaining battery life

There would be a negative correlation between time spent talking on a cell phone and remaining battery life. This is also likely to be a causal relationship because your phone uses energy as you are talking and depletes the energy in the phone's battery.

7. the height of a toddler and the size of the toddler's vocabulary

There maybe a positive correlation between toddler height and the breadth of a toddler's vocabulary but no causal relationship. The height of a toddler does not determine the toddler's vocabulary.

8. the number of hats your own and the size of your head

A correlation is unlikely. The number of hats you own does not depend on the size of your head.

9. the weight of a dog and the length of its tail

There might be a positive correlation but no causal relationship. The weight of a dog does not determine the length of its tail.