

Name: Answer Key Per: \_\_\_\_\_ Date: \_\_\_\_\_  
 Serafino • Algebra 2E

**2-RE Unit 2 – Recap & Exploration**

**3 Part 3: Regressions**

Part 3: Regressions

- Calculating Linear Regression Models
  - From data points a graph
  - Calculate  $r$ ,  $r^2$
  - Interpolate/extrapolate
- Average Rate of Change
  - between two data points from list
  - Between two points on a function

I. AVERAGE RATE OF CHANGE

1. Road Trip! Lydia left for a road trip. The following points track her y, distance from home, x hours after she's left. (0.5, 8), (1, 14), (2, 19), (2.25, 20), (4, 120), (6, 266), (10, 554)

What is her average speed (rate of change) between...

- a. 0.5 hours and 1 hour? 12 mph
- b. 1 hour and 2 hours? 5 mph
- c. 2 hours and 2.5 hours? 4 mph
- d. 4 hours and 6 hours? 73 mph
- e. 6 hours and 10 hours? 72 mph
- f. 2.25 hours and 6 hours? 66 mph
- g. 0.5 hours and 6 hours? 46.9 mph
- h. 2 hours and 10 hours? 66.9 mph
- i. 0.5 hours and 10 hours? 57.47 mph

Use a calculator to calculate the: LINEAR REGRESSION MODEL:

$f(x) = 59.6951x - 76.5927$

Use that linear regression model (round to 4 decimal places) to...

j. Interpolate a data point & describe it:

$f(8) = 400.9$  At 8 hours, she's 400 miles away.  
 $(8, 400.9)$

k. Extrapolate a data point & describe it:

$f(11) = 550$  At 11 hours, she's 550 miles away.  
 $(11, 550)$

l. Find the average rate of change between those two points.

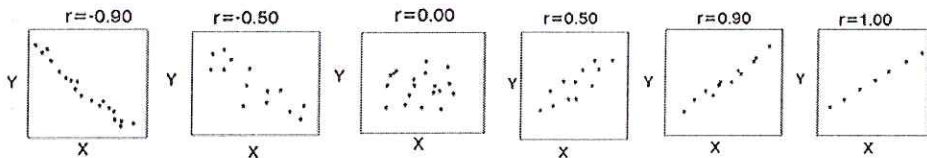
$\frac{180.3}{3} = \underline{60.01 \text{ mph}}$

**CORRELATION COEFFICIENT & COEFFICIENT OF DETERMINATION**

How much does your linear regression model capture your data? What's the correlation between your variables? There are two numbers that help describe the relationship between our linear regression model and our original data points:

**Correlation Coefficient:**  $r$  Describes "how linear" your original points are. You are describing how closely correlated your  $x$  and  $y$  values are.

$-1 \leq r \leq 1$ .



m. For the data above, what is  $r$ ?

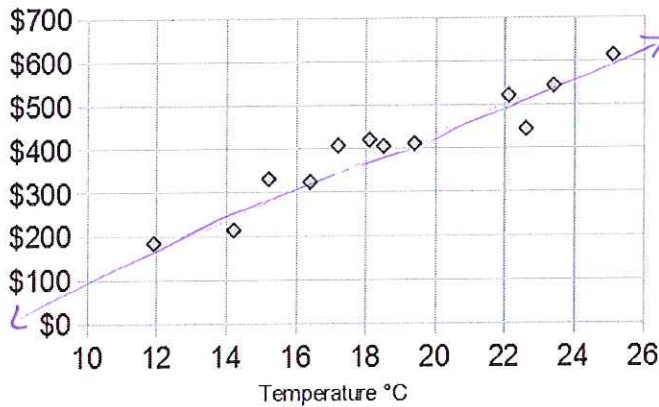
$r = 0.9816$

**Coefficient of Determination:**  $r^2$  Describes what percent one factor influences variation in the other  $0 \leq r^2 \leq 1$ .

n. For the data above, what is  $r^2$ ?

$r^2 = 0.9636$

II. Ice Cream & Temperature Historically, there is a relationship between the outside temperature and daily ice cream sales. Here are 12 data points for ice cream sales for an ice cream truck in Europe.



Temperature °C	Ice Cream Sales
14.2°	\$215
16.4°	\$325
11.9°	\$185
15.2°	\$332
18.5°	\$406
22.1°	\$522
19.4°	\$412
25.1°	\$614
23.4°	\$544
18.1°	\$421
22.6°	\$445
17.2°	\$408

1. Draw a line of best fit.

a. Estimate the linear regression by hand:

$f(x) = 30x + 100$

or  
 $f(x) = 30x - 160$   
 if you calculate what y-int would be.

b. Define your input (what is x?)

x: Deg. Celsius after 10°

c. Test a point you KNOW is on your line to ensure your regression is correct.

$f(4) = 220 \checkmark$

2. Put the data points in your calculator and calculate a linear regression model.

a. Equation:  $f(x) = 30.088x - 159$

b. What is the average rate of change for sales and temperature?

$\approx \$30$  per degree

c. Predict ice cream sales when the temperature is 30°. Is that interpolation or extrapolation?

$f(30) = \$748.64$

Predict ice cream sales when the temperature is 21°. Is that interpolation or extrapolation?

$f(21) = \$472.85$

d. What is the temperature when ice cream sales are \$2,000?

$200 = 30.088x - 159$

$x = 71.97^\circ$

3. a. What is the correlation coefficient, r?

$r = 0.9575$

b. What is the coefficient of determination?  $r^2$ ?

$r^2 = 0.9168$

4. Find two data points between which the average rate of change is...

a. ... positive, but lower than in your model

$(11.9, 185) (14.2, 215)$

c. ...negative

$(22.1, 522) (22.6, 445)$

b. ... positive, but higher than in your model

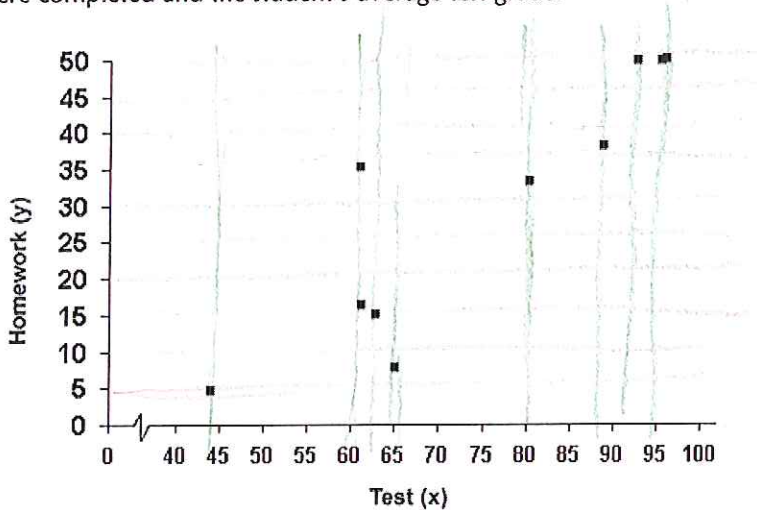
$(22.6, 445) (23.4, 544)$

d. .... approximately 0.

$(18.1, 421) (18.5, 406)$

III. Homework & Tests: In a math class, 10 students were surveyed at the end of a marking period. Info was taken about how many, out of the 50 homework assignments, were completed and the student's average test grade.

Estimate the points:



X	Y
44	5
61	16
61	36
63	15
65	7
80	33
88	37
92	49
95	49
96	50

1. Use the data points to calculate the linear regression model in your calculator.

$$f(x) = 0.8649x - 34.7424$$

2. Extrapolate a data point using your model.

$$f(40) = -0.1544$$

Interpolate a data point using your model

$$f(65) = 30.11$$

4. What is the correlation coefficient,  $r$ ?

$$r = 0.8847$$

What is the coefficient of determination,  $r^2$ ?

$$r^2 = 0.7826$$

5. How you describe the relationship between homework and test scores?

- a. Positive      None      Negative
- b. Strong      Medium      Weak

IV: Politics & Education: The following scatterplot describes the relationship between years of school and how politically involved someone is, on a scale from 1-10, on a survey given to 18 people.

a. Estimated linear regression:

$$y = 12 + b \quad (11, 5) (12, b) \text{ used}$$

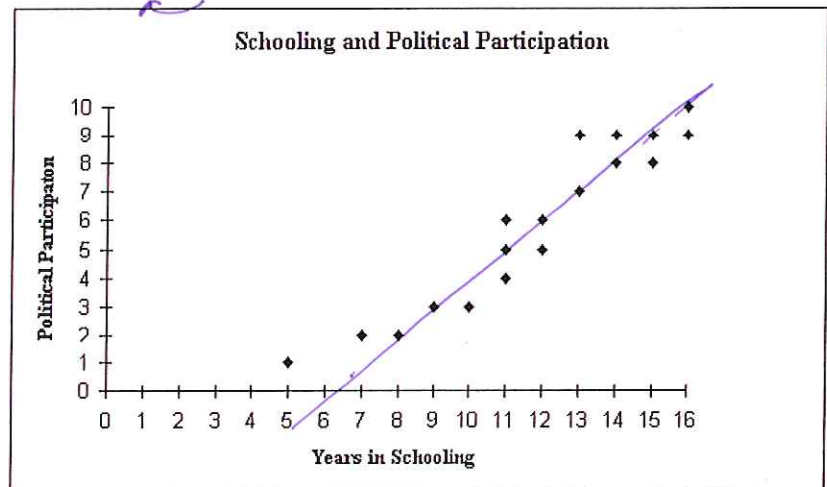
$$b = -6$$

$$f(x) = x - 6$$

b. Calculated linear regression:

$$f(x) = 0.88156x - 4.4939$$

c.  $r = 0.9513$        $r^2 = 0.9051$



V: Alcohol and Dexterity: The following scatterplot describes the relationship how many drinks someone has had on how they score on a dexterity test.

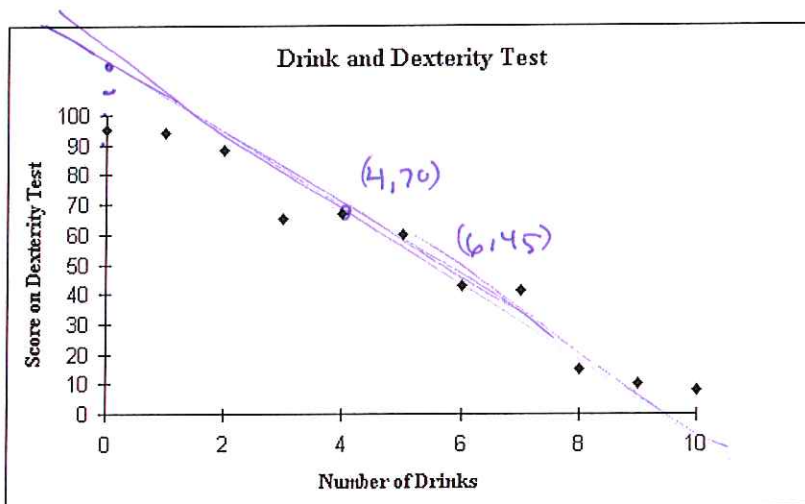
a. Estimated linear regression:

$$f(x) = -15x + 120$$

b. Calculated linear regression:

$$f(x) = -9.4724x + 101.818$$

c.  $r = [-.9780]$      $r^2 = [.9566]$



VI. AVERAGE RATE OF CHANGE ON FUNCTIONS

1.  $f(x) = 2x - 7$

a. Between 3 and 4

$$\frac{f(4) - f(3)}{4 - 3} = \frac{1 - (-1)}{1} = 2$$

b. Between 6 and 8

$$\frac{f(8) - f(6)}{8 - 6} = \frac{9 - 5}{2} = 2$$

Duh!  
Constant rate of change b/c it's a line!  
☺

2.  $f(x) = |x - 2| + 3$

a. Between 3 and 6?

$$\frac{f(6) - f(3)}{6 - 3} = \frac{7 - 4}{3} = 1$$

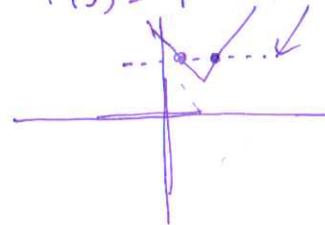
b. Between 0 and 2?

$$\frac{f(2) - f(0)}{2 - 0} = \frac{3 - 5}{2} = -1$$

c. Between 1 and 3?

$$\frac{f(3) - f(1)}{3 - 1} = \frac{4 - 2}{2} = 1$$

Duh! It's the linear "arms" of the "parabola" ☺



3.  $f(x) = -2|x| + 3$

b. Between -3 and 2?

$$\frac{f(2) - f(-3)}{2 - (-3)} = \frac{-1 - (-3)}{5} = \frac{2}{5}$$

b. Between -5 and 1?

$$\frac{f(1) - f(-5)}{1 - (-5)} = \frac{1 - (-7)}{6} = \frac{8}{6} = \frac{4}{3}$$

c. Between 0 and 5?

$$\frac{f(5) - f(0)}{5 - 0} = \frac{-7 - 3}{5} = -2$$