Notice that there are two different data points with 70 minutes spent studying. One of those corresponds to a grade of 75 and the other to a grade of 90. Therefore, it seems reasonable that substituting 70 for x in the equation of the regression line would result in a number between those two grades.

b. $f(110) = 0.44(110) + 47.97$
$= 96.37$

Notice that the data point for studying 110 minutes resulted in a grade of 94, which is pretty close to the grade predicted by the regression line.

c. $f(95) = 0.44(95) + 47.97$
$= 89.77$

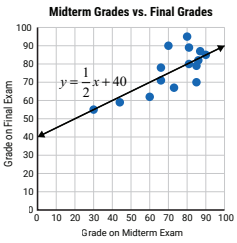
Notice that the data points for studying 90 minutes resulted in grades of 80 and 85, and the data point for studying 100 minutes resulted in a grade of 90. While there's not a data point for studying 95 minutes, there is a positive linear correlation between the amount of time spent studying and the grade earned. Therefore, we would expect that studying 95 minutes would result in a grade that is somewhere in the range of 80 to 90.

Now work margin exercise 5.

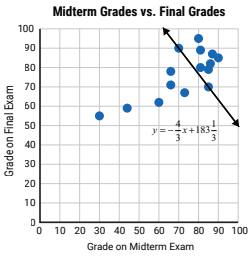
Margin Exercise Answers

1. negative correlation **2. a.** weak negative correlation **b.** strong negative correlation **c.** weak positive correlation

3. a. $y = \frac{1}{2}x + 40$



b. $y = -\frac{4}{3}x + 183\frac{1}{3}$



4. $y = 0.54x + 37.93$ **5. a.** 59.53 **b.** 70.33 **c.** 83.83

3.5 Exercises

Concept Check

Fill-in-the-Blank. Complete each sentence using information found in this section.

1. The relationship between variables is called _____.
2. A regression line with a correlation coefficient of 1 is a called _____ _____ correlation.
3. If there is no linear relationship on a scatter plot, the correlation will be _____.

4. The process of modeling the _____ _____ between two variables is called linear regression.

5. If there is a strong linear relationship between two variables in a data set, the linear regression can be used to _____ values in the data set.

6. The linear equation that best fits the data is called the _____ line.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement is true. (**Note:** There may be more than one acceptable change.)

7. When a data set is presented in a scatter plot and there appears to be an upward trend in the data, we say there is a positive correlation.

8. If the correlation coefficient r of a data set is close to zero, the two variables have a strong correlation.

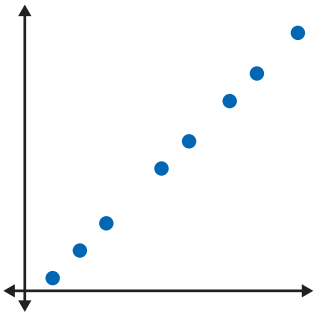
9. If the correlation coefficient r of a data set is zero, the variables are perfectly correlated.

10. Linear regression can be used to predict some values under certain conditions.

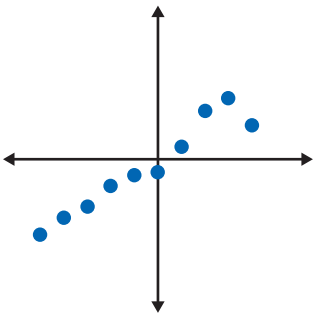
Practice

Determine if the data set appears to have a positive correlation, a negative correlation, or no correlation. See Example 1.

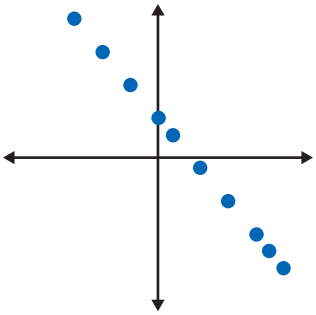
1.



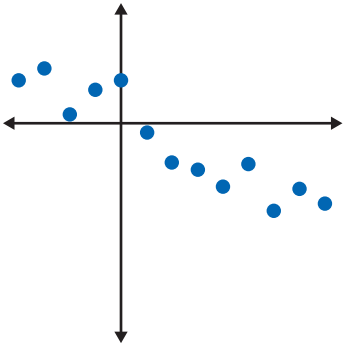
3.



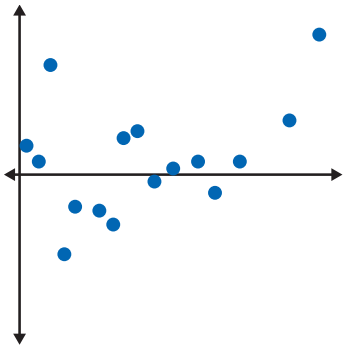
2.



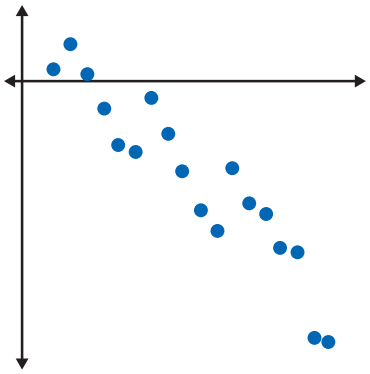
4.



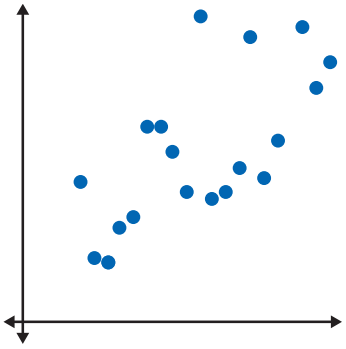
5.



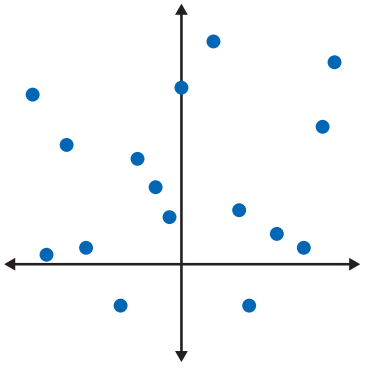
7.



6.



8.



Determine whether a data set with the given correlation coefficient has a positive correlation, a negative correlation, or no correlation. If the data set has a positive or negative correlation, indicate whether it is strong or weak. See Example 2.

9. $r = 1$

10. $r = 0.9$

11. $r = -0.95$

12. $r = 0$

13. $r = -1$

14. $r = 0.1$

15. $r = -0.15$

16. $r = -0.8$

17. $r = 0.35$

18. $r = -0.2$

Solve. See Example 3.

19. Use the given points to determine the point-slope form of the equation that represents the data set for the discount in a clothing store versus the number of customers in this store per day. Graph both lines on the scatter plot of the data set.

Discount vs. Number of Customers

Discount (%)	Number of Customers
5	51
10	59
15	68
20	78
25	101

a. (5, 51) and (10, 59)

b. (15, 68) and (25, 101)

20. Use the given points to determine the point-slope form of the equation that represents the data set for outside temperature versus the number of scoops sold at an ice-cream stand during the morning. Graph both lines on the scatter plot of the data set.

Temperature vs. Number of Ice-Cream Scoops Sold

Temperature (in °F)	Number of Scoops Sold
78	24
80	22
64	12
67	11
59	9
69	13
75	19

a. (67, 11) and (59, 9)

b. (80, 22) and (64, 12)

21. Use the given points to determine the point-slope form of the equation that represents the data set for the price of a used car versus the number of calls the seller receives from potential buyers. Graph both lines on the scatter plot of the data set.

Price vs. Number of Calls Received

Price (in thousand dollars)	Number of Calls Received
14.7	10
15.6	10
19	7
20.6	8
23.1	6
24.1	4
27.5	4
29.6	3

a. (15.6, 10) and (29.6, 3)

b. (23.1, 6) and (24.1, 4)

22. Use the given points to determine the point-slope form of the equation that represents the data set for the number of cars of a particular brand sold in several cities in 2017 and 2018. Graph both lines on the scatter plot of the data set.

Number of Cars Sold in 2017 vs. 2018

Number of Cars Sold in 2017	Number of Cars Sold in 2018
1248	1589
1529	1712
1188	1390
1000	1130
485	606
863	1036
609	676
528	671
750	1050
642	796

a. (1248, 1589) and (528, 671)

b. (1000, 1130) and (750, 1050)

23. Use the given points to determine the point-slope form of the equation that represents the data set for the monthly average high temperatures in Miami, Florida. Graph both lines on the scatter plot of the data set.

Month vs. Average High Temperature

Month Number	Temperature (in °C)
1	23.3
2	23.9
3	25
4	26.7
5	28.3
6	30
7	30.6
8	31.1
9	30
10	28.3
11	26.1
12	24.4

a. (4, 26.7) and (6, 30.0)

b. (7, 30.6) and (11, 26.1)

24. Use the given points to determine the point-slope form of the equation that represents the data set for the ratings of several movies on a critic website versus their positions in the list of best movies. Graph both lines on the scatter plot of the data set.

Movie Rating vs. Position in the List of Best Movies

Rating	Position in List
9.2	1
9.1	2
9	3
8.9	5
8.8	9
8.7	13
8.6	17
8.5	28
8.4	48
8.3	70
8.2	99
8.1	144
8	218

a. (8.8, 9) and (8.2, 99)

b. (9.0, 3) and (8.5, 28)

25. Use the given points to determine the point-slope form of the equation that represents the data set for the number of months that marathon runners train versus their overall place in a marathon. Graph both lines on the scatter plot of the data set.

Number of Months Training vs. Place in the Marathon

Number of Months	Overall Place
2	30
4	27
4	21
5	25
8	15
9	23
12	12
14	7
18	10
24	5
30	2
36	9
36	1
42	4
48	3

a. (4, 27) and (8, 15)

b. (36, 9) and (48, 3)

26. Use the given points to determine the point-slope form of the equation that represents the data set for the number of games played versus the number of goals scored for several soccer forwards. Graph both lines on the scatter plot of the data set.

Number of Games Played vs. Number of Goals Scored

Games	Goals
33	21
36	22
28	17
29	7
34	18
27	10
15	3
31	12
24	6
32	12
30	14
37	16
16	5
25	7
27	7
35	13

a. (28, 17) and (29, 7)

b. (24, 6) and (32, 12)

Use the following data sets and a TI-84 graphing calculator to find the linear regression equation. Round all values to two decimal places. See Example 4.

27. Number of Cars Sold in 2017 vs. 2018

Number of Cars Sold in 2017	Number of Cars Sold in 2018
1248	1589
1529	1712
1188	1390
1000	1130
485	606
863	1036
609	676
528	671
750	1050
642	796

28. Month vs. Average High Temperature

Month Number	Temperature (in °C)
1	23.3
2	23.9
3	25
4	26.7
5	28.3
6	30
7	30.6
8	31.1
9	30
10	28.3
11	26.1
12	24.4

29. Movie Rating vs. Position in the List of Best Movies

Rating	Position
9.2	1
9.1	2
9	3
8.9	5
8.8	9
8.7	13
8.6	17
8.5	28
8.4	48
8.3	70
8.2	99
8.1	144
8	218

30. Number of Months Training vs. Place in the Marathon

Number of Months	Overall Place
2	30
4	27
4	21
5	25
8	15
9	23
12	12
14	7
18	10
24	5
30	2
36	9
36	1
42	4
48	3

Solve. See Example 5.

31. Use the provided regression line, $y = 2.38x + 35.7$, to predict the number of customers in the clothing shop for the given discount (in percent form).

a. 0%

b. 20%

c. 40%

32. Use the provided regression line, $y = 0.73x - 35.42$, to predict the number of scoops sold at the ice-cream stand for the given temperature.

a. 50 °F

b. 60 °F

c. 75 °F

33. Use the provided regression line, $y = -0.49x + 17.22$, to predict the number of calls the seller will receive for the given car price.

a. 25 thousand dollars

b. 30 thousand dollars

c. 35 thousand dollars

34. Use the provided regression line, $y = 1.11x + 84.66$, to predict the number of cars sold in a city in 2018 for the given number of cars sold in 2017.

a. 800 cars

b. 1200 cars

c. 1500 cars

35. Use the provided regression line, $y = -0.54x + 23.47$, to predict the place of a marathon runner for the given number of months spent training.

a. 10 months

b. 15 months

c. 25 months

36. Use the provided regression line, $y = 0.73x - 9.10$, to predict the number of goals scored by a striker for the given number of games played.

a. 20 games

b. 30 games

c. 40 games