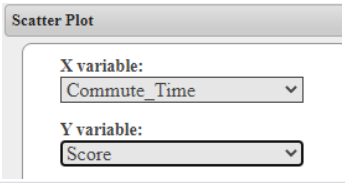
1. The data in the table to the right are based on the results of a survey comparing the commute time of adults to their score on a well-being test. .

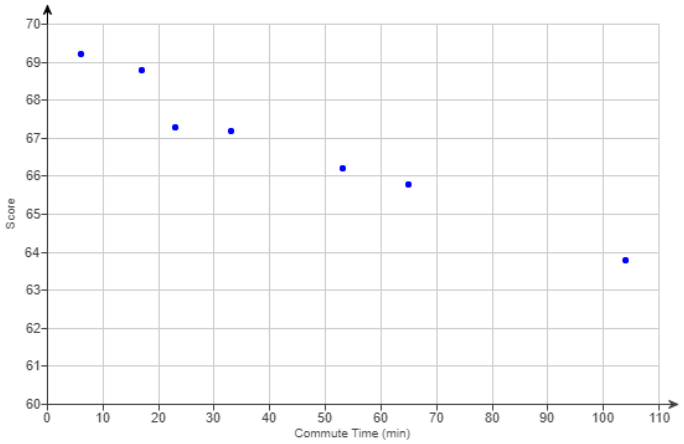
Commute Time (in minutes)	Well-Being Score
6	69.2
17	68.8
23	67.3
33	67.2
53	66.2
65	65.8
104	63.8

STATCRUNCH – GRAPH – SCATTER PLOT



D. The explanatory variable is commute time and the response variable is the well-being score because commute time affects the well-being score.

(b) Draw a scatter diagram of the data. Which of the following represents the data?



2. What does it mean to say that two variables are positively associated? Negatively associated?

What does it mean to say that two variables are positively associated?

A. There is a linear relationship between the variables, and whenever the value of one variable increases, the value of the other variable decreases.

B. There is a linear relationship between the variables.

C. There is a relationship between the variables that is not linear.

D. There is a linear relationship between the variables, and whenever the value of one variable increases, the value of the other variable increases.

What does it mean to say that two variables are negatively associated?

A. There is a linear relationship between the variables, and whenever the value of one variable increases, the value of the other variable decreases.

3. If r = -1, then a perfect negative linear relation exists between the two quantitative variables.

4. True or false: Correlation implies causation.

Choose the correct response.

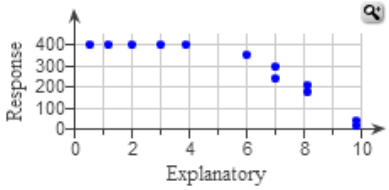
- ○ True
- ✓ False

Nice Work!

Often times in observational studies, we cannot conclude two correlated variables have a causal relationship. The presence of a lurking variable that is related to both the explanatory variable and the response variable can make the two variables correlated without having a causal relation.

Done

5. Determine whether the scatter diagram indicates that a linear relation may exist between the two variables. If the relation is linear, determine whether it indicates a positive or negative association between the variables. Use this information to answer the following.



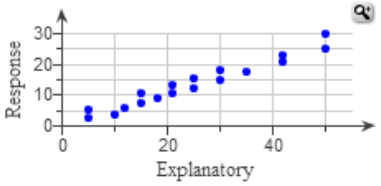
Do the two variables have a linear relationship?

- ○ A. The data points do not have a linear relationship because they lie mainly in a straight line.
- ✓ B. The data points do not have a linear relationship because they do not lie mainly in a straight line.
- ○ C. The data points have a linear relationship because they lie mainly in a straight line.
- ○ D. The data points have a linear relationship because they do not lie mainly in a straight line.

If the relationship is linear do the variables have a positive or negative association?

- ○ A. The variables have a positive association.
- ○ B. The variables have a negative association.
- ✓ C. The relationship is not linear.

6. Determine whether the scatter diagram indicates that a linear relation may exist between the two variables. If the relation is linear, determine whether it indicates a positive or negative association between the variables.
Use this information to answer the following.



Do the two variables have a linear relationship?

- ○ A. The data points have a linear relationship because they do not lie mainly in a straight line.
- ✓ B. The data points have a linear relationship because they lie mainly in a straight line.
- ○ C. The data points do not have a linear relationship because they do not lie mainly in a straight line.
- ○ D. The data points do not have a linear relationship because they lie mainly in a straight line.

Do the two variables have a positive or a negative association?

- ✓ A. The two variables have a positive association.

the line has positive slope, if falls has negative association

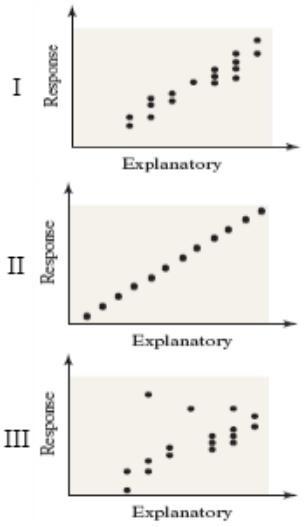
7. Match the linear correlation coefficient to the scatter diagram. The scales on the x- and y-axis are the same for each scatter diagram.
(a) $r = 0.523$, (b) $r = 1$, (c) $r = 0.946$

(a) Scatter diagram III .

(b) Scatter diagram II .

(c) Scatter diagram I .

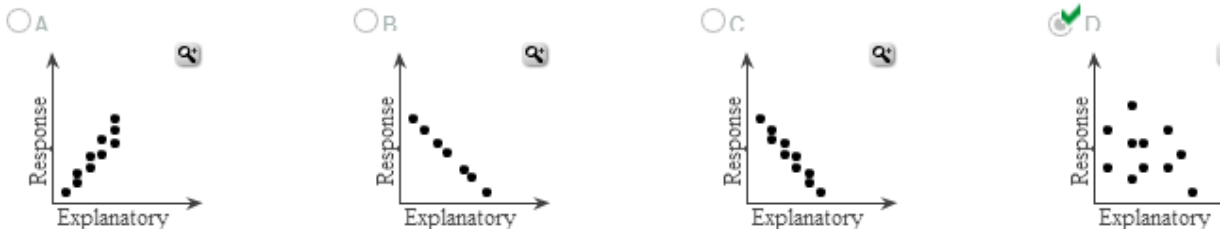
More precise r is closer to 1, straighter of a line



8. Match the linear correlation coefficient to the scatter diagram.

$r = -0.025$ Negative falls and 0.025 is not close to making a straight line

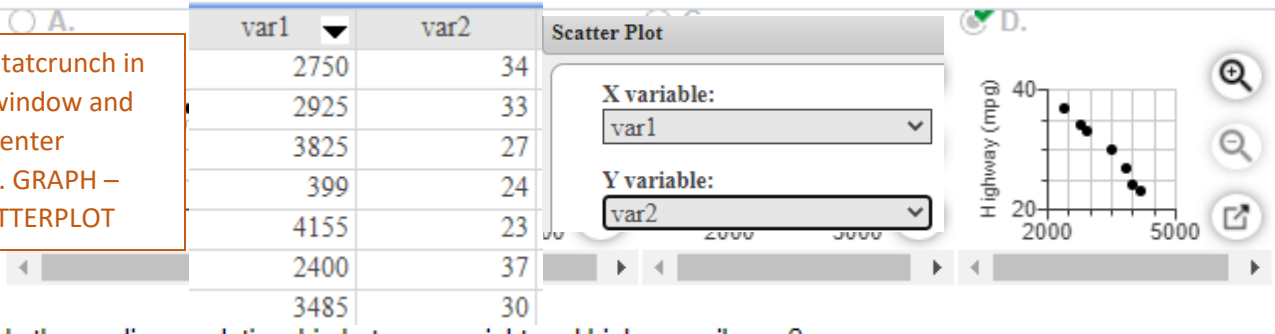
Choose the correct graph below.



9. The table lists weights (pounds) and highway mileage amounts (mpg) for seven automobiles. Use the samp data to construct a scatterplot on your calculator. Use the first variable for the x-axis. Based on the scatterpl what do you conclude about a linear correlation?

Weight (lb)	2750	2925	3825	3990	4155	2400	3485
Highway (mpg)	34	33	27	24	23	37	30

Open statcrunch in new window and enter data. GRAPH – SCATTERPLOT



Is there a linear relationship between weight and highway mileage?

A. Yes, as the weight increases the highway mileage decreases.

10. For the accompanying data set, (a) draw a scatter diagram of the data, (b) by hand, compute the correlation coefficient, and (c) determine whether there is a linear relation between x and y.

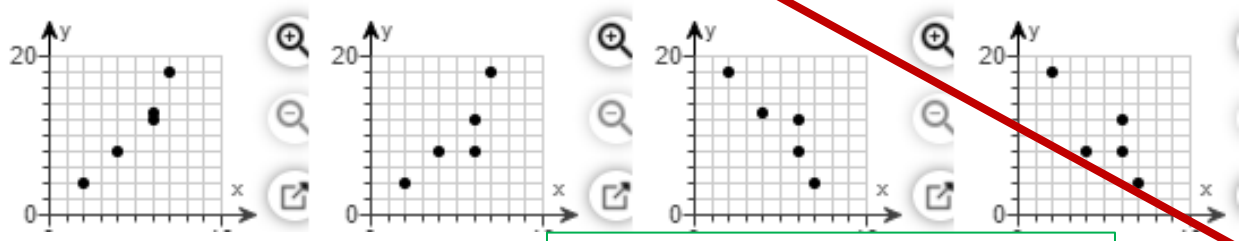
Click here to view the data set.
Click here to view the critical values table.

Stat crunch

STAT – REGRESSION – SIMPLE LINEAR

(a) Draw a scatter diagram of the data. Choose the correct graph below.

A. B. C. D.



Click right arrow to show graph

Simple linear regression results:
Dependent Variable: y
Independent Variable: x
y = -1.8125 + 2.5625 x
Sample size: 5
R (correlation coefficient) = 0.96853396
R-sq = 0.93805804
Estimate of error standard deviation: 1.5206906

The sample size is 5 so we find critical value for n=5
Use the data set to get n then the critical values

(b) By hand, compute the correlation coefficient.

The correlation coefficient is r = .969 . (Round to three decimal places as needed.)

Critical Values for Correlation Coefficient

n	
3	0.997
4	0.950
5	0.878

(c) Determine whether there is a linear relation between x and y.

Because the correlation coefficient is positive and the absolute value of the correlation coefficient, .969 , is greater than the critical value for this data set, .878 , a positive linear relation exists between x and y.
(Round to three decimal places as needed.)

Make sure this sentence matches your data and graph

11. For the accompanying data set, (a) draw a scatter diagram of the data, (b) compute the correlation coeffic
(c) determine whether there is a linear relation between x and y.

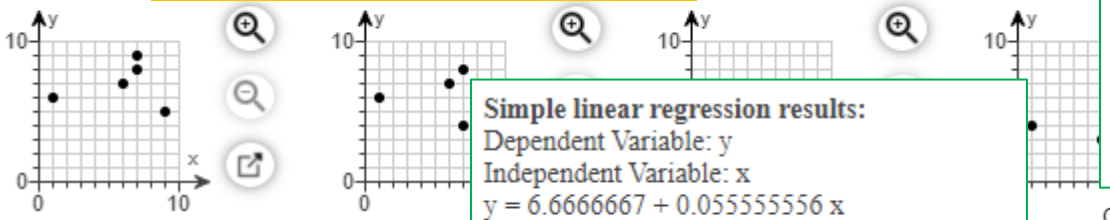
Click the icon to view the data set.
Click the icon to view the critical values table.

Stat crunch

STAT – REGRESSION – SIMPLE LINEAR

Click right arrow to show graph

A.



Simple linear regression results:
Dependent Variable: y
Independent Variable: x
y = 6.6666667 + 0.055555556 x
Sample size: 5
R (correlation coefficient) = 0.10540926
R-sq = 0.011111111
Estimate of error standard deviation: 1.8155705

The sample size is 5 so we find critical value for n=5
Use the data set to get n then the critical values

Critical Values for Correlation Coeffi

n	
3	0.997
4	0.950
5	0.878

(b) Compute the correlation coefficient.

The correlation coefficient is r = .105 .

(c) Determine whether there is a linear relation between x and y.

Because the correlation coefficient is positive and the absolute value of the correlation coefficient, .105 , is not greater than the critical value for this data set, .878 , no linear relation exists between x and y.
(Round to three decimal places as needed.)

12. The data in the table to the right are based on the results of a survey comparing the commute time of adults to their score on a well-being test. Complete parts (a) through (d) below.

Click the icon to view the critical values for the correlation coefficient.

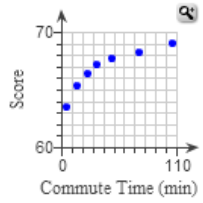
Commute Time (in minutes)	Well-Being Score
5	69.1
15	68.3
24	67.7
33	67.2
48	66.5
74	65.4
105	63.5

(a) Which variable is likely the explanatory variable and which is the response variable?

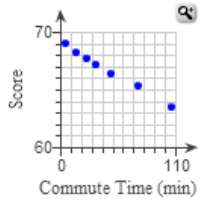
- A. The explanatory variable is commute time and the response variable is the well-being score because commute time affects the well-being score.
- B. The explanatory variable is the well-being score and the response variable is commute time because commute time affects the well-being score.
- C. The explanatory variable is commute time and the response variable is the well-being score because well-being score affects the commute time score.
- D. The explanatory variable is the well-being score and the response variable is commute time because well-being score affects the commute time.

(b) Draw a scatter diagram of the data. Which of the following represents the data?

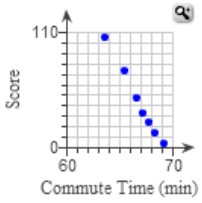
A



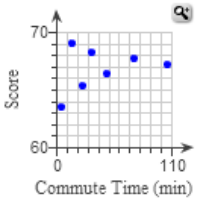
B



C



D



(c) Determine the linear correlation coefficient between commute time and well-being score.

r = −.996

(Round to three decimal places as needed.)

Stat crunch

STAT – REGRESSION – SIMPLE LINEAR

yes, the variable commute time and well being score are negatively assiciatedbecause r is ngative and the absolute value of the correlation coefficient is greater than the critical value **0.754**

Critical Values for Correlation Coefficient

n	
3	0.997
4	0.950
5	0.878
6	0.811
7	0.754
8	0.707

n = 7

13. A pediatrician wants to determine the relation that may exist between a child's height and head circumference. She randomly selects 8 children from her practice, measures their height and head circumference, and obtains the data shown in the table. Complete parts (a) through (e) to the right.

Height (in.)	Head Circumference (in.)
27.5	17.3
25	17.1
26	17.2
25.25	17
27.25	17.6
26.75	17.4
25.75	17.2
27.25	17.3

Click here to see the Table of Critical Values for Correlation Coefficient.

(d) Does a linear relation exist between height and head circumference?

(Round to three decimal places as needed.)

- A. Yes, the variables height and head circumference are positively associated because r is positive and the absolute value of the correlation coefficient is greater than the critical value, .707 .

(a) If the pediatrician wants to use height to predict head circumference, determine which variable is the explanatory variable and which is the response variable.

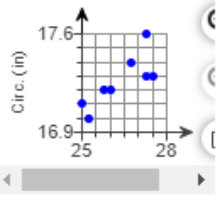
- The explanatory variable is height and the response variable is head circumference.
- The explanatory variable is head circumference and the response variable is height.

(b) Draw a scatter diagram. Which of the following represents the data?

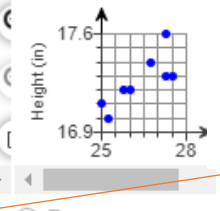
Critical Values for Correlation Coefficien

n	
3	0.997
4	0.950
5	0.878
6	0.811
7	0.754
8	0.707

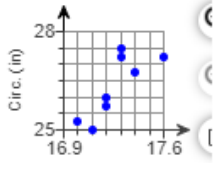
A.



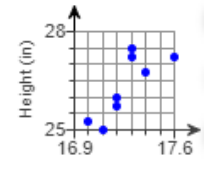
B.



C.



D.



(e) Convert to centimeters (1 inch = 2.54 centimeters)

*multiply all by 2.54

Height (in.)	Head Circumfer
27.5	17.3
25	17.1
26	17.2
25.25	17
27.25	17.6
26.75	17.4
25.75	17.2
27.25	17.3

Height (centimeters)	Head Circumference (centimeters)
69.85	43.941
63.5	43.434
66.04	43.688
64.135	43.18
69.215	44.704
67.945	44.196
65.405	43.688
69.215	43.942

the original r from your found first.

The new linear correlation coefficient is r = .798 . The conversion to centimeters had no effect on r.

(Round to three decimal places as needed.)

14.

Researchers initiated a long-term study of the population of American black bears. One aspect of the study was to develop a model that could be used to predict a bear's weight (since it is not practical to weigh bears in the field). One variable thought to be related to weight is the length of the bear. The accompanying data represent the lengths and weights of 12 American black bears. Complete parts (a) through (d).

Click the icon to view the data table.

Click the icon to view the critical values table.

Stat crunch

STAT – REGRESSION – SIMPLE LINEAR

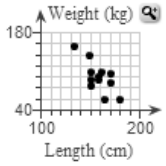
(a) Which variable is the explanatory variable based on the goals of the research?

- A. The length of the bear
- B. The weight of the bear
- C. The number of bears

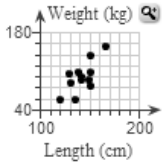
Click right arrow to show graph

(b) Draw a scatter diagram of the data. Choose the correct graph below.

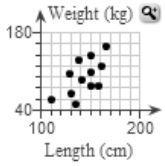
A



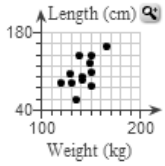
B



C



D



(c) Determine the linear correlation coefficient between weight and length.

The linear correlation coefficient between weight and length is r = .747 .

(Round to three decimal places as needed.)

They want critical value when n=12 from question, by using the critical value table we find .576

(d) Does a linear relation exist between the weight of the bear and its length?

Because the correlation coefficient is positive and the absolute value of the correlation coefficient, .747 , is greater than the critical value for this data set, .576 , a positive linear relation exists between the weight of the bear and its length.

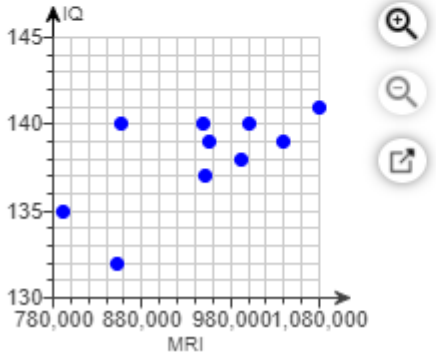
(Round to three decimal places as needed.)

15. Researchers wondered whether the size of a person's brain was related to the individual's mental capacity. They selected a sample of 5 females and 5 males and measured their MRI counts and IQ scores. The data is reported to the right. Complete parts **(a)** through **(d)** below.

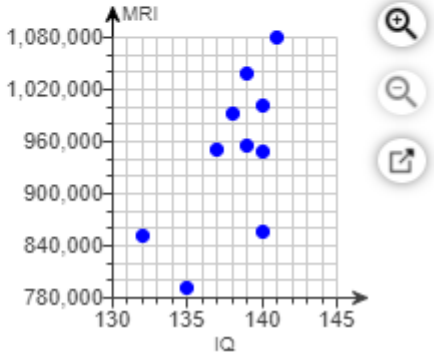
Click the icon to view the critical values table.

Females		Males	
MRI	IQ	MRI	IQ
951,545	137	949,395	140
991,305	138	1,001,121	140
856,472	140	1,038,438	139
852,244	132	1,079,550	141
790,619	135	955,003	139

C.



D.



Put total MRI and IQ values in two new columns together using regression steps with var5 and var6

StatCrunch Applets Edit Data Stat Graph Help

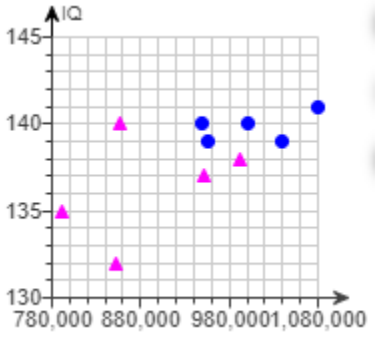
Row	Females_IQ	Males_MRI	Males_IQ	var5	var6
1	137	949395	140	951545	137
2	138	1001121	140	991305	138
3	140	1038438	139	856472	140
4	132	1079550	141	852244	132
5	135	955003	139	790619	135
6				949395	140
7				1001121	140
8				1038438	139
				1079550	141
				955003	139

(b) Compute the linear correlation coefficient between MRI count and IQ. Are MRI count and IQ linearly related? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.
(Round to three decimal places as needed.)

A. Yes, MRI count and IQ are linearly related since the linear correlation coefficient is .654.

(c) Change the scatter diagram to use a different plotting symbol for each gender.

Let fuchsia triangles represent females and let blue circles represent males. Which scatter diagram represents both sets of data plotted on the same axes?



Stat crunch

STAT – REGRESSION – SIMPLE LINEAR
for FEMALES and then MALES separate

(d) Compute the linear correlation coefficient between MRI count and IQ for females. Compute the linear correlation coefficient between MRI count and IQ for males.

The linear correlation coefficient for females is .387.

The linear correlation coefficient for males is .490.
(Round to three decimal places as needed.)

The sample size is 5 so we find critical value for n=5 *Make sure you get the number count in your sample for n value then the 0.878 is the nth position in the original table.

Are MRI count and IQ linearly related?

Because the correlation coefficient for females is positive and the absolute value of this correlation coefficient, .387, is not greater than .878, the critical value for the female data set, no relation exists between MRI count and IQ for females. Because the correlation coefficient for males is positive and the absolute value of this correlation coefficient, .490, is not greater than the critical value for the male data set, .878, no relation exists between MRI count and IQ for males.
(Round to three decimal places as needed.)

16. An engineer wanted to determine how the weight of a car affects gas mileage. The accompanying data represent the weights of various domestic cars and their gas mileages in the city for a certain model year. Complete parts (a) through (d) below.

Click here to view the car data.
Click here to view the table of critical values of the correlation coefficient.

(a) Determine which variable is the likely explanatory variable and which is the likely response variable. Choose the correct answer below.

- The explanatory variable is the weight and the response variable is the miles per gallon.
- The explanatory variable is the miles per gallon and the response variable is the weight.

(b) Draw a scatter diagram of the data. Choose the correct graph below.

Car	Weight (lbs)	Miles per Gallc
Car 1	3775	19
Car 2	3964	18
Car 3	3530	21
Car 4	3175	22
Car 5	2580	27
Car 6	3730	18
Car 7	2605	26
Car 8	3772	17
Car 9	3310	20
Car 10	2991	25
Car 11	2752	26

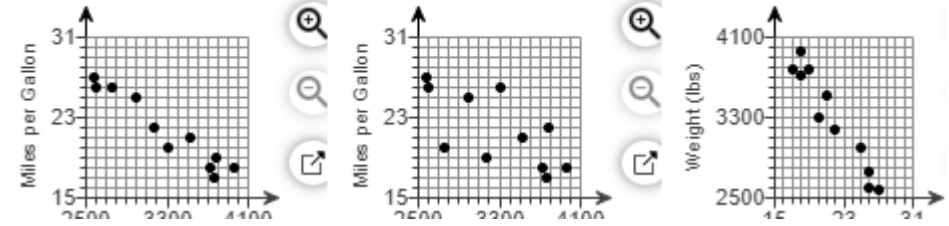
Options (1 of 2)

Simple linear regression results:
Dependent Variable: Miles per Gallon
Independent Variable: Weight (lbs)
Miles per Gallon = 44.973613 - 0.0070669285 Weight (lbs)
Sample size: 11
R (correlation coefficient) = -0.96491001
R-sq = 0.93105132
Estimate of error standard deviation: 1.0214128

Parameter estimates:

Parameter	Estimate	Std. Err.	Alternative	DF
Intercept	44.973613	2.1310446	≠ 0	9

A. B. C.



n	
3	0.997
4	0.950
5	0.878
6	0.811
7	0.754
8	0.707
9	0.666
10	0.632
11	0.602

(d) Comment on the type of relation that appears to exist between the weight of a car and its miles per gallc based on the scatter diagram and the linear correlation coefficient.

The variables weight of a car and its miles per gallon are negatively associated because r is negative and the absolute value of the correlation coefficient is greater than the critical value .602.
(Round to three decimal places as needed.)

17. The linear correlation between violent crime rate and percentage of the population that has a cell phone is −0.918 for years since 1995. Do you believe that increasing the percentage of the population that has a cell phone will decrease the violent crime rate? What might be a lurking variable between percentage of the population with a cell phone and violent crime rate?

Will increasing the percentage of the population that has a cell phone decrease the violent crime rate? Choose the best option below.

- ✔ No
- Yes

What might be a lurking variable between percentage of the population with a cell phone and violent crime rate?

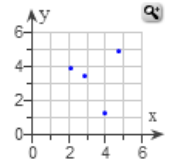
- A. the police
- B. overall cell phone signal strength
- ✔ C. the economy
- D. the average cell phone's effectiveness as a weapon

18. Consider the data on the right. (a) Draw a scatter diagram of the data and compute the linear correlation coefficient. (b) Draw a scatter diagram of the data and compute the linear correlation coefficient with the additional data point (10.3,9.2). Comment on the effect the additional data point has on the linear correlation coefficient. Explain why correlations should always be reported with scatter diagrams.

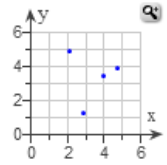
x	y
2.1	3.9
4	1.3
2.9	3.5
4.7	4.9

(a) Which of the following best represents the data?

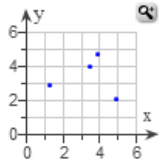
✔ A



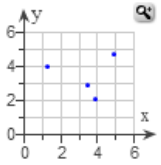
B



C



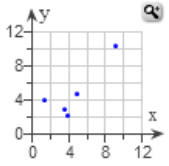
D



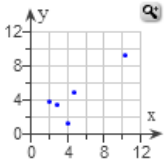
The linear correlation coefficient for the four pieces of data is −.002.
(Round to three decimal places as needed.)

(b) Draw a scatter diagram of the data with the additional data point (10.3,9.2).

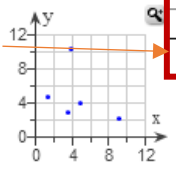
A



✔ B

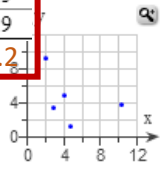


C



x	y
2.1	3.9
4	1.3
2.9	3.5
4.7	4.9
10.3	9.2

D



The linear correlation coefficient for the five pieces of data is .848.
(Round to three decimal places as needed.)

Comment on the effect the additional data point has on the linear correlation coefficient.

- A. The additional data point does not effect the linear correlation coefficient.
- B. The additional data point weakens the appearence of a linear association between the data points.
- ✔ C. The additional data point strengthens the appearence of a linear association between the data point

✔ B. The scatter diagram is needed to see if the correlation coefficient is being affected by the pr

Critical Values for Correlation Coefficient

n	
3	0.997
4	0.950
5	0.878

19. What does it mean to say that the linear correlation coefficient between two variables equals 1? What would the scatter diagram look like?

Choose the correct answer below.

- A. When the linear correlation coefficient is 1, there is a perfect horizontal linear relation between the two variables. The scatter diagram would contain points that all lie on a horizontal line.
- ✔ B. When the linear correlation coefficient is 1, there is a perfect positive linear relation between the two variables. The scatter diagram would contain points that all lie on a line with a positive slope.
- C. When the linear correlation coefficient is 1, there is a perfect negative linear relation between the two variables. The scatter diagram would contain points that all lie on a line with a negative slope.
- D. When the linear correlation coefficient is 1, there is no linear relation between the variables. The scatter diagram would contain points that show no discernable relationship.

The linear correlation coefficient is a measure of the strength and direction of the linear relation between two quantitative variables that is always between -1 and 1, inclusive. When the value is 1, it means that there is a perfect positive linear relation between the variables. That means all the data points lie on a straight line with a positive slope.

20. What does it mean if $r = 0$?

Choose the correct answer below.

- A. A linear relationship does exist between the variables.
- B. A relationship does exist between the variables.
- C. No relationship exists between the variables.
- ✔ D. No linear relationship exists between the variables.

21. Suppose that two variables, X and Y, are negatively associated. Does this mean that above-average values of X will always be associated with below-average values of Y? Explain.

Choose the correct answer below.

- A. Yes, because if one or more above-average values of X are associated with above-average values of Y, the variables cannot be negatively associated.
- ✔ B. No, because association does not mean that every point fits the trend. The negative association only means that above-average values of X are generally associated with below-average values of Y.
- C. No, because when two variables, X and Y, are negatively associated, above-average values of X are associated with above-average values of Y.
- D. No, because there will always be at least one point that does not fit the trend.

Two variables that are linearly related are negatively associated when above-average values of one variable are associated with below-average values of the other variable. That is, two variables are negatively associated if, whenever the value of one variable increases, the value of the other variable decreases. However, this association does not require every point to fit the trend. A negative association means that above-average values of X are generally associated with below-average values of Y.

EXTRA

An engineer wanted to determine how the weight of a car affects gas mileage. The following data represent the weight of various cars and their gas mileage.

Car	Weight (pounds)	Miles per Gallon
A	3000	22
B	2770	24
C	2580	27
D	3985	18
E	3565	20

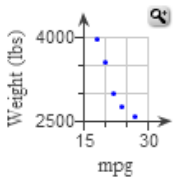
Click the icon to view the critical values table.

(a) Determine which variable is the likely explanatory variable and which is the likely response variable.

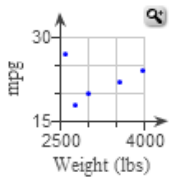
- The explanatory variable is the weight and the response variable is the miles per gallon.
- The explanatory variable is the miles per gallon and the response variable is the weight.

(b) Draw a scatter diagram of the data. Choose the correct scatter plot.

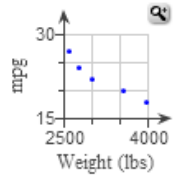
A



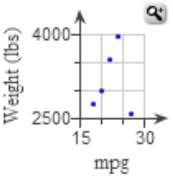
B



C



D



The sample size is 5 so we find critical value for n=5 *Make sure you get the number count in your sample for n value then the 0.878 is the nth position in the original table.

(c) Compute the linear correlation coefficient between the weight of a car and its miles per gallon.

$r \approx$ −.960

(Round to three decimal places as needed.)

(d) Comment on the type of relation that appears to exist between the weight of a car and its miles per gallon based on the scatter diagram and the linear correlation coefficient.

Because the correlation coefficient is negative and the absolute value of the correlation coefficient, .960, is greater than the critical value for this data set, 0.878, a negative linear relation exists between the weight of a car and its miles per gallon.

An engineer wanted to determine how the weight of a car affects gas mileage. The accompanying data represe weights of various domestic cars and their gas mileages in the city for a certain model year. Suppose that we a Car 12 to the original data. Car 12 weighs 3,305 pounds and gets 19 miles per gallon. Complete parts (a) throu below.

Click the icon to view the data table.

(a) Draw the scatter diagram with Car 12 included.

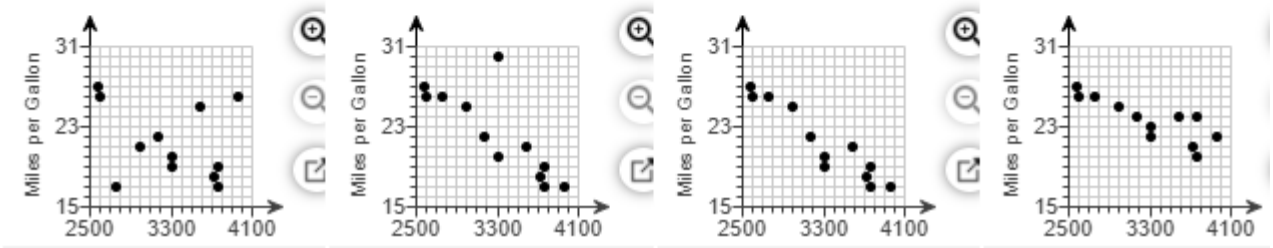
Choose the correct graph below.

Scatter Plot

X variable: Weight (lbs)

Y variable: Miles per Gallon

A. B. C.



9	3310	20
10	2991	25
11	2752	26
12	3305	19

Add car 12 info

(b) Compute the linear correlation coefficient with Car 12 included.

The linear correlation coefficient with Car 12 included is r = −.949.

(Round to three decimal places as needed.)

(c) The linear correlation coefficient for the data without Car 12 included is r = −0.968. Compare the results of parts (a) and (b) to the scatter diagram and linear correlation coefficient without Car 12 included. Why are the results here reasonable?

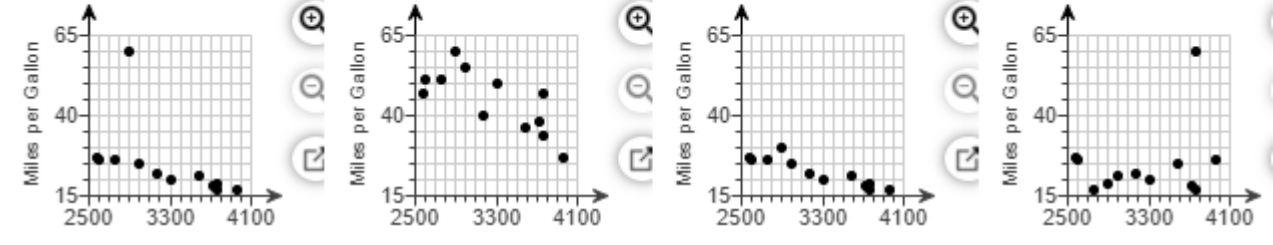
The absolute value of the correlation coefficient did not change significantly and the sign of the correlation coefficient did not change. The results here are reasonable because Car 12 follows the overall pattern of the data.

Add car 13 info and take out car 12 info

10	2991	25
11	2752	26
13	2890	60

(d) Now suppose that Car 13 (a hybrid car) is added to the original data (remove Car 12). Car 13 weighs 2,890 pounds and gets 60 miles per gallon. Redraw the scatter diagram with Car 13 included.

A. B. C. D.



A. Car 13 is a hybrid car, while the other cars likely are not.