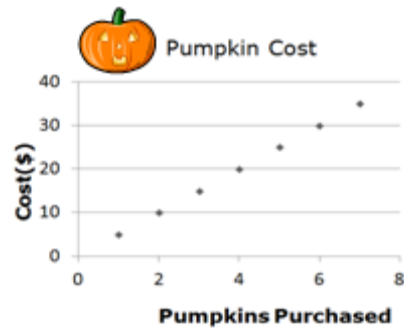
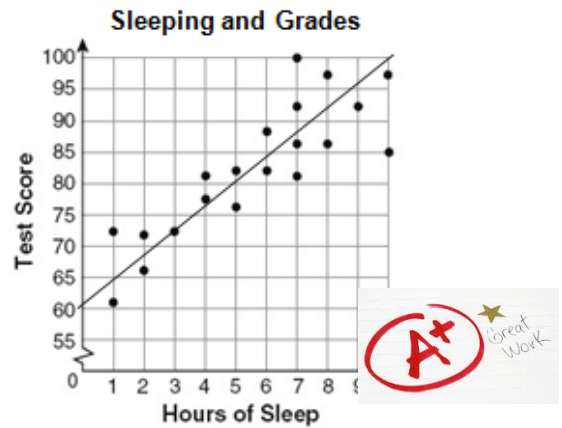
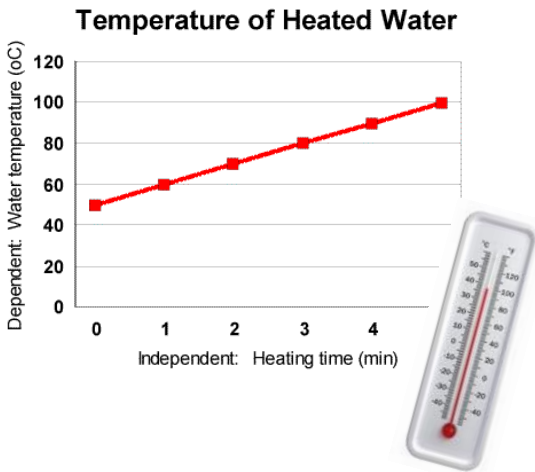


BI-VARIATE DATA

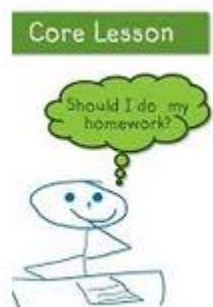


- I can create and analyze linear scatter plots



Middle School Music and Sports Survey

	Plays Team Sport	Does Not Play Team Sport	Total
Plays Instrument	8	3	11
Does Not Play Instrument	2	7	9
Total	10	10	20



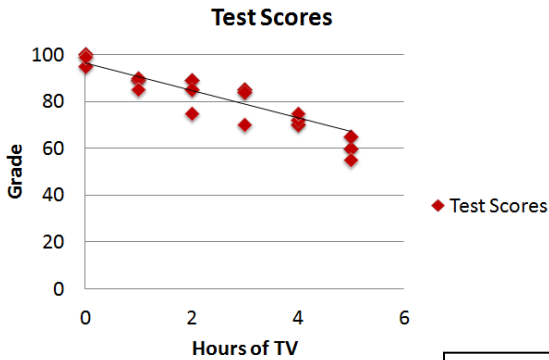
Let's collect some BIVARIATE data!

Name	HW Done	Test Grade
John	5	70
Jose	9	88
Justice	10	100

LEARN ZILLI

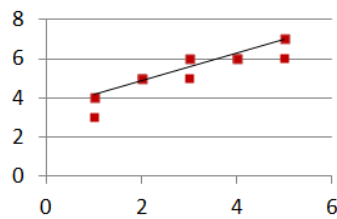
Introducing Scatter Plots

A **scatter plot** is a type of graph that relates two groups of data.

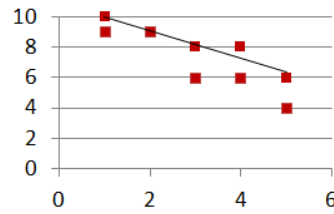


What does this trend tell us about grades and how much TV you watch?

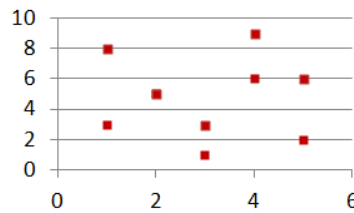
There are 3 kinds of scatter plot correlations:



Positive Correlation – both sets of data increase together.



Negative Correlation – one set of data increases, while the other decreases.

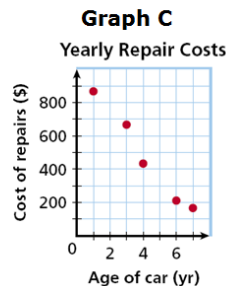
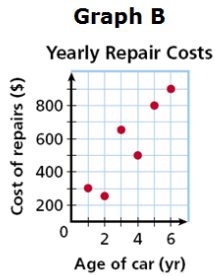
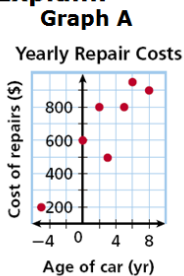


No Correlation – when the data doesn't seem to be related.

What kind of correlation would you expect between the following data sets?

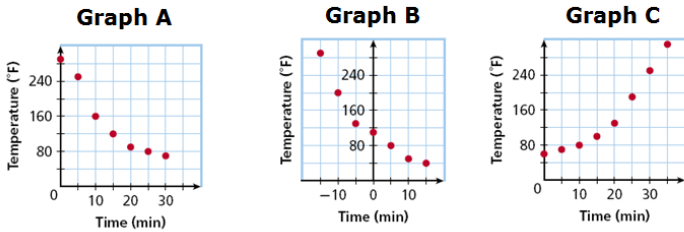
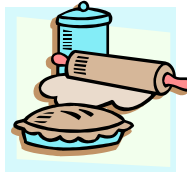
1. A person's age and the number of pets he/she has _____
2. The number of times you brush your teeth and the number of cavities you have _____
3. The number of days it rains in a year and the number of umbrellas sold _____

4. **Choose the scatter plot that best represents the relationship between the age of a car and the amount of money spent each year on repairs. Explain.**



Which graph? _____ Explanation: _____

5. Choose the scatter plot that best represents the relationship between the number of minutes since a pie has been taken out of the oven and the temperature of the pie. Explain.

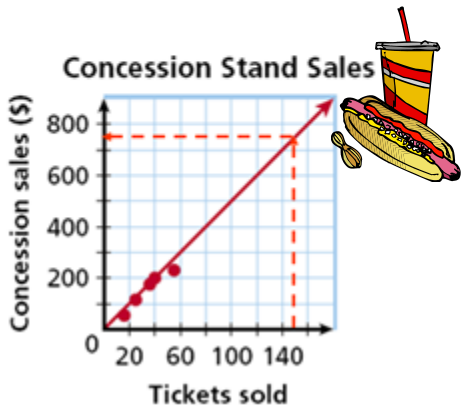
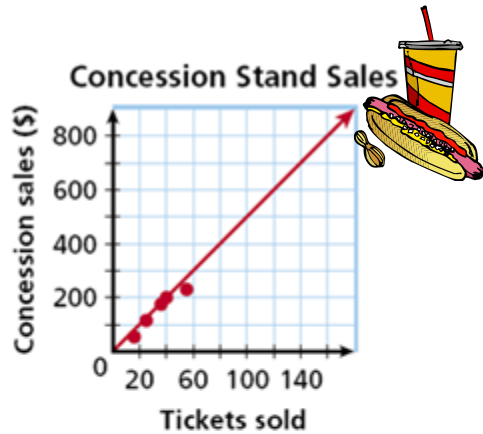


Which graph? _____ Explanation: _____

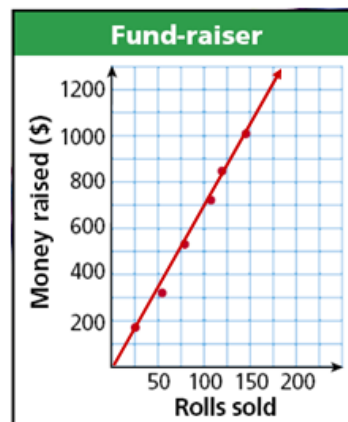
Introducing Trend Lines or Lines of Best Fit

You can graph a function on a scatter plot to help show a relationship in the data. Sometimes the function is a straight line. This line, called a **trend line**, helps show the correlation between data sets more clearly. It can also be helpful when making predictions based on the data.

6. The scatter plot shows a relationship between the total amount of money collected at the concession stand and the total number of tickets sold at a movie theater. Based on this relationship, predict how much money will be collected at the concession stand when 150 tickets have been sold.



7. Based on the trend line, predict how many wrapping paper rolls need to be sold to raise \$500.



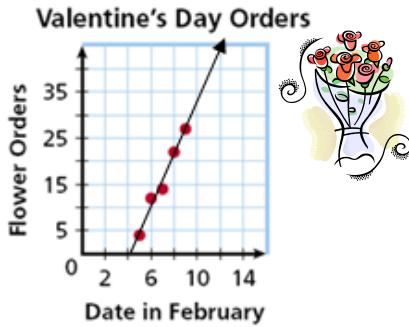
Practice with Scatter Plots

For Items 1 and 2, identify the correlation you would expect to see between each pair of data sets. Explain.

1. The outside temperature in the summer and the cost of the electric bill _____

2. The price of a car and the number of passengers it seats _____

3. The scatter plot shows the number of orders placed for flowers before Valentine’s Day at one shop.



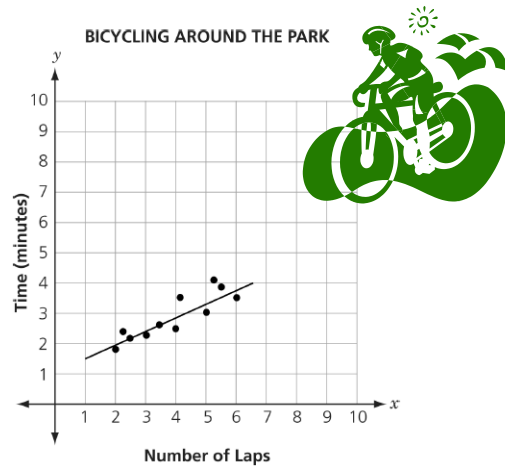
Based on this relationship, predict the number of flower orders placed on February 12.

—

4. A group of friends recorded the time it took to ride their bikes around the park. The scatter plot shows their results with the line of best fit.

Using the line of best fit, which is *closest* to the number of minutes it would take to complete 9 laps?

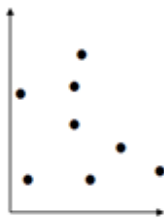
- A. 4 B. 5 C. 6 D. 7



5. The scatter plots of data relate characteristics of children from 0 to 18 years old.

State the **type of correlation** (positive, negative, or none) for each plot and **match** each scatter plot with the appropriate **variables studied**.

- a. age and height
- b. age and eye color
- c. age and time needed to run a certain distance



Type: _____

Circle one:

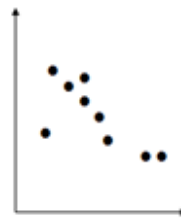
- a. b. c.



Type: _____

Circle one:

- a. b. c.

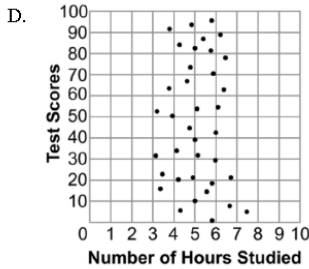
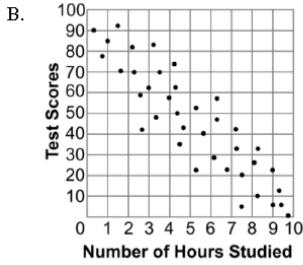
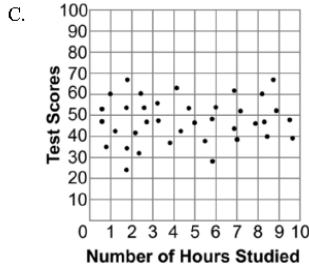
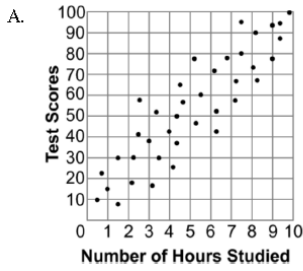


Type: _____

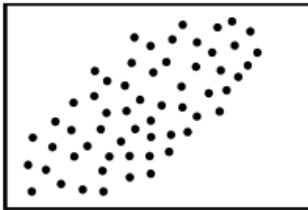
Circle one:

- a. b. c.

6. Which graph best shows a positive correlation between the number of hours studied and the test scores?



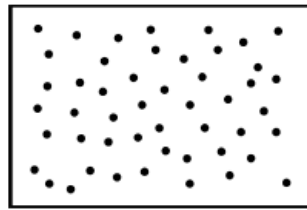
7. Which of the scatter plots suggests a strong negative correlation?



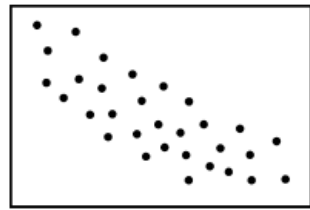
A



B

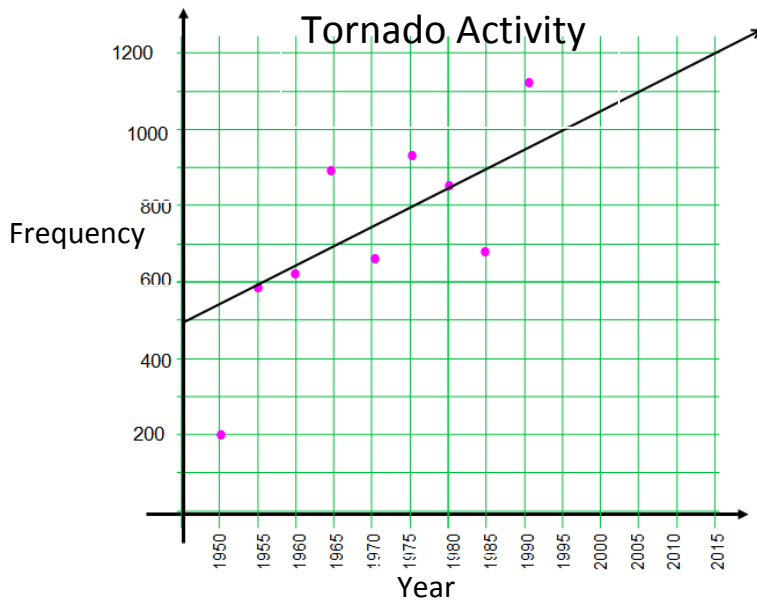


C



D

8. Use the line of best fit to predict how many tornadoes may be reported in the United States in 2015 if the trend continues.



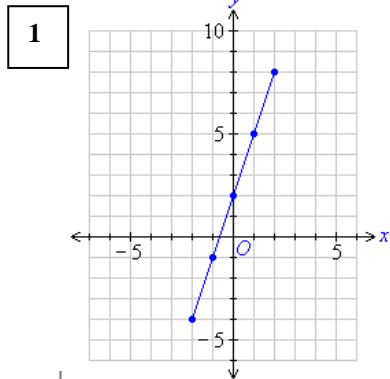
$y = mx + b$

$m = \text{slope}$,
draw your step
 $\frac{\text{rise}}{\text{run}}$

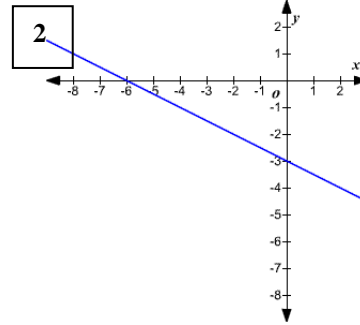
$b = \text{y-intercept}$
where the line
intersects the y-axis

Review Writing an Equation from a Graph

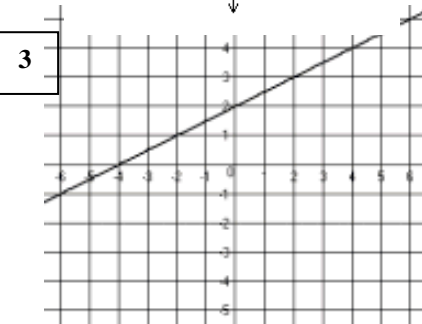
Find the slope of the line, the y-intercept of the line, and write the equation for the line.



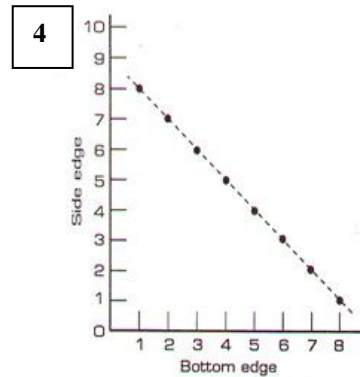
Slope: _____
y-intercept: _____
Equation: _____



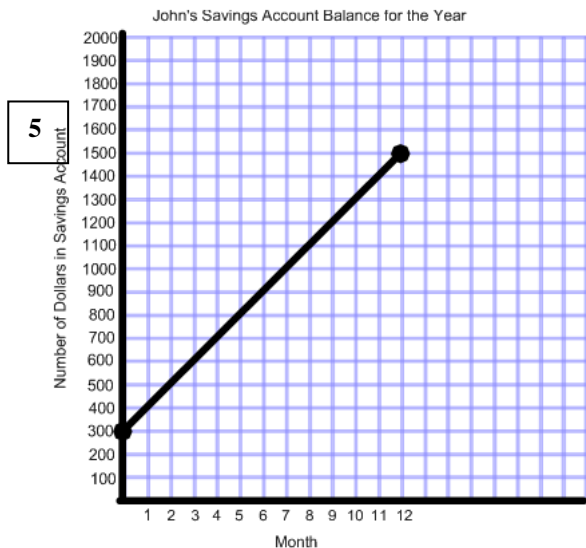
Slope: _____
y-intercept: _____
Equation: _____



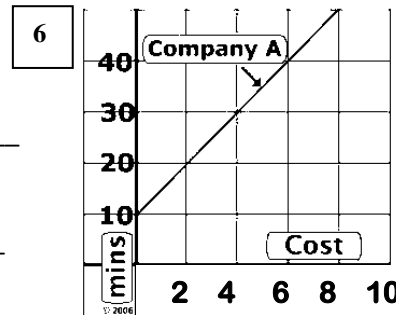
Slope: _____
y-intercept: _____
Equation: _____



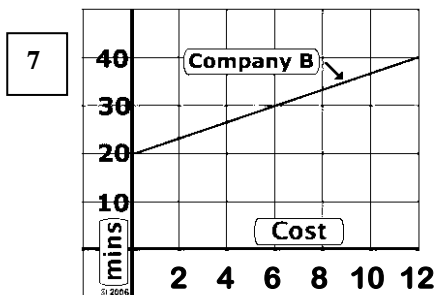
Slope: _____
y-intercept: _____
Equation: _____



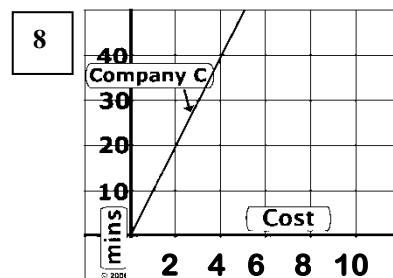
Slope: _____
y-intercept: _____
Equation: _____



Slope: _____
y-intercept: _____
Equation: _____



Slope: _____
y-intercept: _____
Equation: _____



Slope: _____
y-intercept: _____
Equation: _____

Using Scatter Plots to make Predictions

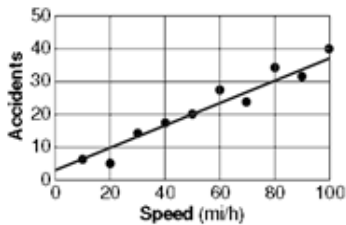
Line of best fit: a line drawn near the points on a scatter plot to show the trend between two sets of data

To draw a line of best fit:

- Draw the line through as many points as you can.
- Try to get an equal number of points above the line as below.
- Ignore any outliers.
- It may happen that none of the points lie on the line.

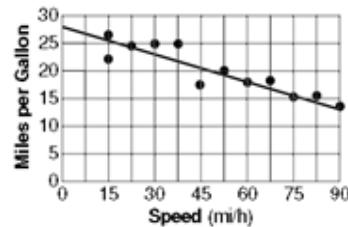
The line of best fit for the data in the scatter plot below slants up, indicating a positive correlation.

The slope of this line of best fit is positive and its y-intercept is about 3.



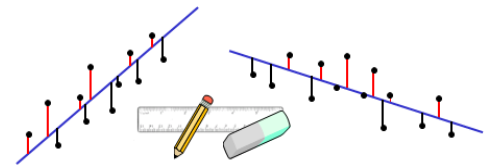
The line of best fit for the data in the scatter plot below slants down, indicating a negative correlation.

The slope of this line of best fit is negative and its y-intercept is about 28.



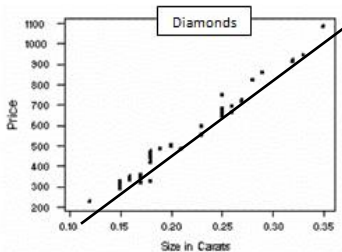
Drawing a Line of Best Fit

A line of best fit can be drawn to data that shows a correlation. The stronger the correlation between the data, the easier it is to draw the line. The line can be drawn by eye and should have roughly the same number of data points on either side.

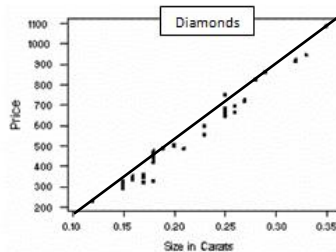


The sum of the vertical distances above the line should be roughly the same as those below.

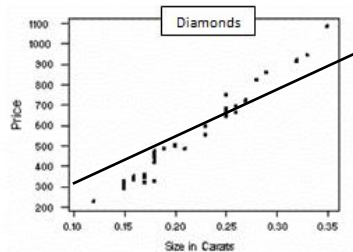
Examples of lines drawn:



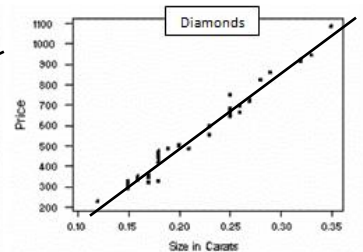
Bad line: too many points above the line



Bad line: too many points below the line



Bad line: not close to most of the points



Good Line

Correlation describes the type of relationship between two data sets. The **line of best fit** is the line that comes closest to all the points on a scatter plot. One way to estimate the line of best fit is to lay a ruler's edge over the graph and adjust it until it looks closest to all the points.

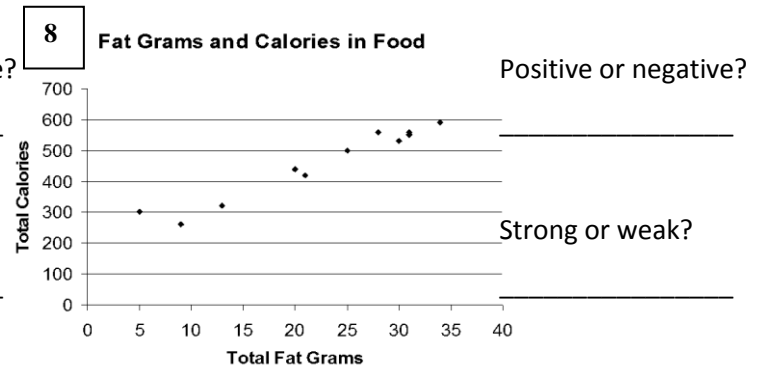
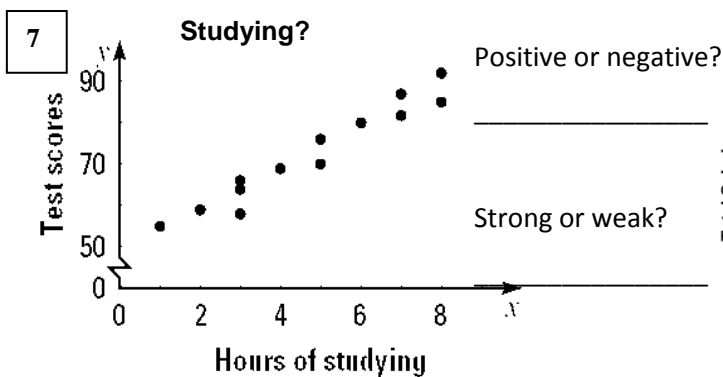
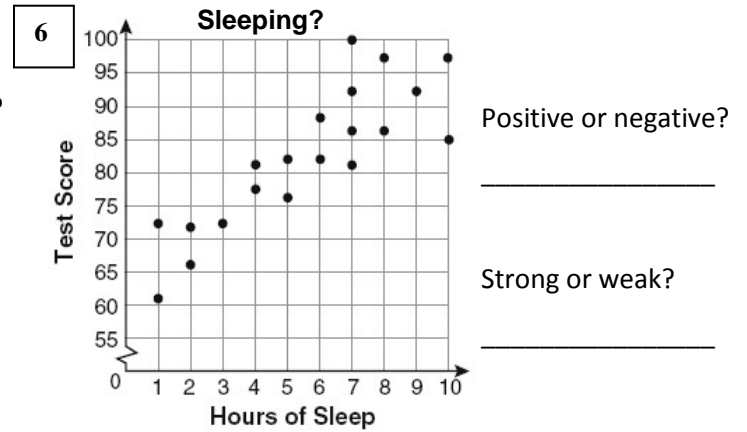
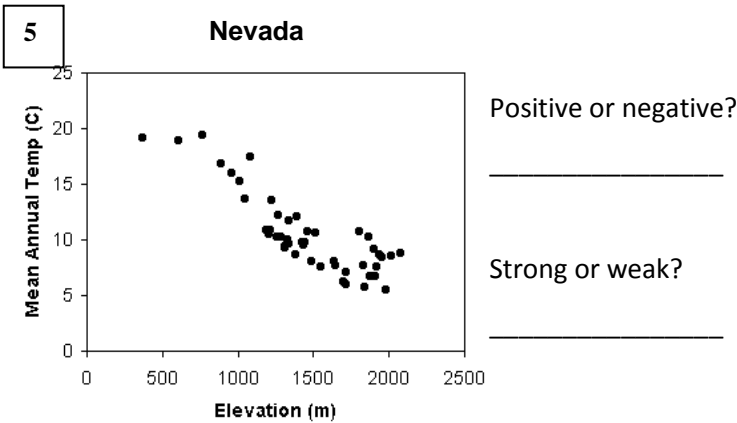
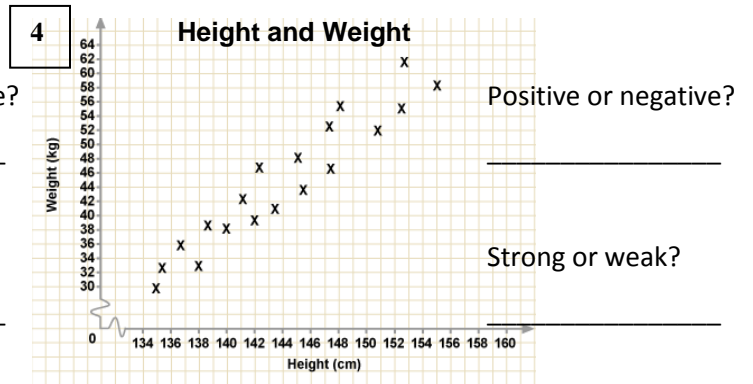
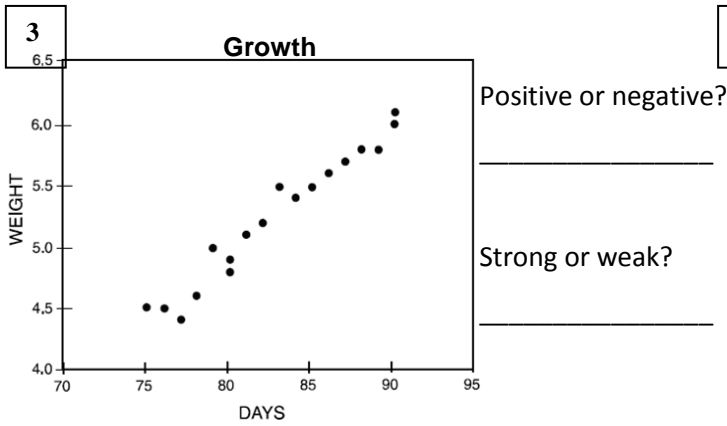
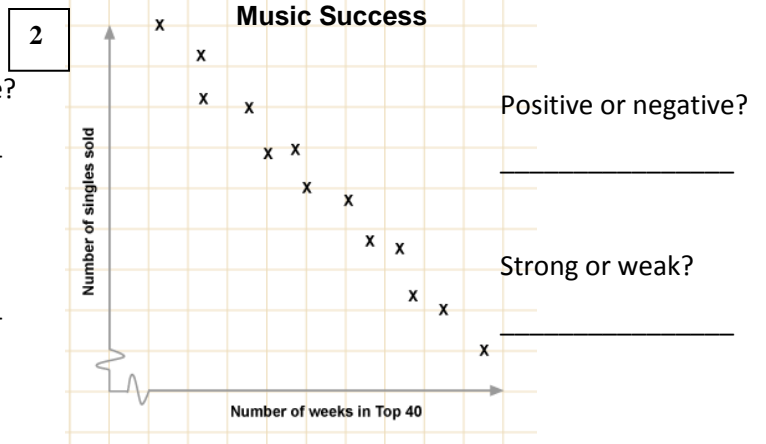
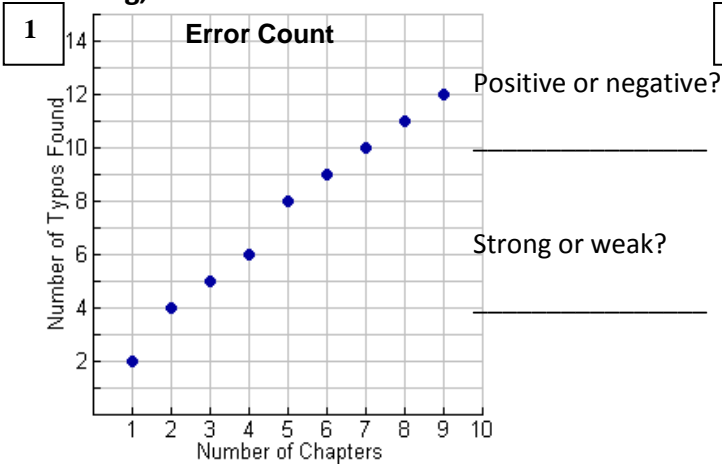


Positive correlation; both data sets increase together.

No correlation; The values don't seem "linked" at all!

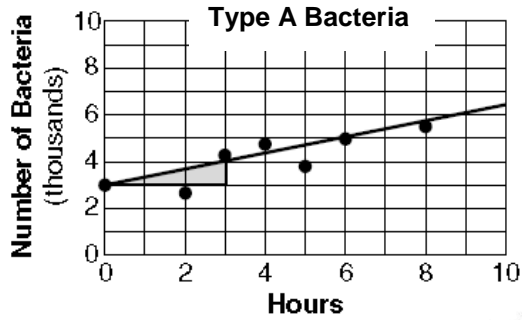
Negative correlation; as one data set increases, the other decreases.

For each scatter plot, draw a line of best fit. State whether the scatter plot has a positive, negative, strong, or weak correlation.



For the next two scatter plots, the trend line is drawn and marked. Find the slope and y-intercept and write an equation for the line. Use your equation to answer the question.

9.

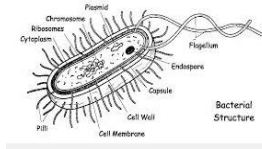


$m = \underline{\hspace{2cm}}$, $b = \underline{\hspace{2cm}}$,

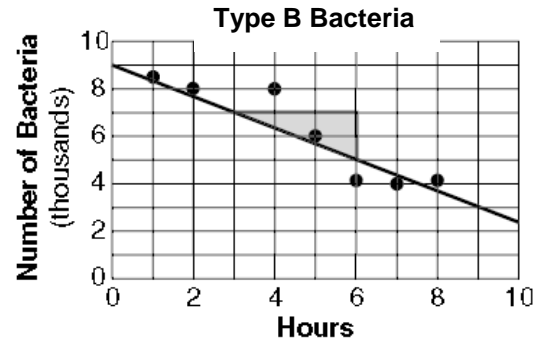
equation: $\underline{\hspace{4cm}}$

The expected number of bacteria after 10 hours is about $\underline{\hspace{2cm}}$.

Show work:



10.



$m = \underline{\hspace{2cm}}$, $b = \underline{\hspace{2cm}}$,

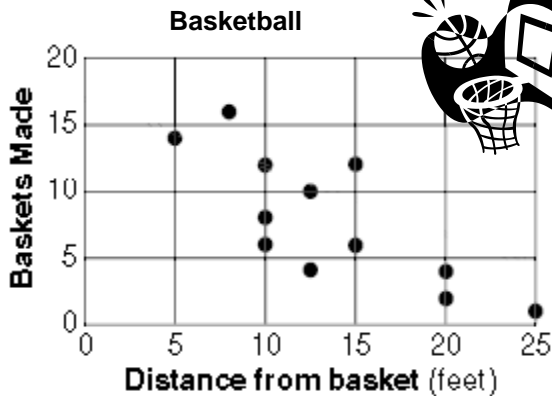
equation: $\underline{\hspace{4cm}}$

The expected number of bacteria after 10 hours is about $\underline{\hspace{2cm}}$.

Show work:

For the next two scatter plots, draw an appropriate trend line. State the slope and y-intercept and write an equation for the line. Use your equation to answer the question.

11.



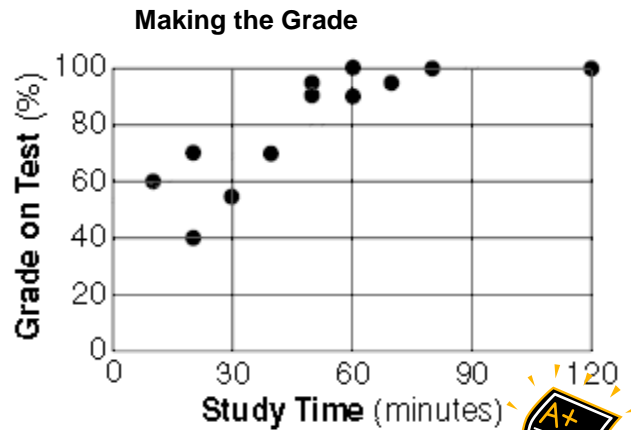
$m = \underline{\hspace{2cm}}$, $b = \underline{\hspace{2cm}}$

equation: $\underline{\hspace{4cm}}$

The expected number of baskets 10 feet from the basket is about $\underline{\hspace{2cm}}$.

Show work:

12.



$m = \underline{\hspace{2cm}}$, $b = \underline{\hspace{2cm}}$

equation: $\underline{\hspace{4cm}}$

The expected grade average on a test you spend 45 minutes studying for is about $\underline{\hspace{2cm}}$.

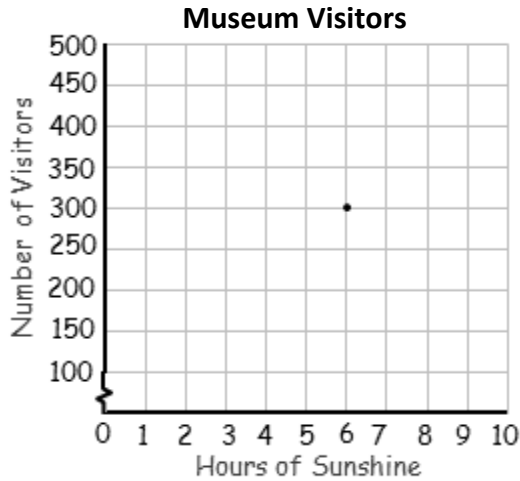
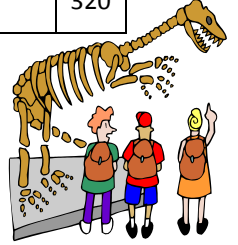
Show work:



13. Create a scatter plot from the data, draw an appropriate trend line. State the slope and y-intercept and write an equation for the line. Use your line of best fit to answer the questions.

The table shows the number of people who visited a museum over a 10 day period last summer together with the daily sunshine totals.

Hours of Sunshine	6	0.5	8	3	8	10	7	5	3	2
# of Visitors	300	475	100	390	200	50	175	220	350	320



$m = \underline{\hspace{2cm}}, b = \underline{\hspace{2cm}}$

equation: $\underline{\hspace{4cm}}$

The number of visitors for 4 hours of sunshine $\underline{\hspace{2cm}}$

The hours of sunshine when 250 people visit. $\underline{\hspace{2cm}}$

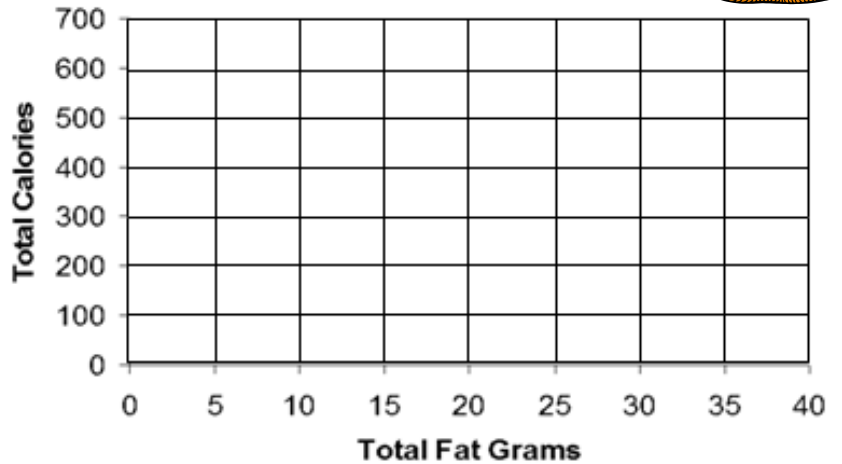
Show work:

14. Create a scatter plot from the data, draw an appropriate trend line. State the slope and y-intercept and write an equation for the line. Use your line of best fit to answer the questions.

The table shows the number of total calories for various sandwiches and their corresponding number of grams of total fat.

Sandwich	Total Fat (g)	Total Calories
Hamburger	9	260
Cheeseburger	13	320
Quarter Pounder	21	420
Quarter Pd with Cheese	30	530
Big Mac	31	560
Arch Sandwich Special	31	550
Arch Special with Bacon	34	590
Crispy Chicken	25	500
Fish Fillet	28	560
Grilled Chicken	20	440
Grilled Chicken Light	5	300

Fat Grams and Calories in Food



$m = \underline{\hspace{2cm}}, b = \underline{\hspace{2cm}}$

equation: $\underline{\hspace{4cm}}$

The number of calories if the sandwich has 40 grams of fat $\underline{\hspace{2cm}}$

The number of grams of fat if the sandwich has 250 calories. $\underline{\hspace{2cm}}$

Show work:

INCOME AND EDUCATION

1. Examine the table to the right. What does the data say?

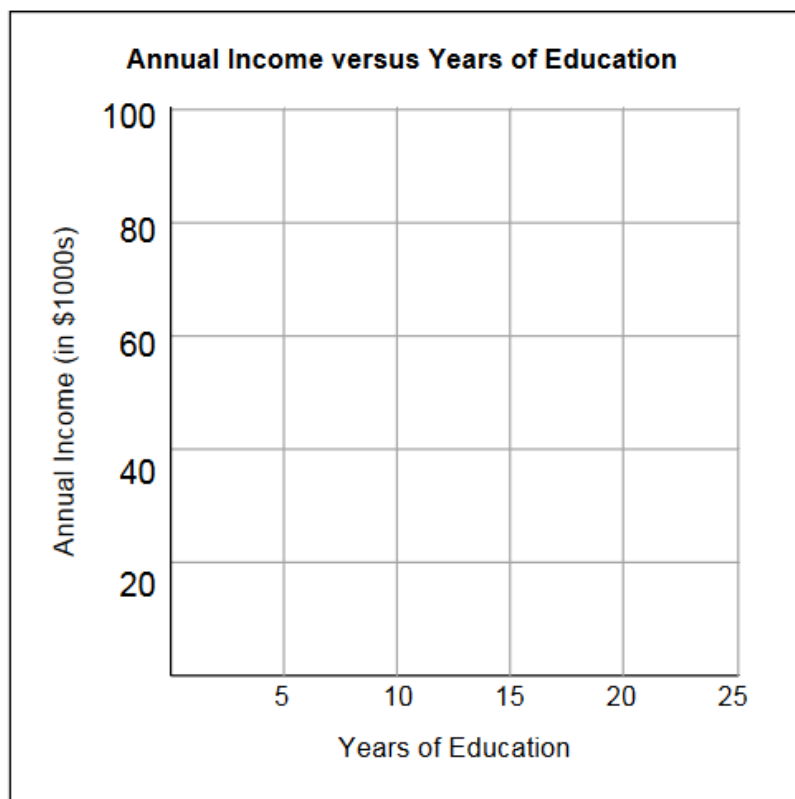
Level of Education	Average Years of Education	Average Annual Income (in \$1000s)
Not a High School Graduate	10	23
High School Graduate	12	32
Some College, No Degree	13	36
Associate Degree	14	38
Bachelor Degree	16	53
Master Degree	17	63
Doctorate Degree	20	81

2. Write sentences to describe what these ordered pairs from the table represent.

a. (12, 32):

b. (20, 81):

3. Graph of the data from the table.
4. Describe the shape of the graphed data.



UNEMPLOYMENT AND EDUCATION

1. Examine the table to the right. What does the data say?

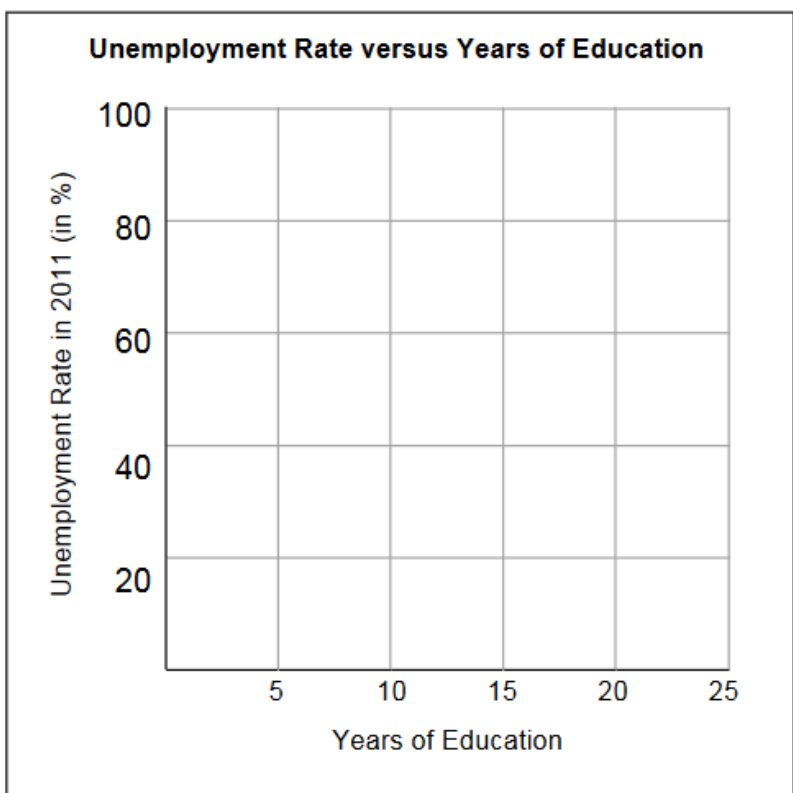
Level of Education	Average Years of Education	Unemployment Rate (in %)
Not a High School Graduate	10	14.1
High School Graduate	12	9.4
Some College, No Degree	13	8.7
Associate Degree	14	6.8
Bachelor Degree	16	4.9
Master Degree	17	3.6
Doctorate Degree	20	2.4

2. Write sentences to describe what these ordered pairs from the table represent.

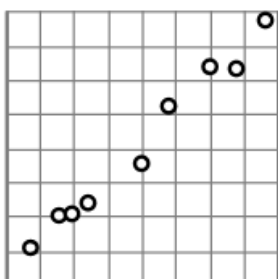
c. (10, 14.1):

d. (20, 2.4):

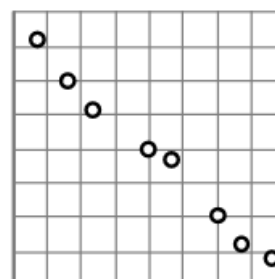
3. Graph of the data from the table.
4. Describe the shape of the graphed data.



1. With your teacher's help, describe the association for each graph below.



We say the linear association is **strong** if it "clusters around a line."



_____ association

_____ association

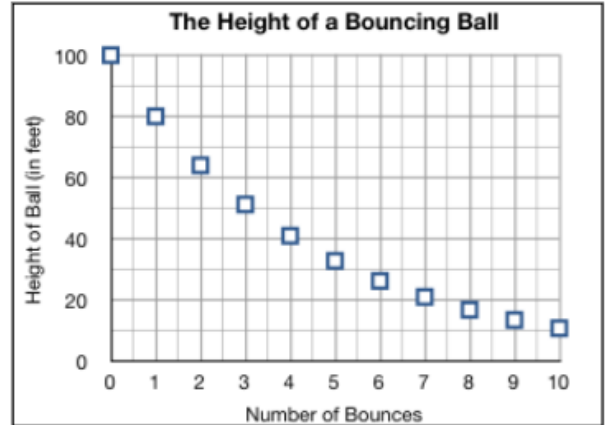
Use the "Income and Education" data:	Use the "Unemployment and Education" data:
<p>2. Does the association between income and education appear to be strong? Explain.</p> <p>3. What kind of association does there appear to be between income and education? _____.</p> <p>4. In general, we can say that the _____ education people have, the <u>more</u> income they will likely earn.</p> <p>5. In general, we can also say that the <u>less</u> education people have, the _____ income they will likely earn.</p>	<p>6. Does the association between Unemployment and Education appear to be strong? Explain.</p> <p>7. What kind of association does there appear to be between Unemployment and Education? _____.</p> <p>8. In general, we can say that the _____ education people have, the <u>more</u> likely they could be unemployed.</p> <p>9. In general, we can also say that the <u>more</u> education people have, the _____ likely they could be unemployed.</p>

10. What are some possible reasons why these associations might exist?

NONLINEAR ASSOCIATIONS

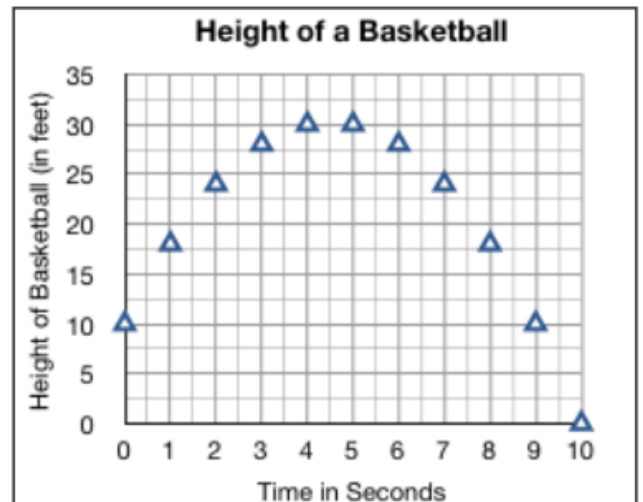
Here are two examples of bivariate measurement data that are not linear.

The graph on the right shows the height of a bouncing golf ball measured at the top of each bounce.



1. What does the data point (2, 64) mean in the context of the problem?
2. Do there appear to be any outliers in the data? Explain.
3. What does the data say?
4. Would a linear model be a good model for this graph? Explain.

The graph on the right below the height of a basketball measured over a period of time after it is thrown in the air.



5. What does the data say?
6. Why would a line not be a good model for this pattern?