Name _____     Period _____     Date _____

**MathLinks**

**8-10**
**STUDENT PACKET**

**MATHLINKS GRADE 8**
**STUDENT PACKET 10**
**BIVARIATE DATA**

# WORD BANK

| Word | Definition | | Example or Picture |
|------|-----------|---|-------------------|
| association | | | |
| bivariate data | | | |
| categorical data | | | |
| frequency table | | | |
| line of best fit | | | |
| measurement data | | | |
| numerical data | | | |
| relative frequency table | | | |
| two-way table | | | |

# CATEGORICAL DATA

| Summary (Ready) | Goals (Set) |
|---|---|
| We will use two-way tables to display the frequencies and relative frequencies of categorical data.  We will examine patterns of association in bivariate categorical data.  We will draw conclusions about possible associations. | • Construct two-way frequency and relative frequency tables using bivariate data.<br>• Interpret two-way frequency tables.<br>• Conduct a survey. |

### Warmup (Go)

Numerical data is data consisting of numbers.

Below are some data about Ms. Robertson's 8th grade math class.

| | |
|---|---|
| • Number of boys……………………………………….....… | 12 |
| • Number of girls……………………………………………… | 18 |
| • Number of students who ate breakfast this morning……. | 20 |
| • Number of students who passed the math test today...… | 25 |

Use the data to answer the questions below.

1. How many students are in the class?  $n =$ _____

2. What percent of the students in the class are boys? _____

   What percent of the students in the class are girls? _____

   Why must the sum of these percents equal 100%?


3. What percent of the students ate breakfast this morning? _____

   What percent of the students passed the math test today? _____

   Why is it possible that the sum of these percents doesn't equal 100%?

# WHAT IS CATEGORICAL DATA?

> Categorical data is data sorted into categories, such as colors,
> ranges of measurements, or other attributes of the data.
> Generally there are only finitely many categories.

1. For each topic below, list categories for organizing collected data. Then create a possible survey question that you could use to collect data for each category.

| Topic | Possible Categories | Possible Survey Question(s) |
|---|---|---|
| Example: Hair color | Black, brown, blonde, red, other | What color is your hair? OR Do you have dark hair? |
| Music | | |
| Art | | |
| Fruit | | |
| Ecosystems | | |

2. If you were reading a table that had categorical data labeled "swimming," "football," and "basketball," what might be the larger topic that is being explored?

3. Choose a topic that you could collect data about and list possible categories related to that topic.

Topic: _____

Categories:

# CATEGORICAL QUESTIONS

<u>Categorical survey questions</u> are used to collect categorical data.  These questions usually have word responses.  For example, "Do you own at least one dog?" is a categorical survey question because the answer is either "yes" or "no."

<u>Numerical survey questions</u> are used to collect numerical data.  Numerical data sometimes comes from counting.  It can sometimes come from measurements.  These questions usually have number responses.  For example, "How many dogs do you own?" is a numerical survey question because the answer is a number like zero or five.

<u>State whether each question in the table below</u> is a categorical or numerical survey question.

| Question | | Categorical (C) or Numerical (N)? |
|---|---|---|
| 1.  Are you male or female? | | |
| 2.  What is your favorite color? | | |
| 3.  How many dress shirts do you own? | | |
| 4.  Are you an only child? | | |
| 5.  How many siblings do you have? | | |
| 6.  What were the class scores on the test? | | |
| 7.  What types of birds did we observe today? | | |
| 8.  What are the average family incomes of different cities in my state? | | |

9.  State whether the question is categorical or numerical.  Then rewrite the question in the other form.

   "How many video games do you own?"  Type: _____

   Rewritten in other form:


10. Create a categorical question and then rewrite it as a numerical question.

# BIVARIATE CATEGORICAL DATA

Bivariate data is data that has two variables based on the same population.

The results of an 8<sup>th</sup> grade survey about favorite color are below.

|  | **Pink** | **Red** | **Blue** | **Purple** | **TOTAL** |
|---|---|---|---|---|---|
| **Boys** | 2 | 10 | 10 | 3 | |
| **Girls** | 8 | 2 | 3 | 7 | |
| **TOTAL** | | | | | |

1.    Complete the table by finding totals for the rows and the columns.

2.    How many students total were surveyed?  $n =$ _____

3.    How many girls were surveyed?  _____

4.    What percent of girls preferred pink?  _____

5.    How many boys were surveyed?  _____

6.    What percent of boys preferred pink?  _____

7.    How many students preferred pink?  _____

8.    What percent of the students who preferred pink are girls?  _____

9.    What percent of the students who preferred pink are boys?  _____

10.   Compare the **questions** from problems 4 and 8.  How are they different?

11.   Compare your **answers** from problems 4 and 8.  Why are they different?

12.   The table above is called a two-way table.  Explain what you think a two-way table is in your own words.
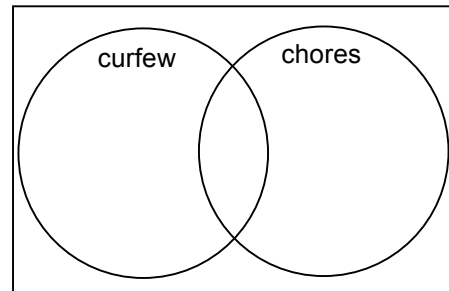
# CHORES AND CURFEWS

Ten different 8$^{th}$ graders were asked the following questions:

- Do you have a curfew?
- Are you assigned chores at home?

Data was collected on their responses and recorded in the table below.

| | Students A through J | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J |
| Curfew | Yes | No | No | Yes | Yes | No | Yes | No | No | Yes |
| Chores | Yes | No | Yes | Yes | No | No | Yes | Yes | No | Yes |

1. Use the sections in the Venn diagram to record the number of students in each category. Be sure to include the number of students with neither chores nor curfew outside of the circles.



2. How many students were surveyed? _____
This is called the number of observations (*n*) or sample size for the survey.

3. How many students surveyed had chores? _____

4. How many students surveyed had a curfew? _____

5. What percent of students had both chores and a curfew? _____

6. What percent of students had neither chores nor a curfew? _____

7. What percent of students who had chores also had a curfew? _____

8. What percent of students who had a curfew also had chores? _____

9. Madhav thinks that most students have both a curfew and chores. Does the data support Madhav's claim? Explain.

# TWO-WAY FREQUENCY TABLES

> A frequency table is a table that lists items and the number of times they occur in a data set.

A two-way frequency table is useful for displaying bivariate categorical data.

1.  Use the data on the previous page to complete the table.

| | Students with **Curfew** | Students with **No Curfew** | **TOTAL** |
|---|---|---|---|
| Students with **Chores** | | | |
| Students with **No Chores** | | | |
| **TOTAL** | | | |

Based on this table:

2.  Circle the number that indicates the sample size for the whole survey.

    What percent of all students had chores? _____

3.  Draw a square around the number that indicates the total number of students who had chores.

    What percent of students who had chores also had a curfew? _____

4.  Draw a triangle around the number that indicates the total number of students who did not have a curfew.

    What percent of the students who did not have a curfew also did not have chores?

    _____

5.  Draw a parallelogram around the number that indicates the total number of students who had a curfew.

    What percent of students who had a curfew also had chores? _____

6.  Raji thinks that most students who had chores were more likely to have a curfew. Does the data support Raji's claim? Explain.

# RELATIVE FREQUENCY TABLES

A frequency table with raw data can be used to create a <u>relative frequency table</u> that contains percents. The strength of any association or relationship between two variables can be easier to describe using percents.

1. Here is one way to create a relative frequency table about curfews and chores.  Use data from the previous page to complete the table.

**Table 1: Curfew and Chores**

|  | **Curfew** | **No Curfew** | **TOTAL** |
|---|---|---|---|
| **Chores**<br>(*n* = ____) |  |  | 100% |
| **No Chores**<br>(*n* = 4) | $\frac{1}{4}$ = 25% |  | 100% |

2. Here is another way to create a relative frequency table about curfews and chores.  Use data from the previous page to complete this table.

**Table 2: Curfew and Chores**

|  | **Curfew**  (*n* = 5) | **No Curfew** (*n* = _____ ) |
|---|---|---|
| **Chores** |  |  |
| **No Chores** | $\frac{1}{5}$ = 20% |  |
| **TOTAL** | 100% | 100% |

3. Circle the percent of students with both curfews and chores in each table.  Why is this percent different in the two tables?


4. Raji thought that students who had chores were more likely to have a curfew as well.  Do these relative frequency tables support her claim? ____  Explain.


5. Barbara states, "Of the students who were surveyed, students without curfews are less likely to have chores compared to those with a curfew."

   Draw squares around the percents that show the association between not having a curfew and not having chores.  Then determine if Barbara's reasoning is correct.

# ATHLETES AND GRADES

Jose collected data on the grades of athletes in his high school. He asked 500 students the following questions:

- Did you play a varsity sport last semester?
- Did you make honor roll last semester?

1. Jose lost some of his work. Help him figure out the missing values in his frequency table, and then record data in the Venn diagram.

**Academics and Athletics**

|  | sport | no sport | TOTAL |
|---|---|---|---|
| **honor roll** | 110 | | 240 |
| **no honor roll** | | 220 | |
| **TOTAL** | 150 | | 500 |
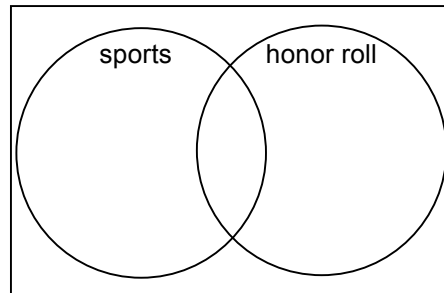


2. Complete these relative frequency tables for Jose's data.

**Table 1:**
**Do Athletes Earn Better Grades?**

|  | sport | no sport | TOTAL |
|---|---|---|---|
| **honor roll** (n = ____) | | | 100% |
| **no honor roll** (n = ____) | | | 100% |

**Table 2:**
**Do Athletes Earn Better Grades?**

|  | sport (n = ____) | no sport (n = ____) |
|---|---|---|
| **honor roll** | | |
| **no honor roll** | | |
| **TOTAL** | 100% | 100% |

3. Jose's conjecture was that students who played sports had a greater likelihood of making the honor roll compared to students who do not play sports.

Explain why the **relative** frequency tables make this association easier to see compared to the frequency table and Venn diagram above.

# ATHLETES AND GRADES (Continued)

4. Which relative frequency table (1 or 2) can be used to answer the question,  "What percent of students who made honor roll also played a sport?" _____

   Answer the question:  _____%

   Write another question that can be answered from this table and answer it.

5. Which relative frequency table (1 or 2) can be used to answer the question,  "What percent of students who played sports did not make the honor roll? _____

   Answer the question:  _____%

   Write another question that can be answered from this table and answer it.

6. Jose's conjecture was that students who played sports had a greater likelihood of making the honor roll compared to students who do not play sports.
   Which of the percentages in the relative frequency tables best support his argument? Explain.

7. Jose is going to present to the school board and argue against proposed budget cuts to the athletic program.  What are three statistics that he could use in his presentation to show that participation in athletics helps support academic success?

# NUMERICAL  DATA

| Summary (Ready) | Goals (Set) |
|---|---|
| We will construct scatter plots for bivariate numerical data.  We will investigate various patterns of association in bivariate data.  We will interpret scatter plots. | • Construct scatter plots.<br>• Describe various patterns of association in bivariate data.<br>• Interpret and draw conclusions from scatter plots. |

## Warmup (Go)

Identify each question in the table below as Categorical (C) or Numerical (N).  Then change each categorical question into a related numerical question and each numerical question into a related categorical question.

| Question | Categorical (C) or Numerical (N)? | Related question rewritten in the other form |
|---|---|---|
| Example:<br>Do you have a college degree? | C | N:<br>How many years did you go to school? |
| 1.  How much money do you earn? | | |
| 2.  Do you own your home? | | |
| 3.  Do you exercise every week? | | |
| 4.  How many miles did you walk today? | | |

# INCOME AND EDUCATION

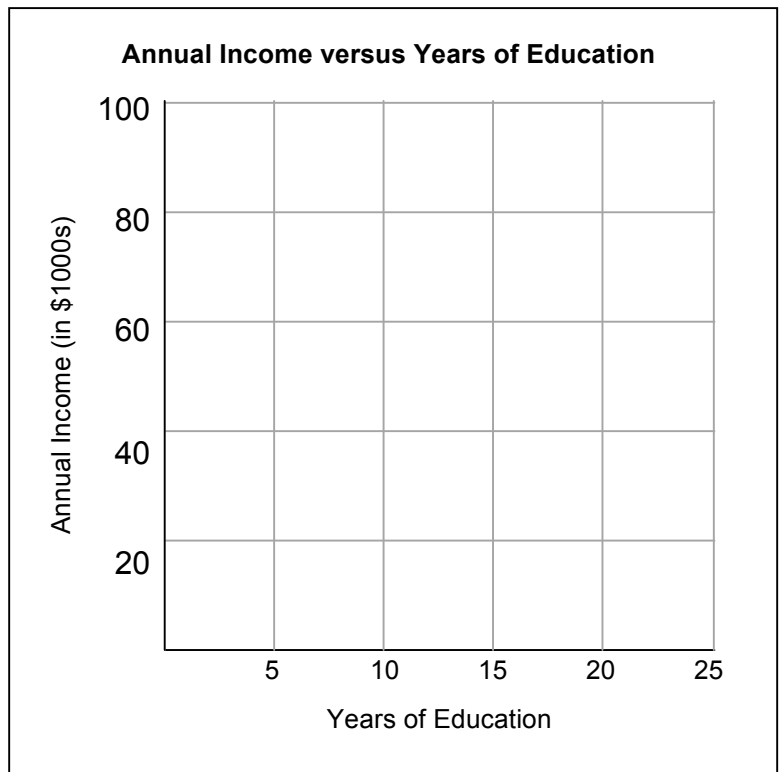1. Examine the table to the right. What does the data say?

| 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 the data from the table.

4. Describe the shape of the graphed data.

**Annual Income versus Years of Education**

Annual Income (in $1000s)

Years of Education

# 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.
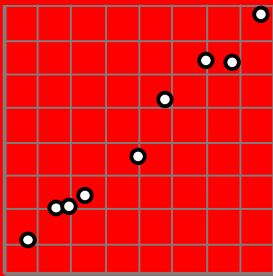
   c. (10, 14.1):

   d. (20, 2.4):

3. Graph the data from the table.

4. Describe the shape of the graphed data.
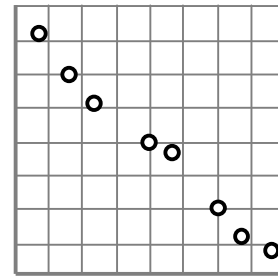
**Unemployment Rate versus Years of Education**
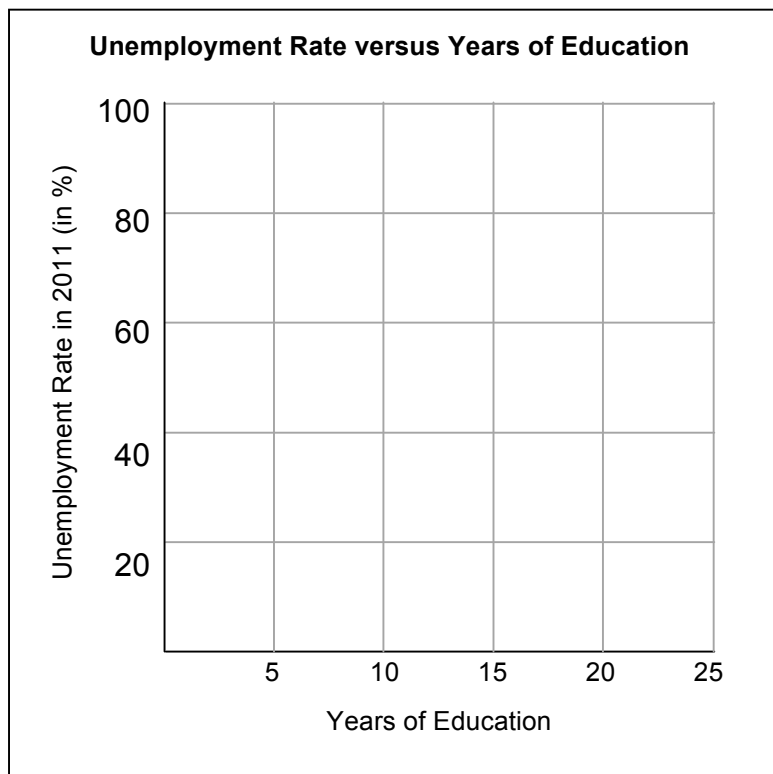
# DESCRIBING LINEAR ASSOCIATION

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

We say the data suggests
a **strong** linear association
if it "**clusters along a line**."
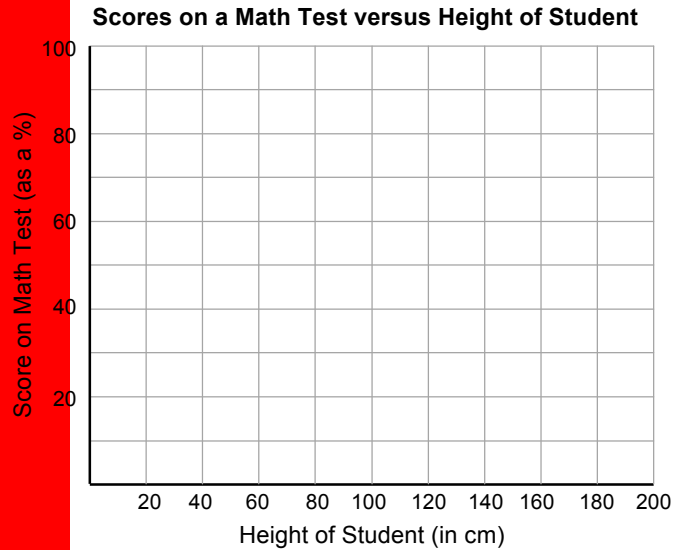
_____ association

_____ association

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

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

# DESCRIBING LINEAR ASSOCIATION (Continued)

11. Examine the table below.  Then make a scatter plot of the data.

**Scores on a Math Test versus Height of Student**

| Height of Student (in cm) | Score on Math Test (as a %) |
|:---:|:---:|
| 150 | 50 |
| 130 | 30 |
| 140 | 70 |
| 120 | 90 |
| 180 | 40 |
| 100 | 80 |
| 150 | 95 |
| 120 | 55 |

We say the association is **weak** or **does not exist** if the data "**clusters in a cloud**."

12. Does there appear to be an association between the scores on the math test and the height of a student?  Explain.

---

13. Examine the pairs of variables below.  What kind of association (if any) do you think might exist for each pair?  Be prepared to share your reasoning with others.
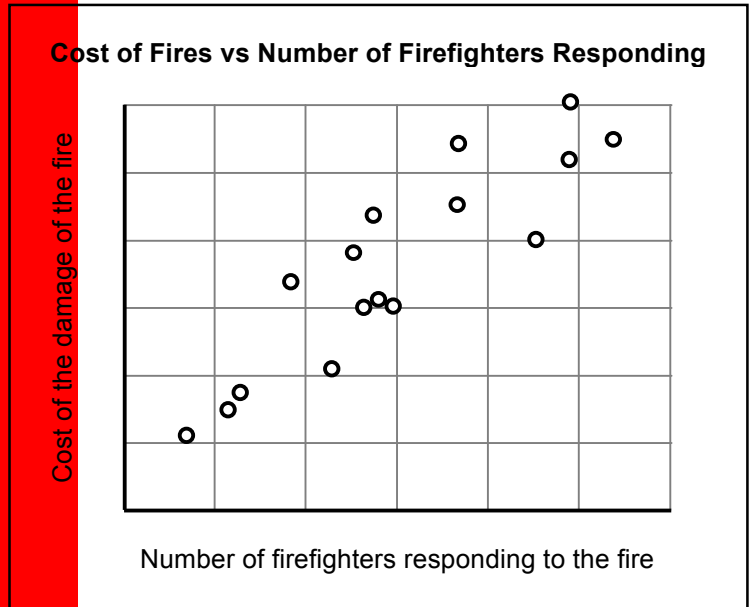
| Pairs of variables | Kind of association (if any) |
|---|---|
| Number of sodas consumed and number of cavities. | |
| Age and quality of eyesight. | |
| Number of traffic tickets and cost of car insurance. | |
| Shoe size and number of pets at home. | |
| Life expectancy and income. | |

14. What are some other examples of variables that might have positive or negative associations?

# ASSOCIATION DOES NOT IMPLY CAUSATION

1. What variables are
   compared on this graph?

**Cost of Fires vs Number of Firefighters Responding**

2. What does the data tell you?

Cost of the damage of the fire

Number of firefighters responding to the fire

If two variables are associated, there is often some connection between them that can explain the association. **However, association does not imply causation!**

3. Chase said, the graph shows "Firefighters cause damage because the more firemen who respond to a fire alarm, the more costly the damage of the fire."

   a. What is wrong with Chase's statement?

   b. What other variable *might* be a cause of the association between cost of the damage and the number of firefighters?
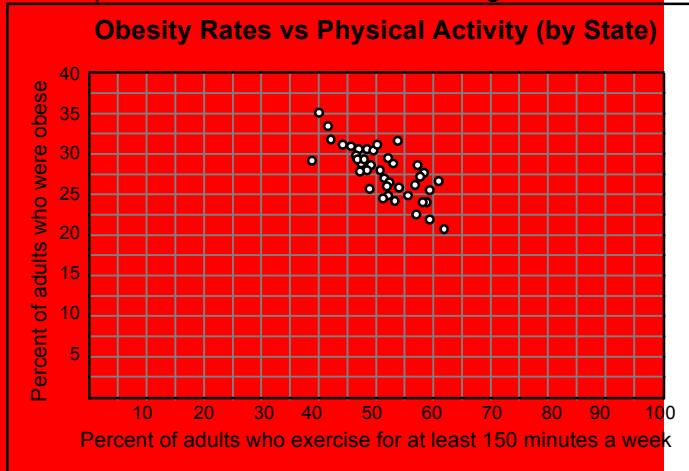
These statements confuse association with causation. For each statement, list other factors that *might* be a cause for the association.

| Example | Other possible causes |
|---|---|
| 4. People who walk faster tend to live longer. Therefore, if you want to live longer, walk faster. | |
| 5. As sales of ice cream increase, the rate of drowning deaths increases.  Therefore, ice cream causes people to drown. | |
| 6. The more cell phones a country has, the longer the life expectancy of people in that country. Therefore, cell phones cause you to live longer. | |

# OBESITY AND EXERCISE

The graph below compares data on exercise and obesity for 46 states. Data for the remaining 4 states is shown in the table.

1. Graph the data for the remaining states.

**Obesity Rates vs Physical Activity (by State)**



Percent of adults who were obese

Percent of adults who exercise for at least 150 minutes a week

| State | Exercise Rate (%) | Obesity Rate (%) |
|---|---|---|
| Washington | 54.3 | 26.5 |
| West Virginia | 43.1 | 32.4 |
| Wisconsin | 57.5 | 27.7 |
| Wyoming | 53.3 | 25.0 |

2. Explain what Washington's data point (54.3, 26.5) means in the context of the problem.


3. Describe any association that can be seen in the graph.



4. Fill in the blanks with "higher" or "lower" so that the statements accurately reflect the association.

   States that have a higher exercise rate tend to have a _____ obesity rate.
   States that have a _____ exercise rate tend to have a higher obesity rate.

5. On July 10, 2012, the *New York Times* published an article titled "Despite Obesity Concerns, Gym Classes Are Cut."

   Is this headline related to the graph above? Explain.

# LINES OF BEST FIT

| Summary (Ready) | Goals (Set) |
|---|---|
| We will construct linear models for measurement and other numerical data clustered around a straight line.  We will draw lines of best fit.  We will estimate an equation for the line of best fit.  We will use the equation as a model to make predictions. | • Draw lines of best fit and estimate their equations.<br>• Interpret the slope and *y*-intercept of linear models in context of the data.<br>• Use linear models to make predictions.<br>• Explore the effect that potential outliers have on data patterns.<br>• Distinguish between linear and nonlinear association. |

## Warmup (Go)

1.  What are the coordinates for points *A* and *B*?

    *A* ( _____, _____ )        *B* ( _____, _____ )

2.  Use a straightedge to draw a line that goes through both points and extends to the left and right of the points.

3.  Use the graph to find the missing value of each point on the line listed below.

    (6, _____ )    (3, _____ )    ( _____, 7)
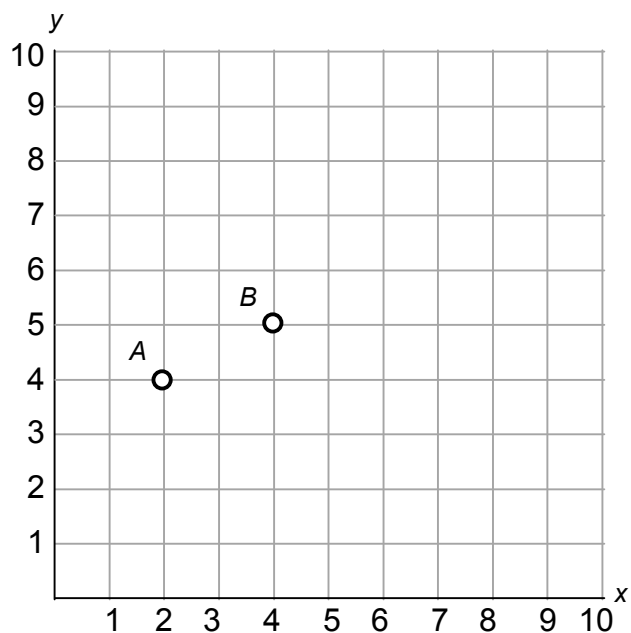
4.  The line through *A* and *B* has slope = _____ and *y*-intercept = _____.

5.  Write an equation for this line. _____

6.  Substitute each ordered pair from problem 3 into this equation to prove that they are on the line.

|  |  |  |
|---|---|---|
|  |  |  |

# A MODEL FOR PLANT GROWTH

Measurement data is data that comes from making measurements.

A line of best fit for a scatter plot is a straight line that best represents (in some sense) the data points in the scatter plot.

The table shows bivariate measurement data of the height of a plant (in cm) over a period of weeks.

| Time (in weeks) | Height (in cm) |
|-----------------|----------------|
| 1               | 3              |
| 2               | 7              |
| 4               | 10             |
| 6               | 19             |
| 7               | 21             |
| 8               | 25             |
| 10              | 29             |



The Height of a Plant Over Time
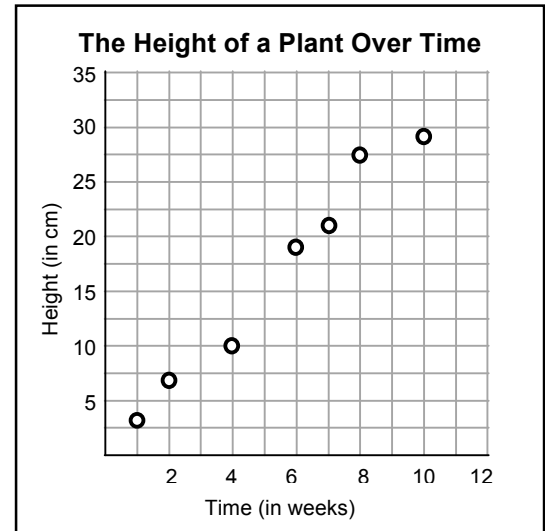
1.  Explain what the data say.

2.  Draw a straight line through (1, 3) and (7, 21). Does this line capture the overall trend in the data?  Explain.

3.  Use a colored pencil to draw a line through the points (2, 7) and (4, 10). Is this a good line of best fit?  Explain.

4.  Use a different colored pencil to draw a line through the points (3, 8) and (9, 27).  Does this represent a good line of best fit?  Explain.

# A MODEL FOR PLANT GROWTH (Continued)

Linear functions can be used to model bivariate measurement data that have positive or negative associations. These linear models help us understand the data and make predictions.

5.  Use the line through (1, 3) and (7, 21) to estimate how tall the plant will be

    after 12 weeks. _____

    Use the same line to estimate how tall the plant will be after 50 weeks. _____

6.  Use the coordinates (1, 3) and (7, 21) to find a linear function that could model the growth of the plant. Write the function in slope-intercept form.

7.  Explain what the slope of this line represents in the context of this problem.

8.  Explain what the $y$-intercept of this line represents in the context of this problem.

Use your model (linear function) to answer the following questions.

9.  How tall will the plant be in 50 weeks?

10. How long will it take your plant to grow to a height of 2 meters (200 cm)?

# INCOME AND EDUCATION REVISITED

The income and education data from the previous lesson is reproduced in the table below along with a scatter plot of the data showing two student examples of lines of best fit.

| Average Years of Education | Average Annual Income (in $1000) |
|---|---|
| 10 | 23 |
| 12 | 32 |
| 13 | 36 |
| 14 | 38 |
| 16 | 53 |
| 17 | 63 |
| 20 | 81 |
| 22 | 87 |



Annual Income vs Years of Education
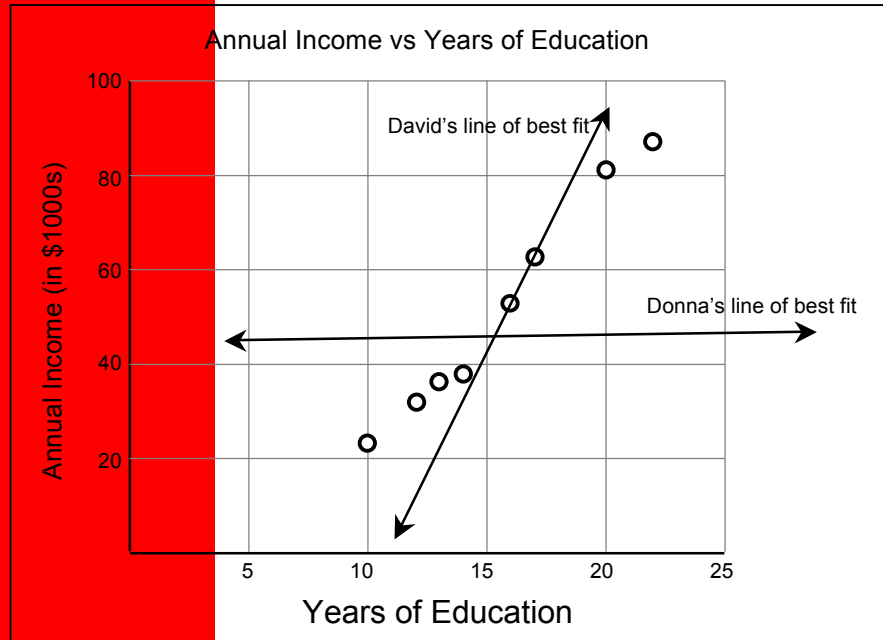
David:   "My line of best fit is the best because it goes through two data points."

Donna:  "My line of best fit is the best because it goes through the middle of the points. Half the points are above my line and half the points are below my line."

1.  Critique the reasoning of each student.

2.  Draw a line of best fit on the graph. Then write the equation of your line in slope-intercept form.

## INCOME AND EDUCATION REVISITED (Continued)

3.  Compare your linear model with three classmates. Then answer the following questions.

    a.  Is your line of best fit in the exact same place as theirs on the graph? _____

    b.  Are your values for the slope and *y*-intercept exactly the same? _____

    c.  Is it possible that there could be more than one line of best fit that is accurate enough? Explain.

4.  Explain what the slope represents in the context of this problem.

5.  According to your model, how much is a year of school worth in terms of a year's income?

6.  Is it reasonable to use the *y*-intercept to make predictions about the income of a person with zero years of education? Explain.

7.  A person graduates high school at age 18 and then works for 50 years, earning $32,000 a year on average. How much income is this?

8.  Another person graduates college at age 22 and then works for 46 years, earning $53,000 a year on average. How much income is this?

9.  In these cases, how much more money does the college graduate make compared to the high school graduates over their working careers?

# OUTLIERS

An <u>outlier</u> of a data set is a data value that is unusually small or unusually large relative to the overall pattern of values in the data set.

The graph on the right shows data for 18 math students (grades on the final exam versus their grades on the midterm exam).

**Grades on the Final Exam versus the Midterm**
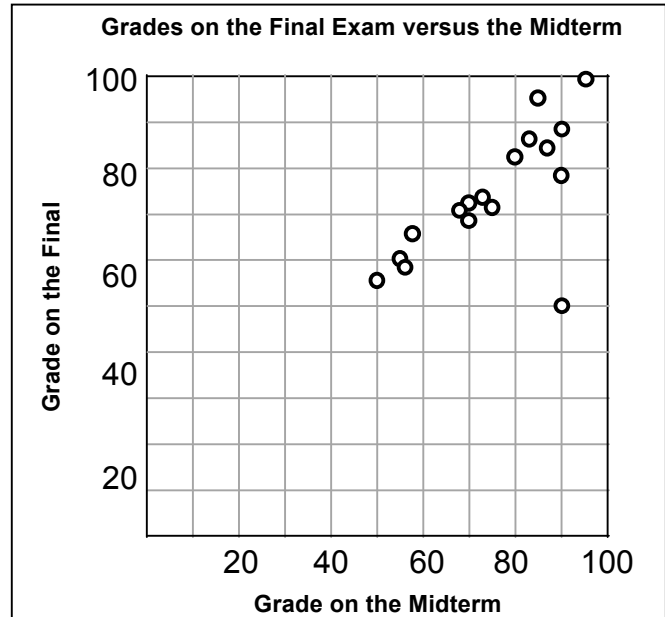
1. What does the data point (95, 88) mean in the context of this problem?

2. Circle any data points that appear to be potential outliers. What effect do these potential outliers have on the pattern of association in the data?

3. If you remove these potential outliers, what happens to the apparent strength of the association?

4. Draw a line of best fit on the graph.  Compare your model with a classmate.

Potential outliers can also trick us into seeing patterns that are not really there.

**Does this graph show a strong association?**

5. Do you think the graph on the right show a strong association?

6. Graph the points (45, 45) and (35, 40).

7. Do these new points appear to be potential outliers?  Explain.

8. What effect do these potential outliers have on the appearance of an association?
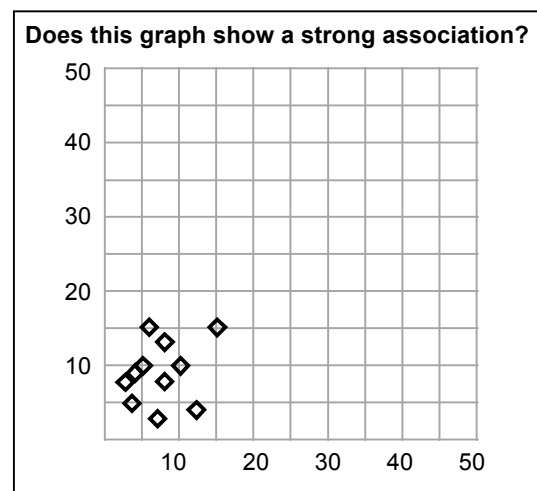
# NONLINEAR ASSOCIATIONS

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.

**The Height of a Bouncing Ball**
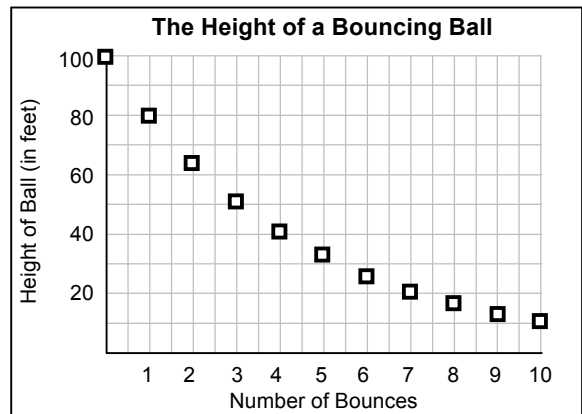
1. What does the data point (2, 64) mean in the context of the problem?

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.
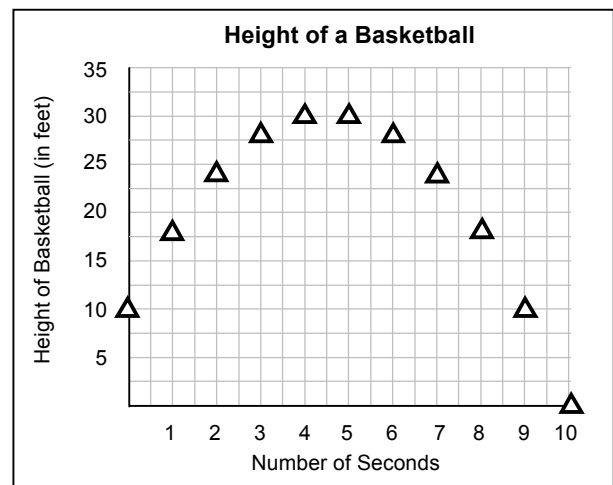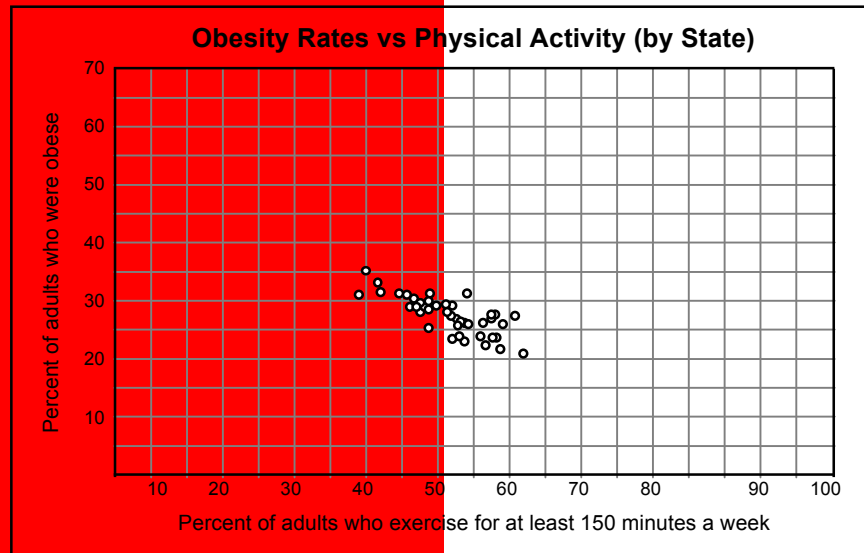
5. What does the data say?

**Height of a Basketball**

6. Why would a line not be a good model for this pattern?

# OBESITY AND EXERCISE REVISTED

The graph below shows data from the previous lesson about obesity rates and exercise rates for different states

1. Draw a line of best fit on the graph.

**Obesity Rates vs Physical Activity (by State)**

Percent of adults who were obese

Percent of adults who exercise for at least 150 minutes a week

2. Using two points on your line of best fit, find the slope.

3. Explain what the slope means in the context of the problem.

4. Find an equation for your line of best fit.

5. Use your equation to predict the obesity rate in a state where 50% of the population exercises.

6. The governor of Oregon wants to lower the obesity rate in her state to less than 20%. What does your model predict that the exercise rate should be for her to meet this goal?

# SKILL BUILDERS, VOCABULARY, AND REVIEW

## SKILL BUILDER 1

Change to a percent, rounded to the nearest hundredth of a percent if necessary.

1. $\dfrac{1}{4}$  

2. $1\dfrac{1}{4}$  

3. $\dfrac{3}{5}$

4. $\dfrac{5}{8}$  

5. $\dfrac{1}{3}$  

6. $\dfrac{2}{7}$

Calculate.

7. 10% of 565  

8. 25% of 300  

9. 52% of 50

10. 5.4% of 120  

11. 0.34% of 12  

12. 120% of 60

Fill in the missing information.

13. 50% of 300 is _____.  

14. ____% of 400 is 100.

15. 100% of _____ is 250.  

16. Finding ___% is equivalent to taking three-fourths of the whole.

17. 40% is equivalent to ____ out of 200.  

18. Getting 54 answers correct out of 71 questions is a score of ____%.

Use the information in the table to answer the questions below.

| Total school population | # of males | # of females | # of students | # of 8th graders |
|---|---|---|---|---|
| 300 | 140 | 160 | 275 | 100 |

19. What percent of the school population are females? _____

20. What percent of the school population are students? _____

21. How many non-students are there in the school population? _____

22. What percent of the school population is NOT an 8th grader? _____

# SKILL BUILDER 2

1.  What is the slope of segment *BC*?

2.  What is the slope of segment *DC*?

3.  What is the slope of segment *AB?*

4.  Name a segment with an undefined slope.

**Use this graph to answer #1-4**
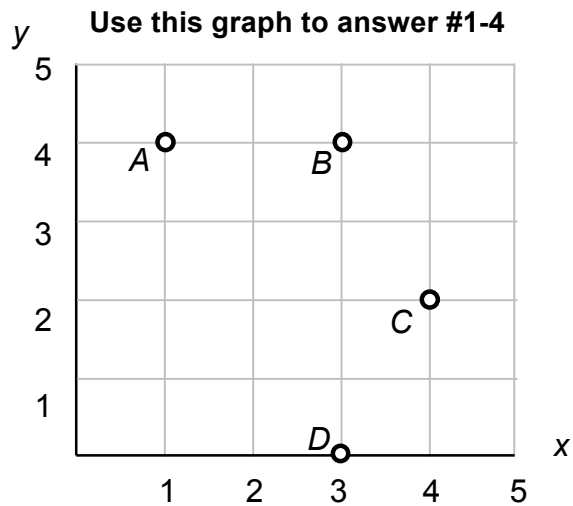
5.  Find the slope of the line through the points (-3, -4) and (-2, 5).

6.  Find the slope of a line that passes through the point (4, 5) and has a *y*-intercept of 3.

7.  Graph a line that goes through the point (3, -2) and has a slope of $-\dfrac{1}{3}$.

    What is the equation of this line?

8.  Solve the system of equations algebraically.

$$\begin{cases} 2x + y = 7 \\ x - y = 10 \end{cases}$$
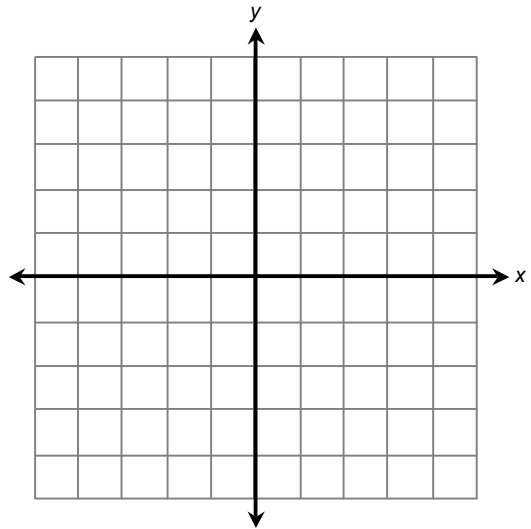
# SKILL BUILDER 3

1.  What are the values for the slope and the *y*-intercept for the line $y = -2x + 6$?
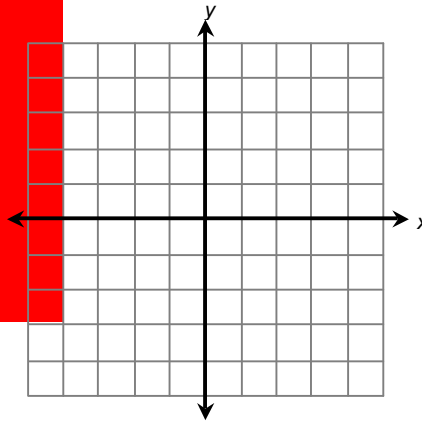
    $m =$ _____        $b =$ _____

2.  Write an equation of a line in slope-intercept form that has a slope of $m = -\dfrac{2}{3}$ and a *y*-intercept of $b = 5$.

3.  Plot the coordinates in the table on the coordinate plane. Then write the equation of the line that passes through the coordinates in slope-intercept form.

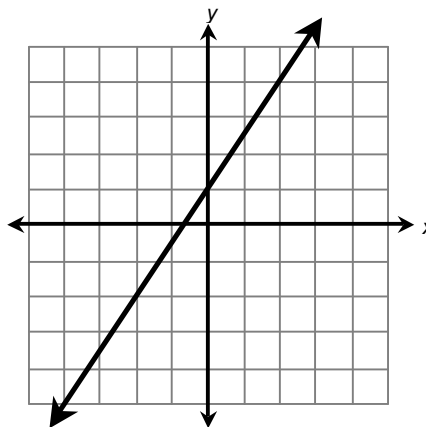    | x  | y |
    |----|---|
    | -3 | 3 |
    | 0  | 2 |
    | 3  | 1 |

    Equation: _____

4.  Use the graph of the linear equation to find the missing values in the table. Then write the equation of the line in slope-intercept form.

    | x  | y |
    |----|---|
    | -2 |   |
    |    | 1 |
    | 2  |   |

    Equation: _____

# SKILL BUILDER 4

Stephanie wanted to know more about the exercise habits of students in her advisory class. She asked 15 students the following questions:

      Are you male or female?
      Do you exercise at least 3 hours a week?

She recorded her data in a table below.

| | 15 Student responses | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male or Female | M | M | F | F | M | F | M | M | M | M | F | F | M | F | F |
| Exercise | Y | Y | N | Y | N | Y | N | N | N | Y | Y | Y | N | N | Y |

1. Fill in the frequency table. Make sure to include appropriate labels for columns and rows.

| | | | Total |
|---|---|---|---|
| | | | |
| | | | |
| Total | | | |

2. Complete the relative frequency tables below. Make sure to include appropriate labels for columns and rows.

| | | Total |
|---|---|---|
| | | |
| | | |

| | | |
|---|---|---|
| | | |
| | | |
| Total | | |

3. Make three accurate statements that describe the association between gender and exercise based on the data of her survey.

# SKILL BUILDER 5

1.  If you were ordering several pizzas to feed a large group of people and wanted to conduct a survey, what categories could you use to organize your data?

2.  If you were gathering information about people's favorite flavor of ice cream, what categories could you create?

3.  What is another topic you could use to create a survey for classmates?

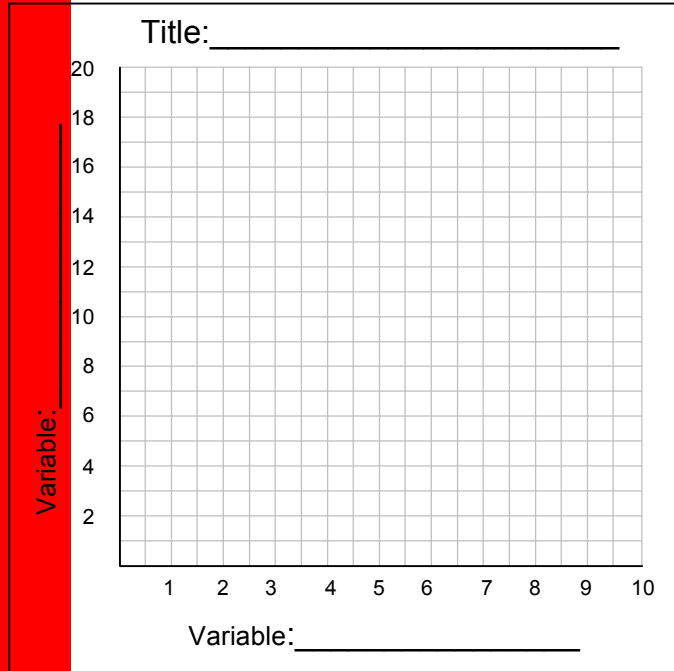    What categories could you use for your data?

4.  Identify each question in the table below as Categorical (C) or Numerical (N).  Then change all categorical questions into numerical questions and numerical questions into categorical questions.

| Question | Categorical (C) or Numerical (N)? | Question rewritten in the other form |
|---|---|---|
| 5.  How many calories do you eat in a day? | | |
| 6.  Do you eat vegetables on a daily basis? | | |
| 7.  How old are you? | | |
| 8.  Are you happy? | | |

# SKILL BUILDER 6

Ricardo is doing some research about water usage at a summer math camp for high school students. He measured the depth of the water in the well each week. His data is recorded in the table below.

| Weeks | Depth of Water in the Well (in feet) |
|-------|--------------------------------------|
| 1     | 18                                   |
| 2     | 15                                   |
| 3     | 14                                   |
| 4     | 10                                   |
| 5     | 9                                    |

Title:_____

Variable:_____

Variable:_____

1.  Plot the measurement data on the graph. Make sure you label each axis appropriately and give your graph a title.

2.  Describe any patterns you see and make a conjecture about what is happening to the depth of the water.

3.  Draw a line of best fit on your graph.

4.  Choose two points on your line and find the slope of your line of best fit.

    What does this slope mean in the context of the problem?

5.  What is the *y*-intercept of your line of best fit?  _____.

    What does the *y*-intercept mean in the context of your problem?

6.  The region where the summer camp is being held is experiencing a severe drought and it's not expected to rain for many more weeks.

    If the summer camp goes for another 5 weeks (10 weeks total), will there be enough water for the campers?

# SKILL BUILDER 7

Billy is conducting a study on the feeding habits of hummingbirds.  For an hour each day, he counted the number of flower blossoms in his garden and the number of different hummingbirds he sees.

His data set is graphed on the scatter plot below.

1.  Does there appear to be a potential outlier in Billy's data?

    Explain.

2.  Ignoring any potential outliers, describe any association in the data.

3.  Draw a line of best fit on your graph.

4.  Choose two points on your line of best fit and find the slope.

**The Feeding Behaviors of Hummingbirds**

Number of Hummingbirds Sighted vs. Number of Blossoms
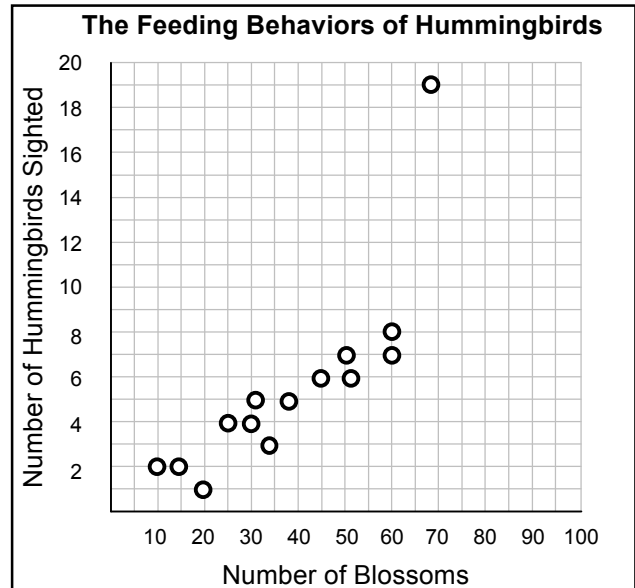
5.  Interpret the slope in the context of the problem.

6.  Find the equation of your line of best fit.

7.  Use your line of best fit to answer the questions below.

    How many hummingbirds can Billy expect to see if he counts 80 flower blossoms?

    How many flower blossoms can Billy expect to count if he sees 3 hummingbirds?

# SKILL BUILDER 8

A cell phone company has approached your marketing agency to help them advertise and sell their new phone.  They want to advertise to potential customers in movie theaters.

You and your marketing team asked 1000 moviegoers the following questions:

- Do you plan on buying a new phone within the next three months?
- Are you older than 25?

1.  The results are in the Venn diagram.  Complete the frequency table.

| | Age > 25 | Age ≤ 25 | TOTAL |
|---|---|---|---|
| buy phone | | | |
| won't buy phone | | | |
| TOTAL | | | 1000 |
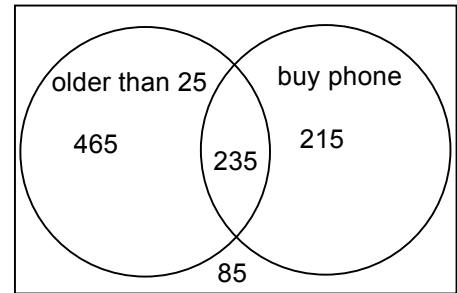


2.  Complete the relative frequency tables below:

Table 1

| | Age > 25 | Age ≤ 25 | TOTAL |
|---|---|---|---|
| buy phone (n = ____) | | | 100% |
| won't buy phone (n = ____) | | | 100% |

Table 2

| | Age > 25 (n = ____) | Age ≤ 25 (n = ____) |
|---|---|---|
| buy phone | | |
| won't buy phone | | |
| TOTAL | 100% | 100% |

3.  Based on this data, should the cell phone company advertise in movies targeting a younger audience or an older audience?  _____ Write a few sentences using the data that support your answer.

# FOCUS ON VOCABULARY

Use vocabulary from this packet to complete the crossword puzzle.
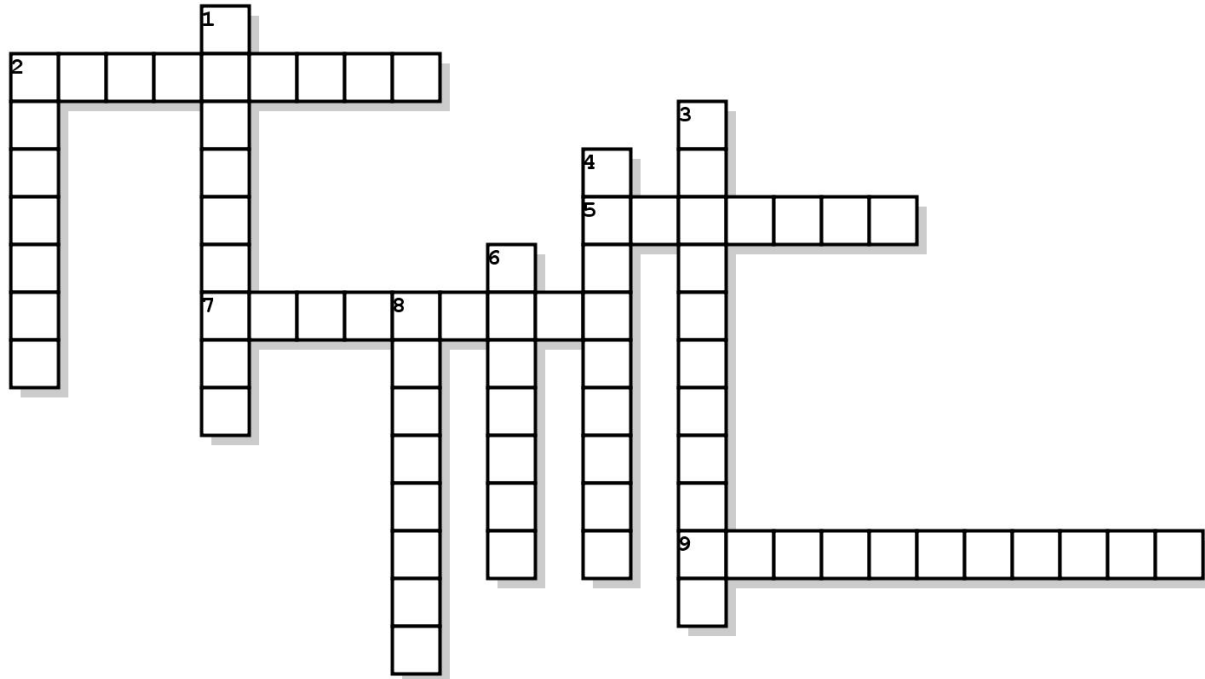


| Across | Down |
|--------|------|
| 2    data that has two variables | 1    table that lists counts from a population |
| 5    unusually large or small value in a data set | 2    line of ___ ___ approximates a linear relationship (2 words) |
| 7    data whose responses are numbers | 3    data sorted by attributes |
| 9    _____ does not imply causation | 4    data not linear that fits a curve is said to have a _____ association |
|  | 6    type of plot of data on a coordinate graph |
|  | 8    type of frequency table that displays percents |

# SELECTED RESPONSE

1. A survey was done on 100 boys and girls about their preference for pizza. Data is displayed in the frequency table below. Which of the following statements accurately describe the data. Choose all that apply.

|  | Boys | Girls | Total |
|---|---|---|---|
| Meat pizza (*M*) | 67% | 33% | 100% |
| Vegetarian pizza (*V*) | 25% | 75% | 100% |

A. 67% of boys prefer *M*.

B. 67% of those who prefer *M* were boys.

C. 75% of girls prefer *V*.

D. 33% of those who prefer *M* were girls.

2. Which of the following statements suggest a positive association? Choose all that apply.

A. The more education a person has, the more money they will likely earn.

B. The taller a person is, the shorter their life expectancy

C. The smaller a person's shirt size, the smaller their shoe size.

D. There is no connection between height and intelligence.

# SELECTED RESPONSE (Continued)

3.  Which of the lines on the graph represent the omst accurate line of best fit?

Line 1

Line 3      Line 2
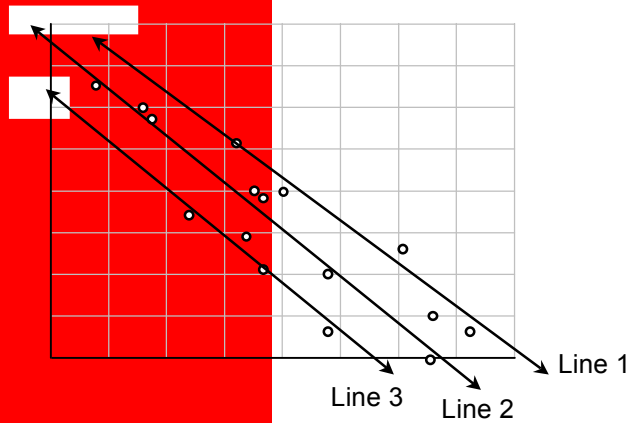
A.  Line 1            B.  Line 2            C.  Line 3            D.  All are accurate.

4.  This graph shows the height of a candle over a period of time.  Using the linear model as a guide, determine which of the following statements are TRUE.  Choose all that apply.

Height of a burning candle (cm)

Time (hours)
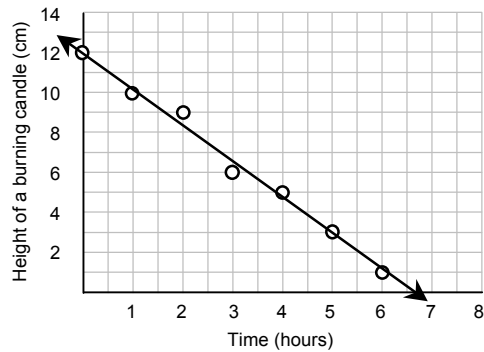
A.  The candle was 12 cm tall when it started burning.

B.  The candle is getting shorter at a rate of 9 cm every 5 hours.

C.  The candle will have a height of zero after about 6.5 hours.

D.  A reasonable equation for the linear model is $y = -\dfrac{9}{5}x + 12$.

# KNOWLEDGE CHECK

Show your work on a separate piece of paper and write your answers on this page.

## 10.1  Categorical Data

Two hundred people were asked the following questions. The results are in the two-way table below.

- Are you older than 35?
- Do you spend 2 or more hours online each day?

1. On a separate sheet of paper, make two tables showing the relative frequencies between age groups and online use.

|  | Older than 35 | Younger than 35 | Total |
|---|---|---|---|
| Spends more than 2 hours online | 40 | 80 | 120 |
| Spends less than 2 hours online | 60 | 20 | 80 |
| Total | 100 | 100 |  |

2. Based on your frequency tables, write three sentences that accurately describe any associations you find in the data.
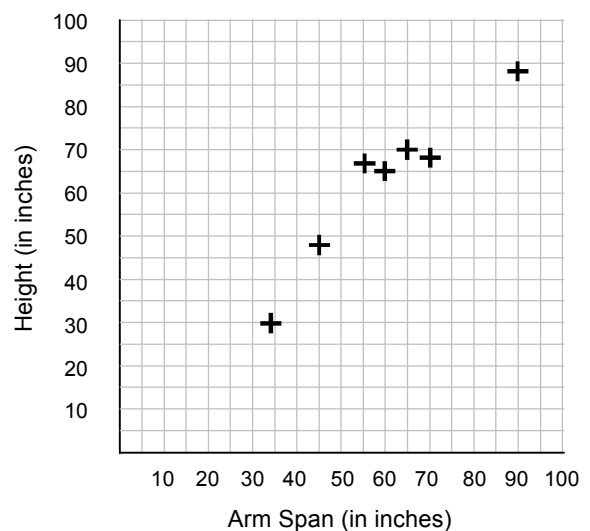
## 10.2  Numerical  Data

The graph on the right shows the heights and arm spans of people of various ages.

3. Add the values from the table below to the graph.

| Arm Span | Height |
|---|---|
| 45 | 40 |
| 80 | 75 |
| 55 | 50 |
| 40 | 30 |

4. Describe any association in the data.

**Height vs Arm Span**



## 10.3 Lines of Best Fit

5. Draw a line of best fit on the graph above.  Find an equation of the line in slope-intercept form.  Then interpret the slope in the context of the problem.

# HOME SCHOOL CONNECTION

Here are some questions you can review with your young mathematician.

Pedro surveyed several 8th grade students and asked them the following questions.

- Did you eat breakfast this morning?
- Did you pass your math test?

He recorded the data in the frequency table below.

|  | Ate breakfast | Did not eat breakfast | Total |
|---|---|---|---|
| Passed the test | 55 | 20 | 75 |
| Did not pass the test | 5 | 20 | 25 |
| Total | 60 | 40 | 100 |

1. On a separate piece of paper, construct two relative frequency tables based on his data.

2. Describe any association that exists and write two sentences that use percentages to measure this association.

3. Why do you think these variables are associated?

Rachel collected data on her classmates' standardized test scores in math and English. She recorded the scores in the table below on the right.

4. On a separate sheet of graph paper, make a scatter plot of Rachel's data. Be sure to label each axis and title your graph.

5. Describe any association you see.

6. If appropriate, draw a line of best fit and write an equation for the line in slope-intercept form.

7. Interpret the slope and the *y*-intercept in the context of the problem.

| Math score | English score |
|---|---|
| 90 | 80 |
| 68 | 75 |
| 95 | 99 |
| 55 | 75 |
| 75 | 65 |
| 80 | 80 |
| 70 | 82 |
| 91 | 73 |
| 100 | 87 |

Parent (or Guardian) Signature _____

# COMMON CORE STATE STANDARDS – MATHEMATICS

## STANDARDS FOR MATHEMATICAL CONTENT

| | |
|---|---|
| 8.F.4 | Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two ($x$, $y$) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. |
| 8.SP.1 | Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. |
| 8.SP.2 | Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. |
| 8.SP.3 | Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.* |
| 8.SP.4 | Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?* |

## STANDARDS FOR MATHEMATICAL PRACTICE

| | |
|---|---|
| MP1 | Make sense of problems and persevere in solving them. |
| MP2 | Reason abstractly and quantitatively. |
| MP3 | Construct viable arguments and critique the reasoning of others. |
| MP4 | Model with mathematics |
| MP6 | Attend to precision. |
| MP7 | Look for and make use of structure. |