Being Counted:
Probability & Statistics

Fast Track GRASP Math Packet

Part 2

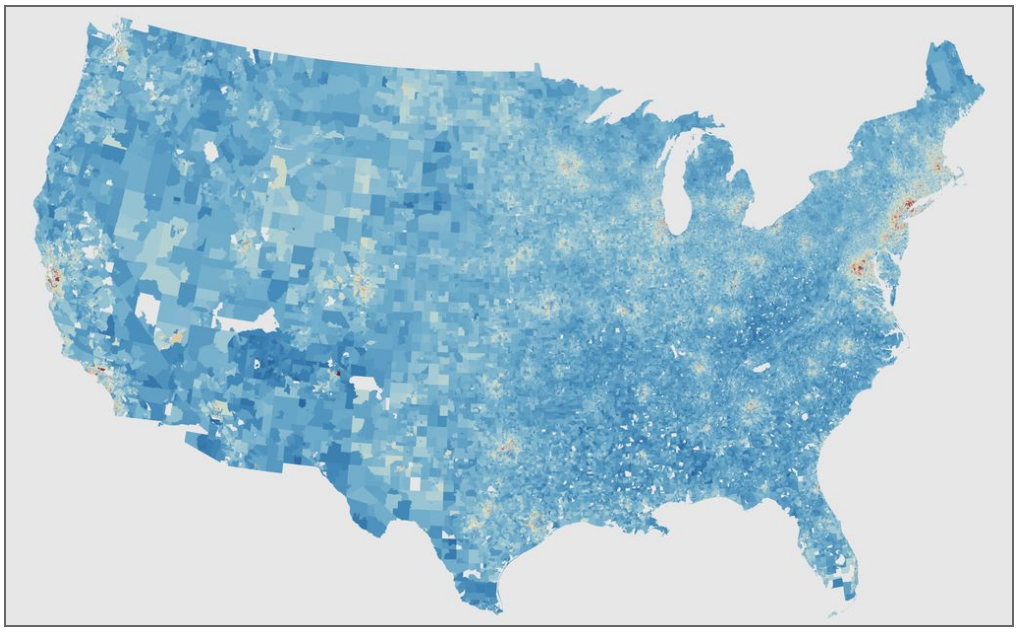

image by Christopher Wolfram (Wikimedia Commons)

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http://www.collectedny.org/ftgmp

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Sampling Populations

If you watch the news or read the paper, you will almost certainly see a *poll*. During an election year there are polls predicting how much support one candidate has over another. The information for polls are gathered by people called pollsters who ask people questions about their opinions. It isn't practical for pollsters to ask every single voter who they will vote for. Instead, pollsters select a sample of the larger population. A *population* is the group being studied. A *sample* is a small part of the whole that is used for analysis. For example, if someone wants to predict who will win a presidential election, they can't survey all voters individually. There are too many people. Instead, they interview a sample of randomly chosen people who are planning to vote in the election. The best samples are the ones where every person in the population has an equal chance of being selected.

This is a photo of former U.S. President Harry Truman. He was president of the United States from 1945 to 1953. Truman was Vice President and became president when President Franklin Roosevelt died in 1945. The headline in the newspaper he is holding reads, "Dewey Defeats Truman." You may be wondering why Truman looks so happy in the photograph.

The picture is from 1948 when Truman ran for a second term as president. On election night, the Chicago Tribune newspaper needed to go to print so that it would be ready for people to read in the morning. The voting was not yet completed when they printed the headline, but they had conducted a survey. Based on the results of the survey, the newspaper believed that Dewey would win and ran the headline.

The newspaper predicted the election results incorrectly because their sample was *biased.* They had conducted their survey by telephone and used a phone book to identify a sample of people to survey. In 1948, most people did not have a phone and the people who did have phones were more likely to be people with money. The survey was *biased* towards people who had more money since they were the people had telephones. The sample of telephone users was not representative of the general population.

In the photograph, Truman is smiling because he was re-elected to be the President of the United States even though a newspaper published a headline saying he had lost.

In his opening monologue for the 2005 Academy Awards, also known as the Oscars, the comedian Chris Rock interviewed people at a local movie theater[1]. He was making a joke about how the film industry's favorite movies were not necessarily the favorite movies of regular people. At the theater, none of the people Chris Rock interviewed had seen any of the movies that were nominated for that year's Best Picture award. And none of their favorite movies were nominated for an Oscar. People who work in the film industry decide who is awarded an Oscar. It would be a different set of nominations if it was based on the total population of people who go to the movies.

In this packet, you will learn more about designing surveys to collect data and different ways to analyze the data you collect. But there is an important step that comes before gathering data with surveys—selecting who will participate in the survey.

Imagine you wanted to find out what the best movie of the year was according to the general population of movie-goers in your hometown. Which of the following do you think would give you the best representation of that larger population?

- Asking elementary school students at the library
- Asking every 10th person who comes into the local supermarket
- Putting up signs and asking for volunteers to fill out a survey online
- Asking every 5th person who walks into the movie theater

Trying to identify the best sample to represent the larger population is related to probability. To create the most representative sample, there should be an equal chance for anyone in the population to be chosen. Asking people who come into the supermarket or movie theater would be the best ways to generate a representative sample above. Everyone goes shopping and everyone at the movie theater will be part of the movie-going population of your town. Asking every 10th person, for example, is a way of making sure that everyone has an equal chance of being selected. On the other hand, asking only elementary school children would likely result in a survey that did not represent the larger population. An online survey would also result in a biased sample since some people would be more likely to do it than others.

[1] You can watch the Chris Rock segment here: https://www.youtube.com/watch?v=JerPfHYro1U

1) The owner of a shopping mall wants to learn about the spending habits of the employees at all the stores in the mall. She specifically wants to find out how many employees eat at the food court during their break time. There are 1500 employees who work throughout the mall. The best way to get a random sample of employees would be to survey:

   A. All of the employees at the larger stores in the mall

   B. Every employee

   C. Every 25th employee who walks through the mall entrance

   D. Employees who volunteer to fill out the survey

2) A survey is being conducted to determine which school board candidate would best serve the Yonkers community. Which group, when randomly surveyed, would likely produce the <u>most</u> bias?

   A. 15 employees of the Yonkers school district

   B. 25 people driving past Yonkers High School

   C. 75 people who enter a Yonkers grocery store

   D. 100 people who visit the local Yonkers shopping mall

3) A survey is being conducted to determine if a cable company should add another sports channel to their schedule. Which random survey would be the least biased?

   A. surveying 30 men at a gym

   B. surveying 45 people at a mall

   C. surveying 50 fans at a football game

   D. surveying 20 members of a high school soccer team

Sampling Populations - Answer Key

1) C

2) A

3) B

Data in the Classroom

Collecting Data

A group of students in an adult education class were studying statistics. They decided to collect data and analyze it to learn more about each other while learning math.

The students started by brainstorming things they wanted to know about their class. The first thing they had to think about is what makes an effective question when trying to gather data. Some of their questions were statistical and others were not.[2]

Read the following pairs of questions:

A. What is the typical age of the students in this class?
B. How old is the teacher?

A. How many cups of coffee do students in this class typically drink per day?
B. Does Juana drink coffee?

A. How long do students in this class typically plan to study in order to pass the high school equivalency exam?
B. How long did Claude study before taking the high school equivalency exam?

1) What differences do you see between the A and B questions in each pair?

The word *typical* means the characteristics you would expect of something in this group. You could ask a friend, "What is the typical monthly rent in this neighborhood?" We know that the rent is not the same for every apartment in a neighborhood, but a typical rent gives us an idea about how expensive it might be to live in this area. Typical means what is common or what can be expected in a given situation.

[2] Open Up Resources. Source curriculum available for free at http://openupresources.org.

The students learned that a statistical question is one that can be answered by collecting data that shows differences in the responses.

For a question to be *statistical*, there are two requirements:

- We can collect data to answer the question.
- We expect the data to show *variation*. In other words, we expect *varied* (or different) responses to the question.

2) The question, "How many hours do students in this class typically sleep per night?" is a statistical question. Explain why.

If a question is statistical, we can collect data to answer the question and the data will show a variety of answers. "How many hours do students in this class typically sleep per night?" is a statistical question since we can collect data by asking students how many hours they usually sleep and we expect that not all their answers will be the same.

3) Decide whether the following questions are statistical:

Question	Is it statistical? Yes/No	Write an explanation.
How many minutes does it take students in this class to get to school?		
How many weeks long is this class?		
How many cups of water do students in this class drink each day?		
How many students are in this class?		

The students created a *survey* of questions for their fellow students to answer. A survey collects data about the opinions or experience of a group of people, based on a series of questions.

The students brought the question, "What is the typical age of students in this class?" to two different classes. The first was a high school class in their neighborhood. The second class was in an adult education program for people studying for the high school equivalency exam.

Look at the data they collected.

	Ages
High School Seniors	{17, 17, 17, 17, 17, 18, 18, 17, 17, 17, 19, 17, 17, 17, 17, 16, 17, 16, 17, 16, 17, 17, 16}
Adult Education Students	{44, 47, 28, 24, 23, 28, 41, 47, 18, 55, 25, 50, 33, 35, 27, 61, 30, 28, 21}

The students decided to analyze the data and write a description of the ages in each class.

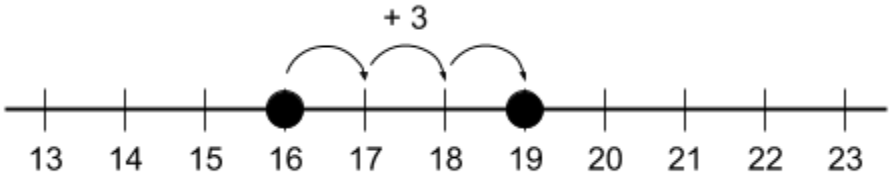
4) How would you describe the ages of the students in the high school class?

5) How would you describe the ages of the students in the adult education class?

Analyzing Data

The research group saw that there was a lot of variation in the ages of their fellow classmates in the adult education class. In adult education, students can be any age as long as they are considered an adult. Their ages *vary* a lot.

A set is a collection of things. The sets we use in this packet are groups of numbers. One way to describe a set of data is by looking at the largest and the smallest number in the set. The oldest student in the high school class is 19 years old and the youngest student is 16. The *range* of ages in the class is 3, which is the difference between 19 and 16.



The range shows the distance between the smallest and largest numbers in a set. The range of 3 years shows that there is not much variation in the ages of the high school students.

The oldest student in the adult education class is 61 years old and the youngest student is 18.

6) What is the range of ages in the adult education class?

   A. 18

   B. 28

   C. 43

   D. 61

The range is a *measure of spread* since it tells us how spread out the data is. We can see the spread in the number lines above. The ages in the high school class are close together (little spread) and the ages in the adult education class have a wide range (a lot of spread). The range of ages is much larger in an adult education classroom, since there is more variation in the ages.

The students continued to analyze the data. They asked themselves, "What is the age of a typical student in each of these classes?"

High School ages: {17, 17, 17, 17, 17, 18, 18, 17, 17, 17, 19, 17, 17, 17, 17, 16, 17, 16, 17, 16, 17, 17, 16}

Adult Education ages: {44, 47, 28, 24, 23, 28, 41, 47, 18, 55, 25, 50, 33, 35, 27, 61, 30, 28, 21}

Three students from the research group came up with different numbers for what they thought was a typical age for the high school class and a typical age for the adult education class.

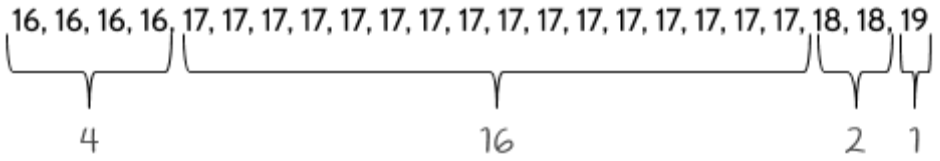
Theresa: "I think a typical student in the high school class is 17 years old and a typical student in the adult education class is 28 years old."

Carmen: "I agree that a typical student in the high school class is 17, but I think the typical student in the adult education class is actually 30 years old."

Claude: "You're both right about students in the high school class, but the typical adult education student is 35 years old."

7) Theresa, Carmen, and Claude agree on the typical age of a student in the high school class, but disagree about the typical age of a student in the adult class. Who do you agree with? Explain your answer.

Let's look at how Theresa figured out the age of a typical student in the high school class. She listed all the students' ages in order from smallest to largest, then counted how many there were of each age:



Theresa's method

Theresa said that 17 is a typical age for students in the high school class because there are more students who are 17 than any other age. There are sixteen 17-year-olds.

8) Teresa used the same strategy when analyzing the ages of the adult education students. How did she get her answer of 28?

Adult education ages: {44, 47, 28, 24, 23, 28, 41, 47, 18, 55, 25, 50, 33, 35, 27, 61, 30, 28, 21}

Theresa's number is called the *mode*. It is the most common number in a set of numbers. In the set {3, 3, 5, 11, 13}, the number 3 is the mode since there are more 3's than any other number. Not every set of numbers has a mode. For example, in the set {4, 6, 8, 8, 10, 10}, there is no mode because there are two 8's and two 10's. There is not a single number that is most common in the set.

9) Find the **mode** for each of the following sets of numbers. If there is no mode, write "none."

{10, 7, 2, 7, 4}

{9, 15, 10, 12, 15, 5}

{1, 8, 6, 7, 1, 8, 4}

{12, 7, 16, 3, 14, 8}

Now let's see how Carmen found the typical age of a student in the high school class. She decided the typical number was the middle one, not the largest and not the smallest. She put the ages in order from smallest to largest, counted until she found the middle of the list, and then chose the age in the middle:

Carmen's method

Carmen said that 17 is the typical age because it is the middle number in the list. An equal number of data points are above and below this number.

10) Carmen used the same strategy when analyzing the ages of the adult education students. Show how she got her answer of 30.

Adult education ages: {44, 47, 28, 24, 23, 28, 41, 47, 18, 55, 25, 50, 33, 35, 27, 61, 30, 28, 21}

Carmen's number is called the *median*. It is the middle number in a set of numbers when the numbers are placed in order from smallest to largest. In the set {3, 3, 5, 11, 13}, the number 5 is the median since it is in the middle of the list of numbers.

Note: To find the median, the numbers must be listed in order. In the set {4, 1, 5, 3, 2}, the number 3 is the median, <u>not</u> 5 (even though 5 looks like it is in the middle).

11) Find the **median** for each of the following sets of numbers.

{2, 4, 7, 7, 10}

{5, 9, 10, 12, 14, 16}

{1, 8, 6, 7, 1, 8, 4}

{12, 7, 16, 3, 14, 8}

What if there are two middle numbers? In the set above {5, 9, 10, 12, 14, 16}, the numbers 10 and 12 are in the middle of the list. There is no one middle number. To find the median, we find the middle number between 10 and 12, which is 11. The median of {5, 9, 10, 12, 14, 16} is 11.

The table below shows the weights of players on the Buffalo Bills football team.

	weight in pounds
Offense	{320, 238, 325, 212, 329, 305, 178, 330, 252, 174, 234}
Defense	{260, 197, 341, 240, 192, 179, 254, 315, 230, 192, 191, 250}

Use the statistics we have learned to describe the weights of the Buffalo Bills offensive and defensive players.

12) Find the range, mode, and median of the offense.

range:

mode:

median:

13) Find the range, mode, and median of the defense.

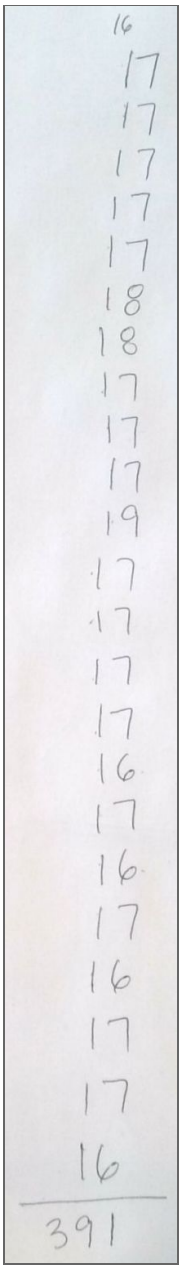
range:

mode:

median:

14) What can you say about the typical weight of an offensive player compared to the typical weight of a typical defensive player on the Buffalo Bills football team?

Finally, Claude explained how he found that the typical age of a student in the high school class is 17. He added all the ages and then divided by the number of students. His notes are on the right.



15) Claude calculated the typical age in the adult education class in the same way. Show how he found the typical age to be 35.

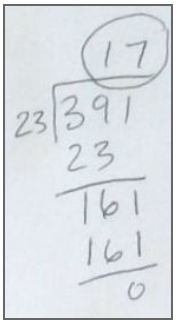
Adult education ages:
{44, 47, 28, 24, 23, 28, 41, 47, 18, 55, 25, 50, 33, 35, 27, 61, 30, 28, 21}

You can think of Claude's method as a way to share equally. Adding all the numbers together and then dividing is a way to equally share the total. As an example, imagine that four friends agreed to share equally the candy they collect on Halloween:

Emil	Liv	Theo	Jazae
20	21	16	35

16) The kids put all the candy in a big pile and each take one piece at a time until the candy is gone. How many pieces will each kid get?

17) A group of five kids go picking apples at an orchard. They decide that they will share the apples equally, no matter how many apples each person picks. The individual kids pick 3, 3, 5, 11, and 13 apples. They put all the apples in a big pile and then each takes one at a time until the apples are gone. How many apples does each child get?



Claude's number is called the *mean*. One way to find the mean of a set of numbers is to find the sum of the numbers and divide by how many numbers there are in the set.

$$3 + 3 + 5 + 11 + 13 = 35$$

There are 5 numbers in the set {3, 3, 5, 11, 13}, so we divide by 35 by 5. The mean is 7.

$$35 \div 5 = 7$$

18) Find the **mean** in each of the following sets of numbers.

{10, 7, 2, 7, 4}

{9, 15, 10, 12, 15, 5}

{1, 8, 6, 7, 1, 8, 4}

{12, 7, 16, 3, 14, 8}

Mode, median, and mean are different ways of describing a typical (or *average)* number in a set. They are all considered *measures of center* since they tell us about middle values in a set of numbers.

mode: the most common number in a set

median: the middle number when numbers are listed from smallest to largest

mean: the equal share when numbers are added together and divided by the number of total values

When people talk about the *average* of a set of numbers, they are usually referring to the mean. However, the mode and median are also types of averages. Each average is a different measure of center that describes a typical number in a set of numbers. Depending on the situation, one of these averages might be more appropriate than another.

19) Employees at a shoe store look at their sales for the last two hours and see that the following shoe sizes were purchased: 6, 7, 8, 9, 10, 10, 10, and 12.

What is the mode? _____ What is the mean? _____

What is the median? _____ What is the range? _____

20) If you were the store manager and needed to order more shoes from the warehouse, which number would you use: the mode, the median, the mean, or the range? Explain your answer.

21) A restaurant has seven employees. Their hourly wages are shown below.

	hourly wage
cook	$16.00
cook	$16.50
dishwasher	$15.00
manager	$30.00
server	$15.00
server	$15.50
supervisor	$25.00

What is the mode? _____

What is the median? _____

What is the mean? _____

What is the range? _____

22) If a friend was looking for a job and asked how much the restaurant pays, which would you give them: the mode, the median, or the mean? Explain your answer.

23) Here are 12 months of electricity bills from a city apartment.

Month	Amount
J	$38.00
F	$35.00
M	$41.00
A	$38.00
M	$43.00
J	$64.00
J	$71.00
A	$80.00
S	$56.00
O	$40.00
N	$37.00
D	$45.00

What is the mode? _____

What is the median? _____

What is the mean? _____

What is the range? _____

24) If you are planning your household budget for the year and need to know how much money to budget for monthly electricity bills, which number would you use: the mode, the median, the mean, or the range? Why?

25) Draw arrows to connect the measurement, the description, and the example.

Measurement	Description	Example in the set {7, 6, 5, 17, 5}
range	the most common number	8
mode	an equal share	12
median	the difference between the smallest and largest number	5
mean	the middle number	6

26) A new 75-year old student joined the same adult education class. Which of the following measures do you think will be the most affected by this new student's age: range, mean, median, or mode. Explain your answer.

Adult education ages: {44, 47, 28, 24, 23, 28, 41, 47, 18, 55, 25, 50, 33, 35, 27, 61, 30, 28, 21, **75**}

Measurement of student ages	Before new student joined the class	After new student joined the class
range	43	
mode	28	
median	30	
mean	35	

27) Which measurement changes most when the new student joins the class?

A. mode B. median C. mean

28) What does a range of 57 mean in this situation?

A. The typical age of students in the class is 57.

B. The oldest student is 57 years older than the youngest student.

C. 57 is the middle age in the data set.

D. There are 57 students in the class.

Comparing Data

The student research group used the data from their survey to make comparisons between groups of people. They gave their survey to a different adult education class at the school and collected data to compare with their own results.

Here are some results of the surveys in the two classrooms:

		Number of students who...					
	Total number of students	... plan to study one year or more for the HSE exam	... sleep eight or more hours per night	... drink coffee at least once per day	... have kids	... are bilingual	... are left-handed
Class 1	20	10	16	10	15	12	2
Class 2	25	13	16	12	20	15	3

29) What do you notice?

We can use ratios and ratio tables to compare the survey data from the two classrooms. One survey question asked how long students planned to study for the high school equivalency exam. The results are shown below.

30) Create equivalent ratios with the ratio tables for Class 1 and Class 2.

Class 1

Students who plan to study one year or more for the HSE exam	10	20			
Total number of students	20	40			

Class 2

Students who plan to study one year or more for the HSE exam	13				
Total number of students	25				

31) In which class do a larger fraction or percent of the students plan to study one year or more for the HSE exam? How do you know?

What if we wanted to look at the two classes and compare the amounts of students who get at least eight hours sleep?

Class 1	Class 2
16 out of 20 students sleep eight hours or more.	16 out of 25 students sleep eight hours or more.

To compare the ratios, it is helpful to create ratios that are "out of" the same amount. If the ratios are out of 100, we know the percentage of students in each class who get eight hours sleep.

32) Fill in the missing blanks below.

Class 1

Students who sleep 8 or more hours per night	16	
All students	20	100

× 5 (above 20 → 100) × 5 (below 20 → 100)

$\frac{16}{20} = \frac{\quad}{100} = \underline{\quad\quad}\ \%$

Class 2

Students who sleep 8 or more hours per night	16	
All students	25	100

× 4 (above 25 → 100) × 4 (below 25 → 100)

$\frac{16}{25} = \frac{\quad}{100} = \underline{\quad\quad}\ \%$

Which class has a higher fraction or percent of students who sleep at least 8 hours?

33) In which class does a larger portion of the students drink coffee?

Class 1

Students who drink coffee at least once per day	9				
All students	20				

Class 2

Students who drink coffee at least once per day	12				
All students	25				

34) In Class 1, 15 out of 20 adult students have children. In Class 2, 20 out of 25 adult students have children. Use this information to complete the missing blanks.

Class 1

Students with children	3	**15**	
Students with no children		5	
All students	**4**	**20**	100

Class 2

Students with children		**20**	
Students with no children			
All students	5	**25**	100

35) Complete these sentences.

Out of 20 adult students in Class 1, 15 have children. _____ % of adult students in Class 1 have children. _____ % of adult students in Class 1 don't have children. _____ out of every 4 adult students in Class 1 have children.

Out of 25 adult students in Class 2, _____ have children. _____ % of adult students in Class 2 have children. _____ % of adult students in Class 2 don't have children. _____ out of every 5 adult students in Class 2 have children.

36) In the classroom survey, the students learned that 12 of the 20 students in their class were *bilingual*[3], meaning they spoke two languages. The other students in the class were *monolingual*, meaning they spoke one language.

Compare the ratio of bilingual students to monolingual students in each class.

	Bilingual students	Monolingual students	All students
Class 1	12		20
Class 2	15		25

What do you notice?

[3] The prefix mono- means "one," the prefix bi- means "two" and lingual refers to "language." Some students may have spoken more than two languages.

Frequency Tables

In statistics, the word *frequency* means how often something happens or the number of responses to a question. For example, a frequency table can show how many survey responses give a certain answer. Here's an example of a question from the classroom survey:

Question: *How long does it take you to get to school?*

	I travel for less than an hour to get to school	I travel for an hour or more to get to school
students	14	6

We can see that 14 students said they travel for less than an hour to get to school. Another way to say this is: The *frequency* of students traveling less than an hour is 14.

37) What is the frequency of students who travel for an hour or more to get to school?

38) How many total students are in the class?

A. 6

B. 8

C. 14

D. 20

The frequency of one response compared with the total number of responses is called *relative frequency*. The relative frequency of students who travel for less than one hour compared with the total number of students is...

$$\frac{\textit{students who travel for less than an hour}}{\textit{total number of students}} = \frac{14}{20}$$

A relative frequency is a ratio that can be expressed as a fraction, percent, or decimal.

39) Which of the following shows the relative frequency of students who travel for an hour or less to get to school? Choose all that apply.

A. $\frac{7}{10}$

B. 7%

C. 70%

D. 0.7

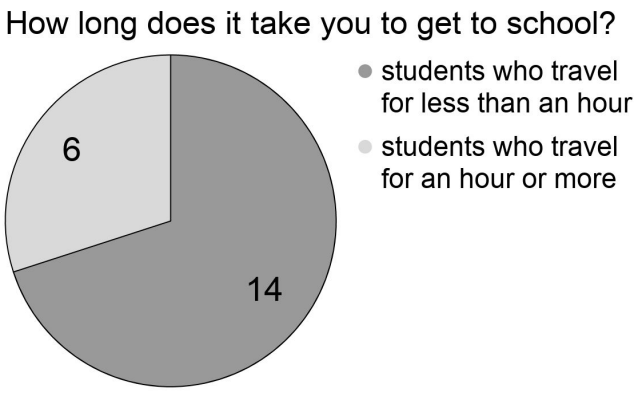
40) What is the relative frequency of students who travel for an hour of more to get to school?

A. 6%

B. 30%

C. 43%

D. 70%



The student research group also asked students in their class how they got to school. Everyone either took public transportation (bus or subway) or walked.

	students
use public transportation	16
walk	4

41) Use the ratio table to find equivalent ratios:

Students who use public transportation	16					
Students who walk to school	4					
Total students	20					

42) Fill in the missing information in the table to show different ways of writing the relative frequency of students who use public transportation to get to school.

original ratio	out of 100	percent	decimal
$\frac{16}{\quad}$	$\frac{\quad}{100}$	%	0.8

43) What is the relative frequency of students who walk to school? You can give your answer as a fraction, decimal, or percent.

Look at the frequency table below.

	Left-handed	Right-handed	Total students
Class 1	2	18	

44) What is the relative frequency of right-handed students in Class 1?

In statistics, relative frequency is often written as a percent, but it can also be written as a decimal, like 0.9.

45) What is the relative frequency of left-handed students in Class 1?

A. 0.01

B. 0.03

C. 0.1

D. 0.3

46) Expressed as a percent, what is the relative frequency of left-handed students in Class 1?

47) Compare the frequency table for Class 1 with the frequency table for Class 2 below. Which class has a higher relative frequency of left-handed people?

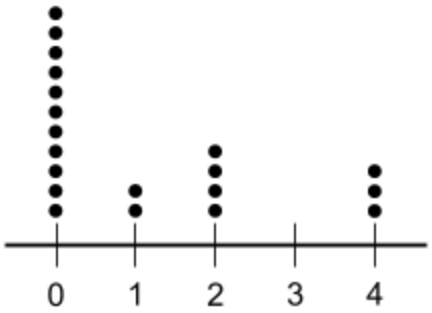
	Left-handed	Right-handed	Total Students
Class 2	3	22	

Displaying Data

Dot Plots

The research group analyzed the data from their survey and created charts to share with the rest of the school. Their first chart was a *dot plot* that shows how many sodas students drink. A dot plot is a chart that includes one dot for each piece of data.

Twenty students responded to the survey. Eleven students responded saying they didn't drink soda at all. Do you see the eleven students who drink 0 sodas?



How many sodas do you drink every day?

48) How many students drink two sodas per day?

49) What is the range of the answers the class gave?

A. 0

B. 3

C. 4

D. 5

50) Which of the sets below could be the students' answers for "How many sodas do you drink every day?"

A. {11, 2, 4, 0, 3}

B. {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 2, 2, 2, 2, 4, 4, 4}

51) What is the median number of sodas that students in this class drink?

A. 0

B. 1.1

C. 3

D. 4

The research group looked at the same data in a table and talked about what they noticed.

Sodas per day	Number of students
0	11
1	2
2	4
3	0
4	3
Total	20

Theresa: "Wow, 55% of the class drinks 0 sodas per day. I'm surprised so many people don't drink soda at all."

Carmen: "Is that true? I see that 11 out of 20 students don't drink soda, but is that 55%? How do you know?"

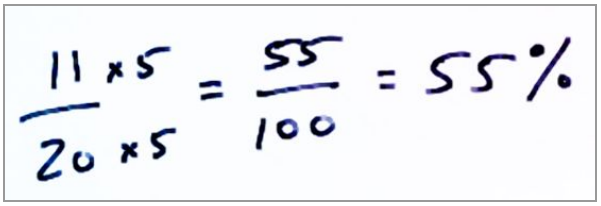
Claude [showing his calculator]: "I think that's right. 11 divided by 20 equals 0.55."

Theresa: "You're right, but I thought about it differently. I just multiplied 11 times 5."

Carmen: "Wait, why did you do that? Is that how you calculate percent?"

Theresa showed her notes to Carmen and Claude.

Theresa: "There are different ways to figure out percent. Percent means *out of 100*, so 55 percent means 55 out of 100. In our data, the 11 people who don't drink soda out of the 20 total students is the same as 55 out of 100. If there were 100 students in our class, 55 of them would not drink soda."



Carmen: "I'm not sure I understand you completely, but I see another reason why 11 out of 20 might be 55 percent. 10 out of 20 is 50% since 10 is half of 20. 11 out of 20 is a little more than that, so 55 percent makes sense."

All three students are right. One way to figure out percentages is to make them "out of 100," like Theresa did. We can also calculate percent using division, like Claude did. And Carmen uses her knowledge of percentages to make an estimate.

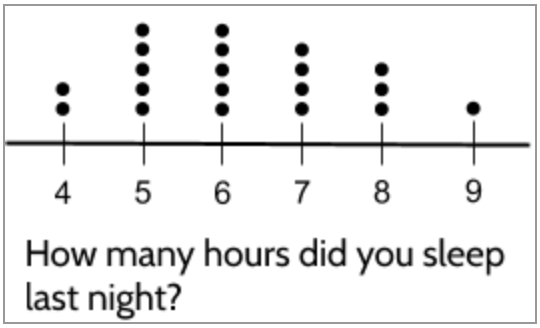
52) What percent of students drink four sodas per day? Use Theresa, Claude, or Carmen's method to answer this question. Try to use at least two different methods.

The Sleep Research Society recommends that adults should sleep for seven or more hours per night on a regular basis to promote good health.[4]

53) This is the Class 1 data for the question, "How many hours do you usually sleep per day?" but there is missing data. Can you fill in the blanks?

Hours of sleep	Number of students	"out of 100"	Decimal	Percent	Fraction
4 hours		$\frac{\quad}{100}$		10%	$\frac{\quad}{20}$
5 hours		$\frac{\quad}{100}$	0.25	%	$\frac{\quad}{20}$
6 hours		$\frac{25}{100}$		%	$\frac{\quad}{20}$
7 hours		$\frac{\quad}{100}$	0.2	%	$\frac{\quad}{20}$
8 hours		$\frac{\quad}{100}$		15%	$\frac{\quad}{20}$
9 hours		$\frac{5}{100}$			$\frac{\quad}{20}$
Total	20	100	1.00	100%	$\frac{20}{20}$

Look at the dot plot showing the Class 1 data on another sleep question, then complete the following.



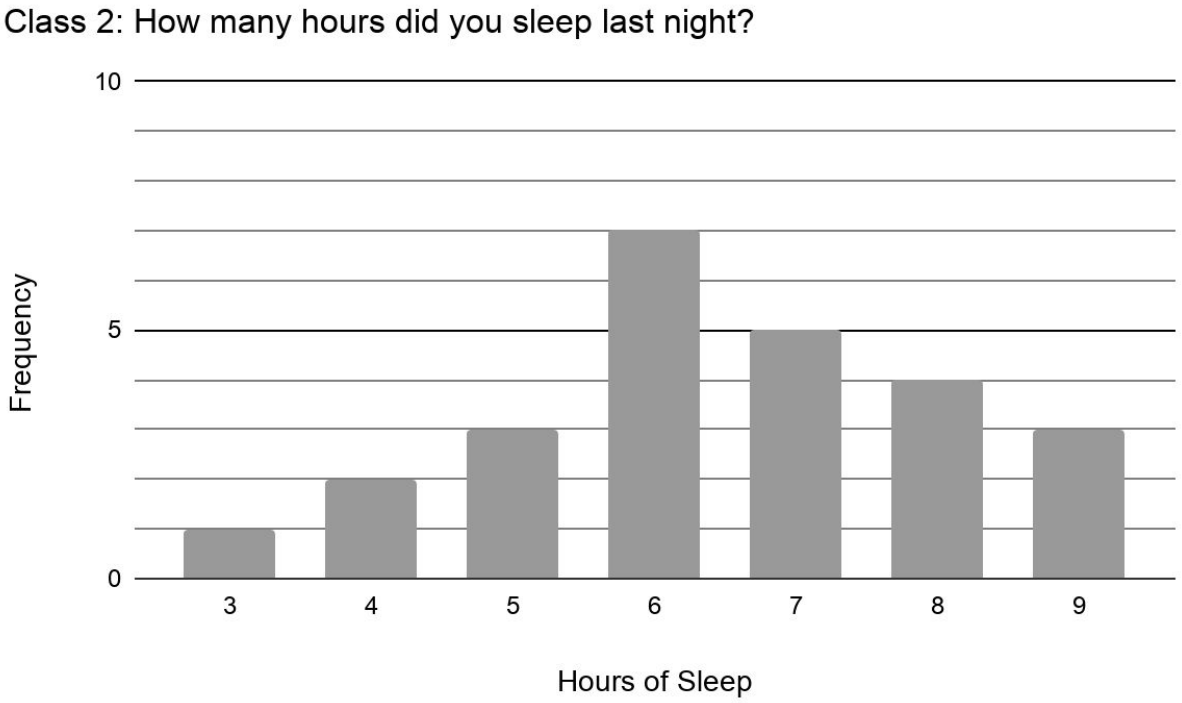
54) True or False: $\frac{1}{5}$ of students in the class slept seven hours the previous night.

55) What percent of students in the class are getting <u>not</u> enough sleep (less than seven hours), according to the Sleep Research Society?

56) What is the range in hours of sleep for students in this class?

[4] Recommended Amount of Sleep for a Healthy Adult (Sleep, June 2015)

Look at the chart for Class 2 and answer the questions below.



57) How many students slept six hours the previous night?

A. 5
B. 6
C. 7
D. 10

58) What is the range in hours of sleep for students in this class?

A. 1
B. 6
C. 9
D. 10

59) What is the relative frequency of students who slept nine hours the previous night? Choose all that apply.

A. 3
B. $\frac{3}{25}$
C. .12
D. 9

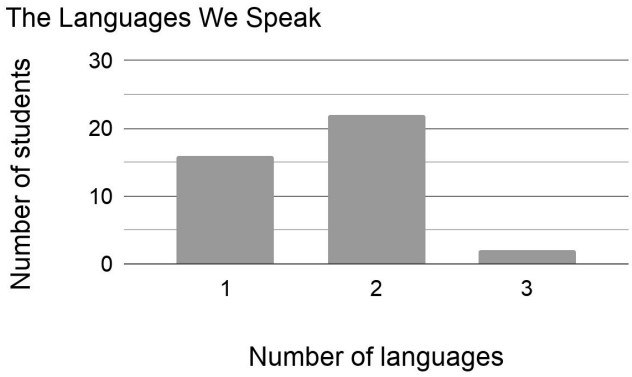
60) What percent of students in Class 2 had less than seven hours of sleep the previous night?

The student research group made charts based on the question, "How many languages are spoken by students in this class?" using data collected from the adult education class:

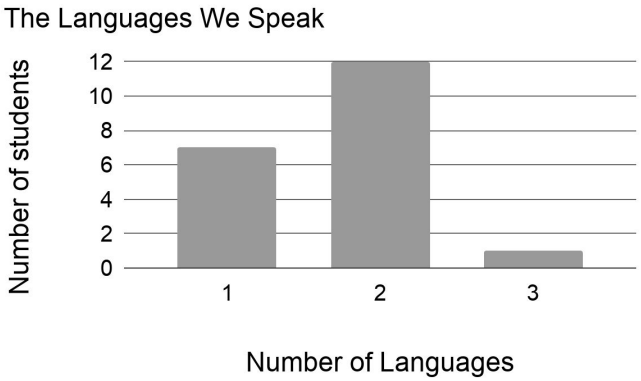
Number of languages spoken	Number of students
1	8
2	11
3	1

61) Which chart below correctly shows the data from the table above?

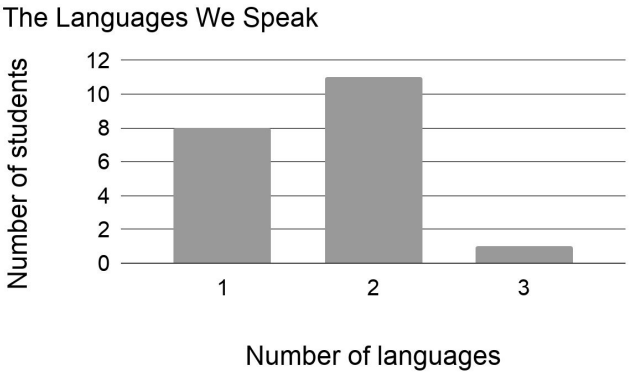
A.



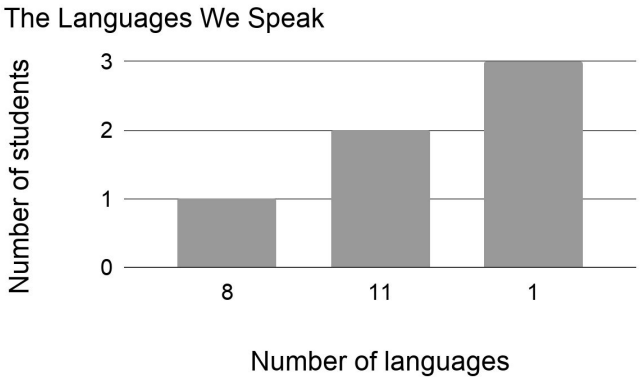
B.



C.



D.



Explain your choice.

Practice with Measures of Center

62) Create a set of five numbers between 1 and 20 with a mean, median, and range that are all the same number.

Can you find more than one correct answer? Find as many solutions as you can.

Answer Key - Data in the Classroom

1) One of the main differences is that the A questions are about more than one person. The B questions are asking about one person. The A questions might lead to different answers from different people. The B questions would lead to one answer. The teacher is 48 years old. Juana drinks 2 cups of coffee per day. Claude studied for 2 years. Each of the B questions results in one answer, rather than a collection of data with different answers to be analyzed.

2) "How many hours do students in this class typically sleep per night?" is a statistical question since we can collect data by asking students how many hours they usually sleep and we expect that their answers will be different. For example, some people will say 9 hours and others will say 5 hours. Their answers will vary. Each of their answers represents data that we collect.

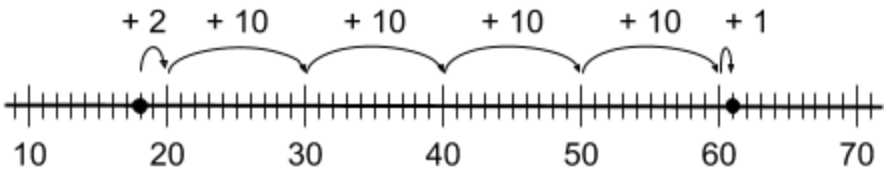
3)

Question	Is it statistical? Yes/No	Write an explanation.
How many minutes does it take students in this class to get to school?	Yes	The question can be answered by collecting data from each student. We expect that there will be variability in the data since it will take different amounts of time for everyone to get to school.
How many weeks long is this class?	No	The question can be answered by collecting data from the teacher, but there is no variability since there is just one answer. The question could be statistical if we collected about the length of different classes at a school or in a city.
How many cups of water do students in this class drink each day?	Yes	The question can be answered by collecting data from each student. We expect that there will be variability since some people drink more water than others.
How many students are in this class?	No	This question can be answered by collecting data, but there is no variability since there is only one answer. A question like, "What is the typical number of students in an adult education class?" is a statistical question because you can expect a range of answers, from small classes in some schools to large classes at other schools.

4) Answers will vary. Look below for more analysis of the ages of the high school students.

5) Answers will vary. Look below for more analysis of the ages of the adult education students.

6) C



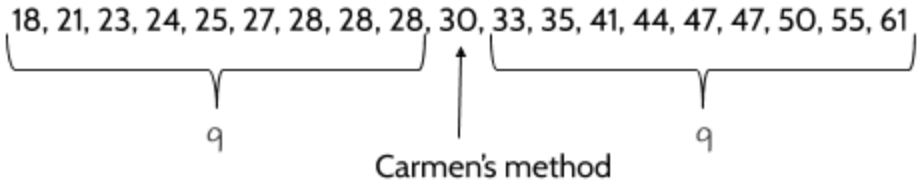
7) Answers will vary. More information about the students' methods below.

8) She found the most common number. There are more students who are 28 than any other age.

9)

7	15
none	none

10) Carmen put the ages in order from smallest to largest, then chose the middle number.



11)

7	11
6	10

12) Offense → range: 156 mode: none median: 252

13) Defense → range: 162 mode: 192 median: 235
(The median is 235 because it's halfway between the middle numbers 230 and 240.)

14) You might say that the typical offensive player weighs about 7 pounds more than the typical defensive player since the median weight of the offensive players is 252 pounds and the median weight of the defensive players is 235 pounds. There is a larger range of weights on the defensive team, since the difference between the lightest and the heaviest player is 162 pounds.

15) Claude added all the ages of the adult education students together to get 665, then divided by 19 (the number of students in the class) to get 35:

$$665 \div 19 = 35$$

16) 23

17) 7

18)

6	11
5	10

19)

mode: 10	mean: 9
median: 9.5	range: 6

20) The mode. There were more size 10 shoes sold than any other size. The other measures of center don't give you the sizes you need to replace. The mean is 9, but there is one pair of size 9 that needs to be replaced. The mode is 9.5 and there weren't any pairs of shoes of that exact size that were sold. The range tells you the difference between the smallest and largest shoes, but not which shoes need to be replaced.

21) mode: $15.00 median: $16.00 mean: $19.00 range: $15.00

22) There are different options. If you gave the mean of $19.00, you might give your friend the impression that they would start at that rate. It's more likely that they would start closer to $15.00, since they are new on the job. The mode of $15.00 or the median of $16.00/hr is a more typical wage for employees. The mean of $19.00/hr is higher because of the manager's wage of $30.00/hr. and the supervisor's wage of $25.00/hr. Both of these wages make the mean higher. $25.00/hr and $30.00/hr. are *outliers* in this situation, meaning they are numbers

that are much different than most of the other numbers. When there are outliers in a data set, the mean is usually a better representative of what is typical.

23) mode: $38.00 median: $42.00 mean: $49.00 range: $45.00
(The median is $42.00 because it's halfway between the middle numbers $41.00 and $43.00.)

24) Different answers could be correct. The mean of $49.00 is probably the best answer, since you would know how much to budget for the whole year: $49.00 × 12 months = $588 (a year's electricity bills). You could also argue that you should use the highest bill of $80.00 in your budget, since you would always know that you have enough money budgeted for electricity. You might also notice that electricity bills tend to be higher in the summer because of air conditioners, so you could budget more money in the summer and less in the winter.

25)

Measurement	Description	Example in the set {7, 6, 5, 17, 5}
range	the most common number	8
mode	an equal share	12
median	the difference between the smallest and largest number	5
mean	the middle number	6

26) The range is most affected. It was 43 and became 57.

Measurement of student ages	Before new student joined the class	After new student joined the class
range	43	57
mode	28	28
median	30	31.5
mean	35	37

27) C. The mode doesn't change. The median goes up by 1.5. The mean goes up by 2.

28) B

29) Answers will vary.

30) Answers will vary. There are many different equivalent ratios you could make.

31) 10 out of 20 is equal to $\frac{50}{100}$ or 50%. 13 out of 25 is equal to $\frac{52}{100}$ or 52%. A slightly higher percentage of students in class 2 plan to study one year or more.

32) Class 1: $\frac{16}{20} = \frac{80}{100} =$ 80% Class 2: $\frac{16}{25} = \frac{64}{100} = 64\%$
Class 1 has a higher portion of students who sleep at least 8 hours.

33) Class 2

34)

Class 1

Students with children	3	15	75
Students with no children	1	5	25
All students	4	20	100

Class 2

Students with children	4	20	80
Students with no children	1	5	20
All students	5	25	100

35) Out of 20 adult students in Class 1, 15 have children. 75% of adult students in Class 1 have children. 25% of adult students in Class 1 don't have children. 3 out of every 4 adult students in Class 1 have children.

Out of 25 adult students in Class 2, 20 have children. 80% of adult students in Class 2 have children. 20% of adult students in Class 2 don't have children. 4 out of every 5 adult students in Class 2 have children.

36) The fraction or percentage of bilingual students is the same in each class. $\frac{12}{20}$ is equivalent to $\frac{15}{25}$, since they both are equivalent to 60%. The ratio of bilingual students to monolingual students is also equal in each class. The ratio 12:8 is each to 15:10, since both ratios are equal to 3:2.

	Bilingual students	Monolingual students	All students
Class 1	12	8	20
Class 2	15	10	25

37) 6

38) 20

39) A, C, D

40) B

41) Answers will vary.

42)

original ratio	out of 100	percent	decimal
$\frac{16}{20}$	$\frac{80}{100}$	80%	0.8

43) $\frac{4}{20} = \frac{2}{10} = \frac{1}{5} = \frac{20}{100} = 0.2 = 20\%$ (any of these answers is correct.)

44) $\frac{18}{20} = \frac{9}{10} = \frac{90}{100} = 0.9 = 90\%$

45) C

46) 10%. You could start with $\frac{2}{20}$ and turn it into a percent. You could also subtract 90% (right-handed students) from 100% (total number of students) to get 10%.

47) Class 2 has a higher relative frequency of left-handed people (.12 or 12%) compared with Class 1 (.1 or 10%).

48) 4

49) 4. The range is the difference between the highest answer (4 sodas per day) and the lowest answer (0 sodas per day).

50) B. Eleven students said 0, two students said 1, four students said 2, and three students said 4.

51) 0 because it is the average of the two middle numbers in this set:
{0, 0, 0, 0, 0, 0, 0, 0, 0, **0**, **0**, 1, 1, 2, 2, 2, 2, 4, 4, 4}

52) Theresa: $\frac{3 \times 5}{20 \times 5} = \frac{15}{100} = 15\%$
Claude: $3 \div 20 = 0.15$
Carmen might think about this in different ways. Maybe she knows that 5 out of 20 is 25%, so 4 out of 25 is less. She might also know that 10% of 25 is 2.5, so 4 out of 20 is more than 10%.

53)

Hours of sleep	Number of students	"out of 100"	Decimal	Percent	Fraction
4 hours	2	$\frac{10}{100}$	0.1	10%	$\frac{2}{20}$
5 hours	5	$\frac{25}{100}$	0.25	25%	$\frac{5}{20}$
6 hours	5	$\frac{25}{100}$	0.25	25%	$\frac{5}{20}$
7 hours	4	$\frac{20}{100}$	0.2	20%	$\frac{4}{20}$
8 hours	3	$\frac{15}{100}$	0.15	15%	$\frac{3}{20}$
9 hours	1	$\frac{5}{100}$	0.05	5%	$\frac{1}{20}$
Total	20	100	1.00	100%	$\frac{20}{20}$

54) True. 4 is ⅕ of 20.

55) 60% ($\frac{12}{20}$)

56) 5

57) 7

58) 6

59) B, C

60) 52%

61) C

62) There are many answers including:

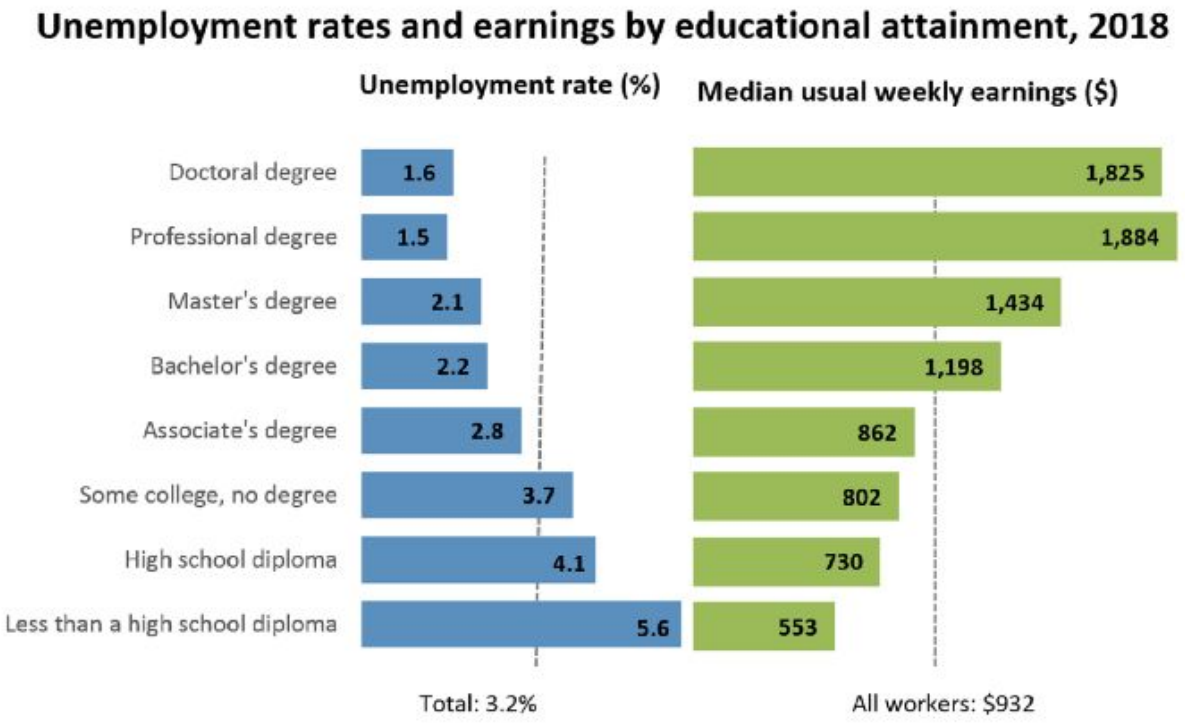
{2, 3, 4, 5, 6} mean, median, range = 4
{3, 4, 6, 8, 9 } mean, median, range = 6
{3, 5, 6, 7, 9} mean, median, range = 6
{4, 6, 8, 10, 12} mean, median, range = 8
{4, 5, 8, 11, 12} mean, median, range = 8
{5, 8, 10, 12, 15} mean, median, range = 10
{6, 8, 12, 16, 20} mean, median, range = 12
{7, 8, 13, 17, 20} mean, median, range = 13
{6, 11, 14, 19, 20} mean, median, range = 14

Statistics in the World

In this section, you will use your statistical skills to analyze data and charts related to education, work, housing costs, and the cost of living. We encourage you to use a calculator in this section.

Education and Careers

Examine the chart below.



1) What do you notice?

Use the chart **Unemployment rates and earnings by educational attainment, 2018** on the previous page to answer the following questions.

According to the graph on the last page, the median weekly earnings for all workers is $932. Remember that median means the middle number in a list of numbers when they are in order from smallest to largest. If we took the millions of different weekly salaries in the United States and put them in order from the smallest to the largest, $932 would be in the middle of the list. Half the people in the United States make more than this and half the people in the United States make less than this.

2) What is the median weekly earnings for someone with less than a high school diploma?

3) What is the median weekly earnings for someone with a high school diploma (but no college)?

4) What is the median weekly earnings for a bachelor's degree?

We can calculate the *yearly* salary by multiplying the weekly earnings by 52 weeks in a year. The median *yearly* salary for all workers is $48,464 because...

$932 per week ✕ 52 weeks in a year = $48,464 per year

5) What is the median yearly earnings for someone with less than a high school diploma?

6) What is the median yearly earnings for someone with a high school diploma (but no college)?

If your calculations were correct, you will see that the median yearly salary for someone with a high school diploma is about $9,000 more than someone without a high school diploma. Typically, people with a high school diploma earn substantially more money than people without a high school diploma.

7) How much more money, on average, do people with an associate's degree earn per year than people with a high school degree?

A. $132
C. $862
B. $730
D. $6,864

Look at the Unemployment Rate statistics on the left side of the graph above. The total unemployment rate means that 3.2% of Americans who wanted to work in 2018 did not have a job. In other words, about 3 out of every 100 Americans were not working when this graph was made.

8) According to the graph, 5.6% of people without a high school diploma were unemployed and 4.1% of people with a high school diploma were unemployed. In which group were more people out of work?

A. People without a high school diploma
B. People with a high school diploma

9) Look at the unemployment rate for people with an associate's degree. About how many people out of every 100 are unemployed?

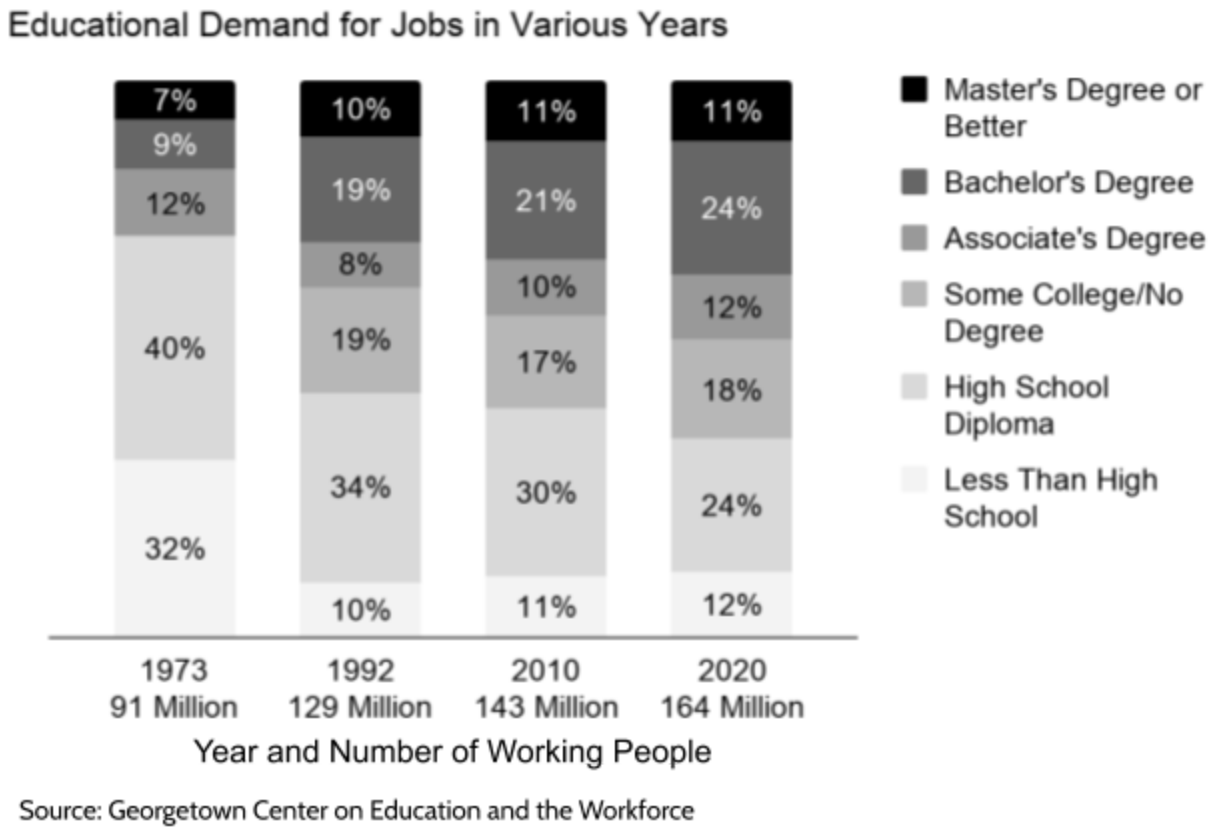
A. 2
C. 4
B. 3
D. 5

10) Which group would you rather be in?

A. Low unemployment rate and low median weekly earnings
B. Low unemployment rate and high median weekly earnings
C. High unemployment rate and low median weekly earnings
D. High unemployment rate and high median weekly earnings

The unemployment and earnings statistics in the previous graph were based on data from 2018. The weekly earnings and the percentages of people out of work were based on one year. When making a decision about your future, it is also important to understand how the jobs that are available change over time.

Examine the chart below.



Source: Georgetown Center on Education and the Workforce

11) What do you notice?

Use the chart **Educational Demand for Jobs in Various Years** on the previous page to answer the questions below.

12) According to the graph, what percentage of jobs in 1973 required less than a high school degree?

13) Out of a total of 91 million jobs in 1973, the percent of jobs that required less than a high school degree was 32%. Approximately how many jobs was this?

A. 7 million
C. 29 million
B. 12 million
D. 45 million

14) In 2020, what percentage of jobs require less than a high school degree?

15) In 2020, approximately how many jobs require less than a high school degree?

A. 12 million
C. 82 million
B. 20 million
D. 164 million

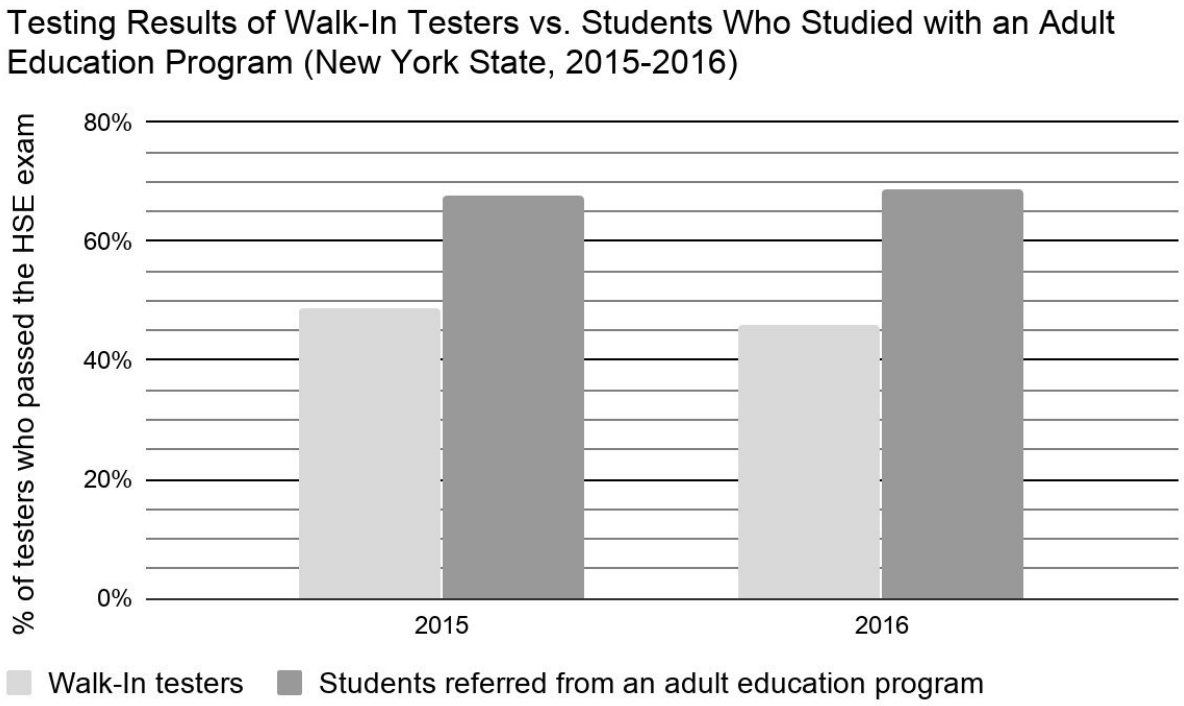
16) Based on the graph, which statement about jobs and education requirements is true?

A. The percentage of jobs available for people with less than a high school diploma went down in each of the years.
B. The percentage of jobs that require an associate's degree went up in each of the years.
C. The percentage of jobs that require a bachelor's degree is lower in 2020 than it was in 2010.
D. Most jobs now require at least some college experience.

The High School Equivalency (HSE) Exam

Many adults decide to work towards their high school equivalency diploma in order to continue their education, find new career opportunities, and serve as an example to their children, family, and community. When preparing to take the HSE exam, there are many questions to ask yourself: How long has it been since you were in school? Which subjects do you feel confident in? Where do you think you need more practice? How can you prepare for college or a career while you study?

People who decide to get their high school equivalency diploma often go to an adult education program to take classes in reading, math, and other subjects. They are referred to the HSE testing center after passing practice tests to show they are ready to pass the exam. Other people take the HSE exam on their own as a "walk-in." They may have studied on their own or they may have decided to see how they would do on the exam without studying.

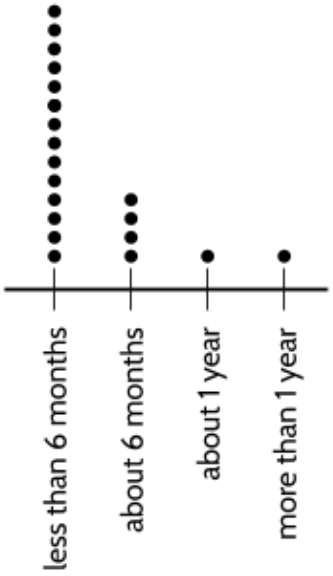


Source: New York State Education Department, Office of Adult Career and Continuing Education Services

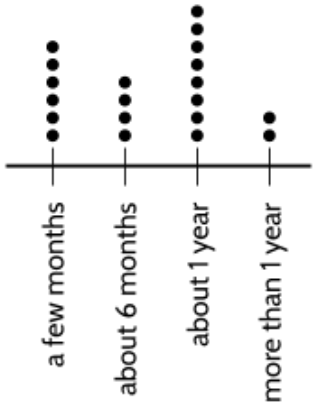
17) Based on this chart, what advice would you give to someone who is interested in getting their high school equivalency diploma? Use evidence from the chart.

The dot plots below show survey results from an adult education class. The students were asked about their preparation for the high school equivalency exam.

18) Analyze the graphs, then complete the sentences below.



How long have you been studying for the HSE exam?



How long do you plan to study to pass the HSE exam?

The relative frequency of students who have been studying for less than 6 months can be written as _____ or _____ . The relative frequency of students who plan to study for about one year can be written as _____ or _____ .

When I first looked at these graphs, _____

_____ .

I would like to show this graph to _____ because

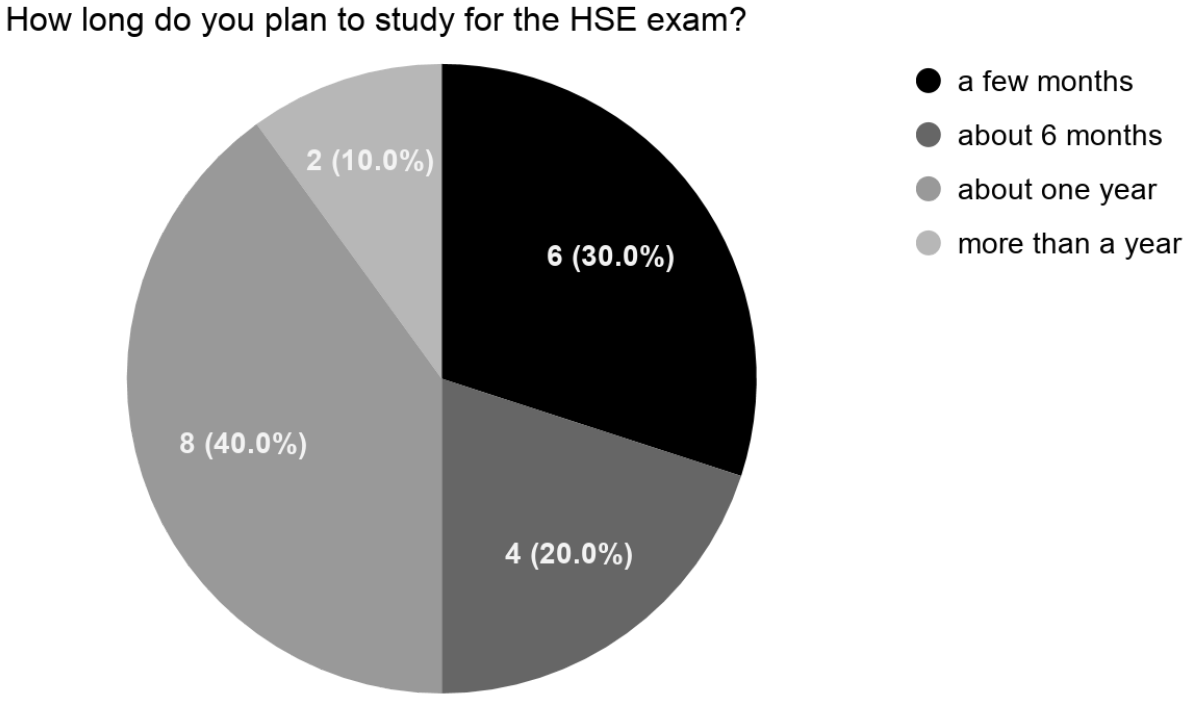
_____

_____ .

19) Mark the following statements true or false.

Statement	True	False
One-tenth ($\frac{1}{10}$) of the students think they will need to study for more than a year before taking the exam.	✓	
$\frac{1}{5}$ of the students expect to study for about one year before taking the test.		
Half of the students expect to study for a year or more before taking the high school equivalency exam.		
One-fifth ($\frac{1}{5}$) of students plan to take the test in about 6 months.		
6% of the students expect to take the high school equivalency test in a few months.		
90% of students plan to study 6 months or more before taking the high school equivalency exam.		

You can check your answers with the pie chart below.



The adult student research group wanted to understand how students in their school did on the TASC exam. They asked their teacher for testing data from their school. The teacher agreed to share some test scores anonymously from a previous year. The teacher chose ten sample scores randomly from a list of 100 test scores by picking strips of paper out of a hat. The ten sample test scores are shown below with the names replaced with letters so that the students are anonymous.

20) Complete the Pass column to indicate whether the student passed the exam.

Student	Writing	Social Studies	Science	Reading	Math	Pass
A	493	558	498	514	535	N
B	507	576	590	568	502	
C	546	549	538	548	494	
D	517	486	553	482	496	
E	496	547	547	560	496	
F	486	506	no score	490	490	
G	535	no score	546	no score	480	
H	530	502	496	528	531	
I	502	550	530	520	502	
J	514	586	595	526	526	

Note: To pass the full exam, each subject test must be 500 or above.

21) Use what you know about range, mode, median, mean, and percent to analyze the HSE exam data above. Provide as much information as you can below.

The student research group then did research on statewide results for the high school equivalency exam.

22) The table below shows high school equivalency exam results in selected New York State counties in 2015. Fill in the missing information. Round your answers to the nearest whole number.

High School Equivalency Pass Rate in Selected New York State County, 2015

County	Passed Exam	Took Exam	Pass Rate
Albany	173	318	54%
Chemung	126	175	
Erie	620	945	
Essex		50	60%
Greene	114	160	
Kings	2,396	5,119	
Rensselaer	31	40	
Tioga	4	4	
Tompkins	75	125	
Wyoming	82	125	

Source: New York State Education Department, Office of Adult Career and Continuing Education Services

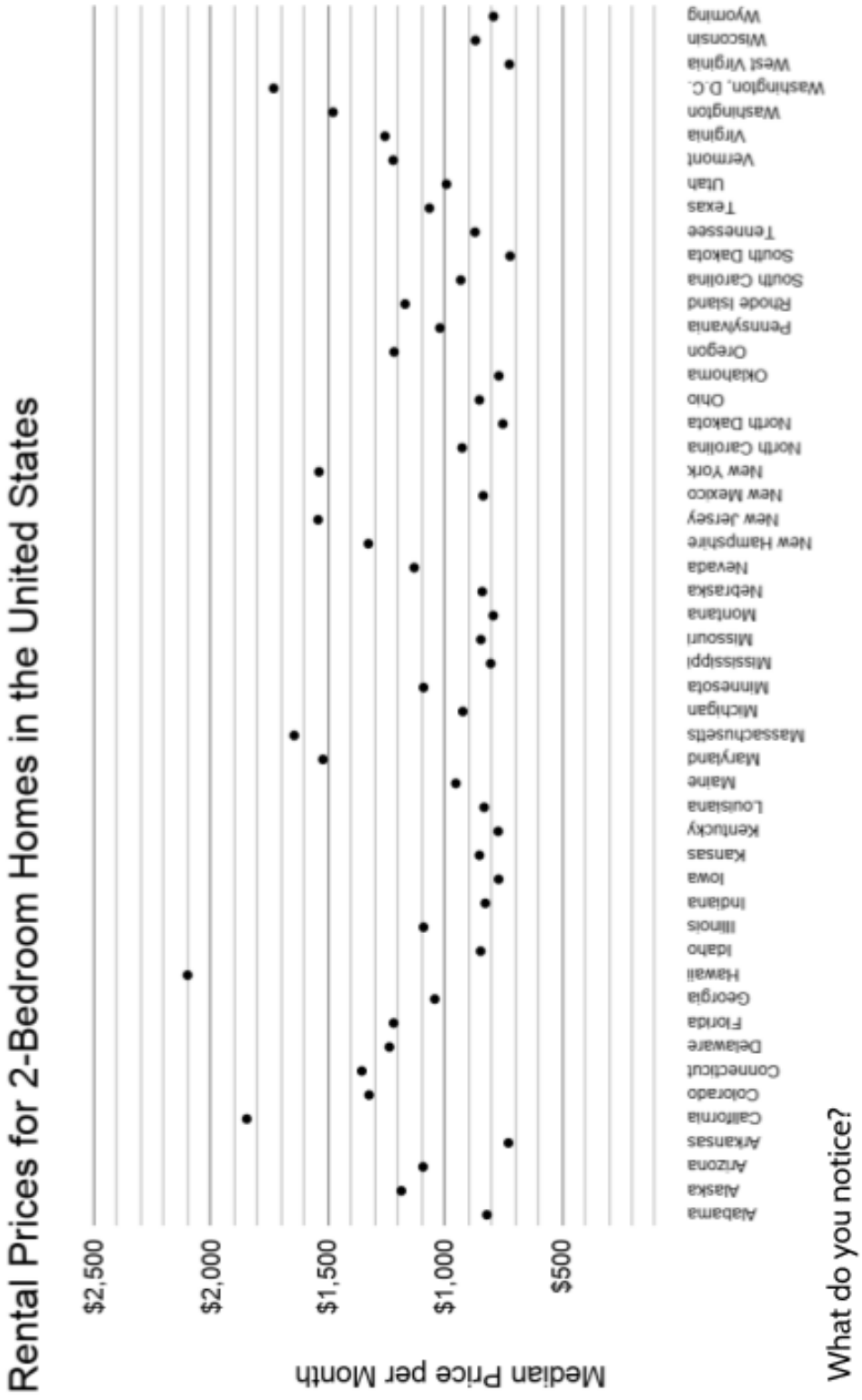
23) Of the counties listed, which had the highest number of passers?

24) Which county had the highest pass rate?

25) Which county had the lowest number of passers?

26) Which county had the lowest pass rate?

The Cost of Housing



27) Which state has the highest median rental price for 2-bedroom homes?

What is the approximate median rental price in this state?

28) Which states have the lowest median rental prices for 2-bedroom homes?

What is the approximate median rental price in these states?

29) What is the approximate range in median rental prices for 2-bedroom homes?

A. $700
B. $800
C. $1400
D. $2100

30) What is the approximate median rental price for 2-bedroom homes in New York State?

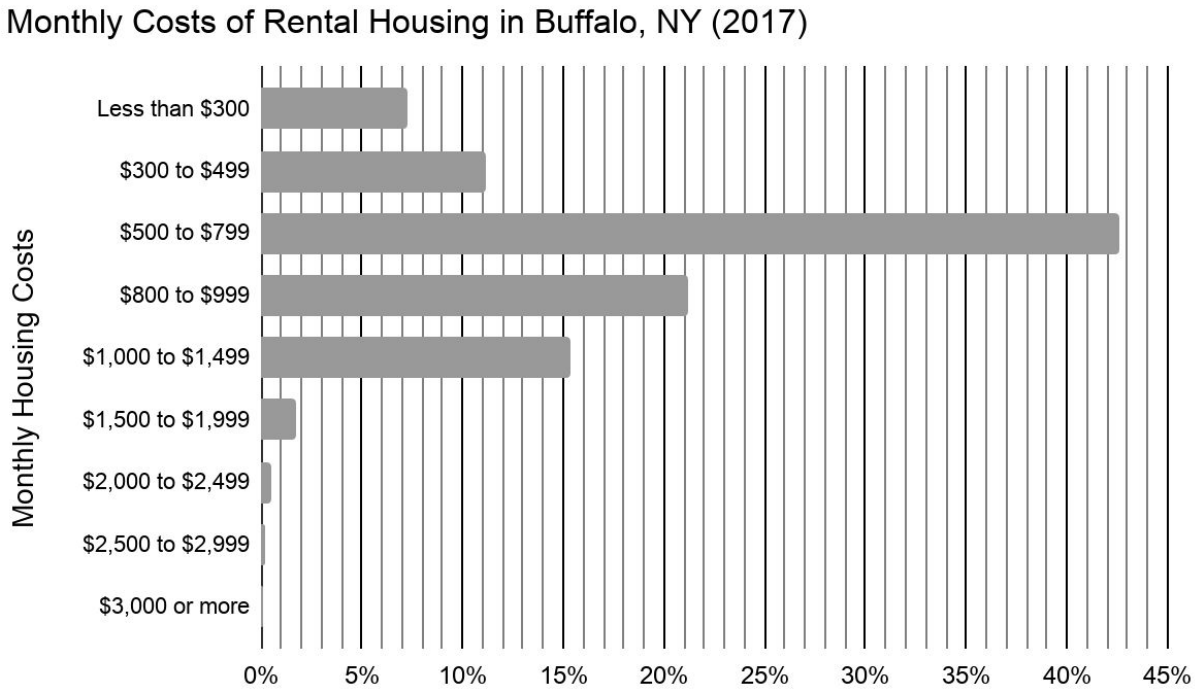
31) How does the median rental price for 2-bedroom homes in New York State compare to prices in the area where you live?

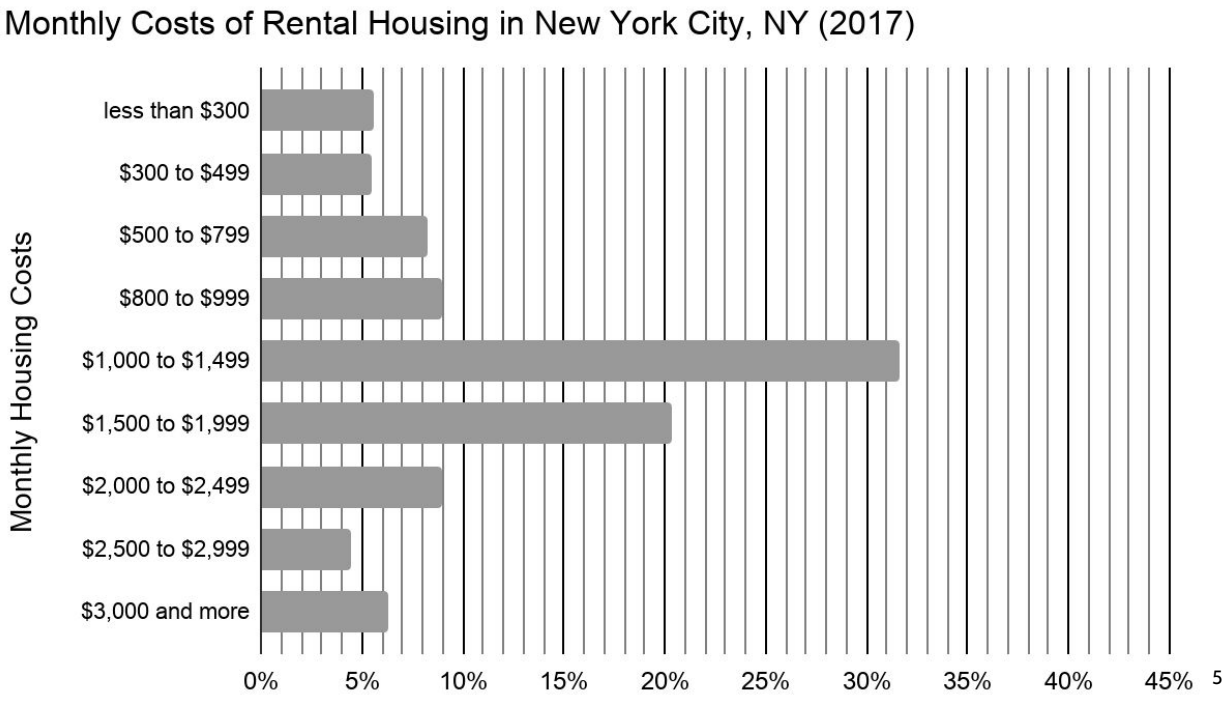
32) What is the approximate difference between median rental prices for 2-bedroom homes in New York State and Pennsylvania?

A. $50
B. $500
C. $1000
D. $1500

33) How much would the median rental price in New York State cost for one year's rent?

Monthly housing costs include average monthly cost of utilities (electricity, water, and sewer) and fuels (oil, gas, wood, etc.), but does not include the cost of rent. Look at the following two graphs with data on the housing costs in Buffalo, NY and New York City, NY.





[5]

[5] http://www.census.gov

34) Compare the two graphs on the previous page, **Monthly Costs of Rental Housing in Buffalo** and **Monthly Costs of Rental Housing in New York City**.

What is similar?

What is different?

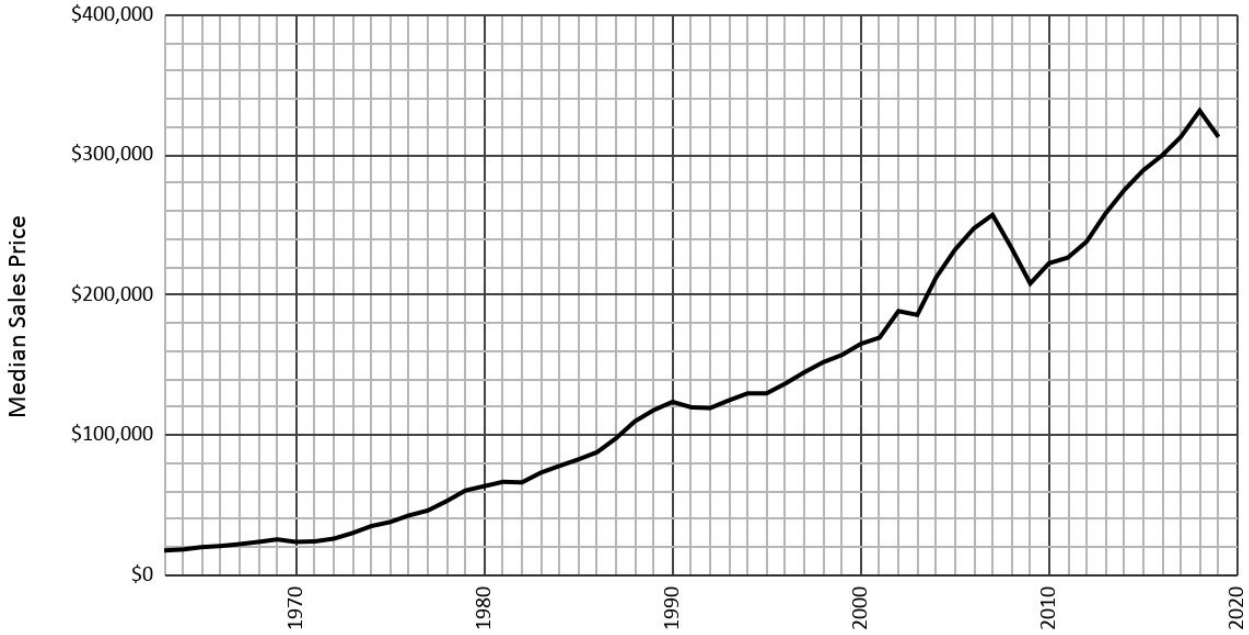
35) What percentage of people pay less than $1,000 in monthly housing costs in Buffalo?

36) What percentage of people pay less than $1,000 in monthly housing costs in New York City?

37) If your monthly housing costs were $650, how much would that cost for a year?

38) If your monthly housing costs were $1300, how much would that cost for a year?

Median Sales Price of Houses Sold for the United States



39) What do you notice?

40) When were sales prices for houses the lowest? What was the approximate median sales price?

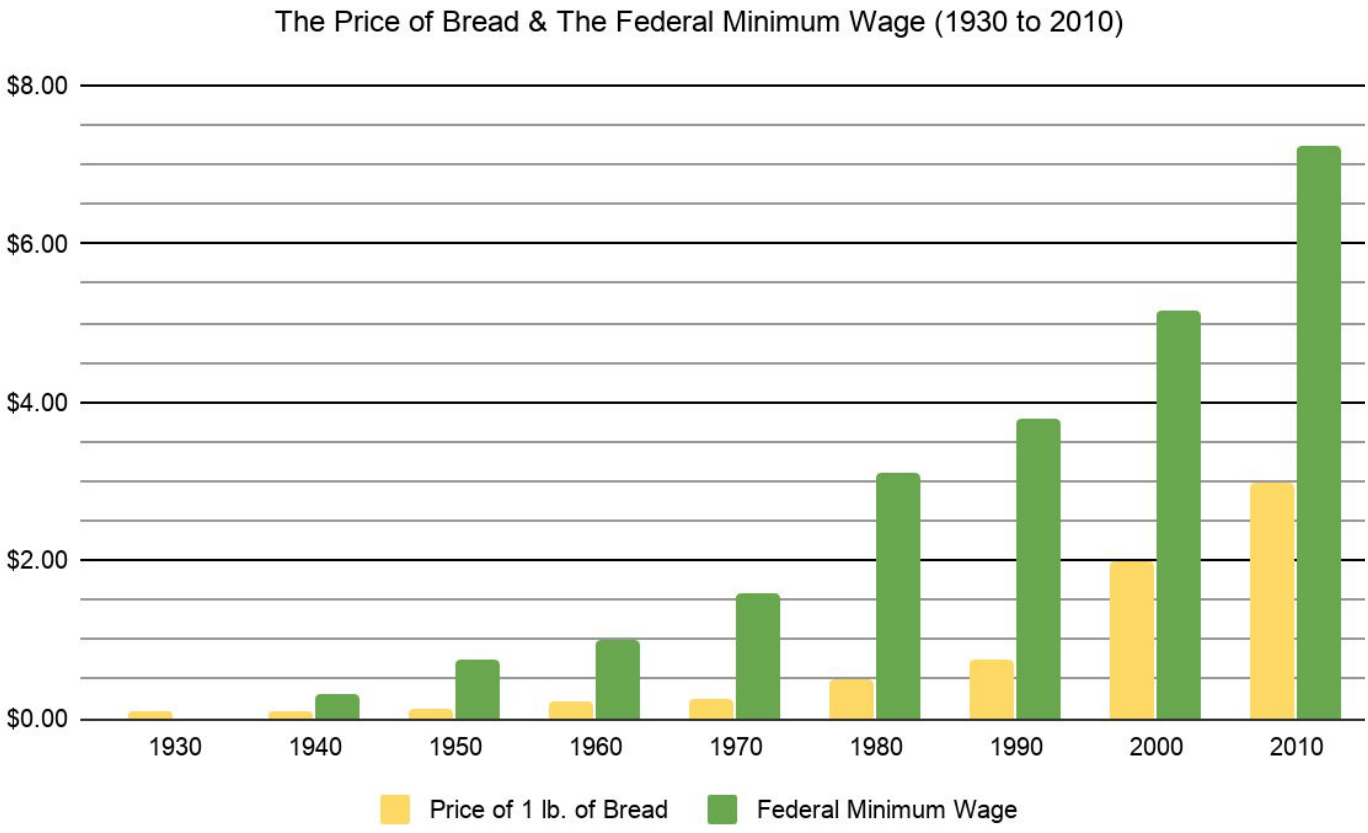
41) When were sales prices for houses the highest? What was the approximate median sales price?

42) What is the approximate range in sales prices shown on the graph?

43) What range in years with data is shown on this chart?

The Cost of Living

Statistics can be used to understand how people are doing economically. In this section, we will look at the history of the price of bread and the federal minimum wage.



44) What do you notice?

The table below includes the same data shown in the graph above.

Year	Price of 1 lb. of Bread	Federal Minimum Wage (hourly)*
1930	$0.09	None
1940	$0.10	$0.30
1950	$0.12	$0.75
1960	$0.23	$1.00
1970	$0.25	$1.60
1980	$0.50	$3.10
1990	$0.75	$3.80
2000	$1.99	$5.15
2010	$2.99	$7.25

* The first Federal minimum wage was introduced in 1938 by the Fair Labor Standards act, under President Franklin Delano Roosevelt.

45) Mark the following statements true or false.

Statement	True	False
In 1940, someone working for the federal minimum wage could buy three pounds of bread for one hour's work.	✓	
In 1980, the federal minimum wage was about six times the price of a pound of bread.		
The price of bread in 2010 was about four times the price of bread in 1980.		
The federal minimum wage in 2010 was about 2.3 times the federal minimum wage in 1980.		
People could buy the most bread for an hour's work in the '70s and '80s.		
People working for federal minimum wage in 2010 could buy the most bread since their hourly wage was the highest.		

46) Think about what it was like to interpret this data, then complete at least three of the following sentences.

When I first looked at this graph, _____

_____ .

When I compare _____ and

_____ , I notice _____

_____ .

Something that took me some time to figure out was _____

_____ .

One thing I did to understand this graph and table was _____

_____ .

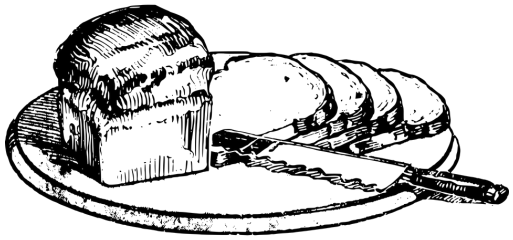
Someone I would share this graph with is _____ because

_____ .

One question I have is _____

_____

_____ .



The Price of Bread and Purchasing Power

Do you make more money than your grandparents did? I looked at census records from 1940 and found out that my grandfather made $3,000 dollars per year working as an editor at a newspaper. How could I compare this income to a salary in the 2000's? Was that a lot of money at the time? Or was my family struggling to survive?

Historians and economists often look at the history of wages and the price of food in order to understand people's standard of living, a measurement of how well people can live on their wages. We can look at how much money people made compared with the cost of basic necessities like food, rent and fuel.

Wages alone don't tell us the whole story. We also need to consider the cost of *goods* (food, cell phones, cars, etc.) and *services* (haircuts, healthcare, plumbing repair, etc.). This is because, in general, the price of all goods and services tends to go up gradually over time through a process called *inflation*. Inflation is an increase in the price of all goods. It results in a decrease in how much we can buy with the money we have. For example, in 2003, we could buy two movie tickets for $12. In 2018, $12 would only get you one ticket. My grandfather made $3,000 dollars in 1940, but you would need $55,000 in 2020 to buy the same amount of goods and services.

Because of inflation, both wages (the price of people's work) and the cost of goods tend to go up over time. The important question is not how much money you make, but how much you can buy with the money you make.

The price of bread has long been used as a way to understand people's economic situations. The cost of food is especially important for people living near the poverty line, below which people would be considered in poverty. To learn more, economists study something called *purchasing power*. Purchasing power is defined as the amount of a "basket of goods" that a person can buy with a certain amount of money. To simplify, we can use bread as one item in the basket of goods, and ask how much bread can someone buy with their wages. We can then see whether the amount of bread we can buy with our wages has increased or

decreased. This tells us whether purchasing power has gone up or down. If your wages have gone up, it doesn't necessarily mean your purchasing power has also gone up.

In 1795 in England, there was a law that said workers should receive at least the equivalent of 26 pounds in bread as weekly wages. That doesn't mean they paid workers with bread. It just means that with the money they received as wages, workers should have been able to buy at least 26 pounds of bread. Obviously, the employees didn't need this much bread every week, and they had other expenses, but this was a way to measure if the wages they received were enough.

In the late 1800's, there was a study of poverty in England. The study determined that in poor families the cost of food was about $\frac{1}{3}$ of the total money spent by a family on necessities. In order to determine the poverty line, the total money spent on food was multiplied by 3. The poverty line is the least amount of money a family can earn in order to stay out of poverty. If they earn less money, they are considered to be in poverty.

The researchers estimated the total food cost for a family by saying the amount of food each person needed daily was equal to four pounds of bread. (This doesn't mean that people ate four pounds of bread each day, but that the cost of food each day was equal to four pounds of bread.) Since an average family had four people, researchers multiplied 4 pounds by 4 people to get 16 pounds of bread needed by the family each day. The total food cost for the family was the cost of 16 pounds of bread. Since the cost of food was considered to be $\frac{1}{3}$ of the total spending by the family, they multiplied 16 by 3 to get 48 pounds of bread.

The cost of 48 pounds of bread was considered the minimum amount a family of four should make in wages. If a family didn't make enough money to buy 48 pounds of bread each day, they were considered to be in poverty. If they were able to buy more than 48 pounds of bread each day, they were considered to be above the poverty line.

Amazingly, the annual salary at the poverty line for a family of four is still determined by multiplying their estimated total food costs by 3. In 2016, the poverty line in the United States was $24,250.

47) How much is one-third of $24,250? Do you think you could feed a family of four for a year on this amount of money?

48) Complete the table. You may want to use a calculator for the last row. Try to calculate the other rows without a calculator.

whole amount	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{5}$	$\frac{1}{10}$
$60		$20	$12	$6
$120				
	$45			
		$50		
			$300	
$3.00				$.30
			$.12	
		$8,000		
	$15,000			
$24,250				

One-third of $24,250 is about $8,083. Even if you could feed a family with $8,083, would you be able to pay your other bills with the remaining money?

Many people have shown that food costs are not actually $\frac{1}{3}$ of a typical family budget these days, but are really $\frac{1}{5}$ or $\frac{1}{10}$, since other costs, such as housing, health care, childcare and transportation, require more money than in the past.

49) The typical family of four spent $8,320 on food in 2014. If $8,320 is $\frac{1}{3}$ of a family's total yearly income, what is their income?

50) If food costs actually make up $\frac{1}{5}$ of the total cost of providing for the same family, how much money would they need to pay all their bills each year?

51) According to one report[6], food costs are actually only $\frac{1}{10}$ of the total cost of providing for a family of four. How much money would the family need to pay all their bills each year?

52) In 2016, the poverty line in the United States was $24,250. Do you think this was a fair amount? What do you think the poverty line should be? Write an explanation.

_____

_____

_____

_____

_____

_____

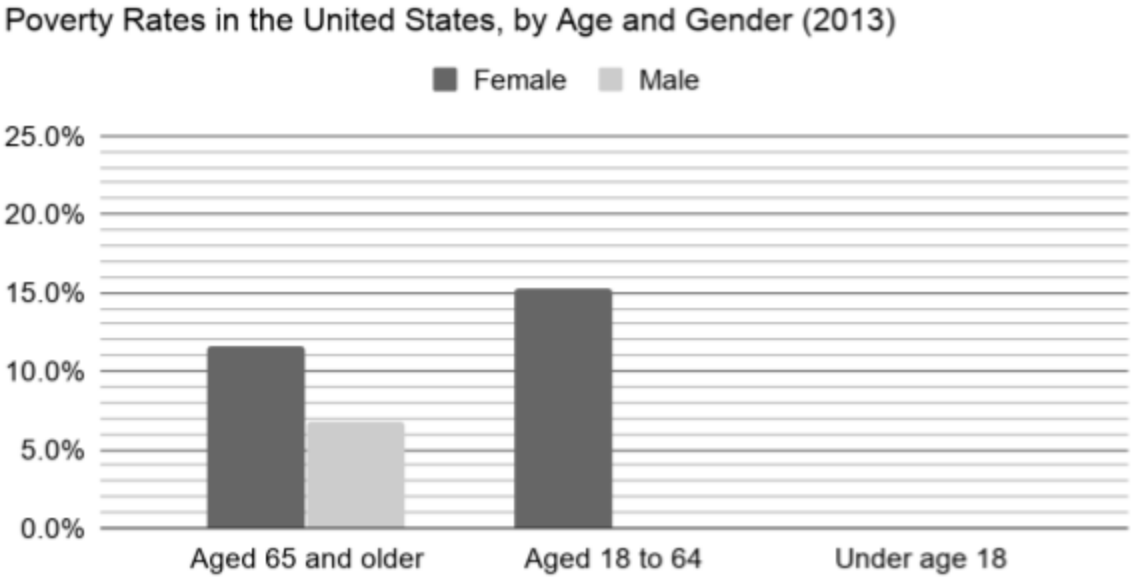
_____

_____

_____

[6] Household Expenditures and Income: Balancing family finances in today's economy, Pew Charitable Trust

The following chart is missing bars for some of its categories.



U.S. Census Bureau, Current Population Survey, 2014 Annual Social and Economic Supplement

The data table for the chart is missing data as well.

	Aged 65 and older	**Aged 18 to 64**	**Under age 18**
Female	11.5%	%	20.0%
Male	%	11.8%	19.8%

53) Use the data table to draw three missing bars and use the graph to fill in two missing percentages.

54) What do you notice when you look at the data in the chart and data table?

Salaries

Of the three measures of center, the median is usually used for wages and salaries. We can see why when we look at the mean and mode for the wages at a restaurant.

When we look at the table on the right, it is clear that most employees are making about $15 or $16 per hour, but two employees are making a much higher hourly wage. We might want to know a typical wage at this restaurant. Is it the mean?

hourly wages
$15.00
$15.00
$15.50
$16.00
$16.50
$25.00
$30.00

55) The mean of these hourly wages is...

A. $15.00
B. $16.00
C. $19.00
D. $25.00

This doesn't seem like a good measure because it is a lot more than most of the employees are making. The median of these hourly wages is $16.00. For this set of data, the median seems like a better measurement of the center of the data.

Median means half of the values are higher and half of the values are smaller.

56) What is the adjusted mean of the hourly wages if you remove $25.00 per hour and $30.00 per hour?

57) How does the adjusted mean compare with the median?

The wages of $25.00/hr and $30.00/hr above are called *outliers*, values that are much different than the other values. These higher wages make the mean larger than the median. Without those two higher wages, the mean and the median are much closer in value. Data for wages, salaries, and home prices often have some values that are much higher than others. For this reason, people will normally use the median as a measure of center instead of the mean for these kinds of statistics.

Consider the following table of salaries at Lukso Industries.

Position	Salary	Number of Employees
Sales Representatives	$32,000	5
Programmers	$50,000	2
Managers	$70,000	2
CEO	$1,000,000	1

The workers at the company are asking for a raise. They say that they can't pay their bills with the money they earn.

The chief executive officer (CEO) of Lukso Industries tells a newspaper, "I don't know what our employees are complaining about. The average salary at Lukso is $140,000, which is more than enough to live on."

58) How did the CEO calculate an average salary of $140,000?

59) Calculate a different kind of average for the salaries at Lukso Industries.

60) Write a response to the CEO from the point of view of an employee.

_____

_____

_____

_____

_____

_____

Getting to Work

The adult education research group created a frequency table for their survey data on transportation type and time spent traveling to school. This is called a two-way frequency table and can show two kinds of data at the same time.

Students in Our Adult Education Class

	travel for less than an hour to get to school	travel for an hour or more to get to school
use public transportation	11	6
walk	3	0

When you see frequency tables like this, we recommend adding a *Total* column on the end and a *Total* row below. This will help you calculate the relative frequency of parts of the table.

61) Fill in the missing boxes.

	travel for less than an hour to get to school	travel for an hour or more to get to school	Total
use public transportation	11	6	17
walk	3	0	
Total		6	20

Notice that totals going down ($17 + 3$) and the totals going across ($14 + 6$) both equal 20.

62) Using the frequency table on the previous page, what is the relative frequency of students traveling for less than an hour and use public transportation?

A. $\frac{17}{20}$

B. $\frac{14}{20}$

C. $\frac{11}{20}$

D. $\frac{20}{20}$

In the two-way frequency table above, 11 out of 20 students travel less than an hour and also use public transportation. This can be written as $\frac{11}{20}$, 0.55 or 55%.

Look back at the frequency table on the last page to answer the following questions.

63) How many students travel for an hour or more and use public transportation?

64) What is the relative frequency of students who travel for an hour or more and use public transportation?

A. 6%
B. 24%
C. 30%
D. 60%

The frequency table below shows how New York State workers 16 years and older got to work in 2018.

	Public Transportation	Personal Car	Walked	Total
New York	2,600,000	5,500,000	500,000	

65) How many total New York State workers are included in the data above?

66) Which of these expressions shows how to calculate the relative frequency of New Yorkers who use public transportation?

A. 5,500,000 ÷ 2,600,000
B. 2,600,000 ÷ 5,500,000
C. 5,500,000 ÷ (2,600,000 + 5,500,000 + 500,000)
D. 2,600,000 ÷ (2,600,000 + 5,500,000 + 500,000)

67) What percent of the workers included above use public transportation? Round to the nearest whole number.

This frequency table below shows similar statistics for workers in New Jersey.

	Public Transportation	Personal Car	Walked	Total
New Jersey	500,000	3,500,000	100,000	

68) What percent of workers take public transportation in New Jersey?

A. 12%
B. 14%
C. 20%
D. 50%

69) Why do you think New York State has a higher relative frequency of workers traveling by public transportation?

This table shows how men and women in the United States traveled to work in 2017.

	Car	Public Transportation	Walked	Biked	Total
Women	60,000,000	3,800,000	1,900,000	200,000	
Men	68,000,000	3,800,000	2,200,000	600,000	
Total					

70) Did men or women have a higher relative frequency of using public transportation? Explain your answer below.

Answer Key - Statistics in the World

1) Answers will vary.
2) $553 per week
3) $730 per week
4) $1,198 per week
5) $28,756 per year
6) $37,960 per year
7) D
8) A
9) B
10) B
11) Answers will vary.
12) 32%
13) C
14) 12%
15) B
16) D
17) Answers will vary.
18) The relative frequency of students who have been studying for less than 6 months can be written as $\frac{14}{20}$, $\frac{7}{10}$, 0.7, 70% or any equivalent ratio . The relative frequency of students who plan to study for about one year can be written as $\frac{8}{20}$, $\frac{4}{10}$, 0.4, 40% or any equivalent ratio . Other answers will vary.

19)

Statement	True	False
One-tenth ($\frac{1}{10}$) of the students think they will need to study for more than a year before taking the exam.	✓	
$\frac{1}{5}$ of the students expect to study for about one year before taking the test.		✓
Half of the students expect to study for a year or more before taking the high school equivalency exam.	✓	
One-fifth ($\frac{1}{5}$) of students plan to take the test in about 6 months.	✓	
6% of the students expect to take the high school equivalency test in a few months.		✓
70% of students plan to study 6 months or more before taking the high school equivalency exam.	✓	

20)

Student	Writing	Social Studies	Science	Reading	Math	Pass
A	493	558	498	514	535	N
B	507	576	590	568	502	Y
C	546	549	538	548	494	N
D	517	486	553	482	496	N
E	496	547	547	560	496	N
F	486	506	no score	490	490	N
G	535	no score	546	no score	480	N
H	530	502	496	528	531	N
I	502	550	530	520	502	Y
J	514	586	595	526	526	Y

21) There are many different statistics you can create with the data. For example, what is the percent of students who passed? What is the percentage of students who didn't pass? What is the average math test score? What is the range in math test scores? What is the percent of passing scores in math? Which subject has the highest pass percent? Which subject has the lowest pass percent? What other questions can you answer?

22)

County	Passed Exam	Took Exam	Pass Rate
Albany	173	318	54%
Chemung	126	175	72%
Erie	620	945	66%
Essex	30	50	60%
Greene	114	160	71%
Kings	2,396	5,119	47%
Rensselaer	31	40	78%
Tioga	4	4	100%
Tompkins	75	125	60%
Wyoming	82	125	66%

23) Kings

24) Tioga

25) Tioga

26) Kings

27) Hawaii. $2,100/month.

28) Arkansas, South Dakota, West Virginia. About $700/month.

29) C

30) $1550/month (the difference between highest rent and the lowest rent)

31) Answers will vary.

32) B

33) $1550 \times 12 = \$18,600$

34) Answers will vary.

35) 7% + 11% + 42% + 21% = 81%

36) 5% + 5% + 8% + 9% = 27%

37) $\$650 \times 12 = \$7,800$

38) $\$1300 \times 12 = \$15,600$

39) Answers will vary.

40) 1963. $20,000.

41) 2018. $330,000.

42) $310,000

43) 56 years (the difference between 2019 and 1963). Notice that there is no data for 2020.

44) Answers will vary.

45)

Statement	True	False
In 1940, someone working for the federal minimum wage could buy three pounds of bread for one hour's work.	✓	
In 1980, the federal minimum wage was about six times the price of a pound of bread.	✓	
The price of bread in 2010 was about four times the price of bread in 1980.		✓
The federal minimum wage in 2010 was about 2.3 times the federal minimum wage in 1980.	✓	
People could buy the most bread for an hour's work in the '70s and '80s.	✓	
People working for federal minimum wage in 2010 could buy the most bread since their hourly wage was the highest.		✓

46) Answers will vary.

47) $8,083. Opinions will vary, but it would be very challenging.

48)

whole amount	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{5}$	$\frac{1}{10}$
$60	$30	$20	$12	$6
$120	$60	$40	$24	$12
$90	$45	$30	$18	$9
$150	$75	$50	$30	$15
$1500	$750	$500	$300	$150
$3.00	$1.50	$1.00	$0.60	$.30
$0.60	$0.30	$0.20	$.12	$0.06
$24,000	$12,000	$8,000	$4,800	$2,400
$30,000	$15,000	$10,000	$6,000	$3,000
$24,250	$12,125	$8,083.33	$4,4850	$2,425

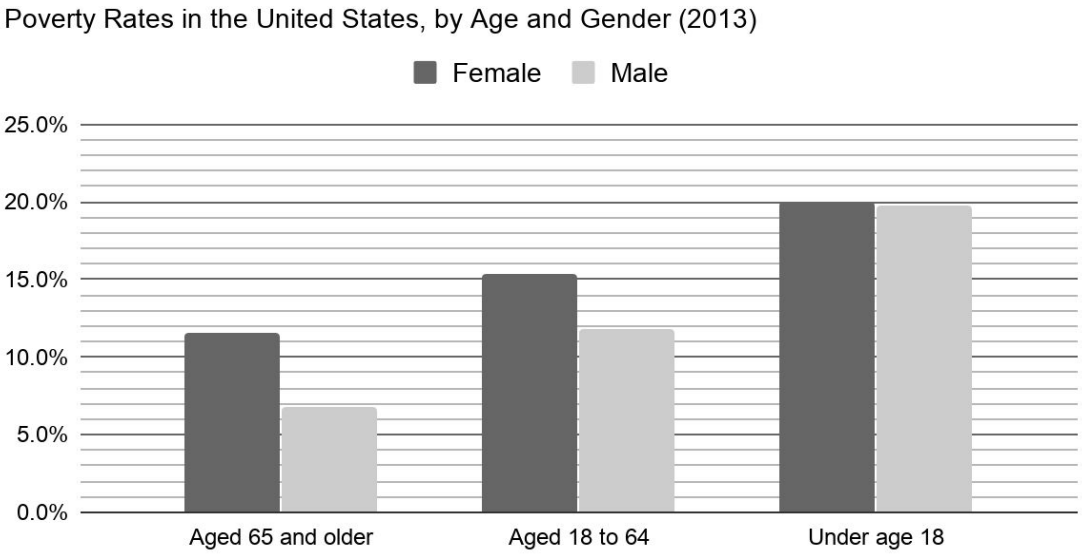
49) $24,960

50) $41,600

51) $83,200

52) Answers will vary.

53)



	Aged 65 and older	Aged 18 to 64	Under age 18
Female	11.5%	15.3 %	20.0%
Male	6.8%	11.8%	19.8%

54) Answers will vary.

55) C

56) $15.60

57) The adjusted mean is $15.60/hr, which is about the same as the median, which is $16.00/hr. Both of these numbers are good estimates of a typical wage at this company. $19.00/hr is not a good estimate since most people make a lot less.

58) Here are two different ways the CEO may have calculated the average. These are both calculations of the mean:

1. $32,000 + $32,000 + $32,000 + $32,000 + $32,000 + $50,000 + $50,000 + $70,000 + $70,000 + $1,000,000 = $1,400,000

   $1,400,000 ÷ 10 employees = $140,000

2. $\frac{(\$32{,}000 \times 5) + (\$50{,}000 \times 2) + (\$70{,}000 \times 2) + (\$1{,}000{,}000)}{10} = \$140{,}000$

59) The median is $41,000 (halfway between $32,000 and $50,000). The mode is $32,000.

60) Answers will vary.

61)

	travel for less than an hour to get to school	travel for an hour or more to get to school	Total
use public transportation	11	6	17
walk	3	0	3
Total	14	6	20

62) C

63) 6

64) C

65) 8,600,000

66) D

67) 30%

68) A

69) There is more public transportation (subways and buses) in New York City, which is a large part of the population of New York State. It is easier to use public transportation in cities than it is in suburban and rural areas.

70)

	Car	Public Transportation	Walked	Biked	Total
Women	60,000,000	3,800,000	1,900,000	200,000	65,900,000
Men	68,000,000	3,800,000	2,200,000	600,000	74,600,000
Total	128,000,000	7,600,000	4,100,000	800,000	140,500,000

3,800,000 out of 65,900,000 women took public transportation to work. This is about 5.7% of female workers. 3,800,000 out of 74,600,000 men took public transportation to work. This is about 5.1% of male workers.

Test Practice Questions

Answer the following questions. You can check your answers in the answer key at the end of the packet.

1) A restaurant sells kids' meals consisting of one main course, one side dish, and one drink, as shown in the table below.

Kids' Meal Choices

Main Courses	Side Dishes	Drinks
hamburger	french fries	milk
pizza	applesauce	juice

Which of these meal combinations is <u>not</u> possible?

A. hamburger, french fries, juice

B. pizza, french fries, milk

C. hamburger, pizza, juice

D. pizza, applesauce, juice

2) A frozen yogurt shop offers chocolate and vanilla yogurt and three different toppings: fruit, nuts, and sprinkles. How many different choices are possible for a single serving of frozen yogurt with one topping?

A. 15

B. 8

C. 6

D. 5

3) Guillermo is buying a new car. The model he likes is available as a convertible or a hatchback. He has to choose between automatic or standard transmission. The available colors are red, white, or grey.

How many different combinations are possible?

A. 2
C. 12
B. 7
D. 16

4) A deli has five types of meat, two types of cheese, and three types of bread. How many different sandwiches, consisting of one type of meat, one type of cheese, and one type of bread, does the deli serve?

A. 10
C. 25
B. 13
D. 30

5) A bag contains six green marbles, four white marbles, and three red marbles. What is the probability of drawing a green or a white marble from the bag?

A. $\frac{10}{13}$
C. $\frac{3}{13}$
B. $\frac{3}{10}$
D. $\frac{4}{13}$

6) Marilyn selects a piece of candy at random from a jar that contains six cherry, five peppermint, four butterscotch, and two lemon candies.

What is the probability that the candy she selects is <u>not</u> a cherry candy?

A. $\frac{6}{17}$
C. $\frac{11}{6}$
B. $\frac{11}{17}$
D. $\frac{17}{11}$

7) A box contains six black balls and four white balls. What is the probability of selecting a black ball at random from the box?

A. 6%
C. 40%
B. 20%
D. 60%

8) A box contains three pennies, seven nickels, six dimes, and four quarters. What is the probability that a coin drawn at random is a penny?

A. 15%
C. 35%
B. 20%
D. 85%

9) How many possible outcomes are there when two six-sided number cubes (dice) are thrown?

A. 2
C. 36
B. 12
D. 72

10) Two fair coins are tossed.

Part I: Which answer choice shows the sample space for this event?

A. {[HH], [TT]}
C. {[HH], [TT], [TH]}
B. {[HT], [HH], [TT]}
D. {[HT], [HH], [TT], [TH]}

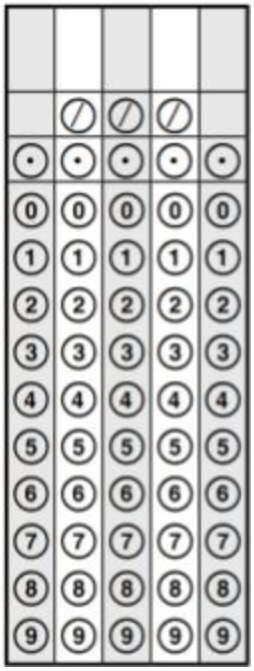
Part II: What is the probability that two tails appear?

A. 25%
C. 50%
B. 33%
D. 75%

Part III: What is the probability that at least one head appears?

A. 25%
C. 50%
B. 33%
D. 75%

11) The faces of a cube are numbered from 1 to 6. What is the probability of not rolling a 5 on a single toss of this cube? Write your answer as a fraction.



12) When a fair coin was tossed ten times, it landed heads up the first seven times. What is the probability that on the eighth toss the coin will land with tails up?

A. 50%
B. 75%
C. 90%
D. 99%

13) If the probability of a spinner landing on red in a game is $\frac{1}{5}$, what is the probability of it not landing on red?

A. 20%
B. 25%
C. 50%
D. 80%

14) Which event is <u>certain</u> to happen?

A. Everyone walking into an elevator will have brown hair.

B. Flipping a coin and getting either a head or a tail.

C. All babies born in June will be males.

D. The sun will rise in the west.

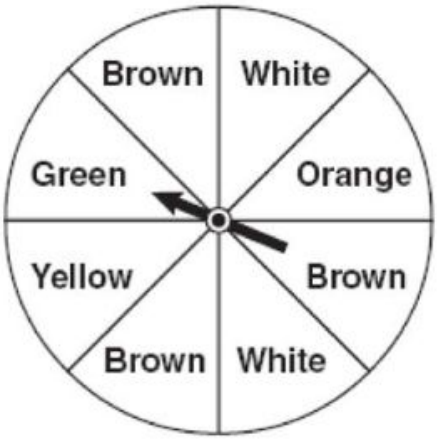
15) Jakima is playing a game using a wheel divided into eight equal sections, as shown in the diagram. What are the chances that the spinner will land on green or brown?

A. $\frac{1}{8}$

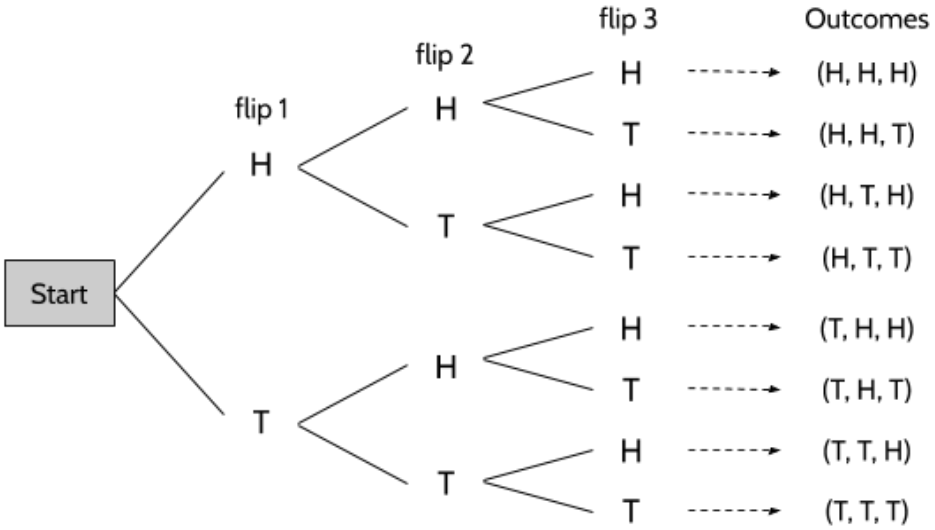
B. $\frac{3}{8}$

C. $\frac{1}{2}$

D. $\frac{4}{4}$



16) Dexter is flipping three fair coins in a probability experiment.



What is the probability that when Dexter flips the three coins, he gets only one tails?

A. $\frac{1}{8}$

B. $\frac{3}{8}$

C. $\frac{1}{2}$

D. $\frac{7}{8}$

17) The table shows the gender and color of 10 puppies in a litter.

Gender and Color of Puppies		
	Male	Female
Black	4	2
Brown	1	3

Part I: If a puppy selected at random from the group is brown, what is the probability it is a male?

A. $\frac{1}{10}$

B. $\frac{1}{4}$

C. $\frac{1}{3}$

D. $\frac{1}{2}$

Part II: Which of the following statements is <u>not</u> true?

A. Most of the female puppies are black.

B. 50% of the puppies are female.

C. Most of the puppies are black.

D. 40% of the puppies are brown.

18) A random group of students from an adult education program were surveyed about which movie they like best.

	Movie A	**Movie B**	**Movie C**	**Movie D**
Students	25	14	8	3

Based on the survey responses, what is the probability that another student from the program prefers Movie B?

A. 14%

B. 25%

C. 28%

D. 72%

19) A small town is conducting a survey to determine whether community members are in favor of raising taxes to fund a new community center. Which sample of the population would provide the most *unbiased* responses?

A. Senior citizens living on a fixed income

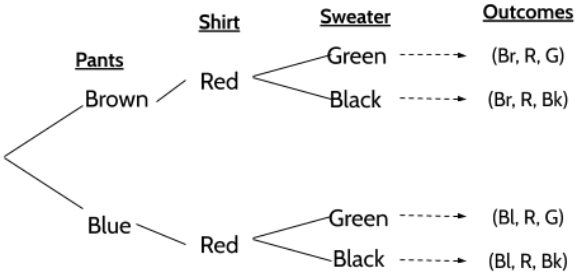
B. Every 5th person 18 years or older who comes in the town's only supermarket

C. Parents at the public school

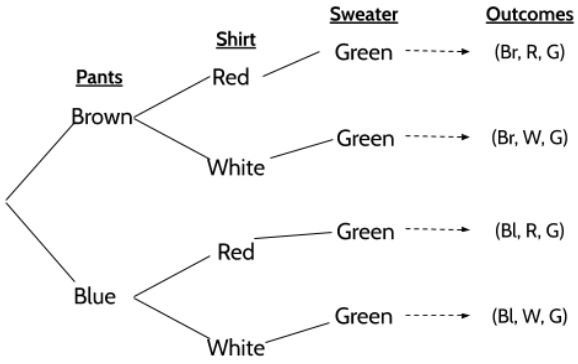
D. Community members who oppose any increase in taxes

20) Erika is travelling for work. She has brought two pairs of pants, two shirts, and two sweaters. Which tree diagram below represents all of her clothing options?

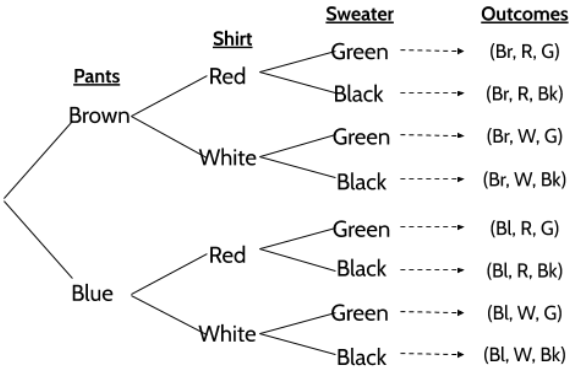
A.



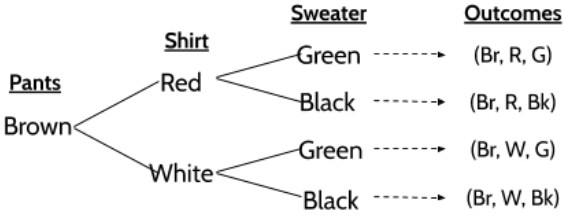
B.



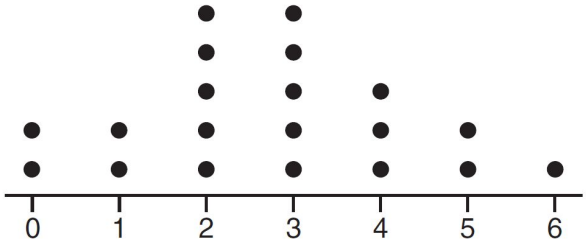
C.



D.



21) The dot plot shown below represents the number of pets owned by students in a class.



Part I: What is the range of the data?

A. 0

B. 2

C. 3

D. 6

Part II: Which statement about the data is true?

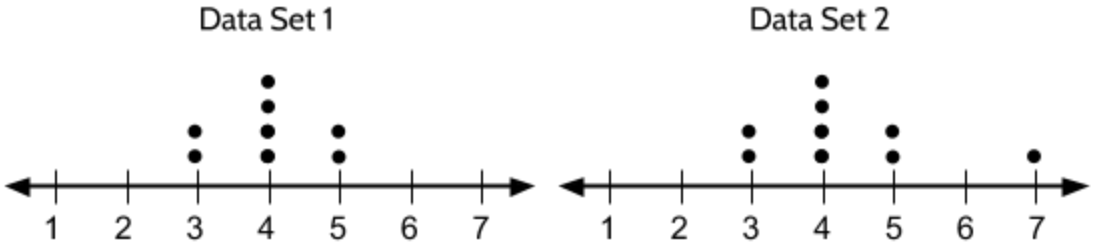
A. The median is larger than the mean.

B. The mean is larger than the median.

C. The mode is 6.

D. Most students own 2 or fewer pets.

22) The frequency distributions of two data sets are shown in the dot plots.



Which two measures are the same for each dotplot?

Choose two answers.

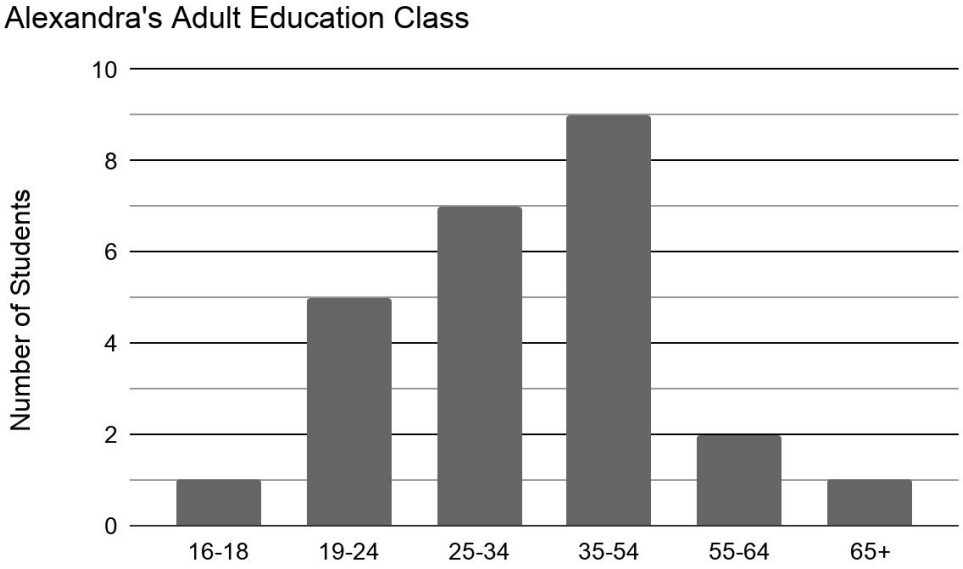
A. median

B. mean

C. mode

D. range

23) Alexandra teaches a high school equivalency class at her local library. The graph shows her class and the students' ages.



Part I: How many students are in Alexandra's class?

A. 9
B. 10
C. 25
D. 65

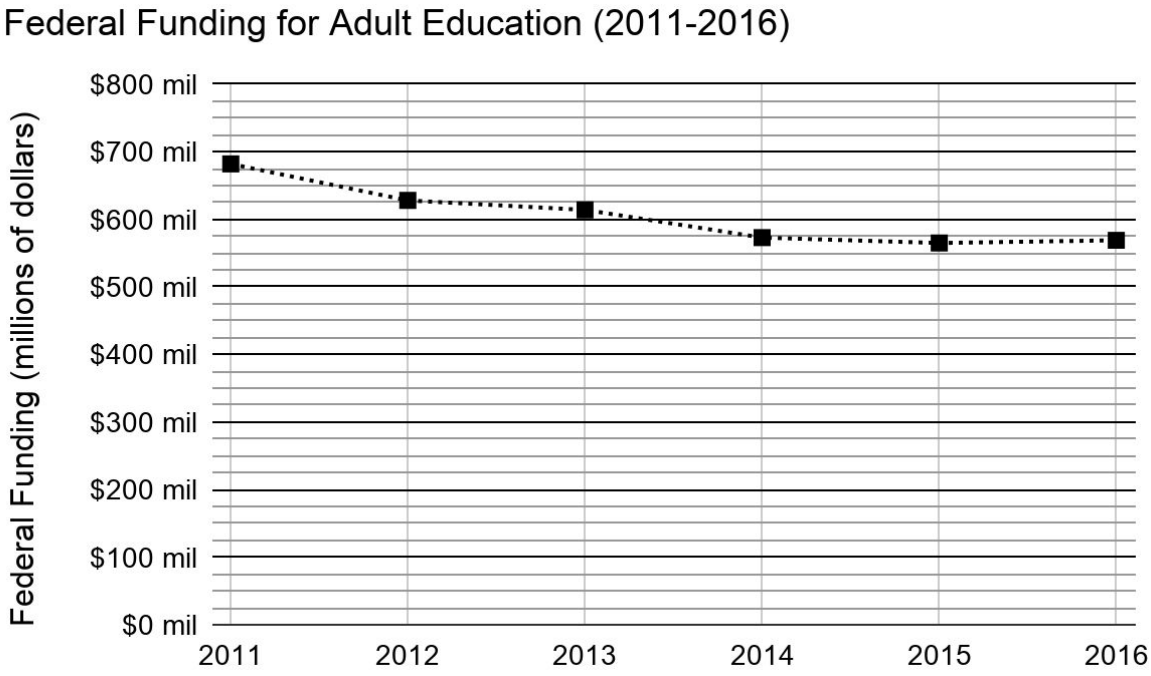
Part II: What percentage of Alexandra's students are between 25 and 34 years old?

A. 7%
B. 10%
C. 28%
D. 78%

Part III: If a 22-year-old student joins the class, which bar on the graph would change?

A. 16-18
B. 19-24
C. 25-34
D. 35-54

24) The following chart shows how much money the federal government invested in adult education between 2011 and 2016.



nationalskillscoalition.org

During which period did the funding go down the most?

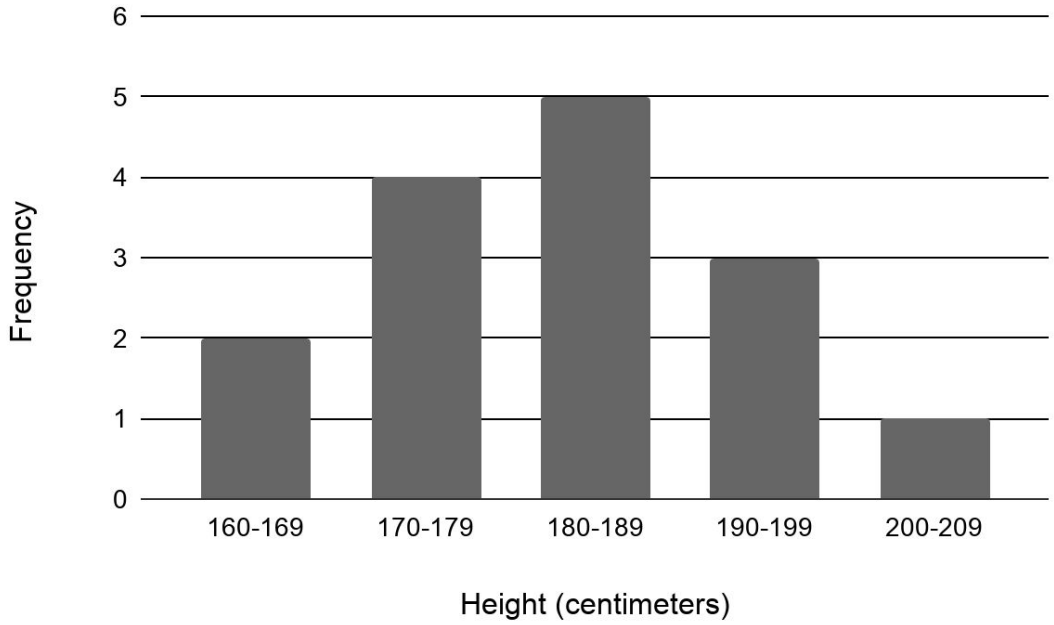
A. 2011-2012

B. 2012-2013

C. 2013-2014

D. 2014-2015

25) The graph below shows the heights of the students in Syed's exercise class.



What is the total number of students in the class?

A. 5

B. 6

C. 15

D. 18

26) A car dealership has 15 cars for sale. The least expensive car costs $10,000. The most expensive car costs $20,000. The mean sales price for the 15 cars is $16,000. Another car, priced at $24,000, is added to the dealership's inventory.

Which two statistical measures will not necessarily increase? Choose two answers.

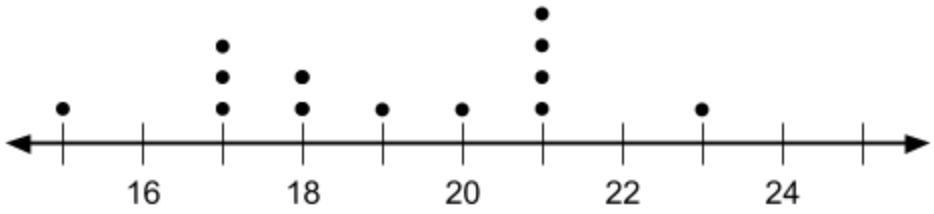
A. mean

B. median

C. mode

D. range

27) The following line plot shows the ages of a group of people who play soccer together on Saturdays.



Part I: What is the difference in age between the youngest and oldest player?

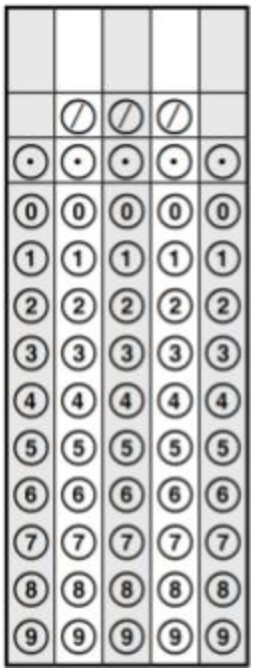
A. 4

B. 5

C. 6

D. 8

Part II: What is the median age of the soccer players? Write your answer in the grid.



28) Minerva collects data from two different companies, each with five employees. The results of the study, based on each worker's age and salary, are listed in the tables below.

Company 1	
Worker's Age in Years	Salary in Dollars
25	31,000
26	32,000
27	33,000
27	36,000
30	38,000

Company 2	
Worker's Age in Years	Salary in Dollars
25	29,000
26	35,000
28	35,000
30	36,000
31	65,000

Which statement is true about these data?

A. The median salaries in both companies are greater than $34,000.

B. The salary range in company 2 is greater than the salary range in company 1.

C. The mean salary in company 1 is greater than the mean salary in company 2.

D. The mean age of workers at company 1 is greater than the mean age of workers at company 2.

29) How many tickets were sold on Friday, if the total sales for the five days is $234 and each ticket costs $4.50?

Day	Frequency
Monday	𝍸 |
Tuesday	𝍸 𝍸
Wednesday	𝍸 𝍸 ||
Thursday	𝍸 ||||
Friday	?

A. 15

B. 37

C. 52

D. 67

30) Which phrase best describes the relationship between the number of miles driven and the amount of gasoline used?

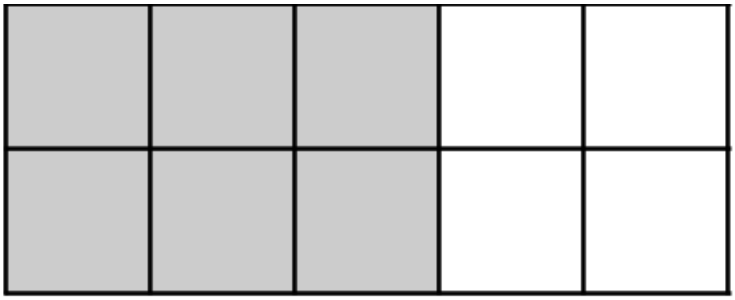
A. causation, but not correlation

B. correlation, but not causation

C. both correlation and causation

D. neither correlation nor causation

31) Examine the rectangle.



Which of the following statements are true? Select all that apply.

A. The ratio of grey squares to white squares is 6:4.

B. The grey squares are 60% of the rectangle.

C. The white squares are $\frac{4}{10}$ of the rectangle.

D. The white squares are 4% of the rectangle.

E. $\frac{3}{5}$ of the squares are grey.

32) The test scores for 10 students in Ms. Cuervo's homeroom were 61, 67, 81, 83, 87, 88, 89, 90, 98, and 100. Which frequency table is accurate for this set of data?

A.

Interval	Frequency
61-70	2
71-80	2
81-90	7
91-100	10

B.

Interval	Frequency
61-70	2
71-80	2
81-90	8
91-100	10

C.

Interval	Frequency
61-70	2
71-80	0
81-90	8
91-100	10

D.

Interval	Frequency
61-70	2
71-80	0
81-90	6
91-100	2

33) Jenna took a survey of her senior class to see whether they preferred pizza or burgers. The results are summarized in the table.

Of the people who preferred burgers, approximately what percentage were female?

	Pizza	Burgers
Male	23	42
Female	31	26

A. 21

B. 38

C. 46

D. 62

34) A public opinion poll was taken to explore the relationship between age and support for a candidate in an election. The results of the poll are summarized in the table below.

Age	For	Against	No Opinion
21-40	30	12	8
41-60	20	40	15
Over 60	25	35	15

What percent of the 21-40 age group was for the candidate?

A. 15
B. 25
C. 40
D. 60

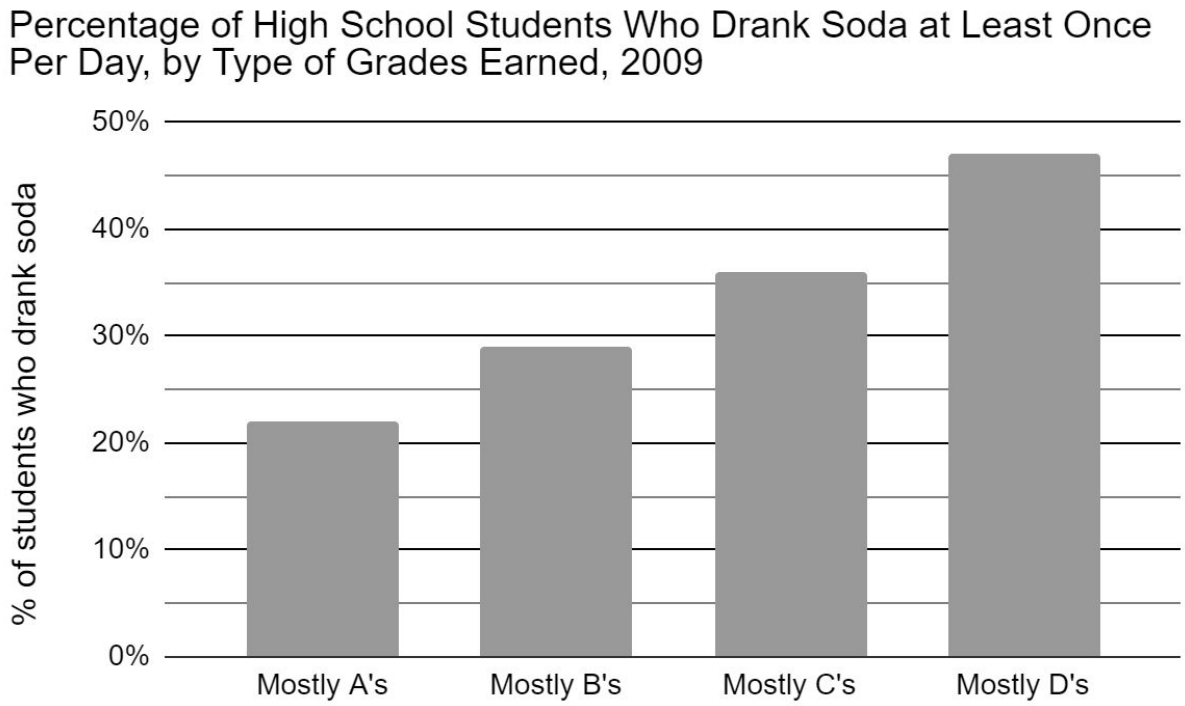
35) Which relationship can best be described as causal?

A. Snow is falling and stores sell out of snow shovels.
B. The alarm goes off and the sun rises.
C. The car is moving slowly and the driver is singing.
D. Ice cream and sunglasses sales are high.

36) Which situation describes a correlation that is not a causal relationship?

A. The car is driven farther and more gasoline is needed.
B. The microwave is more powerful and the food cooks faster.
C. The runner is faster and finishes the race quicker.
D. In the summer, ice cream sales go up and more sunglasses are sold.

37) The Centers for Disease Control and Prevention (CDC) has provided a graph that groups students by the grades they earned. It also shows the percentage of high school students in each group who drank soda at least one time per day.



Center for Disease Control and Prevention, Youth Risk Behavior Survey, http://www.cdc.gov/healthyyouth/health_and_academics/data.htm

Which conclusion can be drawn about the relationship between drinking soda and getting poor grades?

A. There is a correlation between drinking soda and earning poor grades.

B. Drinking soda causes students to earn poor grades.

C. Getting poor grades more likely causes students to drink soda.

D. There is no relationship between drinking soda and earning poor grades.

38) Cheap and Fast gas station is conducting a consumer satisfaction survey. Which method of collecting data would most likely lead to a biased sample?

A. interviewing every 5th customer to come into the station

B. interviewing customers who call an 800 number posted on the customers' receipts

C. interviewing customers chosen at random by a computer at the checkout

D. interviewing every customer who comes into the station on a day of the week chosen at random out of a hat

39) Four hundred licensed drivers participated in the math club's survey on driving habits. The table below shows the number of drivers surveyed in each age group.

Ages of People in Survey on Driving Habits	
Age Group	**Number of Drivers**
16-25	150
26-35	129
36-45	33
46-55	57
56-65	31

Which statement best describes a conclusion based on the data in the table?

A. It may be biased because no one younger than 16 was surveyed.

B. It would be fair because many different age groups were surveyed.

C. It would be fair because the survey was conducted by the math club students.

D. It may be biased because the majority of drivers surveyed were in the younger age intervals.

40) A survey completed at a large university asked 2,000 students to estimate the average number of hours they spend studying each week. Every tenth student entering the library was surveyed. The data showed that the average number of hours that students spend studying was 16 hours per week.

Which characteristic of the survey could create a bias in the results?

A. the size of the sample

B. the size of the population

C. the method of analyzing the data

D. the method of choosing the students who were surveyed

41) A medical researcher is selecting participants for a study on the effects of a drug on memory. She is separating the participants into two groups. The first group will receive the drug and the second group will receive a placebo.

Which method will ensure a random selection of participants in each group?

A. The participants are selected based on their age.

B. The group selections are made by selecting names out of a hat.

C. The men are put in one group and the women are put in the other.

D. The participants are allowed to choose which group they want to be in.

42) What percent of New Yorkers have a high school degree?

A. 14%

B. 59%

C. 68%

D. 86%

	New York Residents	New Jersey Residents	
High school graduate or higher	16,700,000	7,800,000	
Hasn't graduated high school yet	2,700,000	900,000	

43) Analyze the data below.

Year	Price of 1 lb. of Bread	Federal Minimum Wage (hourly)*
1930	$0.09	None
1940	$0.10	$0.30
1950	$0.12	$0.75
1960	$0.23	$1.00
1970	$0.25	$1.60
1980	$0.50	$3.10
1990	$0.75	$3.80
2000	$1.99	$5.15
2010	$2.99	$7.25

* The first Federal minimum wage was introduced in 1938 by the Fair Labor Standards act, under President Franklin Delano Roosevelt.

Purchasing power is a measure of how much a person can buy with their wages. Given that definition, which interpretation of the data from 1940 to 2010 is correct?

A. The purchasing power of minimum wage earners increased steadily.

B. The purchasing power of minimum wage earners decreased steadily.

C. The purchasing power of minimum wage earners was weakest in 2010.

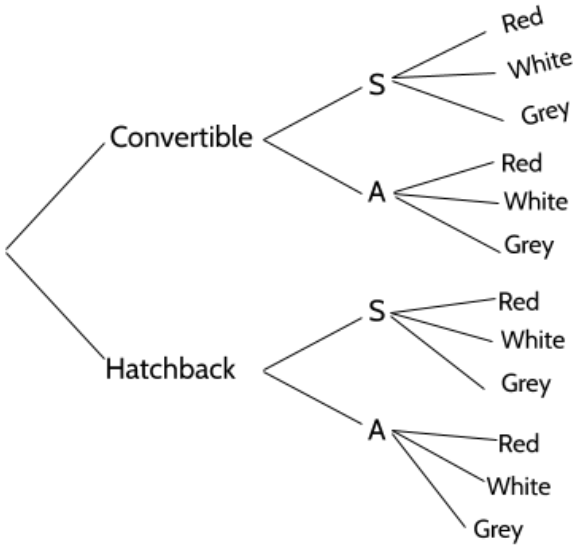
D. The purchasing power of minimum wage earners was strongest in 2010.

Answer Key - Test Practice Questions

1) C

2) C (Chocolate with fruit, chocolate with nuts, chocolate with sprinkles, vanilla with fruit, vanilla with nuts, vanilla with sprinkles)

3) C



4) D. Five types of meat, multiplied by 2 types of cheese, multiplied by 3 types of bread. 5 × 2 × 3 = 30

5) A. There are 10 desired outcomes (6 green and 4 white). There are 13 total marbles in the bag.

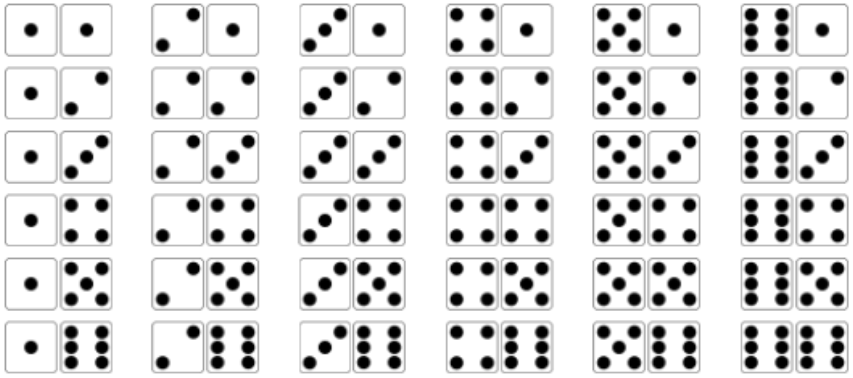
6) B. There are 17 total candies in the jar. If 6 of them are cherry, then 11 of them are <u>not</u> cherry. A is the probability of selecting a cherry.

7) D. There are 6 black balls and 10 balls total. $\frac{6}{10} = \frac{60}{100}$

8) A. There are 20 coins total and 3 pennies.

3	6	9	12	**15**
20	40	60	80	**100**

9) C



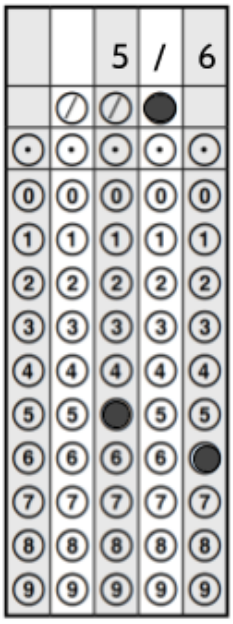
All possible rolls of two dice

10) Part I: D

Part II: A. There are four possible outcomes and only one of them includes 2 tails, which is a probability of ¼. Since the answer choices are in percentages, the answer is 25%.

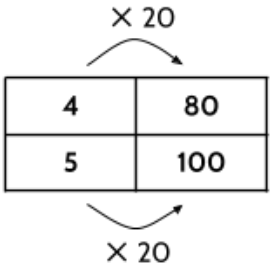
Part III: D. There are 4 possible outcomes and 3 of them contain at least one head.

11)



12) A. Remember that no matter how the coin has landed on previous flips, the probability of getting a tails is always ½ or 50%. Chance has no memory.

13) D. The probability of the spinner not landing on red is ⅘.



14) B

15) C. 4 of the 8 sections are Brown or Green so the probability of a spin landing on one of those two colors is $\frac{1}{2}$.

16) B. There are three outcomes with only one tail: (H,H,T), (H,T, H), and (T,H,H) out of 8 possible outcomes.

17) Part I: B

Part II: A. Of the female puppies, 3 are brown and 2 are black so it is not true to say that "Most of the female puppies are black." B is true because 5 out of the 10 puppies are female. C is true because 6 of the 10 puppies are black. D is true because 4 out of 10 of the puppies are brown.

18) C. 14 out of 50 students in the random group prefer Movie B. 14 out of 50 is equivalent to 28 out of 100, or 28%.

19) B

20) C

21) Part 1: D. In the graph, 0 represents the fewest number of pets owned and 6 represents the greatest number of pets. The difference between 0 and 6 is 6.

Part II: A. The mean for this set of numbers is 2.75. The median is 3. Nine students own 2 or fewer pets, and 11 students own 3 or more pets.

22) A and C. Both sets have a median of 4 and a mode of 4.

23) Part I: C. There are one student 16-18, five students 19-24, seven students 25-34, nine students 35-54, two students 55-64, and one student who is 65+.

Part II: C. 7 out of 25 students are between 25 and 34 years old.

Students 25-34	7	14	21	28
Total Students	25	50	75	100

Part III: B.

24) A

25) C

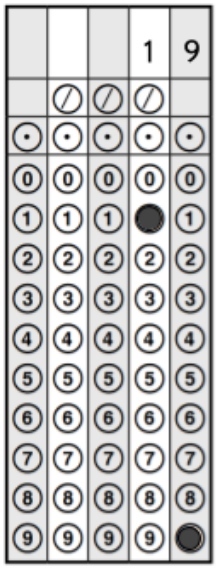
26) B and C . The question is asking which statistical measures will not necessarily increase. If the most expensive car is $20,000, adding another car that costs $24,000 will not increase the mode. We know it would be the only car with a sales price of $24,000, so it won't impact the mode. Adding a car costing $24,000 might impact the median, but it might not. Can you create a set of 15 prices where the median would not increase if you added a car costing $24,000?

We can eliminate A: If the mean sales price for the original 15 cars is $16,000, then the total cost for all the cars is $240,000 (16,000 × 15). If we add $24,000 to that total we get $264,000. If we divide that new total cost by 16 cars, the new mean is $16,500.

We can eliminate D: Since the most expensive car is $20,000, if a more expensive car is added to the inventory then the range has to increase.

27) Part I: D. The youngest person is 15 and the oldest is 23. That is a difference of 8.

Part II: ~~15~~, ~~17~~, ~~17~~, ~~17~~, ~~18~~, ~~18~~, 19, ~~20~~, ~~21~~, ~~21~~, ~~21~~, ~~21~~, ~~23~~
(gridded answer response on the right.)



28) B. The salary range at Company 1 is $7,000 and the salary range at Company 2 is $34,000. A can be eliminated because the median salary in Company 1 is $33,000. C can be eliminated because the mean salary at

Company 1 is $34,000 and the mean salary in Company 2 is $40,000. D can be eliminated because the mean age at Company 1 is 27 and at Company 2 it is 28.

29) A. There are 37 tick marks on the frequency table. If each ticket costs $4.50, that is $166.50. If total ticket sales were $234, they need to sell $67.50. Since each ticket costs $4.50, 15 tickets cost $67.50. Be careful of answer D - $67 is close to the ticket sales for Friday, not the number of tickets sold on Friday.

30) C

31) A, B, C, E

32) D

33) B. 68 people preferred burgers and 26 of those were female. $\frac{26}{68} = 0.38235...$

34) D. There are 50 people in the 21-40 age group and 30 of those people were for the candidate. 30 out of 50 is equivalent to 60 out of 100.

35) A. Snowfall would cause an increase in the sales of snow shovels.

36) D. A rooster crowing does not cause the sun to rise, but since roosters tend to crow when the sun is rising, the relationship is correlated.

37) A. The graph shows a relationship between grades and soda. The lower the grades earned, the higher percentage of students who drank soda. We can eliminate D, which claims there is no relationship. B and C suggest that there is a casual relationship. B suggests that drinking soda causes low grades. C suggests that getting low graders causes more soda consumption. There is nothing in the graph to support either suggestion.

38) B. Only interviewing customers who call an 800 number would not result in a random sample of all Cheap and Fast customers. Each of the other answer choices are random.

39) D

40) D. By only surveying students who entered the library, the university was creating a bias in their survey. The sample was <u>not</u> a random sample of *students at the university*, it was a random sample of *students entering the library*.

41) B

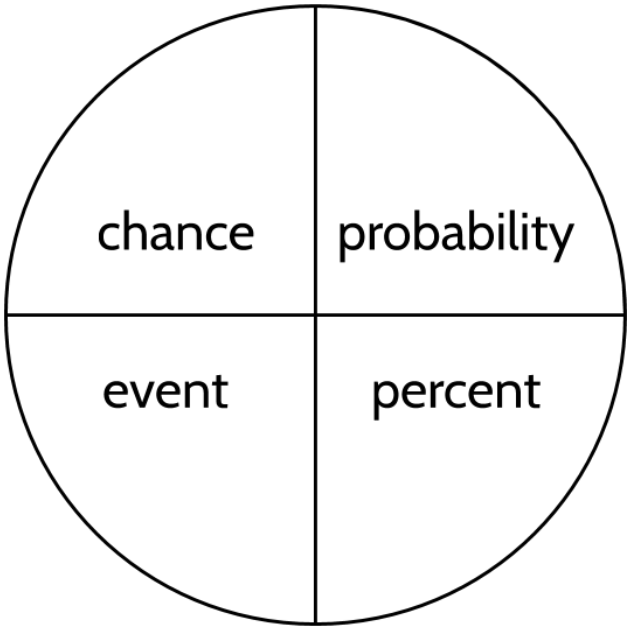
42) D. $\frac{16{,}700{,}000}{(16{,}700{,}00+2{,}700{,}000)} \approx \frac{86}{100} \approx 86\%$

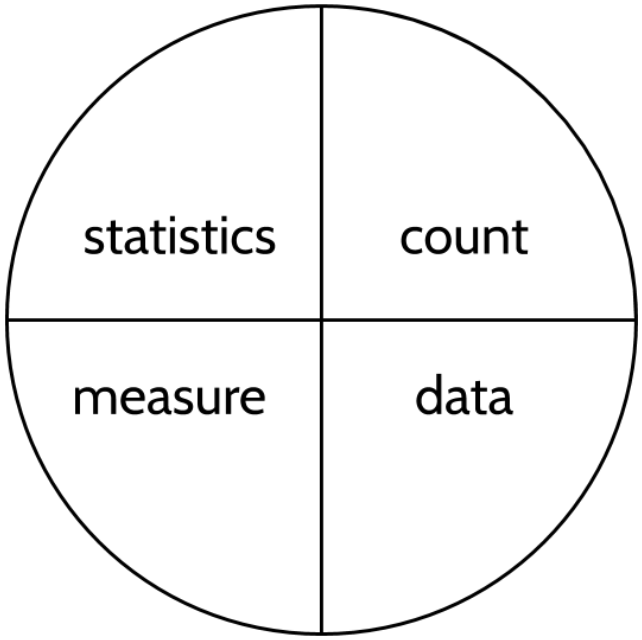
43) C. In 2010, you could buy only 2.4 pounds of bread for an hour's work ($\frac{\$7.25}{\$2.99}$). If you divide the hourly wage by the price of bread for each of the other years, you will see that people could buy more bread for an hour's work in each of those years.

The Language of Probability and Statistics

Concept Circle

1) Explain these words and the connections you see between them.





Probability and Statistics in the World

2) Look around you. Where do you see probability and statistics? Describe an example from the world you see using vocabulary words from the end of the packet.

Vocabulary Review

You can use this section to look up words used in this math packet.

average (noun): See <MODE>, <MEDIAN>, and <MEAN> below.

cause (verb): to make something happen

causation (noun): When something happens because of something else.

census (noun): a census is an official count involving every member of a population. The US conducts the US Census every 10 years to count all the people living in the United States.

certain (adjective): Something that is certain is something that is sure to happen. We say something that is certain has a probability of 1 or 100%. For example, It is certain that if you drop a drinking glass, it will fall.

chance (adjective): the likelihood that something will happen. For example, "What are the *chances* that it will snow tomorrow?"

coin (noun): In the United States, we have the following coins: cents (pennies), nickels, dimes, quarters, half dollars, and dollar coins. Each of these coins has a *head* and a *tail*, the two sides of the coin. The heads of US coins refers to the side with the faces or heads of former presidents and leaders.

combination (noun): A combination is any of the ways we can combine things when order does not matter. For example, if we have a pair of red pants, a pair of blue pants, a red shirts and a blue shirt, the following 4 combinations are possible: {red shirt, red pants}, {red shirt, blue pants}, {blue shirt, red pants}, {blue shirt, blue pants}

correlation (noun): A relationship or connection between two things. Sometimes, one thing causes the other thing. There is a correlation between the amount of exercise and the number of calories burned. Exercise causes calories to be burned. Sometimes, there is a connection, but one doesn't cause the other. There is a correlation between the amount of ice cream sold and the number of sunglasses sold. Increased ice cream sales doesn't cause people to buy sunglasses, or vice-versa.

data (noun): Facts that can be analyzed or used to gain knowledge or make decisions; information.

denominator (noun): The bottom number in a fraction. Shows how many equal parts the item is divided into.

dice (noun): A die is a solid object with numbers or dots on each face. The most common dice are cubes with dots on them of the numbers 1 - 6. Dice can be used to generate random numbers because there is an equal chance of rolling a 1, 2, 3, 4, 5, or a 6.

> *die*: This is the singular of "dice." Example: Minerva rolled one die to see which child would go down the slide first.

difference (noun): How much one number differs from another. One way to visualize difference is how far one number is from another on a number line. For example, Paulina is 35 and her son is 11, so there is a 24 year age difference between them.

distribution (noun): The number or percentage of each group in a set of data. For example, the Mars, Inc. company has said that the distribution of M&Ms is 24% blue, 20% orange, 16% green, 14% yellow, 13% red, and 13% brown. These are the percents overall, but the distribution of colors in a bag of M&Ms are probably different.

estimate (verb): to come up a value that is close enough to the actual value

event (noun): An outcome from an experiment.

experiment (noun): Something that can be repeated that has a set of possible results. Flipping a coin or rolling a die can be part of a probability experiment.

fair (noun): Treated equally, without having an advantage or disadvantage. A fair game is a game in which each player has the same chance of winning.

frequency (noun): The number of times that something happens.

likelihood (noun): The probability or the chances of something happening. An event might have a small likelihood (low probability) or a high likelihood (high probability) of happening.

mean (noun): The equal share when numbers are added together and divided by the number of total values.

measures of center (noun): This term refers to the measurements mode, median, and mean, which are all ways of finding the center of a set of data.

measures of spread (noun): This term refers to the measurements such as range, which is the difference between the largest and smallest number in a data set, and shows how spread out the data is.

median (noun): The middle number in a set of numbers when the numbers are placed in order from smallest to largest.

mode (noun): The most common number in a set of numbers.

numerator (noun): The top number in a fraction. It shows how many parts we have.

odds (noun): the ratio of the number of ways an event *can* happen to the number of ways it *can not* happen. For example, the odds of a month starting with the letter J are 3:9 (or 1:3) because there are 3 months that start with a J (January, June, July) and 9 months that do not start with a J.

outcome (noun): A possible result of an experiment. For example, when flipping a coin, a "head" or a "tail" are the two possible outcomes. When rolling a six-sided die, a 1, 2, 3, 4, 5, or a 6 are the possible outcomes. An outcome is sometimes called an event.

percent (noun): Parts per 100. It is a ratio "out of 100."

population (noun): a group that is being studied.

probability (noun): the mathematics of chance. Probability is the study of the chance that something will happen, over the long term. The probability of an event is expressed as a ratio, fraction, decimal, or percent. The probability of an event is between 0 and 1, where 0 means there is no chance of the event happening and 1 means the event will definitely happen.

> *experimental probability* (noun): The actual result of an experiment. The probability found by experimenting.
>
> *theoretical probability* (noun): A probability found by using calculations to analyze a situation.

random (adjective): When something happens without being made to happen on purpose.

random sample (noun): a random sample is a smaller selection of a larger population. A sample is random if every member of the population has the same chance of being selected.

range (noun): the difference between the maximum value and the minimum value in a set of numbers. For example, if Troy's paychecks for the past 4 weeks are $380, $420, $450, and $325 then the range in his paychecks would be the difference between $450 and $325.

ratio (noun): A relationship that shows the size of one value in comparison to one or more other values. For example, the ratio of teachers to students in a school might be 1:20, which means that there is one teacher for every 20 students.

relative frequency (noun): A ratio that compares the number of times something happens to the total number of outcomes. Example: The relative frequency of students with children was 34. This means that 3 out of 4 students had children. 1 out of 4 students did not. On a survey, the *relative frequency* is the frequency of one response compared with the total number of responses

sample (noun): a group of something (people, animals, objects, etc) selected from a larger population. For example, a blood sample is not all the blood in your body, but a smaller selection.

representative sample (noun): a sample whose characteristics do a good job of reflecting the larger population from where the sample was selected.

sample space (noun): A set or list of all the possible outcomes for an experiment.

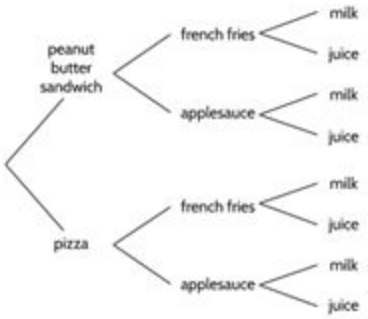
sampling bias (noun): sampling bias is what happens when the sample of a population is <u>not</u> selected randomly. For example, imagine you want to figure out how many hours a week the people of a town spend reading. If you only survey people as they come out of the library, it is unlikely that your sample will represent the general population. Since people who visit the library are more likely to read than the general population, your sample will be biased.

set (noun): A set is a collection of things, which could be numbers or objects. In this packet, the sets are groups of numbers. {3, 5, 8, 10} is a set of 4 numbers.

statistics (noun): The science of collecting, reviewing, and analyzing data.

survey (noun): A process of collecting data about the opinions or experience of a group of people, based on a series of questions.

tree diagram (noun)**:** a diagram using lines that can be used to map out the possible outcomes and the total outcomes in a trial. For example, in the tree diagram to the right all of the possible combinations for a child's lunch order are shown. There are 8 possible different orders shown in this tree diagram. <See *SAMPLE SPACE*>



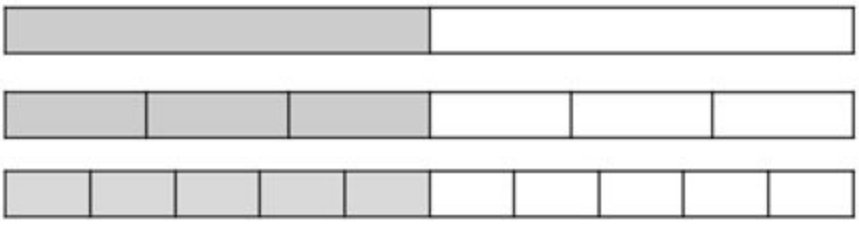
trial (noun): In math, a trial is a test or an experiment. Throwing dice or tossing a coin are examples of a trial.

typical (adjective): The characteristics that you would expect of a member in this group. Averages like mode, median, and mean help us know what would be a typical number in a set.

variability (noun): Differences in the data, how much different data points *vary* from each other. For example, there is a lot of *variability* in the ages of students in an adult education class. Students might be anywhere from 17 years old and up.

variation (noun): Differences in the data. How much different data points *vary* from each other. For example, there is a lot of variation in the ages of students in an adult education class. Students might be anywhere from 17 years old and up.

visual representation (noun): a picture, diagram, or graph that shows data and a relationship between quantities. For example, the visual representation below can be used to show that $\frac{1}{2}$, $\frac{3}{6}$, and $\frac{5}{10}$ are all equivalent fractions.



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