



The GED Mathematics Test

Statistics and Probability



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GED

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Passing the GED Math Test

Smoking is one of the leading causes of statistics.
Fletcher Knebel

Video 37 Focus: how we use statistics and probability in our daily lives and how to solve math problems using statistics and probability.

You Will Learn From Video 37:

- How to use statistics to interpret data.
- How to use statistics to see how things change over time and identify trends.
- That you should question the accuracy of statistics.
- How to use probability to solve problems and make decisions.
- About independent and dependent events in probability.



Words You Need to Know:

While viewing the video, put the letter of the meaning by the correct vocabulary word. Answers are on page 17.

- | | |
|------------------------|--|
| _____ 1. statistics | a. all things to which the experiment might apply |
| _____ 2. population | b. the part of the population that we choose to count |
| _____ 3. probability | c. data about certain populations such as the U. S. Census |
| _____ 4. random sample | d. mathematical study of chance |
| _____ 5. sample | e. sample where every member of the target group has an equal chance of being chosen |



Points to Remember:

- We already use statistics our daily lives.
- Solving problems on the GED Math Test may require that you predict the probability of an event.
- It is important to know how statistics are used to influence readers so that you can judge the accuracy of the information you read.

Introduction to Statistics and Probability



Statistics

The Golden Gate Bridge was built in 1937 at a cost of 35 million dollars.

This piece of information is a statistic. Statistics are facts or groups of data that are sometimes collected by some kind of sampling technique. Statistics are all around us. We see them in newspapers, magazines, and on billboards. We hear them on the radio, on the television news, and at sporting events. If you learn to understand everyday statistics, you will improve your ability study current events and to make good consumer decisions. You will also have to work with statistics on the GED Math Test.

Statistics are used in research when a sample is taken to try to prove trends within the general population. Scientists and sociologists use sampling to create statistics. A biologist might look at one out of every 50 leopard frogs when testing the hypothesis that pesticides have caused the male frogs to develop abnormally. A cultural anthropologist may ask questions to a random group of people in India to find out about their incomes and spending habits.

Statistics are often used to persuade people to make particular decisions. Advertisers and marketing specialists use statistics to try to influence people to use certain products or engage in particular behaviors. Advertisers may claim that their product can strengthen bones because it is enriched with calcium. Other advertisers point out that their cigarettes are lower in tar than other cigarettes. Marketing personnel for airlines may suggest that certain carriers are roomier and provide better snacks than other carriers.

Be careful when you use statistics to make decisions in your own life. Make sure you check the accuracy and source of the findings. You would not want to make a major purchase such as buying a car without accurate information about how the car performs. The advertisers for the car's manufacturer are not always the most reliable sources because they are trying to persuade you to buy their cars. Neutral sources such as consumer magazines or Web sites are often good places to compare products. The term, "Buyer beware!", helps us to remember to check things out carefully before we act.

Probability



Probability is the mathematics of chance. Probability finds out how likely an event is to occur. For example, pollsters may tell us that a particular political candidate has a 52% chance of being elected. That statistic tells us that it is a close race.

We also express probability using ratios. When you shuffle a deck of cards and draw one card, there is 1-out-of-52 chances that the card will be the ace of spades. In mathematics we express probability as the ***number of favorable outcomes compared to the number of possible outcomes***. A ***favorable outcome*** is the event that you are testing, in this case, drawing an ace of spades. A ***possible outcome*** is any event that could happen.

Statistics

Statistics are everywhere and must be evaluated for their effectiveness, or they can mislead us. It is important to consider the following factors when evaluating how much importance to give statistics:

1. sampling techniques
1. sample size
1. accuracy and method of reporting



Sampling Techniques

Most statistics are derived from samples. A **population** includes anyone or anything to which the experiment might apply. The **sample** makes up the ones we choose to count. The student council is interested in finding out whether the senior girls would like the senior dance to be formal or casual with a Hawaiian theme. The population is all 227 girls in the senior class. The sample is the fifty-five girls that the student council decides to ask. The student council believes that asking approximately one-quarter of the population will give them a feel for the girls' preferences.

1. **Random Sample** -- in a random sample every member of the target group has an equal chance of being chosen. To ask a random sample of the senior girls, the student council would draw names from a hat containing all of the names or use a computer-generated system to find the numbers of each girl on a list. Random samples are usually considered the most effective type of sampling especially if a large percentage of the population is sampled.
1. **Systematic Sample** -- in a systematic sample, certain members of the population are chosen based on their position on a list. For example, the student council could ask every fourth name on an alphabetical list of senior girls. Systematic samples are not as effective as random samples because not every member of the population has a chance to be chosen.
1. **Self-selected Sample** -- in this type of sample, members of the population choose to come forward. The student council could ask interested senior girls to vote on the type of dress for the dance event. Self-selected samples are the least reliable samples because often only those who have really strong opinions come forward.

Look at these sampling techniques and write 1, 2, or 3 next to them to show what kind of sample they represent.

Answers are on page 17.

Radio talk show listeners call in to vote yes or no on an issue. _____

In a line for a movie audition, every tenth person is asked to fill out a questionnaire. _____

Names of residents in the city of Akron are randomly drawn by a computer to give opinions about the services provided by the local fire department. _____

Every other person seated in the theater was asked to give an opinion on the movie. _____

Sample Size

The size of the sample is important to evaluate whether or not enough data was considered to analyze the situation. If the student council only asks five girls and reports that 80% want to have the dance be a formal event, the sample is too small to really be useful to find out what the girls want. Yet, 80% sounds as though it is really significant. The larger the sample, the more accurate the data will be to achieve the purpose of the experiment.



Accuracy and Method of Reporting



The accuracy and method of reporting the results from a sample of a population must be evaluated by the reader or consumer. Results can be skewed by the way questions are asked or by the way the sample is chosen or counted. Findings can be reported using narratives, simple statements of fact, tables, graphs, or charts. Using various scales on a graph or having a complicated presentation of the results may make it difficult for people to understand the results. It is important to use your critical reading skills in your daily lives as well as on the GED Social Studies, Science, and Math Tests to make sure you are not misled by statistics.

When statistics are reported, it is good if the **margin of error** is reported along with the data. The margin of error shows how much the actual results in a statistical study may vary. The margin of error is usually written as a percent and can be found at the end of the article or at the bottom of a graph. For example, a margin of error of $\pm 6\%$ means that the actual results can be from 6% less to 6% greater than the reported results. Be wary of studies that do not report a margin of error.

Practice using what you have learned about statistics in the following exercise.
Answers are on page 17.



Label these sampling techniques random, systematic, or self-selected:

Internet users respond to a survey sent by e-mail. _____

Registered voters are selected at random from the population and respond to a telephone survey.

Every 100th person in the telephone book is called to respond to a poll about the upcoming election.

The membership representatives for a large, national adult education organization were giving statistics at the board meeting. The northeast representative said that membership for the six states had risen 10%. The representative for the west was very proud that NV had a 33% increase in membership. The northeast region started with 332 members. NV had three members last year and this year has four. What important conclusions can you draw from comparing these statistics?

About Math and Life



The Placerville Senior Community Center wanted to find out why more seniors were not enjoying spending time at the center. They developed a questionnaire for seniors to evaluate the services offered at the center. They planned to give the questionnaire to the first 25 people who came into the center. Then one of the regular volunteers, who taught craft classes at the center, pointed out that this was not a good design to gather the data that they wanted. What are the problems with the plan? Answers are on page 17.

How can the study be re-designed to give the center directors the information they need to try to increase participation?

Probability



Probability tells us how likely an event is to happen. In mathematics we express probability as the *number of favorable outcomes compared to the number of possible outcomes*. A *favorable outcome* is the event that you are testing. A *possible outcome* is any event that could happen. For example, how likely is it that you will roll a four when you roll a die? The favorable outcome is rolling a four, and there is only one face with a four. The possible outcomes are any of the six faces on the die.

We express the probability as a fraction: $\frac{\text{favorable outcomes}}{\text{possible outcomes}}$

$$\frac{\text{one four}}{\text{six faces}} = \frac{1}{6}$$



We can also express probability as a percent. Change $1/6$ to a decimal (.166) and then to a percent (16.6%). The probability or chance of rolling a four is *about 17%*.

Practice finding the probability of each new roll of a die. Express the probability as a fraction and as a percent. Answers are on page 17.

Rolling a three	$1/6$	17%
Rolling a two	_____	_____
Rolling an even number	_____	_____
Rolling a prime number	_____	_____
Rolling a number divisible by three	_____	_____

Probability of Drawing Cards from a Deck



Lola shuffles a standard deck of cards from which the two jokers have been removed. Then she draws one card. There are 52 cards that include 13 cards for each of the four suits: spades, hearts, diamonds, and clubs. What is the probability of each event occurring if the card(s) are replaced and the deck reshuffled after each event? Answers are on page 18.

Draw	Favorable Outcome (s)	Possible Outcomes	Fraction (reduce)	Percent
a red card				
an ace				
a jack				
a diamond				
a one-eyed jack				
a two of hearts				
a three or four				
a face card				
a black face card				

Probability of Flipping a Coin



When you flip a coin, the probability of it landing heads up is $1/2$. There is one favorable outcome (heads) and two possible outcomes (heads and tails). Experimentation is another way to learn about probability. If you flip the same coin 10 times, how many times would you expect it to be heads? _____

Flip a coin 25 times and tally the number of heads and the number of tails.

Heads	Tails

Now try the same experiment with a different coin and tally your results.

Heads	Tails

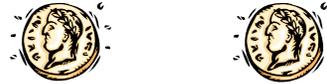
Write an explanation of what happened and why you think it happened the way it did.

How many times do you think you would have to flip the coins to come close to the expected results? _____



One good way to illustrate multiple events is to consider flipping two coins. It is a short experiment to discover the probability of one of the events such as flipping two heads. First find the ratio for each coin. The chance of the coin landing with heads up is:

favorable outcome $\frac{1}{2}$
possible outcomes



Multiply the ratios to find the probability of **both** coins landing with heads up.
 $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

There is a one-fourth chance of flipping two heads. You can easily draw all of the possible outcomes to prove that this is the correct ratio. Answers are on page 18.

First Coin		Second Coin	
H		H	
H		T	
T		H	
T		T	



What is the probability of flipping two tails? Fraction _____ Percent _____
 What is the probability of flipping one head and one tail? Fraction _____ Percent _____

Practice multiplying ratios of single events to find the probability of multiple events. Express your answers as fractions, ratios, and percents. Answers are on pages 18 and 19.

Events	Fraction	Ratio	Percent
Rolling two dice and getting two fours	$\frac{1}{36}$	1:36	About 17%
Flipping two coins and getting two tails			
Flipping three coins and getting all heads			
Drawing a card from each of two decks of cards and getting two red cards			
Flipping two coins and getting one head and one tail			
Drawing from two decks of cards and getting two diamonds			
Drawing a card from each of two decks of cards and getting two kings			

Measure Up



1 square foot = _____ square inches

_____ square feet = 1 square yard

1 cubic foot = _____ cubic inches

_____ cubic feet = 1 cubic yard

1 cubic meter (stere) = _____ cubic centimeters (cm^3)

1 cubic decimeter = _____ cm^3

Data Analysis Review

Answers are on page 19.



The Andersonville Kennel Club weighs in dogs before each show. The following weights were recorded for the standard poodles: 50, 51, 51, 55, 58, 61, 61, and 69. Find the mean, median, mode, and range of this data set.

Mean _____

Median _____

Mode _____

Range _____

Sarah has maintained an average of 84 on the four tests she had in her astronomy class. The final is weighted double. What does she have to get on the final to raise her average to 87?

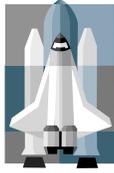


Monica had to make a chart of the daily temperature for two weeks in her science class. She read the thermometer every day at 4:00 in the afternoon. The chart below is a summary of the data she collected.

 	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Week 1	78	80	75	81	84	77	81
Week 2	81	86	79	77	78	82	84

Then she had to summarize the data on a graph. She decided to use a line graph to show the rise and fall of the temperatures. Draw an example of such a line graph in the space below. Remember to give the graph a title and to label each axis.

Out into Space



A domino is a plane figure made up of two squares joined together to form a common side from end to end. Sometimes dominoes have white dots that stand for numbers and are part of a popular game.

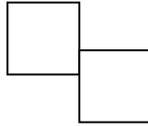


In this exercise we will use our spatial skills.

dominoes and other plane figures to practice



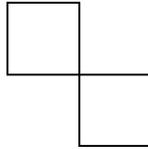
domino



not a domino (common side is not end to end)

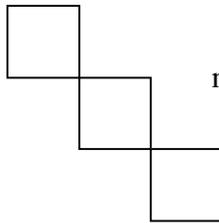
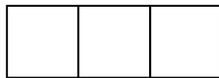


domino

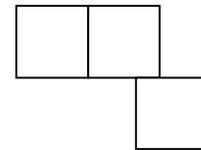


not a domino (no common side)

Triominoes are figures that are made of three squares each joined to at least one other square with a common side from end to end.



not triominoes

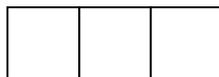
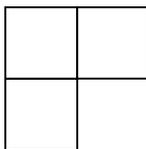


triominoes

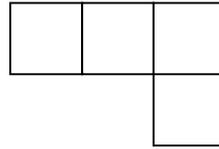
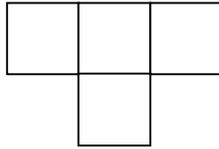
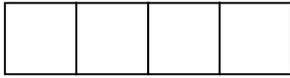
Flips and rotations are the same figure.

The triominoes above are rotations or flips of one another.

There are only two triominoes. Here is what they look like:
and

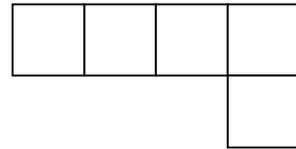
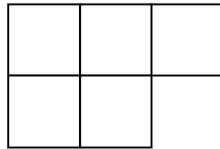


Quadraminoes are figures that are made of four squares each joined to at least one other square with a common side from end to end. Here are some quadraminoes:



There are five quadraminoes altogether. Remember that flips and rotations of the ones above do not count. Draw the other two quadraminoes here:

Pentaminoes are figures that are made of five squares each joined to at least one other square with a common side from end to end. Here are some pentaminoes:



How many different pentaminoes do you think there are? Write your guess here _____

Draw all of the pentaminoes here:

Answers are on page 19.

Mixed Review -- Statistics and Probability



Answers are on page 20.

1. A statistics professor at the community college decided to conduct a study where she asked a sample of enrolled students some questions about career goals. She considered several sampling techniques. Label each technique using the labels found on page 3:
 - Asking for student volunteers in her statistics classes _____
 - Asking every 25th student on the list of registered students _____
 - Asking 400 registered students generated from a computer-generated random number selection _____
 - Putting an article in the campus newspaper and asking any student who responded _____

2. Which type of sampling would be most likely to give some reliable information about students and their career goals? _____

3. What is the probability of each of the following events? Review pages 5-8 if you need help.

Event	Fraction (reduce)	Percent
Flipping a coin and having it land heads up		
Drawing the queen of clubs from a deck of cards		
Rolling a die and getting a two		
Drawing a heart from a deck of cards		
Drawing one card from each of two decks and getting a red and a black card		
Rolling two dice and getting two threes		
Flipping two coins and getting one head and one tail		
Flipping three coins and getting all tails		

4. Once the probability of an event occurring has been established, the information is often used to report the statistic. For example, you may read in the newspaper that there is a 25% chance that Asian women will contract a certain disease. What do you have to keep in mind when evaluating information about the probability of events?

STRATEGY SESSION



Read Carefully and Critically

It is very important on the GED Social Studies, Science, and Math Tests to read questions, charts, graphs, and tables carefully and critically. In order to be successful on questions dealing with data analysis, statistics, and probability, you must be a careful and critical reader. These skills will also help you evaluate information that is presented in magazines, in newspapers, and in advertisements.

Structured practice is one way to improve your ability to read critically. Some of the important skills to practice are:

- To look at the titles and key words. Key words may be *italicized* or **bold**.
- To read the question before you look at the graph, but not the answer choices ahead of time. Reading the question will help you focus. Reading the answers is wasted time and may confuse you. Remember, four of them are **WRONG!**
- To watch out for *extreme words* such as always, never, everyone, everything, and without exception.
- To notice the source of the material.
- If a statistical analysis is quoted, notice if the margin of error is given if a statistical analysis is quoted.
- To take note of the type and size of the sample if the sample for the study is described.



The Hometown Gazette ran a feature article on senior citizens in the community. The article quoted many statistics about the senior population in Hometown. Here is a *portion* of the article.

Most of the senior citizens in Hometown choose to live in their own homes after retirement. About 35% of the seniors choose to live in one of the two planned senior communities. These residents are about equally divided between Wildwood Senior Living and Serenity Village. Andres Jones of Serenity Village reported, “Our residents are completely satisfied with our many services. We are proud to offer a homeowners’ association, laundry and dry cleaning services, swimming pools and recreation rooms, and transportation in the van.”

A. Based on the information from the article, which statement is true?

- 1) Over 1,000 seniors live in planned senior communities in Hometown.
- 2) Approximately 18% of Hometown’s seniors live in Serenity Village.
- 3) About 7,000 seniors live in their own homes after retirement.
- 4) Serenity Village offers more services than Wildwood Senior Living.
- 5) Both retirement communities are open to all seniors in Hometown.

B. Which of the following phrases from the article should you most question without having more information about sources and sampling techniques?

- 1) “choose to live”
- 2) “about equally divided”
- 3) “completely satisfied”
- 4) “proud to offer”
- 5) “swimming pools and recreation rooms”

Write an explanation about why you chose each of the answers for questions A and B above. Include why the other choices were not as good as the answer you chose.

A.

B.

If the Serenity Village staff wants to verify and prove to the newspaper and the community that the residents are satisfied with the services offered, what kind of study should they conduct. Explain what they could do to find the information that they need.



What method could the newspaper use to verify the percentage of seniors in Hometown that live in planned senior communities.



Read Carefully and Critically

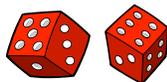
GED Exercise

1. Chat Chat Magazine reported that a movie star had secretly married her gardener. What method should the reporter **not** use to verify this fact before printing it?



- 1) check the county marriage license records
 - 2) ask her neighbors
 - 3) ask the movie star and the gardener
 - 4) check the church records
 - 5) check the state department of vital statistics
2. Before the football game, the referee tosses a coin to see which team will kick and which will receive. The captain call heads or tails when the coin is in the air. What is the probability that he will be right?
- 1) 30%
 - 2) 40%
 - 3) 50%
 - 4) 60%
 - 5) 70%
3. Andy and Katie each rolled a die. What are the chances that both will roll a six?

- 1) 1:6
- 2) 2:6
- 3) 1:12
- 4) 1:18
- 5) 1:36



4. At the casino the croupier for the roulette wheel runs the games. Players can place different kinds of bets. The simplest bet is one color or the other -- red or black. What are the chances that a person betting on black will win on a single spin?

- 1) 1/2
- 2) 1/6
- 3) 1/12
- 4) 1/18
- 5) 1/24



5. Mr. Allen ordered a two cubic yards of wood chips for his landscaping project. How many cubic feet of wood chips did he get?
- 1) 9
 - 2) 12
 - 3) 27
 - 4) 54
 - 5) 71
6. Vi owned a restaurant and sold foods children like a lot. Each week she sold peanut butter sandwiches. One month, she sold 111, 136, 105, and 88 in each of the four weeks. How many did she average each week?

- 1) 88
- 2) 100
- 3) 110
- 4) 118
- 5) 136

Answers and Explanations

Words You Need to Know

page 2

1. c.
2. a.
3. d.
4. e.
5. b.

Statistics

page 4

- 3
- 2
- 1
- 2

Statistics

page 5

self-selected
random
systematic

Comparing percents of increase without considering the size of the population is very misleading. Instead compare actual member increases. One new member in NV should be compared to 34 new members in the northeast to get a more valid comparison.

About Math and Life

page 6

Answers may vary somewhat. Check with your teacher or tutor.

The main problem is that these people already use the center so are probably fairly happy with the services. Also, choosing the first 25 does not really provide a sample of those who use the center on different days and at different times.

The questionnaire should be given to a sample of all of the seniors in the whole community. The size of the sample should be determined by the size of the population. If possible, the seniors sampled should be randomly sampled.

Probability

page 7

- | | |
|-----|------|
| 1/6 | 17% |
| 3/6 | 50 % |
| 3/6 | 50% |
| 2/6 | 33% |

Draw	Favorable Outcome (s)	Possible Outcomes	Fraction (reduce)	Percent
a red card	26	52	$1/2$	50%
an ace	4	52	$1/13$	7.7%
a jack	4	52	$1/13$	7.7%
a diamond	13	52	$1/4$	25%
a one-eyed jack	2	52	$1/26$	3.8%
a two of hearts	1	52	$1/52$	1.9%
a three or four	8	52	$2/13$	15.4%
a face card	12	52	$3/13$	23%
a black face card	6	52	$3/26$	11.5%

5

Answers will vary.

Probability	Favorable Outcome (s)	Possible Outcomes	Fraction (reduce)	Percent	Actual Draw
a red card	26	52	$26/52 = 1/2$	50%	ace of spades
an ace	3	51	$3/51 = 1/17$	5.9%	three of diamonds
a jack	4	50	$4/50 = 2/25$	8%	five of hearts
a diamond	12	49	$12/49$	24.5%	queen of clubs
a one-eyed jack	2	48	$2/48 = 1/24$	4.2%	two of clubs
a two of hearts	1	47	$1/47$	2%	jack of diamonds
a three or four	7	46	$7/46$	15.2%	six of clubs
a face card	10	45	$10/45 = 2/9$	22%	seven of hearts
a black face card	5	44	$5/44$	11.4%	

 $1/36$ $1/36$ $1/4$

25%

 $1/2$

50%

Events	Fraction	Ratio	Percent
Rolling two dice and getting two fours	$1/36$	1:36	About 17%
Flipping two coins and getting two tails	$1/4$	1:4	25%
Flipping three coins and getting all heads	$1/8$	1:8	12.5%

Drawing a card from each of two decks of cards and getting two red cards	1/4	1:4	25%
Flipping two coins and getting one head and one tail	1/2	1:2	50%
Drawing from two decks of cards and getting two diamonds	1/16	1:16	6.25%
Drawing a card from each of two decks of cards and getting two kings	1/169	1:169	.6%

Measure Up

page 10

144 square inches
1,728 cubic inches
1,000,000

9 square feet
27 cubic yards
1,000 cm³

Data Analysis Review

page 10

Mean

Median

Mode

Range

57

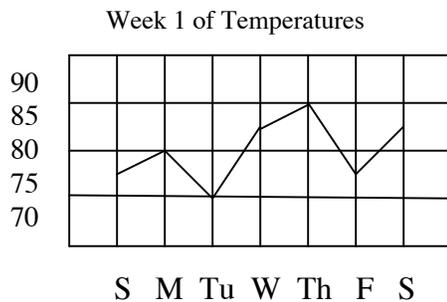
56.5

51 and 61
(bi-modal)

50-69 or 18

93

Graphs will vary. An example of one type is below



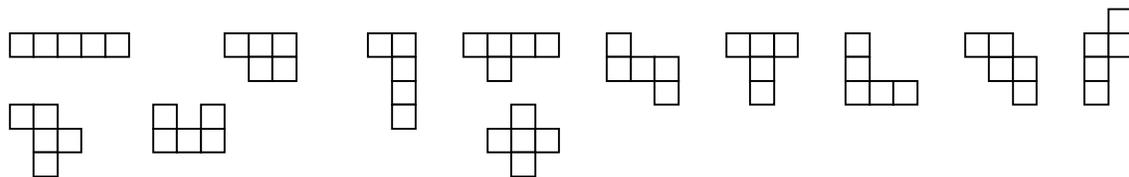
Out into Space

pages 11 and 12

Other two quadraminoes:



There are 12 pentaminoes:



1.
 - self-selected
 - systematic
 - random
 - self-selected

2. random sample

3.

Event	Fraction (reduce)	Percent
Flipping a coin and having it land heads up	$1/2$	50%
Drawing the queen of clubs from a deck of cards	$1/52$	1.9%
Rolling a die and getting a two	$1/6$	16.67%
Drawing a heart from a deck of cards	$13/52 = 1/4$	25%
Drawing one card from each of two decks and getting a red and a black card	$1/2 \times 1/2 = 1/4$	25%
Rolling two dice and getting two threes	$1/36$	2.8%
Flipping two coins and getting one head and one tail	$1/2$	50%
Flipping three coins and getting all tails	$1/8$	12.5%

4.
 - quality of design
 - type of sample
 - size of sample

Strategy Session

pages 14 and 15

A. 2)

B. 3)

- A. Answer 2) is stated in the portion of the article that is quoted. Answers 1) and 3) are incorrect because we don't know how many seniors live in Hometown. Answers 4) and 5) are incorrect because we don't know anything about the services offered at Wildwood Senior Living and we don't know about the admission policies of either place.
- B. Answer 3) would be most in question because of the extreme word, "completely." Most people are not completely satisfied with anything!

The staff at Serenity Village could design a survey about the services offered, and those that are not yet offered, and distribute the survey to a random sample of the residents. If the community is not too large, they could survey all of the residents.

The newspaper could get a count of the seniors in the community from the census data and also get a count of the residents from each of the two planned communities.

GED Exercise

1. 2)

2. 3)

3. 5)

4. 1)

5. 4)

6. 3)