Name: _____ Hour: _____ Date: _____

Is anchored putting better? The opener.
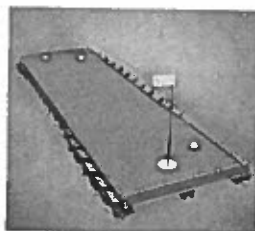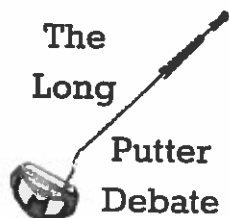
The
Long
Putter
Debate

| Many golfers started using longer putters (anchored putting), until it was recently banned. Are anchored putters actually better than traditional putters? |

1. In your group, discuss an experiment that we could do IN CLASS to test which putter is better. Give very specific details.

2. What is the data that you will collect?

3. What variables will you try to keep the same during the experiment? How?

4. What if one putter is better for short putts and the other is better for long putts. Will your experiment be able to tell? Adjust your experiment if needed.

5. What if some of the people in the experiment are really good at golf and others are very bad. Will that affect the results?

Lesson 3.1: What is a Statistical Question?

What types of questions do we investigate in statistics? The attached page contains two different types of questions: statistical and non-statistical. Cut out the questions and sort them into two different groups according to a characteristic they have in common.

1. Describe the criteria you used to sort the questions? What is the main difference between your two groups of questions?

2. How can we tell the difference between a statistical question and a non-statistical question?

3. Attach 3 each type of question to the table below to use as examples of statistical and non-statistical questions.

4. In the last box of each column, write your own examples of a statistical and a non-statistical question.

Statistical Questions	Non-statistical Questions

|	
Which musical artist or group has the most downloads on iTunes?	What are the heights of the teachers at this school?
How many siblings do the students in this class have?	How many hours do seniors work each week?
Who won the 2016 NBA championship?	How old is this school building?
How old are your parents?	How many snow days did we have last year?
How many points did the football team score on Friday?	How many students in this class ate breakfast this morning?
Where are students in this class going to college next year?	How long do you wait in line for lunch each day?

Lesson 3.1 – Introduction to Data Collection

Important ideas from the text:

**Application 3.1 Do you have dinner plans?**

Researchers at Columbia University randomly selected 1000 teenagers in the United States for a survey. According to an ABC News article about the research, "Teenagers who eat with their families at least five times a week are more likely to get better grades in school."

1. What is the statistical question that the researchers were trying to answer?

2. Identify the population and sample.

3. Is this an observational study or an experiment? Explain.
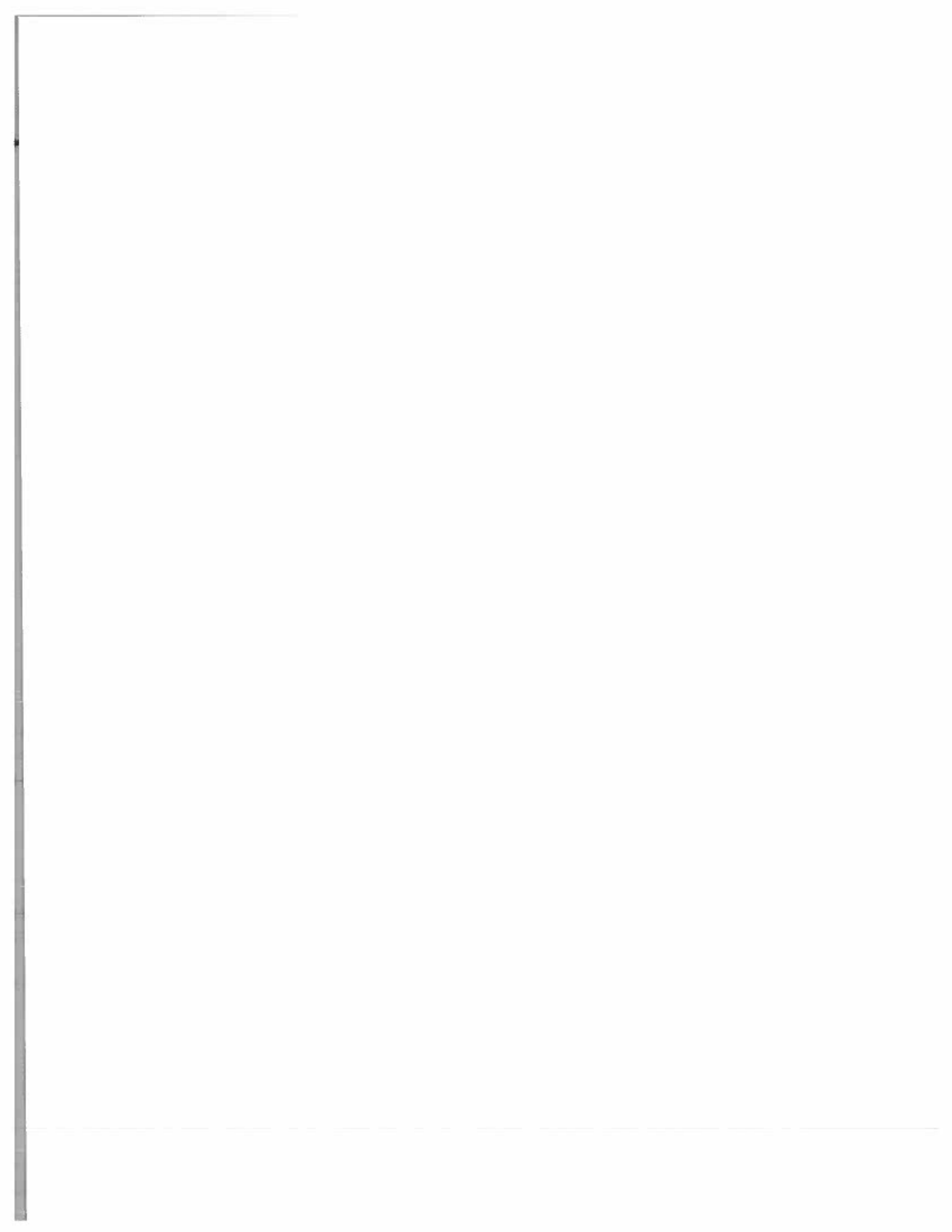
Lesson 3.2: What is the average word length of the Gettysburg Address?
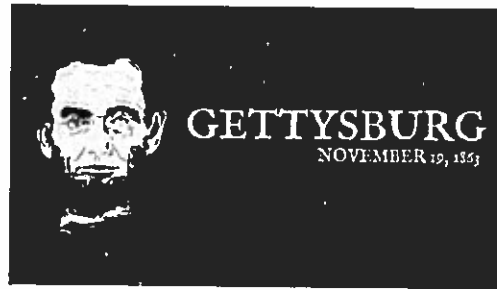
1. Quickly circle a random sample of 5 words. Write them below. How many letters in each word?

2. What is the average word length of your sample? _____.

3. Put your average on the dotplot on the white board at the front of the room. Copy the class dotplot below.

4. Find a new sample of 5 words using a random number generator. Put your average on the dotplot on the white board at the front of the room. Copy the class dotplot below.

5. How is the dotplot from #4 different than the dotplot for #3?

Name: _____ Hour: _____ Date: _____

Lesson 3.2 – Sampling Good and Bad

Important ideas from the text:

Application 3.2 Still on the phone?

In June 2008, *Parade* magazine posed the following question: "Should drivers be banned from using all cell phones?" Readers were encouraged to vote online at www.parade.com. The July 13, 2008, issue of *Parade* reported the results: 2407 (85%) said yes and 410 (15%) said no.

1. What type of sample did the *Parade* survey obtain?

2. Explain why this sampling method is biased.

3. Is 85% likely to be greater than or less than the percent of all adults who believe that cell phone use while driving should be banned? Why?

4. Explain how *Parade* magazine could avoid the bias described above.

Lincoln's Gettysburg Address

Four score and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation or any nation so conceived and so dedicated can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field as a final resting place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this. But in a larger sense, we cannot dedicate, we cannot consecrate, we cannot hallow this ground. The brave men, living and dead who struggled here have consecrated it far above our poor power to add or detract. The world will little note nor long remember what we say here, but it can never forget what they did here. It is for us the living rather to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us--that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion--that we here highly resolve that these dead shall not have died in vain, that this nation under God shall have a new birth of freedom, and that government of the people, by the people, for the people shall not perish from the earth.

#	Word	#	Word	#	Word	#	Word	#	Word
1	Four	55	We	109	cannot	163	for	217	they
2	score	56	are	110	dedicate,	164	us	218	gave
3	and	57	met	111	we	165	the	219	the
4	seven	58	on	112	cannot	166	living,	220	last
5	years	59	a	113	consecrate,	167	rather,	221	full
6	ago,	60	great	114	we	168	to	222	measure
7	our	61	battlefield	115	cannot	169	be	223	of
8	fathers	62	of	116	hallow	170	dedicated	224	devotion,
9	brought	63	that	117	this	171	here	225	that
10	forth	64	war.	118	ground.	172	to	226	we
11	upon	65	We	119	The	173	the	227	here
12	this	66	have	120	brave	174	unfinished	228	highly
13	continent	67	come	121	men,	175	work	229	resolve
14	a	68	to	122	living	176	which	230	that
15	new	69	dedicate	123	and	177	they	231	these
16	nation:	70	a	124	dead,	178	who	232	dead
17	conceived	71	portion	125	who	179	fought	233	shall
18	in	72	of	126	struggled	180	here	234	not
19	liberty,	73	that	127	here	181	have	235	have
20	and	74	field	128	have	182	thus	236	died
21	dedicated	75	as	129	consecrated	183	far	237	in
22	to	76	a	130	it,	184	so	238	vain,
23	the	77	final	131	far	185	nobly	239	that
24	proposition	78	resting	132	above	186	advanced.	240	this
25	that	79	place	133	our	187	It	241	nation,
26	all	80	for	134	poor	188	is	242	under
27	men	81	those	135	power	189	rather	243	God,
28	are	82	who	136	to	190	for	244	shall
29	created	83	here	137	add	191	us	245	have
30	equal.	84	gave	138	or	192	to	246	a
31	Now	85	their	139	detract.	193	be	247	new
32	we	86	lives	140	The	194	here	248	birth
33	are	87	that	141	world	195	dedicated	249	of
34	engaged	88	that	142	will	196	to	250	freedom,
35	in	89	nation	143	little	197	the	251	and
36	a	90	might	144	note,	198	great	252	that
37	great	91	live.	145	nor	199	task	253	government
38	civil	92	It	146	long	200	remaining	254	of
39	war,	93	is	147	remember,	201	before	255	the
40	testing	94	altogether	148	what	202	us,	256	people,
41	whether	95	fitting	149	we	203	that	257	by
42	that	96	and	150	say	204	from	258	the
43	nation,	97	proper	151	here,	205	these	259	people,
44	or	98	that	152	but	206	honored	260	for
45	any	99	we	153	it	207	dead	261	the
46	nation	100	should	154	can	208	we	262	people,
47	so	101	do	155	never	209	take	263	shall
48	conceived	102	this.	156	forget	210	increased	264	not
49	and	103	But,	157	what	211	devotion	265	perish
50	so	104	in	158	they	212	to	266	from
51	dedicated,	105	a	159	did	213	that	267	the
52	can	106	larger	160	here.	214	cause	268	earth.
53	long	107	sense,	161	It	215	for		
54	endure.	108	we	162	is	216	which		

TheStatsMedic

Lesson 3.3: Gettysburg Address – Part Two.
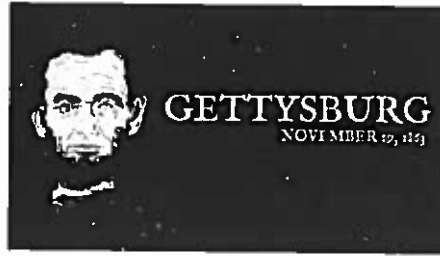
1. Copy the class dotplot from your notes from yesterday (the random sample, not the convenience sample).

2. Describe in words the process that we used yesterday to select a random sample. Be detailed.

3. Describe in words how we could use the "names from a hat" method to take a random sample. Be detailed.

4. Take a random sample of <u>10</u> words from the Gettysburg Address. Find the average of your sample and put it on the dotplot at the front of the room. Copy the dotplot below.

5. What happens when we increase the sample size?

Lesson 3.3 – Simple Random Samples

Important ideas from the text:

Application 3.3 Do you Tweet?

What proportion of students at your school use Twitter? To find out, you decide to survey a simple random sample of students from your school. In your sample of 50 students, 76% say they use Twitter.

1. Describe how you could select an SRS of 50 students using a random number generator.

2. Will your sample result (76%) be exactly the same as the true population proportion for all students? Explain.

3. Which would be more likely to yield a sample result closer to the true population value: an SRS of 50 students or an SRS of 100 students? Explain.

Name: _____ Hour: _____ Date: _____

Lesson 3.4: How much TV do students watch?

modern family

EMPIRE

An SRS was conducted to find out how much television students watch on the weekend. Twenty-five students were selected and asked "How many hours of TV did you watch this weekend?" Their responses are listed below.

5, 4, 3, 7, 5, 2, 5, 4, 8, 3, 6, 6, 5, 4, 6, 7, 5, 5, 3, 4, 6, 5, 7, 6, 4

1. What kind of data is this, categorical or quantitative.

2. Enter the data at tinyurl.com/SPAapplets. What is the mean? Do you expect that this mean is the same as the true population mean? Explain.

Because of sampling variability we know that if we continue to sample students in groups of 25 we will get different means. Some will be above and some will be below our sample mean of 5. To get a better idea of what this looks like, we will use the applet to simulate taking 30 samples and finding each mean.

3. In the applet, scroll down to Perform Inference and choose "Simulate sample mean" from the drop-down menu. Add 30 samples and Perform Simulation. Sketch the dotplot below.

4. Draw and label vertical lines on your dotplot to mark each of the following:
   a. The mean of 5.
   b. One standard deviation above and below the mean of 5. (You can find the SD listed under the dot plot.)
   c. Two standard deviations above and below the mean of 5.

5. What percentage of the sample means are within two standard deviations above or below the mean?

6. Write an interval that includes all the data two standard deviations above and below the mean.

Everything we have done so far has been to estimate a margin of error for a sample mean. We can also find a margin of error for a sample proportion. Try the example below.

> How many students text during class? A student created an anonymous survey asking students whether or not they text in class. Of the 50 students who responded, 64% said they text in class.

1. Is this a categorical or quantitative variable?

2. How many students responded yes? How many said no?

Use the applet to enter the data in 1 Categorical Variable. Enter the category names ("Yes" and "No") with the number of students who answered each. Click Begin analysis.

Scroll down to Perform Inference and choose "Simulate sample proportion" from the drop-down menu. Keep "Yes" as the category to indicate as success and change the third drop-down menu to the observed proportion. *Note: Leave the Hypothesized proportion blank.* Add 100 samples.

3. What is the standard deviation of the sample proportions?

4. Calculate the margin of error.

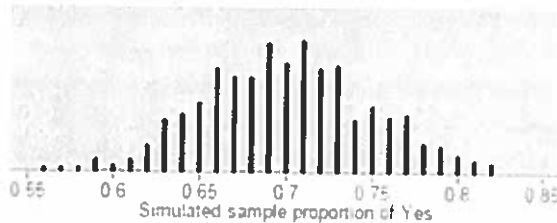5. Interpret the margin of error.

Lesson 3.4 – Margin of Error

Important ideas from the text:

Application 3.4   Can you roll your tongue?

Many people can roll their tongues, but some can't. Javier is interested in determining the proportion of students at his school that can roll their tongue. In a random sample of 100 students, Javier determines that 70 can roll their tongue. The dotplot below shows the proportion of people who can roll their tongue in each of 500 random samples of size 100 from a population where 70% can roll their tongue.


Distribution of Simulated Proportion		
# samples	mean	SD
500	0.701	0.045

1. Use the results of the simulation to approximate the margin of error for Javier's estimate of the proportion of students at his school that can roll their tongue.

2. Interpret the margin of error.

3. Javier's biology teacher claims that 75% of people can roll their tongue. According to Javier's study, is this claim plausible? Explain.

4. Explain how Javier could decrease the margin of error.
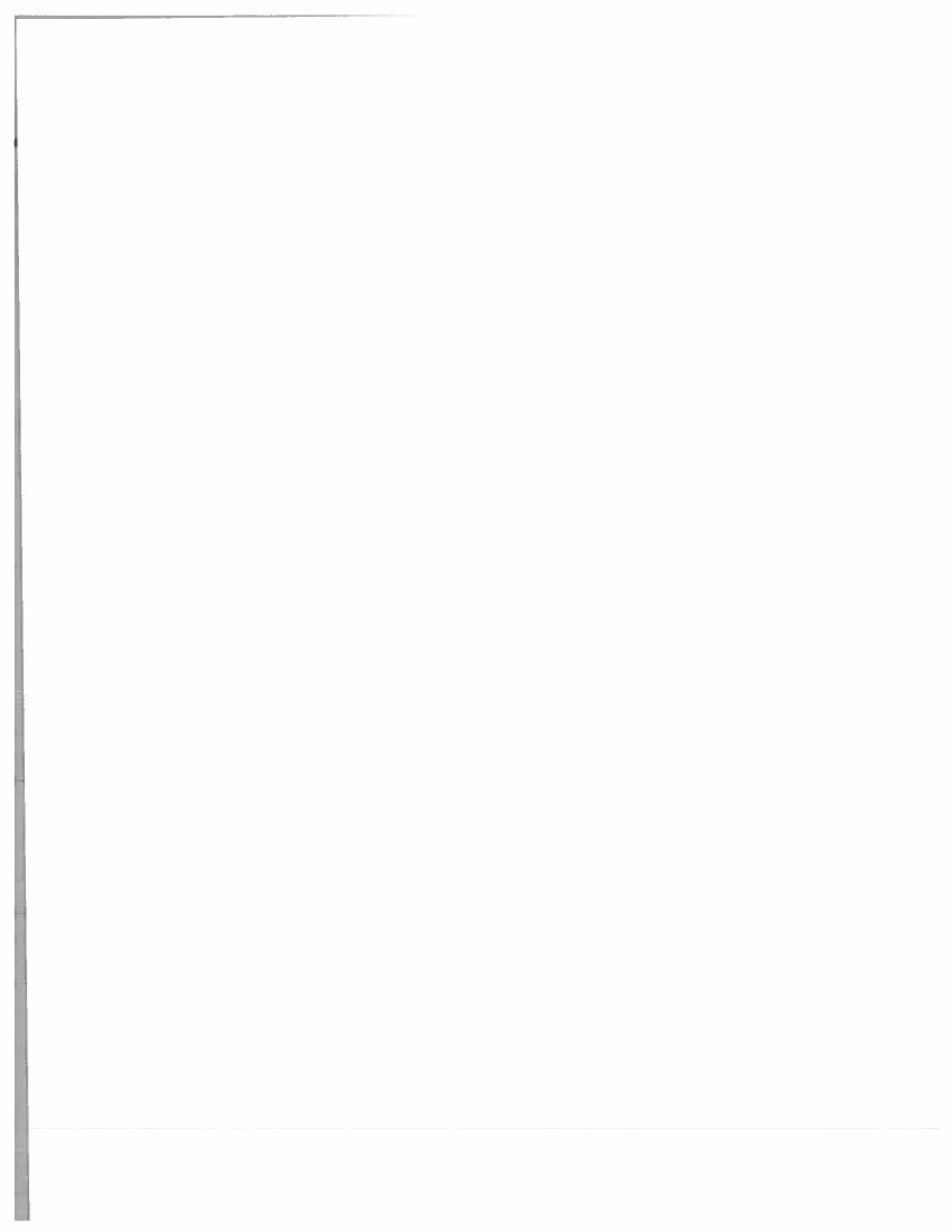
Lesson 3.5: What is wrong with these surveys?
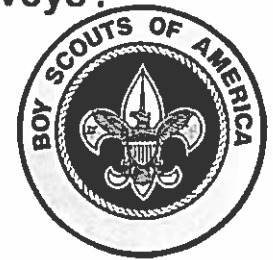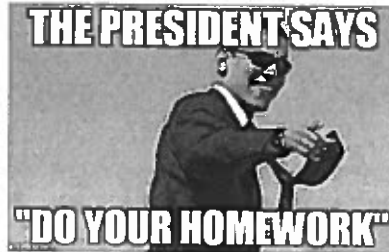
Identify what is wrong in each of these surveys. Be sure to explain.

1. The mayor of Springfield is interested in finding out the average age of people in the city. He obtains a list of all of the landline telephones in the city, and then contacts a simple random sample of 300 people. He uses the data from the sample to estimate the average age of all the people in the city.

    a. What is wrong with this survey?

    b. Do you think the Mayor will over or underestimate the true mean age of people in Springfield? Why?

2. The administration at a school wants to know the proportion of students that did all of their homework last night. They select a simple random sample of 100 students and send an email to each of them asking if they did all of their homework last night. Of the 40 responses, 36 of the students said that they did all of their homework last night (90%).

    a. What is wrong with this survey?

    b. Do you think the administration will over or underestimate the true proportion of students who did all of their homework last night? Why?

3. Boy Scout Peter M. wants to know the proportion of people in his neighborhood who support the Boy Scouts. He takes a random sample of 30 homes and visits them dressed in his uniform.

    a. What is wrong with this survey?

    b. Do you think Peter will over or underestimate the true proportion of his neighbors who support the Boy Scouts? Why?

Name: _____ Hour: _____ Date: _____

Lesson 3.5 – Sampling and Surveys

Important ideas from the text:

Application 3.5   Who did you say is calling? Literary Digest?

One of the most famous flops in survey history occurred in 1936. To predict the outcome of the presidential election between Republican Alf Landon and Democrat Franklin D. Roosevelt, the magazine *Literary Digest* sent over 10,000,000 " ballots" to its subscribers. They also sent "ballots" to registered owners of an automobile or telephone. About 2,400,000 of the ballots were returned, with a large majority (57%) favoring Landon. The election turned out to be a landslide, but for Roosevelt (61%) instead of Landon

1. Explain how undercoverage might have led to bias in this survey.

2. Explain how nonresponse might have led to bias in this survey.

3. If the magazine followed up with people who didn't return their ballots and was able to obtain responses, would this eliminate the bias described in parts (a) or (b)? Explain.

Lesson 3.6: Would you fall for that?

Would you fall for the placebo effect? Watch this video, then complete the rest of the questions.

1. Describe what you saw in the video. Why do you think the people in the video got stronger?

2. Mr. Wilcox is trying out a new facial hair ointment to make his beard grow faster for No Shave November. At the end of November, his beard is 3 inches long. He concludes since his beard grew 3 inches, the ointment must work. What is wrong with his reasoning?

3. In a recent medical study testing the effectiveness of a new medication, researchers gave participants either the new medication or a sugar pill. When participants came to get the pills, they were told whether they had been assigned to the medication or to the sugar pills. At the conclusion of the study, researchers found the medication was more effective than the sugar pill. Are the results valid?

4. Identify any possible variables that could be the cause of the correlations below:

   a. Those people who tend to carry boxes of matches in their pockets also have a higher risk of cancer.

   b. People who drink diet sodas tend to have a higher body mass index (weight to height ratio).

   c. Students who eat dinner with their family often are more likely to have better grades.

Lesson 3.6 – Observational Studies and Experiments

Important ideas from the text:

Application 3.6   What happens when physicians study themselves?

Does regularly taking aspirin help protect people against heart attacks? The Physicians' Health Study I was a medical experiment that helped answer this question. The subjects in this experiment were 21,996 male physicians. Half of these subjects took an aspirin tablet every other day and the remaining subjects took a dummy pill that looked and tasted like the aspirin but had no active ingredient. After several years, 239 of the control group but only 139 of the aspirin group had suffered heart attacks. This difference is large enough to provide convincing evidence that taking aspirin does reduce heart attacks.

1. Why was it necessary to perform an experiment rather than simply asking the doctors whether or not they take aspirin regularly?

2. Explain why it was necessary for the experiment to include a control group that didn't receive aspirin.

3. Was blinding used in this experiment? Explain why this is an important consideration.

Lesson 3.7: Is anchored putting better? Part 2.
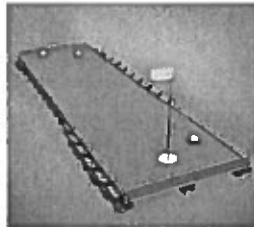
The
Long
Putter
Debate

Many golfers started using longer putters (anchored putting), until it was recently banned. Are anchored putters actually better than traditional putters?

Suppose that we have 30 students willing to participate in our experiment to test short putters vs. long putters. We decide to have 15 students use the short putter and 15 students use the long putter.

1. Suppose we let students pick which putter they wanted to use. Why might this be a problem?

Instead of letting students choose which putter they will use, we can use **random assignment** to select 15 students for the long putter and 15 students for the short putter.

2. Explain how you could use slips of paper to do random assignment.

3. Explain how you could use a random number generator to do random assignment.

4. What is the purpose of using random assignment?

5. What other variables will we attempt to keep the same during this experiment (list several)? Why?

Name: _____ Hour: _____ Date: _____

Lesson 3.7 – How to Experiment Well

Important ideas from the text:

Application 3.7   Multitasking? Or multiple distractions?

Researchers in Canada performed an experiment with university students to examine the effects of multitasking on student learning. The 40 participants in the study were asked to attend a lecture and take notes with their laptops. Half of the participants were randomly assigned to complete other online tasks not related to the lecture during that time. These tasks were meant to imitate typical student Web browsing during classes. The remaining students simply took notes with their laptops. At the end of the lecture, all participants took a comprehension test to measure how much they learned from it. The results: students who were assigned to multitask did significantly worse (11%) than students who were not assigned to multitask.
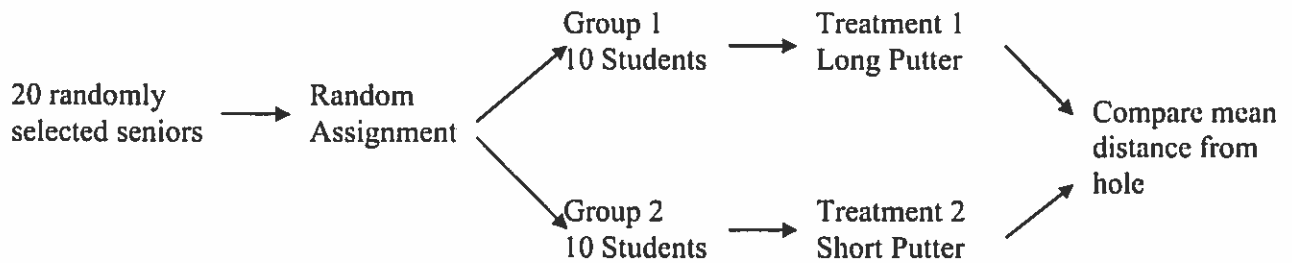
1. Describe how the researchers could have carried out the random assignment.

2. Why was it important that the researchers randomly assigned treatments to the students?

3. Identify one variable that the researchers kept the same for all subjects. Provide two reasons why it was important for the researchers to keep this variable the same.

Lesson 3.8: Is anchored putting better? Part 3.

The
Long
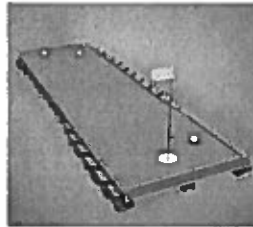
Putter
Debate

How do we know if the experimental results are different due to the treatments or if the difference occurred purely by chance?

1. Below is a diagram that details how one group conducted an experiment to test if the long or short putter was better. Use the diagram to describe how the experiment was conducted.

20 randomly
selected seniors
→
Random
Assignment
→
Group 1
10 Students
→
Treatment 1
Long Putter
→
Compare mean
distance from
hole
Group 2
10 Students
→
Treatment 2
Short Putter
↗

Below are the results of the experiment showing how far each ball was from the hole (in cm) after the putt.

	Distance of ball from the hole (in cm)										Mean Distance
Long Putter	2	3	0	2	5	4	2	1	6	3	
Short Putter	2	8	10	9	6	5	6	5	0	6	

2. Find the mean distance from the hole for each putter. Calculate the difference in means for the putters (short – long)? Explain in context.

How do we know whether or not the difference in means is large enough to say one putter is better? Could the difference have occurred purely by chance? In order to decide if this result is **statistically significant** we will use the applet to simulate many experiments to see how often this result occurs by chance.

Step 1: Enter the data: Go to tinyurl.com/SPAapplets. Select 1 Quantitative Variable. Add an additional group and enter the data.

Step 2: Simulate difference in two means: Scroll down to Perform Inference. Use the Inference Procedure drop down menu and select Simulate difference in two means. Add 50 samples. Sketch the dot plot below.

What does each dot represent?

Step 3: Calculate a percentage: What percentage of the dots are greater than or equal to the difference in means from our experiment?

Step 4: Make a decision: Do you think the difference in means we found from our experiment is due to the treatments or has it occurred purely by chance?

# Lesson 3.8 – Inference for Experiments

Important ideas from the text:

Application 3.8   Does fish oil affect blood pressure?

To see if fish oil can help reduce blood pressure, males with high blood pressure were recruited and randomly assigned to different treatments. Seven of the men were randomly assigned to a 4-week diet that included fish oil. Seven other men were assigned to a 4-week diet that included a mixture of oils that approximated the types of fat in a typical diet. At the end of the 4 weeks, each volunteer's blood pressure was measured again and the reduction in diastolic blood pressure was recorded. These differences are shown in the table below. Note that a negative value means that the subject's blood pressure *increased*.

Fish oil: 8   12   10   14   2   0   0
Mixture: –6   0   1   2   –3 –4   2

1. Outline a completely randomized design for this experiment.

2. Calculate the mean reduction for each group and the difference in mean reduction (fish oil – mixture).

3. One hundred trials of a simulation were performed to see what differences in means are likely to occur due only to chance variation in the random assignment, assuming that the type of oil doesn't matter. Use the results of the simulation below to determine if the difference in means from part (b) is statistically significant. Explain your reasoning.

-8   -6   -4   -2   0   2   4   6   8
Simulated Difference in Means
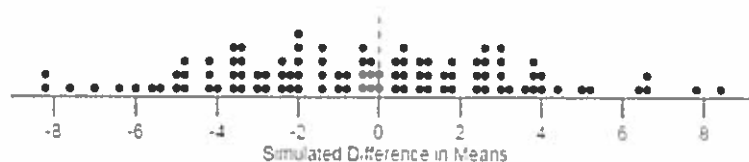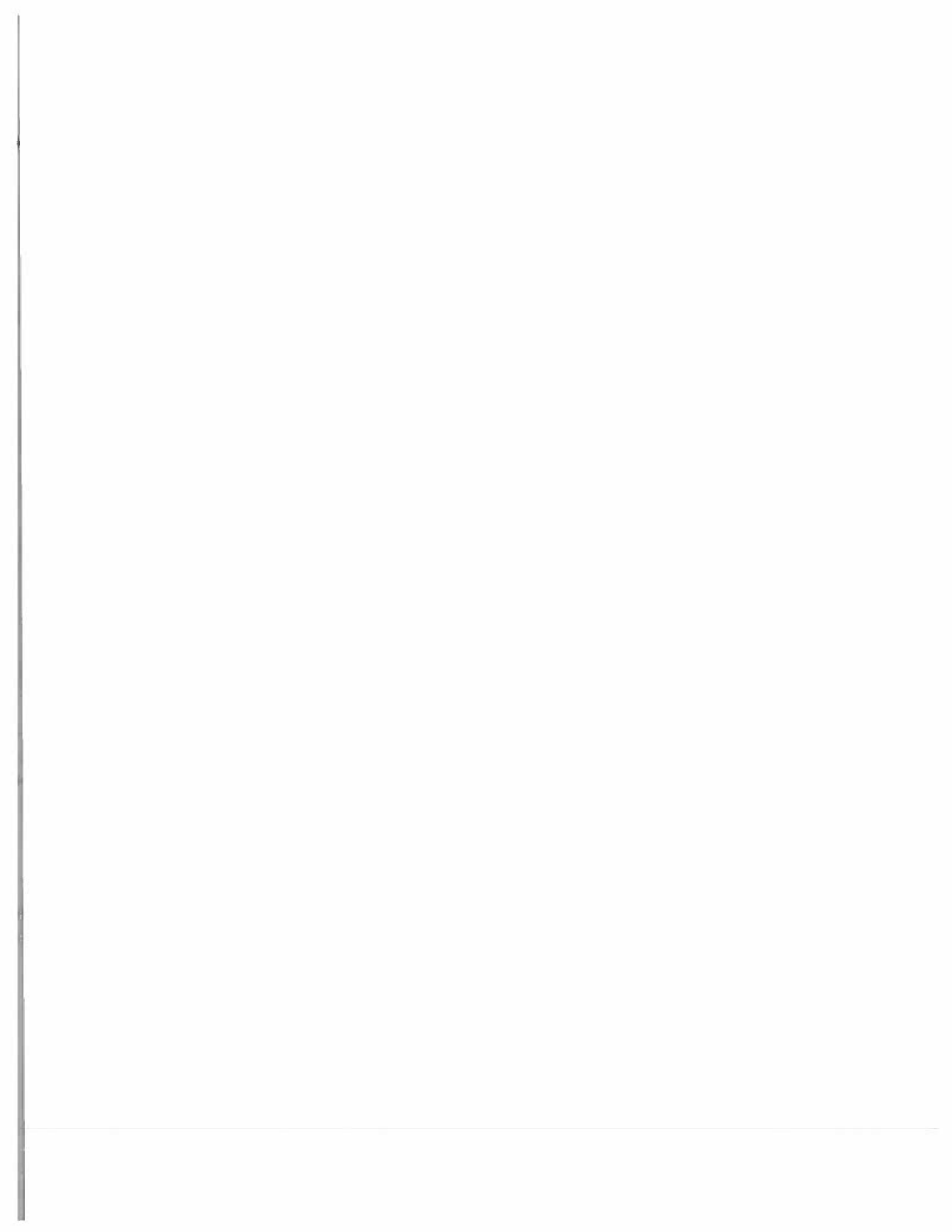
Name: _____ Hour: _____ Date: _____

Lesson 3.9: Does listening to music improve GPA?

Spotify

P PANDORA

♫ iTunes

> Some students at your school claim that listening to music while studying will help improve their GPA. Design a study to help discover if this claim is true.

Here are four proposed studies for investigating the question of the day. Suppose we found that the mean GPA of students who listen to music is significantly lower than the mean GPA of students who didn't listen to music. What conclusions could we make?

1. Get all the students in your statistics class to participate in a study. Ask them whether or not they study with music on and divide them into two groups based on their answer to this question.

Random sample?_____   Random assignment?_____

Conclusion:

2. Select a random sample of students from your school to participate in a study. Ask them whether or not they study with music on and divide them into two groups based on their answer to this question.

Random sample?_____   Random assignment?_____

Conclusion:

3. Get all the students in your statistics class to participate in a study. Randomly assign half of the students to listen to music while studying for the entire semester and have the remaining half abstain from listening to music while studying.

Random sample?_____   Random assignment?_____

Conclusion:

4. Select a random sample of students from your school to participate in a study. Randomly assign half of the students to listen to music while studying for the entire semester and have the remaining half abstain from listening to music while studying.

Random sample?_____   Random assignment?_____

Conclusion:

Lesson 3.9 – Using Studies Wisely

Important ideas from the text:

Define **random sample**:

Why do we take **random samples**?

What conclusion can be made for a study that uses **random sampling**?

Define **random assignment**:

Why do we do **random assignment**?

What conclusion can be made for a study that uses **random assignment**?

**Application 3.9   Is foster care better for children than an orphanage?**

Do abandoned children placed in foster homes do better than similar children placed in an institution? The Bucharest Early Intervention Project found that the answer is a clear "Yes." The subjects were 136 young children abandoned at birth and living in orphanages in Bucharest, Romania. Half of the children, chosen at random, were placed in foster homes. The other half remained in the orphanages. (Foster care was not easily available in Romania at the time and so was paid for by the study.)

1. Did this study use random sampling?

2. Did this study use random assignment?

3. What conclusion(s) can we draw from this study? Explain.

4. The children in this study were too young to provide informed consent. Does this make this study unethical? Explain.

Is anchored putting better? The Finale.
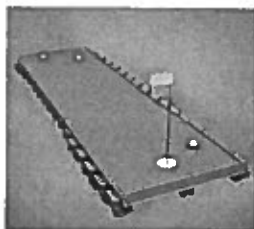
The
Long
Putter
Debate

Many golfers started using longer putters (anchored putting), until it was recently banned. Are anchored putters actually better than traditional putters?

Today we will carry out an experiment to see if the long putter is better than the short putter. You must answer the first 10 questions before we are ready to collect the data.

1. "How far will each putt go with the long putter?" Is this a statistical question? Why?

2. Will we be doing an observational study or an experiment today? Explain.

3. What are some other confounding variables that might affect our results?

4. If we really just want to see if the long putter is better, why can't we just have one group who all uses the long putter?

5. Describe how we could randomly assign the students in the class into two groups (long putter and short putter) using slips of paper.

6. Describe how we could randomly assign the students in the class into two groups (long putter and short putter) using a random number generator.

7. Why do we use random assignment to create the two groups?

8. What other variables will we try to keep the same for all the experimental units?

9. What are the two benefits of keeping these variables the same?

10. Draw an outline of the experiment we will be conducting today.

11. Data Collection!!

Distance from hole (inches)

Long Putter																
Short Putter																

12. Let's start by entering the data for the long putter only. Go to www.tinyurl.com/SPAapplets and click *One Quantitative Variable*. Enter the distances from the hole for the long putter only. Click "Begin Analysis" and find the mean:_____

13. Under **Perform Inference**, choose "Simulate sample mean" from the drop down menu. Add 100 samples. What is the standard deviation (SD) of the Distribution of Simulated Mean? Use it to find the margin of error and then interpret the margin of error.

SD: _____   Margin of error:_____

Interpret:

14. Now change the Number of Groups to 2 and add the data for the short putter. Record the mean of each and find the difference.

Mean (short putter):_____   Mean (long putter):_____

Difference (short – long):_____

15. Under **Perform Inference**, choose "Simulate difference in two means" from the drop down menu. Add 50 samples. Sketch the dot plot below.

16. What percent of the dots are larger than the difference in means we got from our experiment? Is the difference statistically significant?

17. Did we use random sampling in this experiment? Did we use random assignment? What conclusion can we make?

18. Was this experiment conducted in an ethical manner? Explain.