

CHAPTER 4 SOLUTIONS

Section 4.1

- 1) *Individuals are:* each player
Categorical variables are: position, and J.V. or Varsity
Numerical variables are: batting average, number of at-bats, number of hits, and number of stolen bases

- 2) *Individuals are:* each employee
Categorical variables are: highest degree earned, job title, home address, and phone number
Numerical variables are: annual salary, years with the company, yearly contribution toward 01K, and number of children

- 3) a) numerical
b) categorical
c) categorical
d) numerical
e) categorical
f) categorical

- 4) weather
 - a) *variable of interest:* The temperature at Sand Creek Elementary School, during the specified 5 week time period.
instrument: The thermometer that is near the classroom window
units: Degrees (they did not specify Fahrenheit or Celsius)
 - b) *validity:* This is a valid way to measure temperature
reliability: This should be reliable (as long as the kids know how to read the thermometer)
bias: This should be free from bias (unless the placement of the thermometer is in a place that is much warmer or much cooler)

- 5) measurement
 - a) *variable of interest:* Lengths, widths, heights of various objects
instrument: Each person will use his or her "own-foot-ruler"
units: number of "my-own-feet" for each child
 - b) *validity:* This is not a very valid way to make a measurement, because it doesn't make sense to make measurements with different length 'rulers'.
reliability: This will not be reliable, because everyone will be getting different answers.
bias: Some people may feel that this is not biased because some kids will have big feet and some will have small feet. Some people may feel that it is biased, because the answers will all be much higher than they would be if measured in actual feet. These are all first graders with smaller feet than 12 inches.

- 6) Answers for all of these will vary.
- a) This is not reliable because it is unpredictable. Fix it.
 - b) This is not valid because factors other than what one eats affect cholesterol. Also, this is not reliable because people may forget what they ate, lie to appear to have better dietary habits, or not take the survey seriously. This will most likely be biased, resulting in underestimates of cholesterol levels. Use a blood test instead to be accurate.
 - c) This should be good.
 - d) This is not valid because there are many other factors. This is not reliable because a student may rate themselves differently on different days. This may have bias (too high), but it may not because some students will rate themselves too high, while others will rate themselves too low. Use this rating scale as part of the grade only.
 - e) If the test is well written, then this may be a valid way to determine a grade. This is not going to be reliable though, because it is just one test. For example, someone may have had a bad day, be a terrible test taker, or have been sick, or someone may have cheated. Use more than one test.
 - f) This is going to be biased, because it is always registering higher than it should. Fix it.

7) Teacher survey

- a) Census
- b) Answers will vary.
- c) Answers will vary.

8) Data collection method

- a) Sample survey
- b) Observational study
- c) Experiment
- d) Census
- e) Experiment

9) Rates vs. counts

- a) Pasquale's had 17 returns and Marco's had 27 returned. Marco's had a higher number of returns.
- b) Pasquale's had $(17/127)$ 13.4% returns and Marco's had $(27/268)$ 10.1% returns. Pasquale's had a higher rate of returns.
- c) The rate is a better way to compare the two stores, because the number of returns cannot be compared when the number sold was so different.

10) Amount of raise is: $12.45 - 10.85 = 1.60$.

Percent of a raise is: $1.60/10.85 = 0.1475 * 100 = 14.75\%$ raise

11) Amount of discount is: $42.99 - 27.99 = 15$

Percent of discount is: $15/42.99 = 0.3489 * 100 = 34.89\%$ mark down

12) $84 - 37 = 47$ fewer

$47/84 = 0.5595$

55.95% decrease

13)

a)

School Year	2010-2011	2011-2012	% of change (+ or -)
Total number of tardies	5186	4295	17.2% decrease
More than 10 tardies	175	59	66.3% decrease
More than 20 tardies	112	77	31.3% decrease

b) The most significant change was among the students with more than 10 tardies.

c) Based on these calculations, it seems that the tardy policy is decreasing the number of tardies among students at the SRHS. There was a significant drop in the number of students with more than 10 tardies (down 66.3%) and those who have more than 20 tardies (down 31.3%).

Section 4.2

1) Parameter or Statistic?

- a) Parameter
- b) Parameter if her students are the population
- c) Statistic
- d) Parameter
- e) Parameter
- f) Statistic

2)

- a) All graduates of MBHS
- b) The number of seats needed per graduate
- c) The 148 graduates of MBHS whose surveys were returned
- d) 6.2 seats per graduate
- e) Voluntary response sample
- f) 27.3% response rate (148/543)
- g) They used a bad sampling method (voluntary response survey) and only had 27.3% returned. This is a case of nonresponse bias. It is likely that only the people who are worried about not having enough seats will respond.
- h) Answers will vary. If you think it is too high, then the result is renting too big of a hall and wasting a lot of money. If you think it is too low, then the result is renting too small of a hall and having a lot of angry families who do not have a seat for graduation.

3)

- a) Stratified Random Sample. Good way to be sure that all grades are represented.
- b) Systematic Random Sample. Good method—possible that some grades will be underrepresented.
- c) Voluntary Response. Bad method. Most will end up in the garbage. Only people with strong opinions on the topic will take the time to respond.
- d) Simple Random Sample. Good method—possible that some grades will be underrepresented.
- e) Multi-Stage Random Sample. Good method—possible that some grades will be underrepresented.
- f) Convenience Sample. Bad method. Many students will not even have a chance to be included in this sample. All kids who are surveyed have at least something in common—having one of these three teachers.

4)

- a) Response bias. He is putting the wrong answers to try to be funny.
- b) Non-response bias. People did not return them.
- c) Response bias. Students would not want to tell anything that would get them into trouble.
- d) Random Sampling Error
- e) Processing error. This was a human mistake.
- f) Bad sampling method. The radio host is using a voluntary response survey and will only hear from those with strong opinions on this topic.
- g) Under-coverage. Entire neighborhoods were left out. Whoever lives in the neighborhoods that were skipped will not be included in the results.
- h) Wording of questions bias. The question is very slanted to get a certain result.

5) $4/6 = 2/3 = 0.667 = 66.7\%$

6) $1/6 = 0.167 = 16.7\%$

7) $10/36 = 5/18 = 0.278 = 27.8\%$

8) $6/216 = 1/36 = 0.0278 = 2.78\%$

Section 4.3

1) a)

- Assign numbers 01 to 56 to the list of employees
- Use random digit table, starting on line #108
- Look at two digits at a time
- Ignore 57-99, 00 and any repeats
- Stop when 12 are selected

b) The employees selected are: 07, 20, 24, 17, 49, 43, 09, 06, 56, 41, 36, 15

2) Results of the SRSs will vary.

First SRS

- Assign numbers 01 to 50 to the alphabetical list of states
- Use random digit table, starting on line # __?__
- Look at two digits at a time
- Ignore 51-99, 00 and any repeats
- Stop when 5 are selected
- *The five states selected were ____, ____, ____, ____, and ____
*Students should report both the numbers and the names of the states selected.

Second SRS

- Starting on line # __?__
- *The five states selected were ____, ____, ____, ____, and ____

Comparison

Students should write a few sentences comparing the results of their SRSs to at least one classmate's SRSs.

3) Stratified Random Sample

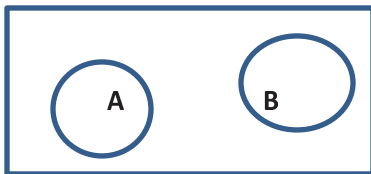
Varsity SRS of size 3

- Assign numbers 01 to 13 to the alphabetical list of Varsity players
- Use random digit table, starting on line #122
- Look at two digits at a time
- Ignore 14-99, 00 and any repeats
- Stop when 3 players are selected
- The three players who will be tested are: West (#13), Gustaf (#05) and Radmacher (#09)

Junior Varsity SRS of size 5

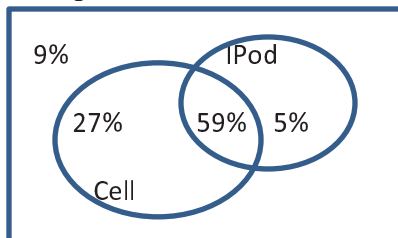
- Assign numbers 01 to 21 to the alphabetical list of Junior Varsity players
- Use random digit table, starting on line # 123
- Look at two digits at a time
- Ignore 22-99, 00 and any repeats
- Stop when 5 are selected
- The five players who will be tested are: James (#08), Randal J (#15), Hansen (#07), Linder (#10), and Sams (#18)

4) Mutually exclusive means no outcomes in common.



5)

a) Venn Diagram



b) $P(C \text{ and } I) = 59\%$

c) $P(C \text{ or } I) = 91\%$

Section 4.4

- 1) Texting
 - a) All MBHS students
 - b) The proportion who text during class
 - c) 270 MBHS students who were surveyed
 - d) $\hat{p} = 0.6593$ $\hat{p} = \frac{178}{270}$
 - e) $m.e. = \pm 0.0609$ $m.e. = \pm \left(\frac{1}{\sqrt{270}}\right)$
 - f) 0.5984 to 0.7202 $(0.6593 - 0.0609 = 0.5984 \text{ and } 0.6593 + 0.0609 = 0.7202)$
 - g) "We are 95% confident that the true proportion of MBHS students who text while in class is between 0.5984 and 0.7202."
 - h) Answers will vary.

- 2) Mayoral election
 - a) All voters in this community
 - b) The proportion who describe themselves as "leaning Democratic"
 - c) 814 voters who were surveyed
 - d) $\hat{p} = 38.2\% = 0.382$ (given)
 - e) $m.e. = \pm 0.0350 = \pm 3.50\%$ $m.e. = \pm \left(\frac{1}{\sqrt{814}}\right)$
 - f) 34.7% to 41.7% $(38.2\% - 3.5\% = 34.7\% \text{ and } 38.2\% + 3.5\% = 41.7\%)$
 - g) "We are 95% confident that the true percent of voters in this community who are "leaning Democratic" is between 34.7% and 41.7%."

- 3) "leaning Republican"
 - a) 38.8% to 45.8% $(42.3\% - 3.5\% = 38.8\% \text{ and } 42.3\% + 3.5\% = 45.8\%)$
 - b) No. This mayoral race is still too close to call. There is an overlap between those who are leaning Democratic and those are leaning Republican.

- 4) Spaz Cola
 - a) All cans of Spaz Cola
 - b) The proportion of cans that are not made with the correct recipe (specifically too little sugar)
 - c) 480 cans analyzed today
 - d) $\hat{p} = 0.0896$ $\left(\frac{43}{480}\right)$
 - e) $m.e. = \pm 0.0456$ $m.e. = \pm \left(\frac{1}{\sqrt{480}}\right)$
 - f) 0.0440 to 0.1352 $(0.0896 - 0.0456 = 0.0440 \text{ and } 0.0896 + 0.0456 = 0.1352)$
 - g) "We are 95% confident that the true proportion of cans of Spaz Cola made today that have too little sugar is between 4.40% and 13.52%."
 - h) Answers may vary. This confidence interval includes 4.40% to 13.52%, so the company should probably check the machines. I feel that anything above 5% being wrong warrants a check.

- 5) Marcus got $+18/42 = 0.4286 = 42.86\%$ on his science test. He earned $+31/55 = 0.5636 = 56.36\%$ on his history test. So, he did better on his history test because he got a higher percent correct.

- 6) Lydia got $+15/23 = 0.6522 = 65.22\%$ on her quiz. She then got $+37/48 = 0.7708 = 77.08\%$ on her probability test. So, she did better on the test because she got a higher percent correct.
- 7) Total area = $16 \cdot 28 = 448 \text{ m}^2$
 Shaded area = total – cutout area = $448 - (\pi \cdot 5^2 + 4^2) = 448 - 94.5 = 353.5 \text{ m}^2$
 $P(\text{shaded area}) = \text{shaded}/\text{total} = 353.5/448 = 0.7891 = 78.91\%$ chance of hitting the shaded area
- 8) Answers will vary.

Section 4.5

- 1) Scratch-Be-Gone
- Subjects:* 450 pets with allergies
 - Explanatory Variable:* Scratch-Be-Gone pet allergy drug
 - Response Variable:* any change/reduction in allergy symptoms
 - This could certainly be **double-blind**. The pet owners do not need to know which medicine their pets are receiving. Also, the researcher distributing the medicine does not need to know which medicine each patient is being given. The two medicines can be made to look the same and an outside party can package the medicines and label them with a code.
 - Outline:*



2) Ms. Rokinroll

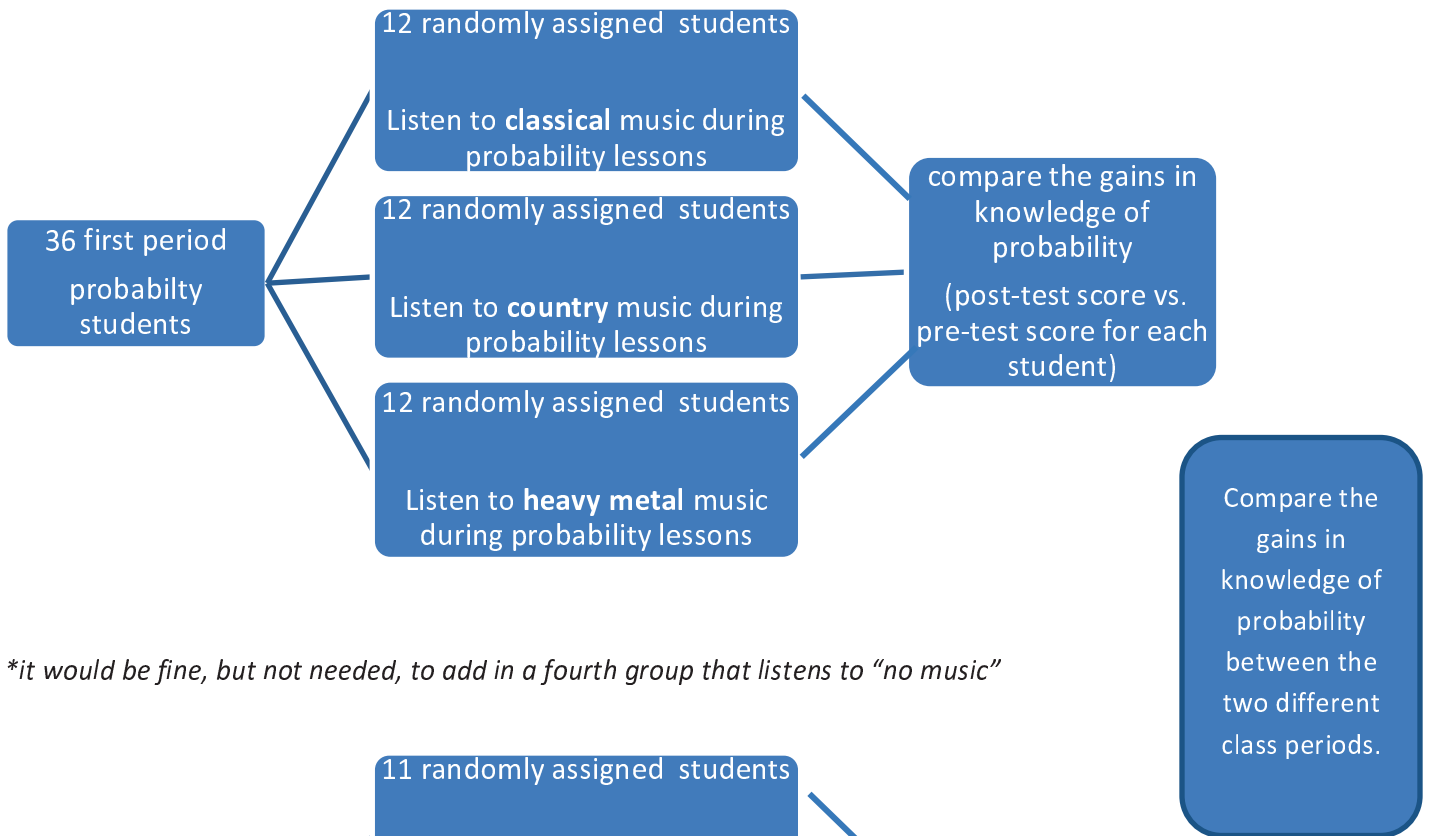
- a) *Subjects*: 36 probability students in first period and 34 probability students in last period
- b) *Explanatory Variable*: Listening to **classical, country, or heavy metal music** while doing probability problems
- c) *Response Variable*: any change in knowledge of probability
- d) Answers will vary. Some may feel that the various types of music will serve as enough control. Others will feel that a group listening to “*no music*” should be added.
- e) Answers will vary.

Blind and double-blind will be difficult because each student will certainly know what type of music he or she is listening to, and it is likely that the kids would comment on the music type. It might be possible that they do not know that others are listening to something different, until after the first lesson is over. Also, it could be that the teacher does not know which type of music each student is listening to (head phones). Again, the kids will comment on what they heard. So, blind and double-blind do not seem very practical in this case.

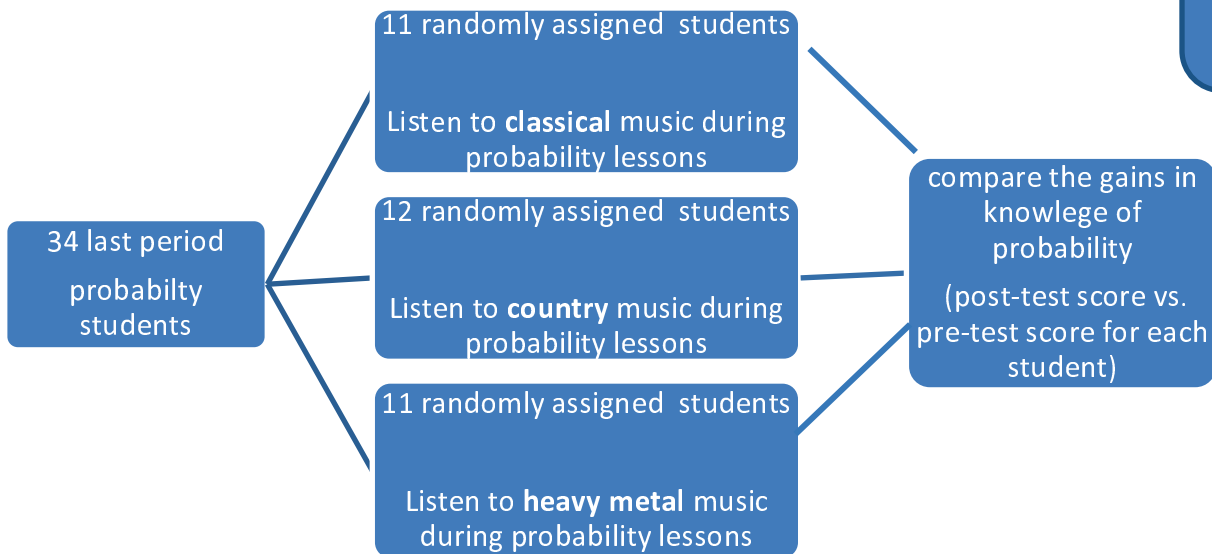
A **Pre-test** seems necessary for this. It would be important to know how much each student already knew about probability before the lessons started, in order to determine how much they learned during the lessons. So, a pre-test and a post-test will need to be given to each student to see how much they have learned.

In this situation a **placebo control** could be that a group of students has headphones, but is not listening to any music. After the first lesson, when they realize others are listening to music, this could become a lurking variable. A placebo control could be included, but is not necessarily needed, because the different music types can be the control.

f) Outline:



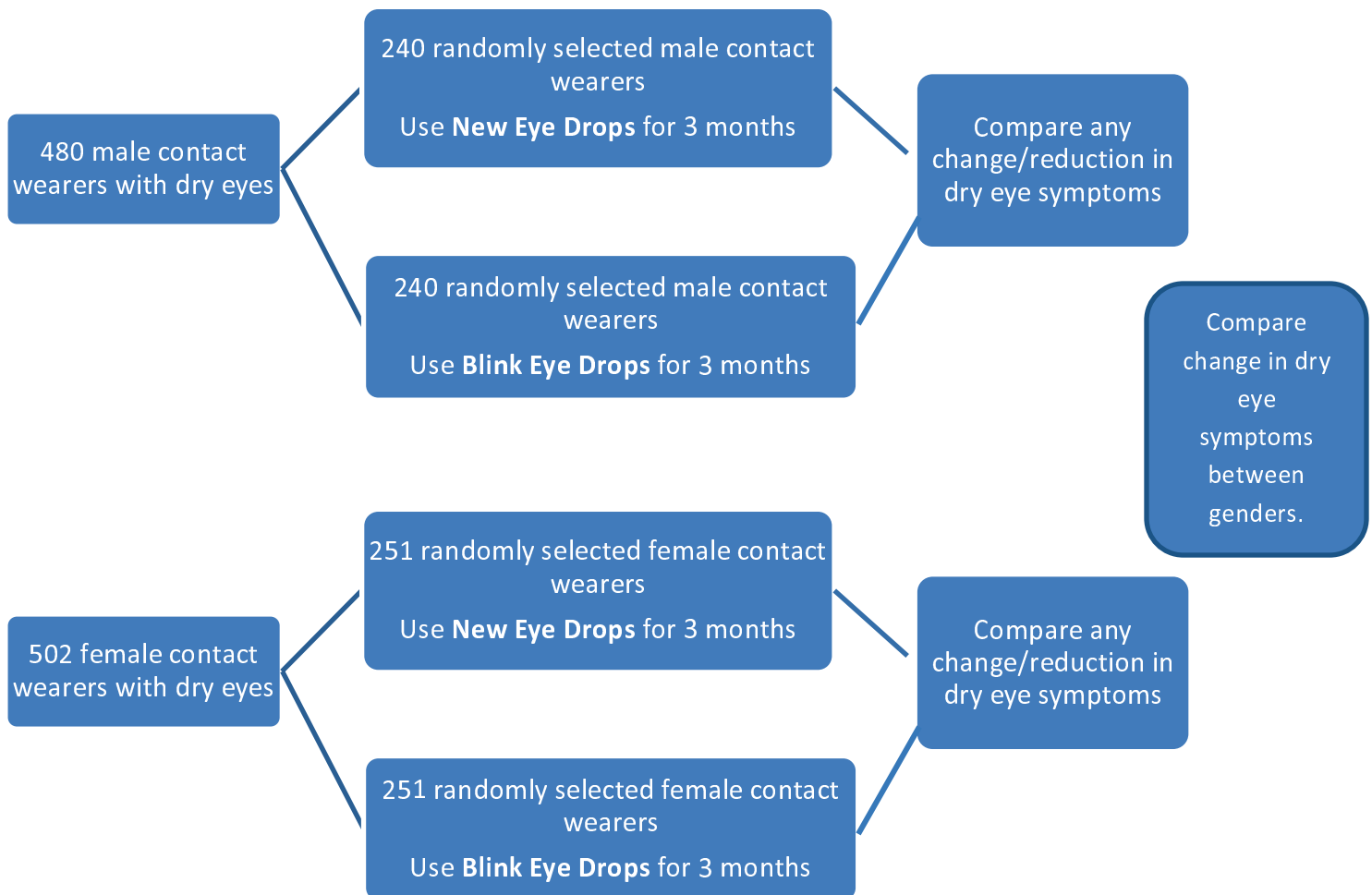
**it would be fine, but not needed, to add in a fourth group that listens to “no music”*



3) Blink Brand Eye Drops

- a) *Subjects:* 480 male contact wearers who suffer from frequent dry eyes
502 female contact wearers who suffer from frequent dry eyes
- b) *Explanatory Variable:* New eye drops and Blind Eye drops
- c) *Response Variable:* change/reduction in dry eye symptoms

- d) *Outline*: It will be blocked by gender. We do not need a placebo control, because we want to compare one brand to another brand. It will be double-blind (neither researcher nor patients know which medicine they are receiving).



- e) *Random selection*: this will be two separate random selections, one for males & one for females. Everyone selected will be in the first treatment group—New Eye Drops. Everyone not selected will be in the second treatment group—Blink Brand Eye Drops.

- Assign numbers 001 to 480 to the list of males (and 001 to 502 to the list of females)
- Use line #129 on random digit table (start on line # __?__ for females)
- Look at 3-digits at a time
- Ignore numbers 481-999, 000 and repeats (for females ignore 503-999, 000 and repeats)
- Stop when 240 males are selected (stop when 251 females are selected)
- The first five males to be in the first treatment group are: #367, #468, #288, #229, and #131...

4) MUMM cell phone

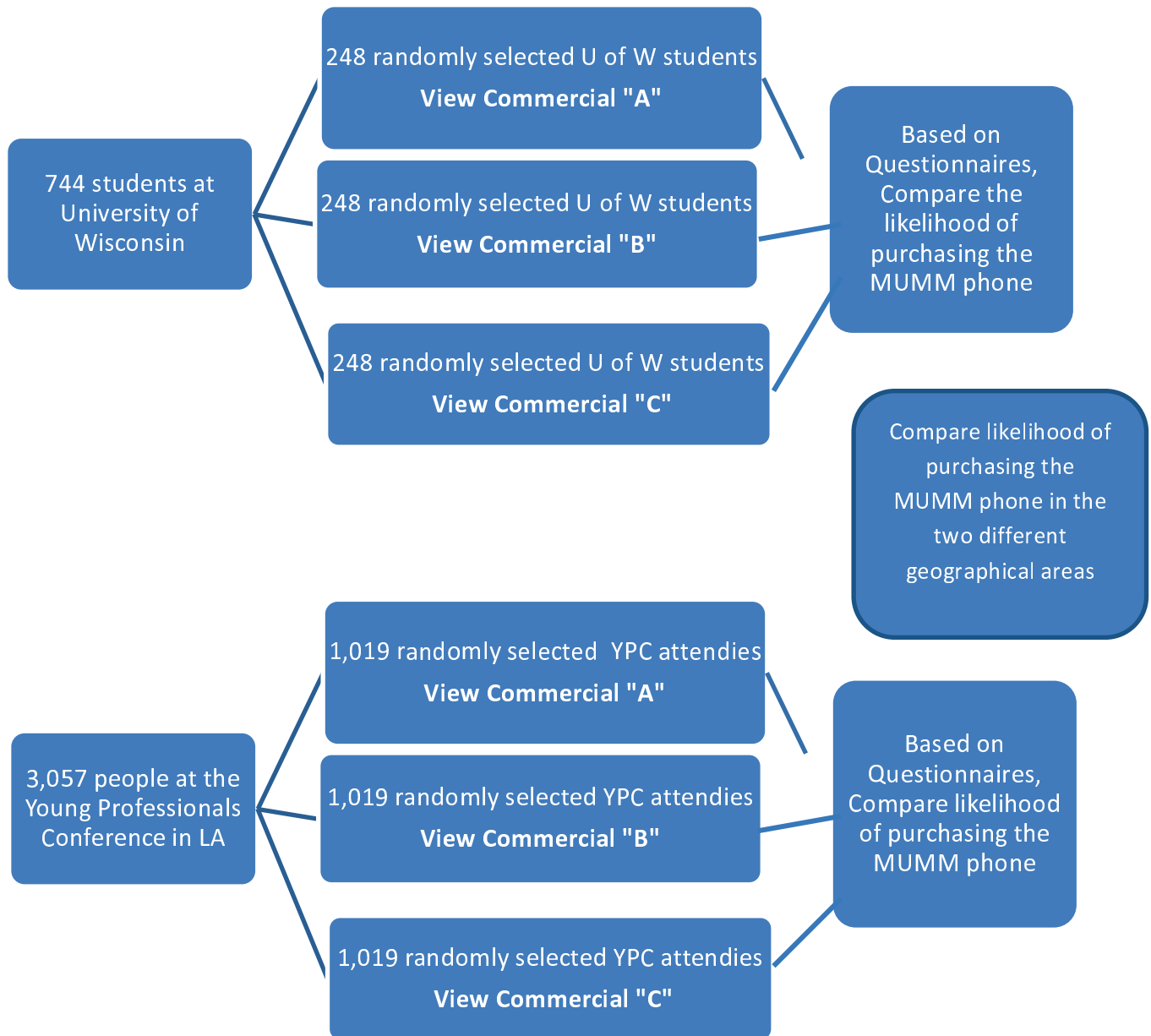
- a) *Subjects*: 744 students at the University of Wisconsin

3, 057 people who attend this year's Young Professionals Conference in Los Angeles

- b) *Explanatory Variable*: the 3 different commercials

- c) *Response Variable*: Likelihood to purchase a new MUMM phone

- d) *Outline:* We will block by location. No placebo control—what’s the point of showing a fake commercial? It cannot be blind because people will know which commercial they are viewing. The subjects do not need to know that others are seeing a different commercial. The researchers who analyze the questionnaires could be “blind” as to which commercial people viewed.



- e) *Randomization:* Answers will vary. It needs to be random though (not 1st person to A, next to B, next to C, next to A, etc.) One idea is that each person who walks up can roll a die: 1-2 view commercial A, 3-4 view commercial B, and 5-6 view commercial C. Another idea is a spinner with 3 sections marked A, B, and C.

5) Students will each make his or her own flashcards for the chapter 4 terms.

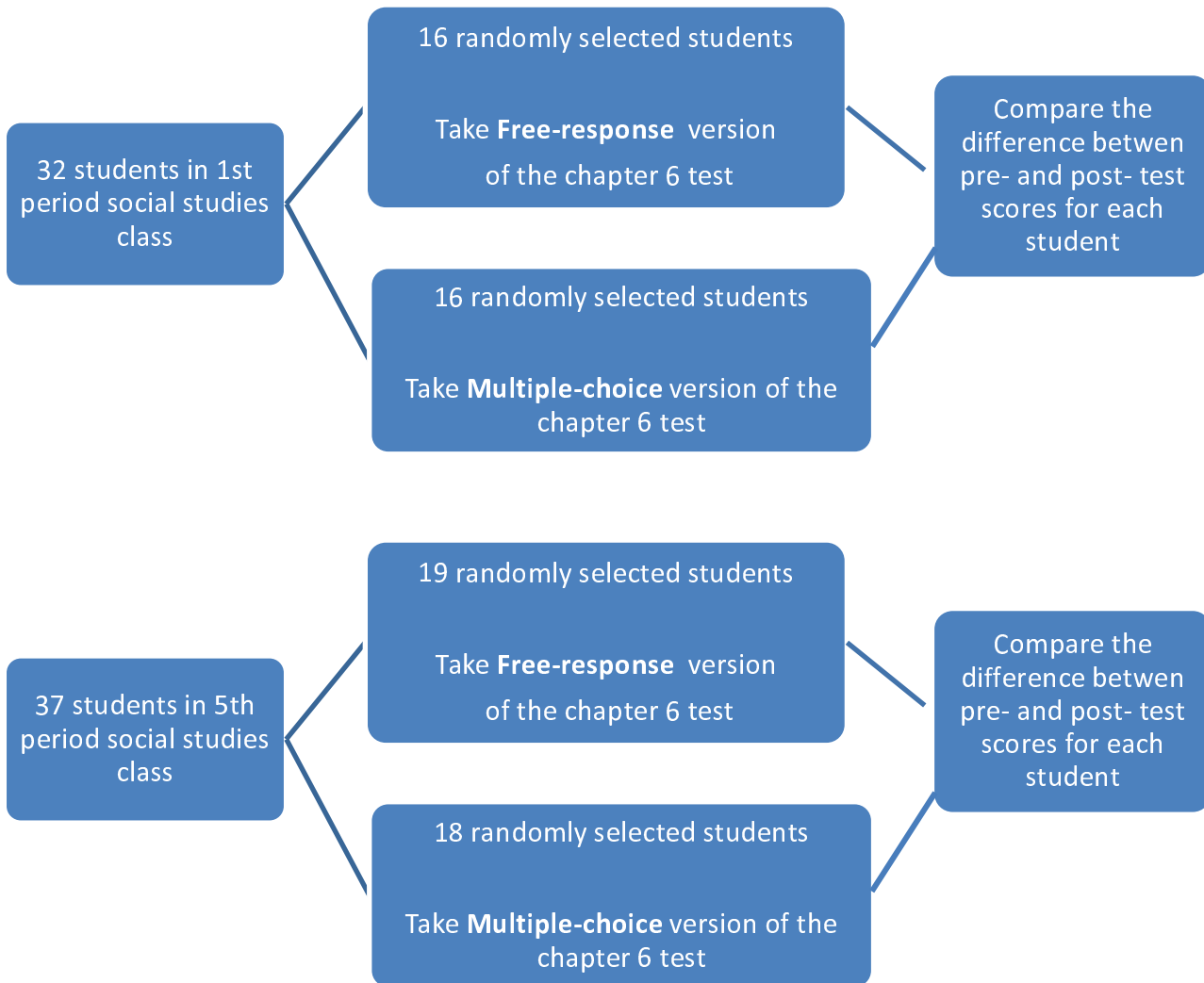
Section 4.6 Review

- 1) Show your teacher your flashcards. Students will each make own flashcards to study terms.
- 2)
 - a) She is saying that it is biased because she always gets lower than she should.
 - b) She is saying that it is not valid because it doesn't really test whether or not someone is ready for college.
 - c) He is saying that they are not reliable because he got such different scores.
- 3) University of Coolness
 - a)
 - Assign numbers 0001 to 4700 to the list of all females on campus
 - Use a random digit table starting on line #137
 - Look at 4-digits at a time
 - Ignore 4701 to 9999, 0000, and any repeats
 - Stop when 350 are selected
 - b) The women with the following numbers will be the first 5 selected:
#1261, #4214, #1260, #4592, #1689,
- 4) U of C continued
 - a) All women on the University of Coolness campus
 - b) The proportion of these women who "*did not feel safe walking on campus after dark*"
 - c) The 350 women on campus who were surveyed
 - d) $\hat{p} = \frac{74}{350} = 0.2114$
 - e) $m. e. = \pm \frac{1}{\sqrt{350}} = \pm 0.0535$
 - f) 0.1579 to 0.2649 or (15.79% to 26.49%)
 - g) "*We are 95% confident that the true percent of women on the University of Coolness campus who "did not feel safe walking on campus after dark" is between 15.79% and 26.49%.*"
- 5) Free-response vs. Multiple-choice
 - a) 32 social studies student sin 1st hour and 37 social studies students in 5th hour
 - b) Free-response test and Multiple-choice test
 - c) Any change in students' chapter 6 test scores
 - d) It would be difficult to make this blind because the students will see the test they are taking. Perhaps it could be blind if the students do not realize that others are taking a different type of test. Double-blind would be difficult because the teacher will see the tests and will need to grade them. There is no reason to have a placebo—what is a fake test?

*It would be a good idea to give a pre-test to each student in order to determine how much each student learns.

*Another valid experiment would be to have each student take both versions of the chapter 6 test, in a random order, and to compare which they scored higher on.

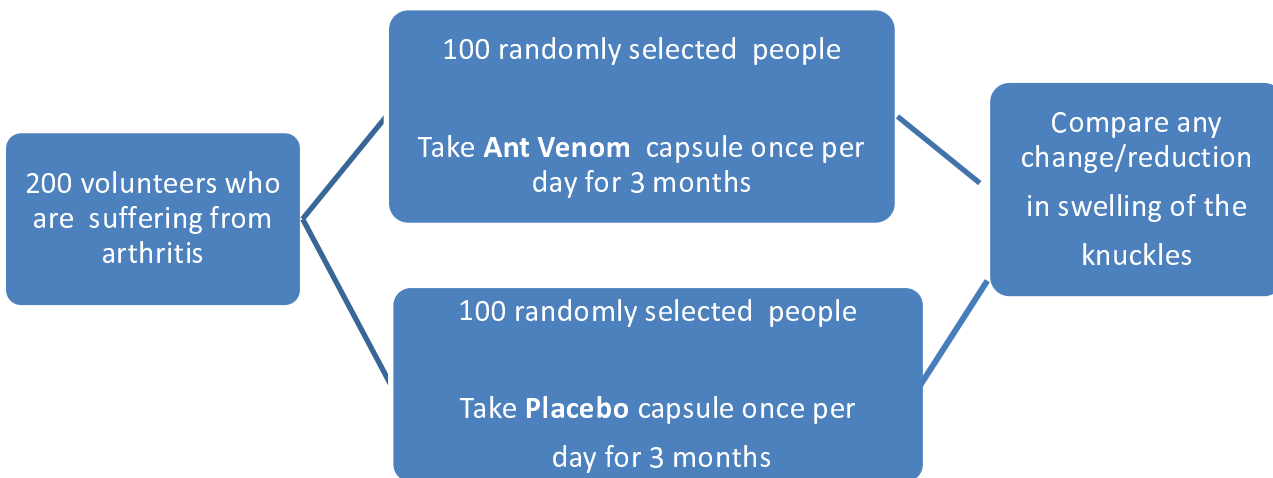
e) Outline



6) Child care centers

- a) Observational study
- b) Sample Survey
- c) Census
- d) Experiment

- 7) Child care continued.
- What might go wrong? Answers will vary. Here are some possible answers:
 - Children may act differently when being observed. Many behaviors may go un-noticed. Someone may be having an 'off day'.
 - Response bias. Parents are likely to give inaccurate information. This could be due to lying to make their children or themselves look better, not remembering all behaviors, being busy and not knowing their children very well.
 - Same as 'b'.
 - This could be considered un-ethical because the researchers are intentionally irritating small children.
 - Answers will vary. The observational study or experiment are probably most likely to return the best results.
- 8) Ant venom
- 200 people suffering from arthritis
 - The ant venom capsules
 - Any change/reduction in swelling of knuckles
 - This experiment should have a placebo control group and should be double-blind. Neither the researchers nor the subjects will know who is receiving the placebo and who is receiving the ant venom.
 - Outline



- 9) This is an experiment because she did something different. The treatment imposed is the chocolate given before the test. It is not a good experiment because it does not have any random assignment.

10) $\frac{\text{amount of discount}}{\text{original}} \times 100 = \text{percent of discount}$

$$\frac{7}{30} = 0.2333 = 23.3\% \text{ discount}$$

11) Cost of gas

- a) \$2.30 increase
- b) 158.6% increase

12) Graduations

School	Number of Seniors	Number graduating	Graduation rate %
McArthur	423	354	83.7%
Meade	125	110	88.0%
Eisenhower	392	379	96.7%

- a) Eisenhower has the most graduating, McArthur is second, and Meade has the least
- b) See table
- c) Eisenhower has the highest rate, Meade is second, and McArthur is lowest

13) Sampling methods

- a) Systematic random sample
- b) Random cluster sample
- c) Stratified random sample
- d) Random cluster sample
- e) Voluntary response sample
- f) Convenience sample
- g) Stratified random sample
- h) Multi-stage random sample
- i) Convenience sample
- j) Simple random sample (SRS)

14) Answers will vary. This will yield extremely biased results. One problem is under-coverage, because he left out most of the tax paying community. He only asked people who have a stake in the athletic program (parents of athletes and coaches). Another problem is that he used a bad sampling method-there is nothing random about how he made his selections, and the sample chosen will certainly not represent the entire population of this community.

15) Pro wrestling. Possible problems/bias:

- a) Voluntary response & under-coverage - people who visit WWE website
- b) Non-response - due to the time of day people may not answer
- c) Response bias - people do not give truthful answers
- d) Wording of this question - could be leading
- e) Processing error - results lost and not included in final statistics
- f) Random sampling error most likely - slightly different results
- g) Voluntary response & under-coverage - people who went to a pro wrestling event