Unit 3 worksheet #1

Name Key (2016)
Hour_____

1. For each of the following identify the population, sample, and variable(s) measured.
(a) A furniture maker buys wood in large lots. They choose five pieces of wood from each lot and test their moisture content. If any piece exceeds 12% moisture, the lot is sent back.

Sample 5 pieces of wood from each lot

Population all pieces of wood from each lot

Variable(s) moisture level

(b) A business school researcher wants to know what factors affect the survival and success of restaurants. She selects a sample 150 restaurants listed in the yellow pages of a large city and asks how much money they spent on advertising in the past year.

Sample_____

Population_____

Variable(s)_____

(c) When a truckload of apples arrives at the juice production plant three buckets of apples are selected. These apples are inspected carefully. Based on the inspection results, the entire truckload is accepted or rejected.

Sample 3 buckets of apples from truck

Population all apples from truck

Variable(s) • color of apples
- ripeness
- taste
- bug damage?
- bruising?

} possibilities

2. You and your friends want to find out which is the "coolest" car at Anoka High School.

(a) What are the individuals?

cars

(b) Name at least 3 quantitative variables you could record.

1) gas mileage 2) _____ 3) _____

(c) Name at least 3 qualitative variables you could record.

1) leather or cloth interior 2) _____ 3) _____

(d) Would you use an observational study or an experiment to collect the data? Explain.

this is your opinion — pick one and explain how

3. Does the color red make bees angry? To test this, half of the class is selected (drawing names from a hat) to wear red clothes and the other half to wear white clothes. Then, bees are turned loose in the classroom and the number of times each student is stung is recorded.

(a) Is this an observational study or an experiment? Why?

We intentionally try to cause reaction, treatment = shirt color

(b) What variable(s) are recorded?

- shirt color
- # of bee stings

(c) If students wearing red clothes are stung much more often than students wearing white, can we conclude that the color red causes bees to get angry? Why or why not?

Experiments are needed to show "cause", but I think this experiment needs to be redesigned to believe results show cause of bee anger.

4. Does Caribou sell more hot chocolate or chai tea? To answer this question, daily receipts were gathered for one week in October.

a) Is this an observational study or an experiment? Why?

(b) What variable(s) are recorded?

Unit 3 worksheet #2

Name Key (2016)
Hour

1. You can measure your distance from a lightning flash by counting the number of seconds between the flash and the thunderclap. Divide your time by 5, and you have the approximate distance in miles.

(a) Is this a *valid* way to measure the distance to the lightning strike? Explain.

(b) Is this a *reliable* way to measure the distance to the lightning strike? Explain.

(c) Is this an *accurate* way to measure the distance to the lightning strike? Explain.

2. A tape measure will be used to measure the height of the students in statistics. Each student's grade will then be based on their height. The shorter you are, the better your grade.

(a) Is this a *valid* way to assign a statistics grade? Explain. No! Your height has nothing to do with achievement in stats

appropriate? reasonable?

(b) Is this a *reliable* way to assign a statistics grade? Explain. Yes, if repeatedly assigning grades to 5' tall students, for ex., would always give same grade.

consistent results?

(c) Is this a *biased* way to assign a statistics grade? Explain.

one-sided?

No. Some students would get higher grade then earned, some lower, some correct.

3. The age of a pine tree was measured 5 times using a new electronic probe. The measured values were 43, 40, 45, 44, and 41 years old. Later the tree was cut down and found that it was really 34 years old. Does this new probe have a greater problem with *bias* or *unreliability*? Explain.

4. Some companies used to give IQ tests to all job applicants. This is now illegal because IQ is not related to job performance. Was the policy changed because of the *bias,* the lack of *reliability*, or the lack of *validity* for using IQ tests as a measure of job performance? Explain.

IQ tests are not an appropriate/reasonable way to measure job performance.

5. *Money* magazine ranks cities in the U.S. for the best places to live. In 1997, first place went to Nashua, New Hampshire. In 1996, Nashua was ranked 42nd and in 1995 it was ranked 19th. Are these facts evidence that *Money*'s ratings are *invalid, biased,* or *unreliable*? Explain.

6. Apgar scores are a measurement of an infant's overall health taken a few minutes after birth. The score ranges from 0 to 10 based on heart and breathing rate, muscle tone, and other criteria.

(a) Here are three criticisms about why the Apgar score isn't a perfect measurement. Match each criticism with its greatest measurement concern.

III reliability — I: Many important issues of health that are not measured by this score.

I validity — II: Doctors may give low values to babies because their births were difficult.

II bias — III: Different doctors may give different Apgar scores for the same baby.

(b) If several doctors judge the same baby and average their score will this

- improve the *validity*? no
- improve the *reliability*? yes
- reduce the *bias*? maybe, a bit

↳ Many doctors averaging their scores will not change validity (still missing important issues), may help make a bit less biased, but mainly helps make more consistent results.

7. A teacher wonders if a new English curriculum will increase the creativity of students in writing poetry. A sample of each student's poetry is given to a panel of five experts who rate the creativity of the poem. Match each statement below with the measurement issue it addresses.

_____ reliability — I: The five experts seemed to rate each student nearly the same each time.

_____validity — II. The experts tended give high ratings to students with neat handwriting.

_____bias — III: A critic argued that the ratings were a poor way to measure creativity.

8. You want to measure the "effectiveness" of teachers at your high school.

(a) Give an example of a clearly *invalid* way to measure good teaching.

(b) Describe a method that you think is *valid* to measure good teaching.

Unit 3 worksheet #3

Name Key (2016)
Hour

1. Which statements are true about a table of random digits and which are false? Explain.

(a) There are exactly four 0s in each row of 40 digits. False, there are only 3 in 1st row. Expect each row to be approx. 4 out of 40 zeros.

(b) Each pair of digits has a 1/100 chance of being 00.

(c) The digits 0000 can never appear as a group, because it is not random. False, because random any 4 digit combination can occur.

2. You want to choose an SRS of 25 of a city's 440 voting precincts for a survey.

(a) How will you label the 440 precincts?

(b) Use Table A at line 111 to select the first four precincts.

3. Use Table A at line 122 to select an SRS of 3 of the following volunteers for a drug test. Show your steps.

01 Andrews	04 Brockman	07 Fuhrmann	10 Hixon	(13 Moser)	16 Petrucelli	19 Smith
02 Baer	(05 Chen)	08 Garcia	11 Lee	14 Musselman	17 Reda	20 Sundheim
03 Berger	06 Frank	09 Healy	12 Lynch	(15 Pavnica)	18 Roberts	21 Wilson

line 122: (13) 87 38 (15) 98 95 (05) 29

4. You are asked to select 100 students from AHS which has 2,600 students. Use Table A at line 133 to select the first three students. Show your steps.

5. A student stands in front of the cafeteria before school, now and then stopping other students to ask them questions. Explain why this sampling method is **not** random.

6. In 1997, the WBNS evening news ran the story of a plan to build a light rail system financed by an increase in the sales tax. After the story, the news anchor invited viewers to register their opinions by calling one of two "900" phone numbers. The results of this survey were reported on the Thursday night broadcast.

(a) What sampling method was used? Voluntary Response (call-in)

(b) Tell why the results are likely to be biased. Which direction do you think this bias will to go?

People that feel negatively are more likely to respond. Results will be skewed toward not increasing tax.

7. A student wants to know how fellow students feel about the parking fees at Anoka. She decides to stand at the entrance of the free lot and survey students as they drive in.

(a) What sampling method was used?

(b) Do you feel that the results of this survey will accurately represent all students' opinions? Explain.

8. The Public Library wants to estimate the percent of households with an adult who had read at least one book in the last month. The homes of 400 people who have library cards are sampled, and it turns out that 90% have an adult who said "yes." Explain why this sample is likely to be a biased estimate for the true percent.

Sample is only made up of library card holders - not general population. This group is more likely to read more books than general population.

9. Choosing at random is not always a good idea because sometimes we don't want to treat everyone the same. In each of the following, would you support or oppose choosing randomly? Explain your choice.

these are your opinion answer + explain

(a) 7000 students want tickets to the basketball game in an arena that has 4,000.

(b) The list of people who need liver transplants is larger than the number of available livers.

(c) During the Vietnam War young men were chosen for army service at random, by a "draft."

Unit 3 worksheet #4

Name Key (2016)

Hour

1. State whether each underlined number is a *parameter* or a *statistic.*

(a) Bottles of ketchup filled at a plant were supposed to contain an average of 14 ounces of ketchup. Quality control inspectors samples 50 bottles at random and are found to contain an average of 13.8 ounces.

14: parameter - about all the bottles

13.8: statistic - about a sample of 50 bottles

(b) On a flight 8% of the 125 passengers were selected for random security screening prior to boarding. According to the Transportation Security Administration, 10% of airline passengers are chosen for random screening.

8%: _____

10%: _____

2. A random sample of 2,200 adults is taken in Chicago (population 2,900,000) to determine the percent of voters who support a new crime bill passed by Congress. A second survey is given in Dayton, Ohio (population 166,000) also using a sample size of 2,200. Will the Dayton sample provide a larger, smaller, or same size margin of error as the Chicago sample?

Chicago MOE:

Dayton MOE:

3. The Gallup Poll asked a random sample of 1493 teens aged 13 to 18 years, "Are you afraid to be home alone at night because of crime?" Of the sample, 672 said "Yes." Make a 95% confidence statement about the percent of all teens who fear being home alone.

sample 1493 teens (aged 13 to 18)

population all teens

statistic $\frac{672}{1493} \cdot 100 = 45.0\%$ of the sample afraid to be alone.

parameter % of population afraid to be home alone.

MOE $\frac{1}{\sqrt{1493}} \cdot 100 = 2.6\%$

confidence interval $45 - 2.6 = 42.4\%$ $\quad 45 + 2.6 = 47.6\%$

confidence statement I am 95% confident that 42.4 to 47.6% of all teens are afraid to be home alone b/c of crime.

Unit 3 worksheet #5

Name Key (2013) Hour_____

1. A local high school found that they did not have enough seats for all the family members who wished to attend the previous year's graduation ceremony. The administrators decide to send out a questionnaire to each of the 543 senior's families. They ask for the surveys to be completed and returned within a week. Of the 148 surveys returned, the average number of seats desired is 6.2. To be safe, the administrators decide to rent a hall that is big enough to allow 7 people from each family to attend this year.

a. What is the sample? 148 senior families

b. What is the population? all (543) senior families

c. What is the statistic? ave = 6.2 seats for 148 senior families

d. What is the parameter? ave # seats for all (543) senior families

e. What sampling method was used? voluntary response survey

f. Identify (two) types of errors might occur using this method and describe how they might occur.

lying - people may say more seats than they really need
nonresponse - many may not return survey
bias - maybe just large families return survey
processing error - maybe some mistake made in calculating ave,
wording error - survey could have been confusing, people weren't sure how to respond

2. Suppose that a survey is to be conducted at Anoka High School. For each of the following identify the sampling method used and comment on any potential errors that may occur.

a. Every freshman's name is put on a slip of paper and put into a giant bucket. Sixty names are pulled out of the hat. This process is repeated for each grade level.

Simple Random Sample - random sampling error could occur

b. Surveys are handed out with lunches. Students are asked to complete them and turn them in on a table in the front of the cafeteria.

c. Twelve teachers volunteer to survey the students in all of their classes.

d. A computer randomly selects 240 names from the list of all students in the school.

3. Researchers have conjectured that the use of the words "forbid" and "allow" can affect people's responses to survey questions. Students in an introductory statistics class were randomly assigned to answer one of the following questions:

people often say yes to this word

I. Should your college allow speeches on campus that might incite violence?

II. Should your college forbid speeches on campus that might incite violence?

↓ people often say no to this word

The results:

One of the questions above resulted in 73% allow/27% forbid and the other 86% allow/ 14% forbid. Which question do you think resulted in 86%/14%? Why?

II. people feel strongly about not forbidding their rights

4. Two similar opinion poll questions are shown below.

I. Do you favor or oppose sending additional troops to Iraq?

II. Do you support our President's decision to send additional troops to Iraq?

The results:

The response to one question found 58% supported sending more troops and the other found only 43% supported sending more troops. Which question do you think resulted in the 58%? Why?

5. A university has 2000 male and 500 female faculty members. The employment office wants to poll the opinions of a random sample of faculty members. They decide to choose a *stratified random sample* of 200 males and 200 females.

a. Assign labels for the males.

b. Assign labels for the females?

} make sure to assign a # for all 2000 males and all 500 females!

c. Starting at line 122 of the random number table, choose the first three males.

d. Starting at line 104 of the random number table, choose the first three females.

. In your opinion, do you feel that choosing 200 of each is fair? Can you suggest a better way?

Unit 3 worksheet #6

Name Key (2016)

Hour

1. Circle the explanatory variable and underline the response variable.

(a) The amount of yearly rainfall (explains) and the bushels of crop harvested (responds).

(b) The number of car accidents and the amount of snowfall.

(c) The weight (responds) and height (explains) of a person.

(d) A student's scores on the SAT math exam and the SAT verbal exam.

(e) A family income and the years of education their eldest child completes.

2. Researchers recently investigated whether calcium and vitamin D can help the elderly avoid broken bones. They randomly divided 389 subjects aged 65 or older into two groups. One group took pills containing calcium and vitamin D each day. The second group took pills each day that looked and tasted the same, but contained only inactive ingredients. Over the next three years it turned out that 6% of the group taking the calcium and vitamin D had broken bones compared to 13% in the second group.

(a) Is this an experiment? Why or why not?

Yes, because purposely causing a reaction. Treatment = Calcium & Vit. D

(b) Explain *why* the second group took pills containing no active ingredients.

To cause the "placebo effect" - psychological benefit of thinking you're getting real treatment

(c) Could this study have been carried out in a double-blind manner? How?

Yes, the patients and the doctors overseeing their care could be kept from knowing which treatment given.

(d) Do you think that the results were statistically significant? Why or why not?

Sample size: 389

Results: treatment = 6%, placebo = 13%

Although large difference between treatment & placebo groups, I feel sample size too small to be "statistically significant"

3. A report in the April 26, 2001 *New England Journal of Medicine* studied a new treatment for children with a severe anxiety disorder. The study conducted with 2500 children was a randomized and double-blind. Data from the study showed that 76% of the children treated with the new drug had a reduced anxiety level. Of the children given a placebo, 29% had a reduced anxiety level.

(a) Explain the meaning of the word "placebo" in the above description.

(b) Explain what is meant by "double-blind" in the above description.

(c) Why was it important to make this experiment double-blind?

(d) Do you think the results were statistically significant? Why or why not?

Unit 3 Review Name Key (2016)

Hour_____

1. Scotland is considering independence from England. An opinion poll showed that 51% of Scots favor "independence." Another poll taken at the same time showed that only 34% favored being "separate" from England. These results differ by so much because
(a) samples will usually differ just by chance due to random sampling.
(b) the wording of questions has a big effect on poll results.
(c) more follow-up efforts reduced the nonresponse rate of the second poll.
(d) the sample sizes are different, so the margins of error are different.

2. Suppose that many of the households asked their income by the Census Bureau give an answer that is too low because they fear that their answer will go to the IRS.
(a) This is a lying error that causes bias.
(b) This is a lying error that increases variability.
(c) This is a processing error that causes bias.
(d) This is a processing error that increases variability.

3. Gallup conducts its polls by telephone, so people without phones are always excluded from the Gallup sample. Any errors in the final result due to excluding people without phones
(a) are included in Gallup's announced margin of error.
(b) are in addition to the announced margin of error.
(c) can be ignored, because these people are not part of the population.
(d) can be ignored, because this is a nonsampling error.

MOE → only for "random sampling error"

4. Your statistics class has 30 students. You want to call an SRS of 5 students from your class to ask where they use a computer for the online exercises. You label the students 01, 02, . . . , 30. You enter the table of random digits at this line: 14459 26056 80315 50310 22532 24906 11815

14, 03, 10, 22, 06

(a) 14, 45, 92, 60, 56
(b) 14, 31, 03, 10, 22
(c) 14, 03, 10, 22, 22
(d) 14, 03, 10, 22, 06
(e) 14, 03, 10, 22, 11

5. You take an SRS of size 500 from the 37,000 students at Purdue University. You then take an SRS of size 500 from the 4,400,000 adults in the state of Indiana. The margin of error in a 95% confidence statement for the Indiana sample is
(a) about the same as for the Purdue sample because both are samples of size 500.
(b) smaller than for the Purdue sample because the population is much larger.
(c) larger than for the Purdue sample because the population is much larger.
(d) either larger or smaller than for the Purdue sample because it changes at random when we take a sample.

MOE for both = $\frac{1}{\sqrt{500}} \cdot 100$

6. A Census Bureau report on the income of Americans says that with 95% confidence the median income of all U.S. households in 1997 was $37,005 with a margin of error of ± $342. This means that
(a) 95% of all households had incomes in the range $37,005 ± $342.
(b) we can be sure that the median income for all households lies in the range $37,005 ± $342.
(c) 95% of the households in the sample interviewed had incomes in the range $37,005 ± $342.
(d) the Census Bureau got the result $37,005 ± $342 using a method that will cover the true median income 95% of the time when used repeatedly.

7. We divide our school into two groups: first year students and others. We then take random samples from each group. This is an example of
(a) simple random sampling.
(b) convenience sampling.
(c) voluntary response sampling.
(d) stratified random sampling.
(e) systematic random sampling.

<u>The next 4 questions refer to the following experiment:</u> Students in a large statistics class were randomly divided into two groups. The first group took the midterm exam with soft music playing in the background while the second group took the exam with no music playing. The scores of the two groups on the exam were compared.

8. In this experiment the response variable is
(a) the score on the midterm exam.
(b) whether or not music was playing during the exam.
(c) the placebo.
(d) the scores of the students on the final exam.
(e) a lurking variable.

9. In this experiment the explanatory variable is
(a) the score on the midterm exam.
(b) whether or not music was playing during the exam.
(c) the placebo.
(d) the scores of the students on the final exam.
(e) a lurking variable.

10. The study design for this experiment is called
(a) a simple random sample design.
(b) a randomized blocks design.
(c) a matched pairs design.
(d) a randomized comparative design.
(e) an observational study.

11. This experiment was not double-blind because
(a) students were allowed to keep their eyes open while taking the exam
(b) the exam was too long.
(c) the students knew whether or not music was playing while they were taking the exam.
(d) some of the students did not study for the exam.
(e) students were randomized into the two groups.

12. Two essential features of all statistically designed experiments are
(a) compare several treatments; use the double-blind method.
(b) compare several treatments; use chance to assign subjects to treatments.
(c) always have a placebo group; use the double-blind method.
(d) always use a large number of subjects; use the double-blind method.

13. Mrs. Boo wears a pedometer, a device that measures distance traveled, when she walks. The pedometer gives her distance in both number of steps and miles.
(a) Mr. Boo, who has a much longer stride than his wife, decides to use Mrs. Boo's pedometer one day. He is unaware that the pedometer has been set to his wife's stride length. Will this affect the validity, reliability, or bias of the measurement? Explain carefully.

Bias – pedometer will always give Mrs Boo's results which will be consistently shorter distances than Mr. Boo

(b) People do not always take the same length steps throughout the day (sometimes short steps, sometimes long steps). So, if a person is measuring their distance with a pedometer, will this issue affect the validity, reliability, or bias of the measurements? Explain.

Reliability – unpredictable results

14. Trucks are weighed on a Truck Scale to establish the amount owed in road taxes. Someone complains that the weighing procedure has three problems. Match each measurement problem with the correct description.

___III___ reliability — I: Sometimes the driver is sitting in the truck when it is weighed. — weighs too much

___II___ validity — II: When the legislature established the tax, they intended to tax according to the *value* of the goods being shipped. — weight doesn't measure value

___I___ bias — III: When the same truck is weighed more than once, the truck scale will give different values. – inconsistent

15. A pollster draws 1500 high school students' names from a hat and asks them about their favorite school subject. In all, 988 say it is "Math" (of course!).

Method of data collection Simple Random Sample

Sample 1500 High School Students

Population All U.S. Students

Statistic $\frac{988}{1500} \cdot 100 = 65.9\%$ of the sample love Math

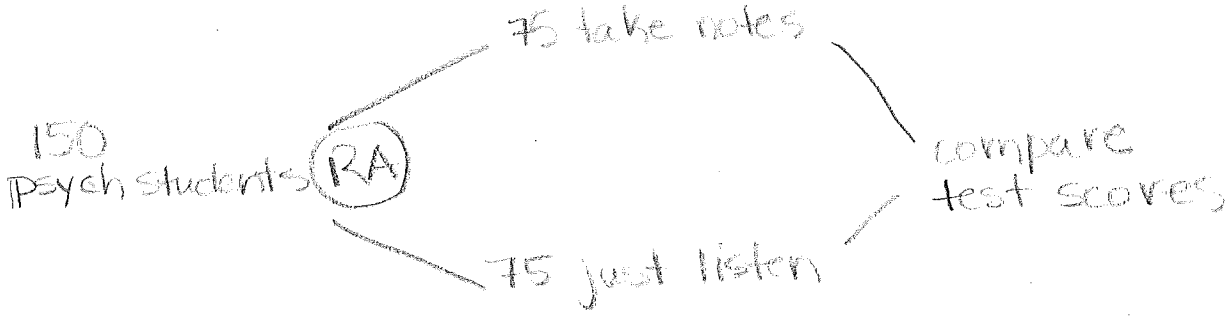
Parameter % of population that love math

Margin of error $= \frac{1}{\sqrt{1500}} \cdot 100 = 2.6\%$

Confidence interval $65.9 - 2.6 = 63.3\%$ $65.9 + 2.6 = 68.5\%$

Confidence statement I am 95% confident that between 63.3 and 68.5% of all U.S. students favorite subject is Math!

16. A psychology professor wants to know if students perform better in class if they take notes during lectures versus just listening. She recruits 150 student volunteers from her class to take part in this study and gives them all the same test at the conclusion. Make a diagram for the design of a completely randomized experiment for this study.



17. Researchers want to test a new eye drop against Blink Brand Eye Drops to see if it is better at reducing dry eye symptoms for contact wearers. The researchers are also interested in whether males and females will respond differently. The subjects available are 480 male and 502 female contact wearers who suffer from frequent dry eyes.