Unit 3 Answer Key

3.1 Answers

1)
   a. This is an observational study – they observed the students amount of sleep, caffeine consumption, etc. They did not control any variables or apply treatments.
   b. Since this is an observational study, we cannot conclude causation – only that the observed data correlates.

2) Assign a number to each name on the petition, 0001 to 8000. Use a random number table to generate 40 numbers in this range and check the randomly selected 40 individuals' signatures. (note: you could also describe the process with slips of paper or with a random number generator)

3)
   a. Cluster sampling (the religious studies classes are the pre-existing heterogeneous clusters)
   b. Convenience sample
   c. Stratified sample (the strata are faculty, staff, and students, three non-overlapping homogeneous groups)
   d. To obtain a sample of the people attending the Bruce-Mahoney basketball game, a researcher selects the 15^{th} person through the door and then every 20^{th} person after that is included in the sample. Systematic sample (selecting one individual and then systematically selecting every k^{th} person past that individual)
   e. Simple random sample

4)
   a) What concerns, if any, do you have about generalizing these results to all people on social media? Since the group is all volunteers and not a simple random sample, it is not necessarily representative of the population, so you cannot generalize to the population.
   b) You could get lists of users on social media platforms and randomly select users of social media platforms and then collect and analyze the data as you did with the volunteers.

5) No, this is not a simple random sample – the group volunteered and it was only Californians, so it could not be generalized to the rest of the United States. (For example, mercury is often found in fish, and if Californians, being from a coastal state consume more fish than individuals in other states, the data would not likely generalize to the rest of the U.S.)

6) Since the two surveys were asked to different groups (online vs. telephone), it is possible that there is ***undercoverage*** (see the next section) in either or both studies – that is the telephone survey may have gotten more older respondents, while the online survey might have gotten more younger respondents.

3.2 Answers

1) The second will more likely predict the outcome of the election, because you are asking specifically about the candidate, rather than simply party affiliation. There is the potential for bias in both questions, but likely more bias in just naming political parties – a person polled who might not know or be interested in particular candidates might have a loyalty to a political party, but if the survey is trying to find which candidate has more support (rather than which party) you should ask the question about the candidate. Not mentioning the party affiliation of the candidates when you name them has the potential for bias as well, because some people may be more likely to vote for a candidate if they know the party affiliation – without affiliation, they might decline to answer.

2)

a. Non-response bias
b. Self-reporting bias
c. Non-random sampling bias3
d. Non-random sampling bias and self-reporting bias
e. Undercoverage bias (many registered voters may not have a home phone)

3)

a. No, because there is undercoverage bias – he has selected from groups that do not represent the entire student athlete population.
b. A stratified sample might be better, but it may be problematic, because you might not have truly homogenous, non-overlapping groups (one student could play multiple sports and be asked to answer the survey multiple times) so a simple random sample is likely the best option.

3.3 Answers

1)

(a) Assign each student a number from 01 to 24, and then use a random digit table to generate two digit numbers. Select the first twelve distinct values in this range that the table generates and use those 12 students as one group, and the remaining 12 are in the other group.
(b) Students self-selecting may choose a group based on a preference for that style, and their enthusiasm for the type of instructional program could bias the results. For example, if the students who chose dissection are very interested in the physical interaction, this enthusiasm could translate to working harder on the assignment which could bias the posttest results. A similar thing could occur with students who choose the computer simulation.

2)

(a) Write each patient's number on identical slips of paper, place the papers into a container, mix thoroughly, and select 10 slips without replacement. These patients will be administered the beta-blocker, and the remaining 10 will be in the control group. The 10 in the control group should be given a placebo, and the experiment should be double-blinded.

(b)

96746 12149 37823 71868 18442 35119 62103 39244 96927 19931
36809 74192 77567 88741 48409 41903 43909 99477 25330 64359
40085 16925 85117 36071 15689 14227 06565 14374 13352 49367
81982 87209 36759 58984 68288 22913 18638 54303 00795 08727

Label the patients 01 to 20, pick two digits at a time, ignoring repeated values and 21 – 99 and 00, and stop after 10 distinct patients are selected. They will go into the beta-blocker group, and the remainder will be in the placebo group.

Beta-Blocker group: 18, 19, 10, 03, 06, 08, 11, 15,13, 09

Placebo group: 01, 02, 04, 05, 07, 12, 14, 16, 17, 20

3)

(a) Assign each person in the study a number from 1 to 10, write the numbers on identical slips of paper, place in a container, mix thoroughly and select 5 numbers without replacement. Those 5 individuals squeeze the scale with their right hands, and the remaining 5 squeeze the scale with the left hand. Record the data and compare the results.

(b) Yes, there is potential that one group or the other may contain stronger individuals (a single-subject matched pairs design might be better for this experiment).

(c)

55588 99404 70708 41098 43563 56934 48394 51719

Assign the participants numbers 0 to 9, select the first five unique values on the table – those individuals will squeeze with their right hand, and the rest will squeeze with the left. Read the measurements and compare the results. (5,8,9,4, and 0 will be in the right-hand squeezing group, the remaining individuals will be in the left-hand squeezing group).

4)

Assign each plot of land a number, 1 through 20, and write the numbers on identical slips of paper, mix thoroughly in a container, and select ten slips of paper one at a time without replacement. These ten plots of land will receive the new fertilizer; the remaining plots will receive the old fertilizer. Record the number of bushels harvested at the end of the growing season and compare the results. Explanatory Variable: Fertilizer, Response Variable: number of bushels harvested. Land fertility could be confounding. It is possible that some of the plots of land have more fertile soil, and this could affect the number of bushels harvested. (Note that this experiment could be done as a single blind experiment.)

5)

This is now a matched pairs experiment, not a completely randomized experiment. This experiment controls the possible confounding variable of land fertility since we are using both fertilizers on each subplot. The current fertilizer is acting as a control group, and this will give us a base line against which we can compare the new fertilizer.

6)

Use a matched-pairs design, where you match a worker's left hand with their right hand. Assign each worker a pair of gloves, and flip a coin for each worker. If the coin is heads, the new glove is on the right hand and the current glove is on the left hand. If the coin is tails, the current glove is on the right hand and the new glove is on the left hand. Record the heat resistance over the four-month period, and compare the results. The experiment can be double-blinded if the gloves are identical in appearance. If they are, then you can conceal the type of glove on each hand from both the worker and the experimenter.

7)

Separate the classes into two blocks – day classes and evening classes. You will have two treatments and a control for each group: Treatment 1 is to tell the class "females perform better than males in statistics", Treatment 2 is to tell the class "males perform better than females in statistics", and the control is to not tell the class anything about gender and performance. For the daytime classes, assign each class a number from 1 to 9, write the numbers on identical slips of paper, mix thoroughly, and draw six numbers, one at a time, without replacement. The first 3 drawn will receive treatment 1, the second 3 will receive treatment 2, and the 3 remaining will be in the control group. For the evening classes, assign each class a number from 1 to 6, write the numbers on identical slips of paper, mix thoroughly, and draw four numbers, one at a time, without replacement. The first 2 drawn will receive treatment 1, the second 2 will receive treatment 2, and the 3 remaining will be in the control group. Collect the data on the performance of students in each class over the semester and compare the results.

3.4 Answers

1)

a. No we cannot, because the results were **not** statistically significant.
b. We could conclude the new paint actually does wear less in ice and sleet environments, but we cannot make any conclusions about wind and temperature resistance (because the results were **not** statistically significant).

2)

a. No we cannot, because it was a random sample of obese adults – this is not necessarily representative of the entire United States.
b. No we cannot, the placebo was our control group for comparison. The placebo group being

3) **Multiple Choice:** Researchers for a pharmaceutical company want to use a well-designed experiment to test the effectiveness of a new anti-viral versus a placebo in preventing severe flu symptoms. Which of the following will provide evidence that the new anti-viral prevents severe flu symptoms?

(a) The experiment cannot be used to show the new anti-viral causes the prevention severe flu symptoms, only that it is correlated to the prevention of severe symptoms.
(b) The experiment cannot be used to show the new anti-viral causes prevention of severe flu symptoms because the new anti-viral is not being compared to an older anti-viral.
(c) Any difference between the responses to the new anti-viral and the placebo provides evidence that the new anti-viral is effective at causing the prevention of severe flu symptoms.
(d) Prevention of severe symptoms would need to occur in all subjects who take the new anti-viral and in none of the subjects who take the placebo to provide evidence that the new anti-viral causes the prevention of severe symptoms.
(e) The difference between the responses to the new anti-viral and the placebo must be shown to be statistically significant to provide evidence that the new anti-viral causes the prevention of symptoms.