Problem set 1

Online S520

**Upload your answers through the Assignments tab on Canvas**

1. (5 points) For each of the following scientific questions, state whether the question is best answered using a randomized experiment or an observational study, and briefly explain why.
   1. Does the flu vaccine prevent the flu?
      * **Randomized.** Since we’re studying cause-and-effect, randomization would be the best option.
   2. Has support for same-sex marriage increased over time?

* **Observational**. This is a survey-type experiment. We can control for bias, but cannot assign members to control or experiment groups.
  1. Does banning laptops in class improve exam scores?
* **Randomized**. The experiment could test the hypothesis by controlling for laptop use or no laptop use, similar to the Lanarkshire Milk experiment.
  1. Are voters with college degrees more likely to support Hillary Clinton than voters without college degrees?
* **Observational**. Similar to the Dewey-Truman surveys conducted in 1948. We cannot control whether people are in a particular experiment group.
  1. Does bacon cause colorectal cancer?
* **Observational**. Normally since we’re studying cause and effect, a randomized study would be appropriate. However, since we can’t ask people to eat bacon in order to study cancer, we need an observational study.

1. (5 points) According to a study done at Kaiser Permanente in Walnut Creek, California, women who use oral contraceptives (“the pill”) have a higher rate of cervical cancer than women who do not use the pill, even after adjusting for age, education, and marital status.
   1. Was this study a blind randomized experiment or an observational study? **Blind** **Randomized**.
   2. Does the study prove that the pill causes cervical cancer? Explain why or why not. **This could indicate correlation, but almost certainly not causation. There are likely other variables contributing to use of the pill that can better explain cancer contraction rates. It could be that another group characteristic or habit of the women who use the pill is contributing more to the cancer rates than the use of the pill.**
   3. Besides age, education, and marital status, what other factor(s) related to cervical cancer are different (on average) between women who use the pill and women who don’t? **Income and related variables. Income largely drives lifestyle, including domicile type, geographic location, diet, etc., each of which could be important variables as well.**
2. (5 points) The Center for American Progress to study public attitudes toward sports teams that expressed opinions on issues that could be controversial, such as LGBT issues. One research question they were interested in was: “To what degree do people believe that professional sports teams should take public stances on social causes?”

In general, respondents either “somewhat agreed” (33.2 percent) or “strongly agreed” (19.3 percent) that “professional sports teams should utilize their platforms to advocate for causes they believe in.” One in three respondents (30 percent) stated they were neutral on this issue or had “no opinion.” Among respondents who identified as men, 46.5 percent either “somewhat agreed” or “strongly agreed” that sports teams should use their platforms to advocate for causes, while 33 percent had “no opinion.” Among respondents who identified as women, 60.4 percent either “somewhat agreed” or “strongly agreed” with that statement, with another 25.6 percent stating that they were neutral or had “no opinion.”

The study also gave the following information about their survey:

The results presented above are from a convenience sample of 367 respondents recruited using Amazon Mechanical Turk, an online platform that allows for the purposeful sampling of respondents who meet relevant criteria. This survey-hosting website has been shown to be an efficient platform for gathering reliable data from diverse populations. . . 44.1 percent of respondents were between the ages of 18 and 29, 38.3 percent were between the ages of 30 and 44, and 17.8 percent were above the age of 44. 10.4 percent of respondents identified as “strong Democrat,” 26.0 percent as “Democrat,” 16.7 percent as “independent-lean Democrat,” 18.9 percent as “independent,” 8.7 percent as “independent-lean Republican,” 10.4 percent as “Republican,” and 4.6 as “strong Republican.”

* 1. Was this survey a statistically unbiased answer to the question “To what degree do people believe that professional sports teams should take public stances on social causes?” If so, explain why; if not, describe and explain the likely direction of the bias. **Two variables – age and political identity seem to be most important here. The sample population is biased toward younger and Democratic populations (~80% below the age of 44, 53% identify as Democrat, 19% as independent, and only 23.7% as Republican). The biases could be attributed to the use of an online platform to carry out the survey.**
  2. Suppose an interested party gives you a reasonable budget to carry out a more rigorous study of the Center for American Progress’ research question. Describe briefly the study you would perform. **I would collect survey samples from various channels (phone, email, online, post) to ensure a representative sample of the entire population. I would control sampling to ensure that more people than those who watch sports and who are interested in social issues.**

1. (5 points) Trosset chapters 2.5 exercise 3.
   1. Ac = 2, 4, 6, 8, 10
   2. Bc = 4, 6, 7, 8, 10
   3. (A U B)c = 4, 6, 8, 10
   4. (A ∩ B)c = 2, 4, 6, 7, 8, 10
2. (5 points) I toss two fair coins: a penny and a quarter. The penny is tossed 10 times and the quarter is tossed 5 times.
   1. How many sequences of 15 tosses result in a total of exactly 6 heads?
      * **5,005**
   2. How many sequences of 15 tosses result in exactly 2 heads in 10 tosses of the penny and exactly 4 heads in 5 tosses of the quarter?
      * **1350**
3. (5 points) Trosset chapter 2.5 exercise 14, parts (a) to (e). Note: is defined in Trosset ch. 2.1 (pg 24).
4. φ: → defined by φ(x)=2x.
   1. 64
   2. 8
   3. 2R
   4. {-4, 4}
   5. {-.5, .5}
   6. {[-6, -1.414] U [1.414, 6]} (I don’t have Union symbol)