Part 1: Multiple Choice

1. B	5. C	9. B	13. A	17. B
2. B	6. B	10. A	14. A	18. C
3. C	7. A	11. C	15. D	19. A
4. A	8. A	12. B	16. D	20. C

Part 2: Short Answer

1. (a) The population is **all Hispanic residents** in Denver. The sample is the **200 people** at the selected addresses (at most one person per address).
(b) Sampling error arises because of **undercoverage**, usually the result of an inaccurate sampling frame. Here, there are many Hispanic residents in Denver that do not live in "predominantly Hispanic neighborhoods." These people are excluded. The sample chosen here may be an accurate representation of "predominantly Hispanic neighborhoods," but not all residents of Denver.
(c) Here are examples of **nonsampling errors**:

- Interviewer bias: The officer is Hispanic. S/he could intentionally or unintentionally bias the results by the way the questions are asked.
- Selected individuals could lie to the officer.
- Selected individuals could refuse to answer the questions (e.g., not even answer the door).
- Data entry errors on the officer's part; e.g., marking "Yes," when the resident answered "No."
- A household may not have Hispanic representation; this is a house sampled whose residents are ineligible to participate.

2. The **sample proportion** of American adults who believe the recent Women's March will be good for women around the world is

$$\widehat{p} = \frac{420}{1000} = 0.42 \text{ (or 42\%)}.$$

The margin of error of this sample proportion (assuming a 95% confidence level) is

$$\textbf{margin of error} = \frac{1}{\sqrt{1000}} \approx \frac{1}{31.62} \approx 0.03 \quad \text{(that is, about 3\%)}.$$

Here is the confidence statement:

- "We are 95 percent confident that <u>the proportion of American adults</u> who believe the recent Women's March will be good for women around the world is between 0.39 and 0.45 (i.e., between 39% and 45%)."

3. The topic discussed in the Singer paper was how biology was taught in high schools in Louisiana, in particular, evolution-based instruction and creationism-based instruction. The paper originated from a *New York Times* editorial that cited a PhD dissertation written on this topic. Unfortunately, the sample survey that formed the basis for the dissertation was plagued with sampling and nonsampling errors. Each of these points were mentioned by Dr. Singer:

- The author of the PhD dissertation was part of a Supreme Court case that argued in favor of evolution-based instruction. He is the one that did the survey of Louisiana teachers! **Interviewer bias!**
- The **response rate** among the teachers was only 50%. Huge nonsampling error (remember, this was supposed to be a census). The author of the PhD dissertation inflated this to make his "study" look more reliable.
- The questions on the survey given to teachers were **worded poorly**. Evolution was called a "theory;" creationism was not. Nonsampling error!
- Teachers were promised recent literature on evolution for returning their survey quickly. This biases their responses in favor of evolution.
- The editorial insinuated that 41% of high school biology teachers in Louisiana believed in teaching creationism. This was based on "cherry-picking" the results from biased questions. The number based on essentially the same questions (worded differently) was closer to 16%.

Of course, the *New York Times* editorial board ignored all of these errors, perhaps because it didn't fit with the theme of their argument.

Never believe anything you read or hear in the news! (That is, without thoroughly checking it yourself). Unfortunately, the media often publishes questionable statistics and doesn't reveal precisely where they come from. Singer's analysis calls into serious question the veracity of the PhD dissertation results. Because this dissertation was used to "bolster" the editorial's argument, the strength of the argument itself is greatly diminished.

4. (a) The margin of error is

$$\textbf{margin of error} = \frac{1}{\sqrt{2864}} \approx \frac{1}{53.52} \approx 0.02 \quad \text{(that is, about 2\%)}.$$

(b) I think two obvious choices are gender and race. Investigators might want to know, for example, "Does health care treatment availability depend on gender? Does it depend on the race of the patient?" Other choices are where the patient lives, financial status, whether a patient has dental insurance (and what type), level of education, etc.
(c) I don't think a randomized-response technique is needed here. There is nothing too

stigmatizing about admitting that you could not get dental treatment (and individuals with HIV might want investigators to know this truthfully). However, if investigators felt that this question was "too sensitive," they could use the randomized-response technique to encourage truthful responses.

5. (a) Patients should be assigned to the three treatment groups **at random**. Randomization could be carried out using R or using the Table of Random Digits (in the text). Provide each patient with a 2-digit code, for example, 01, 02, 03, ..., 90. You could then select 30 numbers randomly from this list (to form Group 1); another 30 numbers randomly (to form Group 2), and then the remaining numbers could be used to form Group 3.
(b) There are many to choose from: gender, severity of the condition, diet, overall health, weight, exercise frequency, etc. Any one of these could be associated with reflux conditions and hence could obscure the results. For example, heavier patients may respond better to one drug better than lighter patients.
(c) The response should be some measure of effectiveness of the drug; e.g., whether it decreased pain/discomfort level, amount of acid present, etc. Something that allows us to describe if the drug is "working."
(d) This means that the differences between the three drug groups are so large that they are likely not due to chance. It does **not** mean that the new drug is better−the new drug could do worse!