

## Chapter 1: Research Design, Measurement, and Analysis

### • Explanations of the answers for the chapter's self-test questions

1. The distinction between qualitative and quantitative research is more a matter of measurement than of design. True or False?

- *True. This is a main point made in the early pages of the chapter. While many researchers talk of qualitative and quantitative designs, I think this is to confuse design with coding and measurement. For example, surveys are often described as quantitative designs, but survey researchers can and often do collect qualitative data on open-ended questions. Students should be warned that this is an issue on which reasonable people disagree.*

2. Knowing the levels at which variables are measured is important because this influences the choice of the appropriate test statistics and measures of association to use in analyzing the variables. True or False?

- *True. See question 8, which covers the same subject.*

3. Measures of association are designed to indicate how likely a particular result is to be due to chance alone, that is, due to sampling error. True or False?

- *False. Tests of significance measure the likelihood of sampling error. It is very important for students to learn these distinctions early.*

4. According to new standards of practice in psychology and education, it is unnecessary for researchers to report statistical results beyond those that indicate whether the findings have reached the threshold of statistical significance. True or False?

- *False. Effect sizes, power, and confidence intervals are all but required by many, perhaps most, journals. Merely reporting significance levels is outdated.*

5. The null hypothesis is very often a statement that there is “no difference” between populations or groups. True or False?

- *True. While the null need not necessarily be the nil hypothesis, it usually is.*

6. Researchers usually hope to be able to disprove or reject their null hypothesis. True or False?

- *True. This is especially the case in experimental research, where researchers want to be able to reject the hypothesis of no difference between control and treatment groups.*

7. The purpose of statistical inference is to enable researchers to draw conclusions about samples based on knowledge of population parameters. True or False?

- *False. One draws conclusions about populations given data about samples.*

8. Knowing the levels at which your variables are measured is important because

- it determines the correct research design to use on your project
- it influences the choice of the appropriate statistical technique to use in analyzing your data
- if your data are non-parametric, then you know that you need to dispense with associational analyses and statistical tests
- of all of the above.

- *Answer = b. For example, one cannot correctly use a Pearson  $r$  unless the data are continuous. Or, one cannot correctly use a  $t$ -test unless the independent variable is categorical. Answer "a" is wrong because level of measurement has little to do with design. Answer "c" is wrong because there are non-parametric associational measures and statistical tests.*

9. If one of your results is "statistically significant" this means that
  - a. the  $p$ -value obtained using a statistical test of that result is larger than a conventional cutoff for significance
  - b. you would not likely have obtained a result this large by chance
  - c. the result is large and practically significant
  - d. all of the above are true.
    - *Answer = b. Answer "a" is incorrect because statistical significance is indicated by a  $p$ -value smaller than the cutoff. Answer "c" is wrong because statistical significance is not necessarily related to effect size or practical significance.*
  
10. Concerning Type I and Type II error, it is accurate to say
  - a. it is generally more important to avoid Type I error
  - b. it is generally more important to avoid Type II error
  - c. typically, reducing the probability of one increases the likelihood of the other
  - d. Type I error is the main concern of significance testing while Type II error is the focus of hypothesis testing.
    - *Answer = c. Answers "a" and "b" are incorrect because either type of error can be more important depending upon the circumstances; neither is generally more important. Answer "d" is incorrect because the distinction between Type I and Type II error has nothing to do with the (somewhat murky) distinction between significance and hypothesis testing.*
  
11. Concerning the null hypothesis, it is accurate to say that
  - a. significance and hypothesis testing imply a null hypothesis, even when one is not explicitly stated
  - b. it is often an hypothesis of no effect or no difference between groups
  - c. it is central to the process of making inferences from a sample to a population
  - d. all of the above are accurate.
    - *Answer = d; answers "a," "b," and "c" are all correct.*
  
12. Concerning the relation of research questions to research designs, it is accurate to say
  - a. for most research questions there is only one appropriate research design
  - b. if a question is not researchable, then only inferential techniques can be used
  - c. various designs can usually be applied to the same research question
  - d. if a design is non-parametric, it is not possible to apply the tools of statistical inference
  - e. all of the above are accurate.
    - *Answer = c. Answer "a" is incorrect because it is a rare problem, indeed, that can be investigated in only one way. Answer "b" is incorrect because if a question is not researchable, no techniques can be used. Answer "d" is incorrect because there are non-parametric methods of statistical inference.*

- **Additional discussion questions and exercises for students**

1. Are the following researchable questions? Explain why or why not. Should “intelligent design” (a.k.a. “creationism”) be taught in high school biology classes? Should it be taught in addition to standard Darwinian theory, instead of Darwinian theory, or not at all?

Find the U.S. District Court ruling in *Kitzmiller et al. versus Dover Area School District* (December 2005) and assess the arguments and evidence used in this case. Were the questions addressed in this case researchable?

2. What do biologists believe about the question of whether intelligent design should be taught in biology classes? What do most parents of school-aged children believe? What kind of research designs could you use to answer these questions?

3. Are the following researchable questions? Explain why or why not. Can stem cell research lead to a cure for Parkinson’s disease? Assuming that human stem cells can be used to cure the disease, should this be permitted?

4. Find a recent newspaper or magazine article that reports data that are interesting to you. The research design reported on in the article can vary widely from experiments, through surveys, to observational analyses of existing data, such as educational achievement data. (It is frequently easiest to find an example from medical research.)

- Go to the original source of the data (you can often do this on line) to compare it with what was reported in the newspaper or magazine.
- Discuss the quality of the reporting in the newspaper as compared to the original research.
- How persuasive is the research in general?

- **Examination questions for Chapter 1**

1. Methods of measurement or coding, whether quantitative or qualitative, can be used to handle the data gathered from most of the major research designs. \*True or False?

2. Methods of measurement are more likely to influence techniques of analysis a researcher uses than choice of design is to determine methods of measurement the researcher employs. \*True or False?

3. Concerning the criteria for a good research question, it is most accurate to say

- a. it should lead to results that are statistically significant
- b. \* it will address a substantively important topic
- c. it will not always be on a topic about which it is possible for researchers to gather evidence
- d. the quality of the research question is less important for a successful research project than employing the correct measurement and analytic techniques.

4. For most research topics there is clearly a single design that is most appropriate and that implies the correct techniques of measurement and analysis. True or \*False?

5. Good quality analysis of most research problems requires both qualitative and quantitative reasoning. \*True or False?