3

Selecting a Statistic to Answer Your Research Question

The Family Support Center needs to know the number of families in its caseload that have a child under school age because of a funding opportunity for a new program for families with young children. The center staff need a descriptive statistic like a frequency (i.e., How many are there?). They also need to know the mean (average) age of the mothers and the fathers of these children because these data must be in the grant proposal. The mean is another descriptive statistic.

The County Social Services Agency is evaluating its foster care program to see whether foster parents have improved in their self-confidence as a foster parent following a special training program. This means agency staff need data on the mean score for the self-confidence scale that was administered before the service was offered and they need to have the mean score at the end of the training program. The difference between the pretest score (before) and the posttest score (after) will be one indicator of the effectiveness of this training program. This is an example of an evaluative study in which before and after data are compared. Such a comparison requires the calculation of a statistic that tells whether there was improvement that cannot easily be explained by chance. The researcher in this case would collect scores for each individual at the pretest time and the posttest time, then choose the appropriate statistic. This requires knowing the structure of the data (discussed later) and having access to guidance (such as the table given in this chapter as Exhibit 3.1) for finding the appropriate statistic for the situation. Finally, the researcher can use Excel to analyze the data. You can submit the data to the appropriate Excel file that accompanies this book to complete the analysis.

As mentioned above, in this chapter you will be given a guide for finding the right statistic to answer your research question. Furthermore, you will learn how to go through the process of finding the appropriate statistic using an example. (In later chapters, you will see how to use the appropriate Excel file.)

In Appendix A is a set of guides for finding an appropriate statistic in a wide variety of situations. These guides are in the form of decision trees, each of which will take you to a particular statistic based on your answers to a set of questions about the structure of your data. For example, the first guide in Appendix A will help you to find a statistic when you are comparing a set of scores to a single score that serves as a threshold of functioning. As revealed by the decision tree, the one-sample *t* test is the statistic that suits this situation. This figure is reproduced here in this chapter (as Exhibit 3.1) for ease of reference.

The figures in Appendix A will also point you to "Quick Guides" to using the computer to analyze your data; you'll find these in Appendix B. Each of these guides lists the specific steps you'll use to employ either SPSS or the special Excel file. Each guide also provides information on how to review the results and report them.

Finally, Appendix C contains a table that summarizes this information, as well as providing links to YouTube tutorials.

In this chapter, you will learn how to navigate these figures to find your statistic. You will also be referred to the table in Appendix C (Exhibit C.1) that summarizes the choice both of the appropriate statistic and of the special Excel file you can use for your data. The table also points you to the Excel file you'll use for your situation so you can easily follow the instructions for entering your data and examining the results.

As always, this book is based on the idea that you learn by doing, so you will have a chance to practice with examples.

You are advised to read through the guides in Appendix B to get a handle on how they work, rather than to try to memorize which statistic fits which situation. The subsequent chapters will help you to learn about statistics by engaging in the use of specific statistics for your various situations in research. When you have become familiar with contents of these chapters, you are advised to use this book in the following manner:

1. Collect your own data for analysis.
2. Based on your knowledge of the structure of your data, use Appendix A to find the appropriate statistic or use Exhibit C.1, which lists nine different situations in summary fashion.
3. Use Appendix B to get a quick guide for using either Excel or SPSS to analyze your data.
4. Enter your data for analysis using either the special Excel file designed for this book or SPSS, if this software package is available to you and you wish to use it.

After you learn about various concepts and statistical tests through the examples in these chapters, you will be ready to go through the process of finding a statistic and using it for your data whenever you have this need. Chapters 9 through 11 of this book provide a synopsis of a number of statistical tests.

Both descriptive statistics and inferential statistics are discussed in this chapter. You may remember from Chapter 1 that descriptive statistics are used to describe a

study sample, whereas inferential statistics are used to infer from a sample to a population. With inferential statistics, you are testing a hypothesis, such as *Student grades during the posttest period will be higher than in the pretest period.*

When you engage in descriptive analysis, you are only concerned with describing the people in your study; therefore, you will not examine the concept of statistical significance. With descriptive research, for example, you might report the mean salary of your study subjects or the proportion who are over the age of 60. This endeavor has nothing to do with statistical significance. When you engage in evaluative research and explanatory research, on the other hand, you want to infer from your sample to a larger population of people for whom you would like to believe your results are relevant. Did your clients achieve a statistically significant improvement in self-esteem? Are older clients more likely than younger ones to have improved in their self-esteem scores? These are the kind of questions for which you will consult inferential statistics.

Finding a Descriptive Statistic

When you examine data for a descriptive study, you will likely examine a number of variables, but you will always examine one variable at a time. In this chapter is information on several descriptive statistics, and this section provides a guide to choosing the statistic that fits your situation.

The key thing to know about selecting a descriptive statistic is the level of measurement of the variable you wish to describe. There are four levels of measurement: nominal, ordinal, interval, and ratio. The first three, mentioned previously, are more important than the fourth, because the distinction between interval and ratio is not relevant to the selection of statistics in evaluation research as it is discussed in this book.

Let's first recap the nominal, ordinal, and interval levels and introduce the ratio level:

1. **Nominal level**. People are put into categories that have no order (e.g., gender, political party affiliation).
2. **Ordinal**. People are put into categories that have an order (e.g., To what extent do you agree that children are supposed to be seen but not heard: strongly agree, agree, disagree, strongly disagree?).
3. **Interval**. People are given a score or some other numerical value (e.g., age or height).
4. **Ratio**. People are given an interval variable that has a fixed zero point. That is, the variable cannot have a negative value (e.g., years of schooling, number of cars owned). As a counterexample, think of money saved over 1 year; net savings would be reported as a positive value, but if a person spent more than they saved, the net savings would be reported as a negative value.

The above levels of measurement form a hierarchy as indicated by the numbered list above. The nominal level is the lowest level of measurement, followed by the ordinal level and then the interval level, and the highest level is ratio. A variable at one level can be treated as though it is measured at a lower level. Ideally, you will select a statistic that operates at the highest level. But if you need to treat a variable as though it is measured at a lower level because of a special situation, that treatment is okay.

The guide for descriptive statistics is simple. For variables measured at the **nominal level**, you can use any of the following:

- **Frequencies** (How many people are in each category?)
- **Proportions** (What percent of the total is in each category?)
- **Mode** (What category has the most people in it?)

For variables measured at the **ordinal level**, you can use any of the statistics for the nominal level plus any of the following:

- **Median** (If you lined everyone up in order, who would be in the middle?)
- **Range** (What is the distance between the least and most?)

For variables measured at the **interval level**, you can use any of the above statistics plus any of these:

- **Mean** (The average of all the scores)
- **Standard deviation** (A measure of variance)

Chapter 4 will discuss each of these statistics in more detail.

Finding a Statistic to Test Your Hypothesis in Evaluative Research

The heart of data analysis for the human service professional is the evaluation of client outcome. Did your at-risk students achieve higher grades and lower incidences of disciplinary actions as a result of your service? Did your clients show progress on their target behavior as evidenced by reduction of scores for depression or enhancement of scores for self-esteem? Did your single client have a higher proportion of days in which homework was turned in to the teacher during the period of the special service than during the period before service began (the baseline period)?

Before you can examine outcome data statistically, you need to have done several things. You need to have articulated an outcome objective such as, for example, to improve the self-esteem of members of the youth support group service. You also should have measured this outcome. Perhaps you gave these group members a self-esteem scale before they started the group experience and you gave it to them again after 2 months of the service. In addition, you need to know the structure of the data that you have collected. For example, if you collected scores once before an experience and once again at the end of the experience for a group of people, you would have matched scores. If you

were comparing the gain scores of a group of clients who got your service with the scores of a group of people who did not get your service, you would be comparing the scores of two groups and would have a different structure. When you know the structure of your data, you can use the guide in this chapter to find an appropriate statistic.

In this chapter is a step-by-step guide to doing all these things. If you are engaged in evaluative research and believe you are already competent do all these things, you can consult Appendix C, which contains a single table that summarizes all the information about selecting a statistic and using the special Excel file for evaluative research. This appendix also provides a link to a YouTube demonstration.

The Study Hypothesis

A useful mechanism for analysis is the study hypothesis. This is a statement of the predicted outcome of the data analysis. An example could be "Posttest scores for depression will be lower than pretest scores." This statement sets forth what you expect to find when you examine your data.

We won't be discussing the null hypothesis in this book, but it is the form of the hypothesis that technically has merit in the field of statistics. The **null hypothesis** is a statement that you will not find differences between scores or correlations among your variables. The null form of the above hypothesis would be "There is no difference in pretest and posttest scores for depression." Those who are oriented to using the null hypothesis will test the hypothesis with the hope that the data will support rejecting it—in other words, that the data support the positive form of the statement. This approach can be confusing for those involved in the everyday practice of human service administration; thus, it will not be used here. In other words, we will articulate a research hypothesis in the positive form of the expected data, such as "The proportion of completed homework assignments will be higher in the treatment period than in the baseline period."

In this chapter, we will examine a number of ideas that should help you to get ready for the analysis of your data for your client outcome study. We will examine the articulation of the outcome objective, the method of measurement, and the study hypothesis. Then we will discuss mechanisms to find a statistic for testing your hypothesis.

Things to Do Before You Seek a Statistic for an Evaluative Hypothesis

There are a number of questions you need to answer before you seek a statistical test for your data. You need to articulate the outcome objective and the hypothesis. You also need to know how the outcome is being measured.

Articulating the Outcome Objective

It is useful to distinguish between concepts related to service process and concepts related to client outcome. *Process* refers to the delivery of a service, while *outcome*

refers to what the client will gain from the service. A process statement could be "We will deliver quality counseling services to the victims of rape." This reveals the process. It says what will be done. It says that clients will get counseling service. But it does not identify an outcome for the client. An outcome objective might be "To reduce depression for the victims of rape." This identifies how the client will be better off as a result of the service that is given. So, you should not say that your outcome objective is to deliver counseling service.

After you articulate the outcome objective, you need to find a way of measuring it. You need to be very clear about this. The task of measurement can be relatively easy if you have chosen a standard scale like the Beck Depression Inventory. You simply administer this scale and record the results. Measuring something concrete like grades in school is also easy. You just get access to the records and acquire the data for your statistical analysis.

But what if you have decided to develop your own measurement tool? This can be a challenge, especially if you are going to administer an instrument to your clients and it is designed to measure more than one thing. It is not within the scope of this book to provide lessons in how to compose a good tool for measurement. Instead, we will just provide a word of caution: Be sure that you know exactly what each item on your survey measures before you collect data to enter into the computer for statistical analysis.

Articulating the Study Hypothesis

It is recommended that you articulate a research hypothesis for each dependent variable that you measure. The **dependent variable** is the measure of client outcome. Suppose that you have the following three objectives:

1. To enhance feelings of social support for victims of spouse abuse enrolled in the Family Support Program
2. To reduce anxiety for victims of spouse abuse enrolled in the Family Support Program
3. To reduce interpersonal dependency for the victims of spouse abuse enrolled in the Family Support Program

Suppose further that you are measuring progress for the first objective with the Social Support Appraisals Scale, which provides *lower* scores for better feelings of support. This means you want scores on this scale to be lower after treatment than before. Suppose further that you are measuring progress for the second objective with the Self-rating Anxiety Scale, which provides higher scores for more anxiety, so you want these scores to go down as a result of your service. Let's also suppose that you are measuring the third objective with the Interpersonal Dependency Inventory, which gives higher scores for greater interpersonal dependency, so you also want scores on this scale to go down.

You would be advised to articulate the hypotheses as follows:

1. Posttest scores on the Social Support Appraisals Scale will be lower than pretest scores.
2. Posttest scores on the Self-rating Anxiety Scale will be lower than pretest scores.
3. Posttest scores on the Interpersonal Dependency Inventory will be lower than pretest scores.

You will notice that the first instrument was scored in a way that is not usual for scales of mental health and social functioning in that lower scores are better, even though you wish for this particular behavior to be enhanced rather than reduced. Be careful about such matters when you are engaging in the statistical analysis of data.

Determining Your Data Structure for Testing the Evaluative Hypothesis

In this chapter, we will examine how to select a statistic for testing the hypothesis when we are conducting an evaluation of client outcome (an evaluative study). In a future chapter, we will examine how to select a statistic for testing the hypothesis in an explanatory study. Remember that an evaluative study examines the effectiveness of services, while an explanatory study attempts to explain variables by examining their relationships. If you want to know whether the grades of the kids in your tutoring service improved, you will be undertaking an evaluative study. If you want to know whether grades are related to self-esteem, you will be undertaking an explanatory study.

Appendix A includes decision trees that will help you to find a statistic for your data. To use these figures, you will need information on the following:

1. The research design employed
2. The level of measurement of the dependent variable
3. Whether scores are matched or independent

The **research design** reveals a major part of the structure of your data. You need to know whether you are comparing pretest and posttest scores for a single group, or gain scores from two groups, or baseline and treatment scores for a single-subject design, or something else. The level of measurement is also critical for the selection of a statistic measure, because different statistics make different assumptions about the level of measurement of the variables in the analysis. What follows is an elaboration of these criteria for selection of a statistical measure.

What Is Your Evaluative Research Design?

When you engage in an evaluative study, you should know which research design you are employing. In group designs, a group of people are given the same measure of progress, and in single-subject designs, a single client is measured repeatedly. When using the latter type of design, you measure client outcome repeatedly during various phases of the evaluation process; some of these phases are baseline phases in which the client is not receiving the treatment, and some are treatment phases in which the client is receiving the treatment. Letters are used in discussions of the single-subject design to specify baseline and treatment phases, with the letter *A* always referring to a baseline period and other letters referring to one or more treatments (or services). Some of the common designs will be reviewed here.

One-Group Pretest–Posttest Design

With the **one-group pretest–posttest design**, you are measuring client progress once before treatment and once again at the end of treatment for a single group of clients.

Comparison Group Design

With a **comparison group design**, you are comparing progress for two groups of people, the ones being treated and a group that has not had the service.

Alternative Treatment Design

In an **alternative treatment design**, you are doing one of two things:

1. Comparing progress for two groups of clients who received different services that were designed to achieve the same objective
2. Comparing the gains of a single group of clients who were given one treatment for a period of time and then a different treatment for another period

The first alternative is similar to the comparison group design because you are comparing the progress for two groups of people. You follow the same directions as for the comparison group design, except that you treat one of the groups as the treatment group and the other as the comparison group.

For the second situation, you would employ procedures identical to those for the one-group pretest–posttest design, with the first treatment scores being treated as the "pretest" and the second treatment scores being treated as the "posttest."

Limited AB Single-Subject Design

With a **limited AB single-subject design**, you measure your single client one time before treatment begins (baseline) and several times during the time that service is given.

The treatment scores are compared to the single baseline score to see whether the treatment scores are better. You should have a minimum of four treatment scores. If you have only three scores, you can undertake this analysis, but you are relying on a small sample of scores to represent the trend in behavior during the treatment period. If you have only two treatment scores, you should declare your data not amenable to statistical analysis.

AB Single-Subject Design

When you employ the **AB single-subject design**, you measure a single client several times (preferably four or more times) during the baseline period (before service is given) and several times during the treatment period.

BC Single-Subject Design

The **BC single-subject design** is illustrated by the situation in which you plan to give your single client a given treatment (e.g., tutoring) and you plan to change the treatment after several measurements of progress. You then continue to measure progress during the second phase when the second treatment is being given (e.g., a combination of tutoring and play therapy). This design is similar to the AB design because you compare scores from two periods of time. The difference is that you begin with the first treatment (B phase) and change to a different treatment (C phase), so you compare the effectiveness of two treatments for a single client. For this reason, there is no separate explanation of how to examine data statistically for the BC design—just follow the directions for the AB design.

ABC Single-Subject Design

When you employ the **ABC single-subject design**, you first measure client outcome before treatment begins (baseline period). Then you implement the first intervention (e.g., tutoring) and continue to measure client outcome several times during this treatment period. Finally, you implement another treatment (e.g., tutoring combined with counseling) and measure client outcome several times during this second treatment period. When you analyze the data, you engage in the same procedures as in the AB design, except that you conduct two analyses—first comparing the A and B phases, then comparing the B and C phases.

You need to come to the task of finding a statistic with knowledge of the research design because it reflects the data collection procedures. These procedures are critical to knowing what statistical measure will be appropriate for your situation.

At What Level Is Your Dependent Variable Measured?

When you select a statistical measure for your study, you must know the level of measurement of your dependent variable. Remember that the dependent variable in

evaluative research is the target behavior that is being treated and measured. The **independent variable** is the treatment. You need to know the level of measurement because different statistical tests make the assumption that the variables in the analysis are measured at a given level. Recall the description of levels of measurement you saw earlier in this chapter.

The Special Case of the Dichotomous Variable

A nominal variable that has only two categories is referred to as a **dichotomous variable**. Dichotomous is not a level of measurement, but it is important in the selection of a statistic. In fact, most statistical measures included in the guide in this book are for variables measured at the interval level or for nominal variables that are dichotomous. So, you will see references to "nominal and dichotomous" when the question asks about level of measurement, and you may see a follow-up question that asks whether the nominal variable is measured as a dichotomy.

One of the challenges for the student of the human service professions is recognizing that a score is a measure at the interval level, even when the score is derived from items on a questionnaire that are measured at the ordinal level. Typically, you will see a scale that is comprised of several items, each of which is measured at the ordinal level. Then values are assigned to each response. For example, the option "strongly agree" might be assigned a value of 4, while the option "agree" is assigned a value of 3, and so on. Finally, these values are summed to arrive at the total score, a variable measured at the interval level.

Another challenge is recognizing that a score may be derived from assigning one point to each answer of *yes* to a set of questions. The individual items are nominal (and dichotomous), but the assignment of a point for each positive response and the summing of these values makes this variable an interval variable.

Are the Data From Paired Samples or Independent Samples?

If you are examining the relationship between two variables and the data are drawn from different groups of people, you have data that is drawn from independent samples. Comparing the mean gain scores of males and females is an example. On the other hand, if you have two sets of scores drawn from the same study subjects, you have data drawn from **paired samples (or paired data).** The critical example of this for human service evaluation is the comparison of pretest and posttest scores for one group of clients. You have matched scores because you have the pretest score for each client and you have that client's posttest score. If you are unable to match each client's pretest score with his or her posttest score, you do not have paired samples.

Finding Your Statistic for Testing the Evaluative Research Hypothesis: One Example

This section will guide you through the process of finding a statistic using one example. Once you are familiar with how this process works, you can refer to Appendix A to identify the statistics you need for your particular situation.

Determining Whether the Data Support Your Evaluative Research Hypothesis

Don't forget that you need two pieces of information to determine whether your data support your hypothesis. You first need to know whether the data went in the hypothesized direction. If you have hypothesized that posttest scores for anxiety will be lower than pretest scores, you must determine whether the mean posttest score is lower than the mean pretest score. Second, you need to know whether your data are statistically significant. As you have seen, statistical significance is measured by the value of p. A p value of .34 means that your data would occur by chance 34 times in 100, a value that is too high to support the hypothesis. On the other hand, if you see "$p < .05$," your data support the hypothesis.

Using Exhibit A.1 for the One-Group Pretest–Posttest Design

When you refer to Exhibit A.1, you will notice that your first task is to find the level of measurement for your dependent variable (the target behavior that was measured). If your dependent variable is measured at the interval level, you will determine whether the data are from matched scores or not. If you know the pretest and posttest scores for client 1, and the same for client 2 and so forth, you have matched scores. If you collected data at the pretest and at the posttest but did not collect identifying information that allows for the matching of each person's pretest and posttest scores, you do not have matching data. With matched scores, you can see that the paired t test is appropriate. Without matched scores, you will use the mean pretest score as the **threshold** score. In this case, you will enter the posttest scores and employ the one-sample t test, which will compare the mean pretest score to all of your posttest scores.

Appendix A offers no guidance for analyzing dependent variables measured at the ordinal level. That does not mean there is no such option in statistics, but for most purposes, you can consider treating your ordinal variable as though measured at the interval level and using the interval-level data options. If your dependent variable is measured at the nominal level, it must be dichotomous (only two categories) for you to use this guide.

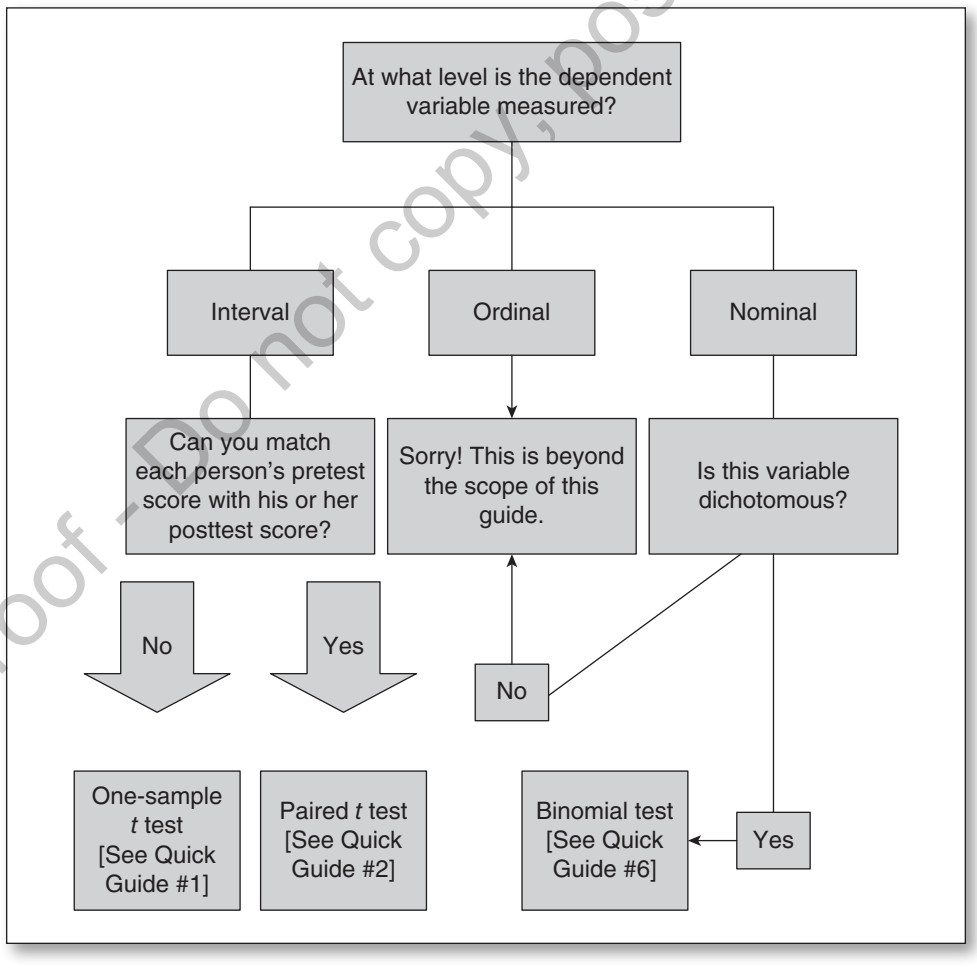
Practice Exercise

In this section, you will confront an example of a research situation. Your job will be to decide which statistical measure to employ to test the hypothesis. You will need to consult Appendix A to complete this exercise.

Case: Improving Parental Attitudes

In this study, the intervention is the Parent Training Program, which has the objective of improving parental attitudes for a group of parents who have been identified as being at risk for child neglect and abuse. Progress has been measured by the Index of Parental Attitudes (IPA), which is a 25-item scale designed to measure the

Exhibit 3.1 Finding a Statistic for the One-Group Pretest–Posttest Design



extent, severity, or magnitude of problems that family members have in their relationships with one another. Study subjects respond to a set of statements like the following:

1. My child gets on my nerves.
2. I get along well with my child.
3. I dislike my child.
4. I feel that I can really trust my child.

The study subject responds to each statement according to the following scale:

1 = None of the time
2 = Very rarely
3 = A little of the time
4 = Some of the time
5 = A good part of the time
6 = Most of the time
7 = All of the time

Positive statements are reverse scored, so that the higher score represents more problems. Scores are converted to a 100-point scale and represent the percentage of the highest possible score one could obtain for those items that were responded to. Thus, if a participant responded to each item on the scale and answered at the most negative end of the scale for every item, the score would be 100. Likewise, if a participant responded to only half the items and answered each in the most negative way, the score would also be 100 because this figure represents the percent of negative reactions

The IPA has two cutting scores. The first is a score of 30—scores above 30 are considered to indicate the presence of a clinically significant problem in family relations. The next cutting score (threshold score) is 70—scores above this score indicate severe stress with a clear possibility that some type of violence could be considered or used to deal with problems.

The following are the IPA scores for the eight clients of this training program, both at the beginning (pretest) and the end (posttest) of the training.

Client ID number	Pretest Score	Posttest Score
1	72	69
2	66	57
3	46	52
4	66	47
5	77	61
6	72	65
7	42	31
8	54	56

Review Questions

1. What hypothesis is being tested in this case?
   a. Clients will improve as a result of the Parent Training Program.
   b. Because the Parent Training Program will address poor attitudes toward parenting, the parents of this program will achieve a significant gain.
   c. Scores on the IPA will be lower at posttest than at pretest.
   d. Scores on the IPA will be higher at posttest than at pretest.
2. What is the research design employed in the evaluation of the Parent Training Program?
   a. Comparison group design
   b. AB single-subject design
   c. Basic experimental design
   d. One-group pretest–posttest design
3. At what level is the dependent variable measured?
   a. Nominal
   b. Ordinal
   c. Interval or ratio
   d. Dichotomous
4. Are these data matched or independent?
   a. They are matched because they come from two different groups of people.
   b. They are independent because they come from two different groups of people.
   c. They are matched because the pretest score for each person can be matched with his or her posttest score.
   d. They are independent because the pretest score for each person cannot be matched with his or her posttest score.
5. What statistical measure would be appropriate for testing the hypothesis for the evaluation of the Parent Training Program?
   a. The independent-samples *t* test
   b. The paired-samples *t* test
   c. The one-sample *t* test
   d. The chi square test

KEY TERMS

ABC single-subject design. A research design in which a single client is measured several times before treatment begins (baseline period), several times during the first treatment period (e.g., tutoring), and several times during a second treatment period in which the treatment has been changed (e.g., tutoring and counseling).

AB single-subject design. A research design in which a single client is measured on the dependent variable several times (preferably four or more times) before treatment begins (baseline period) and several times during the treatment period.

Alternative treatment design. With this design, you are comparing the gain of two or more groups of clients, each of which received a different intervention.

BC single-subject design. With this research design, a single client is given an intervention, and the target behavior is repeatedly measured during the first treatment period. Then the intervention is changed, and the same target behavior is repeatedly measured during this second treatment period.

Comparison group design. With this research design, you measure progress for two groups of people, the ones being treated and a group that has not had the service, and then compare the gain for the two groups.

Dependent variable. The variable that depends upon (or is believed to be caused by) the independent variable (i.e., the treatment). In evaluative research, the dependent variable is the client's target behavior or, in other words, the measure of client outcome.

Dichotomous variable. A variable that has only two categories.

Frequency. The number of people in a category.

Independent variable. The variable that is believed to be the cause of the dependent variable. In evaluative research, the independent variable is the intervention.

Interval level of measurement. For a variable measured at the interval level, people are given a score or a similar numerical value, meaning that the distance of the interval between one value and the next value is the same as with all such comparisons. Examples include age measured in years or scores on a scale. The distance between age 31 and age 32 is 1, and this is exactly the same as the interval between age 56 and age 57.

Limited AB single-subject design. With this research design, you measure your single client one time before treatment begins (baseline) and several times during the period of time that service is given.

Mean. The average of scores on an interval variable. This is computed by adding up the scores and dividing that sum by the number of scores.

Median. The midpoint value in an array of data lined up in numerical sequence. The median for the ages of 17, 23, 29, 30, and 31 would be 29 because this is the age of the middle person in this sequence.

Mode. The most recurrent value in an array of data. The mode for the ages of 23, 25, 27, 27, and 28 would be 27 because there are two people with the age of 27 and no other age has more than one.

Nominal level of measurement. For a variable at this level of measurement, people are placed into categories that have no order. Such data are sometimes called *categorical data*.

Null hypothesis. This is a statement of what the data for a research question would look like if they do not represent what is expected. For example, you may expect to find that males have higher

salaries than females, so the null hypothesis would be "There is no difference in salary between males and females." In traditional research methodology, the idea is that you test the null hypothesis, and if you reject it, you have provided evidence in support of your research hypothesis, which is what you expect the data to show. This hypothesis has more theoretical importance than practical importance, so this book focuses on the research hypothesis.

One-group pretest–posttest design. With this research design, a group of clients are measured on the dependent variable one time before they receive the intervention and one time after they have received the intervention.

Ordinal level of measurement. For a variable at this level of measurement, people are placed into categories that are ordered from low to high.

Paired samples (or paired data). Data that have been taken from a single group of people more than one time, or otherwise is matched. These data are sometimes referred to as *related samples* or *related data*.

Proportion. The percent of a category, or the number out of 100. This is calculated by dividing the number in the referent category by the total in the sample and multiplying this figure by 100. If 10 people are female and 20 are male, you would calculate the percentage of the sample who are women by first dividing 10 by 30, getting 0.33, and then multiplying this figure by 100 to get 33%.

Range. The difference between the minimum value and the maximum value in a distribution. To find the range for the ages of 25, 29, 55, 61, and 86, subtract 25 from 86 and get 61.

Ratio level of measurement. A variable at this level of measurement has the properties of an interval variable but is also measured in such a way that there is a fixed zero point, meaning there can be no negative values.

Research design. In evaluative research, the research design is the set of procedures whereby people are designated to be in a group and data will be collected. One research design is the one-group pretest–posttest design, in which one group of clients are measured on the dependent variable one time before they receive the intervention and one time again after they have received the intervention. The research design should be distinguished from the *research plan*, which is all the decisions that go into the development of an evaluative research study, from problem formulation to study conclusions. The research design is only one part of the research plan.

Standard deviation. A measure of variance used in various statistical tests. It represents the proportion of people in a category of the normal distribution. Though similar (but not identical) to the average deviation, standard deviation is computed to take into account a normal distribution of data.

Threshold. A single score or proportion that is the basis for comparison of posttest data.