TOPIC 41 SCALES OF MEASUREMENT

There are four scales (or levels) at which we measure. The lowest level is the **nominal** level (also called the *nominal scale*). This may be thought of as the "naming" level. For instance, when we ask participants to name their marital status, they will respond with *words*—not numbers—such as "married," "single," "divorced," and so on. Notice that nominal data do not put participants in any particular mathematical order. There is no logical basis for saying that one category, such as "single," is higher or lower mathematically than any other category.

The next level is **ordinal**. At this level, the measurements place participants in order from high to low. For instance, an employer might rank applicants for a job on their professional appearance. Traditionally, we give a rank of 1 to the participant who is highest, 2 to the next highest, and so on. It is important to note that ranks do not tell us by how much participants differ. If we are told that Janet has a rank of 1 and Frank has a rank of 2, we do not know if Janet's appearance is greatly superior to Frank's or only slightly superior. To measure the *amount* of difference among participants, we use the next two levels of measurement.

Measurements at the **interval** and **ratio** levels have equal distances among the scores they yield. For example, when we say that Jill weighs 120 pounds and Sally weighs 130 pounds, we know by *how much* the two participants differ. Also, note that a 10-pound difference represents the same amount regardless of where participants are on the scale. For example, the difference between 120 and 130 pounds is the same as the difference between 220 and 230 pounds.

The ratio scale is at a higher level than the interval scale because the ratio scale has an absolute zero point that we know how to measure. Thus, *weight* is an example of the ratio scale because it has an absolute zero.

The interval scale, while having equal intervals like the ratio scale, does not have an absolute zero. The most common examples of interval scales are scores obtained using objective tests such as multiple-choice tests of achievement. It is widely assumed that each multiple-choice test item measures a single point's worth of the trait being measured and that all points are equal to all other points, making it an interval scale (just as all pounds are equal to all other pounds of weight). However, such tests do not measure at the ratio level because the zero on such tests is arbitrary, not absolute. To see this, consider someone who gets a zero on a multiple-choice final examination. Does the zero mean that the student has absolutely no knowledge of or skills in the subject area? Probably not. He or she probably has some knowledge of simple facts, definitions, and concepts, but the test was not designed to measure at the low skill level at which the student is operating. Thus, a score of zero indicates only that the student knows nothing *on that test*, not that the student has zero knowledge of the content domain. Thus, the scores are at the interval level, not the ratio level.

Here is a summary of the levels:

Lowest Level	Scale	Characteristic
	Nominal	*naming*
⇩	**Ordinal**	*ordering*
	Interval	*equal interval without an absolute zero*
	Ratio	*equal interval with an absolute zero*
Highest Level		

For those of you who like to use mnemonics, remember this environmentally friendly phrase:

No Oil In Rivers

The first letters—**NOIR**—are the first letters of the scales in order from lowest to highest.

At which level should we measure? First, some variables are inherently nominal in nature. For example, when we need to know participants' gender or state of residence, nominal data are the natural choice. Second, many novice researchers overuse the ordinal scale. For instance, if we want to measure reading ability, it would usually be much better to use a carefully constructed standardized test (which measures at the interval level) than having teachers rank students in terms of their reading ability. Remember, measuring at the interval level gives us more information than measuring at the ordinal level because the interval-level measurements tell us by *how much* students differ. In addition, as you will learn when we explore statistics, we can conduct more interesting and powerful types of analy-

ses when we measure at the interval rather than at the ordinal level. Thus, if you are thinking in terms of having participants ranked (for ordinal measurement) when planning a research project, consider whether there is an alternative way to measure the trait at the interval level.

The choice between interval and ratio depends solely on whether it is possible to measure with an absolute zero. When it is possible, we usually do so. For the purposes of applied statistical analyses, however, interval and ratio data are treated in the same way.

The level at which we measure has important implications for data analysis, so you will find references to scales of measurement throughout the discussion of statistics in subsequent topics in this book.

EXERCISE ON TOPIC 41

1. If we ask participants to name the country in which they were born, we are using which scale of measurement?

2. Which two scales of measurement have equal distances among the scores they yield?

3. If we have a teacher rank students according to their oral language skills, we are using which scale of measurement?

4. Which scale of measurement has an absolute zero?

5. Which scale of measurement is at the lowest level?

6. Objective, multiple-choice achievement tests are usually assumed to measure at what level?

7. If we measure in such a way that we find out which participant is most honest, which is the next most honest, and so on (without measuring to determine how much honesty each one has), we are measuring at what scale of measurement?

8. The number of minutes of overtime work that employees perform is an example of which scale of measurement?

9. Weight measured in pounds is an example of which scale of measurement?

Question for Discussion

10. Name a trait that inherently lends itself to nominal measurement. Explain your answer.

For Students Who Are Planning Research

11. List the measures you will be using in your research, and name the scale of measurement for each one.