Levels of measurement

What a scale actually means and what we can do with it depends on what its numbers represent. Numbers can be grouped into 4 types or levels: nominal, ordinal, interval, and ratio. Nominal is the most simple, and ratio the most sophisticated. Each level possesses the characteristics of the preceding level, plus an additional quality.

Nominal

Nominal is hardly measurement. It refers to quality more than quantity. A nominal level of measurement is simply a matter of distinguishing by name, e.g., 1 = male, 2 = female. Even though we are using the numbers 1 and 2, they do not denote quantity. The binary category of 0 and 1 used for computers is a nominal level of measurement. They are categories or classifications. Nominal measurement is like using categorical levels of variables, described in the *Doing Scientific Research* section of the Introduction module.

Examples:

MEAL PREFERENCE: Breakfast, Lunch, Dinner
RELIGIOUS PREFERENCE: 1 = Buddhist, 2 = Muslim, 3 = Christian, 4 = Jewish, 5 = Other
POLITICAL ORIENTATION: Republican, Democratic, Libertarian, Green

Nominal time of day - categories; no additional information

Ordinal

Ordinal refers to order in measurement. An ordinal scale indicates direction, in addition to providing nominal information. Low/Medium/High; or Faster/Slower are examples of ordinal levels of measurement. Ranking an experience as a "nine" on a scale of 1 to 10 tells us that it was higher than an experience ranked as a "six." Many psychological scales or inventories are at the ordinal level of measurement.

Examples:

RANK: 1st place, 2nd place, ... last place
LEVEL OF AGREEMENT: No, Maybe, Yes
POLITICAL ORIENTATION: Left, Center, Right

Ordinal time of day - indicates direction or order of occurrence; spacing between is uneven

Interval

Interval scales provide information about order, and also possess equal intervals. From the previous example, if we knew that the distance between 1 and 2 was the same as that between 7 and 8 on our 10-point rating scale, then we would have an interval scale. An example of an interval scale is temperature, either measured on a Fahrenheit or Celsius scale. A degree represents the same underlying amount of heat, regardless of where it occurs on the scale. Measured in Fahrenheit units, the difference between a temperature of 46 and 42 is the same as the difference between 72 and 68. Equal-interval scales of measurement can be devised for opinions and attitudes. Constructing them involves an understanding of mathematical and statistical principles beyond those covered in this course. But it is important to understand the different levels of measurement when using and interpreting scales.

Examples:

TIME OF DAY on a 12-hour clock
POLITICAL ORIENTATION: Score on standardized scale of political orientation

OTHER scales constructed so as to possess equal intervals

Interval time of day - equal intervals; analog (12-hr.) clock, difference between 1 and 2 pm is same as difference between 11 and 12 am

Ratio

In addition to possessing the qualities of nominal, ordinal, and interval scales, a ratio scale has an absolute zero (a point where none of the quality being measured exists). Using a ratio scale permits comparisons such as being twice as high, or one-half as much. Reaction time (how long it takes to respond to a signal of some sort) uses a ratio scale of measurement -- time. Although an individual's reaction time is always greater than zero, we conceptualize a zero point in time, and can state that a response of 24 milliseconds is twice as fast as a response time of 48 milliseconds.

Examples:

RULER: inches or centimeters
INCOME: money earned last year
GPA: grade point average
YEARS of work experience
NUMBER of children

Ratio - 24-hr. time has an absolute 0 (midnight); 14 o'clock is twice as long from midnight as 7 o'clock

Applications

The level of measurement for a particular variable is defined by the highest category that it achieves. For example, categorizing someone as extroverted (outgoing) or introverted (shy) is nominal. If we categorize people 1 = shy, 2 = neither shy nor outgoing, 3 = outgoing, then we have an ordinal level of measurement. If we use a standardized measure of shyness (and there are such inventories), we would probably assume the shyness variable meets the standards of an interval level of measurement. As to whether or not we might have a ratio scale of shyness, although we might be able to measure zero shyness, it would be difficult to devise a scale where we would be comfortable talking about someone's being 3 times as shy as someone else.

Measurement at the **interval** or **ratio** level is desirable because we can use the more powerful statistical procedures available for Means and Standard Deviations. To have this advantage, often **ordinal** data are treated as though they were interval; for example, subjective ratings scales (1 = terrible, 2= poor, 3 = fair, 4 = good, 5 = excellent). The scale probably does not meet the requirement of equal intervals -- we don't know that the difference between 2 (poor) and 3 (fair) is the same as the difference between 4 (good) and 5 (excellent). In order to take advantage of more powerful statistical techniques, researchers often assume that the intervals are equal.

Self-test #2
Self-test #3

Enrichment #1 (not required): Statistical procedures for each level of measurement

On to **consumer ratings**