Levels of Measurement

- Another way to classify data is to use use levels of measurement. Four of these levels are discussed in the following slides

Scales of Measuring the Data

- **Nominal variables** allow for only qualitative classification. That is, they can be measured only in terms of whether the individual items belong to some distinctively different categories, but we cannot quantify or even rank order those categories. Typical examples of nominal variables are gender, race, color, city, etc

nominal level of measurement

characterized by data that consist of names, labels, or categories only. The data cannot be arranged in an ordering scheme (such as low to high)

Example: survey responses yes, no, undecided

- **Ordinal variables** allow us to rank order the items we measure in terms of which has less and which has more of the quality represented by the variable, but still they do not allow us to say "how much more.” A typical example of an ordinal variable is the socioeconomic status of families

ordinal level of measurement

involves data that may be arranged in some order, but differences between data values either cannot be determined or are meaningless

Example: Course grades A, B, C, D, or F

- **Interval variables** allow us not only to rank order the items that are measured, but also to quantify and compare the sizes of differences between them. For example, temperature, as measured in degrees Fahrenheit or Celsius, constitutes an interval scale

❖interval level of measurement

like the ordinal level, with the additional property that the difference between any two data values is meaningful. However, there is no natural zero starting point (where *none* of the quantity is present)

Example: Years 1000, 2000, 1776, and 1492

- **Ratio variables** are very similar to interval variables; in addition to all the properties of interval variables, they feature an identifiable absolute zero point, thus they allow for statements such as x is two times more than y. Typical examples of ratio scales are measures of time or space

❖ ratio level of measurement

the interval level modified to include the natural zero starting point (where zero indicates that *none* of the quantity is present). For values at this level, differences and ratios are meaningful.

Example: Prices of college textbooks ($0 represents no cost)

Summary - Levels of Measurement

- Nominal - categories only
- Ordinal - categories with some order
- Interval - differences but no natural starting point
- Ratio - differences and a natural starting point

Indicate which level of measurement is being used in the given scenario

1. The teacher of a class of third graders records the height of each student

2. The teacher of a class of third graders records the eye color of each student

SOLUTION

1. This is the **ratio level** of measurement. There is a starting point (0 feet, 0 inches) and it makes sense to say that 6 feet is twice as long as 3 feet

2. This is the **nominal level** of measurement. Eye color is not a number, and so the lowest level of measurement is used.

Cont question

3. The teacher of a class of third graders records the letter grade for mathematics for each student.

4. The teacher of a class of third graders records the percentage that each student got correct on the last science test

SOLUTION

- 3. This is the **ordinal level** of measurement. The letter grades can be ordered with A as high and F as low, however differences between these grades are meaningless. An A and a B grade could be separated by a few or several points, and there is no way of telling if we are simply given a list of letter grades

SOLUTION

4. This is the **ratio level** of measurement. The numbers have a range from 0% to 100% and it makes sense to say that one score is a multiple of another.

Cont question

- 5) A meteorologist compiles a list of temperatures in degrees Celsius for the month of May

6) A meteorologist compiles a list of temperatures in degrees Fahrenheit for the month of May

SOLUTION

- 6) This is also the **interval level** of measurement, for the same reasons as the last problem.

7) Careful! Even though this is another situation involving temperatures as data, this is **the ratio** level of measurement. The reason why is that the Kelvin scale does have a absolute zero point from which we can reference all other temperatures. The zero for the Fahrenheit and Celsius scales is not the same, as we can have negative temperatures with these scales

Cont question

8) A film critic lists the top 50 greatest movies of all time.

9) A car magazine lists the most expensive cars for 2012

SOLUTION

- 8) This is the **ordinal level** of measurement. The rankings are ordered from 1 to 50, but there is no way to compare the differences in rankings. Movie #1 could beat #2 by only a little, or it could be vastly superior (in the critic's eye). There is no way to know from rankings alone.

9) Prices can be compared at the **ratio level** of measurement

Cont question

- 10.) The roster of a basketball team lists the jersey numbers for each of the players

11) A local animal shelter keeps track of the breeds of dogs that come in.

12. A local animal shelter keeps track of the weights of dogs that come in

SOLUTION

- 10. Even though there are numbers associated with this data set, the numbers serve as alternate forms of names for the players and the data is at the **nominal level** of measurement. Ordering the jersey numbers makes no sense, and there is no reason to do any arithmetic with these numbers.

SOLUTION

- 11. This is the **nominal level** due to the fact that dog breeds are not numeric

12. This is the **ratio level** of measurement. Zero pounds is the starting point for all weights and it makes sense to say ``The 5 pound dog is one quarter the weight of the 20 pound dog.

Thank you!