GEO-A-CC-3-07-TH – Statistical Methods in Geography

Topic 2: scales of measurement (Nominal, Ordinal, Interval and Ratio)

SCALES OF MEASUREMENT

NOMINAL, ORDINAL, INTERVAL & RATIO

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- Common way of classifying data is to use four levels of measurement: nominal, ordinal, interval, and ratio

- *Don't do computations and don't use statistical methods that are not appropriate for the data.* For example, it would not make sense to compute an average (mean) of Social Security numbers, because those numbers are data that are used for identification, and they don't represent measurements or counts of anything.

Level of Measurement	Brief Description	Example
Ratio	There is a natural zero starting point and ratios make sense.	Heights, lengths, distances, volumes
Interval	Differences are meaningful, but there is no natural zero starting point and ratios are meaningless.	Body temperatures in degrees Fahrenheit or Celsius
Ordinal	Data can be arranged in order, but differences either can't be found or are meaningless.	Ranks of colleges in *U.S. News & World Report*
Nominal	Categories only. Data cannot be arranged in order.	Eye colors

DEFINITION

The **nominal level of measurement** is characterized by data that consist of names, labels, or categories only. The data cannot be arranged in some order (such as low to high).

Here are examples of sample data at the nominal level of measurement.

1. **Yes** , **No** , **Undecided:** Survey responses of *yes*, *no*, and *undecided*
2. **Coded Survey Responses:** For an item on a survey, respondents are given a choice of possible answers, and they are coded as follows: “I agree” is coded as 1; “I disagree” is coded as 2; “I don’t care” is coded as 3; “I refuse to answer” is coded as 4; “Go away and stop bothering me” is coded as 5. The numbers 1, 2, 3, 4, 5 don’t measure or count anything.

Because nominal data lack any ordering or numerical significance, they should not be used for calculations. Numbers such as 1, 2, 3, and 4 are sometimes assigned to the different categories (especially when data are coded for computers), but these numbers have no real computational significance and any average (mean) calculated from them is meaningless and possibly misleading.

DEFINITION

Data are at the **ordinal level of measurement** if they can be arranged in some **order**, but differences (obtained by subtraction) between data values either cannot be determined or are meaningless.

Here is an example of sample data at the ordinal level of measurement.

Course Grades: A college professor assigns grades of A, B, C, D, or E. These grades can be arranged in order, but we can't determine differences between the grades. For example, we know that A is higher than B (so there is an ordering), but we cannot subtract B from A (so the difference cannot be found).

Ordinal data provide information about relative comparisons, but not the *magnitudes* of the differences. Usually, ordinal data should not be used for calculations such as an average (mean).

DEFINITION

Data are at the **interval level of measurement** if they can be arranged in order, and differences between data values can be found and are meaningful. *Data at this level do not have a **natural zero starting point** at which none of the quantity is present.*

These examples illustrate the interval level of measurement.

1. **Temperatures:** Body temperatures of 98.2oF and 98.8oF are examples of data at this interval level of measurement. Those values are ordered, and we can determine their difference of 0.6oF. However, there is no natural starting point. The value of 0oF might seem like a starting point, but it is arbitrary and does not represent the total absence of heat.

2. Years: The years 1492 and 1776 can be arranged in order, and the difference of 284 years can be found and is meaningful. However, time did not begin in the year 0, so the year 0 is arbitrary instead of being a natural zero starting point representing “no time.”

DEFINITION

Data are at the **ratio level of measurement** if they can be arranged in order, differences can be found and are meaningful, and *there is a natural zero starting point* (where zero indicates that none of the quantity is present). For data at this level, differences and ratios are both meaningful.

The following are examples of data at the ratio level of measurement. Note the presence of the natural zero value, and also note the use of meaningful ratios of "twice" and "three times."

1. Heights of Students: Heights of 180 cm and 90 cm for a high school student and a preschool student (0 cm represents no height, and 180 cm is *twice* as tall as 90 cm.)

2. Class Times: The times of 50 min and 100 min for a statistics class (0 min represents no class time, and 100 min is *twice* as long as 50 min.)

The distinction between the interval and ratio levels of measurement can be a bit tricky. Here are two tools to help with that distinction:

1. Ratio Test Focus on the term “ratio” and know that the term “twice” describes the ratio of one value to be double the other value. To distinguish between the interval and ratio levels of measurement, use a “ratio test” by asking this question: Does use of the term “twice” make sense? “Twice” makes sense for data at the ratio level of measurement, but it does not make sense for data at the interval level of measurement.

2. True Zero For ratios to make sense, there must be a value of “true zero,” where the value of zero indicates that none of the quantity is present, and zero is not simply an arbitrary value on a scale. The temperature of 0F is arbitrary and does not indicate that there is no heat, so temperatures on the Fahrenheit scale are at the interval level of measurement, not the ratio level.

Reference:
1. Triola, Mario F., Elementary statistics, 13th edition. | Boston : Pearson, [2018], pp.13-19.