Measurement Scales

In quantitative research four classic measurement scales are distinguished: *nominal, ordinal, interval*, and *ratio* scales. Before doing any statistical analysis, it is important for the researcher to be able to identify which measurement scales are being used.

Nominal scale

A scale is said to be nominal when it distinguishes discrete categories, such as male or female, or strings, woodwinds, brass, or percussion. Nominal scales can be numerical, such as the numbers assigned to football players. In this case, the numbers have no meaning apart from identifiers.

Ordinal scale

A scale in which categories are ordered or ranked, but where numerical differences are meaningless (and so cannot be compared). An example of an ordinal scale would be the rank ordering of people in terms of age. The ages of seven people might be 18, 22, 23, 26, 26½, 35, and 57. Nevertheless, they might be coded according to their order: 1, 2, 3, 4, 5, 6 and 7. In ordinal or rank-ordered data, numerical differences are meaningless. For example, the difference between 15 and 20 is not necessarily the same as the difference between 25 and 30.

In music, a classic example of an ordinal scale is the sequence of dynamic markings. From quiet to loud, we can rank-order the dynamics as: *ppp, pp, p, mp, mf, f, ff,* and *fff*. Notice that we can't claim that the difference between *ppp* and *pp* is the same as the difference between *f* and *ff*. All we can say is that *ppp* is quieter than *pp*, which in turn is quieter than *p* and so on.

Interval scale

A measurement scale where differences are meaningful, but where there is no true zero. For example, zero degrees Fahrenheit doesn't have any special numerical significance, so the Fahrenheit scale is an interval scale.

Ratio scale

A ratio scale exists when numerical ratios are meaningful. For example, the difference between 20 and 40 (doubling) is comparable to the difference between 40 and 80 (another doubling). This occurs when the scale contains a true zero, where zero means the absence of something. Examples of ratio scales include common

physical measures such as length, time, volume, etc.

Transforming scales

Unlike *Fahrenheit* and *Celsius* (which are interval scales), temperature in *Kelvin* is a ratio scale because zero has a true meaning of the total absence of any heat energy. Notice that 0 Kelvin is the same as -273 degrees Celsius. Since `degrees Celsius = Kelvin + 273`, you might think that Celsius is also a ratio scale. However, transforming a ratio scale in this way will cause the scale to become an interval scale.

It is also possible to transform scales in the opposite direction. For example, consider the case of measuring the ***change*** in temperature (rather than temperature). Here the change from 22 to 24 degrees Celsius (+2 degrees change) is the same as the change from 84 to 86 degrees (+2 degrees change). Moreover, zero now has a special meaning: it means "no change in termperature." Moreover, a change of 4 degrees is twice as much change as a change of 2 degrees. Hence, although *Celsius* is an interval scale, *change in Celsius* is a ratio scale.

Mnemonic

It may help to remember the acronym *NOIR* Nominal-Ordinal-Interval-Ratio.

Nominal comes from the Latin `nomen` meaning "name." A nominal scale is simply one where categories are used to name things.

Ordinal comes from the Latin `ordinum` meaning "order." An ordinal scale is a scale in which items can be placed in order.

Interval means that distances (intervals) are meaningful.

Ratio means that fractional manipulations like "doubling" and "halving" are meaningful.