Measurement Scales

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Measurement scales are ubiquitous throughout scientific research, especially among the disciplines of social sciences. These are useful to record data and thus apply statistical or other scientific analysis on this data. In fact, all data analysis is broken down into four major measurement scales as described below.

1. Nominal

This type of measurement scale is used for mutually exclusive and exhaustive categories. This means that the variable under measurement can take one and only one value out of the given options. In addition, every observation [1] must fall into one of the categories.

Examples:

- In a survey, the variable 'sex' is a nominal scale of measurement because there are two possibilities, male and female, which cover the entire population under study.
- In a medical test, a lab animal may be either dead or alive. Every animal under study is in one of the two states and there is no animal that cannot be described by these two states.
- In Quantum mechanics, the measured spin of an electron is either +1/2 or -1/2. The measurement cannot yield any other value and this is true for any electron under study.

The states of a nominal measurement scale can be assigned numerical values, e.g. 1 for

female and 0 for male in the first example. These are usually arbitrary values and do not correspond to an inherent numerical value that is universally assignable.

2. Ordinal

Unlike for a nominal case, here the numerical values associated with the measurement have some relevance in terms of ranking of the system. In a nominal measurement, the values are arbitrary. In our previous example, assigning 1 to female and 0 to male does not in any way mean that a female participant is "more" or "higher" than a male one. However, in an ordinal measurement, there is a ranking involved.

Examples:

- In an Olympic race, the participants are ranked according to the ascending order of the time taken to finish the race. In this, the number tells us something about the relative performance of an athlete.
- The grading system used in university is a measurement scale of the type ordinal because there is a hierarchy involved.

3. Interval

The interval measurement scale tells us some quantitative data about the difference between the measurements [2]. In an ordinal measurement scale, we only get qualitative information about the relative ranking.In our previous example of a race, we only know who was first, second and third, but we know nothing about how close the second was to the first and the second to the third. For this information, we need an interval scale.

Examples:

- In temperature measurement, we use scales that are interval measurement scales. The scales are also uniform in that the difference between 200C and 400C is the same as the difference between 400C and 600C.
- The number system that we use is another example of a uniform measurement scale.
- Not all interval measurement scales are uniform. A log scale is commonly used for plotting data, which is not uniform in nature.

In an interval scale, the ratio of values doesn't make sense. You cannot say, for example, that 200C is twice as cold as 400C. (it would be absurd for example, to say that 0.0010C is 1000 times colder than 10C). The main reason for this is that the zero scale is chosen arbitrarily.

4. Ratio

The ratio measurement scale is most commonly used in physical sciences and engineering applications. Most physical measurements are ratio scales. Like the name suggests and unlike the interval scale, here the ratio between two values makes perfect sense. The zero scale is not chosen arbitrarily in this case.

For example, when we say that the mass of a body is 2kg, it means that it is twice as heavy

as a 1kg object that is defined in some scientific way.

The ratio measurement reflects our physical world and is thus very common in science and engineering. On the other hand, it is very rare in social sciences and surveys.

Links
[1] https://explorable.com/scientific-observation
[2] https://explorable.com/scientific-measurements