

Measurement

Measurement and error
Validity and reliability
Levels of measurement

Measurement and error

Statistics are based on the concept of measurement
In quantitative research, you must measure.
You use an instrument to measure.
What are possible types of instruments?

Components of measurement and error

Observed score = true score +
systematic error (bias) + random error

Example 1

In a math test with 20 math questions designed to test learning of math concepts:

- What is the true score?
- What are some sources of systematic error?
- What are some sources of random error?

Example 2

Measuring a personality trait by asking people about their past behavior.

Such a scale might include questions like: Are you always, sometime, or never on time for appointments.

The instrument might indeed measure the personality trait but also capture some error.

Insuring quality measurement

Two main measures of quality:

Validity

Reliability

Validity

An instrument is valid to the extent it measures what you want it to measure.

Validity is usually a matter of degree and involves the question "how valid."

No measure is perfectly valid.

Internal validity: concerned with design considerations.

External validity: concerned with the ability to generalize.

Reliability

Reliability refers to how consistent the measurement is.

- External Reliability: If the measures were applied and re-applied, would the measurement be the same?
- Internal Reliability: Do questions that are supposed to measure the same thing get the same results?

An example

Suppose we want to measure women's advancement into corporate management of communication companies.

We examine the women on the boards of directors as listed in annual reports of the top 500 communication companies.

Levels of measurement

Nominal: Categories that have no numerical difference or no ordered relationships

Ordinal: Numbers signify ordered relationships

Interval: Numbers signify equal ordered relationships but no absolute zero

Ratio: Numbers signify equal ordered relationships with an absolute zero

Nominal measurement

Also called discrete measurement

The weakest level of measurement because the numbers tell us nothing about the categories

Least Precision, least amount of information.

Example

. Gender:

- (1) Male
- (2) Female
- (4) Other

Ordinal measurement

Assigned numbers have meaning in terms of greater than and less than.

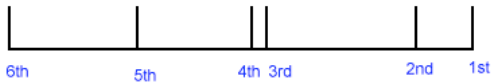
The magnitude of the “more” is not part of the scale

We don’t know how much more

Ordinal variables provide information concerning the relative position of participants or observations

Ordinal variables do not tell us anything about the absolute magnitude or the difference between them.

An example



Interval measurement

The assignment of numbers to categories with equivalent intervals between them but no absolute zero.

The intervals are both known and equal

When a variable is measured on an interval scale, the distance between numbers or units on the scale is equal—for all levels of the scale

An example



32 degrees F, 0 degrees C

212 degrees F, 100 degrees C



Ratio measurement

The intervals are both known and equal and there is a meaningful zero.

Communication research rarely has this type of measurement.

Example

Measurement of time, length, weight, counting...

How many classes are you taking this semester:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

(Assumption: maximum 12 classes allowed)

Scales

- Nominal scales are considered
 - qualitative
 - categorical
- Ordinal, interval, and ratio scales are considered
 - quantitative
 - “continuous” measures

Selecting a measurement level

Select the measurement level based on the statistical test that you will use to analyze the data.

Some statistical tests are inappropriate with certain measurement levels

Example

Suppose you had 20 subjects, 12 of which were male, and 8 of which were female.

If you assigned males a value of '1' and females a value of '2', compute the mean sex of subjects in your sample?

How would you interpret a mean sex of 1.4?

A caveat

Much social science research uses semantic scales:

1 = Strongly disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly agree

Review

A professor is interested in the relationship between the number of times a student is absent and his or her grade on the final exam.

What is the measurement scale for the number absences?

What is the measurement scale for the grade?

Review

A researcher wants to study the effect of room temperature in Fahrenheit degrees on automobile manufacturing productivity of assembly line workers. At one facility the temperature is set at 60 degrees, in another at 65 degrees, and 70 degrees at a third. Productivity is measured by the average number of cars produced each day.

What is the measurement scale of the room temperature?

What is the measurement scale for the number of cars produced each day?

Review

A researcher wants to find out if different newspapers offer different “amounts” of coverage about primary elections campaigns. What variables/measurements will she use and what level of measurement will be appropriate.

Review

A scholar wants to see if the income level of parents impacts the success of their children at college. Variables? Scales?

Converting Scales

. You can convert a variable (after gathering information) from a “higher” to a “lower” level, but not vice-versa.

Wrong: Nominal → ordinal → interval → ratio

Correct: Ratio → interval → ordinal → nominal
