Quantitative Methodology Toolkit

Gavin Henning, Ph.D.
Student Affairs Planning, Evaluation, and Research
Dartmouth College

Section Outcomes

- Articulate the concepts of data level, reliability, and validity
- Articulate the strengths and weaknesses of quantitative assessment methodologies
- Apply the basics of quantitative sampling

Assessment Topic

- Consider an assessment question you want to know the answer to.

Paradigm, Methodology, Method

- What is the difference?
- Paradigm: worldview or perspective
  - qualitative vs. quantitative
- Methodology: theory of how inquiry should proceed
  - experimental, causal comparative, survey
- Method: tool or technique for collecting data
  - experiment, survey, checklist

(Schwandt, 1997)

What is It?

- In small groups, list the the characteristics of quantitative assessment.

Some Quantitative Tenets

- Facts and data have an objective reality.
- Variables can be identified and measured.
- Events are viewed from an objective, outsider's perspective.
- Life is static.

(Burns, 2000, pp. 391-392.)

Levels of Data

- Nominal/Categorical
- Ordinal
- Interval
- Ratio

Levels of Data

- Nominal/Categorical — Qualitative
- Ordinal
- Interval — Quantitative
- Ratio

Levels of Data

Nominal/Categorical

- Applies to data which are classified only by name
- Sometimes called "qualitative" data

Examples
- First year, sophomore, junior, senior
- On-campus vs. off-campus

Levels of Data

Ordinal

- Not only things that differ from each other by belonging in different groups, but are different in amount or degree
- Differences between ranks may not be equal

Example
- Strongly disagree, disagree, agree, strongly agree

Levels of Data

Interval

- Distances between the categories or intervals of measurement are defined in fixed and equal terms

Example
- Temperature (Celsius, Farenheit)
- GPA

Levels of Data

Ratio

- Has all the properties of interval data, but it DOES have a true zero point, at which it is assumed that there is a complete absence of the element being measured
- These numbers have all of the properties of actual numbers and may be added, divided, or multiplied

Examples
- Number of credits
- Income
- Age

Levels of Data

- Nominal/Categorical - no ordering
- Ordinal - ordering exists, but not distance
- Interval - distance exists, but not ratios
- Ratio - ratios exist

(www.stat.wmich.edu/s216/book/node4.html)

Levels of Data

- Why are levels of data important?

Reliability

- What is it?
- Why is it important?

Validity

- What is it?
- Why is it important?

Validity

- Three types
  - Internal
  - Instrument
  - External

Internal Validity

- "Observed differences on dependent variable are due to independent variable" (Fraenkel and Wallen, 2003 p. 179)
  - History
  - Maturation
  - Testing/pre-testing procedures
  - Instrumentation/instrument decay
  - Selection/subject characteristics

Internal Validity

- Mortality
- Data collector characteristics
- Data collector bias
- Attitude of subjects
- Regression to the mean

Internal Validity

- Thinking about your assessment topic, which threats to internal validity should you be concerned about for your assessment and why?
  - History
  - Maturation
  - Testing/pre-testing procedures
  - Instrumentation/instrument decay
  - Selection/subject characteristics
  - Mortality
  - Data collector characteristics
  - Data collector bias
  - Attitude of subjects
  - Regression to the mean

Instrument Validity

- 3 types of instrument validity
  - Content
  - Criterion
  - Construct

Instrument Validity

- **Content validity**: The degree to which an instrument or test examines the total content of the element or area being measured

Instrument Validity

- **Criterion validity**: The degree to which the results of a test or other data gathering instrument is in agreement with the findings of other criterion measures

Instrument Validity

- **Construct validity**: The degree to which given explanatory concepts or constructs may account for the performance of subjects
  - Is the construct you want to measure *actually* being measured?

External Validity

- The extent to which the results from the sample can be generalized to the population under study

Reliability and Validity

- Can a data collection methodology be valid, but not reliable?
- Can a data collection methodology be reliable, but not valid?

Quantitative Methodologies

- Experiment
- Causal-comparison
- Correlation
- Survey / Interview

Experiment

- Experiments: seek to control threats to validity through the use of random assignment or other methods (i.e., assessment design, statistical control)

Experiment

Examples

- Determine if roommate matching increases satisfaction with living environment
- Determine if participation in study groups increases course grades compared to non-participation

Experiment

Strengths

- Convenient to supervise
- May be less expensive to carry out than large-scale descriptive studies
- Can postulate causation because researcher can control variables
- Easy to replicate because there are detailed steps for performance

Experiment

Weaknesses

- May be very costly if it requires special environments, trained observers, or testing procedures
- Lab experience may not simulate reality effectively
- Usually have small number of subjects, so findings may be misleading
- Might be regarded as harmful from an ethical perspective because people have to do something or you have to alter their life

Causal Comparison

- "Investigators attempt to determine the cause or consequence of differences that *already exist* between or among groups of individuals"

(Fraenkel and Wallen, 2003, p. 368)

Causal Comparison

Examples

- Effects of group membership (student org member)
- Causes of group membership (major)
- Consequences of intervention (how engaged are students in a leadership development course)

Causal Comparison

Strengths

- A focus on determining causation
- Can identify relationships
- Allows the study of variables that cannot be manipulated

Causal Comparison

Weaknesses

- Lack of control over threats to validity
- Cannot control all variables
- Causation cannot be fully determined

Correlation

- Relational – used to determine a relationship between variables

Correlation

Examples

- Determine association between high-risk alcohol use and gender
- Determine association between participating in a leadership development course and academic success
- Determine association between extroversion and being an effective resident assistant

Correlation

Strengths

- Can be used to explain
- Can be used to predict
- Correlation coefficients are relatively easy to understand

Correlation

Weaknesses

- Correlation is NOT causation
- Correlations can be "muddied" by influence of other variables
- More advanced correlational techniques (e.g., regression, discriminant analysis, and path analysis) can be difficult to perform and interpret

Survey/Interview

- Information is collected from a group of people to describe characteristics of that group (Fraenkel and Wallen, 2003, p. 396)
- Samples of a population are often used
- Types
  - Cross-sectional
  - Longitudinal

Survey/Interview

Examples

- Describe the beliefs of our students regarding why they came to college
- Describe how many hours our students volunteered last semester
- Describe how many drinks, on average, our students consume in a typical week

Survey/Interview

Strengths

- Relatively easy to implement
- Variety of data collection methods available

Survey/Interview

Weaknesses

- Question development is more difficult than it may seem
- Questions may not be as precise of a measurement as one would want
- Many assumptions made regarding participants' responses

Assessment Topic

- Thinking about your assessment topic, is quantitative methodology most appropriate and if so, which methodology(s) would be the best for your assessment and why?
  - Experiment
  - Causal-comparison
  - Correlation
  - Survey/Interview

References

- Burns, Robert. (2000). *Introduction to research methods.* Thousand Oaks, CA: Sage.
- Fraenkel, J. R. & Wallen, N. E. (2003). *How to design and evaluate research in education* (5th ed.). Boston: McGraw-Hill.
- Schwandt, T. A. (1997). *Qualitative inquiry: A dictionary of terms.* Thousand Oaks, CA: Sage.