



Business Research Methods

Chapter 13. MEASUREMENT AND SCALING CONCEPTS

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What Do I Measure?

- **Measurement** is the process of describing some property of a phenomenon of interest, usually by assigning numbers in a reliable and valid way.
- The numbers convey information about the property being measured.
- When numbers are used, the researcher must have a rule for assigning a number to an observation in a way that provides an accurate description.

Concept

- A generalized idea about a class of objects, attributes, occurrences, or processes

Operational Definition

Specifies what the researcher must do to measure the concept under investigation



➤ **scales**


A device providing a range of values that correspond to different values in a concept being measured.

➤ **correspondence rules**

Indicate the way that a certain value on a scale corresponds to some true value of a concept.

➤ Hopefully, they do this in a truthful way.

➤ Here is an example of a correspondence rule: “Assign the numbers 1 through 7 according to how much trust that you have in your sales representative. If the sales representative is perceived as completely untrustworthy, assign the numeral 1, if the sales rep is completely trustworthy, assign a 7.”




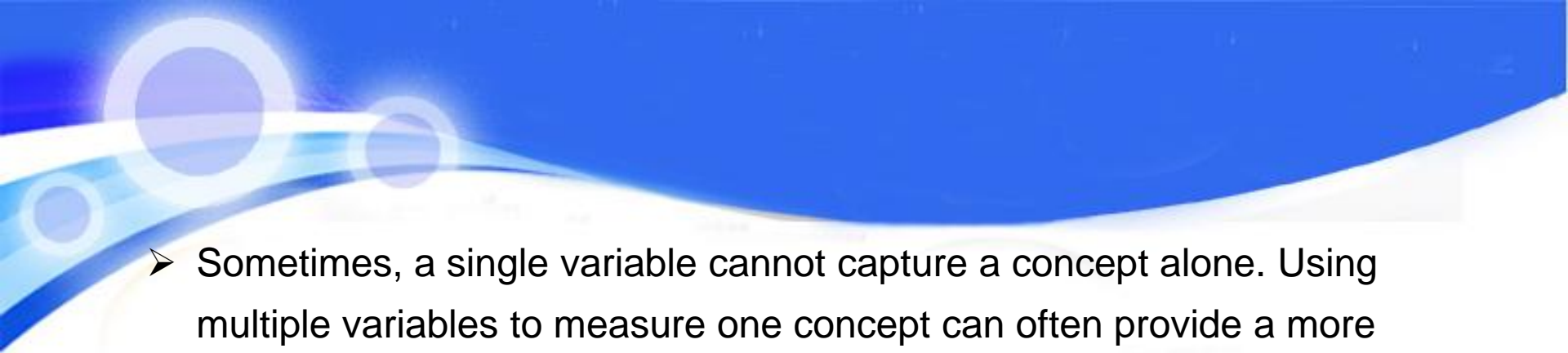
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- **Variables** are things that we measure, control, or manipulate in research.
 - Before variables can be measured they must be defined. Types of definitions:
 - ✓ Theoretical: the words used in a theory; basically dictionary or common use
 - ✓ Operational: a definition that explains how the variable is to be measured
 - ✓ Operational definition: assigns a meaning to a concept or variable by specifying the operations needed to measure it

EXHIBIT 13.3 Susceptibility to Interpersonal Influence: An Operational Definition

Concept	Conceptual Definition	Operational Definition
Susceptibility to interpersonal influence	Susceptibility to interpersonal influence is "the need to identify with or enhance one's image in the opinion of significant others through the acquisition and use of products and brands, the willingness to conform to the expectations of others regarding purchase decisions, and/or the tendency to learn about products and services by observing others or seeking information from others." Susceptibility to interpersonal influence is a general trait that varies across individuals.	Please tell me how much you agree or disagree with each of the following statements: <ol style="list-style-type: none">1. I frequently gather information about stocks from friends or family before I invest in them.2. To make sure I buy the right stock, I often observe what other investors invest in.3. I often consult other people to help choose the best stock to invest in.4. If I have little experience with a (type of) stock, I often ask my friends and acquaintances about the stock.5. I like to know what investment decisions make good impressions on others.6. I generally purchase those stocks that I think others will approve of.7. I often identify with other people by purchasing or selling the same stocks they sell or purchase.8. I achieve a sense of belonging by purchasing or selling the same stocks that others purchase or sell.9. If others can see in which stocks I invest, I often invest in stocks that they invest in.


Sources: Bearden, W. O., R. G. Netemeyer, and M. F. Mobley, *Handbook of Marketing Scales: Multi Item Measures for Marketing and Consumer Behavior Research*, 2nd ed. (Newbury Park, Calif: Sage Publications, 1999); Hoffmann, A. O. I. and T. L. J. Broekhuizen, "Susceptibility to and Impact of Interpersonal Influence in an Investment Context," *Journal of the Academy of Marketing Science* doi 10.1007/s11747-008-0128-7 (forthcoming), published with open access at <http://springerlink.com>.


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- Sometimes, a single variable cannot capture a concept alone. Using multiple variables to measure one concept can often provide a more complete account of some concept than could any single variable.
 - In social science, many concepts are measured with multiple measurements.
 - **A construct is a term used for concepts that are measured with multiple variables.**
 - **For instance**, when a business researcher wishes to measure the customer orientation of a salesperson, several variables like these may be used, each captured on a 1–5 scale:
 1. I offer the product that is best suited to a customer's problem.
 2. A good employee has to have the customer's best interests in mind.
 3. I try to find out what kind of products will be most helpful to a customer.
- Constructs can be very helpful in operationalizing a concept.


Levels of Scale Measurement

The four levels or types of scale measurement are *nominal*, *ordinal*, *interval*, and *ratio* level scales.

- ✓ **Nominal** variables allow for only qualitative classification.
- ✓ That is, they can be measured only in terms of whether the individual items belong to some distinctively different categories, but we cannot quantify or even rank order those categories.
- ✓ For example, all we can say is that two individuals are different in terms of variable A (e.g., they are of different race), but we cannot say which one "has more" of the quality represented by the variable.
- ✓ Typical examples of nominal variables are *gender*, *race*, *color*, *city*, etc.

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- **Ordinal variables** allow us to rank order the items we measure in terms of which has less and which has more of the quality represented by the variable, but still they do not allow us to say "how much more."
 - A typical example of an ordinal variable is the socioeconomic status of families.
 - For example, we know that upper-middle is higher than middle but we cannot say that it is, for example, 18% higher.
 - we can say that nominal measurement provides less information than ordinal measurement, but we cannot say "how much less" or how this difference compares to the difference between ordinal and interval scales.

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- **Interval variables** allow us not only to rank order the items that are measured, but also to quantify and compare the sizes of differences between them.
 - For example, temperature, as measured in degrees Fahrenheit or Celsius, constitutes an interval scale. We can say that a temperature of 40 degrees is higher than a temperature of 30 degrees.

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- **Ratio variables** are very similar to interval variables; in addition to all the properties of interval variables, they feature an identifiable absolute zero point, thus, they allow for statements such as x is two times more than y.
 - Typical examples of ratio scales are measures of time or space.
 - For example, as the Kelvin temperature scale is a ratio scale, not only can we say that a temperature of 200 degrees is higher than one of 100 degrees, we can correctly state that it is twice as high.
 - Interval scales do not have the ratio property. Most statistical data analysis procedures **do not distinguish** between the interval and ratio properties of the measurement scales.



20 Seconds



1.0 Second



1 minute 59 $\frac{2}{5}$ seconds for $\frac{1}{4}$ miles

Level	Examples	Numerical Operations	Descriptive Statistics
Nominal	Student ID number Yes – No Male – Female Buy – Did Not Buy East region Central region West region	Counting	<ul style="list-style-type: none"> • Frequencies • Mode
Ordinal	Student class rank Please rank your three favorite movies. Choose from the following: <ul style="list-style-type: none"> • Dissatisfied • Satisfied • Very satisfied • Delighted Indicate your level of education: <ul style="list-style-type: none"> • Some high school • High school diploma • Some college • College degree • Graduate degree 	Counting Ordering	<ul style="list-style-type: none"> • Frequencies • Mode • Median • Range
Interval	Student grade point average (GPA) Temperature (Celsius and Fahrenheit) Points given on an essay question 100-point job performance rating provided by supervisor	Common arithmetic operations	<ul style="list-style-type: none"> • Frequencies • Mode • Median • Range • Mean • Variance • Standard deviation
Ratio	Amount spent on last purchase Salesperson sales volume Number of stores visited on a shopping trip Annual family income Time spent viewing a Web page	All arithmetic operations	<ul style="list-style-type: none"> • Frequencies • Mode • Median • Range • Mean • Variance • Standard deviation

DISCRETE MEASURES

- ✓ **Discrete measures are those that take on only one of a finite number of values.**
- ✓ **A discrete scale** is most often used to represent a classification variable. Therefore, discrete scales do not represent intensity of measures, only membership. Common discrete scales include any yes-or-no response, matching, color choices, or practically any scale that involves selecting from among a small number of categories. Thus, when someone is asked to choose from the following responses
 - Disagree
 - Neutral
 - Agree
- ✓ the result is a discrete value that can be coded 1, 2, or 3, respectively. This is also an ordinal scale to the extent that it represents an ordered arrangement of agreement.
- ✓ Nominal and ordinal scales are discrete measures.


CONTINUOUS MEASURES

- ✓ Continuous measures are those assigning values anywhere along some scale range in a place that corresponds to the intensity of some concept.
- ✓ Ratio measures are continuous measures.

Strictly speaking, interval scales are not necessarily continuous.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy participating in online auctions	1	2	3	4	5

This is a discrete scale because only the values 1, 2, 3, 4, or 5 can be assigned. Furthermore, it is an ordinal scale because it only orders based on agreement. We really have no way of knowing that the difference in agreement of somebody marking a 5 instead of a 4 is the same as the difference in agreement of somebody marking a 2 instead of a 1.

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- ✓ The mean and standard deviation may be calculated from continuous data.
 - ✓ Using the actual quantities for arithmetic operations is permissible with ratio scales.
 - ✓ Thus, the ratios of scale values are meaningful. A ratio scale has all the properties of nominal, ordinal, and interval scales.
 - ✓ However, the same cannot be said in reverse.
 - ✓ An interval scale, for example, has ordinal and nominal properties, but it does not have ratio properties (see Exhibit 13.5).

Three Criteria for Good Measurement

- The three major criteria for evaluating measurements are **reliability, validity, and sensitivity.**
- **Reliability** is an indicator of a measure's internal consistency.
- **Validity** is the accuracy of a measure or the extent to which a score truthfully represents a concept. In other words, are we accurately measuring what we think we are measuring?
- **Sensitivity** refers to an instrument's ability to accurately measure variability in a concept.

RELIABILITY: INTERNAL CONSISTENCY

- ❑ **Internal consistency** is Represents a measure's homogeneity or the extent to which each indicator of a concept converges on some common meaning.
- ❑ **split-half method** is A method for assessing internal consistency by checking the results of one-half of a set of scaled items against the results from the other half.
- ❑ **coefficient alpha (α)** is The most commonly applied estimate of a multiple-item scale's reliability.
- ❑ It represents the average of all possible split-half reliabilities for a construct.
- ❑ When the coefficient is below 0.6, the scale has poor reliability

VALIDITY

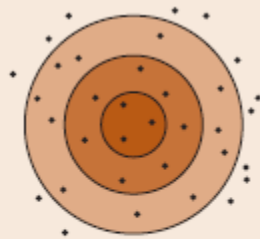
- ✓ The four basic approaches to establishing validity are *face validity*, *content validity*, *criterion validity*, and *construct validity*.
- ✓ **Face validity is** A scale's content logically appears to reflect what was intended to be measured.
- ✓ **content validity is** The degree that a measure covers the breadth of the domain of interest.
- ✓ **criterion validity is** The ability of a measure to correlate with other standard measures of similar constructs or established criteria.
- ✓ **construct validity is** Exists when a measure reliably measures and truthfully represents a unique concept; consists of several components including face validity, content validity, criterion validity, convergent validity, and discriminant validity.

Construct validity

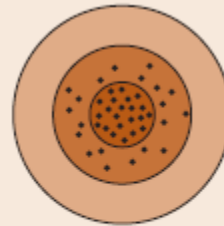
Construct validity consists of several components, including

- Face validity
- Content validity
- Criterion validity
- **Convergent validity is** Concepts that should be related to one another are in fact related; highly reliable scales contain convergent validity.
- **Discriminant validity is** Represents how unique or distinct is a measure; a scale should not correlate too highly with a measure of a different construct.

Validity & Reliability



Old Rifle
Low Reliability
(Target A)



New Rifle
High Reliability
(Target B)



New Rifle Sunglare
Reliable but not Valid
(Target C)