

# Measurement

# Measurement

- ***The process of assigning numbers or other symbols to characteristics or attributes of a concept according to specified rules.***
- **Tools**
  - Ruler, thermometer, stopwatch, weight scale.
- **Scales**
  - Beck Depression Scale
  - Family Environment Scale
  - Self-esteem Scale
  - Conflict Tactics Scale
- **Self report / Other report**
- **Direct observation**
- **Analysis of interview or other records**



# Variables

- **Something that can vary**
  - If we study self-esteem, it varies from low levels to high levels.
  - Attitudes vary from strongly disagree to strongly agree.
- **Measurement choices**
  - Ask questions (Primary data)
  - Observe (Primary data)
  - Consult existing records (Secondary data)
- **What is Measured**
  - Frequency (how often)
  - Duration (how long)
  - Magnitude (how much)



# Defining Variables



- **Nominal definition (dictionary)**
  - *Self-esteem*: one's overall feelings about their personal worth and value.
  - *Ethnic group*: identification with a group of people that have common culture, traditions, and history.
- **Operational Definition Choices (*Self-esteem*)**
  - Self-report (Lots, Some, Not at all)
  - Scale (Total score from 25 item questionnaire)
  - Teacher ranking (Highest to Lowest)
  - Rater report after interview (Good, Moderate, Poor)
- ***How to operationalize "Ethnic Group"?***
  - *Check mark on a list of groups.*
  - *Response to open-ended question.*

# Levels of Measurement

- **Nominal** – categories
  - Sex, race, religious affiliation, political party
  - No numerical meaning.
- **Ordinal** – more or less: groupings
  - Satisfaction or Agreement: high, medium, low.
  - Education: high school, some college, college.
  - Quantitative meaning is unclear.
- **Interval** – category distance has meaning
  - I.Q. score. (But no zero I.Q.)
- **Ratio** – equal intervals and true zero.
  - Age, number of children, number of days absent.



# Which Level of Measurement?

## ■ *Nominal, Ordinal, Interval, Ratio ?*

- Democrat or Republican
- Grade point average
- Exercise: None, A little, Moderate, Great deal
- SAT score
- Marital Satisfaction Scale from 15 to 150
- Which research class: 1=M, 2=W, 3=S
- Classmate Popularity: rank order from most popular to least popular
- Income (actual)
- Income: 1 = <\$20,000; 2=\$20,000 – \$50,000; 3=>\$50,000



# Survey Research



- A systematic way of gathering data using a structured format.
  - Measure what respondents know, believe, feel, or how they say they behave
- **Self-administered questionnaire**
  - A survey that is mailed to potential respondents or that is given in person
  - Web-based surveys are increasingly used
- **Interview Schedule:**
  - survey is administered face to face or by telephone.
    - CATI (Computer Assisted Telephone Interview)

# Types of Surveys



- **Structured – maintain uniformity**
  - Closed-ended questions with forced choices
    - “Are you a Democrat, Republican, or Other?”
- **Semi-structured**
  - Interviewer is free to clarify the questions and follow-up on the participant’s responses, but questions are pre-arranged.
  - Use of open-ended questions – no choices
    - “How has caring for your elder parent affected you?”
- **Unstructured**
  - Totally open-ended interview with no predetermined direction for questions.
    - “Tell me a little about yourself.”

# Observational Research

"Actions speak louder than words"

- **Pure observation**

- Researcher remains apart from the observed:
  - Avoids **social desirability** – tendency to say the socially acceptable thing or to tell people what you think they want to hear.

- **Participant observation**

- Observer becomes an active participant in the research setting.
  - **Reactivity** – people tend to change behavior when they know they are being observed.
  - **Observer Inference** – Observer interprets events from her/his own point of view.

# Existing Records

- Paper and electronic documents, databases, and other non-document artifacts of human behavior. E.g., census data, agency files, police records.
  - Advantages:
    - Inexpensive, fast
  - Disadvantages:
    - No control over the types or accuracy of the data
    - Different data sets may be difficult to compare or combine



# Apples or Oranges



## ■ Quantitative

- Consistent; standardized
- Large samples; generalizable results
- Reductionistic; limited number of predefined variables

## ■ Qualitative

- Open-ended, in-depth, insight-oriented
- No preconceived answers to questions
- Seeks patterns and processes
- No limit on types of data or questions

Both provide useful information

# Standardized Instruments



- **A tool to measure a concept**
  - **Item:** single indicator of a variable, e.g., one question.
  - **Index:** simple addition or mean of items.
  - **Scale:** includes different weighting of items.
- **May be *normed***
  - Information about how various large groups scored on the instrument.
  - Need to assess the generalizability of the norms and when they were established.

**All instruments have some degree of error.**

# Measurement Error



- **Random error**

- Errors that are not consistent or patterned.
- Anything that can't be controlled but is likely to be equally distributed among subjects.
  - Health, motivation, random answers, typos
  - Feelings about the researcher or subject matter
  - Reading level
- Thought to balance out across the study.

# Systematic Error

- *Patterned or consistent error*
  - *Bias in how questions are asked*

Interviewer smiles when we get the right answer.

    - Keep data collectors and subjects “blind.”
  - *Response set*

Tending to agree or disagree.
  - *Social desirability*

Saying the nice or “right” thing to look good.
  - *Question wording*

“Assistance to poor” versus “Welfare.”

# Systematic Error (cont'd.)



- *Question order or questionnaire introduction*
  - Question: “Which are the most prevalent social problems today?”
  - Answers: CRIME, poverty, health
- *Subject selection*
  - Reading level doesn't match subject ability
- *Cultural / language bias*  
e.g., I.Q. tests, SAT

**Always pretest your instrument**

# Validity

- *Does the instrument measure what you think it's measuring? Real meaning.*
- **Face validity**
  - Does it makes sense?
  - Will people take it seriously?
- **Content Validity**
  - How are the items selected?
  - Do they represent the full range of the concept?



# Validity (cont'd.)



## ■ Criterion Validity

- Same results as something known to measure the concept (e.g., skin-based blood sugar).
- *Concurrent Validity*: test against another valid measure.
- *Predictive Validity*: ability to predict future events, e.g., suicide scale predicts attempts.
- *Discriminant Validity*: ability to discriminate known groups, e.g., abusers from non-abusers, depressed from not depressed.

# Validity (cont'd.)



- **Construct Validity**
  - Correlation with expected concepts and propositions, NOT with others outside of the theory.
    - Abuse correlates with stress and social isolation but not with hair color or IQ.
    - Technology skills correlate with years of computer ownership, but not with birth order or life satisfaction.

# Reliability



- **Stability:** Measures don't change:
  - Thermometer, bathroom scale
- **Equivalence:** all items measure the same concept.
  - Spelling test shouldn't have math items.
- **Internal consistency**
  - Items testing the same concept should have similar scores.
- **Reliability does not equal accuracy**
  - Bathroom scale off by 15 pounds is reliable.
  - Thermometer is broken, but is reliably wrong.

# Promoting Reliability



- **Questions**
  - Keep it simple
  - Be sure people know the answer or opinion
- **Interviewers / Raters**
  - Training, regular check-ups
- **Testing Reliability**
  - Test-retest
  - Parallel forms or Split half
  - Interrater reliability (two or more)
  - Intrarater reliability (test same rater twice)
  - Internal consistency (consistency of item scores with each other)

# Relationship

- If reliable, not always valid.
- If not reliable, never valid.
- If not valid, may be reliable.
- If valid, always reliable.



# Finding Measures

- Program objectives and research needs determine measures to use.
- Places to find measures:
  - Measure is part of journal article.
  - Published in book of measures.
  - Contact the test author and request permission to use their test.
  - Use a directory published by scientific and professional associations like APA.
  - If these attempts to locate the author fail, contact the publisher holding the copyright to the original material and request permission from the publisher.
  - Search the Internet.

# Designing Measures



- **Maximize response rate**
  - Use a professional looking instrument
    - Avoid the cluttered look and small type.
  - Be explicit in explaining to respondents why the research is being conducted.
  - Make assurances that the results will be kept confidential, and that no services will be withheld or denied even if the respondent chooses not to participate.
  - If potentially sensitive items are to be asked, keep them to a minimum and position them later in the instrument.

# Design (cont'd.)

- Avoid asking questions that the target population is not expected to know anything about.
- Avoid biased questions
  - e.g., “Do you believe that all forms of abortion, the killing of pre-born babies, should be illegal?”
- Keep open ended questions to a minimum.
- Keep survey as short as possible.
- Begin with interesting questions first.
- Explain transition to next section.



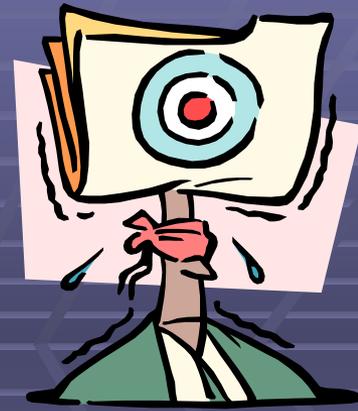
# Design (cont'd.)



## ■ Minimize Error

- Consider the audience: age, education, etc
- Have simple, clear questions
  - Keep questions short, under 20 words.
  - Avoid slang terms.
- Position response categories vertically underneath the question stem rather than side-by-side.
- Use the highest level of measurement possible.
  - Ask exact age rather than a category.
- Don't ask for unavailable information
  - Asking college seniors, "How much did you study in the 7<sup>th</sup> grade?"

# Design (cont'd.)



- Avoid double questions
  - *Do you support abortion or are you a conservative?*
- Avoid negative wording
  - *Do you not think the government should pay for school lunches?*
- Use clear instructions.
- Have instruments translated when necessary.
- Reduce social desirability
  - Anonymous
  - Remind users that there are no right answers

# The Politics of Measures

- **Definition of measures is political**
  - Define “Marriage.” Who is included and who is not? How is it measured?
- **Measures may not be generalizable to all groups**
  - Many measures are tested on white, middle-class college students.
  - Some medicines are tested only on men, but their dosages may be different for women.
- **Measurement may be used to reinforce stereotypes**
  - Girls can’t do math.
  - Men have higher SAT scores. (Is the test biased?)

