Conceptualization

• 1. Definition
• 2. Dimensions
• 3. Indicators
• 4. Comparison of Concept, Dimension, and Indicator
• 5. Example
Definition

• Conceptualization is the process of development and clarification of concepts.

• In other words, clarifying one's concepts with words and examples and arriving at precise verbal definitions.

• e.g., what is meant by education?

• “Amount of knowledge and training acquired in school.”
Another Example

• What do we mean by "social status?"
  – Wealth (millionaire)
  – Prestige (Harvard professor)
  – Power (military general)

• These are called “dimensions” of social status.
Dimensions

• We classify different meanings into different groups. Such groups are called "dimensions."

• A concept may have more than one dimension (e.g., as in case of social status).

• At a practical level, we are usually more interested in dimensions than in concepts (which are more abstract, vague).
Indicators

• When a dimension is not directly observable, we use indicators.

• For example, to measure power, we may use
  – (1) number of people under your supervision
  – (2) extent of your supervision (work-related only, or sleep and food?)
  – (3) your annual budget
  – (4) amount of equipment under your control
Comparison of Concept, Dimension, and Indicator

- In practice, the three terms are often interchangeable (e.g., gender, race).
- One difference is the level of abstraction:
  
<table>
<thead>
<tr>
<th>Concept</th>
<th>Dimension</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly abstract</td>
<td>Abstract</td>
<td>Concrete</td>
</tr>
</tbody>
</table>

- One concept may have multiple dimensions; and one dimension may have multiple indicators
A Related term: Variables

- A variable is a statistical term, meaning a quantity that can take on different possible values.
- Both dimension and indicator can be variables.
- When a concept has only one dimension with one indicator, a concept is practically equivalent to a variable.
Summary
Example: SES

- SES
  - Wealth
  - Prestige
  - Power
    - $I_{31}$
    - $I_{32}$
    - $I_{33}$
    - ...

Measurement

• When it comes to measurement, we are talking about variables and indicators.

• Definition of measurement: "the assignment of numbers or labels to units of analysis to represent variable categories."

• Numbers mean different things under different circumstances.
Types of Measurement

- **Nominal** measurement
- **Ordinal** measurement
- **Interval** measurement
- **Ratio** measurement
Nominal Measurement

• Nominal measurement is a system in which cases are classified into two or more categories on some variable.

• Arbitrary numerical assignments. e.g., Race = 1 for white, 2 for black, and 3 for Asian.

• Two criteria for classifications:
  – Exhaustiveness
  – Mutual exclusiveness
**Ordinal Measurement**

- In ordinal measurement, numbers indicate the ranking order on a dimension.
- **e.g.,** for a typical attitude question on surveys,

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

- There is no **intrinsic** scale – you only know relative rankings.
- Should not do arithmetic (such as averaging).
Interval Measurement

• Interval measurement assumes equal distances or intervals between "numbers."
• Numbers represent not only rankings but also “values.”
• e.g., (70, 90, 80) is the same as (80, 80, 80) for the test component of your Soc.357 final grade.
**Ratio Measurement**

- If an interval variable has an absolute zero, it becomes a ratio variable.
- E.g., weight, number of siblings, birth rate, etc.
- Compare three temperatures: C, F, and K.
A Comparison of the Four

<table>
<thead>
<tr>
<th>Information Provided</th>
<th>Nominal</th>
<th>Ordinal</th>
<th>Interval</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Rank order</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Equal intervals</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Relative value</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

More general → More specific
Quality of measurement

• 1. Precision
  Precision is the extent to which numerically-detailed measurement remains meaningful (e.g., measuring annual income).

• 2. Accuracy
  Accuracy is the extent to which the measuring instrument measures what it is intended to measure. (Commonly gauged by reliability and validity).
Consequence of measurement error: descriptive versus explanatory studies

• In explanatory studies, we are interested in relationships between two concepts, or two variables. When a concept is poorly defined, the relationship is still there.

• e.g., gender and religiosity.

• Say the research interest lies in the differential between men and women. If we underestimate the absolute level by 30% for both, we still have an accurate measure of the relative value.
Gender and Religiosity Example

<table>
<thead>
<tr>
<th>Gender</th>
<th>True</th>
<th>Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td>Women</td>
<td>100</td>
<td>70</td>
</tr>
</tbody>
</table>

• i.e., explanatory analysis is **robust** to marginal changes of measurements.
• Reason: overestimation or underestimation for all units of analysis.
• Beware of **differential** under(over)estimation.
Methods for Assessing Reliability

• Test-retest method
  As in panel design, you measure the same quantity twice. Let us call the first measurement $y_1$, the second $y_2$. Reliability measure: correlation between $y_1$ and $y_2$.

• Low correlation means large random noise.
Methods for Assessing Reliability (Continued)

• Split-half method
  You may calculate correlations among different items on the same survey instrument, assuming equivalence of different items.

• High correlation: high reliability
Bias (Lack of Validity)

• In regression context,
  \[ y_i = \alpha + \beta x_i + \varepsilon_i \]
  \( \varepsilon_i \) does not have a mean of zero. Rather, it could be that
  \[ \varepsilon_i = 4 + \delta_i, \] where \( \delta_i \) is well behaved (i.e., has a mean of zero). Thus, 4 is the bias.
Methods for Assessing Validity

• A. Face validity
  See whether a measurement makes any sense to you and to others (also compare with similar independent measures – GSS)

• B. Criterion-related validity
  Does this measure predict other measures that can be measured more objectively.

• Use correlation or regression techniques.
Example: Predictability of SAT score of College Performance

- If SAT is a good measure of academic ability, why doesn’t it predict college performance well?

**Problems:**

- (1) selection bias;
- (2) mediating factors between first measurement and criterion (e.g., instruction);
- (3) measurement problems for the criterion (e.g., grade inflation, differential grading, etc.).
Methods for Assessing Validity (Continued)

• C. Content validity
  The extent to which an empirical measurement reflects a specific domain of content.

• D. Construct validity
  Construct validity is concerned with the extent to which a particular measure relates to other measures in ways consistent with theoretically derived hypotheses.
A Graphic Model for Construct Validity

\[ \text{X} \rightarrow \text{Y} \]

\[ I_{x1} \quad I_{x2} \quad I_{y1} \quad I_{y2} \]