

Applied Statistics for Public Policy Analysis

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A Policy Context

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- Every year, nearly **471 billion PKR** is being spent on Benazir Income Support Program as part of the broader social protection policy (MoF, 2024).
- Currently, Pakistan has the world's second-highest number of out-of-school children (OOSC) with an estimated **22.8 million children aged 5-16** not attending school, representing **44 percent of the total population** in this age group—(UNICEF, 2024).

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- How does access to clean drinking water affect health outcomes in urban vs. rural populations of Pakistan?
- Does the Sehat Sahulat Program reduce household health expenditure? If so, how much?
- What is the impact of extreme weather events on child malnutrition and the prevalence of waterborne diseases in rural communities?
- Think about recent floods in Punjab!

What is Research?

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- **Public Good**

- Research contributes to a broader base of knowledge than just researchers own interest.
- Consequently, it is important that research procedures are described in a way that enables other people to understand them, duplicate them and make judgments about their quality (**think about 600 years back**).

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- Using data and Experiments.

The Scientific Method

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- When the null hypothesis is supported, it undermines our proposed theory.

The Research-Practice Continuum



Figure: Research-Practice Continuum

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- Making generalization underlies the risk of Biases.

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- Scientists actively seek explanations grounded in causation rather than correlation.
- Scientific Knowledge should be replicable- Other scientists should reach the same conclusion in different contexts (*following the same design*).

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- Characteristics of Good Theories:
 - Coherent and internally consistent
 - Causal in nature
 - Generate testable hypotheses

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- Concepts are our building blocks to understanding the world and to developing theory that explains the world.

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- The expected relationship is called **THEORY**.

Measurement

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Examples:

- The effectiveness of public officer is measured by having senior officers rate junior officers on various traits.
- Educational attainment may be measured by how well a student scores on standardized achievement tests.
- Good performance by a city bus driver might be measured by the driver's accident record and by his or her record of running on time.
- The success of a nonprofit agency's fund-raising drive might be measured by the amount of money raised.

Thought-Provoking Question!

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Does this indicate poor performance of district health department?

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- Then concepts are measured indirectly through **indicators** specified by operational definitions.
- An **operational definition** is a statement that describes how a concept will be measured.
- An indicator is a variable, or set of observations, that results from applying the operational definition.

Examples of Operational Definition

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- Education attainment is defined by the scores on a standardized test.
- Patients' satisfaction with the service of the Hospital is measured according to the response categories that patients check on a questionnaire item (high satisfaction, medium satisfaction, and low satisfaction).

The goodness of Indicators

- Sometimes, an observed indicators may not offer a complete measure of the underlying concepts.

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- One reason for using *multiple indicators* is that a concept may have more than one dimension.

Validity and Reliability of Measurement

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- A measure is reliable if, when applied to the repeated observations in similar settings, the outcomes are consistent.

How important is the Quality of Measurement??

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- Measurement is *straight-forward* when we can *directly observe the phenomenon*.
- Measurement becomes more challenging when you *cannot directly observe the concept of interest*.

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- Question:
- Is the CSS examinations a valid indicators of on-the-job performance of civil servants?

Validity and Reliability

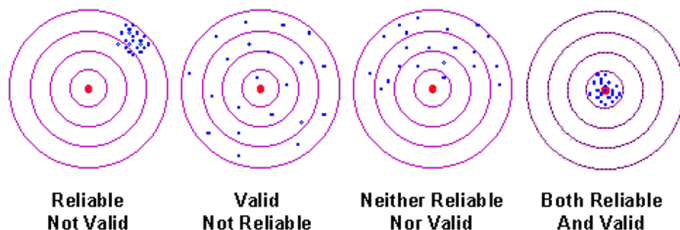


Figure: Validity and Reliability

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Validity Types

- **Convergent Validity:** Do the indicator and the concept converge?
- Measures of constructs that theoretically should be related to each other are, in fact, observed to be related to each other.
 - E.g. you should be able to show a correspondence or convergence between similar constructs

Convergent Validity

Theory

self esteem
construct

item 1

item 2

item 3

item 4

1.00	.83	.89	.91
.83	1.00	.85	.90
.89	.85	1.00	.86
.91	.90	.86	1.00

Observation

the correlations provide evidence
that the items all **converge**
on the same construct

Figure: Convergent Validity

Discriminant Validity

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- Measures of constructs that theoretically **should not be related** to each other are, in fact, **observed to not be related** to each other.
 - e.g. you should be able to discriminate between dissimilar constructs

Discriminant Validity

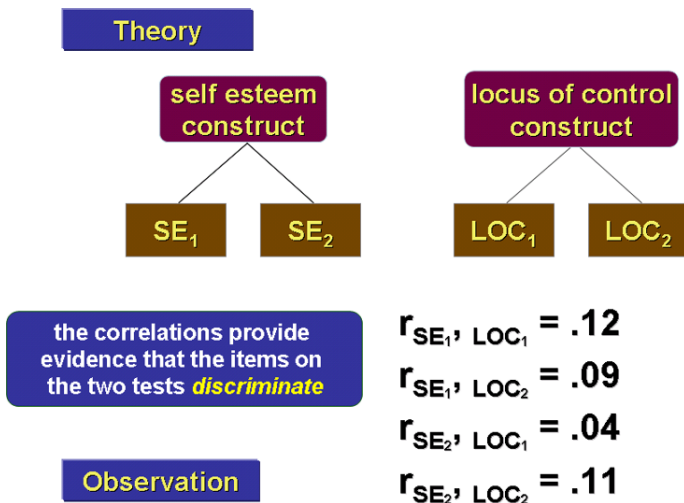


Figure: Discriminant Validity

Theory

self esteem
construct

locus of control
construct

SE₁

SE₂

SE₃

LOC₁

LOC₂

LOC₃

	SE ₁	SE ₂	SE ₃	LOC ₁	LOC ₂	LOC ₃
SE ₁	1.00	.83	.89	.02	.12	.09
SE ₂	.83	1.00	.85	.05	.11	.03
SE ₃	.89	.85	1.00	.04	.00	.06
LOC ₁	.02	.05	.04	1.00	.84	.93
LOC ₂	.12	.11	.00	.84	1.00	.91
LOC ₃	.09	.03	.06	.93	.91	1.00

Observation

the correlations support both
convergence and discrimination,
and therefore construct validity

Figure: Construct Validity

Dealing with Errors in Measurement

- In reality, there is always some possibility that the number assigned does not reflect the true value for that case, i.e.:
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 - Measuring instrument that lacks precision.
- **How to overcome?**
 - Test-Retest Method
 - Cronbach's alpha or Kuder-Richardson Formula

What is Cronbach Alpha: <https://statisticsbyjim.com/basics/cronbachs-alpha/>

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- **Ratio:** You can construct a meaningful fraction (or ratio) with a ratio variable.