

# Measurement Error

POST 8000 – Foundations of Social Science Research for Public Policy

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## Goal for Today

*Discuss what to avoid in your research design (i.e. measurement error).*

## On Error

Error is a fundamental part of a lot of research.

- e.g. random sampling error, random differences between treatment and control.

Thus, KKV argue to reduce error to “manageable proportions.” (p. 150)

# The Two Types of Error

## 1. Systematic

- Definition: a chronic, consistent distortion of a measure in a predictable way.

## 2. Random

- Definition: distortions in the recorded value that is neither a function of the “true” signal being measured, nor predictable.

# Common Types of Systematic Error

1. Selection bias
2. Omitted variable bias
3. Related: endogeneity

# Common Types of Random Measurement Error

1. Miscoding
2. Including irrelevant variables (i.e. garbage can modeling)

# Missing Data

Missing data is a unique kind of measurement error. Types:

1. Missing completely at random (MCAR)
2. Missing at random (MAR)
3. Missing not at random (MNAR)

# Effects of Systematic Measurement Error

- Invalidity
- Bias in our descriptive inferences
- Potential bias in our causal inferences
- Type 1 error



# Effects of Random Measurement Error

- Inefficiency
- Unreliability
- Type 2 error
- Increased variance

# Effects of Missing Data

MCAR: inefficiency

- Typically requires no correction unless missingness  $> 10\%$  of the data.

MAR: bias, but fixable

- Missingness depends on known/measured quantities.
- Underlying assumption of multiple imputation.

MNAR: bias, but unsalvagable

- Silver lining: we typically assume MNAR is actually MAR.
- We can eventually find the reasons why

## Some Caveats on Random Measurement Error

- Random error in the DV: creates more noise, greater difficulty in extracting a signal (huge errors)
- Random error in an IV: collapses effect gradually to zero
  - Potential spillover with other IVs, if they're correlated.

# Discussion

1. What's worse: Type 1 or Type 2 error?
2. When is omitted variable bias not a bias at all?
3. How do you "know" when you have a biased measure?

# Table of Contents

## Measurement Error

Introduction

Types of Error

Effects of Error

Discussion