

Study Design

Brenda Gunderson

Study Design

“Study design” encompasses *everything* in preparation for data-driven research process.

“exploratory” analysis
of available data



highly planned designs to
collect/analyze data

Study Design in Various Fields

- **Clinical** trials for drugs and other medical treatments
- **Reliability** and **quality-assurance** studies for manufactured products
- Observational studies for **human health**
- **Public opinion** and other surveys
- Studies involving **administrative** and other incidental data
- **Market research** studies
- **Agricultural** field trials

Types of Research Studies

- **Exploratory** versus **Confirmatory** studies
- **Comparative** versus **Non-Comparative** studies
- **Observational** studies versus **Experiments**

Confirmatory versus Exploratory Research

Confirmatory: Scientific method ~ specify **falsifiable hypothesis**, then test it → collect data to address single pre-specified question



Exploratory: Collect and analyze data without first pre-specifying question

CAUTION: Informative but **watch out** for
“**overfitting**”, “**multiple testing**” “**p-hacking**”
The more questions you ask from a dataset →
the more likely you are to draw a misleading conclusion.

Comparative Research Studies

Goal = contrast one quantity to another





BALLOT PAPER
HOUSE OF REPRESENTATIVES
YOUR STATE
ELECTORAL DIVISION OF
YOUR ELECTORATE

*Number the boxes
from 1 to 8 in the
order of your choice.*

4

CANDIDATE A
POLITICAL PARTY

6

CANDIDATE B
INDEPENDENT

3

CANDIDATE C
POLITICAL PARTY

1

CANDIDATE D
POLITICAL PARTY

5

CANDIDATE E
POLITICAL PARTY

8

CANDIDATE F
POLITICAL PARTY


2

CANDIDATE G

7

CANDIDATE H
POLITICAL PARTY

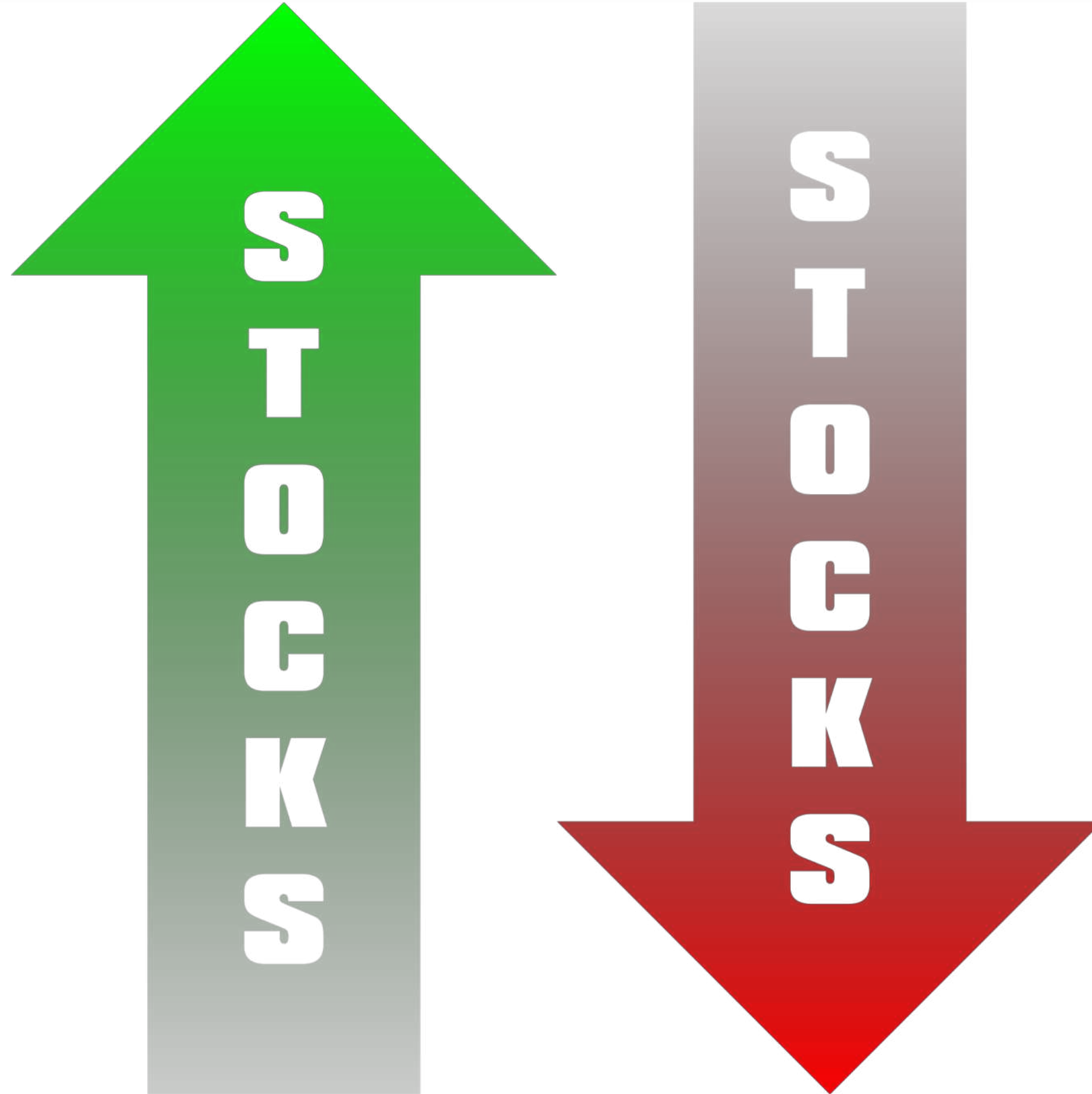
Remember...number every box
to make your vote count.





Non-Comparative Research Studies

Focus = estimating or predicting absolute quantities
~ not (explicitly) comparative





“Blood Pressure Monitor” by [Medisave UK](#) is licensed under [CC BY 2.0](#)

Observational Data and Experiments

arise “naturally”, contrasts based on
“self-selection” of units into groups



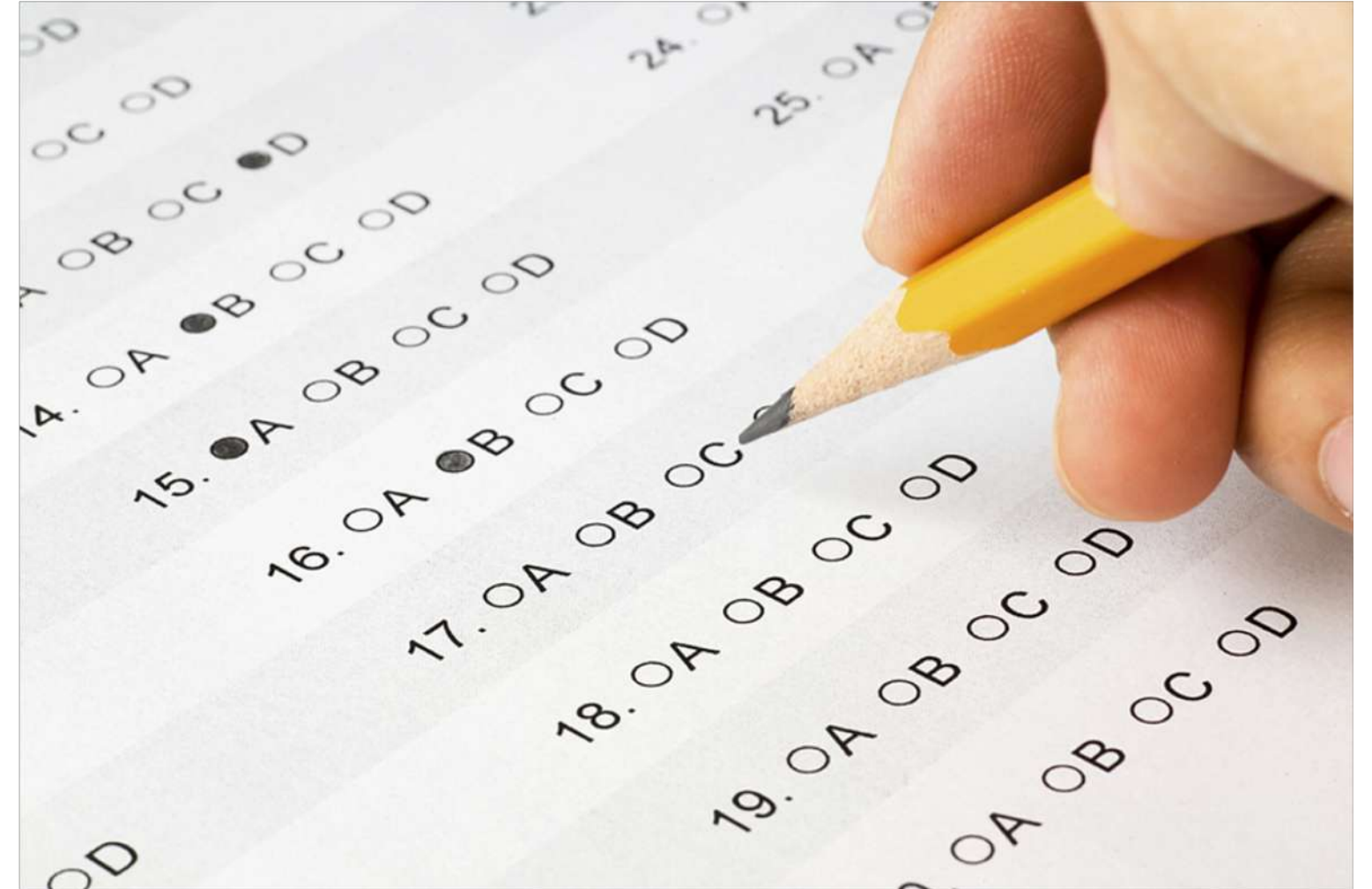
involve manipulation or assignment
→ experimenter deliberately treats
different units in different ways



Observational Study



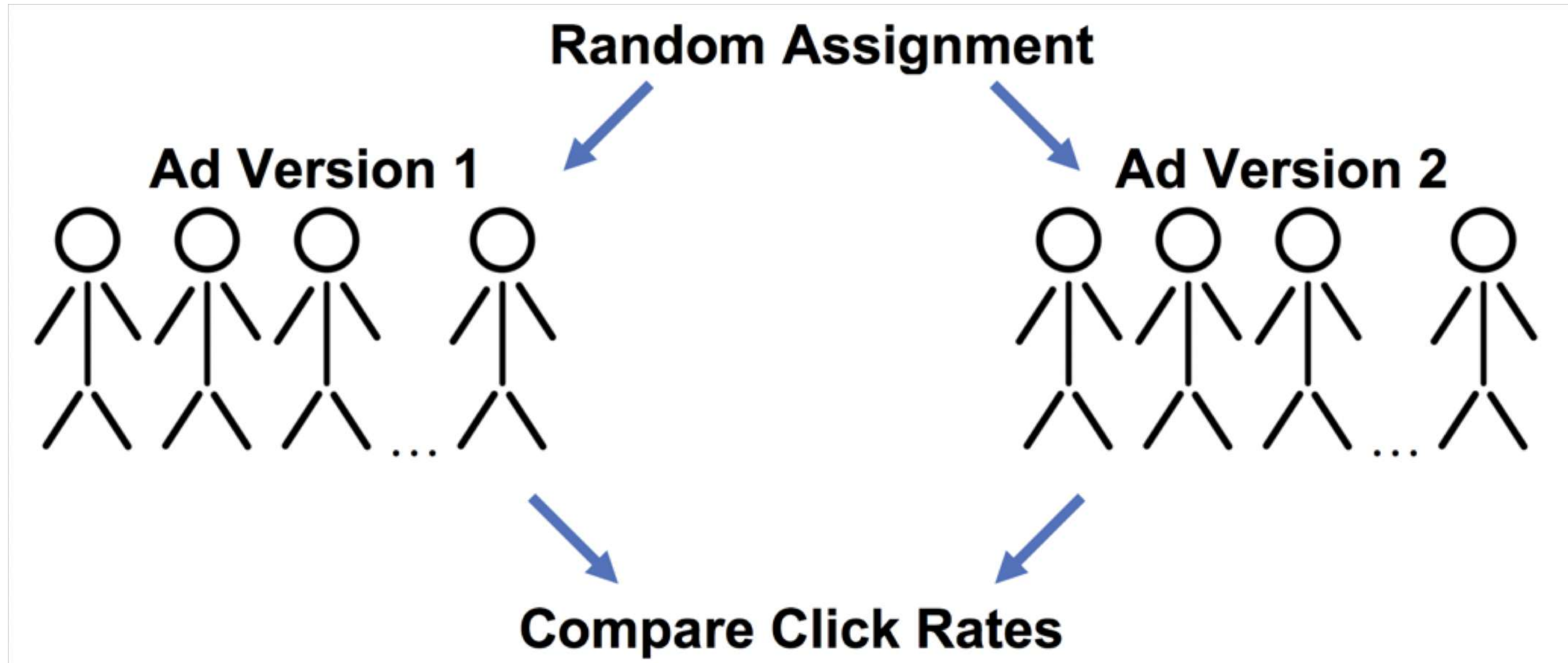
Observational Study



Experiment



Experiment



Implications of Experimental/Observational Design

Experiments
often involve **random assignment** of subjects
to “treatment arms”

Observational Studies
often say subjects are
“**exposed**” to a condition
rather than being “assigned”
*(passive or self-selected, used when
impractical or unethical to assign)*

Power and Bias

Power Analysis: Process to assess whether given study design likely to yield meaningful findings

Bias: Measurements that are systematically off-target, or sample is not representative of population of interest.

Observational studies are especially vulnerable to it.