Study Design

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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

Study Design

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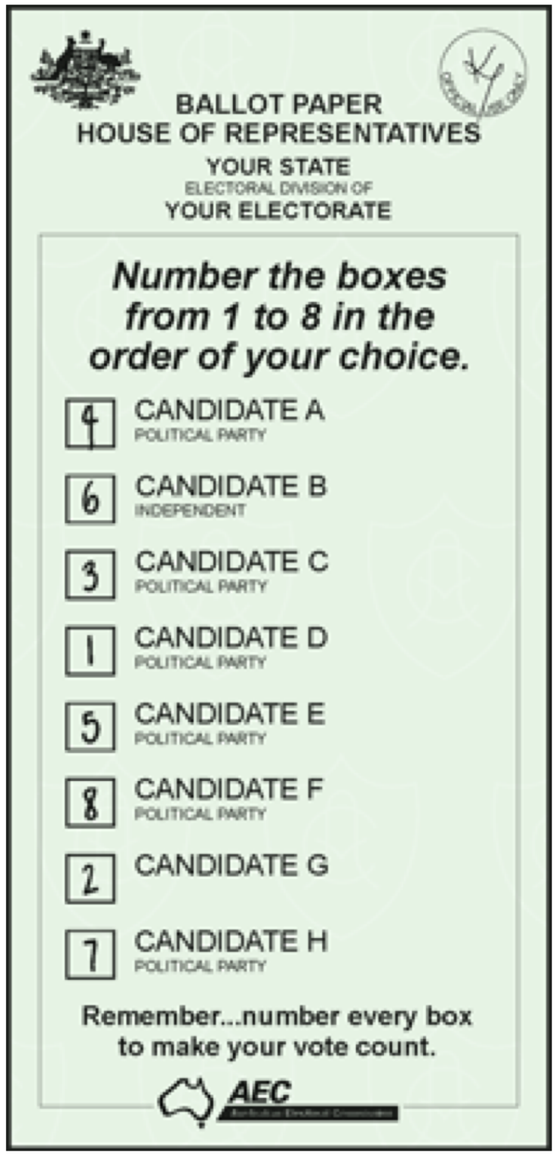

BALLOT PAPER
HOUSE OF REPRESENTATIVES
YOUR STATE
ELECTORAL DIVISION OF
YOUR ELECTORATE

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.

AEC


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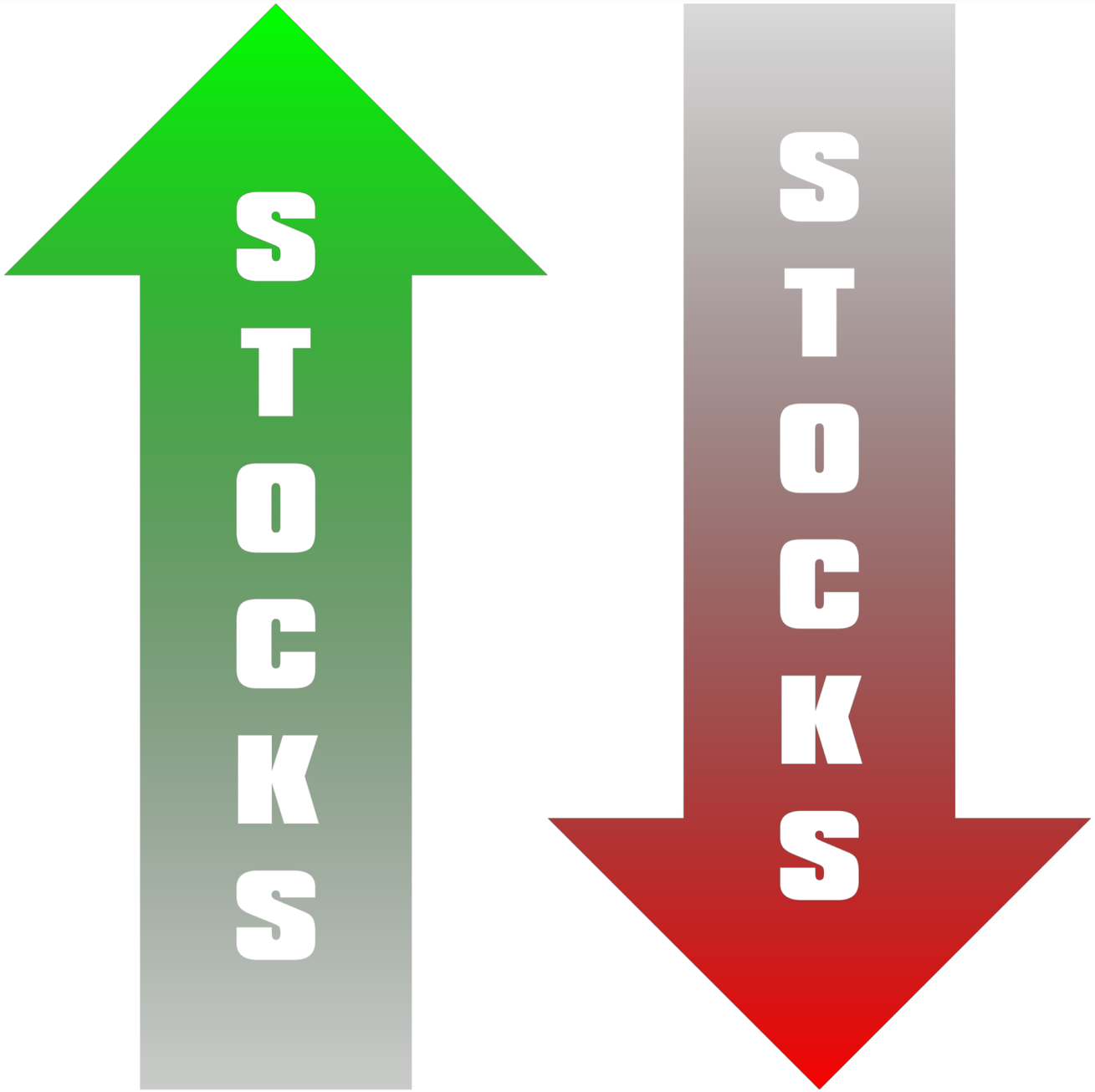
Non-Comparative Research Studies

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


STOCKS
STOCKS

Study Design

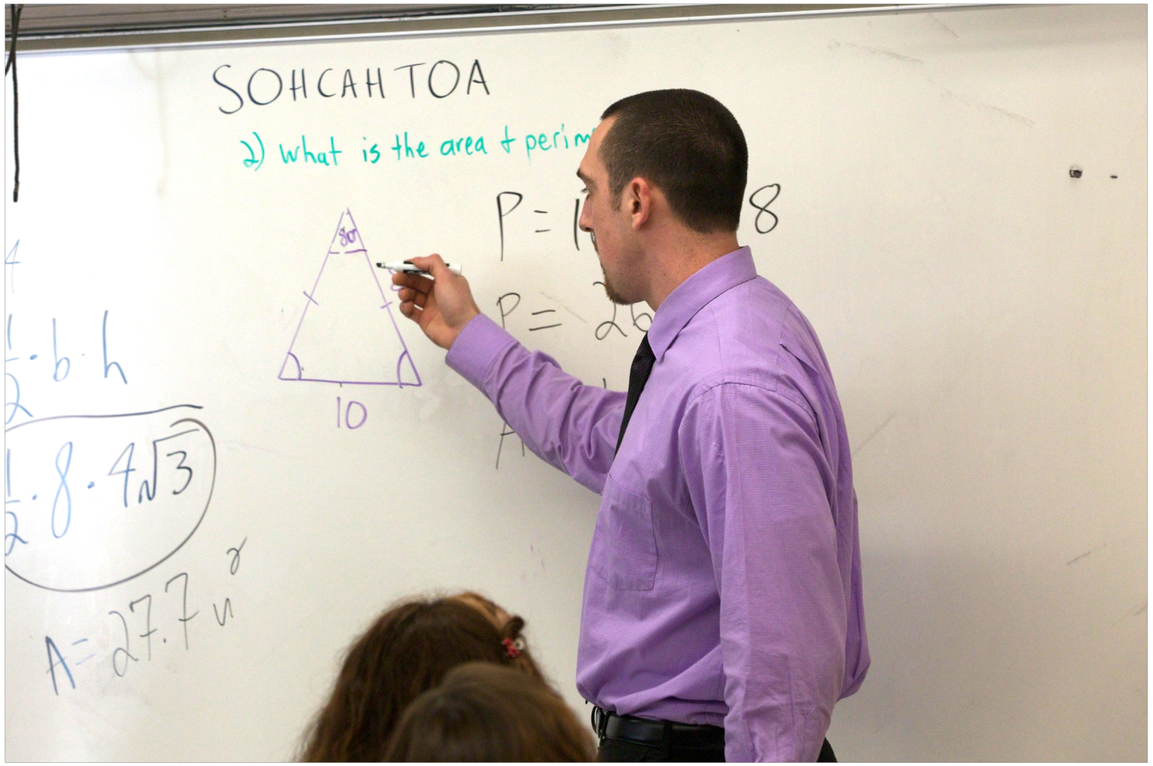
Observational Data and Experiments

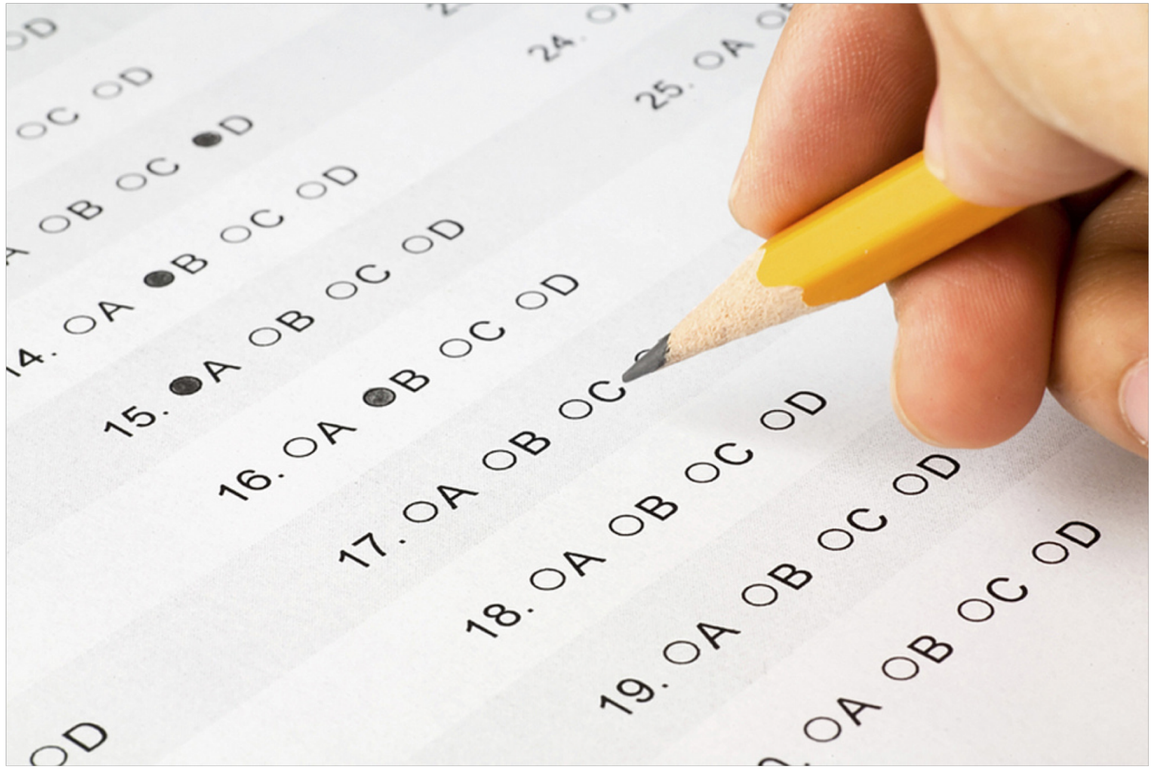
arise "naturally", contrasts based on "self-selection" of units into groups

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

Observational Study

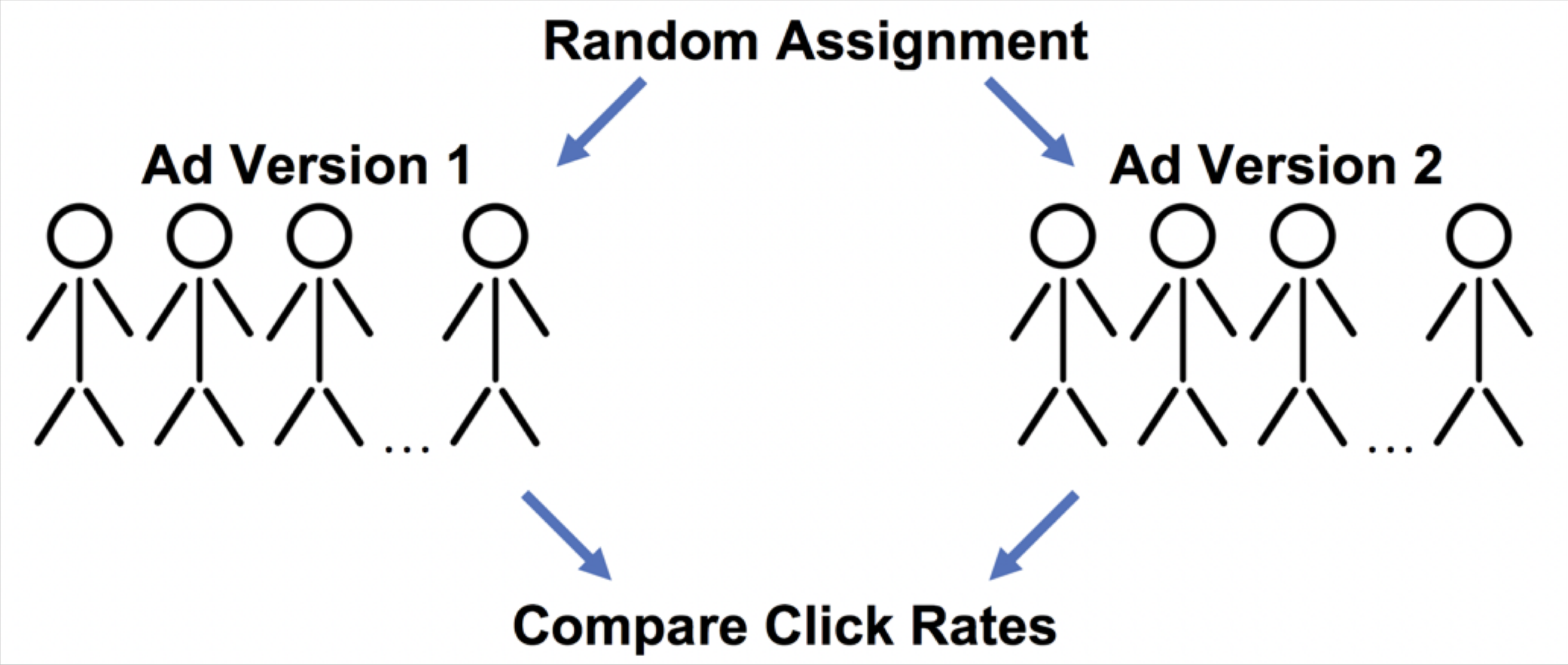
Observational Study





Experiment

Experiment


Random Assignment
Ad Version 1
Ad Version 2
Compare Click Rates

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.