

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

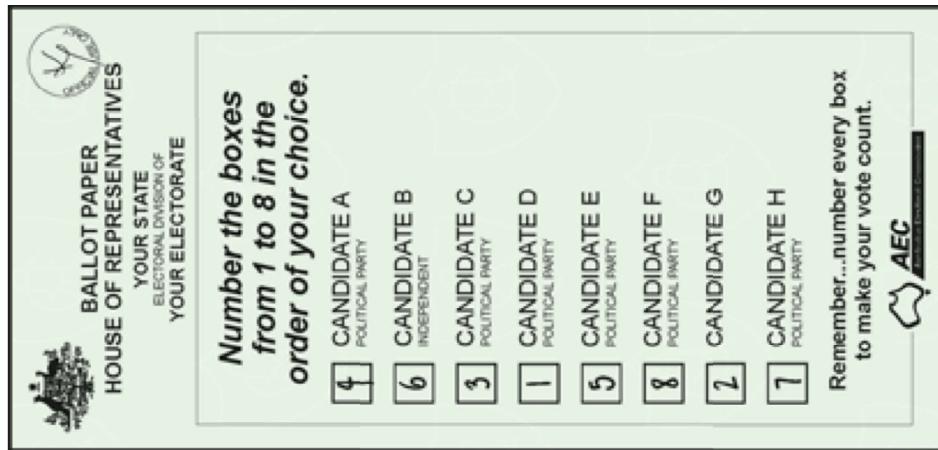
Exploratory: Collect and analyze data without first pre-specifying question

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

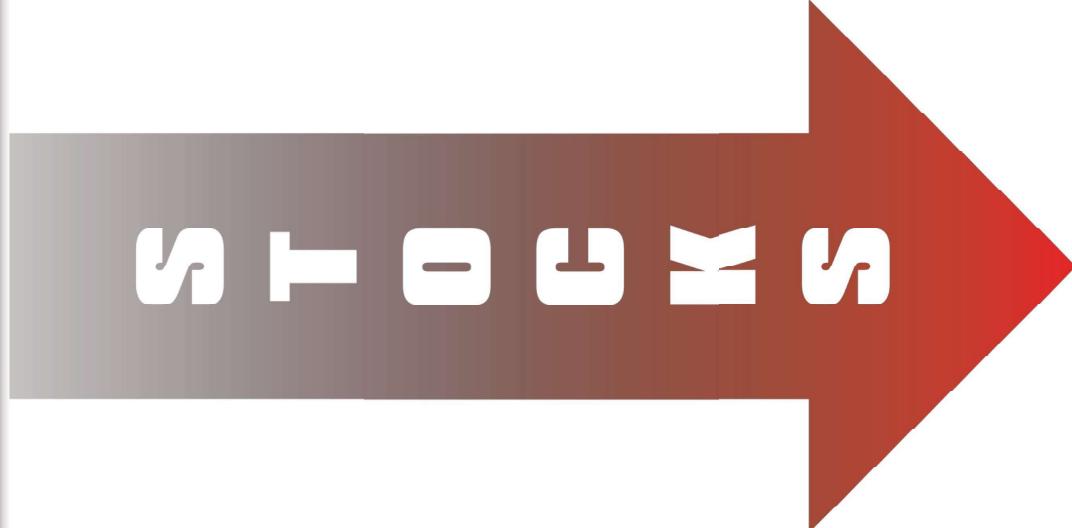




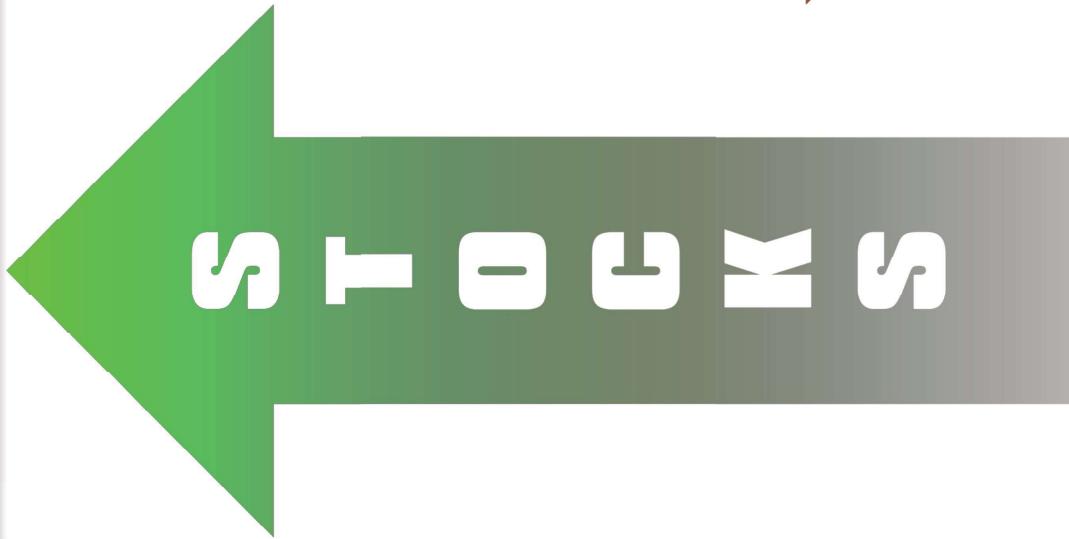


Non-Comparative Research Studies

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



STOCKS



STOCKS



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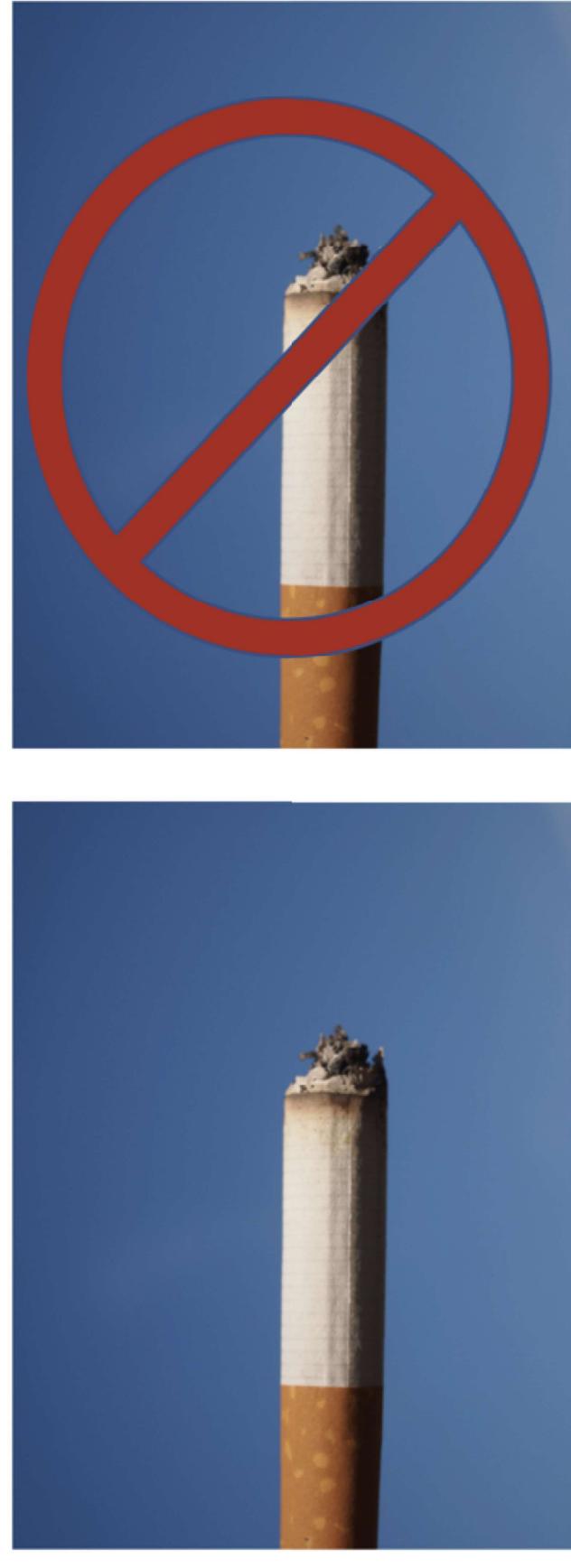
Observational Data and Experiments



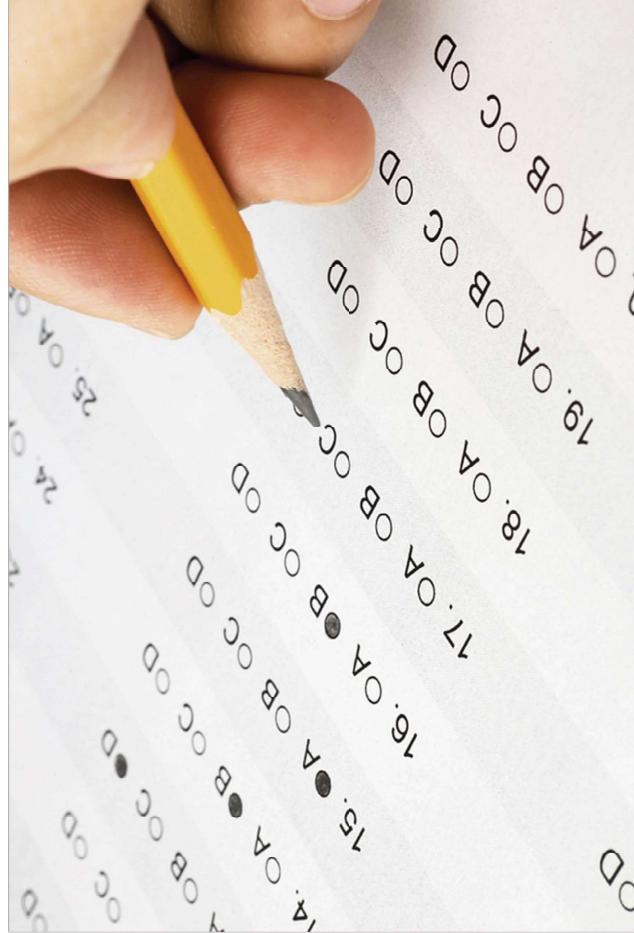
arise “naturally”, contrasts based on
“self-selection” of units into groups
↓
involve manipulation or assignment
→ experimenter deliberately treats
different units in different ways



Observational Study



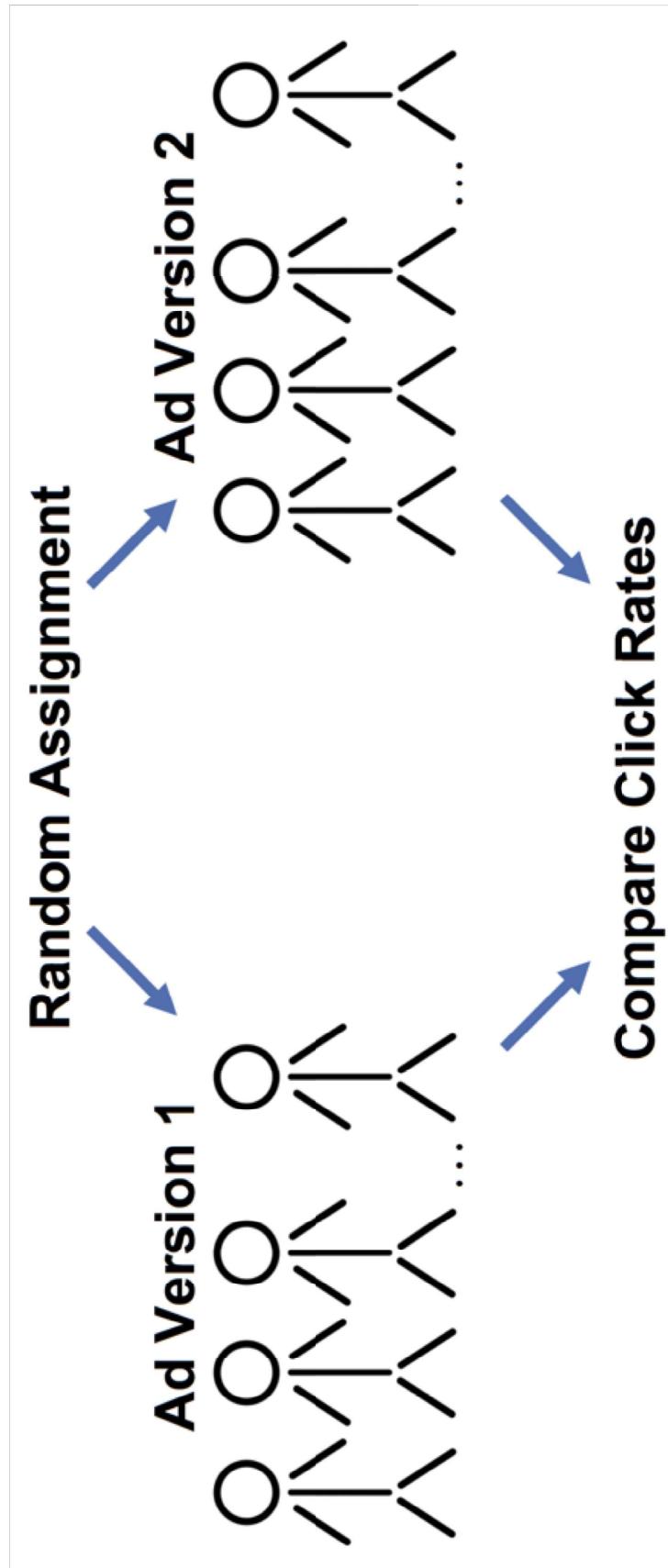
Observational Study



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.