

Methods Core Workshop: Week 3

Causation I: Randomization & Controls



Agenda

1. How did the Formative go?
2. Preparing for your Summative
3. Key Concepts from the Lecture
4. Group Discussion

Preparing your Summative

*“The essay is a critical assessment of the methodologies used to study **a topic of your choosing.**”*

- Hopefully now you have a topic that interests you
- The aim for the remainder of this course is to learn about different research methods and evaluate their strengths and weakness for your research topic

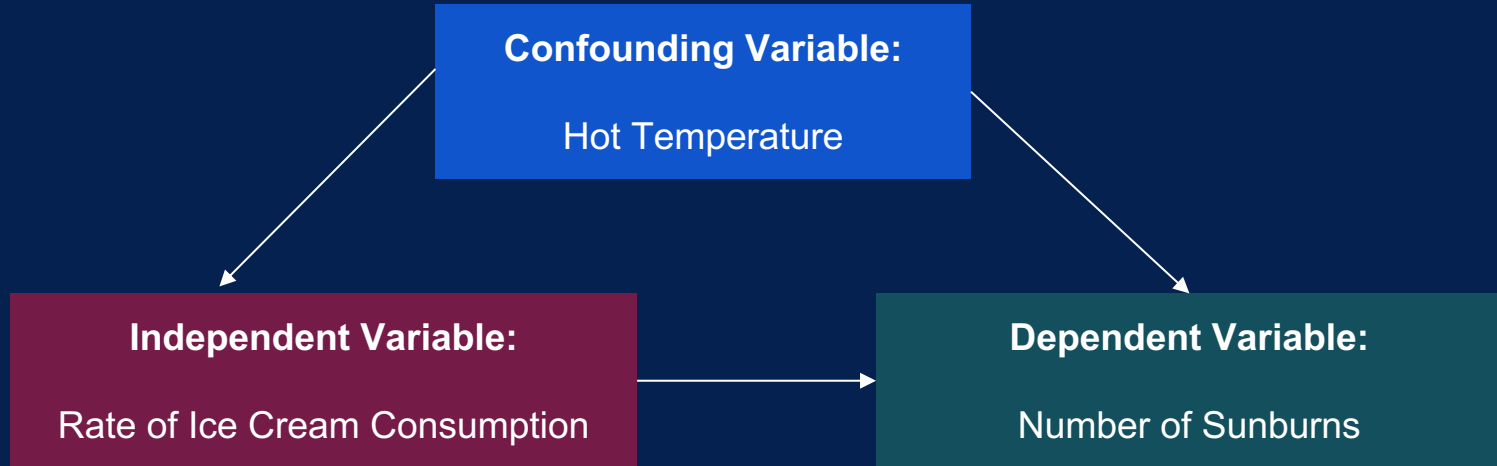
Key Concepts from the Lecture

1. Making Causal Arguments
2. RCTs vs Observational Studies

Making causal arguments

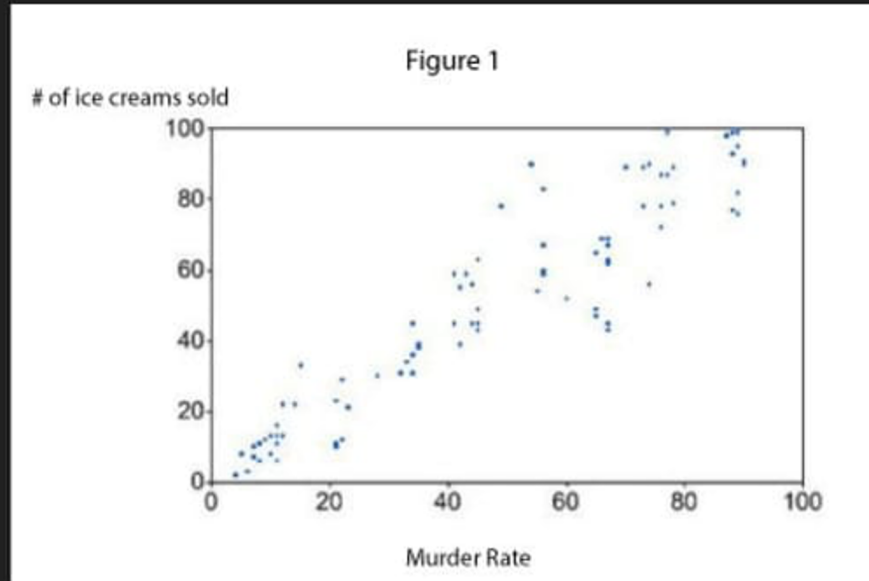
- Causal inference assumes that:
 - There is no random confounding from an excluded cause;
 - Treatment and control group assignment is statistically independent of other variables;
 - Symmetrical distribution and few outliers.
- For causal explanation (Babbie, ch 4)
 - The variables must be correlated
 - The cause takes place before the effect
 - The variables are non-spurious (i.e. effect cannot be explained by some third variable)

An Example of a Spurious Association



An Example of a Spurious Association

Ice Cream Sales VS Murder Rate in New York



RCTs vs Observational Studies

- **Randomized Control Trials:** A study in which participants are randomly allocated to a treatment or control group to measure the impact of the treatment, and establish a causal relationship.
- **Observational Studies:** These studies use pre-existing data to establish causal relationship, often using statistical controls. Subjects in the treatment and control groups are observed in existing groups.

RCT is a Experimental Research Design

- Experimental research is a scientific method for testing relationships between dependent and independent variables in a controlled environment
- The researcher can control and manipulate the environment of the research, including the predictor variable which can be changed. The effect of such manipulations on the DV is then measured, usually over time.
- The hypothesis is at the core of experimental research design and statistical analysis is key to approving or disproving a hypothesis

Benefits and Drawbacks of Randomised Control Trials

Benefits:

- It is comparative. One treatment is directly compared to another.
- An RCT can allow the researcher to make causal inferences, as it is the strongest empirical evidence of the efficacy of the treatment.
- Randomisation minimises confounding

Drawbacks:

- Results may not always mimic real life treatment situation (external validity)
- Potential for random confounding
- Potential ethical concerns (an RCT exposing participants to particular treatments may be unethical)

Advantages of Experiments

- It allows researchers to have a stronghold over variables and collect desired results which are usually specific.
- Cause and effect of a hypothesis can be identified, which can act as a foundation for conducting further research and building more ideas.
- Social scientists often use experimental research design to study and test behavior in humans.
- Medical researchers use experiments develop medicines to treat diseases by collecting samples from patients and testing them under multiple conditions
- Software development heavily depends on experimental research to test programs by letting subjects use a beta version and analyzing their feedback

Disadvantages of Experiments

- It is highly prone to human error due to its dependency on variable control which may not be properly implemented. These errors could eliminate the validity of the experiment and the research being conducted.
- Extraneous variables produce inaccurate conclusions (i.e. any variable that you're not investigating that can potentially have an effect on the outcome)
- The process is time-consuming and expensive
- Ethical implications, e.g. effects of treatments on patients' well-being

Benefits and Drawbacks of Observational Studies

Benefits:

- Often easier and less expensive to gather observational data
- Can cover a prolonged period of time
- Stronger external validity (generalisability)

Drawbacks:

- Selection bias more difficult to control
- Statistical controls are a weaker tool for establishing causal relationships and mitigating confounders
- May rely on self-reporting

Group Task: Identify the pros and cons of these two research designs. How would you improve them?

Randomized Control Trial:

Do educational interventions reduce rates of vaccine hesitancy? Participants in the 'treatment group' are exposed to a video intervention explaining how COVID vaccines work. The vaccine intentions of the treatment group are recorded before and after treatment and control group intentions are also measured. (Witus and Larson 2022)

Observational Study:

Does exposure to vaccine misinformation influence vaccine hesitancy? The authors conduct a survey of 600 adults. The respondents self-report their exposure to misinformation about COVID-19 vaccines and their vaccination status. The authors use a regression model to measure the impact of misinformation on vaccine hesitancy. (Neely et al., 2022)

Any Final Questions?

Additional Explainer Slides

Average Treatment Effect (ATE) - A Quick Explainer

- We cannot see individual-level causal effects, only *average* causal effects.
- What we want to know (i represents an individual):

$$TE_i = Y_{1i} - Y_{0i}$$

Treatment effect = (dependant variable when $x = 1$) - (dependant variable when $x = 0$)

Effect of Smoking = Prob of Cancer when smoking - Prob of cancer when not smoking

- We unable to calculate this at an individual level, instead we can calculate:

$$ATE = E[Y_{1i} - Y_{0i}] = E[Y_{1i}] - E[Y_{0i}]$$

Average Treatment Effect = (expected value of dependant value when $x = 1$) - (expected value of dependant variable when $x = 0$)

Average effect of smoking = mean prob of cancer when smoking - mean prob of cancer when not smoking