

Collecting Data Part II

Up to this point we have explored observational studies, these cannot be used to draw cause-and-effect relationships between variables. They instead give us a 'snap-shot' of the population at some time.

Establishing Relationships between variables.

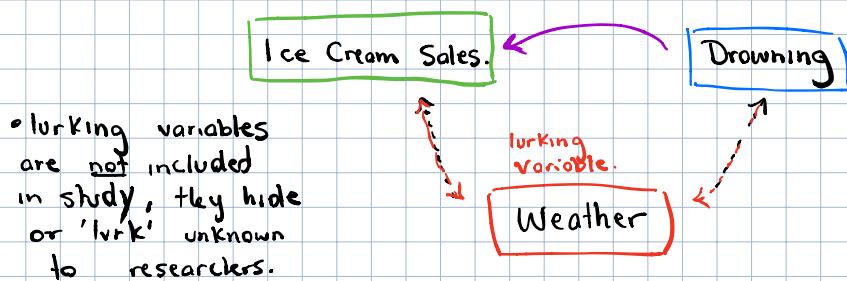
- After collecting data we may explore relationships between variables.
Ex:
 - does a medication help treat high blood pressure.
 - Is the amount of time studying associated with higher grades.
 - Are midterm grades associated with final exam grades.
- We are interested in seeing if changes in one variable (in-part) may affect the other variable. We consider one variable 'changer', and the other the 'responder'!

Explanatory variable: variable that explains or causes changes in another.

Responding variable: The variable that responds to or changes due to changes in explanatory variable.

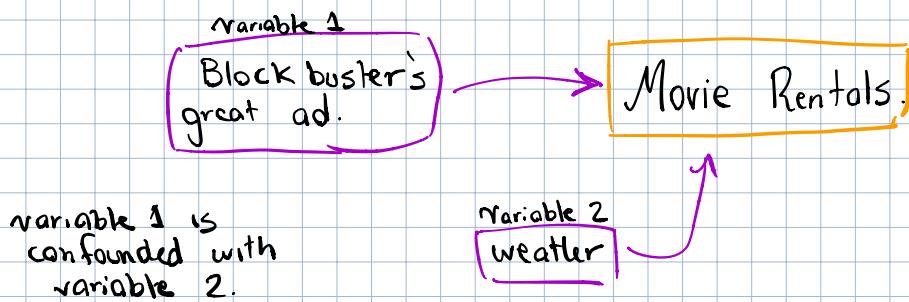
A Lurking Variable: Is a variable that can affect the response variable, but is not accounted for in the studies design.

Example.



Examples

Confounding variable: This is a variable that is related to the explanatory variable of an experiment, that influences the response variable. This creates a false perception of association.



Confounding arises when the response we see in an experiment is at least partially attributable to uncontrolled variables.

↳ extraneous variables

When Exploring relationships we 2 Options

1. Observational Studies.

- cannot establish cause-and-effect relationships.

2. Experiments.

- used to establish cause and effect relationships between variables.

- we look at several 'experimental designs'!

Experiments

- In experiments we impose treatments on experimental units to measure 'response'!

Some Important Vocabulary

Experimental units: individuals that are involved in experiment. When humans we call them 'subjects'!

Factors: a common term to denote explanatory variables.

↳ extraneous factors: thought to have an effect but aren't involved in study, out of researchers control.

↳ confounded factors: are factors whose response effect cannot be distinguished from one another.

↳ Factors may have multiple levels.

The combination of specific levels from all factors that one unit undergoes is known as a treatment.

A placebo: is a treatment that resembles another in appearance, but has no active ingredients at play.

↳ { - Give a drug as one treatment.
- Give tablet resembling drug as another.

A control group is a group that receives no treatment or a placebo treatment.

What must a well-designed Experiment Include?

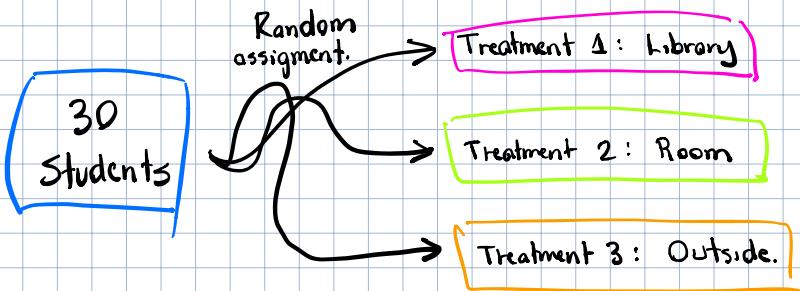
{ Control
Replication
Randomize

- ① Comparison of at least two treatment groups, one of which might be a control.
- ② Random assignment/allocation of treatments to experimental units.
- ③ Replication: require more than one experimental unit for each treatment group.
- ④ Control of potential confounding variables where appropriate.

We look at 3 types of experimental Design

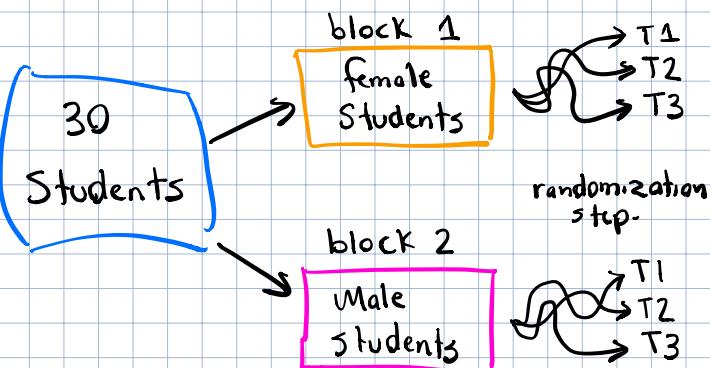
① Completely Randomized Design: All experimental units are assigned at random to treatment groups.

Ex: A researcher wants to conduct an experiment to determine which environment is best suited for studying. A library, ones own room, outside. 30 university students participate in the study



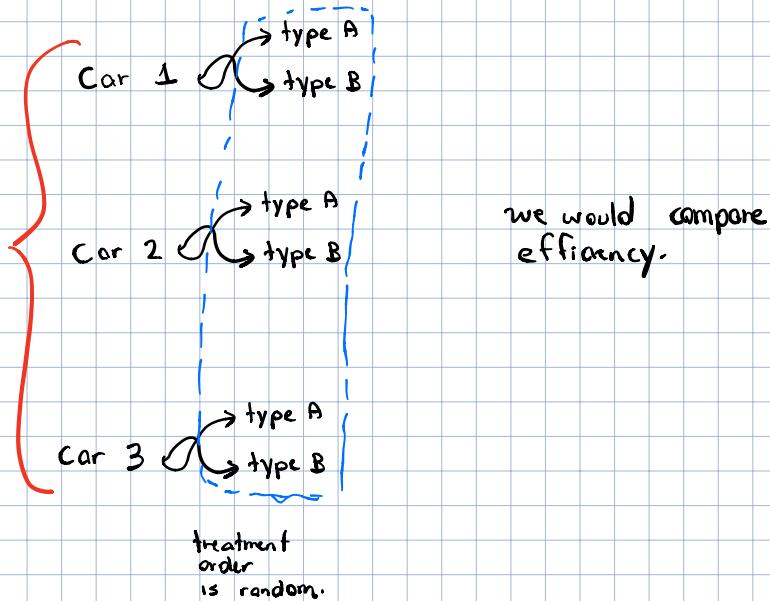
② Randomized Block Design : • experimental units are divided into blocks that are expected to have an outcome on response.
• we block and then randomize

Ex: Same example, but the researcher thinks that gender has an effect on study habits.



Matched Pair Design: A special type of randomized block design that compares 2-treatment groups using the same or similar experimental units.

Ex: What type of gasoline is more efficient, Gas A, Gas B, 3 cars are used in this experiment.



Ex: Sometimes we are unable to use the same units in a matched pairs design, so we use similar units.

- A researcher wants to determine whether or not sleep deprivation has an effect on test scores?
- pair students with similar GPAs for experiment.

pair 1 { • → normal amount of sleep
 • → sleep deprivation

Compare results
for each pair
of people across
all experimental units.

pair { • → normal amount of sleep
 • → sleep deprivation
 :

pair { • → normal amount of sleep
 • → sleep deprivation

Additional Precautions

- single-blind experiment: Experimental units do not know what treatment they are assigned to.

- double-blind experiment: neither research team, or units know which treatment is which.

Confirmation bias: occurs when someone finds results because they want to confirm their own beliefs.

- Another serious weakness of experiments is a lack of realism, meaning treatments/units/design does not realistically replicate the conditions we would like to study.