

Experimental Design in the Real World

We learned what an experiment is in Chapter 5 and some of the terms that come up when discussing experiments. We discussed lurking variables, confounding, the placebo effect, and the fact that we want a randomized comparative experiment to control for these things. This set of lecture notes talks about specific measures we take to avoid these pitfalls (and others) in experiments.

The Goal: We want to generalize our results to the population of interest and be able to defend the conclusions scientifically.

In order to meet this goal we need to have

- *statistically significant* results
- *Realistic settings* - treatments, subjects, and environment of our experiment
- *Repeatability* – the ability to repeat the experiment a number of times in various settings and get the same results

As a start to meeting our goal, we'll discuss three different types of randomized comparative experiments. These specific types of randomized comparative experiments are referred to as the *experimental design* or *design of the experiment*.

1. In a _____ experimental design, all the experimental subjects are allocated at random among all the treatments

Can have more than one explanatory variable

Use treatment combinations to conduct the study

(Comparison to survey design methods: this is the analog to a simple random sample – all the names are put into one hat, then subjects are randomly drawn for treatments)

Draw a Picture:

2. BLOCK DESIGN

A _____ is a group of experimental subjects that are known before the experiment to be similar in some way that is expected to affect the response to the treatments

In a **BLOCK DESIGN**, the random assignment of subjects to treatment is carried out separately within each block

(Comparison to survey design methods: this is the analog to a stratified random sample – first divide the subjects into groups, called blocks, then carry out a separate randomized comparative experiment within each block)

- Allows us to draw separate conclusions about each block
- We can include a potential lurking variable in the design and its effects can now be accounted for – this is called a *blocking variable*
 - A blocking variable is any variable that may have an effect on the response, but isn't one that we're necessarily interested in – we just want to account for the variability it would introduce in the results
- By forming the blocks to account for lurking variables, blocks reduce *confounding*

Draw a picture of a Block Design:

Examples of Blocking in an Experiment:

3. **MATCHED PAIRS**

The **MATCHED PAIRS** design is a type of block design that compares *two* treatments by choosing pairs of subjects that are as closely matched as possible.

- Randomly assign a member of a pair to a treatment
- sometimes a single subject serves as the “pair” by taking both treatments
 - Must randomly allocate the order of the treatments in this case!

Draw a picture of Matched Pairs:

Examples of possible experiments with matched pairs: