

## 4.2 Experiments

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### Observational studies vs. experiments

- What's the difference?
  
- Which can be used convincingly to get to \_\_\_\_\_?

### Basic Vocab

- Individuals on which the experiment is done are the \_\_\_\_\_ (called \_\_\_\_\_ if they are human beings)
- Specific experimental condition applied to the units is called \_\_\_\_\_
- \_\_\_\_\_ are the explanatory variables (there may be multiple)
- Combining specific values (AKA \_\_\_\_\_) of each of the factors is a way to study the joint effects of several factors

### Comparative Experiments

- Experiment design should describe the response variable(s), the factors( \_\_\_\_\_ variables), and the specific treatments
- \_\_\_\_\_ Effect-a dummy treatment that can have \_\_\_ physical effect. A favorable response to a \_\_\_\_\_ often occurs because of the psychological expectations of the supposed \_\_\_\_\_.
- Simple design and \_\_\_\_\_ flaw:  
Observation 1 → Treatment → \_\_\_\_\_  
Placebo effect and other lurking variables are not controlled.
- Remedy
  - experiments should compare \_\_\_\_\_ rather than assess a single \_\_\_\_\_ in isolation
  - compare two or more groups instead
  - placebo effect and other lurking variables operate on all groups
  - \_\_\_\_\_ gets the dummy ( \_\_\_\_\_ ) treatment, assuming a \_\_\_\_\_ is being used. However, a \_\_\_\_\_ is not always necessary

### Completely Randomized Experiments

- Comparison of the effects of several treatments is valid only if we apply all treatments to similar groups of experimental units
- Systematic differences among groups of experimental units in a comparative experiment are possible
- Possible Remedy...try to match the treatments in a systematic way ( \_\_\_\_, \_\_\_\_, \_\_\_\_\_, etc).
- This process may help but there are too many \_\_\_\_\_ variables
- 2<sup>nd</sup> Possible Remedy...use impersonal chance by \_\_\_\_\_.
- Combining comparison and randomization we get the simplest randomized comparative design:

### Completely Randomized Design:

- All \_\_\_\_\_ units are allocated at random among all the treatments
- We can compare any number of \_\_\_\_\_
- Get equal numbers in each group for ease in statistical inference(later)
- Multiple factors ok

- Logic of Experimental Design
  - Randomizing produces groups of experimental units similar in all respects before applying
  - \_\_\_\_\_
  - Comparative design ensures that influences other than the experimental treatment operate equally on \_\_\_\_\_
  - Differences in response variable must be due to effects of treatments...in other words, treatments are not only associated with observational differences, but they must \_\_\_\_\_ them.

Statistical Significance:

- An observational effect too large to come from chance is called “statistically significant” [this is in section 4.3]

Principles of Experimental Design:

- \_\_\_\_\_ - Use a design that compares 2 or more treatments
- \_\_\_\_\_ - Use of impersonal chance to assign subjects to treatments
- \_\_\_\_\_ - Keep other variables the same for all groups. Helps avoid confounding and reduces variation in responses. Helps us decide if a treatment is effective.
- \_\_\_\_\_ - Repeat experiment on many subjects to reduce chance variation in results

Cautions About Experimentation:

- Hidden Bias-experimenters must take care not to deal with experimental units/subjects differently....that way it's the treatments which are the only systematic differences.....DON'T ALLOW \_\_\_\_\_ CONDITIONS....THEY INTRODUCE \_\_\_\_\_.
- \_\_\_\_\_ Experiment-neither the subjects nor the experimenters know which treatment a subject received....protects from subtle influences in recording results
- Lack of Realism-subjects or treatments or setting of an experiment may not realistically duplicate the conditions we are trying to study

Other Experimental Designs:

- \_\_\_\_\_ Design-Random assignment of units to treatments is carried out separately within each \_\_\_\_\_
  - a block is a group of units/subjects that are similar in ways that are expected to affect the \_\_\_\_\_ to the treatments
  - blocking is another form of \_\_\_\_\_ because it \_\_\_\_\_ the effects of some lurking variables by bringing them into the experiment
  - similar to \_\_\_\_\_ sampling
  - we are able to draw separate conclusions from each block
  - systematic \_\_\_\_\_ (between men/women, for example) are removed by way of blocks
- Matched Pairs Design
  - Simple and common type of blocking
  - Compares just \_\_\_\_\_ treatments
  - Each block consists of just \_\_\_\_\_ units, *as closely* \_\_\_\_\_ *as possible*
  - These units are assigned at random to treatments...toss a coin or read odd/even digits from table of random digits
  - Sometimes each subject receives \_\_\_\_\_ in a \_\_\_\_\_ order