4 Key Concepts in Experimental Design

- **Randomization**
  Random assignment (of subjects to treatments or of treatments to trials) reduces bias by equalizing the effects of confounding variables.

  ➡*Remember that random assignment – either* ***of subjects to treatments or of treatments to trials*** *– is a critical component of a good experiment.*

- **Blocking**
  Using extraneous factors to create groups (blocks) that are similar. All experimental treatments are then tried in each block. Not required, but may improve your design. A **matched pairs design** is a type of blocking. *We block to reduce variability*.

- **Direct Control**
  Holding extraneous factors constant so that their effects are not confounded with those of the experimental conditions.

- **Replication**
  Ensuring that there is an adequate number of observations for each experimental condition.

Types of Designs

Similar to SRS

✤Completely Randomized Design (CRD)

✤Blocked Design

Similar to Stratifying

-Matched Pairs Design

➡One Subject

➡Two Subjects

-We block to reduce variability

So what do we mean by block design?

In this experiment from Unit 3-2, we could have ***blocked*** for BMI (Mass Body Index) since sometimes dosage is determined by weight

Note that this does not change the treatments

BMI	Drug	Dr. Gao's Drug	Dr. Heinicke's Drug
BMI ≤ 25	20 mg	Treatment 1	Treatment 2
BMI ≤ 25	50 mg	Treatment 3	Treatment 4
BMI > 25	20 mg	Treatment 1	Treatment 2
BMI > 25	50 mg	Treatment 3	Treatment 4

Vocabulary for Experimental Design

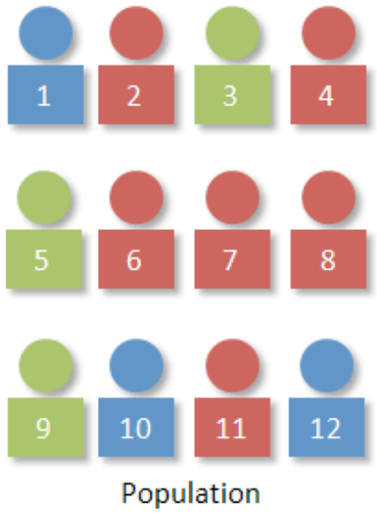
Example: You want to know what combination of fertilizer brand and watering frequency results in the most growth for a wheat plant. You are interested in 3 brands (A, B, and C) of fertilizer and you plan to water either twice a week or four times a week.

- **Explanatory variable**: *x* variable (called the independent variable, combo of fertilizer and watering)
- **Response variable**: *y* variable (called the dependent variable, growth in wheat plants)
- **Experimental units**: what you are experimenting on (wheat plants)
- **Factors**: the different pieces that make up the explanatory variables (here, fertilizer brand and watering frequency)
- **Levels**: the choices you have for each factor (fertilizer brand has three levels and watering frequency has two levels)
- **Treatments**: the combinations you will test (there will be six treatments, which we find by multiplying the three levels for fertilizer by the two levels for watering)

Completely Randomized Design

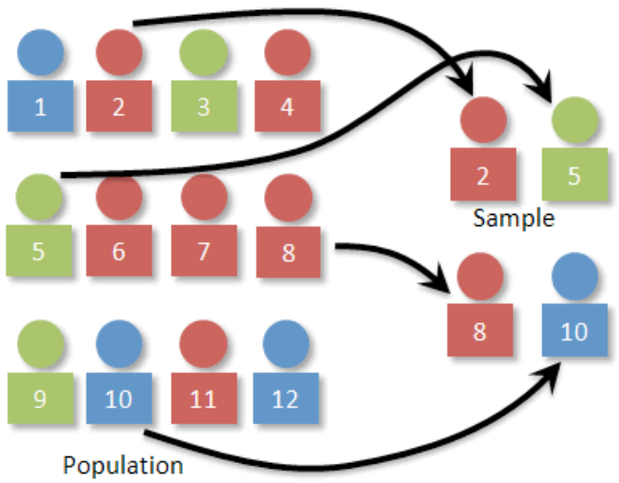
Take the list of experimental subjects, number them, use the random number table, TI-84, or slips of paper to assign them to treatment groups, run the experiment for a given amount of time, then compare the groups on the response variable.

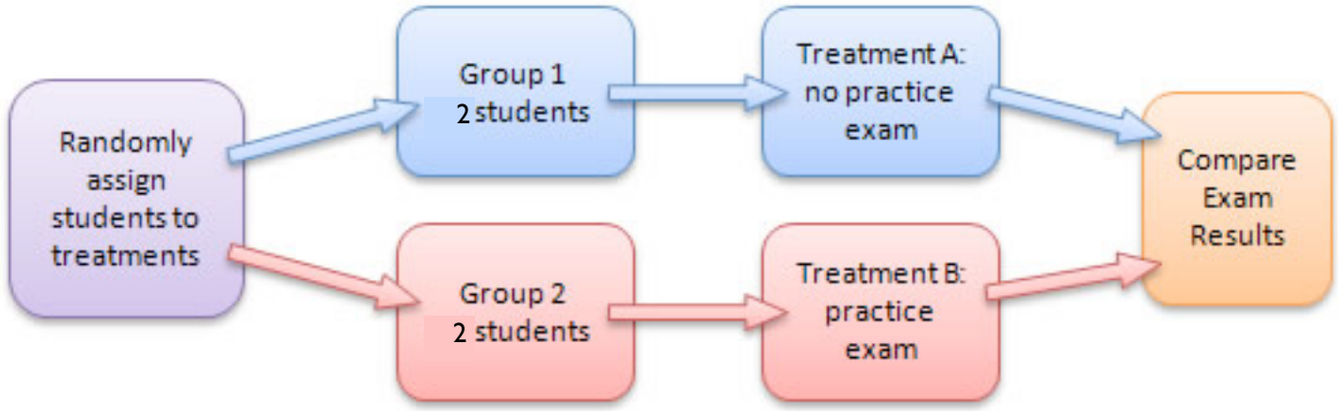
English Analogy
SRS: Sampling
CRD: Experimental Design



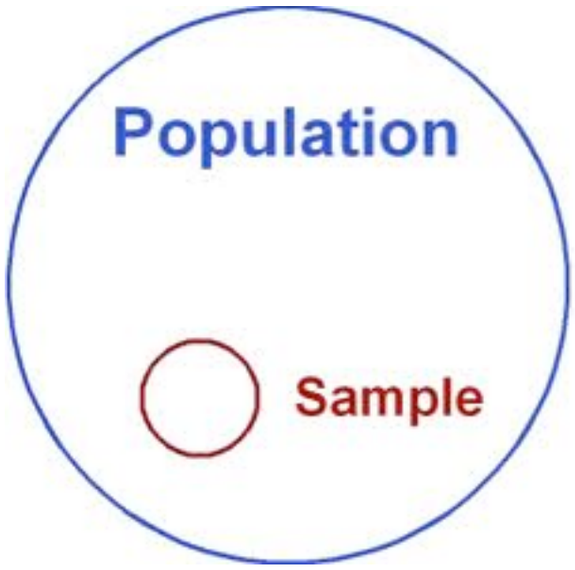
SRS of size 4

•randInt(1, 12, 4) = 10, 2, 8, 5



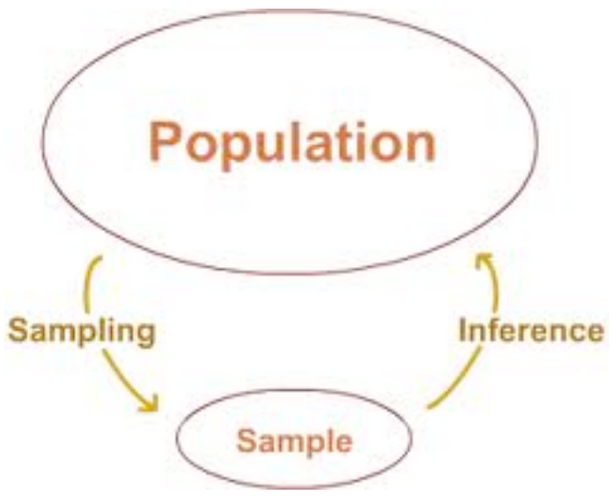


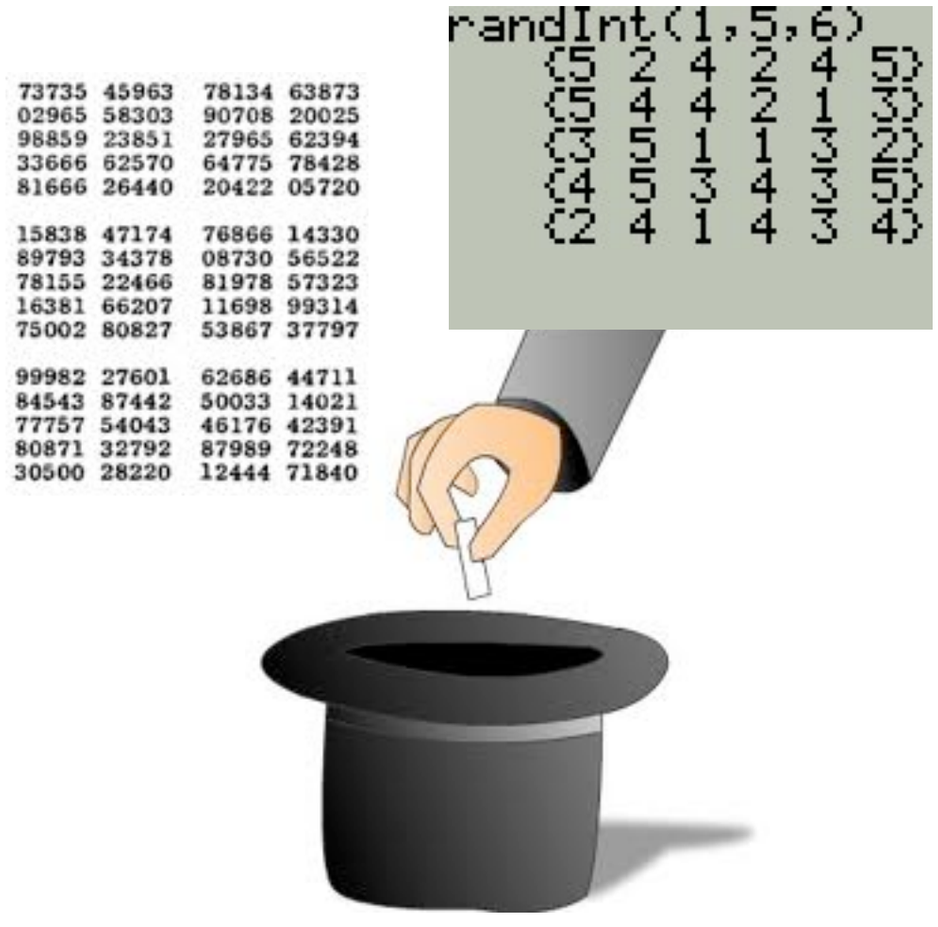
Remember....



A subset of the population.

We randomly select our sample so that we can generalize our findings to the population.





But ... we randomly assign treatments to subjects to reduce bias and variation.