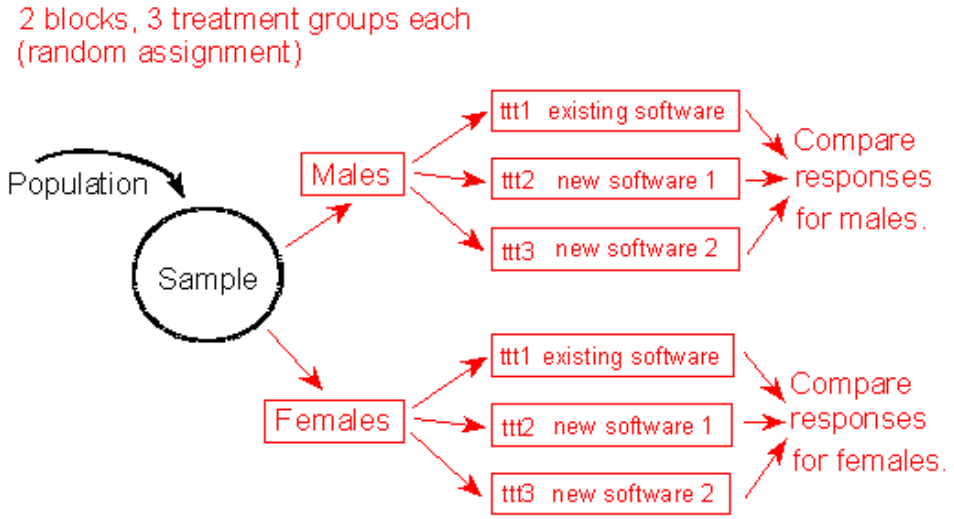
Modifications to Randomization

Learning Objective: Identify the design of a study (controlled experiment vs. observational study) and other features of the study design (randomized, blind etc.).

Modifications to Randomization

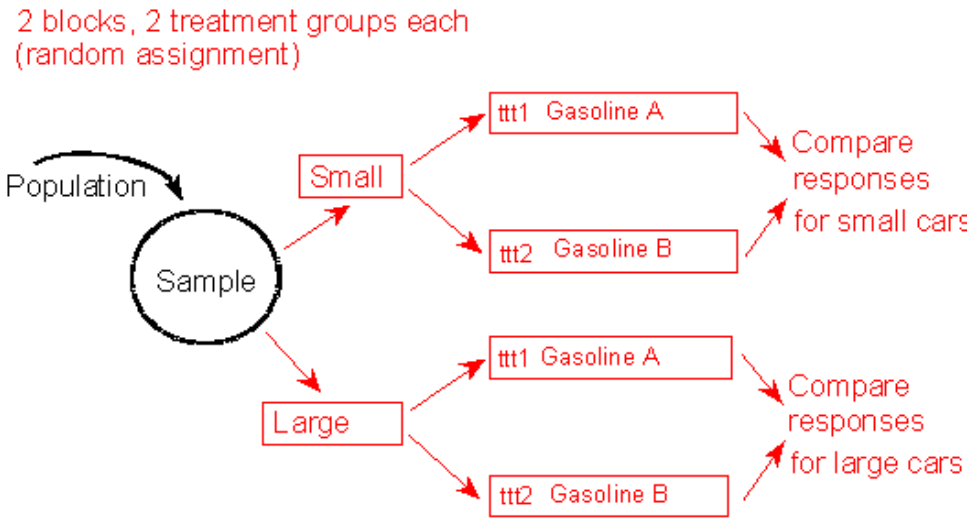
In some cases, an experiment's design may be enhanced by relaxing the requirement of total randomization and **blocking** the subjects first, dividing them into groups of individuals who are similar with respect to an outside variable that may be important in the relationship being studied. This can help ensure that the effect of treatments, as well as background variables, are most accurately measured. In blocking, we simply split the sampled subjects into blocks based upon the different values of the background variable, and then randomly allocate treatments within each block. Thus, blocking in the assignment of subjects is analogous to stratification in sampling.

For example, consider again our experiment examining the differences between three versions of software from the last Learn By Doing activity. If we suspected that gender might affect individuals' software preferences, we might choose to allocate subjects to separate blocks, one for males and one for females. Within each block, subjects are randomly assigned to treatments and the treatment proceeds as usual. A diagram of blocking in this situation is below:



Example

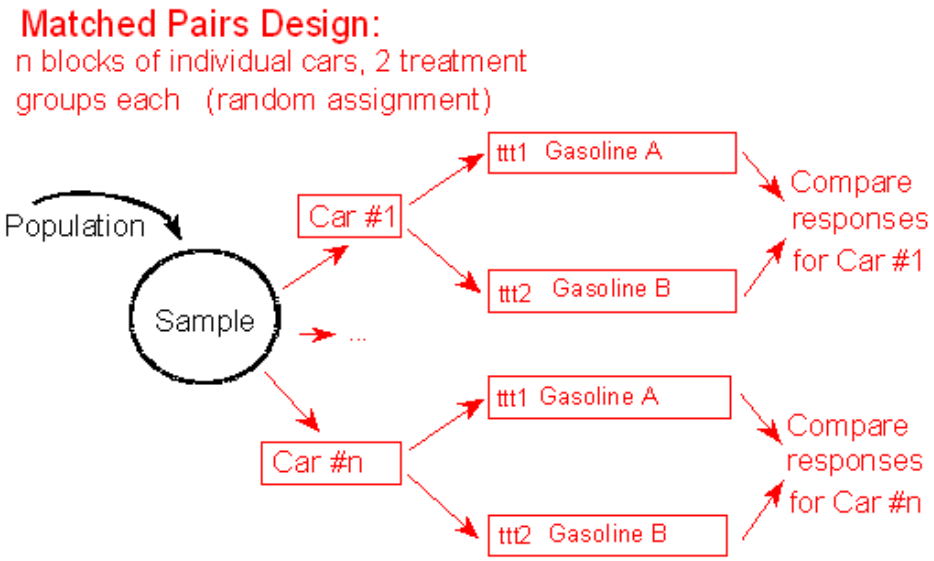
Suppose producers of gasoline want to compare which of two types of gas results in better mileage for automobiles. In case the size of the vehicle plays a role in the effectiveness of different types of gasoline, they could first block by vehicle size, then randomly assign some cars within each block to Gasoline A and others to Gasoline B:



In the extreme, researchers may examine a relationship for a sample of blocks of just two individuals who are similar in many important respects, or even the same individual whose responses are compared for two explanatory values.

Example

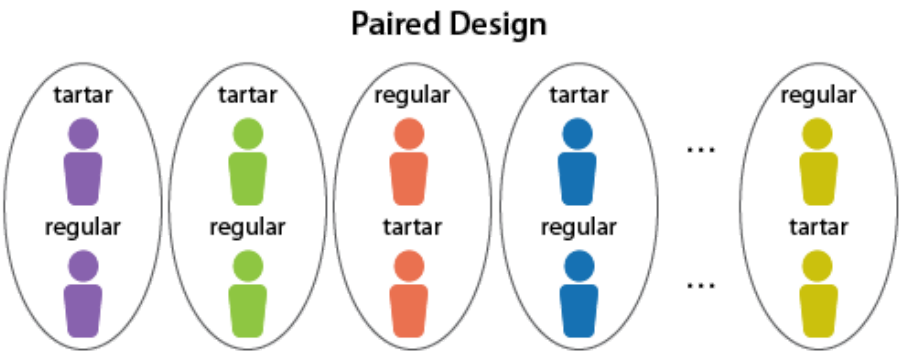
For example, researchers could compare the effects of Gasoline A and Gasoline B when both are used on the same car, for a sample of many cars of various sizes and models.



Such a study design, called **matched pairs**, may enable us to pinpoint the effects of the explanatory variable by comparing responses for the same individual under two explanatory values, or for two individuals who are as similar as possible except that the first gets one treatment, and the second gets another (or serves as the control). Treatments should usually be assigned at random within each pair, or the order of treatments should be randomized for each individual. In our gasoline example, for each car the order of testing (Gasoline A first, or Gasoline B first) should be randomized.

Example

Suppose researchers want to compare the relative merits of toothpastes with and without tartar control ingredients. In order to make the comparison between individuals who are as similar as possible with respect to background and diet, they could obtain a sample of identical twins. One of each pair would randomly be assigned to brush with the tartar control toothpaste, while the other would brush with regular toothpaste of the same brand. These would be provided in unmarked tubes, so that the subjects would be blind. To make the experiment double-blind, dentists who evaluate the results would not know who used which toothpaste.



"Before-and-after" studies are another common type of matched pairs design. For each individual, the response variable of interest is measured twice: first before the treatment, then again after the treatment. The categorical explanatory variable is which treatment was applied, or whether a treatment was applied, to that participant.

Comment

We have explained data production as a two-stage process: first obtain the sample, then evaluate the variables of interest via an appropriate study design. Even though the steps are carried out in this order chronologically, it is generally best for researchers to decide on a study design before they actually obtain the sample. For the toothpaste example above, researchers would first decide to use the matched pairs design, then obtain a sample of identical twins, then carry out the experiment and assess the results.

Scenario: Botox and Sweating

Researchers wanted to study whether or not Botox injected under the arms can reduce sweating.

Did I Get This

1/1 point (graded)
Which of these is a matched pairs design?

- ○ Randomly assign the underarms of some subjects to be injected with Botox, and those of other subjects with salt water.
- ◉ For each subject, one underarm is injected with Botox, and the other with salt water. ✔

Answer
Correct: Indeed, this is a matched pairs design. The same person is getting both treatments.

Submit

Did I Get This

1/1 point (graded)
Suppose each subject has one underarm injected with Botox, and the other with salt water. Which is the best way to make the assignment?

- (●) Inject Botox under the left arm for some participants and the right arm for others, choosing the arm randomly. ✔
- ( ) For the sake of consistency, inject all the right underarms with salt water and the left underarms with Botox.

Answer

Correct: Indeed, treatments should usually be assigned at random within each pair.

Submit