Choosing the Design of an Experiment

> The Academy of Sports Medicine Physicians is interested in determining whether a new training regimen will help long-distance runners improve their performance in marathons. This organization comes to you for some advice on how to design an experiment to test whether this new regimen is more effective than the standard regimen. You have access to a sample of long-distance runners on the track teams at ten different universities. You hope to conduct the experiment over the course of two years because the regimen takes a long time to learn and because you want to include new runners in the sample as they join the track team. You also believe that the effect of the regimen on performance may differ for men and women. Your challenge is to design an experiment that uses a randomized approach to measure the effect of the new regimen on performance. Remember, your design should take into account your concerns about different effects for men and women and should be set up so that new subjects can be properly included in the experiment. Create an experiment that will address these concerns. Pay particular attention to the factors, explanatory and response variables, any blocks or matching characteristics, and the treatment conditions used in the experiment. As much as possible, use diagrams instead of words to summarize your experimental design. (6 points)

First, I would block the subject in terms of gender, separating them into a male block and a female block. I would randomly select half of each block to be assigned to beginning the new regimen, and have the other half of each block act as the control group. When new recruits came along, I would block them first and then randomly assign them to either group. My explanatory variable would be the type of regimen and my response would be marathon time.

> A farm cooperative has asked you to design an experiment that measures the effects of light exposure on the growth of tulips in the Skagit Valley of Washington State. You hypothesize that tulips exposed to more direct light will grow at a faster rate than those exposed to less light. You also wonder whether the effects of light exposure persist when you control for the amount of moisture the plants receive. You want to create a randomized comparative design that considers three factors with the following levels:
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> - Light Exposure (No, Yes)
> - Amount of Light Exposure (3 hours a day, 6 hours a day, 9 hours a day)
> - Amount of Moisture Exposure (1 hour a day, 3 hours a day, 5 hours a day)

> You have 1,000 seedling plants at 12 different nurseries to use in your experiment. Your experiment should run six months in length. Outline the details of your experiment. In your answer you should comment on a strategy for randomization, identify all the possible treatment groups, and discuss what might be a possible response variable. In addition, you should identify a couple confounding variables and discuss a method of controlling for one of these variables. As much as possible, use diagrams instead of words to summarize your experimental design. (6 points)

The total amount of combinations there can be with these groups is 12, with a 13th control group that does not get light or moisture exposure. To properly randomize the plants, I will randomly tag plants in each nursery with numbers to determine which group the plants will be placed into. The response variable I will be looking for is change in height per week. A possible confounding variable in this experiment is the nutrition level of the soil at each nursery, which I can control by using the same soil for plants at each nursery. Another possible confounding variable is the climate around each nursery; most nurseries are not perfectly insulated and airtight, leading the climate to affect the growth of the plants.

> An optometrist is interested in the effects of different brands of eye drops. She wants to know if different drops affect the accuracy of a standard vision test.
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> Some researchers think that Brand A may have more adverse effects on an individual's ability to correctly report the letters in the vision test than Brand B or Brand C. There is also some speculation that the effect of the drops on vision differs dramatically for individuals who are far-sighted compared to those who are near-sighted.
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> The optometrist hires you to design an experiment that tests the effect of the eye drops on test performance. You tell her there are two possible approaches to take: a randomized comparative approach or a matched pairs design. Describe how you would use each design to test the effect of the eye drops on test performance on a random sample of patients. Remember, there is a concern about the effects for near vs. far-sighted patients. As much as possible, use diagrams instead of words to summarize your experimental design. (7 points)

Randomized Comparative Design

For my randomized comparative design, I can ignore the distinction between near- and far-sighted patients, and instead randomly assign a third of the people to use Brand A, another third to use either Brand B or Brand C, and the last third to use nothing at all. I can measure eye performance by having them test before putting on the eye drops and then

testing their performance every week after they put the eye drops in for a period of 6 months.

Matched Pairs Design

For my matched pairs design, I will first block the patients into near-sighted and far-sighted blocks, use the same randomized comparative design in each block, and compare (if there is a noticeable) the magnitude of the effect of the brand on near-sighted people to the effect of the brand on far-sighted people.

> A teacher believes that whatever he says in class has no effect on his students. Just as he's about to quit his profession, a statistician enters the room and suggests that the teacher design a study to test his assumption. The study will look at whether providing in-class feedback on homework assignments enhances classroom performance.
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> The teacher wants to know whether providing feedback before or after returning the assignments is most useful. He's also interested in the most effective means of presenting the feedback: verbal presentation, written handout, or a summary on overheads. Ultimately, he'd like to identify the best approach for increasing test scores of the students. There are 12 classes available in the school for the experiment.
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> Design an experiment that helps answer these questions. Be sure to identify the factors, the levels of the factors, the treatment groups, and the response variable. Comment on how the students will be assigned to the different treatment groups. Is it possible to use simple random assignment of all students? As much as possible, use diagrams instead of words to summarize your experimental design. (6 points)

The 12 groups can be divided into 6 different groups.

1. Feedback before, verbal presentation
2. Feedback before, written handout
3. Feedback before, summary
4. Feedback after, verbal
5. Feedback after, written
6. Feedback after summary

The other variables can be covered with the fact that each group has its own type of student and personalities

The teacher can work with each group on the same exact topic. At the end of the unit, she can test each student, make an average score of each group, which she will then compare to other scores and then use the method used for the group with the highest score. It is possible to use

simple random assignment, but it's harder to analyze, so it is easier to have groups already assigned to observe.