Lesson 29: Blocking and Matched Pairs

Terms:

Blinding - It is usually best if the subject does not know whether they are receiving the treatment or not. This practice is called Blinding. Sometimes it is also best if the experimenter does not know which subject is receiving the treatment and which is not. This will remove any potential bias in the way the experimenter reports his findings. Experiments in which both the subject and the administrator of the experiment do not know who receives the treatment are called **Double Blind**.

Statistically Significant - An observed effect is so large that it would rarely occur by chance is called statistically significant. The typical standard in statistics is that a result become statistically significant if the chance of the result occurring by chance is less than 5%.

Blocking:

Block Designs - A **Block** is a group of experimental units that are known before the experiment to be similar in some way that is expected to affect the response to the treatments.

The purpose of blocking is to reduce variation for the response variable.

Randomized block design:

1. Decide what variable will cause variation in the results (example: gender for average height)
2. Split the subjects according to this variable (example: separate men and women)
3. Perform the experiment on the blocks separately (example: this experiment blocked based on gender)

What is the difference between Stratification and Blocking?

- Both separate subjects into groups.
- Stratification is used in surveys. (Stratification – think of quotas required).
- Blocking is used in experiments

Matched Pairs:

Matched Pair Experiment - These are experimental designs in which either the same individual or two matched individuals are assigned to receive the treatment and the control. In the case where an individual receives both the treatment and the control, the order in which this happens should be random. And the experiment should be conducted as a Double Blind experiment.

The purpose of a matched pair design is that the control and treatment are both used in identical environments

Matched Pair Design:

1. Decide what variable will cause variation in the results (example: IQ when comparing teaching methods).
2. Pair the subjects according to the variable so that they are as similar as possible for that variable (example: put subjects with similar IQ scores together).
3. For each pair, randomly assign one to receive the placebo and one to receive the treatment.

Alternate Method: Each person is their own control. Two different examples are described below:

- Each person can receive the placebo and control at the same time (example: if an ointment effectively treats poison ivy)
- Randomly assign each person to receive the placebo then the treatment OR the treatment then the placebo (example: taste test between regular sugar candy and a sugar substitute candy)

Daily Data Collection

Copy the data from the soda and reaction time activity. Run the analysis as a matched pair design.

Question: does caffeine affect reaction time?

	Heads			Tails		
	Baseline	**After Treatment**	**Change**	**Baseline**	**After Treatment**	**Change**
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
Mean						
St Dev						

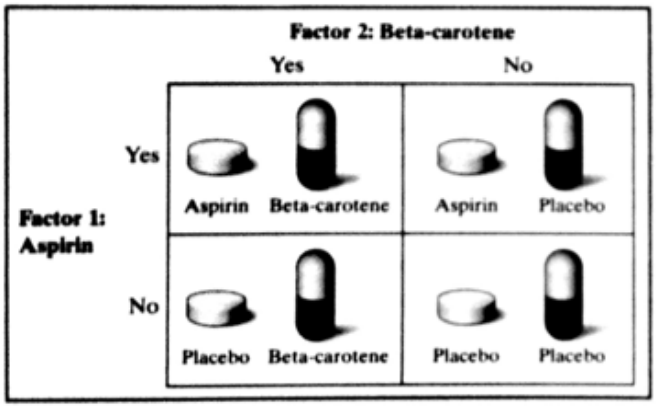
The Physicians' Health Study

A well-designed experiment

Does regularly taking aspirin help protect people against heart attacks? The Physicians' Health Study was a medical experiment that helped answer this question. In fact, the Physicians' Health Study looked at the effects of two drugs: aspirin and beta-carotene. Researchers wondered whether beta-carotene would help prevent some forms of cancer. The subjects in this experiment were 21,996 male physicians. There were two explanatory variables (factors), each having two levels: aspirin (yes or no) and beta-carotene (yes or no). Combinations of the levels of these factors form the four treatments shown in Figure 4.6. One-fourth of the subjects were assigned at random to each of these treatments.

On odd-numbered days, the subjects took either a tablet that contained aspirin or a dummy pill that looked and tasted like the aspirin but had no active ingredient (a **placebo**). On even-numbered days, they took either a capsule containing beta-carotene or a placebo. There were several response variables—the study looked for heart attacks, several kinds of cancer, and other medical outcomes. After several years, 239 of the placebo group but only 139 of the aspirin group had suffered heart attacks. This difference is large enough to give good evidence that taking aspirin does reduce heart attacks.[23] It did not appear, however, that beta-carotene had any effect on preventing cancer.

PROBLEM: **Explain how each of the three principles of experimental design was used in the Physicians' Health Study.**



Men, Women, and Advertising

Blocking in an experiment

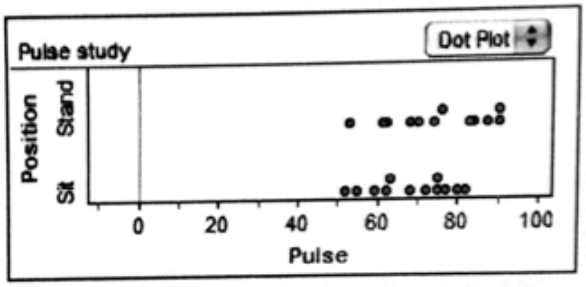
Women and men respond differently to advertising. Researchers would like to design an experiment to compare the effectiveness of three advertisements for the same product.

PROBLEM:

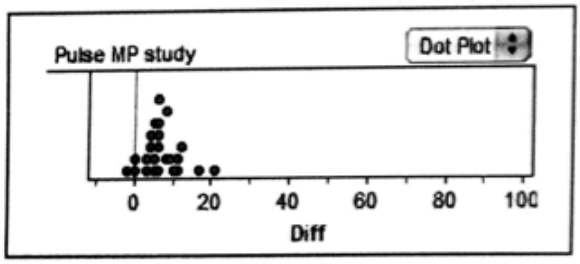
(a) Explain why a randomized block design might be preferable to a completely randomized design for this experiment.

EXAMPLE *Standing and Sitting Pulse Rate*

Design determines analysis



A Fathom dotplot of the pulse rates for their completely randomized design is shown. The mean pulse rate for the standing group is 74.83; the mean for the sitting group is 68.33. So the average pulse rate is 6.5 beats per minute higher in the standing group. However, the variability in pulse rates for the two groups creates a lot of overlap in the graph. These data don't provide convincing evidence that standing pulse rates tend to be higher.



What about the class's matched pairs experiment? The Fathom dotplot shows their data on the difference in pulse rates (standing – sitting). For these 24 students, the mean difference was 6.8 beats per minute. In addition, 21 of the 24 students recorded a positive difference (meaning the standing pulse rate was higher). These data provide strong evidence that people's standing pulse rates tend to be higher than their sitting pulse rates.

HW 29 - Section 4-2: 73, 75, 77, 79, 81, 85