Experiments in the Real World

- **Goal of a randomized comparative experiment: Subjects should be *treated the same* in all ways *except for the treatments we are trying to compare*.**
- ***Example:* Rats in cages given two diets (new cereal and a standard diet), and after some time weight gain was measured.**
- **It turns out rats in top cages grow faster than rats in bottom cages.**
- **To remove/reduce the effect of cage position, we should randomly assign the rats to cages.**

Placebo Effect

- **In experiments, placebos (fake treatments) *do* produce some sort of beneficial response *if the patient doesn't know* the treatment is fake.**
- **Could be psychological reasons, or the effect of mind over matter.**
- **To prove a drug actually works and is worth selling, it should do *significantly better* than a placebo.**
- **To honestly compare a drug treatment to a placebo, researchers should not tell subjects whether they are getting the placebo.**
- **This way the study won't be biased, and any advantage the experimental treatment turns out to have is trustworthy.**

Double-blind Experiments

- **With *Double-blind Experiments*, neither the subject nor the doctor (or other researcher) know which patients are getting the placebo.**
- **If doctors knows a patient is on a placebo, it can psychologically affect how they treat and diagnose a patient.**
- **It could bias the study in favor of the experiment drug treatment.**
- **Ideal experiment is *randomized, double-blind, and placebo-controlled*.**

Clinical Trials and Real-world Difficulties

- ***Clinical Trials:*** **Medical experiments involving human subjects.**
- **Historically, these trials have underrepresented women, minorities, and the poor (This trend is changing lately)**
- ***Nonadherers:*** **Subjects who participate but don't follow the protocol ("the rules") of the clinical trial.**
- ***Example 1*****: In a year-long study, subject neglects to take his daily pill after the first month.**
- ***Example 2*****: In a year-long study, subject begins to take a completely separate (and unauthorized) medication after the first month.**
- ***Example 3*****: In a year-long study, subject neglects the prescribed exercise regimen after the first month.**

Clinical Trials and Real-world Difficulties (Continued)

- ***Dropouts:*** **Subjects who begin the experiment but drop out before the scheduled finish.**
- ***Example 1*****: In a year-long study, subject moves out of town after two months and researchers lose track of her.**
- ***Example 2*****: In a year-long study, subject stops participating because the prescribed pill was making her sick.**
- ***Example 3*****: In a year-long study of cancer patients, subject dies of cancer after six months.**
- ***Example 4*****: In a year-long study of cancer patients, subject dies in a car accident after six months.**

Clinical Trials and Real-world Difficulties (Continued More)

- **If the reason for dropout is *related to the treatment(s)*, then this can bias the study's results.**
- **If the reason for dropout is *unrelated to the treatment(s)*, then the main drawback is simply that the number of subjects is reduced (and sampling variability increased).**

Clicker Quiz 1

What is a major difference between *nonadherers* and *dropouts*?

A. Researchers can adjust for nonadherers more easily

B. The researchers may not be informed of the nonadherers' deviation from the protocol

C. Dropouts tend to be women, minorities, or poor

D. Nonadherers tend to be male

Clicker Quiz 2

In a weight-loss study, 10% of the subjects getting the experimental drug dropped out before the finish and 58% of the subjects getting the placebo dropped out. It is speculated that subjects in a weight-loss experiment may prematurely drop out when they find themselves not losing weight. This is a example of:

A. Nonadherence, but it does not bias the study results

B. Nonadherence that does bias the study results

C. Dropout, but it does not bias the study results

D. Dropout that does bias the study results

Can We Generalize Our Conclusions?

- **We first need to determine whether our sample results are *statistically significant*: Are the results strong enough that it's unlikely that they just occurred by chance in the sample?**
- ***Beyond statistical significance*: Is our experimental setup *realistic*?**
- **Often the treatments, subjects, or experimental conditions in a study may not match those in the real world.**
- **In this case, it may be fruitless to try to generalize results.**

Clicker Quiz 3

A psychologist is studying how failure at a task affects morale among members of a team. In a 90-minute experiment, psychology students are put into teams in a laboratory and made to play a difficult game, and their reactions are observed. Would the study results be generalizable to a real-world work setting?

A. No, because the lab is most likely air-conditioned.

B. No, because in a lab the stakes are small and the game is relatively short in duration.

C. Yes, the results can be generalized.

D. No, because the students are more likely to be angry in nature than real-world workers.

- ***Other considerations:*** **The level of care given to subjects in clinical trials and social experiments may better than the equivalent treatment given to ordinary folks in the real world.**
- ***More considerations:*** **For obvious biological reasons, results from medical experiments on animals may not be generalizable to humans.**
- **Also, the real-world setting may change from the time an experiment is done, making the results less applicable (Example: Center brake light study: 50% or 5% reduction in collisions?)**
- ***Key*****: The experimenter must have good knowledge of the subject matter (not just the statistics) to make proper conclusions.**

Completely Randomized Design

- **In a *Completely Randomized Design*, all experimental subjects are allocated at random to the various treatments.**
- ***Example*: Plant growth study in which subjects (units) are plants in a greenhouse**
- **Two explanatory variables: Fertilizer Type (A, B, C) and Light Source (Natural Sunlight or Artificial Lamp)**
- **There are $2 \times 3 = 6$ combinations possible, so there are 6 *treatments* overall.**
- **In a sample of 30 plants, 5 plants are assigned to each treatment at random.**

Layout of Treatments

		Fertilizer		
		A	B	C
Source	Sunlight	Treatment 1	Treatment 2	Treatment 3
	Lamp	Treatment 4	Treatment 5	Treatment 6

Table 1: The 6 treatments in the plant growth experiment. Plants are randomly assigned to treatments so that there are 5 plants per treatment.

Matched Pairs Design

- ***Matched Pairs Designs*** **are appropriate when comparing two treatments.**
- **In a *Matched Pairs Design*, subjects are paired up so that the two subjects in each pair are *similar* in some critical way.**
- ***Example:*** **Two men of similar age and weight are put on two different weightlifting programs – the goal is to compare the programs in terms of improvement in strength.**
- **In such an experiment, we have actually have a number of pairs of subjects on the two programs and compare the treatments' strength improvement, averaged across the pairs.**

Matched Pairs Design (Continued)

- **In some matched-pairs design, the subject serves as his own “match”.**
- **For example, the subject may take two competing treatments (in a random order) in order to compare the treatments.**
- **Or the response may be measured on a subject before and after some treatment is applied, to test the effectiveness of the treatment.**

Block Design

- **A *block* is a group of subjects (set up at the beginning of the experiment) such that subjects within the block are similar.**
- **The random assignment of treatments to subjects is done *separately within each block*.**
- **Note: Matched pairs designs are simply block designs with two subjects in each "block" (or "pair").**
- **Block designs are a way to *control* for outside variables (besides the treatments) by accounting for those variables in the experiment (when we determine the blocks).**

Clicker Quiz 4

Experiment to compare effectiveness of 3 styles of advertisement: A sample of subjects (men *and* women) will each watch one ad and rate its effectiveness. What is a reasonable block design?

A. The subjects will be randomly assigned to be either men or women.

B. All subjects will be randomly assigned one of the 3 ads. Afterwards, the results will be separated by gender.

C. Each man will be paired with a woman, and the treatments will be randomly assigned within each pair.

D. Subjects will be divided into 2 groups: men and women. The men will be each randomly assigned one of the 3 ads, and the women will be each randomly assigned one of the 3 ads.

Clicker Quiz 5

A sample of consumers is blindfolded and given a slice of Pizza Hut pizza and Domino's pizza. The order of the slices is randomized and the consumers must rate each slice. Why is this study a matched-pairs design?

A. Each consumer's first rating is matched with that consumer's second rating.

B. Pizza Hut and Domino's are similar and thus are "matched".

C. Consumers in the study are chosen specifically because they are "similar."

D. Consumers in the study are chosen specifically because they are "different."

Advantages of Advanced Designs

- **Block designs and matched pairs designs allow us to make more precise conclusions about differences among treatments than we can with completely randomized designs.**
- **These advanced designs let us account for outside variables, and thus differences across blocks are *separated from* the differences among the treatments.**
- **We can also examine the differences among treatments *separately within each block*.**
- **This is similar to using *stratified samples*.**
- **Typically, a statistical expert would oversee these advanced designs.**