Section 6.2
Designing Experiments

Experimental units (subjects) are the individuals (or things) on which the experiment is done.

A **treatment** is the specific experimental condition applied to the units.

For example: Make people try a diet, a drug, watch a show, etc.

Factors (like treatments) are the explanatory variables in an experiment. Note that factors may have several **levels**.

For example: Experimenting on crops: Crops are the units. Treatment is the types of fertilizer. Factors are the different fertilizers that have different levels of chemicals in each of them.

Experiments often use placebos to help judge the effectiveness of a treatment. A **placebo** is a dummy treatment that can have no physical effect. When subjects respond to a placebo treatment, we call this the **placebo effect**.

The fundamental principle of experimental design is **control** – directly holding extraneous factors constant.

There are three fundamental principles of control:

1. **comparison** – you need a control group with which to compare the results of the group that receives treatment. So you want to set up similar groups.

2. **randomization** – by randomly assigning subjects to different treatment groups. Say you want an equal number of men and women or left-handers and right-handers, depending on what your experiment is about.

3. **blindness** – (blind) subjects are not told whether they receive the treatment or the placebo (double-blind) neither the subjects nor the interim know which treatment a subject received (but the original administrator does know).

We need a **control group** which is a group that does not get treatment nor the placebo. Helps to see if any changes would've occurred no matter what.

Matching is a statistical technique which is used to evaluate the effect of a treatment by comparing the treated and the non-treated units.

A **block** is a group of experimental units.

For example, block by gender, we want to see how men react to a drug vs how women react to a drug.

In block design, the random assignment of units to treatments is carried out separately within each block. **Matched pairs design** is a form of blocking; blocks are matched up.

For example, a study to test whether a daily exercise routine improved the cardio-vascular health in the inhabitants of a nursing home could match subjects for age and gender. It may also be possible to match smokers and ex-smokers.

Completely randomized experiments use units allocated at random among all the treatments.

An observed effect is **statistically significant** if it is too large to attribute plausibly to chance.
For example, probabilities that are very large are statistically significant.

Always watch out for:

- **Bias**
- **Lurking variables** – those that affect another variable. *For example, track the number of water bottle sold in July vs December in Houston Texas. The heat in July is the lurking variable.*
- **Lack of Realism –** *For example, a sleep study on people done using a classroom, a gym, etc. Not realistic on how a person sleeps.*

Example: The editor of a magazine is wondering if the type of font used in the articles affects the reading speed of the subscribers of the magazine. He asks 10 subscribers to read 4 articles each with different fonts. If the reading speed increases with a particular font, he will use it in the next publication.

a. Is this an experiment or an observational study? experiment or observational
What's the treatment?

b. If it is an experiment, is it randomized or block design? randomized or block design

c. If it is an experiment, identify the explanatory and response variables.
Response: (What is the editor trying to find out?)

Explanatory:

d. If this is an experiment, draw a diagram representing the levels and treatments.