



Designing Experiments

Part 1

Experimental Units, Subjects, Treatment

The individuals on which the experiment is done are the **experimental units**. When the units are human beings, they are called **subjects**. A specific experimental condition applied to the units is called a **treatment**.

Explanatory vs. Response

- **Explanatory variables** (or **factors**) are variables being manipulated by the experimenter.
 - Each variation of a factor is called a **level**.
- **Response variables** are the observed outcomes of the treatment.

Example 5.13 (3rd edition)– Effects of Class Size



Causation

- **Causation** – Declaring that an outcome was caused by a certain factor.
- In principle, experiments can give good evidence for causation.

Example 5.14 (3rd edition) – TV Advertising



		Factor B: Repetitions		
		1 time	3 times	5 times
Factor A: Length	30 seconds	1	2	3
	90 seconds	4	5	6

Why so many treatments?

Control

- We use control to minimize the effects of lurking variables and maximize the potential effect of our explanatory variables in the experiment.
- It is the **first** basic principle of statistical design of experiments.
- Comparing treatments in the same environment is the simplest form of control.

Example 5.11 – Ulcer Treatment



Placebo Effect –
When a patient
responds to a
dummy
treatment.

Replication

- **Replication** – Applying a treatment to many subjects to reduce chance variation.
- This is the **second** principle of statistical design of experiments.

Example 5.16 (3rd edition)



Replication



Control

Randomization

- **Randomization** –Using chance to assign experimental units to treatment groups.
- This reduces bias and gives each treatment a fair chance of having an effect.
- This is the **third** principle of statistical design of experiments.

Example 5.17 (3rd edition)– Talking and Driving



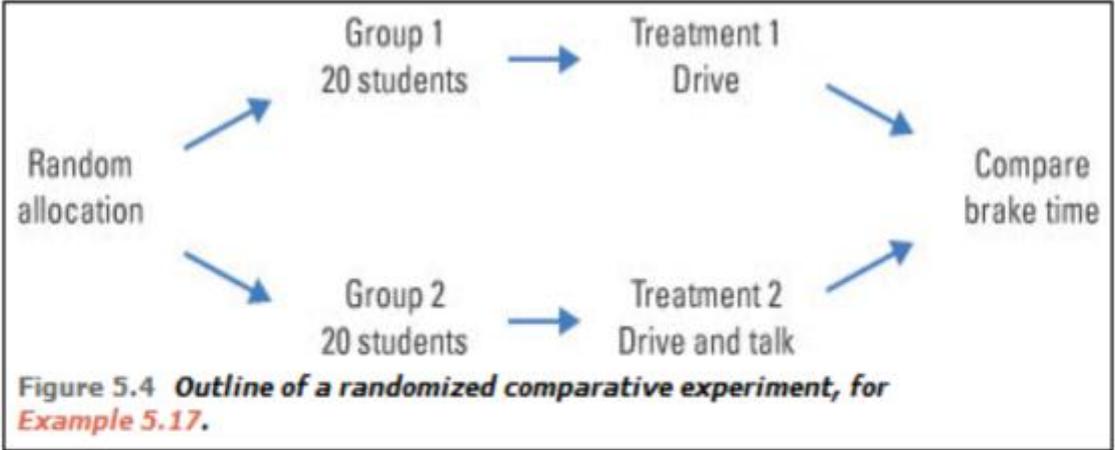
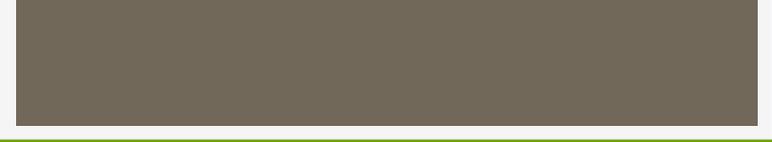


Figure 5.4 *Outline of a randomized comparative experiment, for Example 5.17.*

Example 5.9 – Aspirin, Beta-Carotene, and Heart Attacks



Principles of Experimental Design

- 1. Control** the effects of lurking variables on the response, most simply by comparing two or more treatments.
- 2. Replicate** each treatment on many units to reduce chance variation in the results.
- 3. Randomize** – use impersonal chance to assign experimental units to treatments.

Designing an Experiment in 5 Steps

1. Choose a topic.
2. Narrow your focus to the effects of one or two factors.
3. Create **control** by minimizing the differences in treatments other than the variations of your explanatory variable(s).
4. **Replicate** your treatments by administering them to as many subjects as possible.
5. **Randomize** the assignments of your subjects to their various treatment groups.

