6.2 – Designing Experiments

Experimental units are the individuals on which the experiment is done. When the units are people, they are called **subjects**.

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

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

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**.

There are three fundamental principles of control:

1. **comparison**
2. **randomization**
3. **blindness** (blind or double-blind)

We need a **control group** to manage the effects of **lurking variables**.

Matching is a technique where experimenters try to match treatment groups in a systematic way.

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

A **block** is a group of experimental units that are similar in ways that are expected to affect the response of the treatments

Matched pairs design is a form of block design with just two treatments.

An observed effect is **statistically significant** if it is too large to attribute plausibly to chance.

We must always watch for **hidden bias**, **confounding variables**, and be careful with **lack of realism.**

Examples:

1. 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?
   b. If it is an experiment, is it randomized or block design?
   c. If it is an experiment, identify the explanatory and response variables.
   d. If this is an experiment, draw a diagram representing the levels and treatments.

2. Many colleges and universities have developed "calculus reform" courses which substantially alter the way that calculus is taught. The goal is that the reform courses help students to understand fundamental calculus concepts better than traditionally taught courses do.

a. If you simply compare scores on a standardized calculus test between students in traditional classes and those in reform classes, would you be able to conclude that any differences you might find are attributable to the teaching style?

b. Describe how you might design an experiment to assess whether the goal is being met.