Principles and Techniques of Experimental Designs

1. Experimentation for Comparative Studies

Why Experiment?

Example 1. Does taking aspirin regularly help prevent people against heart attacks? The Physicians Health Study was a medical experiment that helped answer this question. Half of a group of 22,000 male doctors were chosen at random to take an aspirin every other day. The other half of the doctors took a placebo, a dummy pill that looked and tasted just like the aspirin but had no active ingredient. After several years, 239 of the placebo group but only 139 of the aspirin group had suffered heart attacks.

This is an experiment. Typically, an experiment may be run for one or more of the following reasons:

✓ to determine the principal causes of variation in a measured response;
✓ to find the conditions that give rise to a maximum and minimum response
✓ to compare the responses achieved at different settings of controllable variables,
✓ to obtain a mathematical model in order to predict future
responses.

It is more efficient to examine all possible causes of variation simultaneously rather than one at a time (a factorial experiment). There may be a large number of factors to be studies and special techniques are needed to gain as much information as possible from examining only a subset of all possible factor settings.

*The Vocabulary of Experiments*

**Units:** the objects on which the experiment is done. The units receive the treatments.

**Treatment factor (or simply factor):** any substance or item whose effect on the data is to be studied. The *levels of a factor* are the specific types or amounts of the treatment factor that will actually be used in the experiment. An experiment involving two or more treatment factors are called *factorial experiment*.

**Treatment:** a level of a treatment factor in a single factor experiment, or a combination of the levels of treatment factors in a factorial experiment.

2. Replication
Several people of subjects (i.e., units), may be assigned to the same treatment. This is called replication. Replication is used to offset the effects of other factors or variables that are either unknown or unstudied in the experiment.

Replication differs from “repeated measures”. The latter refers to measurements taken from the same unit at different time points.

3. Randomization

The purpose of randomization is to prevent systematic and personal biases from being introduced into the experiment.

4. Blocking

To block an experiment is to divide or partition the observations into groups called blocks in such a way that the observations in each block are collected under relatively similar experimental conditions.
Analysis: The basic idea

Experimental data are analyzed primarily via the Analysis of Variance (ANOVA) which allows for comparison of mean responses of different treatments.