Introduction to the Design of Experimental and Observational Studies

- **Types of Studies:**

1. *Observational Study.* The researcher observes individuals and measures variables of interest but does not attempt to influence the responses. This type of study can only establish *association* between two variables.

   Example: USA Today (Aug. 14, 1995) reported on a study which suggests that "frequently heading" the ball in soccer lowers players' IQs." A psychologist tested 60 male soccer players, ages 14 - 29, who played up to five times a week. Players who averaged 10 or more headers a game had an average IQ of 103, while players who headed one or fewer times per game had an average IQ of 112. Is this an experimental or observational study? Identify the following:

   a. Experimental units: _____
   b. Response variable: _____
   c. Factor: _____
   d. Level of the factor: _____
   e. Treatments: _____

2. *Experimental Study.* The researcher deliberately imposes some treatment on individuals in order to observe their responses. This type of study can establish *cause-and-effect.*

   Example: A simple comparative experiment was conducted to study the effect of baking temperature on the volume of a quick bread prepared from a package mix. Four oven temperatures - low, medium, high, and very high - were tested by randomly assigning each of the four levels of temperature to five package mixes. Is this an experimental or observational study? Identify the following:

   a. Experimental units: _____
   b. Response variable: _____
   c. Factor: _____
   d. Level of the factor: _____
   e. Treatments: _____

3. *Mixed Experimental and Observational Study.*
   Example: An appliance manufacturer operates three regional training centers in the United States for training mechanics to service the company's products. At each regional center, two different training programs were studied, with the trainees from the region assigned at random to one of the two training programs. Identify the following:

   a. Experimental units: _____
   b. Response variable: _____
   c. Factor(s): _____
   d. Level of the factor(s): _____
   e. Treatments: _____

- **Commonly used Experimental Designs:**

  1. *Completely Randomized* - Experimental units are allocated at random among all treatments, or independent random samples are selected for each treatment.
  2. *Randomized Complete Block Design* - The random assignment of units to treatments is carried out separately within each block.
  3. *Nested Designs* - Levels of one or more of the factors are unique to a particular level of another factor.

Plant	O_1	O_2	O_3	O_4	O_5	O_6	O_7	O_8	O_9
I	O_1	O_2	O_3						
II				O_4	O_5	O_6			
III							O_7	O_8	O_9

     In this example, the factor *Operator* (O_i) is nested within the factor *Plant*.
  4. *Repeated Measures Designs* - In one type of repeated measures design, the same experimental unit (person, store, plant, etc.) receives all of the treatment combinations under study. This design is frequently used in product rating experiments, where the same consumer evaluates a set of products.

- **Design of Observational Studies:**

  1. *Cross-Sectional Studies* - This study involves measurements taken from one or more population or subpopulations at a single point in time or a single time interval.
  2. *Prospective Studies* - In this study, one or more groups are formed in a nonrandom manner according to the levels of hypothesized causal factor, and then these groups are observed over time with respect to an outcome variable of interest. Prospective studies answer the question: "What is going to happen?"
  3. *Retrospective Studies* - In this study, groups are defined on the basis of an observed outcome, and the differences among the groups at an earlier point in time are indentified as potential causal effects. Retrospective studies answer the question: "What has happened?"

- Homework: Due Friday.
  Do # 9*, 10, 11, 14*, and 20 on pages 673 - 675.