Math 1342
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1. Data Collection

1.6 Design of Experiments

Our previous data collection has focused on observational studies, where causality *cannot* be claimed, only association between the explanatory and response variables.

Experiments are controlled studies conducted to determine the effect varying one or more factors has on a response variable.

A **treatment** is any combination of values for the factors.

The **experimental unit** (**subject**) is the object (person) on which the treatment is applied. The analogue in observational studies is the **individual**.

A **control group** is a baseline treatment used for comparison to other treatments.

A **placebo** is an innocuous medication, one that mimics the actual treatment in the eyes of the subject.

For integrity of the experiment, it is important that each treatment group be handled with an identical process. To ensure that subjects do not change their behavior based on the presence or absence of any particular treatment, the technique of **blinding** is incorporated.

(1) In *single*-blind experiments, the subject does not know which treatment he is receiving.

(2) In *double*-blind experiments, neither the subject nor the researcher (in contact with the subject) knows which treatment is given.

Steps in Designing an Experiment

(1) Identify the problem to be solved.

(2) Determine the factors that affect the response variable.

(3) Determine the number of experimental units.

(4) Determine the level of each factor, either controlled or randomized.

(5) Conduct the experiment. Replication for reliability.

(6) Test the claim.

Completely Randomized Design is one in which each subject is randomly assigned to a treatment. This is the simplest, though not always best approach.

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Matched-Pairs Design is an experiment in which the subjects are paired up by similar characteristic. There are only two levels of treatment and the pair is randomly assigned using a coin flip or random number generator. It is possible in this design for a subject to be matched with himself, before and after an applied treatment.

ex3 study w/ music

Randomized Block Design divides the subjects into homogeneous groups called blocks, and within each block, randomly assigns the treatments. The analogue to observational studies is stratified sampling.

In **RBD**, it is not the block itself that is the determining factor for the response variable. We actually seek to remove variability by replicating the process within each block.

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This section provides examples and practice with the concepts and methodology of experimental design setup. To make an inference or conclusion about the population from the experiment's results requires even further study in later chapters.

1.6.17 Dominant Hand

Your professor wants to determine if the reaction time of people differs in their dominant hand versus their nondominant hand.

He recruits 15 students.

Each student is asked to hold a yardstick between the index finger and thumb, briefly release the yardstick, and then catch it again as quickly as possible.

The distance the yardstick falls will serve as a measure of reaction time.

A coin flip is used to determine whether the student should use their dominant hand first or second.

(a) What type of experimental design is this?

(b) What is the response variable?

(c) What is the treatment?

(d) Identify the experimental units.

(e) Why is a coin flip used to determine if the dominant hand is first or second?

(f) Draw a diagram to illustrate the design.

1.6.19 Marketing

A marketing research firm wants to determine the most effective method of advertising: print, radio, or television.

They recruit 300 volunteers to participate in the study.

The researchers believe that education plays a role in advertising effectiveness, so they segment the volunteers by level of education.

Of the 300 volunteers:

- 120 have a high school diploma
- 120 have a college diploma
- 60 have an advanced degree

The high school diploma subjects are randomly assigned to either the print, radio, or television group. The same is done for the other two segments.

After 1 hour, a recall exam is given and the number of correct answers recorded.

(a) What type of experimental design is this?

(b) What is the response variable in this experiment?

(c) What are the treatments?

(d) What variable serves as the block?

(e) Draw a diagram to illustrate the design.