Statistics 1: Introduction to Probability and Statistics

Section 1-4

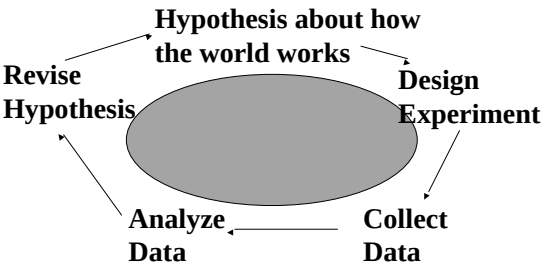
Design of Experiments

- **Definitions**
- **Five different approaches to sampling**

Recap Scientific Method

- **Identify hypothesis and popul.**
- **Plan for collecting data**
- **Collect the data**
- **Analyze the data**
- **Draw conclusions (revise hypothesis)**

Scientific Method



Definitions

- **Observational study**
- **Experiment**

Definitions

- **Observational study: observe (measure) items in the population but without manipulating or modifying the subjects under study**

Definitions

- **Cross Sectional Study**
  - **Data are observed, measured, and collected at one point in time**
  - **A current "snapshot"**

Definitions

- **Retrospective (or Case Control) Study**
  - **Data are collected from the past by going back in time**
  - **Learn from history**

Definitions

- **Prospective ("Longitudinal" or "Cohort") Study**
  - **Form groups (cohorts) that share common factors**
  - **Track cohort members through (future) time to collect informative data**

Definitions

- **Experiment: we "treat" (manipulate / modify) then observe or measure the characteristic of interest. Assess the "effects" of the treatments.**

Definitions

- **Placebo effect**
- **Blinding**

Definitions

- **Placebo effect**
  - **A response due to the "belief" that one is receiving a particular treatment**

Definitions

- **Blinding**
  - **practice of preventing a subject from "knowing" how they are being treated**
  - **practice of preventing the investigator from knowing also (double blind)**

Definitions

- **Blocking**
- **Confounding**

Definitions

- **Blocking**
  - **grouping similar items together**
  - **powerful and simple practice**

Definitions

- **Confounding**
  - **usually undesirable situation in which an extraneous factor is associated with the factor one is studying**

Definitions

- **Confounding example**
  - **Are teachers better at school A than at school B?**
  - **But school A is a private school for poor kids and school B is a public school in a rich neighborhood.**

Definitions

- **Confounding example**
  - **What have you learned when school A students do better than school B students?**
  - **Is it the teachers, the administration, or the students?**

Definitions

- **Replication**
- **Randomization**

Definitions

- **Replication**
  - **– repetition of an experiment**
  - **– repeating the same conditions to see whether the response is consistent**

Definitions

- **Randomization**
  - **– Selecting items or assigning items to treatments so all possible selections or assignments are equally likely**

Five Sampling Methods

- **(Simple) Random Sampling**
- **Stratified (Random) sampling**
- **Systematic sampling**
- **Cluster sampling**
- **Convenience sampling**

Simple Random Sampling

- **Every element in the population is equally likely to be in sample.**

And

- **Every possible sample of size N has the same chance of being chosen.**

Stratified Sampling

- **Subdivide the population into two or more subgroups (strata)**
- **Elements in each subgroup (stratum) share some common feature**
- **Select random samples within each of the strata**

Systematic Sampling

- **Select a starting point**
- **Then select every k^{th} element in the population, or some other structured method of selecting the sample**

Cluster Sampling

- **Identify groups of elements in the population that naturally cluster together**
- **Randomly select clusters (not single elements)**
- **Observe / measure ALL elements in the selected clusters**

Convenience Sampling

Observe and measure elements in the population that are

- **Convenient**
- **Readily available**
- **Cheap to acquire**

May occur in combination with other "designs"

Convenience Sampling with Other Designs

- **Random selection of potential survey participants, but only those who "volunteer" will participate**
- **Stratified population, but selection of elements within each stratum is based on convenience**