1. Randomness and Sample Surveys Chapter 12

In an ideal world, we would study populations and there would be no need for this statistics class. Studying populations is not practical because they are too large (so it costs a lot of time & money.) So we settle for samples.

The **POPULATION** is the entire set of people (or animals, things) we wish to study.

A **SAMPLE** is a part of the population.

A numerical fact about a population is a **PARAMETER**. Examples are μ ("mu") the symbol for the population mean (average) and σ ("sigma") the population standard deviation.

A numerical fact about a sample is a **STATISTIC**. Examples are $\bar{y}$ ("y-bar") for a sample mean (average) and s for a sample standard deviation.

Election & other types of surveys

A little history (p. 223 of your text)

2. BIAS

If a sample is "representative", then a statistic can be a good estimate of the parameter; but if the sample includes or excludes certain people systematically, the sample is BIASED. See examples of non-random samples…results from cnn.com and other places…

3. Getting Rid of Bias

RANDOMNESS is a statistician's friend. The best way to insure representativeness (and protection from bias) in a sample is to make sure that the selection process is RANDOM. The process is called RANDOMIZATION and it effectively "mixes" the population such that a sample selected from the population will reflect all the features of your population.

4. SAMPLE DESIGNS

a. Simple random sample (SRS): every object in the population has an equal chance of getting into the sample with each draw. In practice this is drawing at random without replacement (because it would not make sense to select the same person or measure the same animal/thing twice).

b. Not every sample is a simple random sample; other sampling schemes include CLUSTER SAMPLING (selecting groups and then randomly sampling within groups) and STRATIFIED RANDOM SAMPLING (stratifying sample on the basis of a characteristic, like gender – forcing a sample to be 50%-50% male-female)

c. MULTISTAGE SAMPLES – in practice, survey organizations use a combination of simple random samples, cluster samples, and stratified samples.

5. What can go wrong with sample surveys? Plenty of things.

A. Voluntary Response Bias --- certain types of people choose to respond to a survey
B. Convenience Sampling – when a researcher/pollster just includes people or things just because they are nearby or easy to talk to.
C. Bad sampling frame – when a researcher/pollster has an incomplete list of the population
D. Non-response bias --- people selected for the survey don't bother to answer you

E. Response bias --- people selected for the survey answer, but they lie to you or they are manipulated by the way you asked the question

F. Wording of question --- phrasing may not be neutral (e.g. a loaded question).

6. Investigative Studies (Chapter 13)

Last chapter we examined sample surveys. There are additional ways to gather information

- The observational study: the researcher collects data as they currently are ("in the wild").
- The retrospective study – the researcher collects data from the past. Backward looking.
- The prospective study – the researcher collects data as events unfold. Forward looking.

All three of these suffer from the same problem. The research is not "in charge" of assignment. In other words, the researcher cannot RANDOMLY assign a condition (e.g. race, gender, major, musical education) so for these kinds of studies it is NOT possible to demonstrate "cause and effect" but one can demonstrate ASSOCIATION.

It is possible to demonstrate "cause and effect" in an investigative study by using:

7. The Randomized Controlled Experiment and its features

- At least one Factor (with multiple levels) – the combination of specific levels of different factors (a factor if there is only one) in an experiment is a treatment.
- A comparable Control (what if we never intervened)
- Random assignment to either treatment or control
- A measurable response (a real outcome)
- Subject/participant/experimental unit
- Replication – an experiment should be repeatable

Your textbook mentions "blocking", don't worry about being tested on it in Stat 10.

8. Beneficial aspects of experiments

- Randomization(vocabulary) -- eliminates bias (vocabulary)
- Control Group (vocabulary) – allows a clear comparison
- Placebo (vocabulary) -- eliminates the "placebo effect" (vocabulary)
- Double Blind (vocabulary) -- eliminates bias
- Single Blind (vocabulary) -- may eliminate bias
- Replication (vocabulary) -- validate results

9. What can go wrong? Not as much, but

Confounding (vocabulary) -- the effect of an unforeseen characteristic, behavior, event or procedure on the response that cannot be distinguished from the proposed treatment.

10. Statistical Significance

When an observed difference between two or more groups is too large for us to believe that it occurred "by chance". We consider the difference to be "statistically significant". Just know the verbal definition for now, later, there are way to calculate it.

11. SAMPLE SIZE

One question that arises is "how large of a sample do we need to insure unbiasedness?" What is interesting is that "size matters" but the actual fraction (i.e. percentage) does not. We will return to this in later chapters.

12. SUMMARY: Some types of "questions" involve comparisons

Statistics can help us make rigorous and systematic comparisons of groups, their treatment, and responses and help us avoid arbitrary comparisons that cannot be generalized beyond the particular subjects being studied.