

# Sample Surveys

## Chapter 12

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

1

### Idea 1: Examine Part of the Whole (cont.)

- Opinion polls are examples of sample surveys, designed to ask questions of a small group of people in the hope of learning something about the entire population.
  - Professional pollsters work quite hard to ensure that the sample they take is representative of the population.
  - If not, the sample can give misleading information about the population.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

4

### Background

- We have learned ways to display, describe, and summarize data, but have been limited to examining the particular batch of data we have.
- We'd like (and often need) to stretch beyond the data at hand to the world at large.
- Let's investigate three major ideas that will allow us to make this stretch...

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

2

### Bias

- Samples that don't represent every individual in the population fairly are said to be biased.
  - Bias is the bane of sampling—the one thing above all to avoid.
  - There is usually no way to fix a biased sample and no way to salvage useful information from it.
- The best way to avoid bias is to select individuals for the sample *at random*.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

5

### Idea 1: Examine a Part of the Whole

- The first idea is to draw a sample.
  - We'd like to know about an entire population of individuals, but examining all of them is usually impractical, if not impossible.
  - We settle for examining a smaller group of individuals—a sample—selected from the population.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

3

### Idea 2: Randomize

- Randomizing protects us from the influences of *all* the features of our population, even ones that we may not have thought about.
  - Randomizing makes sure that *on the average* the sample looks like the rest of the population.
- Randomizing makes it possible for us to draw inferences about the population when we see only a sample.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

6

### Idea 3: It's the Sample Size

- How large a random sample do we need for the sample to be reasonably representative of the population?
- It's the size of the sample, not the size of the population, that makes the difference in sampling.
  - Exception: If the population is small enough and the sample is more than 10% of the whole population, the population size *can* matter.
- The *fraction* of the population that you've sampled doesn't matter. It's the *sample size* itself that's important.

### Sampling Variability

- Samples drawn at random generally differ from one another.
  - Each draw of random numbers selects *different* people for our sample.
  - These differences lead to different values for the variables we measure.
  - We call these sample-to-sample differences sampling variability.

### Populations and Parameters

- Models use mathematics to represent reality.
  - Parameters are the key numbers in those models.
- A parameter that is part of a model for a population is called a population parameter.
- We use data to estimate population parameters.
  - Any summary found from the data is a statistic.
  - The statistics that estimate population parameters are called sample statistics.

### Stratified Sampling

- Designs used to sample from large populations are often more complicated than simple random samples.
- Sometimes the population is first sliced into homogeneous groups, called strata, before the sample is selected.
- Then simple random sampling is used within each stratum before the results are combined.
- This common sampling design is called stratified random sampling.

### Simple Random Samples

- We will insist that every possible *sample* of the size we plan to draw has an equal chance to be selected.
  - Such samples also guarantee that each individual has an equal chance of being selected.
  - With this method each *combination* of people has an equal chance of being selected as well.
  - A sample drawn in this way is called a Simple Random Sample (SRS).
- An SRS is the standard against which we measure other sampling methods, and the sampling method on which the theory of working with sampled data is based.

### Stratified Sampling (con't)

- Stratified random sampling can reduce bias.
- Stratifying can also reduce the variability of our results.
  - When we restrict by strata, additional samples are more like one another, so statistics calculated for the sampled values will vary less from one sample to another.

## Cluster Sampling

- Sometimes stratifying isn't practical and simple random sampling is difficult.
- Splitting the population into similar parts or clusters can make sampling more practical.
  - Then we could select one or a few clusters at random and perform a census within each of them.
  - This sampling design is called cluster sampling.
  - If each cluster fairly represents the full population, cluster sampling will give us an unbiased sample.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

13

## What Can Go Wrong?—or, How to Sample Badly (con't)

- **Sample Badly, but Conveniently:**
  - In convenience sampling, we simply include the individuals who are convenient.
    - Unfortunately, this group may not be representative of the population.
  - Convenience sampling is not only a problem for students or other beginning samplers.
    - In fact, it is a widespread problem in the business world—the easiest people for a company to sample are its own customers.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

16

## Systematic Sampling

- Sometimes we draw a sample by selecting individuals systematically.
  - For example, you might survey every 10th person on an alphabetical list of students.
- To make it random, you must still start the systematic selection from a randomly selected individual.
- When there is no reason to believe that the order of the list could be associated in any way with the responses sought, systematic sampling can give a representative sample.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

14

## What Can Go Wrong?—or, How to Sample Badly (con't)

- **Undercoverage:**
  - Many of these bad survey designs suffer from undercoverage, in which some portion of the population is not sampled at all or has a smaller representation in the sample than it has in the population.
  - Undercoverage can arise for a number of reasons, but it's always a potential source of bias.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

17

## What Can Go Wrong?—or, How to Sample Badly

- **Sample Badly with Volunteers:**
  - In a voluntary response sample, a large group of individuals is invited to respond, and all who do respond are counted.
    - Voluntary response samples are almost always biased, and so conclusions drawn from them are almost always wrong.
  - Voluntary response samples are often biased toward those with strong opinions or those who are strongly motivated.
  - Since the sample is not representative, the resulting voluntary response bias invalidates the survey.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

15

## What Else Can Go Wrong!

- **Watch out for nonrespondents.**
  - A common and serious potential source of bias for most surveys is nonresponse bias.
  - No survey succeeds in getting responses from everyone.
    - The problem is that those who don't respond may differ from those who do.
    - And they may differ on just the variables we care about.

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

18

## What Else Can Go Wrong!

---

- Work hard to avoid influencing responses.
  - Response bias refers to anything in the survey design that influences the responses.
  - For example, the *wording* of a question can influence the responses:



Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

19

## Assignment

---

- Read Chapter 18
- Read Chapter 18 a second time!!!
- Try the following exercises from Ch. 12
  - #3, 5, 4, and 11

Copyright © 2006 Pearson Education, Inc. Publishing as Pearson Addison-Wesley

20