Chapter 4

Sample Surveys in the Real World

Lecture Slides

Case Study: Sample Surveys in the Real World 1

An opinion poll talks to 1000 people chosen at random, announces its results, and announces a margin of error. Should we be happy? Perhaps not.

Many polls don't tell the whole truth about their samples.

The Pew Research Center for the People and the Press does a good job of telling how their samples were obtained.

Case Study: Sample Surveys in the Real World 2

Most polls are taken by telephone, dialing numbers at random to get a random sample of households. After eliminating fax and business numbers:

Never answered phone	938
Answered but refused	678
Not eligible: no persons aged 18 or older, or language barrier	221
Incomplete interview	42
Complete interview	1000
Total Called	2879

Case Study: Sample Surveys in the Real World 3

Out of 2879 working residential phone numbers, 33% never answered. Of those who answered, 35% refused to talk. The overall rate of nonresponse (people who never answered, refused, or would not complete the interview) was 1658 out of 2879, or 58%.

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Case Study: Sample Surveys in the Real World 4

Pew called every number five times over a five-day period, at different times of day and on different days of the week. Many polls call only once, and it is usual to find that over half of those who answer refuse to talk.

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Although Pew did obtain the desired sample of 1000 people, can we trust the results of this poll to make conclusions about people with residential phones?

Can the results of the poll be extended to people who only have cell phones?

By the end of this chapter, you will learn how to answer these questions.

How Sample Surveys Go Wrong

Random sampling eliminates bias in choosing a sample and allows control of variability.

When we see the magic words *randomly selected* and *margin of error*, do we know we have trustworthy information before us?

Sampling in the real world is more complex and less reliable than choosing an SRS from a list of names in a textbook exercise.

Confidence statements do not reflect all the sources of error that are present in practical sampling.

Errors in Sampling

Sampling errors are errors caused by the act of taking a sample. They cause sample results to be different from the results of a census.

Random sampling error is the deviation between the sample statistic and the population parameter caused by chance in selecting a random sample. The margin of error in a confidence statement includes *only* random sampling error.

Nonsampling errors are errors not related to the act of selecting a sample from the population. They can be present even in a census.

Errors in Sampling (continued)

1. **Sampling Errors**
   - Caused by the act of taking a sample
   - Cause sample results to be different from the results of a census
2. **Nonsampling Errors**
   - Error not related to the act of selecting a sample from the population
   - Can even be present in a census

1. Sampling Errors

A. Random Sampling Error

- Deviation between the statistic and parameter
- Caused by chance in selecting a random sample
- ONLY error accounted for in the margin of error in a confidence statement

B. Bad Sampling Methods

- Convenience and voluntary response samples
- An incomplete sampling frame can cause **undercoverage,** where certain groups of the population are left out.

Example: Undercoverage

Most opinion polls can't afford to attempt full coverage of the population of all adult residents of the United States.

The interviews are done by telephone, thus missing the 2% of households without phones.

Opting out of modern society was tiring at times, but Ted felt that increasing the undercoverage of opinion polls made it all worthwhile.

Moore/Notz, *Statistics: Concepts and Controversies*, 9e, © 2017 W. H. Freeman and Company

Example: Undercoverage (continued)

Only households are contacted, so students in dormitories, prison inmates, most members of the armed forces, the homeless, and people staying in shelters are left out.

Many polls interview only in English, which leaves some immigrant households out of their samples.

2. Nonsampling Errors

A. Processing Errors

- Mistakes in mechanical tasks such as arithmetic or data entry

B. Poorly Worded Questions

- Question is slanted to favor one response over the other

2. Nonsampling Errors (continued)

C. Response Error

- Response from an individual in the survey that is inaccurate from lying, bad memory, etc.

D. Nonresponse Error

- Failure to obtain data from an individual selected for a sample

Poorly Worded Questions

Look at the difference with a few changed words!

Is our government providing too much money for welfare programs?

44% said yes

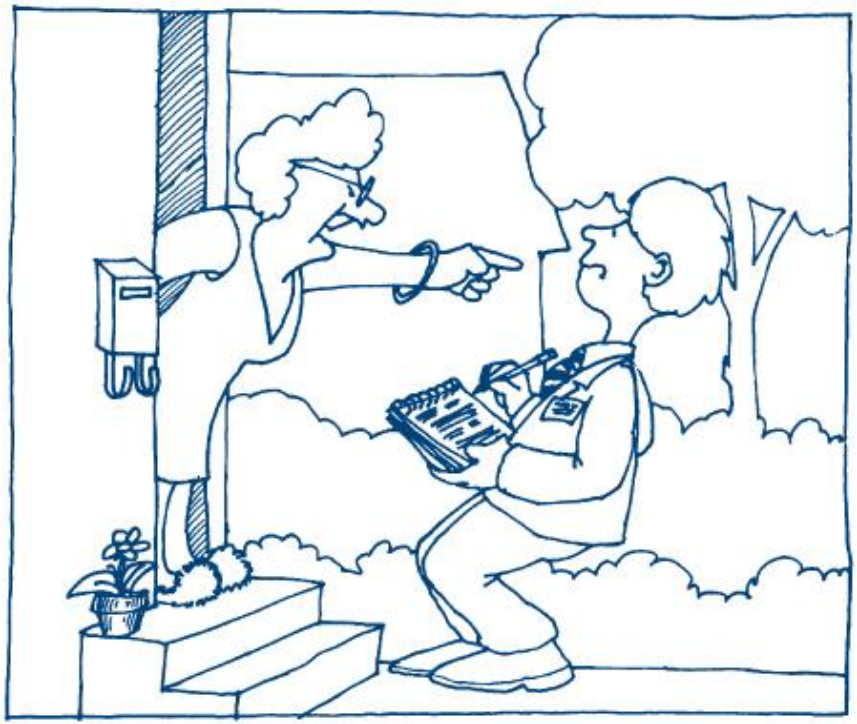
Is our government providing too much money for assistance to the poor?

13% said yes

What the Margin of Error Can't Say

The announced margin of error for a sample survey covers only random sampling error.

Undercoverage, nonresponse, and other practical difficulties can cause large bias that is not covered by the margin of error.



"You can call, you can send email, you can stand at the door all day. The answer is still NO!"

Moore/Notz, *Statistics: Concepts and Controversies*, 9e, © 2017 W. H. Freeman and Company

Other Random Sampling Methods

With an SRS, because each sample of size *n* has the same chance of being selected, we cannot obtain information for separate groups of individuals (e.g., individuals of different gender, race, income class, or religion).

Identify some separate groups we may want to hear from when asking the following question: "Do you think our health-care system works well?"

How to Live with Nonsampling Errors

Substitute other households for the nonresponders. Because nonresponse is higher in cities, replacing nonresponders with other households in the same neighborhood may reduce bias.

Once the data are in, all professional surveys use statistical methods to **weight the responses** in an attempt to correct sources of bias.

Sample Design in the Real World 1

The Current Population Survey (CPS) samples U.S. households. They sample in **stages.**

The nation is divided into 2007 geographic areas called primary sampling units (PSUs); 428 highly populated PSUs are automatically in the sample.

The remaining 1579 are divided into 326 groups, called **strata**. One PSU is drawn at random to represent each stratum.

Sample Design in the Real World 2

Each of the 754 PSUs in the first-stage sample is divided into census blocks (smaller geographic areas), which are also grouped into strata, based on such things as housing types and minority population.

The households in each block are arranged in order of their location and divided into groups, called **clusters**, of about four households each.

Sample Design in the Real World 3

The final sample consists of samples of clusters (not of individual households) from each stratum of blocks. Interviewers go to all households in the chosen clusters.

The samples of clusters within each stratum of blocks are also not SRSs.

To be sure that the clusters spread out geographically, the sample starts at a random cluster and then takes, for example, every tenth cluster in the list.

Stratified Random Sampling

Step 1: Divide the sampling frame into distinct groups of individuals, called ***strata***.

- Choose strata because you have an interest in the groups or because the individuals within each group are similar.

Step 2: Take a separate SRS in each stratum and combine these to make up the complete sample.

Example: Stratifying a Sample of Students 1

A large university has 30,000 students, of whom 3000 are graduate students.

An SRS of 500 students gives every student the same chance to be in the sample. That chance is

$$\frac{500}{30{,}000} = \frac{1}{60}$$

Example: Stratifying a Sample of Students 2

To make sure we have a certain number of grad students (200) and undergraduate students (300) represented, we can stratify.

Label the graduate students 0001 to 3000 and use Table A to select an SRS of 200.

Then label the undergraduates 00001 to 27000 and use Table A a second time to select a sample of 300 of them.

Example: Stratifying a Sample of Students 3

In the stratified sample, each graduate student has a $\frac{200}{3{,}000} = \frac{1}{15}$ chance to be chosen.

Each undergraduate has a $\frac{300}{27{,}000} = \frac{1}{90}$ chance to be chosen.

Example: Stratifying a Sample of Students 4

Because we have two SRSs, we can estimate the opinions of the two groups separately.

The quick and approximate method gives $\frac{1}{\sqrt{200}} = 0.07\ (7\%)$ MOE for the graduate students and $\frac{1}{\sqrt{300}} = 0.058\ (5.8\%)$ MOE for undergraduate students.

A professional analysis would adjust for over-representing graduate students in the final results.

The Challenge of Internet Surveys

Using the Internet for “Web surveys” is becoming increasingly popular.

Advantages:

- Easy to collect large amounts of data
- Costs less money
- Allows for delivery of multimedia content

Disadvantages:

- Not easy to do well
- Voluntary response, undercoverage, nonresponse

Example: Doctors and Placebos

A Web survey of doctors in internal medicine departments at Chicago-area medical schools was possible because almost all doctors had listed e-mail addresses.

An e-mail was sent to each doctor explaining the purpose of the study, promising anonymity, and giving an individual a Web link for response.

Result: 45% of respondents said they sometimes use placebos in their clinical practice.

This is a Web survey done well, since there was a list of all doctors' e-mail addresses and it offered anonymity to reduce the chance of response errors.

Probability Samples

A probability sample is a sample chosen by chance. We must know what samples are possible and what chance, or probability, each possible sample has.

Some probability samples, such as stratified samples, don’t allow all possible samples from the population and may not give an equal chance to all the samples they do allow. As such, not all probability samples are random samples.

Questions to Ask before You Believe a Poll

Who carried out the survey? Even a political party should hire a professional sample survey firm whose reputation demands that they follow good survey practices.

What was the population? That is, whose opinions were being sought?

How was the sample selected? Look for mention of random sampling.

How large was the sample? Even better, find out both the sample size and the margin of error within which the results of 95% of all samples drawn, as this one was, would fall.

Questions to Ask before You Believe a Poll (continued)

What was the response rate? That is, what percentage of the original subjects actually provided information?

How were the subjects contacted? By telephone? Mail? Face-to-face interview?

When was the survey conducted? Was it just after some event that might have influenced opinion?

What were the exact questions asked?

Statistics in Summary 1

Sampling in the real world is complex. Even professional sample surveys don't give exactly correct information about the population.

There are many potential sources of error in sampling. The margin of error announced by a sample survey covers only **random sampling error**, the variation due to chance in choosing a random sample.

Statistics in Summary 2

Other types of error are in addition to the margin of error and can't be directly measured. Sampling errors come from the act of choosing a sample.

Random sampling error and undercoverage are common types of sampling error.

Undercoverage occurs when some members of the population are left out of the **sampling frame**, the list from which the sample is actually chosen.

Statistics in Summary 3

The most serious errors in most careful surveys, however, are **nonsampling errors**. These have nothing to do with choosing a sample; they are present even in a census.

The single biggest problem for sample surveys is **nonresponse**: subjects can't be contacted or refuse to answer.

Statistics in Summary 4

Mistakes in handling the data (**processing errors**) and incorrect answers by respondents (**response errors**) are other examples of nonsampling errors.

Finally, the exact **wording of questions** has a big influence on the answers.

Statistics in Summary 5

People who design sample surveys use statistical techniques that help correct nonsampling errors, and they also use **probability samples** more complex than simple random samples, such as **stratified samples**.

You can assess the quality of a sample survey quite well by just looking at the basics: use of random samples, sample size and margin of error, the rate of nonresponse, and the wording of the questions.