

# Math 140

## Introductory Statistics

Professor Bernardo Ábrego  
Lecture 20  
Sections 8.1

### 8.1 Estimating a Proportion with Confidence

- A recent Phi Delta Kappa/Gallup poll reported that a record 51% of the American public assigns a grade of A or B to the public schools in their community and that this survey had a **margin of error** of 3%. Source: 2001, [www.gallup.com/poll/releases/pr010823.asp](http://www.gallup.com/poll/releases/pr010823.asp).
- These results are based on telephone interviews with a randomly selected national sample of 1108 adults, 18 years and older, conducted May 23–June 6, 2001.
- For results based on this sample, one can say with **95 percent confidence** that the maximum error attributable to sampling and other random effects is plus or minus 3 percentage points. In addition to sampling error, question wording and practical difficulties in conducting surveys can introduce error or bias into the findings of public opinion polls.

### 8.1 Estimating a Proportion with Confidence

- A recent Phi Delta Kappa/Gallup poll reported that a record 51% of the American public assigns a grade of A or B to the public schools in their community and that this survey had a **margin of error** of 3%. Source: 2001, [www.gallup.com/poll/releases/pr010823.asp](http://www.gallup.com/poll/releases/pr010823.asp).
- The Gallup organization is disclosing that they didn't ask all adults in the United States, **only 1108**. Even so, unless there are some special difficulties such as problems with the wording of the question, they are **95% confident** that the error is **less than 3%** either way in the percentages they report. That is, they are 95% confident that if they were to ask all adults in the United States to give a grade to the public schools,  $51\% \pm 3\%$ , or **between 48% and 54%**, would give a grade of A or B. How can the Gallup organization possibly make such a statement?

### Reasonably Likely (Again)

- We learned in 7.3 that if we get a sample of size  $n$  from a population with proportion of success  $p$ , then the **reasonably likely** outcomes fall between the values

$$p \pm 1.96 \sqrt{\frac{p(1-p)}{n}}$$



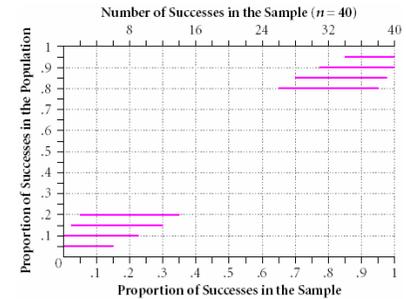
- Recall that **reasonably likely** outcomes are those in the middle 95% of the distribution of all possible outcomes. The outcomes in the upper 2.5% and the lower 2.5% of the distribution are **rare events**—they happen, but rarely.

## Examples

- **Example p.468.** Suppose that you will flip a fair coin 100 times. What are the reasonably likely values of the sample proportion  $\hat{p}$ ? What numbers of heads are reasonably likely?
- **D1.** Suppose 35% of a population think they pay too much for car insurance. A polling organization takes a random sample of 500 people in this population and computes the sample proportion of people who think that they pay too much for car insurance.
  - a. There is a 95% chance that  $\hat{p}$  will be between what two values?
  - b. Is it reasonably likely to get 145 people in the sample who think they pay too much for car insurance?

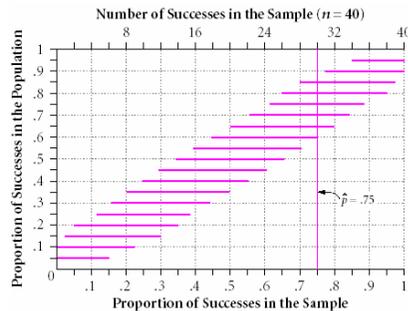
## Activity 8.1b

1. Your instructor will give you one of the population proportions whose line segments are missing in Display 8.1.
2. Compute the reasonably likely outcomes for your population proportion  $p$ .
3. On your copy of the chart in Display 8.1, draw a horizontal line segment showing the reasonably likely outcomes for your group's proportion  $p$ .
4. Get the reasonably likely outcomes from the other groups in your class and complete the chart with the line segments from those values of  $p$ .



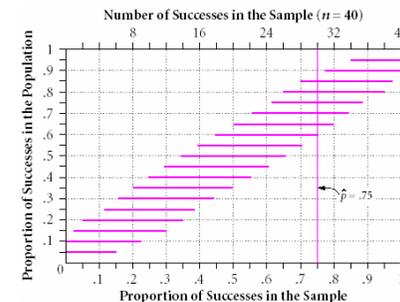
## Activity 8.2 Results

$p$	Left	Right
0.25	0.1158	0.3841
0.3	0.1579	0.4420
0.35	0.2021	0.4978
0.4	0.2481	0.5518
0.45	0.2958	0.6041
0.5	0.3450	0.6549
0.55	0.3958	0.7041
0.6	0.4481	0.7518
0.65	0.5021	0.7978
0.7	0.5579	0.8420
0.75	0.6158	0.8841



## Example: Plausible Percentages

- In a group of 40 adults, exactly 30 were right-eye dominant. Assuming this can be considered a random sample of all adults, is it plausible that if you tested *all* adults, you would find that 50% are right-eye dominant? Is it plausible that 80% are right-eye dominant? What percentages are plausible?



## Confidence Interval

- A **95% confidence interval** consists of those population percentages  $p$  for which the sample proportion  $\hat{p}$  is reasonably likely.
- Notes:
  - In the previous diagram the **horizontal segments** were **reasonably likely intervals**.
  - The **95% confidence intervals** should be represented as vertical segments. In this case  $p$  is the unknown parameter. In the previous example the **95% confidence interval** goes from 0.6 to about 0.85

## Discussion: Confidence Intervals

- D3. According to the 2000 U.S. Census, about 60% of Hispanics in the United States are of Mexican origin. Would it be reasonably likely in a survey of 40 randomly chosen Hispanics to find that 27 are of Mexican origin?  
Source: [www.census.gov/prod/2001pubs/c2kbr01-3.pdf](http://www.census.gov/prod/2001pubs/c2kbr01-3.pdf).
- D4. According to the 2000 U.S. Census, about 30% of people over age 85 are men. In a random sample of 40 people over age 85, would it be reasonably likely to get 60% who are men?  
Source: [www.census.gov/prod/2001pubs/c2kbr01-10.pdf](http://www.census.gov/prod/2001pubs/c2kbr01-10.pdf).
- D5. Suppose that in a random sample of 40 toddlers, 34 know what color Elmo is. What is the 95% confidence interval for the percentage of toddlers who know what color Elmo is?
- D6. Polls usually report a margin of error. Suppose a poll of 40 randomly selected statistics majors finds that 20 are female. The poll reports that 50% of statistics majors are female, with a margin of error of 15%. Use your completed chart to explain where the 15% came from.