

## Homework

### Sampling Distributions of proportions and Hypothesis Testing of proportions.

Things to know about sampling distributions:

1. If you have a binomial random variable  $X \sim \text{Bin}(n, p)$  and both  $np \geq 10$  and  $nq \geq 10$  (where  $q = 1 - p$ ), then  $X$  is approximately normally distributed with mean  $np$  and standard deviation  $\sqrt{npq}$ .
2. If you have the same scenario as #1 above, but instead of looking at  $X$  (the *number* of successes), you look at  $\hat{p}$  (the *proportion* of successes), then  $\hat{p}$  is approximately normally distributed with mean  $p$  and standard deviation  $\sqrt{\frac{pq}{n}}$ .

Practice problems:

1. The Gallup Poll once asked a random sample of 1540 adults, "Do you happen to jog?" Suppose that in fact 15% of all adults jog.
  - a. Find the mean and standard deviation of the proportion  $\hat{p}$  of the sample who jog. Assume the sample is an SRS.
  - b. Check that you can use the normal approximation for the distribution of  $\hat{p}$ .
  - c. Find the probability that between 13% and 17% of the sample jog.
  - d. What sample size would you have to use to reduce the standard deviation of the sample proportion to one-half its present value?
2. A large survey of countries including the United States, China, Russia, France, Turkey, Kenya, and others indicated that most people prefer the color blue. In fact, about 24% of the population claim blue as their favorite color (source: Study by J. Bunge and A. Freeman-Gallant, Cornell University).

Suppose a random sample of 56 college students were surveyed and 12 of them said blue is their favorite color. Does this information imply that college students prefer blue less than the general population?

3. The following is based on information from *The Wolf in the Southwest: The Making of an Endangered Species*, by David E. Brown.

Before 1918, the proportion of female wolves in the general population of all southwestern wolves was about 50%. However, after 1918, southwestern cattle ranchers began a widespread effort to destroy wolves. One theory states that male wolves tend to return sooner than females to their old territory, where their predecessors were exterminated. In a recent sample of 102 wolves, there were only 30 females. Do these data indicate that the population proportion of female wolves is now less than 50% in the region?

4. Athabasca Fishing Lodge is located on Lake Athabasca in northern Canada. In one of its recent brochures, the lodge advertises that 75% of its guests catch northern pike over 20 pounds. A statistician in the area thinks that this percentage may be somewhat high. He takes a random sample of 83 guests, and finds that 53 of them caught a northern pike weighing over 20 pounds. Does this indicate that the proportion of guests who catch a pike over 20 pounds is lower than 75%?
5. According to Meyers-Briggs estimates, about 82% of college student government leaders are extroverts. (Source: Myers-Briggs Type Indicator Atlas of Type Tables.)

Suppose that a Myers-Briggs personality test was given to a random sample of 73 college student government leaders attending a large national leadership conference and that 56 were found to be extroverts. Does this indicate that the Myers-Briggs estimates are too high?

6. Harper's Index reported that 80% of all supermarket prices end in the digit 9 or 5. You suspect this number to be high, so you check a random sample of 115 items in a supermarket and find that 84 have prices that end in 9 or 5. Does this indicate that less than 80% of the prices in the store end in the digits 9 or 5?
7. A cable news network host declares that at least 50% of all TV viewers watch the news. A guest on the program from a national magazine says he's not sure that it's that high, at which point the host tells him to shut up and turns off his microphone. The magazine then commissions a survey of 5000 TV viewers in which 2410 say they watch news programs. Should the magazine dispute the news host's claim, or should they just shut up as per his recommendation?