AP Statistics
Unit 06 – HW #2
Confidence Intervals: Proportions

Name Key
Period

For problems 1-4, consider each situation described below. Identify the population and the sample, explain what p and $\hat{p}$ represent.

1. Police set up an auto checkpoint at which drivers are stopped and their cars inspected for safety problems. They find that 14 of the 134 cars stopped have at least one safety violation. They want to estimate the percentage of all cars that may be unsafe.

   population: all cars
   Sample: 134 cars stopped
   p = true proportion of all unsafe cars.
   $\hat{p} = 14/134 = 0.1045$ or 10.45%

2. A TV talk show asks views to register their opinions on prayer in schools by logging onto a website. Of the 602 people who voted, 488 favored prayer in schools. We want to estimate the level of support among the general public.

   population: general public
   sample: 602 viewers of a TV talk show who logged on
   p = true proportion of people who favor prayer in school.
   $\hat{p} = 488/602 = 0.8106$ or 81.06%

3. A school is considering requiring students to wear uniforms. The PTA surveys parent opinion by sending a questionnaire home with all 1245 students; 380 surveys returned with 228 families in favor of the change.

   population: parents with kids at a particular school.
   sample: 380 parents/families w/ a survey (who returned it)
   p = true proportion of parents/families in favor of school uniforms.
   $\hat{p} = 228/380 = 0.6$ or 60%

4. A college admits 1632 freshman one year, and four years later 1388 of them graduate on time. The college wants to estimate the percentage of all their freshman enrollees who graduate on time.

   population: all college freshman enrollees.
   sample: 1632 students who enrolled that year.
   p = the true proportion of all freshman enrollees who graduate on time.
   $\hat{p} = 1388/1632 = 0.850S$ or 85.05%

5. A may 2000 Gallup Poll found that 38% of a random sample of 1012 adults said that they believe in ghosts.

   a. Find the margin of error for this poll if we want 90% confidence in our estimate of the percent of American adults who believe in ghosts.

$ME = z^* \sqrt{\frac{\hat{p}\hat{q}}{n}}$

$100 - 90 = 10 \div 2 = 0.05$ or 0.95

$= \pm 1.645 \sqrt{\frac{(0.38)(0.62)}{1012}}$

$= \boxed{\pm 0.0251}$

   b. Explain what the margin of error means.

The margin of error allows us to construct a confidence interval at a certain level of confidence. It is the max distance from the point estimate at a particular confidence level. (How far away the CI bounds are from the PE)

   c. If we want to be 99% confident, will the margin of error be larger or smaller? Explain.

It will be larger because z^* will increase and the SD will be multiplied by a larger #.

   d. In general, if all other aspects of the situation remain the same, would smaller samples produce smaller or larger margins of error? Explain.

A smaller sample means dividing by a smaller # which would increase the margin of error. $\frac{1}{n} > \frac{1}{m}$ if $n < m$.

6. An insurance company checks police records on 582 accidents selected at random and notes that teenagers were at the wheel in 91 of them.

   a. Create a 95% confidence interval for the percentage of all auto accidents that involve teenage drivers.

State: we want to estimate the true proportion of all auto accidents that involve teenage drivers with 95% confidence.

Plan: $\hat{p} = 91/582 = 0.156$

Random: selected at random ✓

10% condition: 5820 < all auto accidents ✓

Large counts: $np \geq 10$ $nq \geq 10$

$91 \geq 10$ ✓ $491 \geq 10$ ✓

because the conditions are met, we will do a 1-proportional z-interval

Do: $z^* = 1.96$ $0.156 \pm 1.96\sqrt{\frac{(0.156)(0.844)}{582}} = (0.1269, 0.1859)$

Conclude:

   b. Explain what your confidence interval means.

we are 95% confident that the interval from 0.1269 to 0.1859 captures the true proportion of all auto accidents that involve teenage drivers.

   c. Explain what the confidence level means.

if we take many, many samples of the same size from this population, about 95% of them would result in an interval that captures the true proportion of all auto accidents that involve teenage drivers.

   d. A politician urging tighter restrictions on drivers' licenses issued to teens says, "In one of every five auto accidents, a teenager is behind the wheel." Does your confidence interval support or contradict this statement? Explain.

$1/5 = 20\%$ is not in my interval so there is not convincing evidence that this claim is true. My CI contradicts this claim.

7. A June 2004 Gallup Poll asked Americans who they though better fit their idea of what a first lady should be, Laura Bush or Hillary Clinton. More Americans believed Bush fit the bill, 52% to 43%. The remaining 5% felt that both women equally fit their idea of a first lady or neither of them did, or they had no opinion. The poll was based on a random sample of 1005 adults aged 18 and older.

a. Find the 95% confidence interval for the true proportion of all U.S. adults who believe Laura Bush fits their idea of a first lady.

State: We want to estimate the true proportion of all US adults who believe Laura Bush fits their idea of a first lady with 95% confidence.

$\hat{p} = 0.52$

Plan: Random: random sample ✓

10% condition: 1005 < all US adults 18+ ✓

Large counts: $np \geq 10$ $nq \geq 10$

$0.52 \cdot 1005 \geq 10$ $0.48 \cdot 1005 \geq 10$

$522.6 \geq 10$ ✓ $482.4 \geq 10$ ✓

because our conditions are met, we will do a 1-proportion z-interval.

Do:

$z^* = 1.96$ $0.52 \pm 1.96\sqrt{\frac{(0.52)(0.48)}{1005}} = (0.4895, 0.5513)$

Conclude: We are 95% confident that the interval from 0.4895 to 0.5513 captures the true proportion of all US adults who believe Laura Bush fits their idea of a first lady.

b. If someone assumes that half of the U.S. adult population thinks Hillary Clinton fits the bill, what would you say?

We would have to create another confidence interval because this one is for Laura vs. not Laura, not Laura vs. Hillary.

Do: $0.43 \pm 1.96\sqrt{\frac{(0.43)(0.57)}{1005}} = (0.3992, 0.4605)$

the interval does not include 0.5 so it does not support the assumption that half of US adults think Hillary fits the bill.