Unit 5 Practice Test *Inference for Proportions – Part V*

Name SOLUTIONS (updated 2023-2024)

A 1. A certain population is strongly skewed to the left. We want to estimate its mean, so we collect a sample. Which should be true if we use a large sample rather than a small one?

✓ I. The distribution of our sample data will be more clearly skewed to the left.

✗ II. The sampling model of the sample means will be more skewed to the left.

✗ III. The variability of the sample means will greater.

A) I only B) II only C) III only D) I and III only E) II and III only

D 2. Which is true about a 99% confidence interval based on a given sample?

✗ I. The interval contains 99% of the population.

✗ II. Results from 99% of all samples will lie in this interval.

✓ III. The interval is wider than a 95% confidence interval would be.

A) None B) I only C) II only D) III only E) II and III only

E 3. We have calculated a confidence interval based on a sample of $n = 180$. Now we want to get a better estimate with a margin of error only one third as large. We need a new sample with n at least...

A) 20 B) 60 C) 312 D) 540 E) 1620

$\frac{1}{\sqrt{n}} \Rightarrow \frac{1}{3}$

$n \Rightarrow 9x$

E 4. An online catalog company wants on-time delivery for at least 90% of the orders they ship. They have been shipping orders via UPS and FedEx but will switch to a more expensive service (ShipFast) if there is evidence that this service can exceed the 90% on-time goal. As a test the company sends a random sample of orders via ShipFast, and then makes follow-up phone calls to see if these orders arrived on time. Which hypotheses should they test?

A) $H_0: p < 0.90$, $H_A: p = 0.90$ B) $H_0: p > 0.90$, $H_A: p = 0.90$ C) $H_0: p = 0.90$, $H_A: p < 0.90$ D) $H_0: p = 0.90$, $H_A: p \neq 0.90$ E) $H_0: p = 0.90$, $H_A: p > 0.90$

E 5. A researcher investigating whether joggers are less likely to get colds than people who do not jog found a P-value of 3%. This means that:

A) 3% of joggers get colds.

B) Joggers get 3% fewer colds than non-joggers.

C) There's a 3% chance that joggers get fewer colds.

D) There's a 3% chance that joggers don't get fewer colds.

E) None of these.

If there were actually no difference in colds for joggers & nonjoggers, the difference seen in this study, or more extreme, would happen 3% of the time just by chance

D 6. To plan the budget for next year a college needs to estimate what impact the current economic downturn might have on student requests for financial aid. Historically this college has provided aid to 35% of its students. Officials look at a random sample of this year's applications to see what proportion indicate a need for financial aid. Based on these data they create a 90% confidence interval of (32%, 40%). Could this confidence interval be used to test the hypothesis $H_0: p = 0.35$ versus $H_A: p \neq 0.35$ at the $\alpha = 0.10$ level of significance?

A) No, because financial aid amounts may not be normally distributed.

B) No, because they only used a sample of the applicants instead of all of them.

C) Yes; since 35% is in the confidence interval they accept the null hypothesis, concluding that the percentage of students requiring financial aid will stay the same.

D) Yes; since 35% is in the confidence interval they fail to reject the null hypothesis, concluding that there is not strong evidence of any change in financial aid requests.

E) Yes; since 35% is not at the center of the confidence interval they reject the null hypothesis, concluding that the percentage of students requiring aid will increase.

A 7. We are about to test a hypothesis using data from a well-designed study. Which is true?

× I. A large P-value would be strong evidence against the null hypothesis.

× II. We can set a higher standard of proof by choosing $\alpha = 10\%$ instead of 5%.

× III. If we reduce the risk of committing a Type I error, then the risk of a Type II error will also decrease.

A) None B) I only C) II only D) III only E) I and II only

C 8. Suppose that a device advertised to increase a car's gas mileage really does not work. We test it on a small fleet of cars (with H_0: not effective), and our data results in a P-value of 0.004. What probably happens as a result of our experiment?

A) We correctly fail to reject H_0.
B) We correctly reject H_0.
C) We reject H_0, making a Type I error.
D) We reject H_0, making a Type II error.
E) We fail to reject H_0, committing Type II error.

D 9. We will test the hypothesis that $p = 60\%$ versus $p > 60\%$. We don't know it, but actually p is 70%. With which sample size and significance level will our test have the greatest power?

A) $\alpha = 0.01$, $n = 200$
B) $\alpha = 0.01$, $n = 500$
C) $\alpha = 0.05$, $n = 200$
D) $\alpha = 0.05$, $n = 500$
E) The power will be the same so long as the true proportion p remains 70%.

D 10. A college alumni fund appeals for donations by phoning or emailing recent graduates. A random sample of 300 alumni shows that 40% of the 150 who were contacted by telephone actually made contributions compared to only 30% of the 150 who received email requests. Which formula calculates the 98% confidence interval for the difference in the proportions of alumni who may make donations if contacted by phone or by email?

we don't pool for conf. intervals and we use $\hat{p}$'s

A) $(0.40-0.30) \pm 2.33\sqrt{\frac{(0.35)(0.65)}{150}}$

B) $(0.40-0.30) \pm 2.33\sqrt{\frac{(0.35)(0.65)}{150}+\frac{(0.35)(0.65)}{150}}$

C) $(0.40-0.30) \pm 2.33\sqrt{\frac{(0.35)(0.65)}{300}}$

D) $(0.40-0.30) \pm 2.33\sqrt{\frac{(0.40)(0.60)}{150}+\frac{(0.30)(0.70)}{150}}$

E) $(0.40-0.30) \pm 2.33\sqrt{\frac{(0.40)(0.60)}{300}+\frac{(0.30)(0.70)}{300}}$

11. **Births** A city has two hospitals, with many more births recorded at the larger hospital than at the smaller one. Records indicate that in general babies are about equally likely to be boys or girls, but the actual gender ratio varies from week to week. Which hospital is more likely to report a week when over two-thirds of the babies born were girls? Explain.

The smaller hospital, because smaller sample size means larger std dev, so more extreme things are more likely to occur.

12. **Approval rating** A newspaper article reported that a poll based on a sample of 800 voters showed the President's job approval rating stood at 62%. They claimed a margin of error of ± 3%. What level of confidence were the pollsters using?

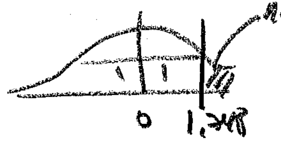
$z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ = margin of error

$z^* \sqrt{\frac{(.62)(.38)}{800}} = .03$

Solve for $z^* = 1.748$

normalcdf(1.748, ∞, 0, 1)

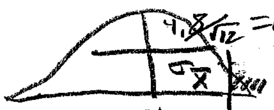
= .04



.04 (.92) .04

$\boxed{92\% \text{ confidence level}}$

13. **Egg weights** The weights of hens' eggs are normally distributed with a mean of 56 grams and a standard deviation of 4.8 grams. What is the probability that a dozen randomly selected eggs weighs over 690 grams? sampling distrib of sample means for $n=12$ eggs:



$4.8/\sqrt{12} = 1.386$ normalcdf(57.5 lower, ∞ upper, 56 mean, 1.386 SD) = $\boxed{.14}$

56g boundary = $\frac{690}{12} = 57.5$ g per egg

14. **Roadblocks** From time to time police set up roadblocks to check cars to see if the safety inspection is up to date. At one such roadblock they issued tickets for expired inspection stickers to 22 of 628 cars they stopped.

   a. Based on the results at this roadblock, construct and interpret a 95% confidence interval for the proportion of autos in that region whose safety inspections have expired.

conditions

- ✓ SRS? assume these cars are typical
- ✓ $n<10\%$ of pop? $628 < 10\%$ of all cars on this road
- ✓ $np \ge 10$? $nq \ge 10$? $np = 22$, $nq = 628 - 22 = 606$
- ✓ Indep? assume no connections b/w these cars

1-PropZInt using

$X = 22$
$n = 628$
C-level = .95

(.02065, .0494)

We are 95% confident that between 2.1% and 4.9% of all cars on this road have expired safety inspections

   b. Explain the meaning of "95% confidence" in part a).

If we took many samples of 628 cars, and found confidence intervals for each, 95% of these confidence intervals would contain the true percentage of all cars with expired safety inspections.

15. **Baldness and heart attacks** A recent medical study observed a higher frequency of heart attacks among a group of bald men than among another group of men who were not bald. Based on a P-value of 0.062 the researchers concluded there was some evidence that male baldness may be a risk factor for predicting heart attacks. Explain in this context what their P-value means.

If there is actually no difference in heart attack rates for bald and non-bald men, for samples of the size in this experiment, there is a 6.2% chance of having a sample with the difference in % of heart attacks this study found, or more extreme, just due to chance.

16. **Employment program** A city council must decide whether to fund a new "welfare-to-work" program to assist long-time unemployed people in finding jobs. This program would help clients fill out job applications and give them advice about dealing with job interviews. A six-month trial has just ended. At the start of this trial a number of unemployed residents were randomly divided into two groups; one group went through the help program and the other group did not. Data about employment at the end of this trial are shown in the table. Should the city council fund this program? Test an appropriate hypothesis and state your conclusion.

	Current job status		
	Employed	Unemployed	
Group 1 (Help program)	x_1 20	34	$n_1=54$
Group 2 (No help)	x_2 13	33	$n_2=46$

H_0: $p_1 = p_2$ Help group not higher % employed than no-help group

H_A: $p_1 > p_2$ Help group has higher % employed than no-help group

p_1 = % of Help group employed at end of program

p_2 = % of no-help group employed at end of program.

Conditions

✓ SRSs? assume these job seekers are typical

✓ $n < 10\%$ of pop? $100 < 10\%$ of all job seekers

✓ $np \geq 10$? $nq \geq 10$? $n_1p_1 = 20$, $n_1q_1 = 34$, $n_2p_2 = 13$, $n_2q_2 = 33$

✓ groups indep? "randomly assigned to groups"

2 Prop-ZTest using

$x_1 = 20$ $x_2 = 13$ $p_1 > p_2$

$n_1 = 54$ $n_2 = 46$

p-value = .176

$z = .93$

With significance level of .05, p-value = .176 is high so we fail to reject H_0. We do not have convincing evidence that the help group has a higher % employed than the no-help group.