AP Statistics 9.2A Activity
Significance Tests for Proportions

Name Key
Per ____ Date ____

C 1. You toss a coin 10 times to test the hypothesis H_0: $p = 0.5$ that the coin is balanced. Which of the following assumptions for inference about a proportion using a hypothesis test are violated?

(a) The data are an SRS from the population of interest.
(b) Independence condition
(c) $np \geq 10$, $n(1 - p) \geq 10$
(d) There appear to be no violations.
(e) More than one condition is violated.

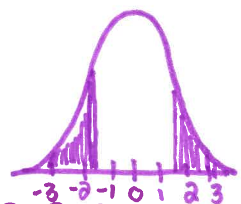
Simon reads a newspaper report claiming that 12% of all adults in the United States are left-handed. He wonders if 12% of the students at his large public high school are left-handed. Simon chooses an SRS of 100 students and records whether each student is right or left-handed. In Simon's SRS, 16 of the students were left-handed.

a 2. The hypotheses for testing the Simon's claim are:

(a) H_0: $p = 0.12$, H_a: $p \neq 0.12$
(b) H_0: $p = 0.12$, H_a: $p > 0.12$
(c) H_0: $p = 0.12$, H_a: $p < 0.12$
~~(d) H_0: $p = 0.16$, H_a: $p < 0.16$~~
~~(e) H_0: $p = 0.16$, H_a: $p \neq 0.16$~~

3. Calculate the test statistic. Show your work!

$$Z = \frac{.16 - .12}{\sqrt{\frac{.12(.88)}{100}}} = \frac{0.04}{.0325} \approx 1.23$$



4. Calculate the P-value. Show your work!

$p \neq$

$$2\,\text{normalcdf}(\underbrace{1.23}_{LB}, \underbrace{100}_{UB}, \mu=0, \sigma=1) = 0.2187$$

5. If $\alpha = 0.05$, what is the correct conclusion? Interpret this in context.

$0.2187 \not< 0.05$ Fail to reject H_0

A buyer for a grocery chain inspects large truckloads of apples to determine the proportion p of apples in the shipment that are rotten. Unless there is clear evidence that this proportion is less than 0.06, she will reject the shipment. To reach a decision she will test the hypotheses

H_0: $p = 0.06$, H_a: $p < 0.06$.

To do so, she selects an SRS of fifty apples from the over 20000 apples on the truck.

C 6. Which of the following assumptions for inference about a proportion using a hypothesis test are violated?

(a) The data are an SRS from the population of interest.
(b) The population is at least ten times as large as the sample.
(c) $np \geq 10$, $n(1 - p) \geq 10$
(d) There appear to be no violations.
(e) More than one condition is violated.

a 7. Suppose that only two of the apples sampled are found to have major defects, and she proceeds with the test. The P-value of her test is

(a) greater than .10
(b) between .10 and .05
(c) between .05 and .025
(d) between .025 and .01
(e) less than .01

$$\frac{.04 - .06}{\sqrt{\frac{.06(.94)}{50}}} = \frac{-.02}{.0336} = -0.595$$

$$\text{normalcdf}(\underbrace{-100}_{LB}, \underbrace{-0.595}_{UB}, \mu=0, \sigma=1)$$

$$= 0.2759$$

Your teacher claims to produce random numbers from 1 to 5 (inclusive) on her calculator, but you've been keeping track. In the past 80 rolls, the number "five" has come up only 8 times. You suspect that the calculator is producing fewer fives than it should. Let p = actual long-run proportion of five's produced by the calculator.

__c__ 8. The hypotheses for testing the teacher's claim are:

(a) H_0: p = 0.2, H_a: p ≠ 0.2

(b) H_0: p = 0.2, H_a: p > 0.2

(c) H_0: p = 0.2, H_a: p < 0.2

~~(d) H_0: p = 0.1, H_a: p < 0.1~~

~~(e) H_0: p = 0.1, H_a: p ≠ 0.1~~

$\frac{1}{5} = 0.2$

__d__ 9. The P-value for this test is closest to:

(a) –2.24

(b) 0.0014

(c) 0.0028

(d) 0.0125

(e) 0.0250

$$\frac{0.1-0.2}{\sqrt{\frac{.2(.8)}{80}}} = \frac{-0.1}{.0447} = -2.236$$

__b__ 10. Which of the following could be used to determine the largest number of fives you could get in 80 rolls and still reject the null hypothesis at the α = .05 level.

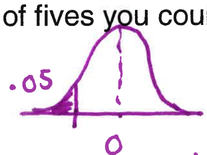
A. $\dfrac{\hat{p}-0.2}{\sqrt{\dfrac{(0.2)(0.8)}{80}}} = 1.645$

B. $\dfrac{\hat{p}-0.2}{\sqrt{\dfrac{(0.2)(0.8)}{80}}} = -1.645$

C. $\dfrac{\hat{p}-0.2}{\sqrt{\dfrac{(0.2)(0.8)}{80}}} = -1.960$

D. $\dfrac{\hat{p}-0.2}{\sqrt{\dfrac{(0.2)(0.8)}{80}}} = -2.576$

E. $\dfrac{\hat{p}-0.2}{\sqrt{\dfrac{(0.2)(0.8)}{80}}} = 2.576$



invNorm
.05 area
$\mu = 0$
$\sigma = 1$

__b__ 11. A noted psychic was tested for ESP. The psychic was presented with 200 cards face down and asked to determine if the card was one of five symbols: a star, cross, circle, square, or three wavy lines. The psychic was correct in 50 cases. To determine if he has ESP, we want to know if his success rate is better than someone who just guesses. That is, we test the hypotheses H_0: p = 0.20, H_a: p > 0.20, where p represent the proportion of cards for which the psychic correctly identifies the symbol in random trials. Assume the 200 trials described above can be treated as an SRS from the population of all guesses the psychic would make in his lifetime. The P-value of this test is

(a) between .10 and .05

(b) between .05 and .025

~~(c) between .025 and .01~~

~~(d) between .01 and .001~~

~~(e) below .001~~

$\frac{50}{200} = 0.25$

$$\frac{.25-.20}{\sqrt{\frac{.2(.8)}{200}}} = 1.76777$$

0.03855

A December 2007 Gallup Poll reported that 43% of Americans use the internet for an hour or more each day. You suspect that a higher proportion of students at your school use the internet that much. To find out, you take a simple random sample of 60 students and find that 35 of them use the internet for an hour or more each day. You will test the hypotheses H_0: p = 0.43 and H_a: p > 0.43, where p = the proportion of students at your school who use the internet for an hour or more each day, at the α = 0.01 level.

__d__ 12. Which of the following best describes the sampling distribution of proportions for this test?

~~(a) Mean = 0.583; Standard deviation = 0.064; shape approx. Normal~~

~~(b) Mean = 0.583; Standard deviation = 0.064; shape unknown~~

~~(c) Mean = 0.5; Standard deviation = 0.064; shape approx. Normal~~

(d) Mean = 0.43; Standard deviation = 0.064; shape approx. Normal

(e) Mean = 0.43; Standard deviation = 0.064; shape unknown

__a__ 13. The test statistic, P-value, and appropriate decision for this test are:

(a) z = 2.40; P-value = 0.008; reject H_0

(b) z = 2.40; P-value = 0.008; fail to reject H_0

~~(c) t = 2.40; P-value = 0.0103; reject H_0~~

~~(d) t = 2.40; P-value = 0.0103; fail to reject H_0~~

(e) no conclusion can be drawn, because the shape of the sampling distribution is unknown.

$.008 < .01$

b 14. In 1999, 2.2% of all cars in the United States were reported stolen. In a random sample of 400 Nissan Maxima cars that year, 12 were reported stolen. Is this evidence (at the a = 0.05 level) that the theft rate for this model is higher than the national rate?

(a) Yes, the P-value = 0.1377, so we reject H_0 and conclude that the rate for Nissans is higher that 2.2%.

(b) No, the P-value = 0.1377, so we fail to reject H_0 and cannot conclude that the rate for Nissans is higher that 2.2%.

~~(c) Yes, the P-value = 0.1685,~~ so we reject H_0 and conclude that the rate for Nissans is higher that 2.2%.

~~(d) No, the P-value = 0.1685, so~~ we fail to reject H_0 and cannot conclude that the rate for Nissans is higher that 2.2%.

(e) We cannot perform this test because the conditions for inference have not been met.

15. LeRoy, a starting player for a major college basketball team, made only 40% of his free throws last season. During the summer, he worked on developing a softer shot in hopes of improving his free throw accuracy. In the first eight games of this season, LeRoy made 25 free throws in 40 attempts. You want to investigate whether LeRoy's work over the summer will result in a higher proportion of free-throw successes this season. What conclusion would you draw at the α = 0.01 level about LeRoy's free throw shooting? Justify your answer with a complete significance test.

Test the hypotheses at a 0.01 significance level

$H_0: p = 0.40$ p = true proportion of free throws that LeRoy makes

$H_a: p > 0.40$

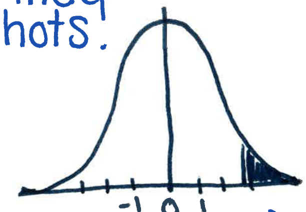
Use a 1 sample z-test

Random: We are going to assume that his first 40 shots are a SRS of his shots all season.

Normal: $0.4(40) = 16 \geq 10$ $0.6(40) = 24 \geq 10$ ✓

Independent: success of each shot is indep. of other shots.

$$z = \frac{.625 - .40}{\sqrt{\frac{.4(.6)}{40}}} = \frac{0.225}{0.0775} = 2.9047$$



P-value = normalcdf(LB 2.9047, UB = 10, $\mu=0, \sigma=1$) = 0.00184

0.00184 < 0.01, Reject Ho

We have convincing evidence that LeRoys free throw percentage is greater than 40%.