AP Statistics 9.2 HW Key

(33) p = true proportion of left handed people

$H_0: p = .12$

$H_a: p > .12$

CONDITIONS

(1) Random: SRS $n = 100$ students

(2) Independent: We assume there are at least $10(100) = 1{,}000$ students at the large high school.

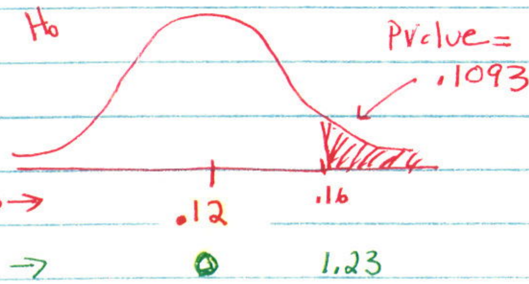
(3) Normal: $np = .12(100) = 12 \geq 10$ ✓

$nq = .88(100) = 88 \geq 10$ ✓

* The conditions have been met to do a 1-sample Z-test for p.

(37) SRS $n = 100$

$\hat{p} = 16/100 = .16$



$$z = \frac{.16 - .12}{\sqrt{\frac{(.12)(.88)}{100}}} = 1.23$$

$P(z > 1.23) = .1093$

normalcdf (1.23, E99, 0, 1)

Conclusion: Since the pvalue is so large, we would fail to reject the null hypothesis. There is not convincing evidence that the proportion of left handed people is greater than 12%.

NAME:

SECTION 9.2 Exercises

** SPECIAL INSTRUCTIONS **

① You will need 3 of the forms "TEST OF STATISTICS TEMPLATE"

② BLANK COPIES ARE ONLINE

41 **Better parking** A local high school makes a change that should improve student satisfaction with the parking situation. Before the change, 37% of the school's students approved of the parking that was provided. After the change, the principal surveys an SRS of 200 of the over 2500 students at the school. In all, 83 students say that they approve of the new parking arrangement. The principal cites this as evidence that the change was effective. Perform a test of the principal's claim at the $\alpha = 0.05$ significance level.

COMPLETE TEST OF STATISTICS TEMPLATE (See template)

43 **Better parking** Refer to Exercise 41.

(a) Describe a Type I error and a Type II error in this setting, and explain the consequences of each.

(b) The test has a power of 0.75 to detect that $p = 0.45$. Explain what this means.

(c) Identify two ways to increase the power in part (b).

45 **Are boys more likely?** We hear that newborn babies are more likely to be boys than girls. Is this true? A random sample of 25,468 firstborn children included 13,173 boys.[13] Boys do make up more than half of the sample, but of course we don't expect a perfect 50-50 split in a random sample.

(a) To what population can the results of this study be generalized: all children or all firstborn children? Justify your answer.

SINCE THE STUDY WAS A RANDOM SAMPLE OF FIRST BORN CHILDREN, RESULTS CAN ONLY BE GENERALIZED TO FIRST BORNS.

45

** (b) Do these data give convincing evidence that boys are more common than girls in the population? Carry out a significance test to help answer this question.

COMPLETE TEST OF STATISTICS TEMPLATE (See template

ANSWER TO # 43 HERE

43A

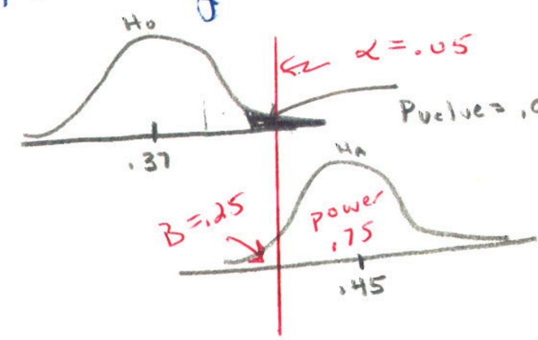
TYPE I ERROR: Conclude that more than 37% of students were satisfied with the new parking arrangement when, in reality, only 37% were satisfied

Consequence: the principal believes that students are satisfied and takes no further action

Type II ERROR: Say that we do not have enough evidence to conclude that more than 37% are satisfied with the parking arrangements when, in fact more than 37% are satisfied.

Consequence: The principal takes further action on parking when none is needed.

43B IF $P = .45$, THE PROBABILITY OF CORRECTLY REJECTING the null hypothesis is .75



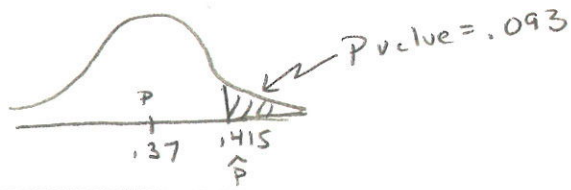
43C TWO WAYS TO INCREASE POWER

① INCREASE THE SAMPLE SIZE

② INCREASE THE SIGNIFICANCE LEVEL (α)

9.2 #41

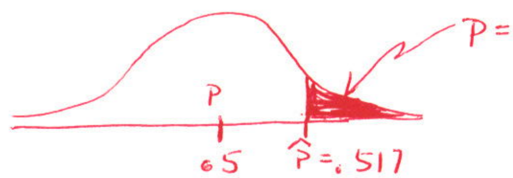
Test of Significance Template

Parameter of Interest	p = actual proportion of students who are satisfied with the parking situation
Choice of Test	ONE-SAMPLE Z TEST FOR p
Level of Significance	$\alpha = .05$
Null Hypothesis	English: Symbols: $H_0: p = .37$
Alternative Hypothesis	English: Symbols: $H_A: p > .37$ (interested in improved satisfaction)
Conditions of Test	① The students were randomly selected ② Independent - There are 200 sampled and since there are 2,500 students in the H.S; the 10% condition is met. ③ Normal condition was met: $np = 200(.37) = 74 \geq 10$ ✓ $nq = 200(.63) = 126 \geq 10$ ✓
Sampling Distribution	Sketch of the sampling distribution of the sample statistic under the null hypothesis, indicating the mean: x = 83 approved n = 200 $\hat{p} = 83/200 = .415$ 
Test Statistic	Formula: $Z = \dfrac{\hat{p} - p}{\sqrt{pq/n}}$ Plug-ins & Value: $\hat{p} = .415$ $q = .63$ $p = .37$ $n = 200$ $Z = \dfrac{.415 - .37}{\sqrt{\frac{(.37)(.63)}{200}}} = \dfrac{.045}{.0341} = 1.32$
P-value	Use correct probability notation. $P(Z \geq 1.32) = \text{normalcdf}(1.32, E99, 0, 1) = .093$
Meaning of the P-value	Since $p = .093 > \alpha = .05$, we fail to reject H_0
Conclusions	❒ Reject null hypothesis ☒ Fail to reject null hypothesis ❒ Significant result ❒ Not Significant result English: SINCE OUR pvalue is greater than .05, we fail to reject the null hypothesis. We do not have evidence to conclude that the new parking arrangement increased student satisfaction with parking at this school

9.2

45B

Test of Significance Template

Parameter of Interest	P = actual proportion boys who were first born children
Choice of Test	ONE SAMPLE Z TEST FOR P
Level of Significance	$\alpha = .05$ (since no α was given)
Null Hypothesis	English: Symbols: $H_0: p = .5$
Alternative Hypothesis	English: Symbols: $H_A: p > .5$
Conditions of Test	① random sample of first born children ② Independent: Reasonable there are $25,468(10) = 254,680$ first born children ③ Normal condition met: $np = 25468(.5) = 12,734 \geq 10$ $\quad nq = 25468(.5) = 12,734 \geq 10$
Sampling Distribution	Sketch of the sampling distribution of the sample statistic under the null hypothesis, indicating the mean: $X = 13173$ BOYS $n = 25,468$ $\hat{p} = .517$ 
Test Statistic	Formula: $Z = \dfrac{\hat{p} - p}{\sqrt{pq/n}}$ Plug-ins & Value: $\hat{p} = .517$, $p = .5$, $Q = .5$, $n = 25,468$ $Z = \dfrac{.517 - .5}{\sqrt{\frac{(.5)(.5)}{25468}}} = \dfrac{.017}{.0031} \approx 5.4$
P-value	Use correct probability notation. $P(Z \geq 5.48) = $ normalcdf$(5.48, E99, 0, 1) \simeq 0$
Meaning of the P-value	$p < \alpha$ $0 < .05$ Reject Ho
Conclusions	☒ Reject null hypothesis ☐ Fail to reject null hypothesis ☐ Significant result ☐ Not Significant result English: Since our pvalue is extremely small and less than .05 significance level, we reject the null hypothesis. It appears that boys are more prevalent among first born children.

49 **Teen drivers** A state's Division of Motor Vehicles (DMV) claims that 60% of teens pass their driving test on the first attempt. An investigative reporter examines an SRS of the DMV records for 125 teens; 86 of them passed the test on their first try. Is this good evidence that the DMV's claim is incorrect? Carry out a test at the $\alpha = 0.05$ significance level to help answer this question.

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COMPLETE TEST OF STATISTICS TEMPLATE (see template)

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51 **Teen drivers** Refer to Exercise 49.

(a) Construct and interpret a 95% confidence interval for the proportion of all teens in the state who passed their driving test on the first attempt.

$\hat{p} = .688$

$n = 125$

$z^* = 1.96$

- CALCULATE BY HAND
- CHECK WITH TI 84 AND WRITE CALCULATOR COMMAND.
- Remember to check conditions

NOTE CI use Sample Statistic

Conditions

1. Teens randomly selected
2. Independent - population more than 1,250
3. Normal: 86 successes ($n\hat{p}$) and 39 failures ($n\hat{q}$) are both greater than 10.

CALC CI with calc

STAT TESTS A: 1 PROP Z INTERVAL

X = 86 n = 125 C-Level = .95

→ (.60678, .76922)

CI: one sample Z interval for p

Calculate 95% CI by hand

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

$$.688 \pm 1.96 \sqrt{\frac{(.688)(.312)}{125}}$$

$$.688 \pm 1.96(.0414)$$

$$.688 \pm .081 \quad (.607, .769)$$

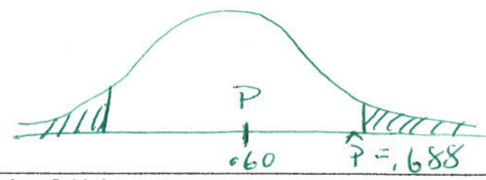
Conclusion We are 95% confident that the interval .607 to .769 captures the true proportion of teens who pass their driving test on their first try

(b) Explain what the interval in part (a) tells you about the DMV's claim.

→ The 95% confidence interval we calculated based on the sample distribution does NOT contain 0.60 as a plausible value of P, which gives convincing evidence against the DMV's claim.

9.2 | #49

Test of Significance Template

Parameter of Interest	P = actual proportion of teens pass their driving test on the first attempt
Choice of Test	ONE SAMPLE Z TEST
Level of Significance	$\alpha = .05$
Null Hypothesis	English: Symbols: $H_0: p = .60$
Alternative Hypothesis	English: Symbols: $H_a: p \neq .60$
Conditions of Test	① SRS of DMV records for 125 teens ② Independent - It is reasonable to think there were 125(10) = 1,250 teens that take DMV tests ③ Normal met - $np = (125)(.6) = 75 \geq 10$ ✓ $nq = (125)(.4) = 50 \geq 10$ ✓
Sampling Distribution	Sketch of the sampling distribution of the sample statistic under the null hypothesis, indicating the mean: $x = 86$ passed $n = 125$ $\hat{p} = .688$ 
Test Statistic	Formula: $Z = \frac{\hat{p} - p}{\sqrt{pq/n}}$ Plug-ins & Value: $n = 125$ $p = .6$ $\hat{p} = .688$ $q = .4$ $Z = \frac{.688 - .6}{\sqrt{\frac{(.6)(.4)}{125}}} = \frac{.088}{.0438} = 2.01$
P-value	Use correct probability notation. $P(Z \leq 2.01)$ OR $P(Z \geq 2.01) = 2(\text{normalcdf}(2.01, E99, 0, 1)) = 2(.022) = .044$
Meaning of the P-value	$P(.044) < \alpha(.05)$ Reject H_0
Conclusions	☒ Reject null hypothesis ❒ Significant result ❒ Fail to reject null hypothesis ❒ Not Significant result English: Since the pvalue is less than .05, we reject H_0. It appears that a proportion other than .60 of teens pass the driving test on their first attempt. Since this is it is a 2 tail test the proportion could be above or below .6.

$Z = 2.008$ $P = .0446$ $\hat{p} = .688$ $n = 125$

$p_0 = .6$ $x = 86$ $n = 125$ $\neq p_0$

STAT TESTS 5: 1PROP ZTEST

CALC Command

9.2 REVIEW TESTS ABOUT PROPORTIONS

53 **Do you Twitter?** In late 2009, the Pew Internet and American Life Project asked a random sample of U.S. adults, "Do you ever . . . use Twitter or another service to share updates about yourself or to see updates about others?" According to Pew, the resulting 95% confidence interval is (0.167, 0.213).[15] Can we use this interval to conclude that the actual proportion of U.S. adults who would say they Twitter differs from 0.20? Justify your answer. ANSWER BELOW

The 95% Confidence interval is (.167, .213).

We can not justify the .20 differs since it is included in the interval

55 **Teens and sex** The Gallup Youth Survey asked a random sample of U.S. teens aged 13 to 17 whether they thought that young people should wait to have sex until marriage.[17] The Minitab output below shows the results of a significance test and a 95% confidence interval based on the survey data.

Session

Test and CI for One Proportion

Test of p = 0.5 vs p not = 0.5 $p \neq .5$

Sample	X	N	Sample p	95% CI	Z-Value	P-Value
1	246	439	0.560364	(0.513935, 0.606794)	2.53	0.011

(a) Define the parameter of interest.

(b) Check that the conditions for performing the significance test are met in this case.

(c) Interpret the *P*-value in context.

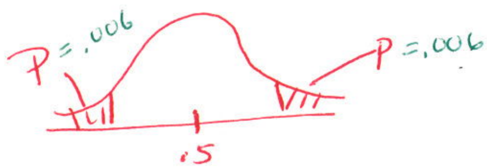
(d) Do these data give convincing evidence that the actual population proportion differs from 0.5? Justify your answer with appropriate evidence.

COMPLETE TEST Template

See template

#85

Test of Significance Template

Parameter of Interest	p = the true proportion of teens who think that young people should wait to have sex until marriage.
Choice of Test	One sample Z test for p
Level of Significance	$\alpha = .05$
Null Hypothesis	English: Symbols: $H_0: p = .5$
Alternative Hypothesis	English: Symbols: $H_A: p \neq .5$ Note: Can only find CI for 2 tail tests
Conditions of Test	① Random Sample 439 US teens 13–17 ② Independent – The population of US Teens is greater than 4,390 (439·10) ③ Normal condition met $np = 439(.5) = 219.5 \geq 10$, $nq = 439(.5) = 219.5 \geq 10$
Sampling Distribution	Sketch of the sampling distribution of the sample statistic under the null hypothesis, indicating the mean: 
Test Statistic	Formula: $Z = \dfrac{\hat{p} - p}{\sqrt{\frac{pq}{n}}}$ Plug-ins & Value: $n = 439$, $\hat{p} = \frac{246}{439} = .56$, $p = .5$, $q = .5$; $Z = \dfrac{.56 - .5}{\sqrt{\frac{(.5)(.5)}{439}}} = \dfrac{.06}{.0239} = 2.51$
P-value	Use correct probability notation. $P(Z \leq -2.51)$ or $P(Z \geq 2.51)$ = normalcdf(2.51, E99, 0, 1) = .006 * 2 P = .012
Meaning of the P-value	Since p is smaller than α, Reject Ho .012 < .05
Conclusions	☒ Reject null hypothesis ❒ Significant result ❒ Fail to reject null hypothesis ❒ Not Significant result English: Since the pvalue is less than $\alpha = .05$, Reject Ho. We conclude that the actual proportion of teens who think that young people should wait is not .50.