NAME:

SECTION 10.2 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

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

ANSWER TO # 43 HERE

43A

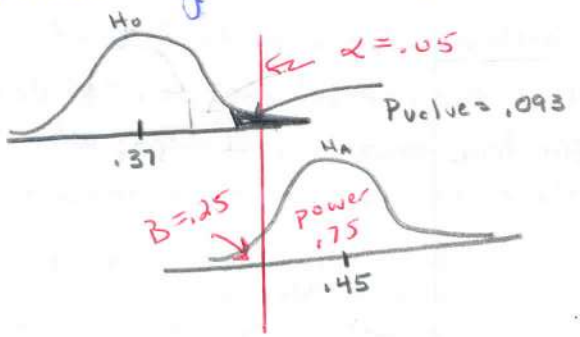
TYPE I ERROR: Conclude that more than 37% of students were satisfied with the new parking arrangement when, in reality, only 37% were satisfied

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 = .045, 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)

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

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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 Simple 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.

CI: one simple Z interval for p

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

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

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

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

Calculate 95% CI by hand

CALC CI with Calc

STAT TESTS A: 1 PROP Z INTERVAL

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

→ (.60678, .76922)

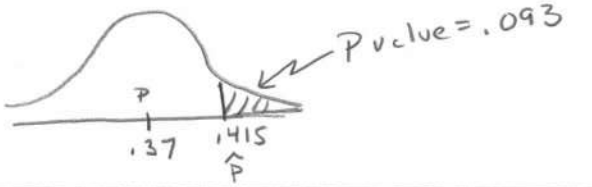
Conclusion We are 95% confident that the interval .607 to .769 captures the true proportion of teens who pass their driving test on their first try

(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.

10.2 #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

10.2 458

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 me:

$np = 25468(.5) = 12,734 \geq 10$ $\quad nq = 25468(.5) = 12,734 \geq 10$

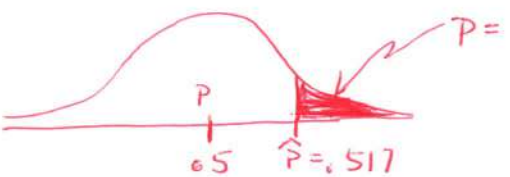
Sampling Distribution

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:

$\hat{p} = .517$, $p = .5$, $q = .5$, $n = 25,468$

$Z = \dfrac{.517 - .5}{\sqrt{\frac{(.5)(.5)}{25468}}} = \dfrac{.017}{.0031} = 5.48$

P-value

Use correct probability notation.

$P(Z \geq 5.48) = \text{normalcdf}(5.48, E99, 0, 1) \simeq 0$

Meaning of the P-value

$p < \alpha$

$0 < .05$ Reject H_0

Conclusions

☒ Reject null hypothesis ☐ Fail to reject null hypothesis

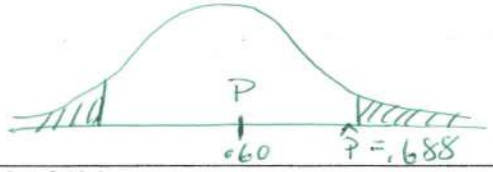
☐ Significant result ☐ Not Significant result

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.

10.2 #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 ☐ Fail to reject null hypothesis ☐ Significant result ☐ 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.

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

$p_0 = .6$ $x = 86$ $n = 125$ # Po

STAT TESTS 5: 1PROP ZTEST

CALC Command