TOPIC: HYPOTHESIS TESTS FOR PROPORTION

Performing a Hypothesis Test for Population Proportion

- Recall: To run a hypothesis test 1) Write Hypotheses, 2) Calc. Test Statistic, 3) Find P-Value, & 4) State Conclusion.

EXAMPLE

A tech company says 90% of its devices pass inspection. A quality inspector thinks it's less, so they test 200 devices, 172 of which passed. At the 0.01 significance level, is there evidence the pass rate is below 90%?

New — **Hypothesis Tests for Proportion**

1) Hyp

$H_0: p =$ ______ $H_a: p$ **[< | > | ≠]**

2) Test Stat

$$z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$$

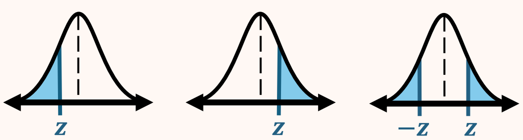
$n =$ _____ $x =$ _____ $\hat{p} = \frac{x}{n} =$ _____

$z =$

3) P-Value

Area "beyond" z

If $H_a: p <$ If $H_a: p >$ If $H_a: p \neq$



P-Value = ______

4) Conclusion

Because P-value **[< | >]** α, we **[REJECT | FAIL TO REJECT]** H_0.

There is **[ENOUGH | NOT ENOUGH]** evidence to suggest…

Criteria

Random Samples? ☐

$np \geq 5$ ☐

$nq \geq 5$ ☐

Recall $q = 1 - p$

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EXAMPLE Perform each hypothesis test using $n = 20$, $x = 14$, a claim of $p = 0.5$ & $\alpha = 0.05$.

Recall

$$z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$$

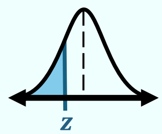
$$\hat{p} = \frac{x}{n}, \qquad q = 1 - p$$

$(\boldsymbol{A})$ One tail - Left

Random Samples? ☐ H_0: H_a:

$np \geq 5$ ☐ $n =$ ___ $x =$ ___ $\hat{p} =$ ___

$nq \geq 5$ ☐ $z =$



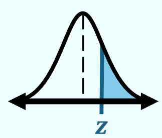
Because P-value = ___ **[< | >]** α = ____ , we **[REJECT | FAIL TO REJECT]** H_0.
There is **[ENOUGH | NOT ENOUGH]** evidence to suggest $H_a: p$ **[< | > | ≠]** 0.5

$(\boldsymbol{B})$ One tail - Right

Random Samples? ☐ H_0: H_a:

$np \geq 5$ ☐ $n =$ ___ $x =$ ___ $\hat{p} =$ ___

$nq \geq 5$ ☐ $z =$



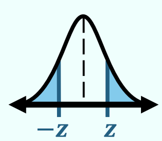
Because P-value = ___ **[< | >]** α = ____ , we **[REJECT | FAIL TO REJECT]** H_0.
There is **[ENOUGH | NOT ENOUGH]** evidence to suggest $H_a: p$ **[< | > | ≠]** 0.5

$(\boldsymbol{C})$ Two tail

Random Samples? ☐ H_0: H_a:

$np \geq 5$ ☐ $n =$ ___ $x =$ ___ $\hat{p} =$ ___

$nq \geq 5$ ☐ $z =$



Because P-value = ___ **[< | >]** α = ____ , we **[REJECT | FAIL TO REJECT]** H_0.
There is **[ENOUGH | NOT ENOUGH]** evidence to suggest $H_a: p$ **[< | > | ≠]** 0.5

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PRACTICE Perform a 2-tailed hypothesis test for the true proportion of successes using the given values:

$(\boldsymbol{A})$ $\alpha = 0.01$, $n = 40$, $x = 28$, & claim is $p = 0.75$

Recall

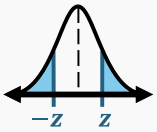
$$z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$$

$$\hat{p} = \frac{x}{n}, \qquad q = 1 - p$$

Random Samples? ☐ H_0: H_a:

$np \geq 5$ ☐ $\hat{p} =$ ___ $z =$

$nq \geq 5$ ☐



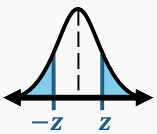
Because P-value = ___ **[< | >]** α = _____ , we **[REJECT | FAIL TO REJECT]** H_0.
There is **[ENOUGH | NOT ENOUGH]** evidence to suggest $H_a: p$ **[< | > | ≠]** 0.75

$(\boldsymbol{B})$ $\alpha = 0.10$, $n = 100$, $x = 42$, & claim is $p = 0.25$

Random Samples? ☐ H_0: H_a:

$np \geq 5$ ☐ $\hat{p} =$ ___ $z =$

$nq \geq 5$ ☐



Because P-value = ___ **[< | >]** α = _____ , we **[REJECT | FAIL TO REJECT]** H_0.
There is **[ENOUGH | NOT ENOUGH]** evidence to suggest $H_a: p$ **[< | > | ≠]** 0.25

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EXAMPLE

A school claims that 30% of its students participate in after-school sports. A survey of 200 students finds that 72 participate. Using $\alpha = 0.01$, determine if the proportion of students who participate in sports is different from 30%.

Random Samples? ☐ H_0: H_a:

$np \geq 5$ ☐ $n =$ ___ $x =$ ___ $\hat{p} =$ ___

$nq \geq 5$ ☐ $z =$

Recall

$$z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$$

$$\hat{p} = \frac{x}{n}, \qquad q = 1 - p$$

Because P-value = ___ **[< | >]** α = ____ , we **[REJECT | FAIL TO REJECT]** H_0.

There is **[ENOUGH | NOT ENOUGH]** evidence to suggest…

PRACTICE

A local park claims that less than 15% of visitors litter. A random sample of 120 visitors finds that 25 litter. At the 0.05 significance level, test if the proportion of visitors who litter is greater than 15%.

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<table>
<tr><th></th><th colspan="2">Mean</th><th>Proportion</th><th>Variance</th></tr>
<tr><td>Step 1) Hypotheses</td><td colspan="2">$H_0: \mu =$ ___
$H_a: \mu$ [$<$ | $>$ | $\neq$] ___</td><td>$H_0: p =$ ___
$H_a: p$ [$<$ | $>$ | $\neq$] ___</td><td>$H_0: \sigma^2 =$ ___
$H_a: \sigma^2$ [$<$ | $>$ | $\neq$] ___</td></tr>
<tr><td>Step 2) Calc. Test Statistic</td><td>(σ Known):
$z = \frac{x - \mu}{\sigma/\sqrt{n}}$</td><td>(σ Unknown):
$t = \frac{x - \mu}{s/\sqrt{n}}$</td><td>$z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$</td><td>$\mathcal{X}^2 = \frac{(n-1)s^2}{\sigma^2}$</td></tr>
<tr><td>Step 3) P-Value</td><td>$P(Z$ [$<$ | $>$] $z)$ OR
$2 \cdot P(Z$ [$<$ | $>$] $z)$</td><td>$P(T_{n-1}$ [$<$ | $>$] $t)$ OR
$2 \cdot P(T_{n-1}$ [$<$ | $>$] $t)$</td><td>$P(Z$ [$<$ | $>$] $z)$ OR
$2 \cdot P(Z$ [$<$ | $>$] $z)$</td><td>$P(\mathcal{X}^2_{n-1}$ [$<$ | $>$] $\mathcal{X}^2)$ OR
$2 \cdot P(\mathcal{X}^2_{n-1}$ [$<$ | $>$] $\mathcal{X}^2)$</td></tr>
<tr><td>Step 4) State Conclusion</td><td colspan="4">Because P-value [$<$ | $>$] α, we [REJECT | FAIL TO REJECT] H_0.
There is [ENOUGH | NOT ENOUGH] evidence to { restate H_a }</td></tr>
</table>