TOPIC: HYPOTHESIS TESTING USING CRITICAL VALUES

Hypothesis Test: Critical Values & the Rejection Region

◆ A **critical value** (found from α) is the ______________ between an "expected" test statistic & an "unusual" one.

***P*-value**	**Critical Value**
z or t → find P-val → compare to α	α → find Critical Value → compare to z or t

► If the test statistic lies in the **rejection region** (area ___________ critical value), then we *reject* H_0.

EXAMPLE

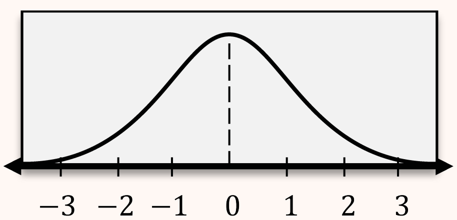
You're a researcher looking at how the current mean age of students in your university has changed from last year, when the mean age was 23. So, you get a sample of students & calculate a test statistic. In each of the following situations, use $\alpha = 0.05$ to find the critical value & determine if the given test stat (z) is in the rejection region.

New **Hypothesis Test**

Left Tail

"Students now are ***younger***…"

$H_0: \mu = 23;\ H_a: \mu < 23$



Critical Val(s): $z_\alpha =$

Test Stat: $z = -2.00$

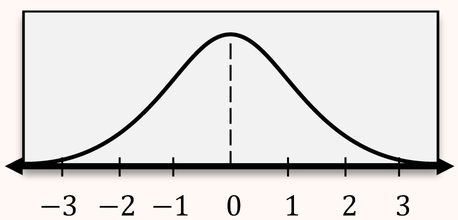
z **[IN | NOT IN]** Rejection Region

[REJECT | FTR] H_0

Two Tail

"Students now have a ***different*** mean age…"

$H_0: \mu = 23;\ H_a: \mu \neq 23$



Critical Val(s):

$-z_{\alpha/2} =$ $\qquad z_{\alpha/2} =$

Test Stat: $z = -1.00$

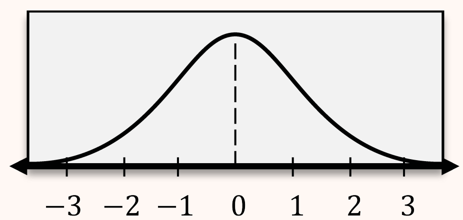
z **[IN | NOT IN]** Rejection Region

[REJECT | FTR] H_0

Right Tail

"Students now are ***older***…"

$H_0: \mu = 23; H_a: \mu > 23$



Critical Val(s): $z_\alpha =$

Test Stat: $z = 0.8$

z **[IN | NOT IN]** Rejection Region

[REJECT | FTR] H_0

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PRACTICE Mark 'TRUE' or 'FALSE' for each of the following.

(***A***) The test statistic & the critical value are the same thing.

[TRUE | FALSE]

(***B***) The critical value is the boundary of the rejection region.

[TRUE | FALSE]

(***C***) You should always reject H_0 if the test statistic is greater than the critical value.

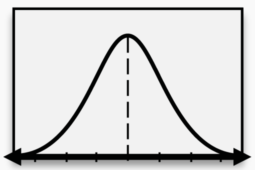
[TRUE | FALSE]

PRACTICE Use α to find the critical value(s), then determine if the given test statistic is in the rejection region.

(***A***)

H_0: $\mu = 7.5$; H_a: $\mu > 7.5$

$a = 0.01$; $z = 2.17$



Test is **[LEFT | TWO | RIGHT]** -tailed

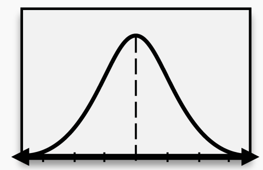
Critical Value(s):

Test stat **[IN | NOT IN]** rejection region.

(***B***)

H_0: $p = 0.64$; H_a: $p < 0.64$

$a = 0.10$; $z = -1.53$



Test is **[LEFT | TWO | RIGHT]** -tailed

Critical Value(s):

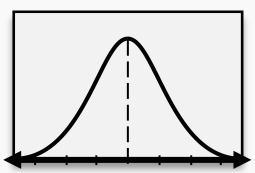
Test stat **[IN | NOT IN]** rejection region.

(***C***)

H_0: $\mu = 98.6$; H_a: $\mu \neq 98.6$

$a = 0.05$

$t = 2.41$; $df = 17$



Test is **[LEFT | TWO | RIGHT]** -tailed

Critical Value(s):

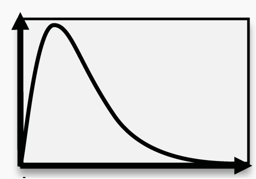
Test stat **[IN | NOT IN]** rejection region.

(***D***)

H_0: $\sigma^2 = 0.3$; H_a: $\sigma^2 > 0.3$

$a = 0.05$

$\chi^2 = 61.7$; $df = 51$



Test is **[LEFT | TWO | RIGHT]** -tailed

Critical Value(s):

Test stat **[IN | NOT IN]** rejection region.

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Hypothesis Test for Mean Using the Critical Value

◆ The **critical value method** for hyp. tests uses all the same steps as the P-value method, except step ______.

EXAMPLE A soda company claims its cans contain 355 mL on average, but a sample of 50 cans has a mean of 352 mL. Test whether the mean volume is less than claimed using $\alpha = 0.01$ & $\sigma = 5$ mL.

Recall — ***P*-Value Method** | **New** — ***Critical Value* Method**

1) Hyp

$H_0: \mu =$ ____ $H_a: \mu$ ______

2) Test Stat

$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$ $\bar{x} =$ ______ $\sigma =$ ______ $n =$ ______

$z =$

3) P-Value

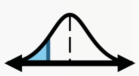
Test Stat

↓

Find P-value from test stat

↓

Compare P-val to α

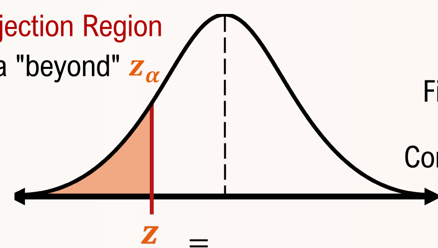


Area "beyond" z P-value = ____

3) Critical Value

Rejection Region

= Area "beyond" z_α



= ____

Test Stat

↓

Find Critical Value from α

↓

Compare Test stat to Crit Val

4) Conclusion

Because P-value **[< | >]** α, | Because test stat. (z) is **[INSIDE | OUTSIDE]** rejection region,

We **[REJECT | FAIL TO REJECT]** H_0. There is **[ENOUGH | NOT ENOUGH]** evidence that $\mu < 355$.

Criteria

X is Normally Distributed? ☐ ***OR*** $n > 30$? ☐

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PRACTICE

A soup company claims that the average sodium content of their most popular soup is 500 mg per can. A nutritionist collects a sample of 36 cans with mean sodium content 507 mg. Assume a known pop. standard deviation of 15 mg & test the nutritionist's suspicion that the mean sodium content is more than 500 mg using the critical value method with $\alpha = 0.01$.

Recall

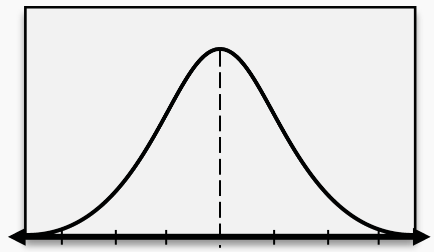
$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

H_0: $\mu =$ _____ $\quad$ H_a: $\mu =$ _____

$\bar{x} =$ _______ $\quad$ $\sigma =$ _______ $\quad$ $n =$ _______

$z =$

Critical Value(s):



Because test stat. (z) is **[INSIDE | OUTSIDE]** rejection region, we **[REJECT | FAIL TO REJECT]** H_0.
There is **[ENOUGH | NOT ENOUGH]** evidence to conclude that…

EXAMPLE

A city claims that 40% of households have backyard gardens. A researcher surveys 150 households and finds 72 with gardens. Use $\alpha = 0.10$ & the critical value method test if the true proportion is different from 40%.

Recall

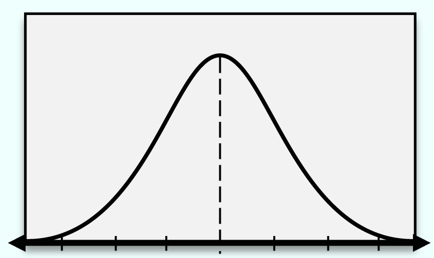
$$z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$$

H_0: $p =$ _____ $\quad$ H_a: $p =$ _____

$x =$ _______ $\quad$ $n =$ _______ $\quad$ $\hat{p} =$ _______

$z =$

Critical Value(s):



Because test stat. (z) is **[INSIDE | OUTSIDE]** rejection region, we **[REJECT | FAIL TO REJECT]** H_0.
There is **[ENOUGH | NOT ENOUGH]** evidence to conclude that…