§8.1 Hypothosis Testing

A Hypothosis Test is a systematic form to make an argument.

(2) H_0: the Null hypothosis is a claim about the population parameter.

H_0: $\mu = \mu_0$ or $p = p_0$

H_0: $\mu = 98.6°$ or $p = .52$

(3) Take Some data, and find a Sample Mean $\bar{x}$ or sample proportion $\hat{p}$ → These are your point estimates.

(7) Calculate the likelyhood of Seeing Sample Statistic given that the Null hypothosis is true. This is the P-Value =

(5) Test Statistic

$$TS: \; Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}} \qquad t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

The Test Statistic is z or t score of Sample data assuming H_0 is True

(5) P-value = Area More extreme than test Statistic

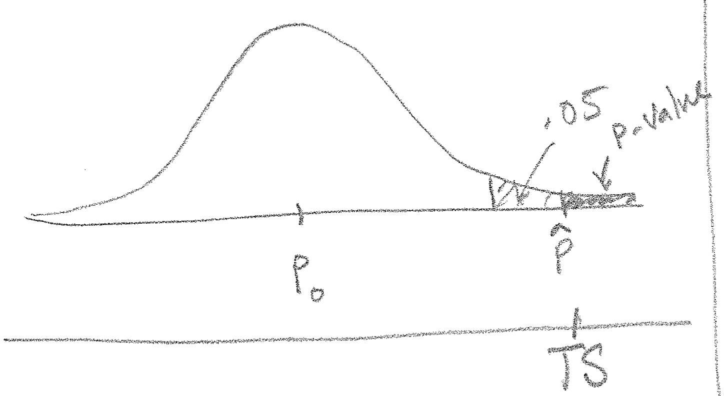
= probability of a sample as or More extreme than my sample given H_0 is true

(8) Conclusion

Reject $H_0: p = p_0$ or fail to Reject H_0

p-value is small

p-value $< \alpha = .05$

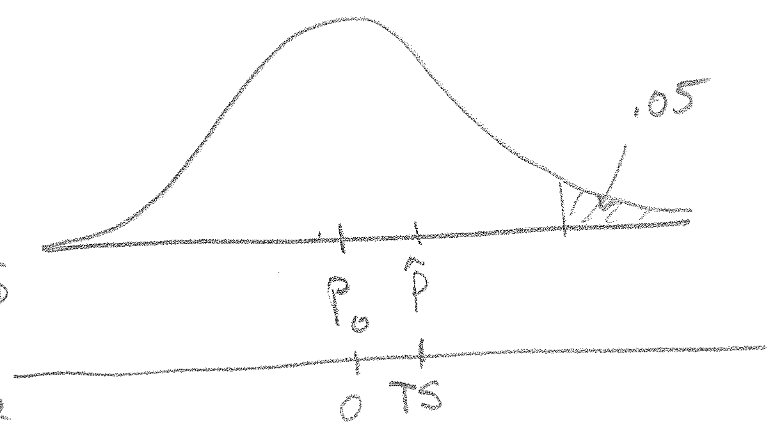


$\hat{p}$

z

TS > z → Critical Value

p-value $> \alpha$



Ex A company claims that the defect rate for their batteries is 4%.

(2) $H_0: p = .04 = p_0$ ← Value in H_0

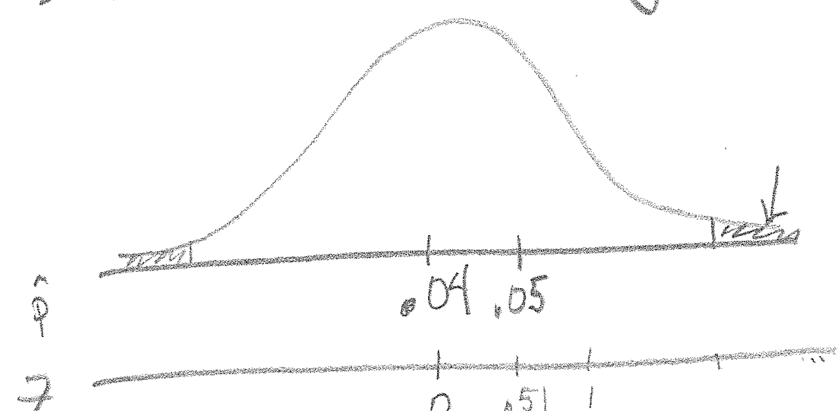
$H_1: p \neq .04$ Alternate hypothosis

(3) Take Some Sample data. In a ship ment of 100 Batterres $\hat{p} = .05$ defect rate

Sample → $\hat{p} = \frac{x}{n} = \frac{5}{100}$

(6) Draw Sampling Distribution for <u>every HW</u>

(5) TS: $Z = \dfrac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$ ← $q_0 = 1 - p_0$



TS

↑

z-score of my sample $\hat{p} = .05$ on dist of sample proportions

$Z = \dfrac{(.05 - .04)}{\sqrt{\frac{.04 \cdot .96}{100}}}$

$Z = 0.51$

3) <u>Skip to Conclusion</u>

fail to Reject H_0

(9) We can't prove beyound a doubt that the Overall proportion of Defects is different from 4%

CLT for prop.

Mean of

$\mu_{\hat{p}} = .04$

$\sigma_{\hat{p}} = \sqrt{\frac{.04 \cdot .96}{100}}$

b) Same claim: $p = .04$

(2) $H_0: p = .04$

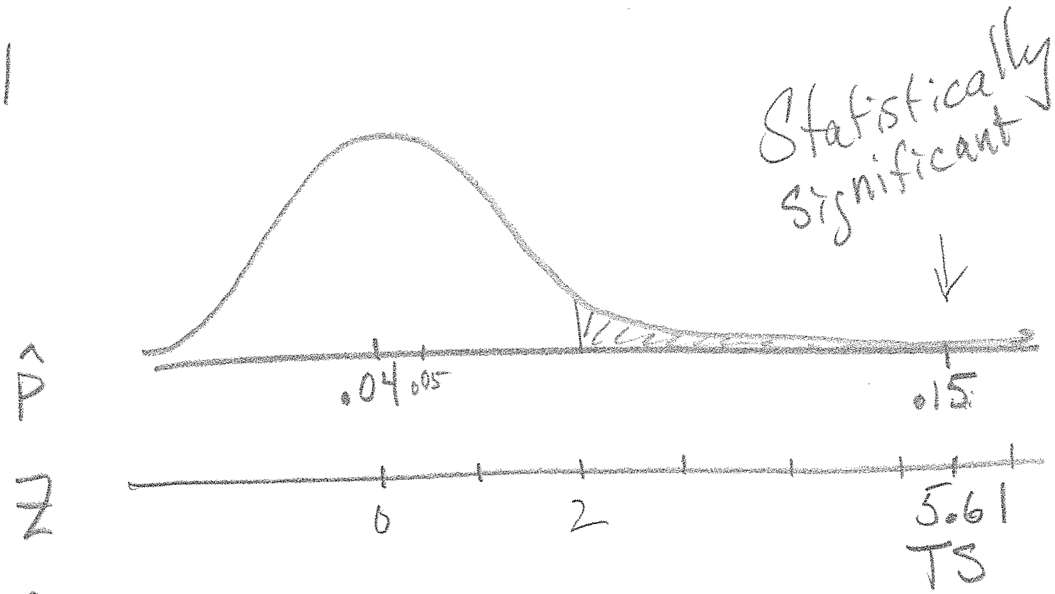
$H_1: p \neq .04$

(3) Take data $\hat{p} = \frac{15}{100} = .15$

(5) TS: $Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}} = \frac{.15 - .04}{\sqrt{\frac{.04 \cdot .96}{100}}}$

$Z = 5.61$

(6) Graph



(8) Conclusion

If Reject H_0 then Support H_1

(9) Reject that proportion of defects is 4% and Support that the Defect rate is Not 4%.

Looks higher

Step 2 Writing H_0 and H_1

Rule 1 $H_0: p = p_0$ or $\mu = \mu_0$ is Always Equal

Rule 2 $H_1: p < p_0$ $\mu > \mu_0$ or $p \neq p_0$

is Always a strict inequality

Rule 3 **Case 1** If claim is $<, >, \neq$ then the claim is the Alternate Hypothesis

Ex Claim: The defect rate is greater than 4%

Translate to math $p > .04$

Contains $>$ $\Rightarrow$ $H_1: p > .04$

Case 2 If claim is $\leq, \geq, =$ then

the Alterate Hypothosis has opposite inequality $>, <, \neq$

Ex Claim: Company Says the Defect rate is at most 4%

Claim: $p \leq .04$

then $H_1: p > .04$

Step 9 Write final Conclusion to Address initial Claim.

$\boxed{\text{If Claim: } p > .04}$ ← has strict inequality

Conclusion → Support H_1

Reject H_0: Support that prop. of defects is greater than 4%

$\hat{p} = .15$

fail to Reject H_0:

fail to Support H_1: there is Not enough data to Support that the proportion of defects is above 4%

$\hat{p} = .05$

$\boxed{\text{If Claim: } p \le .04}$ $H_0: p = .04$ $H_1: p > .04$

Reject H_0 Reject that proportion of Defects is at most 4%

$\hat{p} = .15$

fail to Reject H_0 fail to Reject that the Proportion of defects is at Most 4%

Step ③ Critical Values

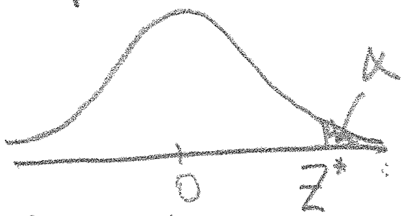
CV: Z_α or $Z_{\alpha/2}$ is the z-score that separates statistically significant Test statistics.

α = Significance level of the Test
= Given or .05

Three Cases

Right Tailed

$H_1: p > p_0$

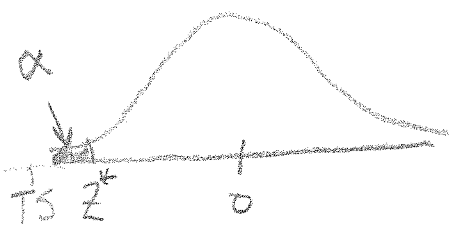


Proportions

CV: $Z^* = \text{invnorm}(1-\alpha, 0, 1)$

Left tailed

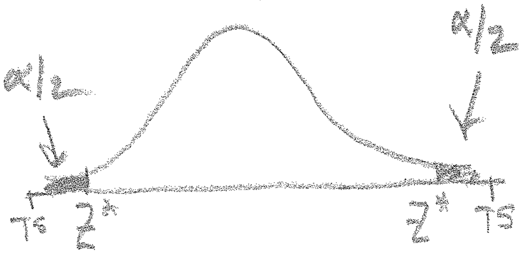
$H_1: \mu < \mu_0$



$Z^* = \text{invnorm}(\alpha, 0, 1)$

Two Tailed

$H_1: p \neq p_0$



$Z^* = \pm\,\text{invnorm}(1-\frac{\alpha}{2}, 0, 1)$

Same as CI

Means

$t^* = \text{invt}(1-\alpha, df)$

$t^* = \text{invt}(\alpha, df)$

Reject Ho

TS < Z^*

$t^* = \pm\,\text{invt}(1-\frac{\alpha}{2}, df)$

Reject Ho

TS < $-Z^*$ or TS > Z

TS: $z > z^*$ CV

then

$\hat{p}$ is statistically significant

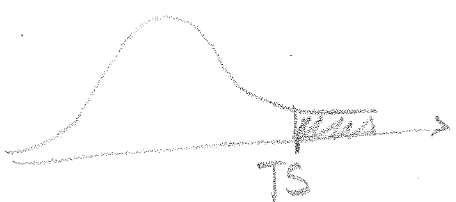
Reject Ho

Assuming H_0 is True

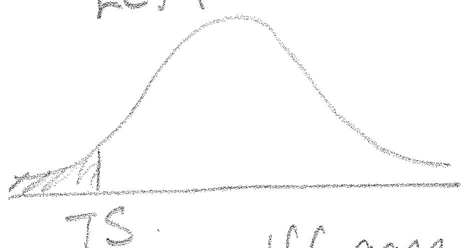
(7) P-value = probability of seeing a sample statistic as or more extreme than the point estimate.

= Area

Right

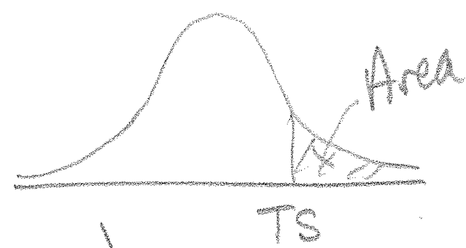


Left



P-value = ncdf(-9999, TS, 0, 1)

Two Tailed



Proportions

P-value = normalcdf(TS, 9999, 0, 1)

P-value = 2 · Area

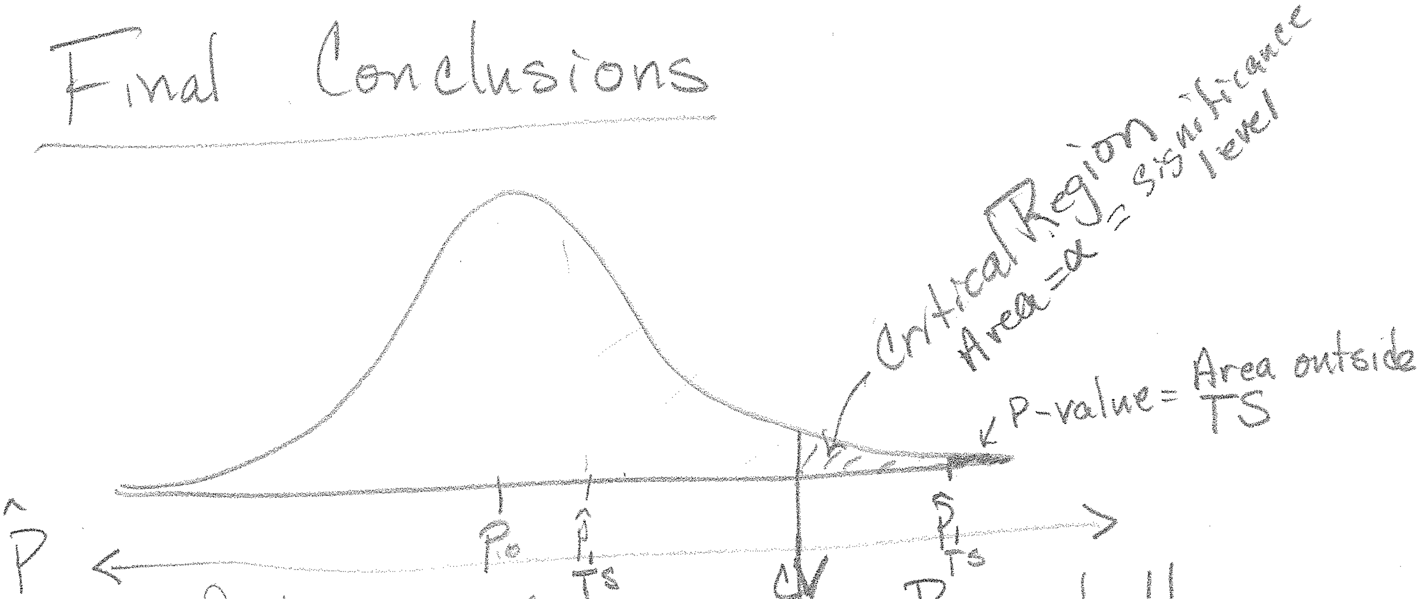
area < .5

Means

= tcdf(TS, 999, df) = tcdf(-999, TS, df)

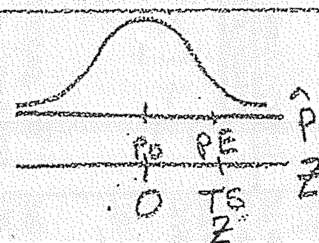
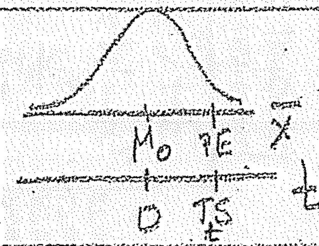
2 · Area

Final Conclusions



	fail to Reject $H_0: p = p_0$	Reject H_0
Traditional	$\lvert TS \rvert < \lvert CV \rvert$	$\lvert TS \rvert > \lvert CV \rvert$
P-value	P-value $> \alpha$	P-value $< \alpha$

Steps For a hypothosis Test

	Proportions	Means
① Check Requirements SRS	$np > 5$ and $nq > 5$	$n > 30$, or Population is Normal
② Write Null and Alternate Hypothoses Claim: <, >, ≠ ⇒ H_1 is claim Claim: ≤, ≥, = ⇒ H_1 is opposite	$H_0: p = p_0$ $H_1: p <, >, \neq, p_0$	$H_0: \mu = \mu_1$ $H_1: \mu <, >, \neq \mu_0$
③ Point Estimate and the Summary Statistics	$\hat{p} = \frac{x}{n}$	$\bar{x}$ from 1-varstat s, n or Given
④ Find Critical Values	CV: $z^* =$ invnorm(Area)	CV: $t^* =$ invT(Area,
⑤ Test Statistic is Score of point estimate	TS: $z = \frac{\hat{p} - p}{\sqrt{\frac{pq}{n}}}$ use p in H_0	TS: $t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$ use μ in H_0 and s from 1-varstat
⑥ Draw Sampling Distribution Vertically line up PE and TS		
⑦ P-value is the probability of being more extreme than PE	P-value Rt = normalcdf(TS, 999) Lt = ncdf(-999, TS) Two Tail = 2 · smaller of Lt or Rt	P-value = tcdf(LB, UB, df
⑧ Make Initial Conclusion Reject H_0 or fail to Reject H_0	$H_0: P = P_0$	$H_0: \mu = \mu_0$
⑨ Write Final Conclusion describing what the population Parameter is in Words.		

Project Collect Data

4 Samples Everyone collect

30 from each population

Two Questions

M/F	Yes/No	Number
	$\hat{p}_1 = \frac{x_1}{n_1}$	$\bar{X}_1$ = Mean # of hrs Summarize
		n_1 = # of Men that play
	$\hat{p}_2 = \frac{x_2}{n_2}$	
	n_1 = # of Men Asked	Population = SRJC Men who play video games
Population	(All SRJC Men)	$\bar{X}_2$ = Mean hrs Women video gamers play