Hypothesis testing and statistical Analysis using z-test.

① Z test
② t test
] → Average
③ Chi-square test → Categorical data
④ ANOVA test → Variance of data.

Z test criteria

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→ S.S ≥ 30 and
→ σ population should be given.

CLT → $\mu = \mu$, $\sigma = \sigma/\sqrt{n}$

↳ Sampling mean distribution → Normal distn.

→ S.S ≥ 30

$$Z_{score} = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \rightarrow \text{n.vi S.S.}$$

Q. Suppose a child psychologist says that the average time working mother spend talking to their children is upto 11 mins. per day. To test the hypothesis you conducted an experiment with random sample of 100 working mothers and find that they spend 11.5 minutes per day talking with their children. Assume prior research suggests that the population standard deviation is 2.3 mins. conduct the test with 5% level of significance ($\alpha = 0.05$)

Hypothesis

Sample → S.S ≥ 30, $\bar{x} = 11.5$, $\sigma_p = 2.3$

Z test.

→ $\mu = 11$ mins, $\bar{x} = 11.5$ min, $\sigma = 2.3$ mi, $n = 100$, $\alpha = 0.05$

↓

LOS / MOE

↓

Complete experiment

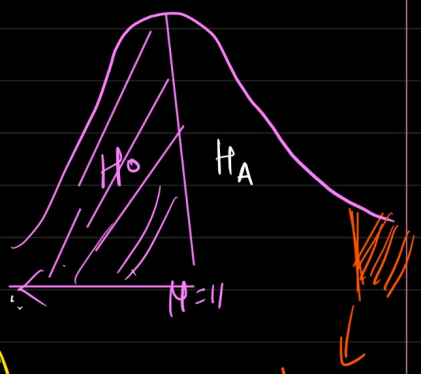
① frame the hypothesis.

upto 11 mins.

$H_0 : \mu \leq 11$

$H_A : \mu > 11$

$\mu \leq 11$ $\quad$ $\mu > 11$



② $\alpha = 5\%$, one tail test

Type of test = Z test

rejection region is at H_A side

③ Z score $\bar{x}$ (test statistics)

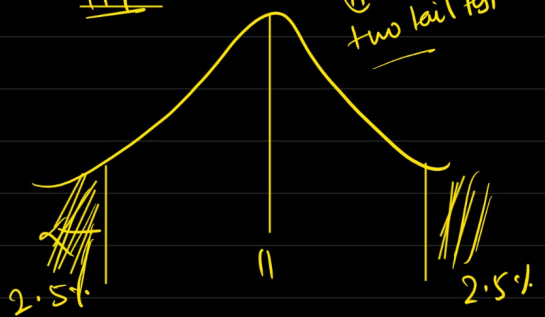
⇓

Z statistics

$$\text{Z score of } \bar{x} = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

$$= \frac{11.5 - 11}{2.3/\sqrt{100}} = 2.17$$

$\mu \neq 11$ (two rejection region) ⇓ two tail test



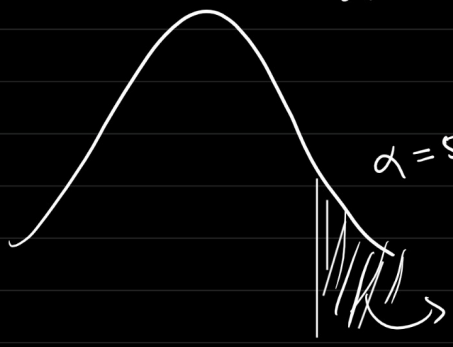
One rejection region ⇓ at one side of dist^n ⇓ One tail test

* To identify two tail test. H_A has $\neq$

④

Z critical ↓ α to Z score

p-value ↓ Z score of test to p-value

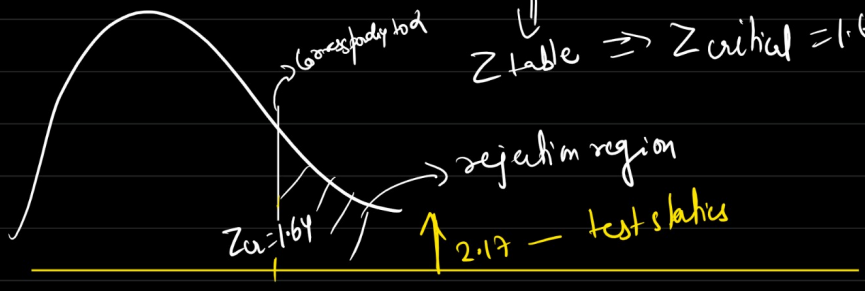


⇓

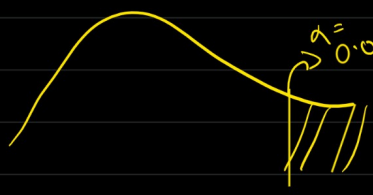
To be converted into Z score

⇓

Z table ⇒ Z critical = 1.64

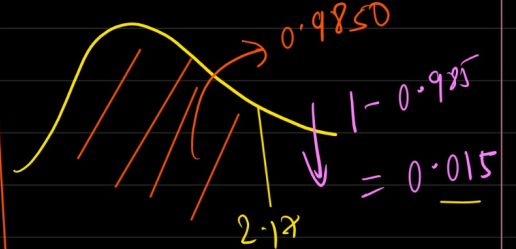


2.17 ↪ prob value

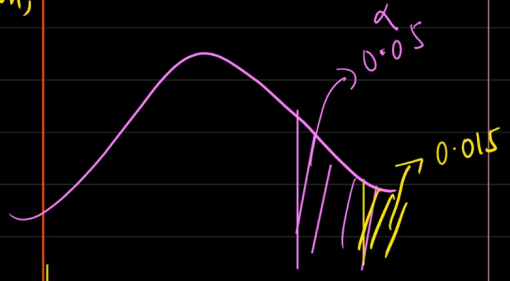


Z score = 2.17

pvalue = 0.98



if Z statistics lies in Z_{cr} region, you reject H_0
(2.17)



Step-5 Conclusion

$Z_{test} > Z_{cr}$

reject the H_0.

meaning → mothers spend more than 11 mins.

pvalue < 0.05

$0.015 < 0.05$

Since pvalue < 0.05

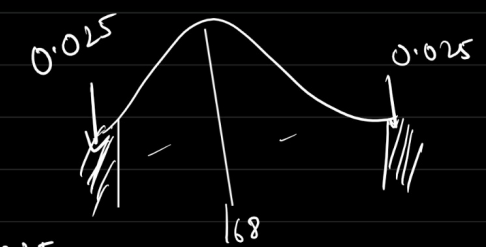
reject the H_0

Q. The average heights of all residents in a city is 168cm with a σ of 3.9cm. One researcher believes that mean is different. He measured the height of 36 individuals and found that the average height is 169.5cm. Test the hypothesis at 95% confidence interval, $\alpha = 5\%$.

$\mu_{ht} = 168cm$, $\sigma = 3.9cm$ $n = 36$, $\bar{x} = 169.5cm$ $\alpha = 5\%$

Step-1 : $H_0 : \mu_{ht} = 168$

$H_A : \mu_{ht} \neq 168$



Step-2 $\alpha = 5\%$ but since two tail test

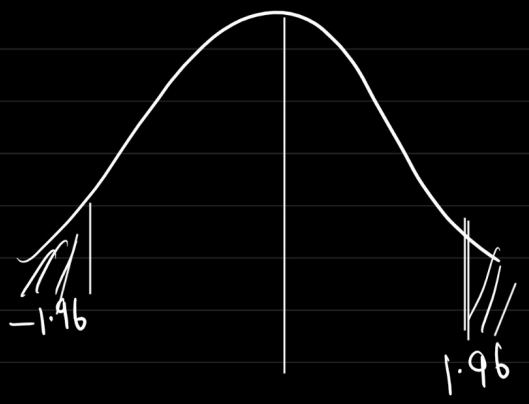
$\alpha = 5/2 = 2.5\%$ or 0.025

Z test

Step-3 $Z_{statistics} = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}} = \dfrac{169.5 - 168}{3.9 / \sqrt{36}} = 2.31$

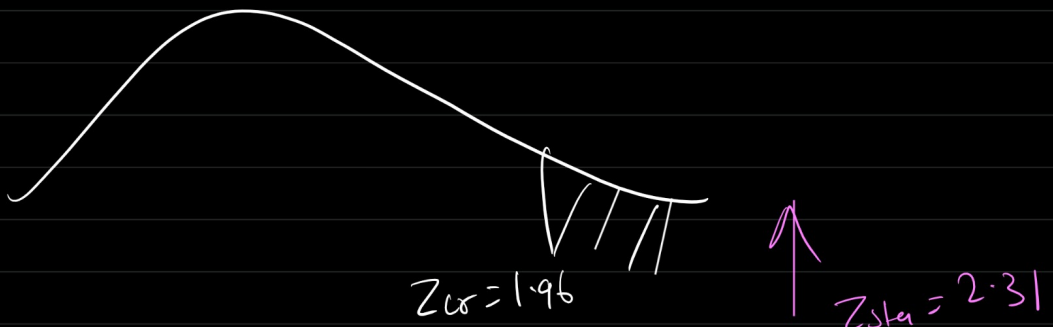
Step-4 $Z_{critical}$ → Since it's a two tail test $= 0.025$

$Z_{cri} = -1.96$



$Z_{statistic} = 2.31$

$Z_{critical} = 1.96$

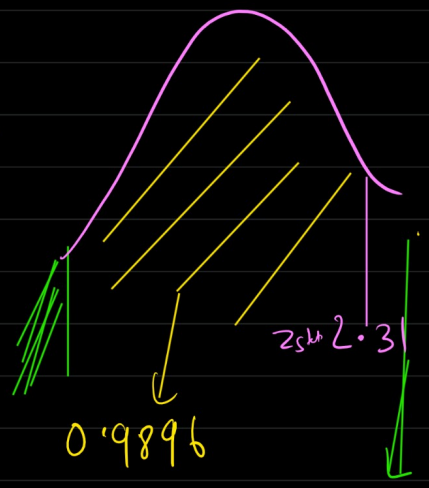


Step-5

$Z_{stats} > Z_{cr}$ = reject the Ho

Conclusion: The avg height ≠ 168cm

* 2nd approach
  - ↳ p value approach



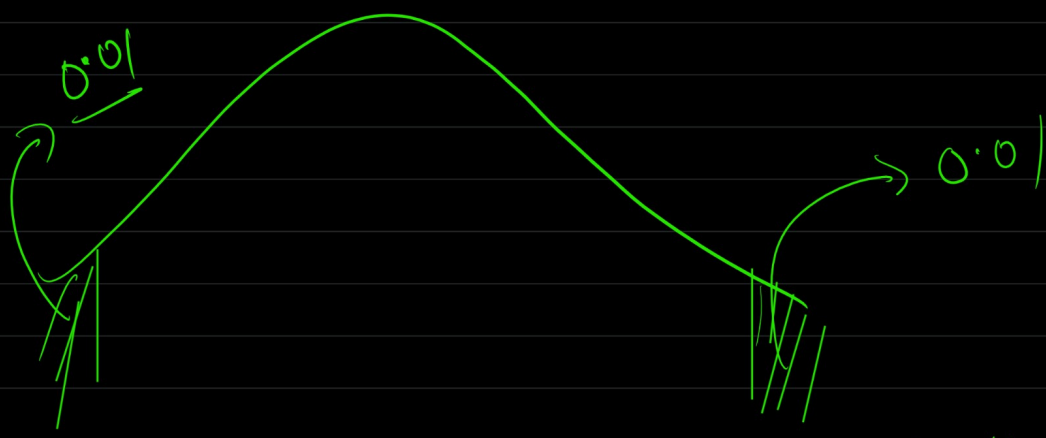
$\Rightarrow 1 - 0.9896$

$\Rightarrow 0.01$

two tail test

total area $= 0.01 + 0.01$

$= 0.02$



$\alpha = 0.05$

↓

two tail

pvalue $< 0.05 \rightarrow$ reject the H_0

$0.02 < 0.05$

↳

Conclusion Mut ≠ 168cm.