

DAY - 6

Problem: The Average height of all residents in a town XYZ is 168 pounds a nutritionist believes the ~~true~~ mean to be different. She measured the weight of 36 individuals & found the mean to be 169.5 pounds with a s.d. of 3.9

- null & Alternate hypothesis
- 95%. Is there enough evidence to disace the null hypothesis?

Solution: $\mu = 168$, $\bar{x} = 169.5$, $s_{\text{dev}} = 3.9$

Step - 1

$$H_0 = 168 \{ \text{null hypothesis} \}$$

$$H_1 \neq 168 \{ \text{Alternate hypothesis} \}$$

Step - 2

$$\begin{aligned} \text{C.I} &= 95\%, \alpha = 1 - 95 \\ &= \underline{0.05} \end{aligned}$$

Step - 3

(this is 2 tail test)

~~#~~ - test

$$Z\text{-Score} = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{169.5 - 168}{3.9/\sqrt{36}}$$

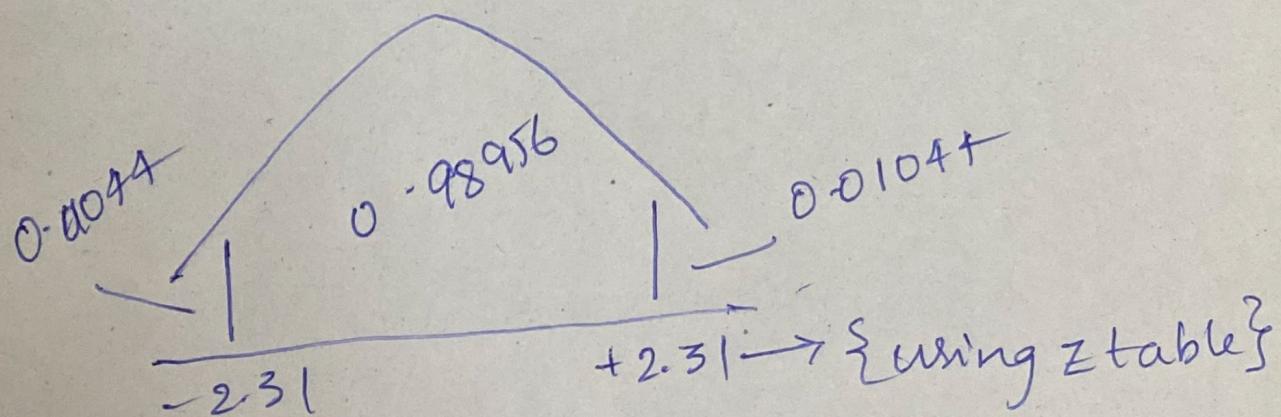
$$= \frac{1.5}{0.65}$$

$$\approx 2.30769$$

Step - 4 $Z_{\alpha/2} = 1.96$

Conclusion : $2.30769 > 1.96$ {Reject the null hypothesis}

Solution using P-value:



Since, it is 2 tail test the both values will be same

$$P\text{-value} = 0.01044 + 0.01044$$

$$= \underline{\underline{0.0288}}$$

Problem: A company manufactures bikes batteries with a average life span of 2 or more years. An engineer believes this value to be less. Using 10 samples, he measures the average life span to be 1.8 years with a s.d of 0.15.

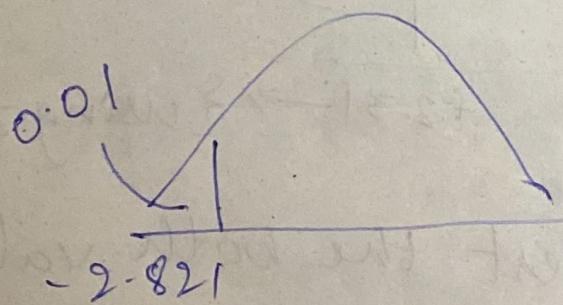
- State the null & Alternative Hypothesis?
- at 99% C.I., is there enough evidence to discard the null hypothesis?

Solution: $\mu = 2$, $n = 10$, $s.d = 0.15$, $C.I = 99\%$

$$\bar{n} = 1.8$$

$$T\text{-test} = \bar{n} + t_{\alpha/2} \left[\frac{s}{\sqrt{n}} \right]$$

degree of freedom is given as $n - 1$
 $= 9$



1 tail test

Because $n < 30$ &
 $s.d$ is given

$$\begin{aligned} \text{Test statistics} : & 1.8 - 2 \left[\frac{0.15}{\sqrt{10}} \right] \\ & = -0.2 [0.4746] \\ & = \underline{-4.214} \end{aligned}$$

Conclusion: $-4.216 < -2.82$

{Reject the null hypothesis}

The average life of the battery is less than 2 years.

* Z-test with proportions:

problem: A tech company believes that the % of residents in town XYZ that owns a cellphone is 70%. A marketing manager believes that this value to be different he conducts a survey of 200 individuals & found that 130 responded yes owning a cellphone

- a) State null & alternate hypothesis at a
- b) 95% of C.I., is there enough evidence to reject the null hypothesis?

Solution: $P_0 = 0.70$ Step 1

$$P_1 \neq 0.70$$

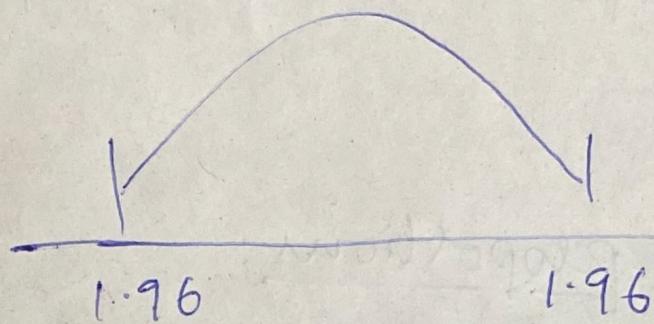
$$n = 200, n = 130$$

$$P^1 = \frac{130}{200} = 0.65$$

$$\begin{aligned}P_0 &= 1 - P_0 = 1 - 0.70 \\&= 0.30\end{aligned}$$

Step-2: CI = 0.95, $\alpha = 0.05$

Step-3:



Step-4: whenever we have Z-test with proportions, formula will change to

$$Z\text{-test} = \frac{\hat{P} - P_0}{\sqrt{\frac{P_0 q_0}{n}}}$$

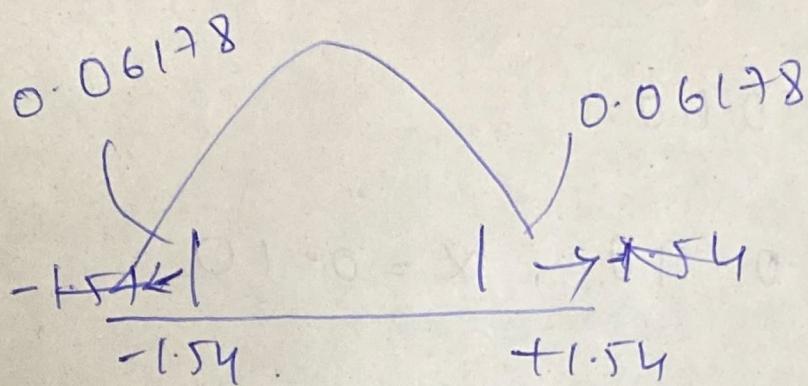
$$= \frac{0.65 - 0.40}{\sqrt{\frac{0.30 \cdot 0.40}{200}}}$$

$$= \frac{-0.05}{\frac{0.4 \times 0.3}{200}}$$

$$= \underline{-1.54}$$

Conclusion: $-1.54 > -1.96$, fail to reject the null hypothesis

Solution using P-Value:



$$\text{P-value} = 0.06178 + 0.06178 \\ = \underline{\underline{0.12356}}$$

P-value > Significance value so we fail to reject the null hypothesis

Problem: A call company that the % of residence in city ABC that owns a vehicle is 60%. or less. A sales manager disagrees with this - he conducts a hypothesis testing surveying 250 residence and found that 140 responded yes to owning a vehicle.

- State null & Alternate Hypothesis
- At 10% significance level, is there enough evidence to support the idea that vehicle ownership in city ABC is 60% or less?

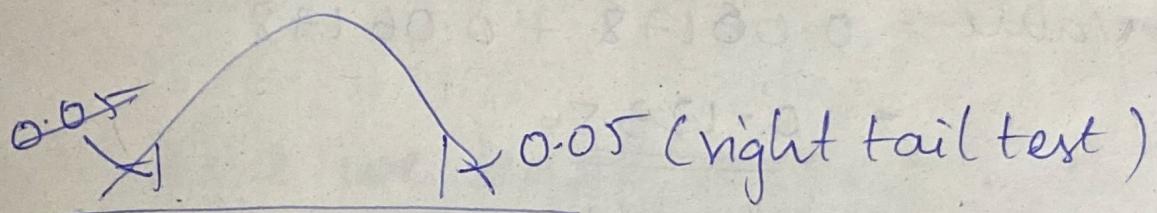
Solution:

$$\underline{\text{Step 1:}} \quad P_0 = 0.60$$

$$P_1 \neq 0.60$$

$$\underline{\text{Step 2:}} \quad C.I = 0.90, \alpha = 0.10$$

Step 3:



Step 4:

Test with proportion.

$$n = 250, x = 170$$

$$P^1 = \frac{170}{250} = \underline{\underline{0.68}}$$

$$q_0 = 1 - P_0 = 1 - 0.60 = 0.4$$

$$z\text{-test} = \frac{P^1 - P_0}{\sqrt{\frac{P_0 q_0}{n}}}$$

$$= \frac{0.68 - 0.60}{\sqrt{\frac{0.60 \times 0.4}{250}}}$$

$$= \frac{0.08}{\sqrt{\frac{0.60 \times 0.04}{250}}} = \underline{\underline{2.588}}$$

*chi Square test : chi square test claims about population proportions. It is a non parametric test that is performed on categorical data. it can include ordinal data Example ranks for ordinal data and nominal data example weekdays

problem : In the 2000 US census of age individuals in a small town found to be the following

< 18	$18 - 35$	> 35
20%	30%	50%

In 2010, ages of $n = 500$ individuals below are the results.

< 18	$18 - 35$	> 35
121	286	91

↑
Individuals were sampled.

Using $\alpha = 0.05$, would you conclude the population distribution of ages has changed in the last 10 years?

Solution:

	< 18	18-35	> 35
Expected	20%	30%	50%

$$n = 500$$

	< 18	18-35	> 35
observed	121	288	91
Expected	100	150	250

Step 1: H_0 = the data meets the expected distribution

H_1 = the data doesn't meet the expected distribution

Step 2: $\alpha = 0.05$, CI = 95%.

Step 3: Degree of freedom {chi square test is applied on categories}

$$\begin{aligned} df &= C - 1 \\ &= 3 - 1 \\ &= 2 \end{aligned}$$

Step 4: Decision boundaries using chi square table.

If my χ^2 {chi square test} \uparrow > 5.991
reject the H_0

Step 5: Chi Square test statistic

$$\begin{aligned} \chi^2 &= \sum \frac{(f_o - f_e)^2}{f_e} = \frac{(121 - 120)^2}{121} + \\ &\quad \frac{(288 - 150)^2}{150} + \frac{(91 - 250)^2}{250} \end{aligned}$$

$$\underline{\chi^2 = 232.494}$$

Conclusion:

$$\chi^2 > 5.99 \text{ reject the } H_0$$