Statistics Notes (Day-6)
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Problem Statement Related with Hypothesis Testing :—

Q) The avg. weight of all resident in a town XYZ is 168 pounds. A nutritrionish believes no true mean to be different. Sho measured the weight of 36 individual and found the means to be 169.5 pound with a Standard Deviation of 3.9.

(a) Null & Alternate Hypothesis
(b) 95% is there enough evidence to discard the Null Hypothesis?

Step 1

$H_0 \Rightarrow \mu = 168$
$H_1 \Rightarrow \mu \neq 168$

(Given)

$\mu = 168$, $n = 36$
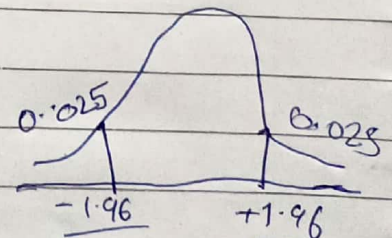$\bar{X} = 169.5$, $Std(\sigma) = 3.9$
$C.I = 95\%$

Step 2

$\angle S.V = 1 - 95\% \Rightarrow 1 - 0.95 \Rightarrow 0.05$

Step 3

0.025 0.025
-1.96 $+1.96$

Step 4

$Z\text{-Score} = \dfrac{\bar{X} - \mu}{S/\sqrt{n}} = 169..$

$= \dfrac{169.5 - 168}{3.9/\sqrt{36}} = \approx \boxed{2.31} \Rightarrow 2.3076$

Conclusion

(A) $2.31 > 1.96$ { Reject the Null Hypothesis}

Now,

p-value
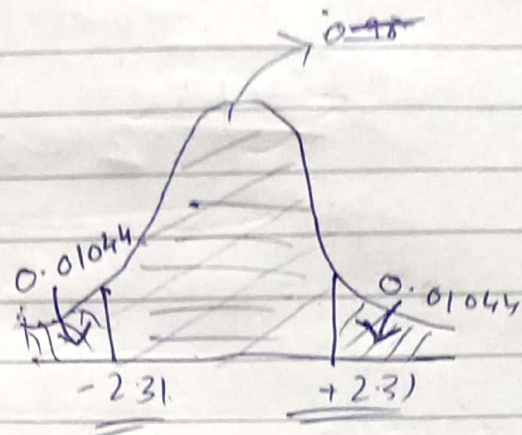
0.01044

−2.31   +2.3)

0.01044

$$p-value = 0.01044 + 0.0144$$
$$= 0.02088 //$$

∴ $0.2080 < 0.05$ { Reject the Null Hypothesis }

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Q2) A Company manufacture bike batteries with an average life span of 2 year or more year. An Engineer believe this value to be less. using 10 samples, he measures the average life span to be 1.8 years with a Standard Deviation of 0.15.

(a) State the Null & Alternate Hypothesis ?
(b) At a 99% C.I, is there enough evidence to discard the H0 ?

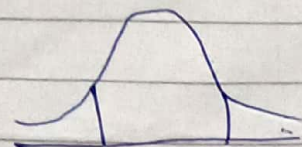| Step1	Given
	$n = 10$, $\sigma = 0.15$,
$H_0 \geq 2$	
$H_1 \not< 2$	$C.I = 99\%$

Step 2

$C.I = 0.99$

$\lambda = 0.01$

Step 3

-2.821
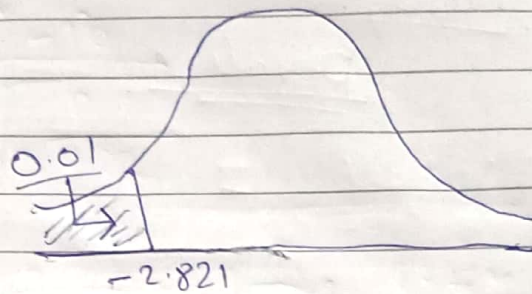
Degree of Freedom $\Rightarrow n-1$
$$= 10-1$$
$$= 9 \,\,//$$

Calculate The T-test Statistics

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{1.8 - 2}{0.15/\sqrt{10}} = -4.216 \,\,//$$

Step 5

$-4.216 < -2.82$ { Reject the Null Hypothesis }

Conclusion

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

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✳ <u>Z-test with proportions :—</u>

Q) A tech company believe that the percentage of residents in Town XYZ that owns a cell phone is 70%. A Marketing Manager believe that this value to be different. He conduct a survey of 200 individual and found that 130 responded, Yes owing a cell phone?

a) State Null & Alternate Hypothesis?
b) At a 95% C.I, is there enough evidence to reject the null Hypothesis?

(Ans) / [Step 1]

Null Hypothesis : $P_0 = 0.70$
Alternate Hypothesis : $P_0 \neq 0.70$

<u>Give</u>
$\boxed{n = 200}$, $\boxed{X = 130}$

$\hat{P} = \dfrac{130}{200} = \boxed{0.65}$

Now,
$$q_0 = 1 - P_0 = \boxed{0.30}$$

[Step 2]
$$C.I = 0.95 \quad, \quad \alpha = 0.05$$

[Step 3] : Decision Boundary

[Step 4]

Z test with proportion

$-1.96 \qquad +1.96$

$$\boxed{Z \; test = \dfrac{\hat{P} - P_0}{\sqrt{P_0 q_0 / n}}}$$

Subject _____

Step 4

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

$$= \frac{0.65 - 70}{\sqrt{\frac{0.7 \times 0.3}{200}}} \approx 1.54$$

Conclusion

$$-1.54 > -1.96 \qquad \left\{ \begin{array}{l} \text{Fail to Reject the} \\ \text{Null Hypothesis} \end{array} \right\}$$

Now,

P - Value

0.06178   0.06178

−1.54   +1.54

$$\# \ p\text{-value} = 0.06178 + 0.06178$$
$$= 0.12356$$

$$P\text{-Value} > \text{Significence Value} \left\{ \begin{array}{l} \text{Fail to Reject} \\ \text{The Null Hypothesis} \end{array} \right.$$

Subject _____

Q) A car company believe that the percentage of resident in city ABC that own a vehicle is 60% or less. A Sales manager disagrees with this. He conduct a hypothesis testing surveying 250 residents and found that 170 responded yes, to owing a vehicle.

a) State the Null & Alternate Hypothesis

b) At 10% Significance level, is there enough conf evidence to support the idea that vehicle owernship in city ABC is 60% or less?
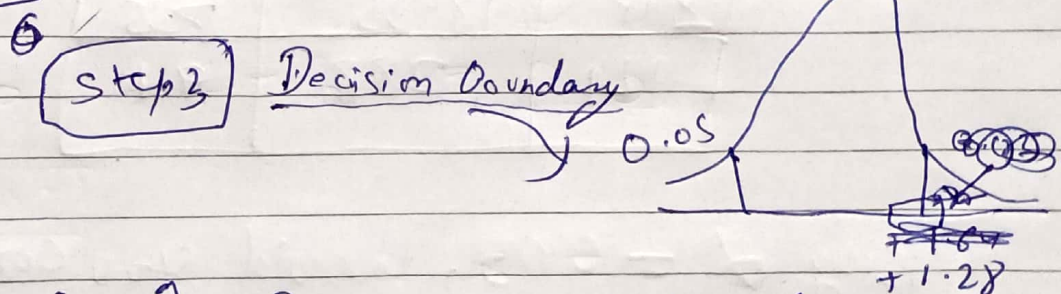

Step 1

Given

$$n = 250, \quad X = 170$$

Null Hypothesis : $P_0 \leq 0.60$
Alternate Hypothesis : $P_0 > 0.60$

$$\hat{P} = \frac{170}{250} = 0.68$$

Now,

$$q_0 = 1 - P_0 \Rightarrow \boxed{0.40}$$

Step 2 $\alpha = 0.10, \quad \& \quad C.I = 0.90$

Step 3 Decision Boundary

0.05

+1.28

Step 4

$$Z \text{ test} = \frac{\hat{P} - P_0}{\sqrt{P_0 q_0 / n}} = \frac{0.68 - 0.60}{\sqrt{\frac{0.6 \times 0.4}{250}}}$$

$$= \frac{0.08}{0.0309} = 2.588 /\!/$$

Conclusion

your writing partner

∴ $2.588 > 1.28 \quad \longrightarrow$ { Reject the Null Hypothesis }

✱ Chi - Square Test :-

→ Chi-Square Test claims about population proportions. It is a non-Parametric test that is performed on Categorical data.

→ (Ordinal Data
Nominal Data

Q) In the 2000, U·S census the age of individuals in a small town found to be the following.

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

In 2010, ages of n = 5000 individuals were sampled. Below are the result.

< 18	18-35	>35
121	288	91

Using α = 0·05, Would you conclude the population Distribution of ages has changed in the last 10 years?

chi-square Table

Subject _____

Soln:

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

n = 500

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

Step 1

Null Hypothesis H_0: The data meets the expected distribution
H_1: The data does not meet the " "

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

Step 3 Degree of Freedom (Categorical)

$$df \Rightarrow C - 1 = 3 - 1 = 2, \quad \boxed{\begin{array}{l}\alpha = 0.05 \\ df = 2\end{array}}$$

No of categories

Step 4:

Decision Boundary: $X^2 > 5.991$ } Reject the Null Hypothesis

$\hookrightarrow$ 5.991 - Checking by Chi-Square Table

Step 5

Chi-Square Test Statistic

$$X^2 = \sum \frac{(f_o - f_e)^2}{f_e} = $$

$$= \frac{(121-100)^2}{100} + \frac{(288-150)^2}{150} + \frac{(91-250)^2}{250}$$

$$\boxed{X^2 = 232.494} \quad \therefore x^2 > 5.99 \text{ & Reject the Null Hypothesis}$$