Hypothesis Testing

$H_0 | H_N$ → Null hypothesis (True statement)

$H_1 | H_A$ → Alternative hypothesis

H_0 : The avg height of Indian Man is 5.7

H_A :- The avg height of Indian man is not 5.7

H_0 : True statement

H_0 :- It will helps to find either we have to accept or reject H_0

P-value

If P-value $<= \alpha$, we can reject H_0

If $P > \alpha$, we have to accept the H_0

α = ~~signifi~~ Significance value

α = 1 - Confidence Interval (68% 95% 99.7%)

* If CI is 68% α is 0.32%
* If CI is 95% α is 0.05%
* If CI is 99.7% α is 0.003

P-value formula

$$Z = \frac{p^{\wedge} - P_0}{\frac{P_0(1-P_0)}{n}}$$

$\hat{p}$ = Sample Propotion

P_0 = Assumed Population propotion in the H_0

n = Sample Size

~~to~~ Note : Hypothesis testing is a framework for making inferences about data and models in machine learning. It helps in model evaluation, feature selection, assumption validation and ensuring the robustness, ~~reab ale~~ reliability of conclusion drawn from models

Type I and Type II Error

R H_0 is True D H_0 is True

R H_0 is True D H_0 is false Type I error

R H_0 is false D H_0 is True Type II error

R H_0 is False D H_0 is False

* If you failed to accept H_0 is type I error
* If you failed to reject H_0 is type II Error and most dangeours

One tail test and two tail test

H_0 :- The chips product weight is 50g

H_A :- The chips Packet weight is not 50 g

$H_0 = 50g$

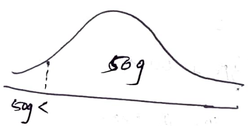
95% CI $\quad H_A \neq 50g$

~~One~~ two tail.

H_0 = The chips packet is more than 50 g

H_A = ~~The~~ No the chips Packet weight is not more than 50g

~~Two~~ One tail



z Test and T test

8 The avg age of clg Student is 24 years with the SD 1.5. Sample of 32 students the mean is 25 years with 95% CI Do the age will vary or not

Population mean (μ) = 24, Population SD (σ) = 1.5, Sample Count: 36, Sample mean ($\bar{x}$) = 25, CI = 95%, $\alpha = 0.05$

Z test

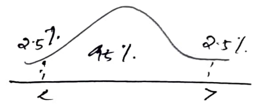
If they given population SD go with z test

t test

If they give sample SD go with t test

H_0 - The avg age is 24

H_A = No the avg age is not 24



$$Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{25 - 24}{\frac{1.5}{\sqrt{36}}} = \frac{1}{1.5 \times 6} = \underline{\underline{4}}$$

z table check value for 4 with α of 0.05

= 0.99997

The area under the curve is 1

So $1 - 0.99997 = 0.00003$

$$\frac{0.00003}{2} = 0.000015 \text{ (p-value)}$$

Here, $p <= \alpha$, $0.000015 < 0.05$ so we have to reject the p-value.

Q. In the population of avg....

A. $\mu = 100$

$\sigma = 15$

$n = 30$

$\bar{x} = 140$

CI = 95%. $\alpha = 0.05$

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{140 - 100}{\frac{15}{\sqrt{30}}} = 14$$

z table check value for 14 with α 0.05

$P = 1 - 1$ $\quad$ $P < \alpha$ so we can reject

$P = 0/2 = 0$

$\alpha = 0.05$

not Imp.

Q. $\mu = 100, \sigma = 15, n = 30, \bar{x} = 130$

CI = 95% $\alpha = 0.05$

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{130 - 140}{\frac{15}{\sqrt{30}}} = 3.66$$

z table check value for 4 with α 0.05

$P = 1 - 0.00013$

$P = \frac{0.99987}{2}$ $\quad$ $P = 0.499$

$P > 0.05$ so accept

Q. Same as above question all scenario same.

$\mu = 100, n = 30, \bar{x} = 140, S = 20, \alpha = 0.5$

Here sample SD is given so we have to do t-test

$$t = \frac{\bar{x} - \mu}{\frac{S}{\sqrt{n}}} = \frac{140 - 100}{\frac{20}{\sqrt{30}}} = 10.95$$

DOF $= n - 1 = 30 - 1 = \underline{29}$

$t >$ t table value with DOF $= 29$ & $\alpha = 0.05$

then ~~a~~ reject ~~the~~ H_0, else accept H_0

Q. Credit card

$n = 140$, $\bar{x} = 19990$ $\sigma = 2500$, $S = 2833$ CI = 95% $\alpha = 0.05$

we have to calculate the interval range

Default always the CI will be 95%

$$CI = \bar{x} \pm Z_\alpha \frac{\sigma}{\sqrt{n}}$$

lower Bound	upper bound
$\bar{x} - Z_\alpha \frac{\sigma}{\sqrt{n}}$	$\bar{x} + Z_\alpha \frac{\sigma}{\sqrt{n}}$
$1990 - Z_{\frac{0.05}{2}} \frac{2500}{\sqrt{140}}$	

$1990 - Z_{0.0025}(211.29)$

$1990 - (1.96).(211.29)$

$= 1576$

upper Bound

$$\bar{x} + Z_{\alpha} \frac{\sigma}{\sqrt{n}}$$

$$= 1990 + \frac{Z_{0.05}}{2} \left(\frac{2500}{\sqrt{100}} \right)$$

$$= 1990 + (1.96)(211.29)$$

$$= 1990 + 414.12$$

$$= 2404$$

The avg balance, they are going to maintain after full fledge launch is [1576 2404).

Q. On a quant test CAT exam of sample of 25 test taker us as sample mean 520 with sample SD of 80. construct 95% CI about the mean

$n = 25$, $\bar{x} = 520$, $S = 80$, $CI = 95\%$, $\alpha = 0.05$

$t = \cancel{\bar{x} \pm Z_{\alpha} t_{\alpha} \sigma}$

$$t = \bar{x} \pm t_{\alpha} \frac{S}{\sqrt{n}}$$

$$t = 520 + t_{0.05} \left(\frac{80}{\sqrt{25}} \right)$$

$$= 520 + t_{0.05} \times 16$$

$$= 520 + 2.05 \times 16$$

$$= \cancel{541}\ 552$$

upper bound

$$t = 520 - t_{0.05} \left(\frac{80}{\sqrt{25}} \right)$$

$$= 487$$