# Hypothesis Testing

① Z test } → Average
② t test
③ chi square → categorical
④ ANNOVA → variance.

Q when to use Z-test vs t-test?

Do you know
population std ($\sigma$)

Yes → Is the sample size above 30
- Yes → use Z-test
- No → use t-test

No → use t-test

* Z-Test :

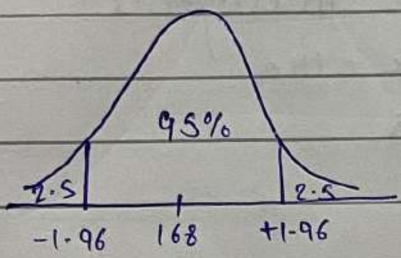
Q The average height of all resident in a city is 168 cm with a population std 3.9. A doctor believes the mean to be different. He measured the height 36 individuals and found the average to be 169.5 cm.

ⓐ State Null and Alternate Hypothesis.
ⓑ At a 95% CI, is there a enough evidence to reject the Null hypothesis.

→ $\mu = 168$ cm, $\sigma = 3.9$, $n = 36$, $\bar{x} = 169.5$ cm

Null hypothesis ($H_0$) : $\mu = 168$ cm
Alternate hypothesis ($H_1$) : $\mu \neq 168$ cm.
$CI = 0.95$, $\alpha = 1 - 0.95 = 0.05$

<u>Decision Boundary</u> :




$1 - 0.025 = 0.9750$

$Z_{0.9750} = \pm 1.96$

If my z-test value falls between -1.96 to +1.96 then we fail to reject the null hypothesis.

→ <u>Statistical Analysis</u>

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

→ $\sigma/\sqrt{n}$ → standard Error

$$= \frac{169.5 - 168}{3.9/\sqrt{36}}$$

$$= 2.39$$

→ <u>conclusion</u> !
Since, 2.39 is greater than +1.96,
we reject the Null hypothesis.

**Q** In the population, the average IQ is 100. A team of researchers want to test a new medication to see if it has either a positive or negative effect on intelligence, or no effect at all. A sample of 30 partici-ponds who have taken the medication has a mean of 140 with a standard deviation of 20. Did the medication affect intelligence?

→ $\mu = 100$, $n = 30$, $s = 20$, $\bar{x} = 140$.

$CI = 95\%$, $\alpha = 1 - 0.95 = 0.05$

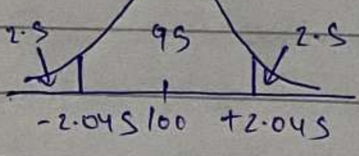
① Null hypothesis $(H_0)$ : $\mu = 100$

Alternate hypothesis $(H_1)$ : $\mu \neq 100$

② Significance Level : $\alpha = 0.05$

③ Degree of freedom : $n-1 = 29$

④ Decision Boundary :




$dof = 29$

$1 - 0.025 = 0.9750$

$t_{0.975, 29} = \pm 2.045$

⑤ <u>T-test</u> :

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{140 - 100}{20/\sqrt{30}} = 10.96$$

⑥ conclusion:

If $t$ is less than $-2.045$ or greater than $+2.045$,

Reject the Null hypothesis.

Since, $t = 10.96 > +2.045$,

$\therefore$ we Reject the Null hypothesis.