* Sampling Distribution :-

- Population ⟶ X_1 , X_2 , X_3 ...... X_n

mean Sampling Distribution $\bar{X}$ = $\dfrac{\bar{X}_1 + \bar{X}_2 + \bar{X}_3 + \bar{X}_n}{n}$ ⟵ $\boxed{\bar{X}_1 \quad \bar{X}_2 \quad \bar{X}_3 \; ...... \; \bar{X}_n}$

- Parmeter ⟶ population $(\mu, \sigma, \sigma^2, p)$ ⟶ proportion
- Statistic ⟶ Sample $(\bar{X}, s, s^2 \; \hat{p})$

Statistics

descriptive ⟶ Sample

inferential ⟶ Conclusion to population from sample

* Population ⟶ Sample distribution

Descriptive

inferential (Conclusion)

- Mean of Sampling Distribution = Mean of population

$$\mu_{\bar{x}} = \mu$$

- SD of Sampling Distribution = $\dfrac{\text{SD of population}}{\sqrt{n}}$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Standard error of mean

note :- كل ما زادت n ⟵ $\downarrow \sigma_{\bar{x}}$

$$\downarrow \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}\uparrow}$$

Population

normal / **non-normal**

normal: regardless $n \geq 30$ or $n < 30$

⇓

Sample distribution normal

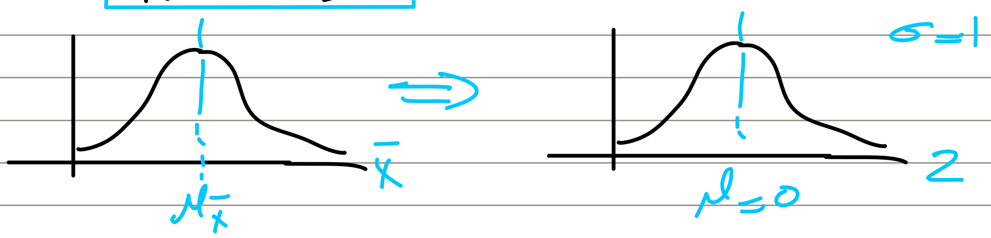
$$\bar{x} \sim N\left(\mu, \frac{\sigma^2}{n}\right)$$

non-normal:

- $n \geq 30$: Sample distribution normal, $\bar{x} \sim N\left(\mu, \frac{\sigma}{n}\right)$
- $n < 30$: Sample distribution non-normal

*Probability of Sampling Distribution:

$$\boxed{\bar{x} \longrightarrow z}$$



$$\bar{x} \sim N\left(\mu, \frac{\sigma^2}{n}\right) \qquad z \sim N(0, 1)$$

$$* \; z = \frac{\bar{x} - \mu_{\bar{x}}}{\sigma_{\bar{x}}} \longrightarrow z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

* Sample proportion ($\hat{p}$):

$p \longrightarrow$ propotion of population

When the population proportion (p) unknown $\xrightarrow{\text{estimet}}$ $\hat{p}$ (sample)

$$* \; \hat{p} = \frac{x}{n}$$

$x \longrightarrow$ Successes

if sample size ↑ $\xrightarrow{\text{approximet}}$ normal $\xrightarrow{\text{when}}$ ① $n \geq 30$ ② $np \geq 5$ + $n(1-p) \geq 5$

$$\hat{p} \sim N(\mu_{\hat{p}}, \sigma^2_{\hat{p}}) \rightsquigarrow \hat{p} \sim N\left(p, \frac{p(1-p)}{n}\right)$$

p: proportion of population or probability of Successes

$\hookrightarrow \sigma = \sqrt{\frac{p(1-p)}{n}}$

* متى احسب probabilite ← $\hat{p}$ ← بحول لـ z

$$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sigma_{\hat{p}}}$$

$\mu_{\hat{p}} \to p$

$\sigma_{\hat{p}} \to \sqrt{\frac{p(1-p)}{n}}$

* Central limit Theorem (CLT) :

when n large → we can approximately sample distribution → normal distribution

* Estimating population:-

- الفكره انه اذا كان Mean ل normal distribution population ← unknown

بستخدم $\bar{X}$ (Sample mean)

* Estimating mean *

Point

$\mu \xrightarrow{\text{Estimating}} \bar{X}$

unknown → known

- Single value

لانه بتعتمد على Chanc مابتكون دقيقة

Interval

$\mu \xrightarrow{\text{Estimating}} \bar{X}-\sigma < \bar{X} < \bar{X}+\sigma$

- range value

متى احنا نكون ل μ داخل الفتره لازم يكون في level

→ CL:-

$1-\alpha$

99% or 95% or 90%

α = ,01 = ,05 = ,1

* CI of population mean *

normal

σ Known

- $n \geq 30$
- Z-Distribution
- $CI = \bar{X} \pm Z_{1-\frac{\alpha}{2}} * \frac{\sigma}{\sqrt{n}}$

σ unknown

$n \geq 30$ ⇓ - Z-Distribution ⇓ - $CI = \bar{X} \pm Z_{1-\frac{\alpha}{2}} * \frac{S}{\sqrt{n}}$

$n < 30$ ⇓ T-Distribution - $CI = \bar{X} \pm t_{1-\frac{\alpha}{2}} \frac{S}{\sqrt{n}}$

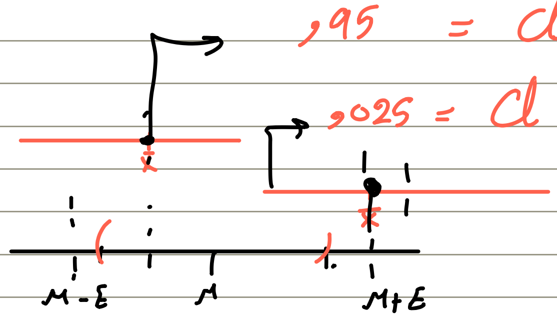
*note:- df = 1-n

* سلايد 11 + 12 + 13:

اذا كان CL ← 95% واخذنا 26 Sample

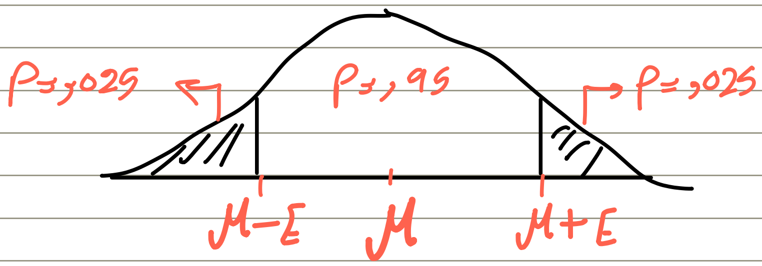
← احتمال انه يكون Mean ل Sample داخل CL = ,95

← احتمال انه Mean ل Sample خارج CL = ,025



* probability if $\bar{x} > \mu + E$ or $\bar{x} < \mu - E$ ⇒ ,025

* probability if $\bar{x} < \mu + E$ or $\bar{x} > \mu - E$ ⇒ ,95



* t-Distribution:-

- mean = 0
- Variance > 1
- بتختلف T-value بختلاف n

$df = n - 1$

* Hypothesis testing :-

- goal → rule out chance   استبعاد الصدفة
- help → to determining if hypothesis true

Hypothesis → Null H_0 / Alternative H_1

Null H_0 (population)

- no different
- after - befor = zero
- $\leq$ or $\geq$ or $=$

* research aims → reject
- different due to chance

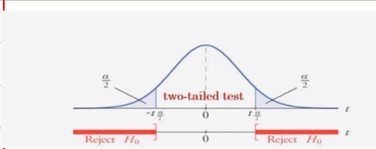
Alternative H_1 (examined sample)

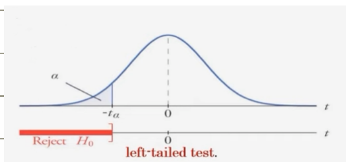
- reflection true → all population
- sample statistics is different than population
- use to reject H_0
- $<$ or $>$ or $\neq$

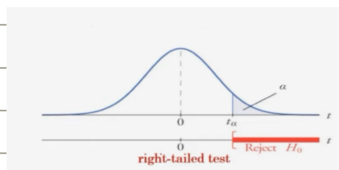
* research aime → accpte
- different less likely to be due chance

* 2 Types of errors → I → H_0 = reject but H_0 → true α
  → II → H_0 = accepting but H_0 → false β

- Two tailed	left - taild	Right - taild
$H_0 : \mu = k$	$H_0 : \mu = k$	$H_0 : \mu = k$
$H_1 :- \mu \neq k$	$H_1 : \mu < k$	$H_1 : \mu > k$







Rejection H_0 :- (left-tailed)

- $Z < -Z_{1-\alpha}$
- $t < -t_\alpha$

Rejection H_0 :- (right-tailed)

- $Z > Z_{1-\alpha}$
- $t > t_\alpha$

population
normal

- Known
  - $n \geq 30$
  - Z-Distribution
  - $$Z = \frac{\bar{X} - \mu_0}{\sigma / \sqrt{n}}$$
- σ unknown
  - $n \geq 30$
    - $\Downarrow$ Z-Distribution
    - $\Downarrow$ $$Z = \frac{\bar{X} - \mu_0}{s / \sqrt{n}}$$
  - $n < 30$
    - $\Downarrow$ T-Distribution
    - $\Downarrow$ $$t = \frac{\bar{X} - \mu_0}{s / \sqrt{n}}$$

* Paired t-test:- تناقض

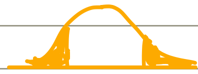
- have 2 competing hypothesis

H_0: true mean difference

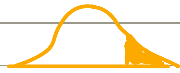
After - Before = Zero

H_1:
- does not matter → 2-Tailed
- does matter → upper-Tailed / lower-Tailed

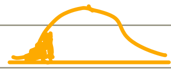
* $H_0 \rightarrow \mu_d = \text{zero}$
* $H_1 \rightarrow \mu_d \neq \text{zero}$



→ $\mu_d > \text{zero}$



→ $\mu_d < \text{zero}$



note:- Hypothesis → never about data
→ about processes of data

H_0 ✓ ← ما في تغير
H_1 ✓ ← في تغير

هدف من Hypothesis انه نحدد صار تغير ولا

Comparisons

Not Paird:
- Use 2 group
  - Control — ما يوخذ دوا
  - treated — يوخذ دوا

Paird:
- Use one group
- objectiv: eliminate maximum variation → by pairs simelar

* $d_i = \text{after} - \text{befor}$
* $\bar{d} = \frac{\sum d_i}{n}$

* $t = \frac{\bar{d} - \mu_{d_0}}{S_d/\sqrt{n}}$

* $t\text{-criticals} = \pm t(1-\frac{\alpha}{2}, df = n-1)$