lec 16 كلمة أنكار

hypothesis

Null (H0)

- assume that no difference of test statistic and population parameter.
- research hypothesis about certain phenomena is not correct.
- no real difference between sample and population

Research /alternative (H1)

- what the research believes to be a true reflection on the population.
- a true explanation for a phenomena in the population.
- the researcher wants to prove: (sample statistics) different than (population parameter)

Null Hypothesis vs Alternative Hypothesis

Null hypothesis H0	Alternative Hypothesis H1
There is no relationship or difference	There is a relationship or difference
Refers to the population	Refers to the examined sample
Research aims to reject the null	Research aims to accept the alternative
Represent an original assumption	Prove statistically a systemic difference or relationship
Assumes a difference is due to chance	Assumes that difference is less likely to be due to chance.

Null Hypothesis or the Hypothesis to be Tested (H_0)

- A claim that there is NO difference between the population parameter like mean (μ) and the hypothesized value. In the testing process the null hypothesis either is rejected or not rejected (we do not say accepted).

Alternative Hypothesis or the Research Hypothesis (H_A or H_1)

- A statement of what we will believe is true if our sample data cause us to reject the null hypothesis. Usually the alternative hypothesis is the research hypothesis (the conclusion that the researcher is seeking to reach).

Example

- A new drug is developed with the goal of lowering blood pressure more than the existing drug.
- **(Null hypothesis)** H_0 :
  - The new drug does not lower BP more than the existing drug.
- **(Alternative hypothesis)** H_1
  - The new drug lowers blood pressure more than the existing drug.

Example

It is believed that a candy machine makes chocolate bars that are on average 5g. A worker claims that the machine after maintenance no longer makes 5g bars. Write Ho and Ha.

$H_0 : \mu = 5$

$H_1 : \mu \neq 5$

A company has stated that their straw machine makes straws that are 4 mm diameter. A worker believes the machine no longer makes straws of this size and samples 100 straws to perform a hypothesis test with 99% confidence.

$H_0 : \mu = 4$

$H_1 : \mu \neq 4$

How to establish a good hypothesis:

- clear + declarative statement.
- relationship between Variables
- reflect a body of literature or theory
- Be direct + explicit
- Be testable + measurable

(Testing hypothesis) → متعلقة بـ μ

① Null-Hyp ⇒ (H_0) ⇒ $\mu = \mu_0$
→ reject
↳ don't reject

② Alternatike Hyp (H_a) or (H_1)

$\mu > \mu_0$ (Rigt tailed test) — μ_0 من السؤال

$\mu < \mu_0$ (left tailed test)

$\mu \neq \mu_0$ (two tailed test)

كيف أعرف على أي نرمية أشتغل ؟
حسب صيغة السؤال .

(test stastic)

- لو σ موجودة ومعاها توزيع normal أو يطرح العبارة أو من خلال sample size ≥ 30

$$z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$$

- لو σ مش موجودة ومكان التوزيع normal و sample size < 30

$$t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$$

[critical value]

- z_{crit}
- t_{crit}

→ من جداول z, t

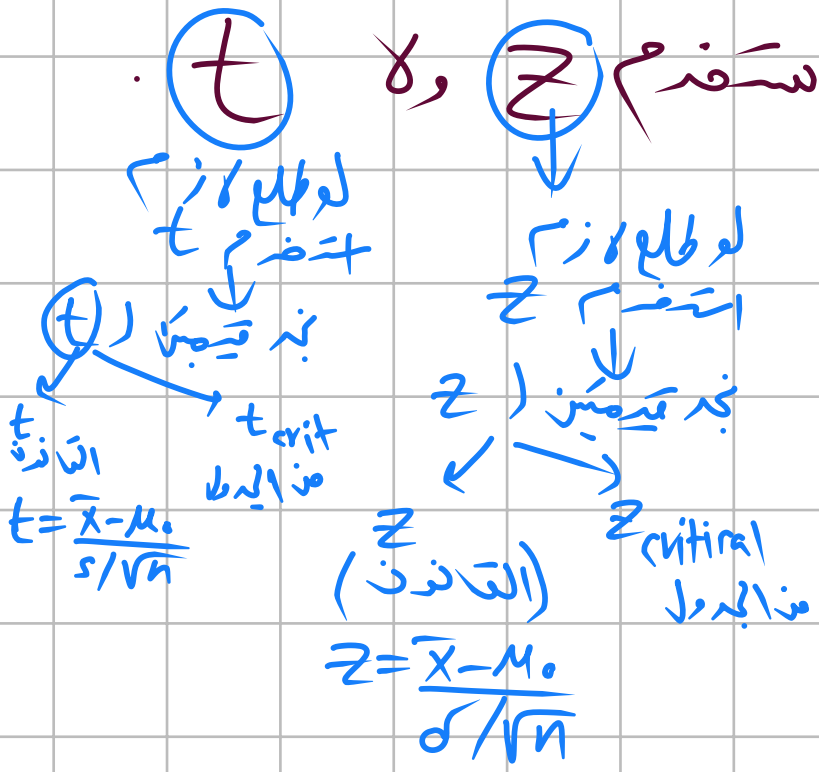
⇓ تقسم المنحنى لقسمين
- rejection area
- non-rejection area

كيف أحل أي سؤال؟

① أول خطوة بحل H_0 ⇐ $H_0 \Rightarrow (\mu = $ قيمة المعطاة بالسؤال$)$

② بحل H_1 يا بتكون أكبر أو أقل أو لا تساوي حسب صيغة السؤال.

③ بتحدد هل أستخدم Z ولا t.



④ هل بدي أقارن قيمة الجدول وقيمة الناتج..

اذ نعتمد هذا المخطط:

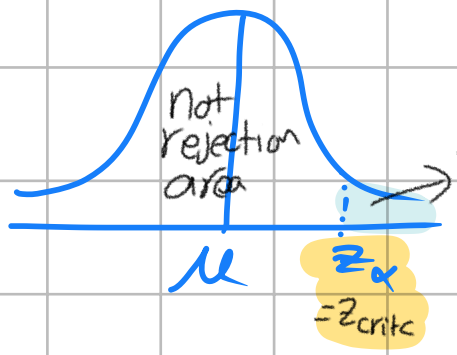
$H_0: \mu = \mu_0$ ← يحتوي السؤال

$H_1: \mu > \mu_0$ ← حسب السؤال

Reject H^0 →

if

$Z_{\text{حاسبة}} > Z_{\text{critc}}$ مقابل الجدول $(1-\alpha)$



أكبر منها H_0 نرفض

Right tailed test

لو t

$t_{\text{حاسبة}} > t_{(\alpha, (n-1))}$

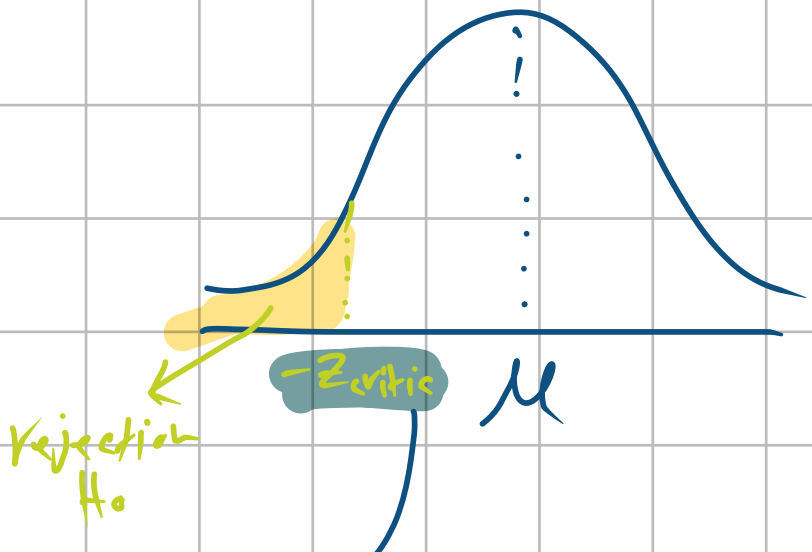
$H_0: \mu = \mu_0$

$H_1: \mu < \mu_0$

لأنها يعني Z_{critc} سالبة

Reject H_0 if

$Z_{\text{الحاسبة}} < -Z_{critc}$ $(1-\alpha)$



أي نتيجة أكبر منها نرفض H_0

left tailed test

one-tail test

$Z_{critc}(1-\alpha)$

$t_{critc}(\alpha, df)$

$H_0 \Rightarrow \mu = \mu_0$

$H_1 \Rightarrow \mu \neq \mu_0$

H_0 reject → اذا يتحقق شرط

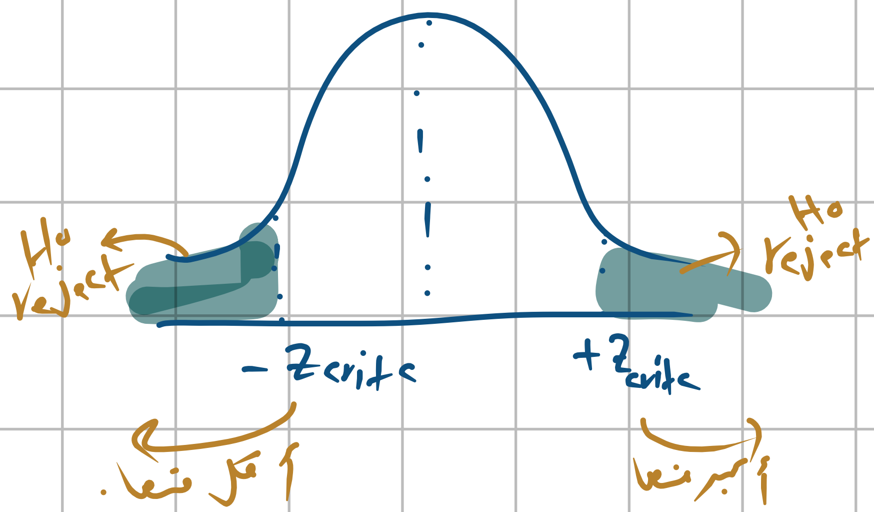
$Z_{\text{محسوبة}} > +Z_{critic\,(1-\frac{\alpha}{2})}$

$Z_{\text{محسوبة}} < -Z_{critic\,(1-\frac{\alpha}{2})}$

$|Z|_{\text{محسوبة}} > Z_{(1-\frac{\alpha}{2})\,\text{جدول}}$

واذا t

$|t|_{\text{محسوبة}} > t_{(\frac{\alpha}{2},\, n-1)}$



$Z_{critic\,(1-\frac{\alpha}{2})}$
$t_{critic\,(\frac{\alpha}{2},\, df)}$ ← two-tailed test

حسب السؤال. نختار ال test المناسب.

Example

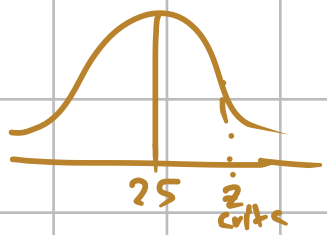
Researcher are interested in the mean age of a certain population. They are wondering if the **mean age** is more than **25 years**. Assuming that the **population** is **normally** distributed with **variance** equal to **20**. A **random sample** of **10** individuals drawn from the population of interest. From this sample, a **mean** of **27** is calculated. Construct the proper hypothesis, test your hypothesis, and then state the proper conclusion? Use **α = 0.05** to test the hypothesis?

$\sigma^2 = 20$, $\sigma = \sqrt{20}$, $n = 10$, $\bar{x} = 27$, $\alpha = 0.05$

$H_0 : \mu = 25$

$H_1 : \mu > 25$

H_0 reject if $Z_{\text{calc}} > Z_{\text{crit}}$



$Z_{\text{الجدول}}$

$Z_{crit} = Z_{(1-\alpha)}$

$= Z_{(1-0.05)}$

$= Z_{(0.95)}$

$= 1.645$

$Z_{\text{الجدول}}$

$Z_{\text{calc}} = \dfrac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$

$= \dfrac{27 - 25}{\sqrt{20}/\sqrt{10}}$

$= 1.414$

H^0 reject if $Z_{\text{calc}} > {}^{+}Z_{crit}$

H^0 not rejected if $Z_{\text{الجدول}} \geq Z_{\text{calc}}$

Example

mean of sample = 32.3

The **mean** maximum oxygen uptake for a sample of **242** women was **32.3** with a **standard deviation** of **12.14**, we wish to know if, on the basis of the data, can we conclude that the **mean** score for a population of such women is **smaller** than **33**? Use **α = 0.01** to test the hypothesis?

$\bar{X} = 32.3$

$n = 242$

$s = 12.14$

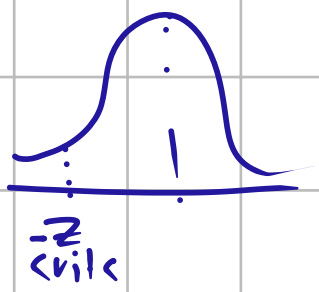
$\mu < 33$

لأن large sample size ← ($\sigma \approx s$)

$H_0 : \mu = 33$

$H_1 : \mu < 33$

H_0 reject if $Z_{\text{test}} < -Z_{\text{crit}}$



$Z_{crit} = Z_{(1-\alpha)} = Z_{(1-0.01)} = Z_{0.99} = 2.33$

$Z_{test} = \dfrac{\bar{X} - \mu_0}{s/\sqrt{n}} = \dfrac{32.3 - 33}{12.14/\sqrt{242}} = -0.897$

$-2.33 < -0.897$

$Z_{جدول} < Z_{معطى}$

H_0 is not rejected

∵ rejection rule isn't satisfied.

normal + غير معروف + small sample size → جدول t

Example

The body mass index (BMI) of a **group** of **14** healthy adult males has a **mean of 30.5** and a **standard deviation of 10.6392**, can we conclude that the **mean** BMI of the **population** is equal to **36** assuming that the population is normally distributed? Use **α = 0.1** to test the hypothesis?

$n = 14$

$\bar{x} = 30.5$

$s = 10.6392$

$\mu = 36$

$\alpha = 0.1$

تمرين بيساوا انه مش مساوي 36 ضروري ؟

two-tailed test.

$H_0 \rightarrow \mu = 36$

$H_1 \rightarrow \mu \neq 36$

H_0 reject if

شرطين

$t_{معطى} > t_{جدول}$, $t_{معطى} < -t_{جدول}$

$|t_{معطى}| > t_{(\frac{\alpha}{2}, n-1)}$

$t_{جدولي}$

$t_{(\frac{\alpha}{2}, n-1)}$

$t_{(0.05, 13)}$

$= 1.771$

$t_{محسوبة}$

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

$$= \frac{30.5 - 36}{10.6392/\sqrt{14}}$$

$$t_{محسوبة} = -1.934$$

$|-1.934| > 1.771$

$t_{محسوبة} > t_{جدولي}$

* H_0 rejected
* Rejection rule is satisfied
* $\mu \neq 36$
* H_1 is accepted at $\alpha = 0.1$