Hypothesis Testing (II)

$H_0 \Rightarrow New \leq old$

Practice.

① Framing Hypotheses.

① Ex: A new teaching method is developed that is believed to be better than current method.

H_0: New method is same/worse than cmt method.

H_A: New method is better than current method.

② A new drug is developed with a goal of lowering B.P. more than the existing drug.

H_0: New drug is same as existing for B.P.

H_A: New drug lowers BP more than existing

Degrees of Freedom (df)

df refers to the max^m no. of logically independent values in a sample.

eg. 3, 8, 5, 4, x

Avg = 6

$$\frac{20+x}{5} = 6$$

$$\boxed{x = 10}$$

→

Sample size = n

$df = (n-1)$

3
8
5
x, y

Avg = 6

2+4 = 6
4+2 = 6

Examples on T-table lookup -

① $t = 2.56$, $df = 16$

② $t = 0.76$, $df = 6$

df p →

$\boxed{t}$

H/w ! Lookout for Python f^n to findout Z / T.
(T/Z Test).

$\boxed{\text{P-value}}$ →

Examples on Tails of the Test:

① Null hypothesis : $\mu = 1200$, $H_A : \mu \neq 1200$ (2 tailed)

② Null " : $\mu >= 1800$, $H_A : \mu < 1800$ (1T → Left)

③ Null " : $\mu =< 2300$, $H_A : \mu > 2300$ (1T → Right)

④ Alt " : $\mu > 2800$, (1T → Right)

Q. The average weights of all the students of my class is 168 lbs. A nutritionist believes that the true mean is different. She measured the weights of 36 individuals and found the mean to be 169.5 lbs with a STD of 3.9. At 95% confidence interval, is there enough evidence to discard the null hypothesis?

:

method : Z-score method / critical value method.

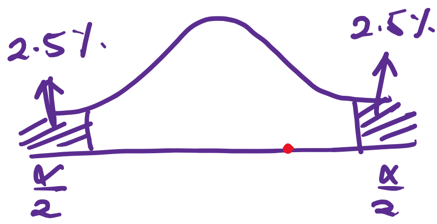
sample size $(n) = 36$

$\bar{x} = 169.5$

$S = 3.9$

$\alpha = 1 - C.I. = 5\%$

$\mu = 168$



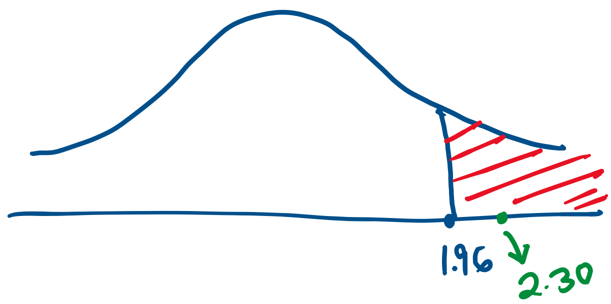
Step 1: $H_0 : \mu = 168$

$H_A : \mu \neq 168 \rightarrow$ 2 tailed Test

Step 2: $Z = \dfrac{\bar{x} - \mu}{S/\sqrt{n}} = \dfrac{169.5 - 168}{3.9/6} = 2.30$

$Z_{cal.} = 2.30$

$Z_{\alpha/2} = \pm 1.96$



$\boxed{Z_{cal.} > Z_{critical}} \rightarrow$ Reject H_0

The Nutritionist's claim is correct.

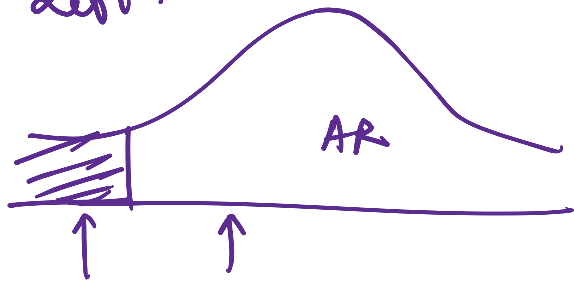
Q. Decision of Test claim's Q. (Principal's claim)

– Principal's claim of his students being above avg. Intelligence is correct and tested / to be right.

Q. The average weights of all the students of my class is 168 lbs. A nutritionist believes that the true mean is less than what is given. She measured the weights of 36 individuals and found the mean to be 169.5 lbs with a STD of 3.9. At 95% confidence interval, is there enough evidence to discard the null hypothesis?

$H_0 : \mu \geq 168$

$H_A : \mu < 168$ → Left tailed Test.



$Z_{cal.} = 2.30$

$Z_{\alpha/2} = -1.65$

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Errors : Type I & Type II error

	Actual	
	H_0 True	(H_0 False) ✓
Measured: Reject H_0	Type I Error False +	✓
Fail to Reject H_0	✓	Type II Error False −

Q.

H_0 : There is no tiger

H_A : " " a " " " " .

COVID-19 Example.

	Actual +	Actual −
measure −	T-I	
measure +		T-II

Ho : There is a tiger

HA : There is no tiger

There is a tiger, villegers Rejected Clu...

	Actual: Ho True	Actual: Ho False
measured: Reject	Type I	
measured: Fail to Reject	✓	

Ho : Villagers beliefs th—

Prob. of Type I error? $\Rightarrow \underline{\underline{\alpha}}$.

Prob. of Type II error? $\Rightarrow \underline{\underline{\beta}}$ ✓✓

Power $= (1-\beta)$

Question: If men predisposed to heart disease have a mean cholesterol level of 300 with a STD of 30 but only mean with a cholesterol level over 225 are diagnosed as predisposed to heart disease. Find prob of "Type-II" error.

.....

H_0 = Person is not Predisposed to heart disease

H_A = " " " " " "

$$Z = \frac{225-300}{30} = \frac{-75}{30} = \underline{\underline{-2.5}}$$

Tail Area of $2.5 = 0.0062$

$$\boxed{P(\text{Type II}) = 0.0062}$$

In continuation,

If men predisposed to heart disease have a mean cholesterol level of 300 with std of 30. Above what cholesterol level should you diagnose mean as predisposed to heart disease if you want the probability of "Type II" error as 1%.

1% area in Tail $= \pm 2.3$

$$-2.3 \times 30 = X - 300$$

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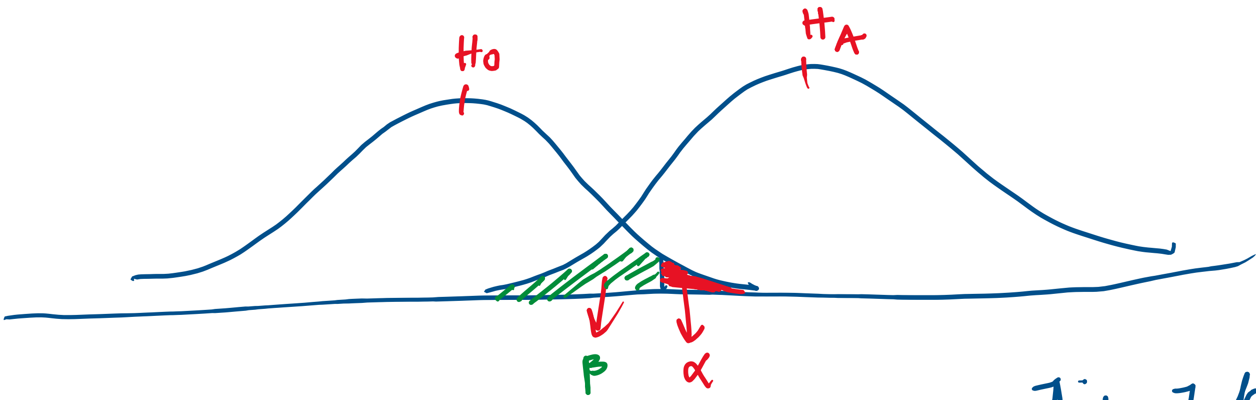
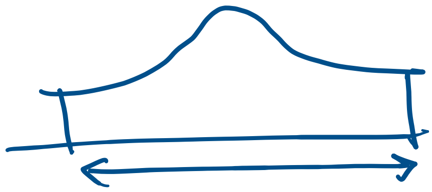


How to Reduce the risk of Committing Type II

↳ sample size (n)

↳ significance level (α)

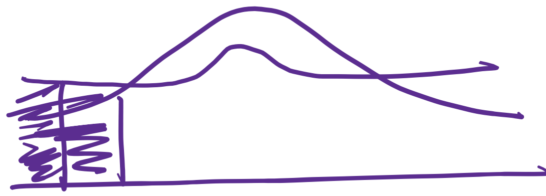
~~Test~~ T-Test → s ↓



Z

sample size ↑ ↘

α ↑ β ↓



ANalysis Of VAriance (ANOVA)

→ 1918

→ Fisher

→ extension of t & Z Test.

→ ? → T/Z Tests are designed to be used for 2 groups

→ helps in analysis of variance within & betn the groups.

① one-way ANOVA : Compare more than 2 grp based on one factor.

eg. → A Company wants to compare the productivity of 5 employees based on one factor (working hours)

② Two-way ANOVA - Compare more than 2 grp based on 2 factors

eg. - productivity comparison using 2 factors (working hours & no. of completed task).

③ N-way ANOVA - Compare more than 2 grp based on N-factors.

eg. → Productivity comparison using more than 2 factors (all factors).

Sales → spend, Quantity, Quality, Marketings

F-test : used to compare variances betn grps.

Applied if

→ $(\text{var})_1$ & $(\text{var})_2$ is known

→ S.D. (Sample 1) > S.D. (Sample 2)

→ $\boxed{F = \frac{SD_1^2}{SD_2^2}}$ with $(n_1 - 1)$ & $(n_2 - 1)$ degrees of freedom.

$\alpha = 0.05$

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