ANOVA Test.

ANOVA:- [Analysis of variance].

ANOVA is a statistical method used to compare the means of 2 or more groups.

ANOVA:-

(1) Factors (2) Levels

Anxiety reducing medicine

Dosage → 0 mg	50 mg	100mg
9	7	4
8	6	3
7	6	2
8	7	3
8	8	5

From the above table

Factor : Dosage

Levels : 0mg, 50 mg, 100mg

Types of ANOVA:-

One way ANOVA:- one factor with atleast 2 levels, levels are independent.

EX:- independent levels

0 mg	50 mg	100mg
9	7	4
8	6	3
7	6	2
8	7	3

2) Repeated Measures ANOVA :- one factor with atleast 2 levels, but levels are dependent.

Ex :-

Factor	Running kms	Day1 $\xleftrightarrow[\text{dependent}]{\text{relation}}$	Day 2 ⟷	Day 3 ⟷	Day 4
levels.	1	6	4	2	10 km
		–	–	–	–
		–	–	–	–
		–	–	–	–

Ex :- study hours

Day1 ⟷ Day2 ⟷ Day3

10hrs 5hrs 2hrs

Ex :- Gym.

Day1 ⟷ Day2 ⟷ Day3

2 hrs 1.5 hrs 1hr

3) Factorial ANOVA :- Two or more factors (each of with atleast 2 levels). Levels can be either independent, dependent or both (mixed).

Ex :-

factor		Day1	Day2	Day3	
	Men	9	7	4	
		8	6	3	→ level 1
		7	5	2	
	Women	8	7	3	→ level 2
		8	8	4	
		9	9	3	
		↓ level 1	↓ level 2	↓ level 3	

* Researchers want to test a new anxiety medication. They split participants into 3 conditions (0mg, 50mg, 100mg) then ask them to rate their anxiety level on scale of 1-10. Are there any differences between the 3 conditions using $\alpha = 0.05$?

0mg	50 mg	100mg
9	7	4
8	6	3
7	6	2
8	7	3
8	8	4
9	7	3
8	6	2

① $H_0 = \mu_{0mg} = \mu_{50mg} = \mu_{100mg}$

H_1 = not all μ's are equal.

② state α and C.I :-

$\alpha = 0.05$ C.I = 95%

③ calculate the degree of freedom :-

statistics

$N = 21$ $n = 7$

$a = 3 \rightarrow$ {No. of level}

$\rightarrow df_{between} = a-1 = 3-1 = 2$

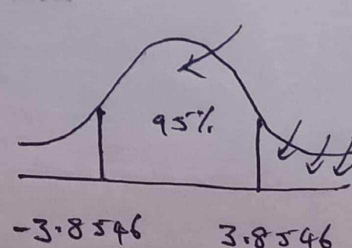
$\rightarrow df_{within} = N-a = 21-3 = 18$

$\rightarrow df_{Total} = N-1 = 21-1 = 20$

④ state Decision Rule :-

$df_{between} = a-1 = 3-1 = 2$ $\{(2,18)\}$

$df_{within} = N-a = 21-3 = 18$



→ If F-test is greater than 3.5546, Reject the Null hypothesis.
↳ from f-table we got this value.

→ If F-test is less than -3.5546, Reject the Null hypothesis.

Calculate F-test statistics:-

	SS	df	MS	F-test
Between	98.67	2	49.34	86.56
within	10.29	18	0.57	
Total	108.96	20		

SS - Sum of squares
df - degree of freedom
MS - Mean squares.

$$SS_{between} = \frac{\Sigma(\Sigma a_i)^2}{n} - \frac{T^2}{N}$$

$$(\Sigma a_i)^2 = (9+8+7+8+8+9+8)^2 + (7+6+6+6+7+8+7+6)^2 + (4+3+2+3+4+3+2)^2$$

$$= 57^2 + 47^2 + 21^2$$

T^2 = (sum of values of level 1 + sum of values of level 2 + sum of values of level 3)^2

$$T^2 = [57+47+21]^2$$

$$SS_{Between} = \frac{57^2+47^2+21^2}{7} - \frac{125^2}{21}$$

$$= 98.67$$

$$SS_{within} = \Sigma y^2 - \frac{\Sigma(\Sigma a_i)^2}{n}$$

$$= \Sigma y^2 - \left[\frac{57^2+47^2+21^2}{7}\right]$$

$$\Sigma y^2 = 9^2+8^2+7^2+8^2+8^2+9^2+ \dots + 2^2 = 853$$

$$= 853 - \left[\frac{57^2+47^2+21^2}{7}\right] = 10.29.$$

$$\text{F-Test} = \frac{MS_{between}}{MS_{within}} = \frac{49.34}{0.57} = 86.56$$

Final conclusion:-

86.56 > 3.5546, so we reject the null hypothesis.