Design of Experiments

Analysis of variance : [ANNOVA]

ANNOVA is a technique that will enable us to test the significance of the difference among more than two sample mean.

Assumption :

1. The observations are random.
2. The observations are independent.
3. The samples are drawn from normal population.
4. population variances are equal.

Basic principles :

1. Randomisation
2. Replication
3. Local control

Basic design :

1. Completely randomised design (CRD) - one way classification.

2. Randomised block design (RBD) - two way classification.

3. Latin Square fractional design [LSD] - three way classification

<u>Note :</u>

F - Ratio

(i.e)., $F = \frac{S_1^2}{S_2^2}$

where $S_1^2 > S_2^2$

<u>procedure to find :</u>

1. Formulating H_0 and H_1
2. Find T and N, where
   T = Sum of all terms and
   N = Total number of sample size
3. Find correction factor $[C.F] = \frac{T^2}{N}$
4. Find TSS = (Sum of the squares of all the terms) - C.F
5. Find SSC = [Sum of squares between samples] - C.F
6. Find SSE = TSS - SSC
7. Form ANNOVA table.
8. Conclusion

Problem : 1

A completely randomized design experiment with 10 plots and 3 treatments gave the following results.

Plot No :	1	2	3	4	5	6	7	8	9	10
Treatment	A	B	C	A	C	C	A	B	A	B
yield	5	4	3	7	5	1	3	4	1	7

Analyse the result for treatment affect.

Solution :

Treatment	-	yield			
(x_1) A		5	7	3	1
(x_2) B		4	4	7	-
(x_3) C		3	5	1	-

x_1	x_2	x_3	Total	x_1^2	x_2^2	x_3^3
5	4	3	12	25	16	9
7	4	5	16	49	16	25
3	7	1	11	9	49	1
1	0	0	1	1	0	0
$\Sigma x_1 = 16$	$\Sigma x_2 = 15$	$\Sigma x_3 = 9$	40	$\Sigma x_1^2 = 84$	$\Sigma x_2^2 = 81$	$\Sigma x_3^2 = 35$

Step 1 : Formulate H_0 and H_1

H_0 : There is no difference between samples.

H_1 : there is difference between samples.

Step 2 : T and N

$$T = \Sigma x_1 + \Sigma x_2 + \Sigma x_3$$
$$= 16 + 15 + 9$$

$$\boxed{\begin{array}{c} T = 40 \\ N = 10 \end{array}}$$

Step 3 : Correction Factor

$$C.F = \frac{T^2}{N} = \frac{[40]^2}{10} = \frac{1600}{10}$$

$$\boxed{C.F = 160}$$

Step 4 : TSS

$$TSS = [\Sigma x_1^2 + \Sigma x_2^2 + \Sigma x_3^2] - C.F$$
$$= [84 + 81 + 35] - 160$$

$$\boxed{TSS = 40}$$

Step 5 : SSC

$$SSC = \left[\frac{[\Sigma x_1]^2}{N_1} + \frac{[\Sigma x_2]^2}{N_2} + \frac{[\Sigma x_3]^2}{N_3}\right] - C.F$$

$$= \left[\frac{(16)^2}{4} + \frac{(15)^2}{3} + \frac{(9)^2}{3}\right] - 160$$

$$= 166 - 160$$

$$\boxed{SSC = 6}$$

Step 6 : SSE

$$SSE = TSS - SSC$$
$$= 40 - 6$$
$$\boxed{SSE = 34}$$

Step 7 : ANNOVA Table

Source of variance	Sum of Squares	Degrees of Freedom	Mean Square	F - Ratio
Between sample [column]	$SSC = 6$	$C-1$ $= 3-1$ $= 2$	MSC $= 6/2$ $= 3$	$F_c = \frac{4.8}{3}$ $= 1.6$
Within samples [Error]	$SSE = 34$	$N-C$ $= 10-3$ $= 7$	MSE $= 34/7$ $= 4.8$	$F_\alpha =$ d.o.f $(\overset{R}{2}, \overset{C}{7})$ $F_\alpha = 19.35$

Step 8 : Conclusion

$$F_c = 1.6 < 19.35 = F_\alpha$$

$\therefore$ H_0 is accepted

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