

Problem 1: Three Varieties A, B, C of a crop are tested in a randomized block design with four replications. The plot yields in pounds are as follows

A	6	5	8	9
C	8	4	6	9
B	7	6	10	6

Analysis the experimental yield and state your conclusion.

Solution:

Step 1: Null Hypothesis: H_0 : There is no significant difference b/w yields and varieties

Step 2: Alternative Hypothesis: H_1 : There is significant difference b/w yields and varieties

Table 1 Yields

Varieties	1	2	3	4	$\sum Y_i$
A	6	4	8	6	$\sum Y_1 = 24$
B	7	6	6	9	$\sum Y_2 = 28$
C	8	5	10	9	$\sum Y_3 = 32$

Table - 2

	X_1	X_1^2	X_2	X_2^2	X_3	X_3^2	X_4	X_4^2
A	6	36	4	16	8	64	6	36
B	7	49	6	36	6	36	9	81
C	8	64	5	25	10	100	9	81
	$\sum X_1$	$\sum X_1^2$	$\sum X_2$	$\sum X_2^2$	$\sum X_3$	$\sum X_3^2$	$\sum X_4$	$\sum X_4^2$
	= 21	= 149	= 15	= 77	= 24	= 200	= 24	= 198

Step 3: $N = n_1 + n_2 + n_3 + n_4$
 $= 3 + 3 + 3 + 3$

$N = 12$

$c = \text{No. of columns} = 4$ $C = 4$

$r = \text{No. of rows} = 3$ $r = 3$

Step 4: $T = \sum X_1 + \sum X_2 + \sum X_3 + \sum X_4$
 $= 21 + 15 + 24 + 24$

$T = 84$

Step 5: Correction factor $CF = \frac{T^2}{N}$

$CF = \frac{84^2}{12} = \frac{84 \times 84}{12} = 588$

$CF = 588$

Step 6: $SST = \sum X_1^2 + \sum X_2^2 + \sum X_3^2 + \sum X_4^2 - CF$
 $= 149 + 77 + 200 + 198 - 588$

$SST = 624 - 588$

$SST = 36$

Step 7: $SSC = \frac{(\sum X_1)^2}{c_1} + \frac{(\sum X_2)^2}{c_2} + \frac{(\sum X_3)^2}{c_3} + \frac{(\sum X_4)^2}{c_4} - CF$
 $= \frac{(21)^2}{3} + \frac{(15)^2}{3} + \frac{(24)^2}{3} + \frac{(24)^2}{3} - 588$

$SSC = 18$

Step 8 :
$$SSR = \frac{(\sum Y_1)^2}{r_1} + \frac{(\sum Y_2)^2}{r_2} + \frac{(\sum Y_3)^2}{r_3} - CF$$

$$= \frac{(24)^2}{4} + \frac{(28)^2}{4} + \frac{(32)^2}{4} - 588$$

$$SSR = 8$$

Step 9 :
$$SSE = SST - SSC - SSR$$

$$= 36 - 18 - 8$$

$$SSE = 10$$

Step 10 : Anova Table

Source of Variation	Sum of Squares	Degrees of freedom	Mean sum of Squares	Variance Ratio F_{cal}	Table Value F_{tab}
B/w columns	$C-1$ $= 4-1=3$	SSC $= 18$	$MSC = \frac{18}{3}$ $= 6$	$F_C = \frac{MSC}{MSE}$ $= \frac{6}{1.6}$ $= 3.75$	F_C tab $(3, 6)$ $= 4.76$
B/w Rows	$r-1$ $= 3-1=2$	SSR $= 8$	$MSR = \frac{8}{2}$ $= 4$	$F_R = \frac{MSR}{MSE}$ $= \frac{4}{1.6}$ $= 2.5$	F_R tab $(2, 6)$ $= 5.14$
B/w Errors	$(C-1)(r-1)$ $= 3 \times 2$ $= 6$	SSE $= 10$	$MSE = \frac{10}{6}$ $= 1.6$		

Step 11 : Conclusion

- (i) $F_C < F_{C tab}$, we accept Null Hypothesis H_0 .
There is no significant difference b/w yields and Varieties
- (ii) $F_R < F_{R tab}$, we accept Null Hypothesis H_0 .
There is no significant difference b/w yields and varieties.