

2) Three different machines are used for a production. On the basis of the outputs, set up one-way ANOVA table and test whether the machines are equally effective.

Outputs.

Machine I	Machine II	Machine III
10	9	20
15	7	16
11	5	10
10	6	14

Given that the value of F at 5% LOS for (2, 9) d.f is 4.26.

Solution: Step 1 Null Hypothesis

H_0 : There is no significant difference. The machines are equally effective.

Step 2: Alternative Hypothesis.

H_1 : There is significant difference.

Table-1

Machine 1		Machine 2		Machine 3	
X_1	X_1^2	X_2	X_2^2	X_3	X_3^2
10	100	9	81	20	400
15	225	7	49	16	256
11	121	5	25	10	100
20	400	6	36	14	196
$\sum X_1$	$\sum X_1^2$	$\sum X_2$	$\sum X_2^2$	$\sum X_3$	$\sum X_3^2$
56	846	27	191	60	952

Step 3: $N = \text{Total no. Samples} = 12$

$C = \text{Total no. of Machines} = 3.$

Step 4: $T = \sum X_1 + \sum X_2 + \sum X_3$
 $= 56 + 27 + 60 = 143$

$T = 143$

Step 5: $CF = \frac{T^2}{N} = \frac{143^2}{12} = 1704.08$
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Step 6: $SST = \sum X_1^2 + \sum X_2^2 + \sum X_3^2 - CF$
 $= 846 + 191 + 952 - 1704.08$
 $= 284.92$

$SST = 284.92$

Step 7: $SSC = \frac{(\sum X_1)^2}{n_1} + \frac{(\sum X_2)^2}{n_2} + \frac{(\sum X_3)^2}{n_3} - CF$
 $= \frac{56^2}{4} + \frac{27^2}{4} + \frac{60^2}{4} - 1704.08$
 $= 784 + 182.25 + 900 - 1704.08$
 $= 162.17.$

$SSC = 162.17$

Step 8: $MSC = \frac{SSC}{C-1} = \frac{162.17}{3-1} = \frac{162.17}{2} = 81.085$

$MSC = 81.085$

Step 9: $SSE = SST - SSC = 284.92 - 162.17$

$SSE = 122.75$

Step 10: $MSE = \frac{SSE}{N-C} = \frac{122.75}{12-3} = \frac{122.75}{9}$

$MSE = 13.63$

Step 11: ANOVA Table.

Source of Variation	Dof	Sum of Squares	Mean Sum of Squares	Variance Ratio F_{cal}	Table Value F_{tab}
B/w Columns	$C-1$ $= 2$	SSC $= 162.17$	MSC $= 81.085$	F_{cal} $= \frac{MSC}{MSE}$ $= \frac{81.085}{13.63}$ $= 5.95$	F_{tab} $= 4.26$ (given)
B/w Errors	$N-C$ $= 9$	SSE $= 122.75$	MSE $= 13.63$		

Step 12: Conclusion.

$F_{cal} > F_{tab}$ at $(2, 9)$ d.f at 5% LoS
is $F_{tab} = 4.26$.

\therefore We reject the null hypothesis H_0 .

i.e., the three machines are not equally effective.