



## DEPARTMENT OF MATHEMATICS

### UNIT - II DESIGN OF EXPERIMENTS

2) The following table shows the lives in hours of four brands of electric lamps.

A : 1610 1610 1650 1680 1700 1720 1800

B : 1580 1640 1640 1700 1750

C : 1460 1550 1600 1620 1640 1660 1740 1820

D : 1510 1520 1530 1570 1600 1680

perform an analysis of variance and test the homogeneity of the means lives of the 4 brands of lamps. Given:  $X_{ij} - 1640$   $A_j$  (min, max)

$x_1$	$x_2$	$x_3$	$x_4$	total	$x_1^2$	$x_2^2$	$x_3^2$	$x_4^2$
-3	-6	-18	-13	-40	9	36	324	169
-3	0	-9	-12	-24	9	0	81	144
1	0	-4	-11	-14	1	0	16	121
4	6	-2	-7	1	16	36	4	49
6	11	0	-4	13	36	121	0	16
8	-	2	4	14	64	-	4	16
16	-	10	-	26	256	-	100	-
-	-	18	-	18	-	-	324	-
<u>29</u>	<u>11</u>	<u>-3</u>	<u>-43</u>	<u>-6</u>	<u>391</u>	<u>193</u>	<u>853</u>	<u>575</u>
$\Sigma n_1$	$\Sigma n_2$	$\Sigma n_3$	$\Sigma n_4$		$\Sigma n_1^2$	$\Sigma n_2^2$	$\Sigma n_3^2$	$\Sigma n_4^2$

Step 1: Formulating  $H_0$  and  $H_1$

$H_0$ : There is no significance difference between the 4 brands of electric bulbs.

$H_1$ : There is significance difference between the 4 brands of electric bulbs.



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Step 2: To find  $T$  &  $N$

$$T = \sum n_1 + \sum n_2 + \sum n_3 + \sum n_4$$

$$= 29 + 11 - 3 - 43 = -6$$

$$N = n_1 + n_2 + n_3 + n_4$$

$$= 7 + 5 + 8 + 6 = 26$$

Step 3: Correction Factor.

$$C.F. = \frac{T^2}{N} = \frac{-6^2}{26} = 1.3846$$

Step 4:  $TSS = \sum n_1^2 + \sum n_2^2 + \sum n_3^2 + \sum n_4^2 - C.F.$

$$= 391 + 193 + 853 + 515 - 13846$$

$$= 1950.61$$

Step 5:  $SSC = \frac{(\sum n_1)^2}{n_1} + \frac{(\sum n_2)^2}{n_2} + \frac{(\sum n_3)^2}{n_3} + \frac{(\sum n_4)^2}{n_4} - C.F.$

$$= \frac{29^2}{7} + \frac{11^2}{5} + \frac{-3^2}{8} + \frac{-43^2}{6} - 13846$$

$$= 120.14 + 24.2 + 1.125 + 308.16 - 13846$$

$$= 452.2404$$

Step 6:  $SSE = TSS - SSC$

$$= 1950.61 - 452.2404$$

$$= 1498.375$$

Step 7: Anova table :



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Source of Variations	Sum of Squares	Degree of freedom	Mean Squares	F-Ratio
Between Samples (C)	SSC 202.165 452.2404	C-1 : 4-1 : 3	MSC 452.2404 202.165 3 : 150.7468	$F = \frac{150.7468}{68.10} = 2.2136$
Within Samples (E)	SSE 1498.375	N-C : 26-4 : 22	MSE 1498.375 22 : 68.10	$F_{\alpha}(3, 22) = 3.05$

Step 8: Conclusion:

$$2.2136$$

$$F = 2.2136 < 3.05 = F_{\alpha}, H_0 \text{ is accepted.}$$

(i) There is no significance difference between the 4 brands of electric bulbs.