Semester: 4 Subject: Statistics for AIDS Academic Year: 2023-2024

ONE-WAY ANOVA:-

To assess the significance of possible variation in performance in a certain test between the convent schools of a city, a common test was given to a number of students taken at random from the fifth class of the 3 schools concerned the results given below.

A	B	C
9	13	14
11	12	13
13	10	17
9	15	7
8	5	9

Solution:

H_0: There is no difference $\mu_A = \mu_B = \mu_C$.

H_1: There is difference.

A	B	C
9	13	14
11	12	13
13	10	17
9	15	7
8	5	9
50	55	60

Source of Variance	Sum of Squares	DOF	Mean Square	F
Between the sample	SSC = 10	$\nu_1 = c-1 = 3-1 = 2$	MSC = SSC/ν_1 = 10/2 = 5	MSC/MSE
Within the sample	SSE = 138	$\nu_2 = n-c = (3\times5)-3 = 12$ columns	MSE = SSE/ν_2 = 138/12 = 11.5	5/11.5 = 0.435

$\bar{X}_A = \frac{50}{5} = 10$, $\bar{X}_B = \frac{55}{5} = 11$

$\bar{X}_C = \frac{60}{5} = 12$ $\quad \bar{\bar{X}} = \frac{\bar{X}_A + \bar{X}_B + \bar{X}_C}{3} = \frac{10+11+12}{3} = \frac{33}{3} = 11 = \bar{\bar{X}}$

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Calculation of SSC:-

$(\bar{X}_A - \bar{\bar{X}})$	$(\bar{X}_A - \bar{\bar{X}})^2$	$(\bar{X}_B - \bar{\bar{X}})$	$(\bar{X}_B - \bar{\bar{X}})^2$	$(\bar{X}_C - \bar{\bar{X}})$	$(\bar{X}_C - \bar{\bar{X}})^2$
(10-11) = -1	1	(11-11) = 0	0	(12-11) = 1	1
(10-11) = -1	1	(11-11) = 0	0	(12-11) = 1	1
(10-11) = -1	1	(11-11) = 0	0	(12-11) = 1	1
(10-11) = -1	1	(11-11) = 0	0	(12-11) = 1	1
(10-11) = -1	1	(11-11) = 0	0	(12-11) = 1	1
$\Sigma(\bar{X}_A - \bar{\bar{X}})$ =	5		0		5.

$SSC = \Sigma(\bar{X}_A - \bar{\bar{X}})^2 + \Sigma(\bar{X}_B - \bar{\bar{X}})^2 + \Sigma(\bar{X}_C - \bar{\bar{X}})^2$.

$= 5 + 0 + 5 = \boxed{10}$.

Calculation of SSE

$(A - \bar{X}_A)$	$(A - \bar{X}_A)^2$	$(B - \bar{X}_B)$	$(B - \bar{X}_B)^2$	$(C - \bar{X}_C)$	$(C - \bar{X}_C)^2$
9-10 = -1	1	13-11 = 2	4	14-12 = 2	4
11-10 = 1	1	12-11 = 1	1	13-12 = +1	1
13-10 = 3	9	10-11 = -1	1	17-12 = 5	25
9-10 = -1	1	15-11 = 4	16	7-12 = -5	25
8-10 = -2	4	5-11 = 6	36	9-12 = -3	9
$\Sigma(X - \bar{X})^2$	16.	~~SSB~~	58		64

$SSE = \Sigma(A - \bar{X}_A)^2 + \Sigma(B - \bar{X}_B)^2 + \Sigma(C - \bar{X}_C)^2$

$= 16 + 58 + 64 = 138$.

Calculated F value = 0.435

Tabulated value F = 3.89.

$0.435 < 3.89$.

The Null hypothesis is accepted.

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Example 2: One Way ANOVA:
The three samples below have been obtained from normal populations with equal variances. Test the hypothesis that the sample means are equal.

A	B	C
8	8	17
10	6	10
7	11	12
14	8	12
11	8	15
16	13	12

Solution:

A	B	C
8	8	17
10	6	10
7	11	12
14	8	12
11	8	15
16	13	12
66	54	78

$\overline{X_A} = \frac{66}{6} = 11$, $\overline{X_B} = \frac{54}{6} = 9$, $\overline{X_C} = \frac{78}{6} = 13$,

$\overline{\overline{X}} = \frac{\overline{X_A} + \overline{X_B} + \overline{X_C}}{3} = \frac{11+9+13}{3} = \frac{33}{3} = 11$.

$\boxed{\overline{\overline{X}} = 11}$

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Source of Variation	Sum of Squares	Degree of Freedom	Mean Square	F
Between the sample	SSC = 48	$\nu_1 = C-1 = 3-1 = 2$	MSC = SSC/ν_1, = 48/2 = 24	MSC / MSE = 24/8.27
Within the sample	SSE = 124	$\nu_2 = n-C = 18-3 = 15$	MSE = SSE/ν_2 = 124/15 = 8.27	= 2.90

(1) Calculation of SSC.

$(\bar{X}_A - \bar{\bar{X}})$	$(X_A - \bar{\bar{X}})^2$	$(\bar{X}_B - \bar{\bar{X}})$	$(\bar{X}_B - \bar{\bar{X}})^2$	$(\bar{X}_C - \bar{\bar{X}})$	$(\bar{X}_C - \bar{\bar{X}})^2$
11-11=0	0	9-11=-2	4	13-11=2	4
11-11=0	0	9-11=-2	4	13-11=2	4
11-11=0	0	9-11=-2	4	13-11=2	4
11-11=0	0	9-11=-2	4	13-11=2	4
11-11=0	0	9-11=-2	4	13-11=2	4
11-11=0	0	9-11=-2	4	13-11=2	4
	0		24		24

$$\leq (\bar{X} - \bar{\bar{X}}) = \leq (\bar{X}_A - \bar{\bar{X}})^2 + \leq (\bar{X}_B - \bar{\bar{X}})^2 + \leq (\bar{X}_C - \bar{\bar{X}})^2$$

$$= 0 + 24 + 24$$

$$\boxed{\leq \bar{X} - \bar{\bar{X}} = 48}$$

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Calculation of SSE:

$(A-\bar{X}_A)$	$(A-\bar{X}_A)^2$	$(B-\bar{X}_B)$	$(B-\bar{X}_B)^2$	$(C-\bar{X}_C)$	$(C-\bar{X}_C)^2$
8-11=-3	9	8-9=-1	1	17-13=4	16
10-11=-1	1	6-9=-3	9	10-13=-3	9
7-11=-4	16	11-9=2	4	12-13=-1	1
14-11=3	9	8-9=-1	1	12-13=-1	1
11-11=0	0	8-9=-1	1	15-13=2	4
16-11=5	25	13-9=4	16	12-13=-1	1
	60		32		32

$$\Sigma(X-\bar{X})^2 = \Sigma(A-\bar{X}_A)^2 + \Sigma(B-\bar{X}_B)^2 + \Sigma(C-\bar{X}_C)^2$$

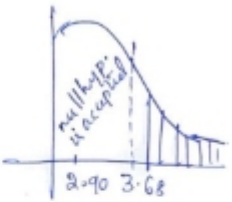
$$= 60 + 32 + 32$$

$$\boxed{\Sigma(X-\bar{X})^2 = 124}$$

Calculated F value = 2.90

Tabulated F value, $F_{0.05} = 3.68$

$2.90 < F_{0.05} = 3.68$



The null hypothesis is accepted.

Hence there is no significance difference between the means. The means are equal.