

Assignment 19.2

Problem:

Using the following data, perform a one-way analysis of variance using $\alpha = 0.05$. Write up the results in APA format.

[Group 1: 51, 45, 33, 45, 67]

[Group 2: 23, 43, 23, 43, 45]

[Group 3: 56, 76, 74, 87, 56]

Solution: Let μ_1, μ_2, μ_3 be the mean for Group 1, Group 2, Group 3 respectively

Null Hypothesis $H_0: \mu_1 = \mu_2 = \mu_3$

Alternate Hypothesis $H_A: \mu_l \neq \mu_m$

where $l \neq m$ and l, m can be 1, 2, 3

Let us calculate mean

x_1 Group 1	x_2 Group 2	x_3 Group 3	$x_1 - \bar{x}_1$	$(x_1 - \bar{x}_1)^2$	$x_2 - \bar{x}_2$	$(x_2 - \bar{x}_2)^2$	$x_3 - \bar{x}_3$	$(x_3 - \bar{x}_3)^2$
51	23	56	2.8	7.84	-12.4	153.76	-13.8	190.44
45	43	76	-3.2	10.24	7.6	57.76	6.2	38.44
33	23	74	-15.2	231.04	-12.4	153.76	4.2	17.64
45	43	87	-3.2	10.24	7.6	57.76	17.2	295.84
67	45	56	18.8	353.44	9.6	92.16	-13.8	190.44
Σx_1 = 241	Σx_2 = 177	Σx_3 = 349		$\Sigma (x_1 - \bar{x}_1)^2$ = 612.8		$\Sigma (x_2 - \bar{x}_2)^2$ = 515.2		$\Sigma (x_3 - \bar{x}_3)^2$ = 732.8
$\bar{x}_1 = \frac{241}{5}$ = 48.2	$\bar{x}_2 = \frac{177}{5}$ = 35.4	$\bar{x}_3 = \frac{349}{5}$ = 69.8						

All the groups combined mean $= \bar{X} = \frac{x_1 + x_2 + x_3}{3} = \frac{48.2 + 35.4 + 69.8}{3} = 51.13$

using the formula used for ANOVA calculation as per
<https://www.analyticsvidhya.com/blog/2018/01/one-way-anova-analysis-of-variance/>

$$SS_{within} = \sum (x_1 - \bar{x}_1)^2 + \sum (x_2 - \bar{x}_2)^2 + \sum (x_3 - \bar{x}_3)^2$$

$$= 612.8 + 515.2 + 732.8$$

$$= 1860.8$$

$$SS_{between} = n_1 (\bar{x}_1 - \bar{x})^2 + n_2 (\bar{x}_2 - \bar{x})^2 + n_3 (\bar{x}_3 - \bar{x})^2$$

$$= 5 (48.2 - 51.13)^2 + 5 (35.4 - 51.13)^2 + 5 (69.8 - 51.13)^2$$

$$= 5 (-2.93)^2 + 5 (-15.73)^2 + 5 (18.67)^2$$

$$= 5 \times 8.58 + 5 \times 247.43 + 5 \times 348.57$$

$$= 42.90 + 1237.15 + 1742.85$$

$$= 3022.9$$

$$df_{within} = N - K = 15 - 3 = 12$$

$$df_{between} = K - 1 = 3 - 1 = 2$$

$$\begin{aligned} N &= \text{Total number of samples} \\ K &= \text{Number of groups} \end{aligned}$$

$$F = \frac{SS_{between} / df_{between}}{SS_{within} / df_{within}}$$

$$= \frac{3022.9 / 2}{1860.8 / 12}$$

$$= \frac{1511.45}{155.067} = 9.747$$

$$= \frac{3022.9 / 2}{1860.8 / 12} = \frac{1511.45}{155.067} = 9.747$$

Do
From DF, F-table, we get ~~F critical value = 3.89 with (2,~~
with (2, 12) degrees of freedom and $\alpha = 0.05$

$$F_{\text{critical}} = 3.89$$

An F value ^{9.79} ~~9.85~~ $> F_{\text{critical}}$ value

We reject the Null hypothesis

Hence mean of at least one group is not equal
to other two groups

In APA notation, we can say:-

A one way ANOVA was conducted to compare three
groups of results group 1, group 2, group 3.

An analysis of variance showed that three groups of
~~resu~~ ~~exp~~ results of mean were significantly
different for at least two group of results

$$F(2, 12) = 3.89, p = 0.05$$

ANOVA					
	Sum of squares	df	Mean Square	F	Significance
Between groups	3053.10	2	1526.85	9.85	0.05
Within group	1860.8	12	155.067		
Total	4914.5	14			

ANOVA					
	Sum of squares	df	Mean Square	F	Significance
BETWEEN GROUP → Between groups	3022.9	2	1511.45	9.797	0.05
WITHIN GROUP → Within group	1860.8	12	155.067		
Total	4883.7	14			