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Oneway ANOVA Example: Dr. Leitzel

Following are the computational formulas for the Oneway ANOVA. These formulas are a little easier to work with than the standard definitional formulas when doing hand calculations. This formula works for the equal n/group case.

Condition	Satisfaction	days	days	nights	nights	saturday	saturday
		X	X ²	X	X ²	X	X ²
Days	5	5	25	5	25	5	25
Days	5	5	25	4	16	5	25
Days	5	5	25	4	16	5	25
Days	4	5	25	3	9	4	16
Days	4	4	16	3	9	4	16
Days	4	4	16	2	4	4	16
Days	4	4	16	2	4	3	9
Days	3	4	16	2	4	3	9
Days	2	3	9	1	1	3	9
nights	5	2	4	0	0	2	4
nights	4	4	16	0	0	2	4
nights	4	4	16	0	0	2	4
nights	3	3	9	0	0	2	4
nights	3	3	9	0	0	2	4
nights	2	2	4	0	0	2	4
nights	2	2	4	0	0	2	4
nights	2	2	4	0	0	2	4
nights	1	1	1	0	0	2	4
nights	0	0	0	0	0	2	4
Saturday	5	5	25	5	25	5	25
Saturday	5	5	25	5	25	5	25
Saturday	5	5	25	5	25	5	25
saturday	4	4	16	4	16	4	16
saturday	4	4	16	4	16	4	16
saturday	4	4	16	4	16	4	16
saturday	3	3	9	3	9	3	9
saturday	3	3	9	3	9	3	9
saturday	3	3	9	3	9	3	9
saturday	2	2	4	2	4	2	4
saturday	2	2	4	2	4	2	4

sums T_j = 41 177 26 88 38 154
squared T_j² = 1681 676
n = 10
N = 30

$$SS_{treat} = \frac{\sum T_j^2}{n} - \frac{(\sum X)^2}{N} \quad SS_{total} = \sum X^2 - \frac{(\sum X)^2}{N}$$

Where T_j=Sum of scores within a single condition
n=# cases in a group
N=total # cases

SS_{error}=SS_{total}-SS_{treat} so once we find treatment and total sums of squares, we can obtain error SS by subtraction

$$SS_{treat} = \frac{1681 + 676 + 1444}{10} - \frac{(41 + 26 + 38)^2}{30} \quad SS_{total} = 177 + 88 + 154 - \frac{(41 + 26 + 38)^2}{30}$$

doing the math above gives us SS_{treat}=12.6 and SS_{total}=51.5, so SS_{error}=51.5-12.6=38.9

$F = \frac{MS_{treat}}{MS_{error}}$ to obtain MS, we simply divide the appropriate SS by the associated df.

For MS_{treat} , $df = \# \text{ of groups} - 1$ and for MS_{error} , $df = N - \# \text{ of groups}$, so in this example, df are 2 and 27, respectively.

$$MS_{treat} = \frac{12.6}{2} = 6.3 \text{ and } MS_{error} = \frac{38.9}{27} = 1.44 \text{ so finally our } F = 6.3 / 1.44 = 4.373$$

So stated in "text format" this result would be $F(2,27)=4.37, p<.05$ since our observed F is larger than the critical value for alpha of .05 but not larger than the critical value for alpha =.01.

The ANOVA summary table would be as follows:

Source	SS	df	MS	F	p
Condition	12.6	2	6.3	4.373	<.05
Error	38.9	27	1.44		
Total	51.5	29			

I have not included means and standard deviations for the three groups in this example as I am focusing exclusively on calculating the F statistic but you would want to be sure that you calculated and included those values as well.

For an ANOVA with unequal n/group, the computational formula for SS_{treat} changes slightly

to: $SS_{treat} = \sum \left(\frac{T_j^2}{n_j} \right) - \frac{(\sum X)^2}{N}$, where

T_j^2 =sum of scores in the jth treatment

n_j =# of subjects in the jth treatment