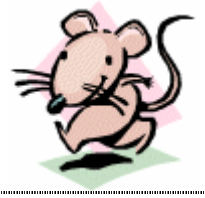
SPSS Guide: 1-Way ANOVA



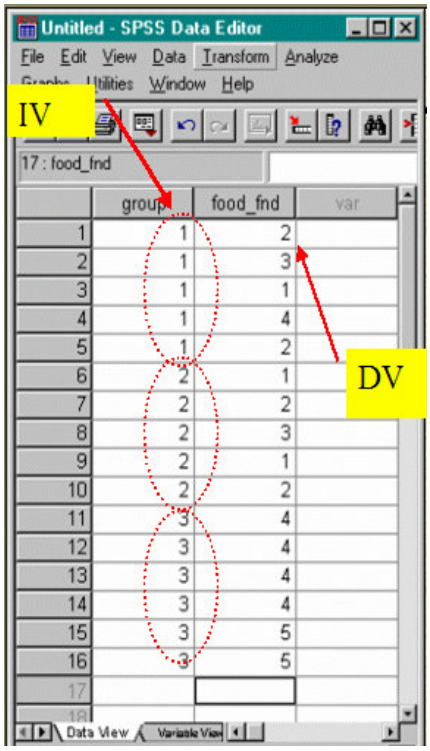
PROBLEM: Does caffeine help or hinder performance? A researcher administers varying levels of caffeine (0, 10, or 20 mg) to lab rats and then measures number of food pellets found. Is there a significant difference in food found?

Why a 1-way ANOVA? We have 3+ levels of an independent variable and only one independent variable.

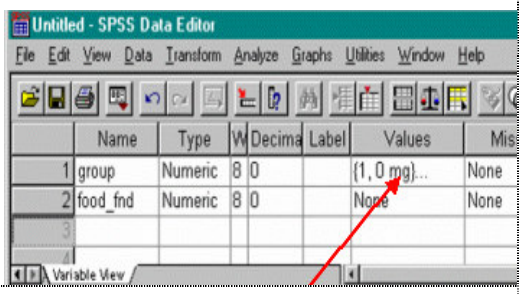
Caffeine Level (IV)

	0 mg	10 mg	20 mg
Food Found (DV)	2	1	4
	3	2	4
	1	3	4
	4	1	4
	2	2	5
			5

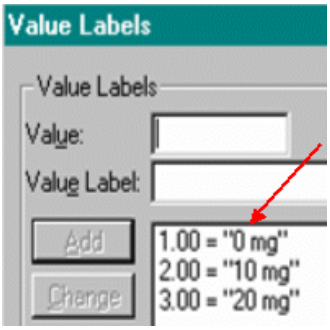
DATA ENTRY: ***#1:*** Indicate the group in the first column (1, 2, or 3) and then the number of food pellets found by each rat in the second column.



#2: Switch to ***variable view*** mode (bottom of screen), and then click on the ***values*** column.

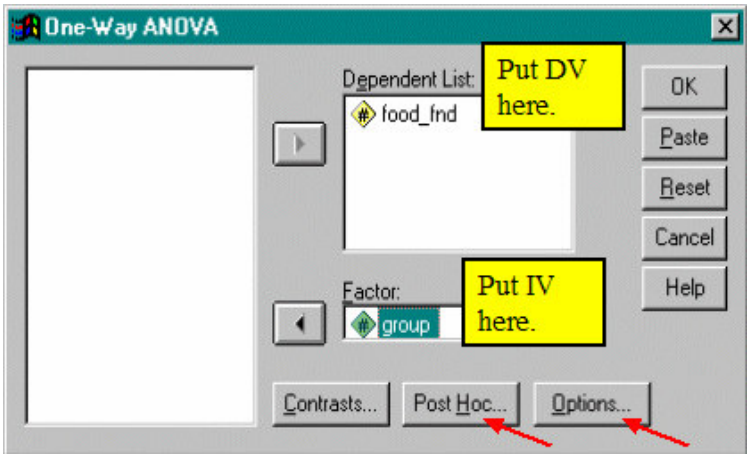


#3: Now label the group ***values***. [Type "1" TAB, "0mg", then click ADD.] Label each value of the variable (in this case 1, 2, and 3).



DATA ANALYSIS:

#1: Go to ***analyze***, ***compare means***, ***one-way ANOVA***

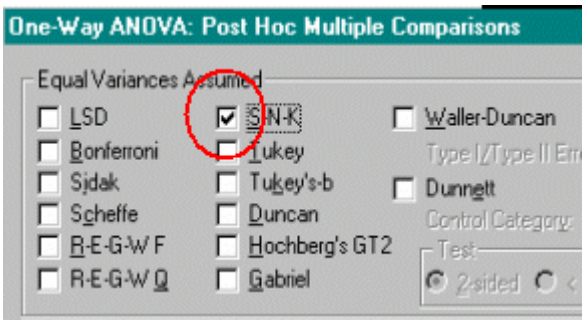


HYPOTHESES:

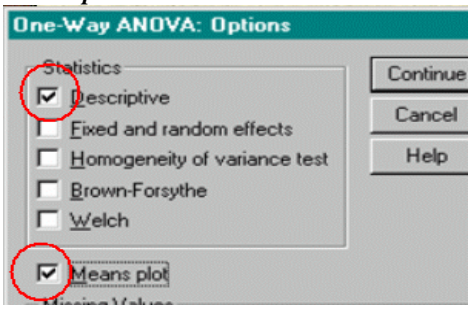
Ho: $\mu_1 = \mu_2 = \mu_3$ [Caffeine (the IV) has no effect.]

Ha: Not all μ's equal [Caffeine caused some difference.]

#2: Click on ***Post-Hoc***, then check ***S-N-K.***



#3: Click on ***Options***, then check ***Descriptives*** and ***Means plot***.



SPSS OUTPUT

Descriptive Statistics

FOOD_FND

	N	Mean	Std. Deviation	Std. Error
0 mg	5	2.40	1.140	.510
10 mg	5	1.80	.837	.374
20 mg	6	4.33	.516	.211
Total	16	2.94	1.389	.347

The first table shows **descriptive** statistics. For example, it shows that rats on 10mg of caffeine found only 1.8 food pellets on average whereas rats on 20mg found 4.33 – more than twice as many. So is this a significant difference? One we can trust? *Conduct the F-test to find out.*

Source of Variation Table – shows the F-Test

FOOD_FND

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19.604	2	9.802	13.65	.001
Within Groups	9.333	13	.718		
Total	28.937	15			

Yes! Because the p-value ("Sig") is below .05, we reject the Ho and conclude that there is a significant difference between the groups (i.e., caffeine causes rats to find more food). *Note: Mean Square is just another name for variance. An ANOVA partitions (divides up) variance into between group (BG) and within group (WG).*

The underlying Formula:

$$F = \frac{MS_{BG}}{MS_{WG}} = \frac{9.802}{.718} = 13.65$$

The larger this gets, the greater the chance for a significant difference.

If conducting an F-test by hand:

df_{BG}: K-1 = 3 –1 = 2

df_{WG}: $N_T - K = 16 - 3 = 13$

df_{TOTAL}: $N_T - 1 = 16 - 1 = 15$

N_T = Total number of subjects
K = Number of groups

MS = SS/df

The Post-Hoc Test

Student-Newman-Keuls [a,b]

GROUP	N	Subset for alpha = .05	
		1	2
10 mg	5	1.80	
0 mg	5	2.40	
20 mg	6		4.33
Sig.		.270	1.0

The F-test tells us at least one pair of means differs significantly – the Post Hoc tells us *which* ones. Means differ if they occupy separate columns. Here the 4.33 differs from both the 1.8 and the 2.4.

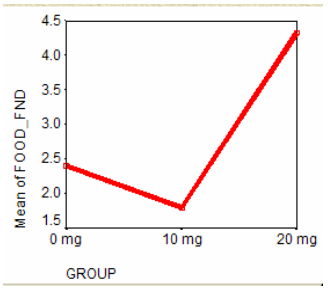
Practical Significance: The η^2 test

If the F-test is significant (i.e., indicates a reliable difference caused by the independent variable), then we want to determine the strength of the effect. So here we determine how strongly caffeine affects food found. Calculating η^2 tells how much variance in food finding (the DV) caffeine (the IV) can explain.

$$\eta^2 = \frac{SS_{BG}}{SS_{Total}} = \frac{19.604}{28.937} = .6775$$

Looking at the source of variation table, we use numbers from the Sum of Squares (SS) column. The value obtained shows caffeine accounts for about 68% of the variance in food finding – that's a lot! We call this type of statistic a calculation of **effect size.**

Means Plot



The *Means Plot* helps visualize the relation among the means. Compare this to the information shown in the post-hoc test.

Summary of the Statistic

F (2, 13) = 13.65, p ≤ .05

The degrees of freedom represent df between groups (2) and df within groups (13).

Explanation of Study Outcome

The hypothesis was largely supported. Rats found significantly more food on 20mg of caffeine (M = 4.33) than on 0mg (M=2.40) or 10mg (M=1.80), F(2,13) = 13.65, p ≤. .05. Caffeine has a large effect on food finding behavior, accounting for about 68% of the variance, $\eta^2 = .6776$.

Guide to Write-ups (standard format)

1. State whether research hypothesis was supported.
2. Summarize the stat. test.
3. Summarize the practical significance (if appropriate).