Chapter 912

Standard Deviation of Means Calculator

Introduction

An important task in finding the power or sample size in an ANOVA-type design is specifying the effect size, which, in this case, is the standard deviation of the means. We often denote this value as *Sm* or σ_m. Since the standard deviation does not have an obvious, physical interpretation, **PASS** provides this tool to aid in determining an appropriate set of *Sm* values.

Note that this tool is only useful for computing *Sm* for individual factors and their two-way interactions. It does not help with higher order interactions.

Technical Details

We begin with an example. Consider a study of two groups of subjects. Each subject was tested, then treated, then tested again at the ten minutes, and then tested a third time after sixty minutes. The researchers want a sample size large enough to detect the following pattern among the means.

Table of Hypothesized Means				
	Factor B			
Factor A	B1	B2	B3	Average
A1	100	130	100	110
A2	120	180	120	140
Average	110	155	110	125

Our task is to convert this table of means into the three *Sm* values need for sample size computations. This is done as follows.

Step 1 – Remove the Overall Mean

Subtract 125, the overall mean, from each of the individual means.

Adjust for Overall Mean				
	Factor B			
Factor A	B1	B2	B3	Average
A1	-25	5	-25	-15
A2	-5	55	-5	15
Average	-15	30	-15	125

Step 2 – Remove the Factor A (group) Effect

Subtract -15 from all entries in the first row and 15 from those in the second row.

Adjust for Factor A				
	Factor B			
Factor A	**B1**	**B2**	**B3**	**Total**
A1	-10	20	-10	-15
A2	-20	40	-20	15
Total	-15	30	-15	125

Step 3 – Remove the Factor B (Time) Effect

Subtract -15 from each entry in the first column, 30 from each entry in the second column, and -15 from each entry in the third column. This leaves the following table of effects.

Table of Effects					
	Factor B				
Factor A	**B1**	**B2**	**B3**	**Effect**	**Average**
A1	5	-10	5	-15	110
A2	-5	10	-5	15	140
Effect	-15	30	-15		
Average	110	155	110		125

This table, called an effects table, reports the individual effect of each component of the ANOVA model. For example, the hypothesized pattern across time is that T10 is 45 units higher than either endpoint. Similarly, we note that the hypothesized pattern for the two groups is that the mean of A1 is 30 units larger than that of A2.

A way to understand the interaction effects is to look at their role in the ANOVA model. The effects are additive components. Thus, the first mean has been partitioned into four components as follows:

$$100 = 125 + (-15) + (-15) + 5$$

Likewise, the mean of the second row is

$$120 = 125 + (-15) + 15 + (-5)$$

Finally, the *Sm* values are computed by summing the squared values of each set of effects and taking the square root. Note that the means do not need to be subtracted because they are always, by definition, zero.

Hence, the three *Sm* values are

$$Sm(A) = \sqrt{\frac{(-15)^2 + (15)^2}{2}} = 15.000000$$

$$Sm(B) = \sqrt{\frac{(-15)^2 + (30)^2 + (-15)^2}{2}} = 21.213203$$

$$Sm(AB) = \sqrt{\frac{(5)^2 + (-10)^2 + (5)^2 + (-5)^2 + (10)^2 + (-5)^2}{2}} = 7.071068$$

Once acceptable *Sm* values have been found, you can copy them one at a time to the clipboard and paste them as needed.