Calculating Power and Determining a Required Sample Size

I. t - tests and Power

Step 1 (Regardless of the type of t-test) find t, *df* , mean difference (X_1-X_2).

Step 2 Find d : $d = \left[\frac{X_1 - X_2}{S} \right]$

Single Sample or Matched Sample *t*: $d = \frac{t}{\sqrt{df}}$

Independent Sample *t*: $d = \frac{2t}{\sqrt{df}}$ Or $d = \frac{t(n_1 + n_2)}{\sqrt{df}\sqrt{n_1 n_2}}$

Step 3 Find the Noncentrality Parameter (Delta): $\delta = d\sqrt{n}$ (for single sample and repeated measures t)

For Independent Sample t (with equal sample sizes) $\delta = d\sqrt{\frac{n}{4}}$ Where $n = n_1 + n_2$

For unequal sample sizes: $\delta = d\sqrt{\frac{n_h}{2}} = where = n_h = \frac{2n_1 n_2}{n_1 + n_2}$

n_h = the harmonic mean

Step 4 Find the Power estimate (1- Beta) on the appropriate chart. (Rows = Delta, Columns = Alpha)

II. N desired - for t and r

Step 1 Determine the Power desired (e.g. between .80 and .90) and the alpha desired (typically .05)

Step 2 Find the Delta with respect to the desired power at a given alpha level.

Step 3 Find d, either based on previous studies or your pilot data.

Step 4 Calculate N desired : $N_{desired} = \left(\frac{\delta}{d} \right)^2$ (For Single Sample and Repeated Measures t)

: $N_{desired} = 4\left(\frac{\delta}{d} \right)^2$ (For Independent Sample t and r)

III. Correlations and Power

Step 1 Find r and square it (r^2) = represents the % variance in DV attributable to the IV

Step 2 Convert r^2 to d : $d = \frac{2r}{\sqrt{1 - r^2}}$

Step 3 Calculate Delta (noncentrality parameter). : $\delta = \left(\frac{2r}{\sqrt{1 - r^2}} \right)\sqrt{\frac{N}{4}}$

Step 4 Find the Power estimate (1- Beta) on the appropriate chart. (Rows = Delta, Columns = Alpha)

IV. Chi Square and Power

Step 1 Find X^2 and *n*

Step 2 Compute the appropriate Phi Square Coefficient : If 2x2 matrix : $\phi^2 = \frac{X^2}{N}$

If 2x3 or larger: $\phi^2 = \frac{X^2}{N(K - 1)}$

Step 3 Compute the noncentrality parameter : $\delta = \left(\frac{2\phi}{\sqrt{1 - \phi^2}} \right)\sqrt{\frac{N}{4}}$ (this only works for 2x2 matrix)

Step 4 Find the Power estimate (1- Beta) on the appropriate chart. (Rows = Delta, Columns = Alpha)

V. Anova and Power

Step 1 Find F and n and $df_{between}$ and df_{within}

Where: $df_{between}$ = (# of groups) - 1

df_{within} = n - (# of groups) - 1

Step 2 Convert to d: $d = \frac{2\sqrt{F}}{\sqrt{df_{within}}}$ because $F = t^2$ (for two groups only, equal group sizes assumed)

For two groups with unequal group sizes $d = \frac{\sqrt{F}(n_1 + n_2)}{\sqrt{df_{within}}\sqrt{n_1 n_2}}$

Step 3 Convert d' to R^2 (eta squared) : $R^2 = \frac{d^2}{d^2 + 4}$ (Represents the % variance accounted for)

If more than 2 group $R^2 = \frac{F(df_{between})}{(F(df_{between})) + (df_{within})}$

Where: $df_{between}$ = (# of groups) - 1

df_{within} = n - (# of groups) - 1

Step 4 Compute the noncentrality parameter: $\delta = \left(\frac{2R}{\sqrt{1 - R^2}}\right)\sqrt{\frac{N}{4}} = d\sqrt{\frac{N}{4}}$ This only works for ANOVA with 2 equal size groups

Step 5 Find the Power estimate (1- Beta) on the appropriate chart. (Rows = Delta, Columns = Alpha)

Desired Sample Size for ANOVA with two groups (If more than 2 groups see Cohen 1992)

$N_{desired} = k2\left(\frac{\delta}{d}\right)^2$ Where k is the number of groups.

n_i = sample size for each group = $N_{desired}$ / k