PSY 308B – ANOVA Midterm Formulas

t tests

Independent samples *t* test

- $t = \frac{(Observed - Expected)}{SE}$

  Observed = difference between two samples means
  Expected = difference between two population means (always defaults to 0)
  SE = standard error of the difference

So…

- $t = \frac{(\overline{x_1} - \overline{x_2})}{SE}$

  Where $SE = \sqrt{\frac{s^2_{pooled}}{N_1} + \frac{s^2_{pooled}}{N_2}}$
  And $s^2_{pooled} = [\ (N_1 - 1) * s^2_1 + (N_2 - 1) * s^2_2\ ]\ /\ [\ (N_1 - 1) + (N_2 - 1)\ ]$

- $df = (N_1 - 1) + (N_2 - 1)$

- Cohen's $d = \frac{(M_1 - M_2)}{SD_{pooled}}$

  Where $SD_{pooled} = \sqrt{s^2_{pooled}}$.

Paired (dependent) samples *t* test

- $t = \frac{(Observed - Expected)}{SE}$

  Observed = sample mean of difference scores
  Expected = population mean of difference scores (always defaults to 0)
  SE = standard error of the difference scores

  Where SE = $\frac{s_d}{\sqrt{n}} = \frac{\sqrt{\frac{\sum(d - \overline{d})^2}{n-1}}}{\sqrt{n}}$ and $\overline{d} = \frac{\sum d}{n}$

- $df = (N - 1)$

- Cohen's $d = \frac{\overline{d}}{s_d}$

One-way ANOVA

- $F = \frac{between\text{-}groups\ variance}{within\text{-}groups\ variance}$
- In other words… $F = \frac{MS_{between}}{MS_{within}}$ or $F = \frac{MS_{treat}}{MS_{error}}$

Source	SS	df	MS	F
treat	$n\sum(x_j - x_T)^2$	k – 1	$\frac{SS_{treat}}{df_{treat}}$	$\frac{MS_{treat}}{MS_{error}}$
error	$\sum(x_{ij} - x_j)^2$	k (n – 1)	$\frac{SS_{error}}{df_{error}}$	
Total	$\sum(x_{ij} - x_T)^2$	N – 1		

- Eta-squared = $\eta^2 = \frac{SS_{treat}}{SS_{total}}$

Factorial ANOVA

- In a factorial ANOVA, you get *F* ratios for main effects of each of your independent variables (F_A and F_B) and for your interaction (F_{AxB})
- $F_A = \frac{MS_A}{MS_{error}}$ $F_B = \frac{MS_B}{MS_{error}}$ $F_{AxB} = \frac{MS_{AxB}}{MS_{error}}$

Source	SS	df	MS	F
Factor A	$bn\sum(x_{A_j} - x_T)^2$	a – 1	$\frac{SS_A}{df_A}$	$\frac{MS_A}{MS_{error}}$
Factor B	$an\sum(x_{B_k} - x_T)^2$	b – 1	$\frac{SS_B}{df_B}$	$\frac{MS_B}{MS_{error}}$
Interaction	$SS_{total} - SS_{error} - SS_A - SS_B$	(a – 1)(b – 1)	$\frac{SS_{AxB}}{df_{AxB}}$	$\frac{MS_{AxB}}{MS_{error}}$
Error (S/AB)	$\sum(x_{ijk} - x_{AB_{jk}})^2$	ab(n – 1)	$\frac{SS_{error}}{df_{error}}$	
Total	$\sum(x_{ijk} - x_T)^2$	N – 1		

- Complete eta-squared = $\eta^2 = \frac{SS_{effect}}{SS_{total}}$
- Partial eta-squared = partial $\eta^2 = \frac{SS_{effect}}{(SS_{effect} + SS_{error})}$

Repeated-measures ANOVA

- $F = \frac{between\text{–}groups\ variance}{Error\ variance}$
- In other words… $F = \frac{MS_{between}}{MS_{error}}$ or $F = \frac{MS_{treat}}{MS_{error}}$

Source	SS	df	MS	F
treat	$n\sum(x_j - x_T)^2$	k – 1	$\frac{SS_{treat}}{df_{treat}}$	$\frac{MS_{treat}}{MS_{error}}$
within	$\sum(x_{ij} - x_j)^2$	k (n - 1)		
subject	$k\Sigma(M_i - x_T)^2$	n - 1		
error	$SS_{within} - SS_{subject}$	(k - 1)(n – 1)	$\frac{SS_{error}}{df_{error}}$	
Total	$\sum(x_{ij} - x_T)^2$	N – 1		

- Eta-squared = $\eta^2 = \frac{SS_{treat}}{SS_{treat}+SS_{error}}$

Mixed Factorial ANOVA

- $F = \frac{between\!-\!groups\ variance}{Error\ variance}$
- In other words… $F = \frac{MS_{between}}{MS_{error}}$ or $F = \frac{MS_{treat}}{MS_{error}}$

Source	SS	df	MS	F
Between-group				
A	$n\sum(x_j - x_T)^2$	a – 1	$\frac{SS_A}{df_A}$	$\frac{MS_A}{MS_{S/A}}$
S/A	$\sum(x_{ij} - x_j)^2$	a (n – 1)	$\frac{SS_{S/A}}{df_{S/A}}$	
Within-group				
B	$k\Sigma(M_i - x_T)^2$	b - 1	$\frac{SS_B}{df_B}$	$\frac{MS_B}{MS_{BxS/A}}$
AxB	$\sum n(Y_{.jk} - Y_{...})^2$	(a - 1)(b – 1)	$\frac{SS_{AxB}}{df_{AxB}}$	$\frac{MS_{AxB}}{MS_{BxS/A}}$
BxS/A	$\sum(Y_{ijk} - Y_{.jk})^2$	a(b - 1)(n – 1)	$\frac{SS_{BxS?A}}{df_{BxS?A}}$	
Total	$\sum(x_{ij} - x_T)^2$	N – 1 *or* (a)(b)(n) - 1	$\frac{SS_{Total}}{df_{Total}}$	

- Eta-squared = $\eta^2 = \frac{SS_{treat}}{SS_{treat}+SS_{error}}$