

# Between Group Variance

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- Factor A between group variance

$$MS_a = \frac{SS_a}{df_a}$$

- $SS_a$  = sum of squares for Factor A
- $df_a$  = degrees of freedom between groups =  $a - 1$
- $a$  = number of levels of Factor A

# Between Group Variance

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- Factor B between group variance

$$MS_b = \frac{SS_b}{df_b}$$

- $SS_b$  = sum of squares for Factor B
- $df_b$  = degrees of freedom between groups =  $b - 1$
- $b$  = number of levels of Factor B

# Between Group Variance

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- Interaction between group variance

$$MS_{a \times b} = \frac{SS_{a \times b}}{df_{a \times b}}$$

- $SS_{a \times b}$  = sum of squares for Factor A×B
- $df_{a \times b}$  = degrees of freedom between groups  
=  $df_a \times df_b = (a - 1)(b - 1)$

# Within Group Variance

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- Within group variance

$$MS_{within} = \frac{SS_{within}}{df_{within}}$$

- $SS_{within}$  = sum of squares within groups
- $df_{within} = N - k$
- $k$  = total number of groups

# Computing F-statistics

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- Main effect of Factor A:  $F = \frac{MS_a}{MS_{within}}$
- Main effect of Factor B:  $F = \frac{MS_b}{MS_{within}}$
- Interaction effect:  $F = \frac{MS_{a \times b}}{MS_{within}}$

# Two-Way ANOVA Summary Table

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Source	SS	df	MS	F
Factor A	$SS_a$	$df_a$	$MS_a$	$MS_a/MS_{within}$
Factor B	$SS_b$	$df_b$	$MS_b$	$MS_b/MS_{within}$
Interaction	$SS_{axb}$	$df_{axb}$	$MS_{axb}$	$MS_{axb}/MS_{within}$
Within	$SS_{within}$	$df_{within}$	$MS_{within}$	
Total	$SS_{total}$	$df_{total}$		

# Effect Size

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- Effect size for main effects:

$$\eta_A^2 = \frac{SS_A}{SS_{total}} \qquad \eta_B^2 = \frac{SS_B}{SS_{total}}$$

- Effect size for interaction:

$$\eta_{AXB}^2 = \frac{SS_{AXB}}{SS_{total}}$$