

**Estimates of Variance Components in one-way, two-way and three-way designs**

r = # of observations per treatment  
K = # of levels of Factor B

J = # of levels of Factor A  
L = # of levels of Factor C

Model	Variance Component Estimate	Model	Variance Component Estimate
$A_f$	$\hat{\sigma}_\alpha^2 = (J-1)(MS_A - MS_e)/rJ$ $\hat{\sigma}_e^2 = MS_e$	$A_f B_f C_r$	$\hat{\sigma}_\alpha^2 = (J-1)(MS_A - MS_{AC})/rJKL$ $\hat{\sigma}_\beta^2 = (K-1)(MS_B - MS_{BC})/rJKL$ $\hat{\sigma}_\gamma^2 = (MS_C - MS_e)/rJK$ $\hat{\sigma}_{\alpha\beta}^2 = (J-1)(K-1)(MS_{AB} - MS_{ABC})/rJKL$ $\hat{\sigma}_{\alpha\gamma}^2 = (MS_{AC} - MS_e)/rK$ $\hat{\sigma}_{\beta\gamma}^2 = (MS_{BC} - MS_e)/rJ$ $\hat{\sigma}_{\alpha\beta\gamma}^2 = (MS_{ABC} - MS_e)/r$ $\hat{\sigma}_e^2 = MS_e$
$A_r$	$\hat{\sigma}_\alpha^2 = (MS_A - MS_e)/r$ $\hat{\sigma}_e^2 = MS_e$	$A_f B_r C_r$	$\hat{\sigma}_\alpha^2 = (J-1)(MS_A - MS_{AB} - MS_{AC} - MS_{ABC})/rJKL$ $\hat{\sigma}_\beta^2 = (MS_B - MS_{BC})/rJL$ $\hat{\sigma}_\gamma^2 = (MS_C - MS_{BC})/rJK$ $\hat{\sigma}_{\alpha\beta}^2 = (MS_{AB} - MS_{ABC})/rL$ $\hat{\sigma}_{\alpha\gamma}^2 = (MS_{AC} - MS_{ABC})/rK$ $\hat{\sigma}_{\beta\gamma}^2 = (MS_{BC} - MS_e)/rJ$ $\hat{\sigma}_{\alpha\beta\gamma}^2 = (MS_{ABC} - MS_e)/r$ $\hat{\sigma}_e^2 = MS_e$
$A_f B_f$	$\hat{\sigma}_\alpha^2 = (J-1)(MS_A - MS_e)/rJK$ $\hat{\sigma}_\beta^2 = (K-1)(MS_B - MS_e)/rJK$ $\hat{\sigma}_{\alpha\beta}^2 = (J-1)(K-1)(MS_{AB} - MS_e)/rJK$ $\hat{\sigma}_e^2 = MS_e$	$A_r B_r C_f$	$\hat{\sigma}_\alpha^2 = (MS_A - MS_{AB} - MS_{AC} + MS_{ABC})/rKL$ $\hat{\sigma}_\beta^2 = (MS_B - MS_{AB} - MS_{BC} + MS_{ABC})/rJL$ $\hat{\sigma}_\gamma^2 = (MS_C - MS_{AC} - MS_{BC} + MS_{ABC})/rJK$ $\hat{\sigma}_{\alpha\beta}^2 = (MS_{AB} - MS_{ABC})/rL$ $\hat{\sigma}_{\alpha\gamma}^2 = (MS_{AC} - MS_{ABC})/rK$ $\hat{\sigma}_{\beta\gamma}^2 = (MS_{BC} - MS_{ABC})/rJ$ $\hat{\sigma}_{\alpha\beta\gamma}^2 = (MS_{ABC} - MS_e)/r$ $\hat{\sigma}_e^2 = MS_e$
$A_f B_r$	$\hat{\sigma}_\alpha^2 = (J-1)(MS_A - MS_{AB})/rJK$ $\hat{\sigma}_\beta^2 = (MS_B - MS_e)/rJ$ $\hat{\sigma}_{\alpha\beta}^2 = (MS_{AB} - MS_e)/r$ $\hat{\sigma}_e^2 = MS_e$	$A_r B_r C_f$	$\hat{\sigma}_\alpha^2 = (MS_A - MS_{AB} - MS_{AC} + MS_{ABC})/rKL$ $\hat{\sigma}_\beta^2 = (MS_B - MS_{AB} - MS_{BC} + MS_{ABC})/rJL$ $\hat{\sigma}_\gamma^2 = (MS_C - MS_{AC} - MS_{BC} + MS_{ABC})/rJK$ $\hat{\sigma}_{\alpha\beta}^2 = (MS_{AB} - MS_{ABC})/rL$ $\hat{\sigma}_{\alpha\gamma}^2 = (MS_{AC} - MS_{ABC})/rK$ $\hat{\sigma}_{\beta\gamma}^2 = (MS_{BC} - MS_{ABC})/rJ$ $\hat{\sigma}_{\alpha\beta\gamma}^2 = (MS_{ABC} - MS_e)/r$ $\hat{\sigma}_e^2 = MS_e$
$A_r B_r$	$\hat{\sigma}_\alpha^2 = (MS_A - MS_{AB})/rK$ $\hat{\sigma}_\beta^2 = (MS_B - MS_{AB})/rJ$ $\hat{\sigma}_{\alpha\beta}^2 = (MS_{AB} - MS_e)/r$ $\hat{\sigma}_e^2 = MS_e$	$A_f B_f C_f$	$\hat{\sigma}_\alpha^2 = (J-1)(MS_A - MS_e)/rJKL$ $\hat{\sigma}_\beta^2 = (K-1)(MS_B - MS_e)/rJKL$ $\hat{\sigma}_\gamma^2 = (L-1)(MS_C - MS_e)/rJKL$ $\hat{\sigma}_{\alpha\beta}^2 = (J-1)(K-1)(MS_{AB} - MS_e)/rJKL$ $\hat{\sigma}_{\alpha\gamma}^2 = (J-1)(L-1)(MS_{AC} - MS_e)/rJKL$ $\hat{\sigma}_{\beta\gamma}^2 = (K-1)(L-1)(MS_{BC} - MS_e)/rJKL$ $\hat{\sigma}_{\alpha\beta\gamma}^2 = (J-1)(K-1)(L-1)(MS_{ABC} - MS_e)/rJKL$ $\hat{\sigma}_e^2 = MS_e$