Sources of Variation

(1)	$\exists$ Variation <u>between group means</u> (Treatment variation) (Factor of interest) $$\Sigma n_i(\bar{x}_i - \bar{x})^2 \, ; \, d.f. = (k-1)$$	SS_B (Between) SS_T (Treatment) SS_{model} TSS (tmt SS)
(2)	$\exists$ Variation <u>within</u> any group "Within group" variation Unexplained random error ("Residual" variance, or "error" variance) $$\Sigma(x_i - \bar{x}_i)^2 \, ; \, d.f. = (N-1)-(k-1) = N-k$$	SS_W (within) SS_{err} (error) SS_{resid} RSS (residual SS)
(3)	<u>Total variation</u> Lump all observations together, ignoring factors of interest. Deviation from the grand mean $$\Sigma(x_i - \bar{x})^2 \, ; \, d.f. = (N-1)$$ Or calculate from SST=SSB+SSW, or SST=SS_{tmt} + SS_{error}	SS_{TOT} (total)
	Under H_0, $MS_{tmt} \approx MS_{err}$ (MSB $\equiv$ MSW) and both estimate σ_e^2 If H_0 false, $MS_{tmt} > MS_{err}$. The "residual standard error" is the "root MSE" (i.e., square root of the mean square error) R^2 is the variation explained by the model = SS_{tmt}/SS_{err}.	