Decomposition of total variability

$$\underbrace{(y_{ij} - \bar{y}_{..})}_{\text{deviation from grand mean}} = \underbrace{(y_{ij} - \bar{y}_{i.})}_{\text{deviation from group mean (= residual)}} + \underbrace{(\bar{y}_{i.} - \bar{y}_{..})}_{\text{deviation of group mean from grand mean (= treatment effect)}}$$

Pyth. $\Rightarrow$ (cross-prod. vanishes)

$$\underbrace{\sum_{i=1}^{g} \sum_{j=1}^{n_i} (y_{ij} - \bar{y}_{..})^2}_{=: SS_T} = \underbrace{\sum_{i=1}^{g} \sum_{j=1}^{n_i} (y_{ij} - \bar{y}_{i.})^2}_{=: SS_E} + \underbrace{\sum_{i=1}^{g} \sum_{j=1}^{n_i} (\bar{y}_{i.} - \bar{y}_{..})^2}_{=: SS_{Trt}}$$

where

SS_T = total sum of squares

SS_{Trt} = treatment sum of squares = $\sum_{i=1}^{g} n_i \hat{\alpha}_i^2$ ("between")

SS_E = error sum of squares ("within") (residual sum of squares)

$$\Rightarrow SS_T = SS_{Trt} + SS_E$$