Chapter 4 Formula Sheet

$y \approx \beta_0 + \beta_1 x$

$\sum_{i=1}^{n}(y_i - \hat{y}_i)^2$ is minimized in least squares

$$b_1 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \quad \text{and} \quad b_0 = \bar{y} - b_1\bar{x}$$

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \cdot \sum (y_i - \bar{y})^2}}$$

$$R^2 = \frac{\sum(y_i - \bar{y})^2 - \sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2}$$

$e_i = y_i - \hat{y}_i$

$y \approx \beta_0 + \beta_1 x + \beta_2 x^2 + \cdots + \beta_k x^k$

$y \approx \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$

In two-way factorials:

$\bar{y}_{ij}$ and $\bar{y}_{i.} = \frac{1}{J}\sum_{j=1}^{J}\bar{y}_{ij}$ and $\bar{y}_{.j} = \frac{1}{I}\sum_{i=1}^{I}\bar{y}_{ij}$ and $\bar{y}_{..} = \frac{1}{IJ}\sum_{i,j}\bar{y}_{ij}$

$a_i = \bar{y}_{i.} - \bar{y}_{..}$ and $b_j = \bar{y}_{.j} - \bar{y}_{..}$ and $ab_{ij} = \bar{y}_{ij} - (\bar{y}_{..} + a_i + b_j)$

In three-way factorials:

$\bar{y}_{ijk}$ and $\bar{y}_{...} = \frac{1}{IJK}\sum_{i,j,k}\bar{y}_{ijk}$ and $\bar{y}_{i..} = \frac{1}{JK}\sum_{j,k}\bar{y}_{ijk}$

and $\bar{y}_{ij.} = \frac{1}{K}\sum_{k}\bar{y}_{ijk}$ etc.

$a_i = \bar{y}_{i..} - \bar{y}_{...}$ and $b_j = \bar{y}_{.j.} - \bar{y}_{...}$ and $c_k = \bar{y}_{..k} - \bar{y}_{...}$

$ab_{ij} = \bar{y}_{ij.} - (\bar{y}_{...} + a_i + b_j)$ and $ac_{ik} = \bar{y}_{i.k} - (\bar{y}_{...} + a_i + c_k)$

and $bc_{jk} = \bar{y}_{.jk} - (\bar{y}_{...} + b_j + c_k)$

$abc_{ijk} = \bar{y}_{ijk} - (\bar{y}_{...} + a_i + b_j + c_k + ab_{ij} + ac_{ik} + bc_{jk})$

useful transformations include $g(y) = (y - \gamma)^\alpha$ and $g(y) = \ln(y - \gamma)$