

## ANOVA TABLES

**One-way ANOVA**

Cause of dispersion	Sum of squares	Degree of freedom	Empirical variance
Between groups	$Q_a = \sum_{i=1}^k n_i (\bar{X}_i - \bar{X}_{..})^2$	$k - 1$	$s_a^2 = \frac{Q_a}{k-1}$
Within groups	$Q_e = \sum_{i=1}^k \sum_{j=1}^{n_i} (X_{ij} - \bar{X}_i)^2$	$n - k$	$s_e^2 = \frac{Q_e}{n-k}$
Total	$Q = \sum_{i=1}^k \sum_{j=1}^{n_i} (X_{ij} - \bar{X}_{..})^2$	$n - 1$	-

**Two-way ANOVA without interaction**

Cause of dispersion	Sum of squares	Degree of freedom	Empirical variance
<i>a</i> -effects	$Q_a = p \sum_{i=1}^k (\bar{X}_i - \bar{X}_{..})^2$	$k - 1$	$s_a^2 = \frac{Q_a}{k-1}$
<i>b</i> -effects	$Q_b = k \sum_{j=1}^p (\bar{X}_{.j} - \bar{X}_{..})^2$	$p - 1$	$s_b^2 = \frac{Q_b}{p-1}$
Random error	$Q_e = \sum_{i=1}^k \sum_{j=1}^p (X_{ij} - \bar{X}_i - \bar{X}_{.j} + \bar{X}_{..})^2$	$(k - 1)(p - 1)$	$s_e^2 = \frac{Q_e}{(k-1)(p-1)}$
Total	$Q = \sum_{i=1}^k \sum_{j=1}^p (X_{ij} - \bar{X}_{..})^2$	$kp - 1$	-

**Two-way ANOVA with interaction**

Cause of dispersion	Sum of squares	Degree of freedom	Empirical variance
<i>a</i> -effects	$Q_a = pn \sum_{i=1}^k (\bar{X}_{i..} - \bar{X}_{...})^2$	$k - 1$	$s_a^2 = \frac{Q_a}{k-1}$
<i>b</i> -effects	$Q_b = kn \sum_{j=1}^p (\bar{X}_{.j.} - \bar{X}_{...})^2$	$p - 1$	$s_b^2 = \frac{Q_b}{p-1}$
<i>ab</i> -interaction	$Q_c = n \sum_{i=1}^k \sum_{j=1}^p (\bar{X}_{ij.} - \bar{X}_{i..} - \bar{X}_{.j.} + \bar{X}_{...})^2$	$(k - 1)(p - 1)$	$s_c^2 = \frac{Q_c}{(k-1)(p-1)}$
Random error	$Q_e = \sum_{i=1}^k \sum_{j=1}^p \sum_{l=1}^n (X_{ijl} - \bar{X}_{ij.})^2$	$kp(n - 1)$	$s_e^2 = \frac{Q_e}{kp(n-1)}$
Total	$Q = \sum_{i=1}^k \sum_{j=1}^p \sum_{l=1}^n (X_{ijl} - \bar{X}_{...})^2$	$kpn - 1$	-