Hotelling's T^2:

$$T_{cal}^2 = T^2 = n(\bar{\boldsymbol{X}} - \boldsymbol{\mu_0})'\boldsymbol{S}^{-1}(\bar{\boldsymbol{X}} - \boldsymbol{\mu_0})$$

$$T_{tab}^2 = T_{n-1}^2 = \frac{(n-1)p}{n-p}F_{p,n-p:0.05}$$

$$F_{p,n-p:0.05} = F_{val} < -qf(p = 0.95, df1 = p, df2 = n - p)$$

Simultaneous confidence intervals:

95% confidence interval for μ_i :-

$$\bar{X_i} \mp \sqrt{T_{tab}^2 \frac{\boldsymbol{S_{ii}}}{n}} \leq \mu_i$$

95% confidence interval for $\mu_i - \mu_{\mathrm{j}}$:-

$$\boldsymbol{S_{pp}} = \boldsymbol{S}_{\mathrm{ii}} * \boldsymbol{S}_{\mathrm{jj}} - 2\boldsymbol{S}_{\mathrm{ij}}$$

$$\left(\bar{X_i} - \bar{X_j}\right) \mp \sqrt{T_{tab}^2 \frac{\boldsymbol{S_{pp}}}{n}} \leq \mu_i - \mu_j$$

Multivariate regression:

$$\widehat{\boldsymbol{\beta}} = (\boldsymbol{X}'\boldsymbol{X})^{-1}\boldsymbol{X}'\boldsymbol{Y}$$

$$\widehat{\boldsymbol{Y}} = \boldsymbol{X}\widehat{\boldsymbol{\beta}}$$

$$\hat{\boldsymbol{\epsilon}} = \mathbf{Y} - \widehat{\mathbf{Y}}$$

Total SS and cross-products = $\boldsymbol{Y}'\boldsymbol{Y}$

Predicted SS and cross-products = $\widehat{\boldsymbol{Y}}'\widehat{\boldsymbol{Y}}$

Residual SS and cross- products = $\hat{\boldsymbol{\epsilon}}'\hat{\boldsymbol{\epsilon}}$

$$\boldsymbol{Y}'\boldsymbol{Y} = \widehat{\boldsymbol{Y}}'\widehat{\boldsymbol{Y}} + \hat{\boldsymbol{\epsilon}}'\hat{\boldsymbol{\epsilon}}$$

MANOVA:

$$\boldsymbol{W} = (n_1 - 1)\boldsymbol{S_1} + (n_2 - 1)\boldsymbol{S_2} + \cdots \ldots \ldots . + \left(n_g - 1\right)\boldsymbol{S_g}$$

$$\overline{\boldsymbol{X}} = \frac{n_1\overline{\boldsymbol{X_1}} + n_2\overline{\boldsymbol{X_2}} + n_3\overline{\boldsymbol{X_3}}}{n_1 + n_2 + n_3}$$

$$\boldsymbol{B} = \sum_{i=1}^{g} n_i(\overline{\boldsymbol{X_\iota}} - \overline{\boldsymbol{X}})(\overline{\boldsymbol{X_\iota}} - \overline{\boldsymbol{X}})'$$

$$\Lambda^* = \frac{|\boldsymbol{W}|}{|\boldsymbol{B} + \boldsymbol{W}|}$$

The test statistics is

$$F_{\text{cal}} = \left(\frac{\sum n_i - p - 2}{p}\right)\left(\frac{1 - \sqrt{\Lambda^*}}{\sqrt{\Lambda^*}}\right)$$

$$F_{tab} = F_{2p,2(n-p-2;0.01)} = \frac{\chi^2{}_{2p;0.01}}{2p}$$

Bartlett's (বারটলেটস) correction

$$\chi^2_{cal} = -\left(n - 1 - \frac{p+g}{2}\right)\ln\Lambda^*$$

$$\chi^2_{tab} = \chi^2_{p(g-1);\alpha}$$

95% simultaneous confidence interval for $\overline{X}_{kj} - \overline{X}_{li}$

$$\overline{X}_{kj} - \overline{X}_{li} \pm t_{n-g}\left(\frac{\alpha}{pg(g-1)}\right)\sqrt{\frac{w_{jj}}{n-g}\left(\frac{1}{n_k} + \frac{1}{n_l}\right)}$$

$$\widehat{\boldsymbol{\tau}_{\iota J = x_J}} = [\overline{X}_\iota - \overline{X}]$$

Box's test:

$$S_{pooled} = \frac{(n_1 - 1)S_1 + (n_2 - 1)S_2 + (n_3 - 1)S_3}{n - g}$$

$$M = \left[\sum_{l}(n_l - 1)\right]\ln\left|S_{\text{pooled}}\right| - \sum_{l}[(n_l - 1)\ln|S_l|]$$

$$u = \left[\sum_{l}\frac{1}{n_l - 1} - \frac{1}{\sum_l (n_l - 1)}\right]\left[\frac{2p^2 + 3p - 1}{6(p+1)(g-1)}\right]$$

$$\chi^2_{cal} = C = (1 - u)M$$

$$\chi^2_{tab} = \chi^2_{\frac{p(p+1)(g-1\}}{2};\alpha}$$