Formulas Statistics 1 and 2 (LAS)

Formulas general part

Mean: $\bar{X} = \frac{\sum_{i=1}^{N} X_i}{N}$

Variance: $S_X^2 = \frac{\sum_{i=1}^{N}(X_i - \bar{X})^2}{N-1}$

Standardized values (Z-values): $Z = \frac{X-\mu}{\sigma}$

Z-statistic in one sample Z-test: $Z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$

Standard error of the mean: $\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{N}}$

Cohen's *d* = $\frac{\bar{X}_1 - \bar{X}_2}{s_{pooled}}$

$$s_{pooled}^2 = \frac{(n_1 - 1) \times s_1^2 + (n_2 - 1) \times s_2^2}{n_1 + n_2 - 2}$$

$$s_{pooled} = \sqrt{s_{pooled}^2}$$

F-statistic in one-way ANOVA: $F(\mathrm{df_B}, \mathrm{df_W}) = \frac{\frac{\mathrm{SS_B}}{\mathrm{df_B}}}{\frac{\mathrm{SS_W}}{\mathrm{df_W}}} = \frac{\mathrm{MS_B}}{\mathrm{MS_W}}.$

Simple regression model: $Y' = b_0 + b_1 X$

Multiple regression model: $Y' = b_0 + b_1 X_1 + b_2 X_2$

$$R^2 = \frac{s_{Y'}^2}{s_Y^2}$$

t-statistic in a one sample t-test: $t = \frac{\bar{X} - \mu_{H0}}{s_{\bar{X}}}$, where $s_{\bar{X}} = \frac{s_X}{\sqrt{N}}$; *df* = *N* - 1

t-statistic in an independent samples t-test: $t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)_{H_0}}{s_{\bar{X}_1 - \bar{X}_2}}$; *df* = $n_1 + n_2 - 2$

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{s_{pooled}^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

Formulas business and economics

Logistic function***:*** $P(Y = 1|X) = \frac{e^{(b_0 + b_1 X)}}{1 + e^{(b_0 + b_1 X)}}$

Transformations:

- From **probability** to **odds**: $\mathrm{odds} = \frac{P}{1-P}$
- From **odds** to **probability**: $P = \frac{\mathrm{odds}}{1 + \mathrm{odds}}$

- From **odds** to **logit**: $\text{logit} = \ln(\text{odds})$
- From **probability** to **logit**: $\text{logit} = \ln\left[\frac{P}{1-P}\right]$
- From **logit** to **odds**: $\text{odds} = e^{\text{logit}}$
- From **logit** to **probability**: $P = \frac{e^{\text{logit}}}{1+e^{\text{logit}}}$

Wald test statistic: $W = \left(\frac{B}{SE(B)}\right)^2$

Formulas cognitive neuroscience

Contrast value: $\psi = c_1\mu_1 + c_2\mu_2 + c_3\mu_3 + c_4\mu_4$

Scheffé: $F_{\text{cv,Scheffé}} = F_{\text{cv}}(\text{k-1})$

$$F = \left(\frac{\text{Difference}}{\text{S.E.}}\right)^2$$

Number of possible pairwise comparisons: $\frac{k\times(k-1)}{2}$

Factorial ANOVA linear model: $Y_{jkl} = \mu_Y + \alpha_k + \beta_l + \alpha\beta_{kl} + \varepsilon_{jkl}$

Eta-squared: Factor A: $\eta_A^2 = \frac{SS_A}{SS_{total}}$

Partial eta-squared: Factor A: $\eta_{partial.A}^2 = \frac{SS_A}{SS_A+SS_W}$

Adjusted mean: $\bar{Y}_i^{(\text{adj})} = \bar{Y}_i - b_w(\bar{X}_i - \bar{X})$

t-statistic in paired samples t-test: $t = \frac{\bar{d}}{\frac{s_{\bar{d}}}{\sqrt{N}}}$; $df = N - 1$

Formulas Social Sciences

Reliability: $r_{xx'} = \frac{var(T)}{var(X)} = \frac{var(T)}{var(T)+var(E)}$

Eigenvalue of component 1 for 6 items: $\lambda_1 = a_{11}^2 + a_{21}^2 + a_{31}^2 + a_{41}^2 + a_{51}^2 + a_{61}^2$

Proportion VAF by component 1 = $\frac{\lambda_1}{\text{TotalVar}} = \frac{\lambda_1}{\text{J}}$

Component loadings of component 1 and item *j*: $a_{j1} = r_{X_jC_1}$

Communality for 2 components: $h_j^2 = r_{X_jC_1}^2 + r_{X_jC_2}^2 = a_{j1}^2 + a_{j2}^2$

Unicity for 2 components: $b_j^2 = 1 - h_j^2$