One Sample test

$\mu = \mu_0$

test stat $= \dfrac{\bar{x} - \mu_0}{\frac{\sigma}{\sqrt{n}}} = Z$

$= \dfrac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}} = t^{n-1}$ / $Z \rightarrow n > 30$

$p = p_0$

↳ $p \rightarrow \hat{p}$

test stat $= \dfrac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}} = Z$

two Sample test

→ **paired t Test**

test stat $= \dfrac{\bar{d} - \Delta_0}{\frac{s_d}{\sqrt{n}}} = t^{n-1}$ ($\Delta_0 = 0$)

(before and after samples) ← Ex

→ **two Sample T-test**

test stat $= \dfrac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$

$s^2 = s_1^2 \left(\frac{n_1 - 1}{n_1 + n_2 - 2}\right) + s_2^2 \left(\frac{n_2 - 1}{n_1 + n_2 - 2}\right)$

test stat $= \dfrac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = Z$ / $Z_{corr} = \dfrac{|\hat{p}_1 - \hat{p}_2| - \left(\frac{1}{2n_1} + \frac{1}{2n_2}\right)}{\sqrt{\hat{p}\hat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$

$\hat{p} = \hat{p}_1 \dfrac{n_1}{n_1 + n_2} + \hat{p}_2 \dfrac{n_2}{n_1 + n_2}$

→ contingency table

test stat $= \sum \frac{(O_{ij}-E_{ij})^2}{E_{ij}} \sim \chi^2_{df}$

df ↙ $(n_{column}-1)(n_{rows}-1)$

corrected → $\sum \frac{(|O_{ij}-E_{ij}|-\frac{1}{2})^2}{E_{ij}}$

~ Chi square Goodness of fit test

↳ Group → $(n_1 < X < n_2)$ → $(n_1' \leq X \leq n_2')$

→ $(n_1'-0.5 \leq X \leq n_2'+0.5)$

→ $(z_1 < z < z_2)$

$E = np$ → $p(z_1 < z < z_2)$

n: total frequency

$$\chi^2_{df} = \sum \frac{(O_{ij}-E_{ij})^2}{E_{ij}}$$

df ↳ $g-k-1$

k ↳ n of parameters

Correlation methods

→ $\rho = 0$

↳ test stat $= r\sqrt{\frac{n-2}{1-r^2}}$

r: estimator of ρ

$$r = \frac{L_{xy}}{\sqrt{L_{xx}\cdot L_{yy}}} = \frac{S_{xy}}{S_x \cdot S_y}$$

↳ $L_{xx} = (n-1)S_x^2 = \sum x^2 - n\bar{x}^2$

$L_{xy} = \sum x_i y_i - n\bar{x}\bar{y}$

$$r\sqrt{\frac{n-2}{1-r^2}} \sim t^{df} \quad df \to n-2$$

→ $\rho = \rho_0$ ($\rho_0 \neq 0$)

test stat $= \frac{Z-Z_0}{\sqrt{\frac{1}{n-3}}} = (Z-Z_0)(\sqrt{n-3}) = \lambda$

$Z = \frac{1}{2}\ln\left(\frac{1+r}{1-r}\right) \quad Z_0 = \frac{1}{2}\ln\left(\frac{1+\rho_0}{1-\rho_0}\right)$

Z: fisher's Z transformation for r

CI → $Z \pm \frac{1}{\sqrt{n-3}} Z_{1-\frac{\alpha}{2}} \to (Z_1, Z_2)$

$Z = \frac{1}{2}\ln\left(\frac{1+r}{1-r}\right)$

$$\left(\frac{e^{2Z_1}-1}{e^{2Z_1}+1}, \frac{e^{2Z_2}-1}{e^{2Z_2}+1}\right)$$

(ρ_1, ρ_2)

Multi Sample

→ $\mu_1 = \mu_2 = \mu_3$

groups

$$\text{test stat} = \frac{MSB}{MSW} = F^{(K-1,\ n-K)}$$

$MSB = \frac{SSB}{K-1}$ $MSW = \frac{SSw}{n-K}$

$$SSB = \sum n_i \bar{y}_i^2 - \frac{(\sum n_i \bar{y}_i)^2}{n}$$

$$SSw = \sum (n_i - 1) S_i^2$$

Between > within (reject H_0)

Within > Between (accept H_0)