

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i n_i \quad n = \sum_{i=1}^n u_i \quad S^2 = \frac{1}{n-1} \left[\sum_{i=1}^n x_i^2 u_i - \frac{\left(\sum_{i=1}^n x_i u_i \right)^2}{n} \right]$$

$$u_i = \frac{x_i - a}{h} \quad \bar{x} = h\bar{u} + a \quad \bar{u} = \frac{\sum_{i=1}^n u_i n_i}{n} \quad S^2 = h^2 \left(\bar{u}^2 - \bar{u}^2 \right) \quad \bar{u}^2 = \frac{1}{n} \sum_{i=1}^n u_i^2 n_i$$

$$S_{popr.}^2 = S^2 - \frac{1}{12} h^2$$

$$P\left(\bar{x} - t_\alpha \frac{s}{\sqrt{n}} \leq \mu \leq \bar{x} + t_\alpha \frac{s}{\sqrt{n}}\right) = 1 - \alpha$$

$$P\left(\bar{x} - u_\alpha \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + u_\alpha \frac{\sigma}{\sqrt{n}}\right) = 1 - \alpha$$

$$P\left(\frac{(n-1)S^2}{c_2} < \delta^2 < \frac{(n-1)S^2}{c_1}\right) = 1 - \alpha \quad c_1 = \chi^2_{\lfloor \frac{\alpha}{2}, n-1 \rfloor} \quad c_2 = \chi^2_{\lceil \frac{\alpha}{2}, n-1 \rceil}$$

$$P\left(\frac{z}{n} - u_\alpha \sqrt{\frac{\frac{z}{n}(1-\frac{z}{n})}{n}} < p < \frac{z}{n} + u_\alpha \sqrt{\frac{\frac{z}{n}(1-\frac{z}{n})}{n}}\right) = 1 - \alpha$$

$$t = \frac{\left| \frac{\bar{x} - \mu_0}{s} \sqrt{n} \right|}{\frac{|x_1 - x_2|}{\sqrt{\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}}$$

$$u = \frac{\frac{x_1 - x_2}{\sqrt{pq}}}{\sqrt{\frac{n_1}{n}}}, \quad p = \frac{x_1 + x_2}{n_1 + n_2}, \quad q = 1 - p, \quad n = \frac{n_1 * n_2}{n_1 + n_2}$$

$$F = \frac{\frac{s_1^2}{n_1^2}}{\frac{s_2^2}{n_2^2}}, \quad \sim F_{\alpha, n_1^{-1}, n_2^{-1}}$$

$$\chi^2 = \frac{2,303}{c} \left[(n-t) \log \widetilde{S}^2 - \sum_{i=1}^t (n_i - 1) \log \hat{S}_i^2 \right]$$

$$\widetilde{S}^2 = \frac{1}{n-t} \sum_{i=1}^t (n_i - 1) \hat{S}_i^2$$

$$c = 1 + \frac{1}{3(t-1)} \left(\sum_{i=1}^t \frac{1}{n_i - 1} - \frac{1}{n-t} \right)$$

$$SS_t = \sum_{i=1}^t \left(\bar{y}_i - \bar{y} \right)^2 n_i = \sum_i \frac{\left(\sum_j x_{ij} \right)^2}{n_i} - \frac{\left(\sum_i \sum_j x_{ij} \right)^2}{\sum_i n_i},$$

$$SS_e = \sum_{i=1}^t \sum_{j=1}^{n_i} \left(y_{ij} - \bar{y}_i \right)^2 = \sum_i \sum_j x_{ij}^2 - \sum_i \frac{\left(\sum_j x_{ij} \right)^2}{n_i},$$

$$r = \frac{\sum_{i=1}^n x_i y_i - \frac{\left(\sum_{i=1}^n x_i \right) \left(\sum_{i=1}^n y_i \right)}{n}}{\sqrt{\left(\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n} \right) \left(\sum_{i=1}^n y_i^2 - \frac{\left(\sum_{i=1}^n y_i \right)^2}{n} \right)}} \quad t = \frac{r}{\sqrt{1-r^2}} \sqrt{n-2}$$

$$\text{cov}(x, y) = S_{x,y} = \frac{\sum_{i=1}^n x_i y_i - \frac{\sum_{i=1}^n x_i \sum_{i=1}^n y_i}{n}}{n-1} \quad b = \frac{\text{cov}(x, y)}{\sigma_x^2} = \frac{\sum_{i=1}^n x_i y_i - \frac{\sum_{i=1}^n x_i \sum_{i=1}^n y_i}{n}}{\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n}}$$

$$a = \bar{y} - b\bar{x}$$

źródło zmienności	stopnie swobody	sumy kwadratów (SS)	średnie kwadraty (MS)	wartość statystyki F
na skutek regresji liniowej	$v_1 = 1$	SS_R	MS_R	$F = MS_R / MS_E$
błąd	$v_2 = n-2$	SS_E	MS_E	
ogólna	$n-1$	SS_G		

$$SS_G = \sum_{i=1}^n y_i^2 - \frac{\left(\sum_{i=1}^n y_i \right)^2}{n} \quad SS_R = \frac{\left(\sum_{i=1}^n x_i y_i - \frac{\sum_{i=1}^n x_i \sum_{i=1}^n y_i}{n} \right)^2}{\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n}} \quad SS_E = SS_G - SS_R$$

$$S_b = \sqrt{\frac{MS_E}{\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n}}} \quad P(b - t_{\alpha, n-2} S_b \leq \beta \leq b + t_{\alpha, n-2} S_b) = 1 - \alpha$$

$$S_r = S_e \sqrt{\frac{1}{n} + \frac{(x_i - \bar{x})^2}{(n-1)*S_x^2}} \quad S_e = \sqrt{\frac{n-1}{n-2}(S_y^2 - \frac{S_{xy}^2}{S_x^2})}$$

$$P(\hat{Y}_i - t_{\alpha,n-2} * S_r < \mu_{x/y} < \hat{Y}_i + t_{\alpha,n-2} * S_r) = 1 - \alpha$$

$$SS_G = \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^r y_{ijk}^2 - \frac{\left(\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^r y_{ijk} \right)^2}{n}$$

$$SS_A = \frac{\sum_{i=1}^a \left(\sum_{j=1}^b \sum_{k=1}^r y_{ijk} \right)^2}{b * r} - \frac{\left(\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^r y_{ijk} \right)^2}{n}$$

$$SS_B = \frac{\sum_{j=1}^b \left(\sum_{i=1}^a \sum_{k=1}^r y_{ijk} \right)^2}{a * r} - \frac{\left(\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^r y_{ijk} \right)^2}{n}$$

$$SS_{AB} = \frac{\sum_{i=1}^a \sum_{j=1}^b \left(\sum_{k=1}^r y_{ijk} \right)^2}{r} - \frac{\left(\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^r y_{ijk} \right)^2}{n} - SS_A - SS_B$$

$$SS_E = SS_G - SS_A - SS_B - SS_{AB}$$

$$\bar{y}_k - \bar{y}_l \sim t_{\alpha,n-t} \sqrt{MS_E \left(\frac{1}{n_k} + \frac{1}{n_l} \right)}$$

$$\bar{y}_k - \bar{y}_l \sim t_{\alpha,r,n-t} \sqrt{MS_E \left(\frac{1}{n_k} + \frac{1}{n_l} \right)}$$

$$\begin{aligned} m_K &= E(x^K) = \sum x_i^K p_i \\ E(X-c)^K &= \sum (x_i - c)^K p_i \end{aligned}$$

$$G_{xx} = \sum_{i=1}^t \sum_{j=1}^{r_i} (x_{ij} - \bar{x}_{..})^2 - \frac{\left(\sum_{i=1}^t \sum_{j=1}^{r_i} x_{ij} \right)^2}{n}$$

$$G_{yy} = \sum_{i=1}^t \sum_{j=1}^{r_i} y_{ij}^2 - \frac{\left(\sum_{i=1}^t \sum_{j=1}^{r_i} y_{ij} \right)^2}{n}$$

$$G_{xy} = \sum_{i=1}^t \sum_{j=1}^{r_i} x_{ij} y_{ij} - \frac{\sum_{i=1}^t \sum_{j=1}^{r_i} x_i \sum_{i=1}^t \sum_{j=1}^{r_i} y_i}{n}$$

$$T_{xx} = \sum_{i=1}^t \frac{\left(\sum_{j=1}^{r_i} x_{ij} \right)^2}{r_i} - \frac{\left(\sum_{i=1}^t \sum_{j=1}^{r_i} x_{ij} \right)^2}{n}$$

$$T_{yy} = \sum_{i=1}^t \frac{\left(\sum_{j=1}^{r_i} y_{ij} \right)^2}{r_i} - \frac{\left(\sum_{i=1}^t \sum_{j=1}^{r_i} y_{ij} \right)^2}{n}$$

$$T_{xy} = \sum_{i=1}^t \frac{\sum_{j=1}^{r_i} x_{ij} \sum_{j=1}^{r_i} y_{ij}}{r_i} - \frac{\sum_{i=1}^t \sum_{j=1}^{r_i} x_{ij} \sum_{i=1}^t \sum_{j=1}^{r_i} y_{ij}}{n}$$

$$E_{xx} = G_{xx} - T_{xx} \quad E_{yy} = G_{yy} - T_{yy}$$

$$E_{xy} = G_{xy} - T_{xy} \quad G = G_{yy} - \frac{G_{xy}^2}{G_{xx}}$$

$$T = T_{yy} - \frac{T_{xy}^2}{T_{xx}} \quad E = E_{yy} - \frac{E_{xy}^2}{E_{xx}} \quad T' = G - E$$