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$$\delta = Y_1 - Y_2$$

(Cross-over)

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta} \right)^2 \sigma_\delta^2}{\delta^2} + \frac{z_{1-\frac{\alpha}{2}}^2}{2}$$

(Concordant)
(Discordant)

$$\sigma_\delta^2 = 2\sigma^2(1-\rho)$$

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d_i

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t z

(): $\sigma^2 \quad \mu = Y_1 - Y_2$

$$\mu = \sum_{j=1}^{2(K-1)} d_j \pi_j \quad \sigma^2 = \sum_{j=1}^{2(K-1)} d_j^2 \pi_j - \mu^2$$

: []
 $j \quad i \quad d_j \quad d_i$

$\sigma_\delta^2 \quad \delta \quad () \quad \sigma^2 \quad \mu$

n_d

()

$$d_i + d_j > 0$$

P_0

K

H_0

$$\frac{K}{K^2} = \frac{1}{K}$$

$$P_0 = 0.5$$

$$1 - \frac{1}{K} = \frac{K-1}{K}$$

P_1

() :

$$n = \frac{n_d}{\frac{K-1}{K}} = \frac{Kn_d}{K-1}$$

$$1 - \beta \quad \alpha$$

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$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta} \right)^2}{3(P_1 - 0.5)^2}$$

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π_{10}	π_{00}	
π_{11}	π_{01}	

$$(K > 2)K$$

$$d_i = Y_{i1} - Y_{i2} \quad i \quad Y_{i2} \quad Y_{i1}$$

$$2(K-1)$$

d_i

$$\pi_{00} \quad \pi_{11} :$$

π_i

$$\pi_{01} \quad \pi_{10} :$$

$$\pi_{01} = \frac{\psi}{\psi + 1};$$

$$\psi = \frac{\pi_{10}}{\pi_{01}}$$

$$\pi_{10} = \frac{1}{\psi + 1}$$

$$1 - \beta \quad \alpha$$

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$$\sigma^2 \quad \mu = \pi_{01} - \pi_{10}$$

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$$\mu = \frac{\psi - 1}{\psi + 1} \quad \sigma^2 = \frac{4\psi}{(\psi + 1)^2}$$

$$n_d = \frac{\left(z_{1-\frac{\alpha}{2}}(\psi + 1) + z_{1-\beta} \sqrt{(\psi + 1)^2 - (\psi - 1)^2 \pi_d} \right)^2}{(\psi - 1)^2}$$

$$\sigma_{\delta}^2 \quad \sigma^2 \quad \delta \quad \mu$$

$$\pi_d = \pi_{01} + \pi_{10} \quad n_d \quad ($$

() :

$$n_d = \frac{4\psi \left(z_{1-\frac{\alpha}{2}} + z_{1-\beta} \right)^2}{(\psi - 1)^2} + \frac{z_{1-\frac{\alpha}{2}}^2}{2}$$

$$n = \frac{n_d}{\pi_d}$$

p

(-

\psi

\psi

k	...			
π_{1k}	...	π_{12}	π_{11}	
π_{2k}	...	π_{22}	π_{21}	
\vdots	\vdots	\vdots	\vdots	\vdots
π_{kk}	...	π_{k2}	π_{k1}	k

$$\pi_{22} \quad \pi_{11}$$

() K

$\pi_{KK} \dots$

$$n_K \dots n_2 \quad n_1$$

n)

n

n

n

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$$\sigma_\delta = 2.48 \approx 2.5 \quad \delta = 3 \quad \beta = 0.1 \quad \alpha = 0.05$$

$$n = 11$$

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$$1+c$$

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p_1

$$\frac{2c}{1+c}$$

n_E

$$d_i + d_j > 0$$

$$n_u = \frac{n_E(1+c)}{2c}$$

n_u

$$\beta = 0.05 \quad \alpha = 0.05$$

$$n \approx 40 :$$

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$$n_c = cn_u$$

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$$n_T = n_c + n_u$$

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(VGB)

d_i

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/ / :

π_i

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$$n_d = 23.44 \approx 24$$

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$$n = 445$$

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$$\sigma_\delta^2 \quad \delta$$

$$n_d = 7$$

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/ / /

$$\sigma^2 = 2.12 \quad \mu \approx 3.09$$

$$\sigma^2 \quad \mu$$

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$$n = \frac{kn_d}{k-1} = \frac{5}{4} \times 7 = 8.79 \approx 9$$

$$n_c = 3270 \quad n_u = 327 \quad c = 10$$

$$n_t = 3270 + 327 = 3597$$

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(Conservative)

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$$\alpha = 0.05$$

$$\psi = \frac{11}{3}$$

$$\delta =$$

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$$1 - \beta = 0.9$$

$$1 - \beta = /$$

$$\alpha = /$$

$$\pi_d$$

$$n_d = 31.7 \approx 32$$

$$n \approx 593$$

$$\sigma^2 =$$

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(VGB)

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