$$P\left(-t_{n-1,\alpha/2} < \frac{\bar{D}-\mu_D}{S_D/\sqrt{n}} < t_{n-1,\alpha/2}\right) = 1-\alpha$$

$$P\left(-t_{n-1,\alpha/2}S_D/\sqrt{n} < \bar{D}-\mu_D < t_{n-1,\alpha/2}S_D/\sqrt{n}\right) = 1-\alpha$$

$$P\left(-\bar{D}-t_{n-1,\alpha/2}S_D/\sqrt{n} < -\mu_D < -\bar{D}+t_{n-1,\alpha/2}S_D/\sqrt{n}\right) = 1-\alpha$$

$$P\left(\bar{D}+t_{n-1,\alpha/2}S_D/\sqrt{n} > \mu_D > \bar{D}-t_{n-1,\alpha/2}S_D/\sqrt{n}\right) = 1-\alpha$$

$$P\left(\bar{D}-t_{n-1,\alpha/2}S_D/\sqrt{n} < \mu_D < \bar{D}+t_{n-1,\alpha/2}S_D/\sqrt{n}\right) = 1-\alpha$$

$$t_{\nu,\alpha} \quad t_{\nu,0.1/2} \qquad -t_{\nu,0.1/2}$$

$$t_{\nu,\alpha} \quad t_{\nu,\alpha/2} \qquad -t_{\nu,\alpha/2}$$

$$\frac{\bar{D}-\mu_D}{S_D/\sqrt{n}} \sim t_{n-1}$$

$$\frac{\hat{p}-p}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}} \sim N(0,1)$$

$$-3.52 \pm 1.968(13.60)/\sqrt{300} = (-5.06, -1.97)$$

$$\bar{d} \pm t_{n-1,0.025}s_D/\sqrt{n}$$

$$\bar{D} \pm t_{n-1,\alpha/2}S_D/\sqrt{n}$$

$$\alpha$$

$$\frac{\bar{Y}-\mu}{S/\sqrt{n}} \sim T_{n-1}$$

$$\frac{\bar{Y}-\mu}{S/\sqrt{n}} \sim ?$$

$$Z = \frac{\bar{Y}-\mu}{\sigma/\sqrt{n}} \sim N(0,1)$$

$$T \sim t_\nu \qquad E(T) = \nu \qquad Var(T) = 2\nu$$

$$\mu_1 \qquad \mu_2 \qquad \mu_D$$

$$\bar{Y}_1 - \bar{Y}_2$$

$$E\left(\bar{Y}_1-\bar{Y}_2\right) = E\left(\bar{Y}_1\right) - E\left(\bar{Y}_2\right) = \mu_1-\mu_2 = \mu_D$$

$$Var\left(\bar{Y}_1-\bar{Y}_2\right) = \sigma_1^2/n + \sigma_2^2/n$$

$$\bar{D} = \frac{1}{n}\sum_{i=1}^{n} D_i = \frac{1}{n}\sum_{i=1}^{n}(Y_{1i}-Y_{2i})$$

$$E\left(\bar{D}\right) = E\left(\frac{1}{n}\sum_{i=1}^{n}(Y_{1i} - Y_{2i})\right) = \frac{1}{n}\sum_{i=1}^{n}\left(E\left(Y_{1i}\right) - E\left(Y_{2i}\right)\right) = \frac{1}{n}\sum_{i=1}^{n}(\mu_1 - \mu_2) = \mu_D$$

$$E\left(\bar{Y}_1\right) = E\left(\frac{1}{n}\sum_{i=1}^{n}Y_{1i}\right) = \frac{1}{n}\sum_{i=1}^{n}E(Y_{1i}) = \frac{1}{n}\sum_{i=1}^{n}\mu_1 = \mu_1$$

$$Var\left(\bar{Y}_1\right) = Var\left(\frac{1}{n}\sum_{i=1}^{n}Y_{1i}\right) = \frac{1}{n^2}Var\left(\sum_{i=1}^{n}Y_{1i}\right)$$

$$= \frac{1}{n^2}\left(\sum_{i=1}^{n}Var(Y_{1i}) + \sum_{i\neq j}Cov(Y_{1i}, Y_{1j})\right) = \frac{1}{n^2}\sum_{i=1}^{n}\sigma_1^2 = \sigma_1^2/n$$

$$Var(aX) = a^2Var(X)$$

$$Var(X - Y) = Var(X) + Var(Y) - 2Cov(X, Y)$$

$$Var\left(\bar{Y}_1 - \bar{Y}_2\right) = Var\left(\bar{Y}_1\right) + Var\left(\bar{Y}_2\right)$$

$$Var\left(\bar{D}\right) = Var\left(\frac{1}{n}\sum_{i=1}^{n}D_i\right) + \frac{1}{n^2}Var\left(\sum_{i=1}^{n}D_i\right) = \frac{1}{n^2}\sum_{i=1}^{n}Var(D_i)$$

$$= \frac{1}{n}Var(D_1) = \frac{1}{n}Var(Y_{11} - Y_{21}) = \frac{1}{n}\left(Var(Y_{11}) + Var(Y_{21}) - 2Cov(Y_{11}, Y_{21})\right)$$

$$= \sigma_1^2/n + \sigma_2^2/n - 2Cov(Y_{11}, Y_{21})/n = \sigma_D^2/n$$

$$Var\left(\bar{D}\right) = \sigma_1^2/n + \sigma_2^2/n - 2Cov(Y_{11}, Y_{21})$$

$$E\left(\bar{D}\right) = \mu_D$$

$$E\left(\bar{Y}_1 - \bar{Y}_2\right) = \mu_D$$

$$Z = \frac{\bar{Y} - \mu}{\sigma/\sqrt{n}} \xrightarrow{d} N(0, 1)$$

$$\bar{Y} \sim N(\mu, \sigma^2/n)$$

$$\sigma_D^2$$

$$\bar{D} \sim N(\mu_D, \sigma_D^2/n)$$

$$T = \frac{\bar{D} - \mu_D}{S_D/\sqrt{n}} \sim t_{n-1}$$