1a. $P(F_{17,20} > f) = 0.05 \therefore f = 2.17$

b. $P(F_{5,15} > f) = 0.025 \therefore f = 3.58$

c. $F_{0.01(1),30,3} = 26.5$

d. $P(F_{3,30} > f) = 0.99 \therefore f = \frac{1}{F_{0.01(1),30,3}} = \frac{1}{26.5} = 0.038$

2. $n_1 = n_2 = [3, 4, 5, 6, 10]$

$\alpha(1) = 0.05$

$1-\beta = 0.75 \therefore \beta = 0.25$ (always 1-sided)

$\frac{\delta}{s} = \sqrt{\frac{2}{n}}\left(t_{\alpha,2\nu} + t_{\beta,2\nu}\right)$

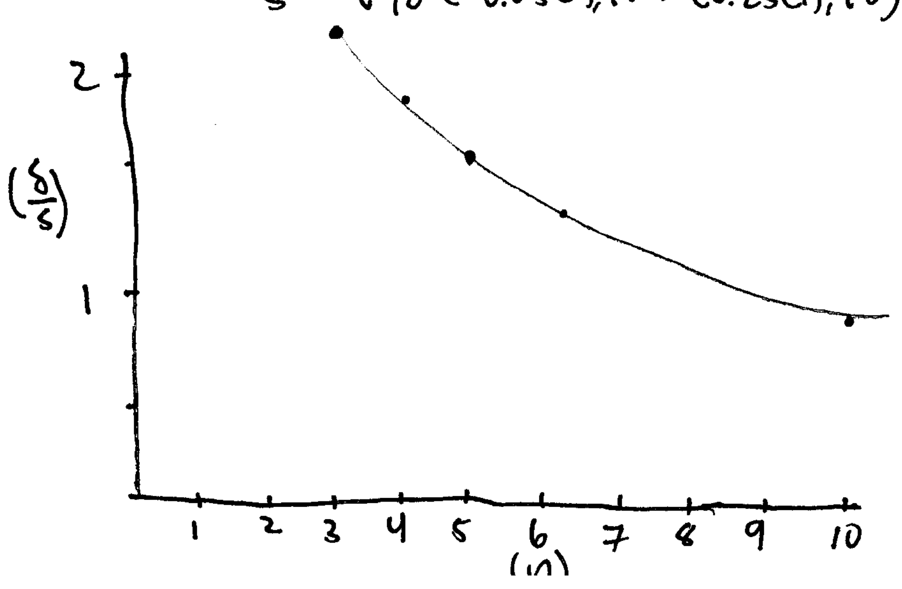
for $n=3$ $\frac{\delta}{s} = \sqrt{\frac{2}{3}}\left(t_{0.05(1),4} + t_{0.25(1),4}\right) = \sqrt{\frac{2}{3}}(2.132 + 0.741) = 2.324$

for $n=4$ $\frac{\delta}{s} = \sqrt{\frac{2}{4}}\left(t_{0.05(1),6} + t_{0.25(1),6}\right) = \sqrt{\frac{2}{4}}(1.943 + 0.718) = 1.882$

for $n=5$ $\frac{\delta}{s} = \sqrt{\frac{2}{5}}\left(t_{0.05(1),8} + t_{0.25(1),8}\right) = \sqrt{\frac{2}{5}}(1.860 + 0.706) = 1.623$

for $n=6$ $\frac{\delta}{s} = \sqrt{\frac{2}{6}}\left(t_{0.05(1),10} + t_{0.25(1),10}\right) = \sqrt{\frac{2}{6}}(1.812 + 0.700) = 1.450$

for $n=10$ $\frac{\delta}{s} = \sqrt{\frac{2}{10}}\left(t_{0.05(1),18} + t_{0.25(1),18}\right) = \sqrt{\frac{2}{10}}(1.734 + 0.688) = 1.083$



Based on the graph, a sample size of $n = 5$ or 6 would be good since there is not a substantial decrease in $\frac{\delta}{s}$ after that point.

3\. a. $H_o: \mu_{drug} - \mu_{placebo} \le 0$ or $\mu_d \le 0$

$H_a: \mu_{drug} - \mu_{placebo} > 0$ or $\mu_d > 0$

where μ_d is $\mu_{drug} - \mu_{placebo}$

b. $t = \dfrac{\bar{d}}{s_{\bar{d}}}$ $\bar{d} = 0.98$ $s_d^2 = 2.968$

$$s_{\bar{d}} = \sqrt{\frac{2.968}{10}} = 0.545$$

$$t_{obs} = \frac{0.98}{0.545} = 1.799$$

$t_{crit} = t_{0.10(1),9} = 1.383$ ∴ Reject Ho.

$0.05 < P < 0.10$ [not necessary in prob.]

There is evidence to suggest the drug produces additional sleep.

4a. $H_o: \sigma_1^2 = \sigma_2^2$ species 1 : $s_1^2 = 0.221$

$H_a: \sigma_1^2 \neq \sigma_2^2$ species 2 : $s_2^2 = 0.46056$

put larger variance on top for 2-sided hypothesis.

$$F_{obs} = \frac{0.46056}{0.221} = 2.084$$

$F_{crit} = F_{0.05(2),9,9} = 4.03$ ∴ Do not reject Ho.

There is not evidence to suggest the two species have different varieance, i.e. the two populations may have the same variance.

4b. $\bar{X}_1 - \bar{X}_2 \pm t_{\alpha(2),\nu} \, s_{\bar{X}_1-\bar{X}_2}$

species1: $\bar{X}_1 = 2.81$ $\quad\quad \nu = \nu_1 + \nu_2 = 9+9 = 18$

species2: $\bar{X}_2 = 2.55$

$t_{0.05(2),18} = 2.101$

$$s_{\bar{X}_1-\bar{X}_2} = \sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}$$

$$s_p^2 = \frac{SS_1 + SS_2}{\nu_1 + \nu_2} = \frac{1.989 + 4.145}{18} = 0.34078$$

$$s_{\bar{x}_1-\bar{x}_2} = \sqrt{\left(\tfrac{2}{10}\right)(0.34078)} = 0.261$$

$$\bar{x}_1 - \bar{X}_2 \pm t_{\alpha(2),\nu} \cdot s_{\bar{x}_1-\bar{x}_2}$$

$$2.81 - 2.55 \pm (2.101)(0.261)$$

95% CI $[-0.288, 0.808]$

Note: will also accept $[-0.808, 0.288]$ since we are not given an indication of which direction to subtract the means.