STAT 13, section 1, Winter 2011, UCLA Statistics
HW 6; Problem Solutions

As we define "difference in means of two population", we can use either $\mu_B - \mu_A$ and $\mu_A - \mu_B$. The two are different in 'sign' in the result, but the conclusions are same. Here, we use $\mu_B - \mu_A$ as SOCR does.

HW 6.1

Let A: Thymus gland weight 14 days and B: Thymus gland weight 15 days.

(a) T test at $\alpha = 0.10$

$H_0 : \mu_A = \mu_B$ or $\mu_B - \mu_A = 0$

$$T_0 = \frac{(\bar{x}_B - \bar{x}_A) - (\mu_B - \mu_A)}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}} = \frac{-2.5}{\sqrt{\frac{8.73^2 + 7.19^2}{5}}} = -0.494$$

$T_0 \sim T_{df}$ with $df = n_A + n_B - 2 = 8$

Since $|T_0| < T_{8,0.05} = 1.86$, we do not reject the null hypothesis at 0.10 level. (Or, we can also conclude with p-value.)

(b) We need plausible biological explanations of the counterintuitive smaller glands for older chicks - one would expect the gland size to increase with incubation days. However, in reality, the gland development may be more critical in the early incubation stage (hence initial rapid gland development) than in the later incubation stages (hence smaller glands). According to the article (see link: http://en.wikipedia.org/wiki/Thymus): Upon atrophy, the size and activity are dramatically reduced, and the organ is primarily replaced with fat (a phenomenon known as "organ involution").

(c)

Result of Two Independent Sample T-Test:

Variable 1 = C2
Sample Size = 5
Sample Mean = 31.720
Sample Variance = 76.197
Sample SD = 8.729

Variable 2 = C3
Sample Size = 5
Sample Mean = 29.220
Sample Variance = 51.677
Sample SD = 7.189

Degrees of Freedom = 8
T-Statistics (Unpooled) = -.494
One-Sided P-Value (Unpooled) = .317
Two-Sided P-Value (Unpooled) = .634

Since the p value = 0.634 is greater than $\alpha = 0.10$, we can't reject the null hypothesis at 0.10 level, which support the result we got in part (a).

HW 6.2

Let A: Control and B: Soap.

(a)

T test at $\alpha = 0.10$

$H_0 : \mu_A = \mu_B$ or $\mu_B - \mu_A = 0$

$$T_0 = \frac{(\bar{x}_B - \bar{x}_A) - (\mu_B - \mu_A)}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}} = \frac{-9.4}{\sqrt{\frac{15.6^2}{8} + \frac{22.8^2}{7}}} = -0.91$$

$T_0 \sim T_{df}$ with $df = n_A + n_B - 2 = 13$

Since $|T_0| < T_{13,0.05} = 1.771$, we do not reject the null hypothesis at 0.10 level. (Or, we can also conclude with p-value.)

(b) Since $|T_0| < T_{13,0.05} = 1.771$, we do not reject the null hypothesis. That is, the mean number of bacteria in dishes with soap and those with water are not significantly different at 0.10 level.

(c)

Result of Two Independent Sample T-Test:

Variable 1 = C2
Sample Size = 8
Sample Mean = 41.750
Sample Variance = 244.500
Sample SD = 15.636

Variable 2 = C3
Sample Size = 7
Sample Mean = 32.429
Sample Variance = 521.286
Sample SD = 22.832

Degrees of Freedom = 13
T-Statistics (Unpooled) = -.910
One-Sided P-Value (Unpooled) = .190
Two-Sided P-Value (Unpooled) = .380

Since the p value = 0.380 is greater than $\alpha = 0.10$, we can't reject the null hypothesis at 0.10 level, which support the result we got in part (a).

HW 6.3

Let A: Ferulic acid in corn siddlings grown in the "Dark" and B: Ferulic acid in corn siddlings grown in the "Photo period".

(a) The scientific question would be "Is the mean concentration of Ferulic acid in corn siddlings grown in the "Dark" different from that of in "Photo period"?

The population parameter is the difference between mean of concentration of Ferulic acid in corn siddlings grown in the "Dark" and that of in the "Photo period"($\mu_B - \mu_A$).

(b) 91% CI for $\mu_B - \mu_A$

$$(\bar{x}_B - \bar{x}_A) \pm t_{6,0.045}\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}} = -23 \pm 2.019\sqrt{\frac{13^2}{4} + \frac{13^2}{4}} = (-41.56, 4.44)$$

(One can use approximately $t_{6,0.05} = 1.943$ in the SOCR T-distribution table.)

83% CI for $\mu_B - \mu_A$

$$(\bar{x}_B - \bar{x}_A) \pm t_{6,0.085}\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}} = -23 \pm 1.559\sqrt{\frac{13^2}{4} + \frac{13^2}{4}} = (-37.33, -8.67)$$

(One can use approximately $t_{6,0.1} = 1.440$ in the SOCR T-distribution table.)

<u>HW6.4</u>

Let A: Successful and B: Unsuccessful

(a) 90% C.I

$$(\bar{x}_B - \bar{x}_A) \pm t_{37,0.05}\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}} = -0.059 \pm 1.687\sqrt{\frac{0.289^2}{22} + \frac{0.262^2}{17}} = (-0.208, 0.090)$$

(One can use approximately $t_{30,0.05} = 1.697$ in the SOCR T-distribution table.)

(b) We are 90% confident that the difference in (population) head width means between two mating phenotype (successful and unsuccessful) in female Mormon cricket is between -0.208mm and 0.090mm.