http://www.stat.ucla.edu/~dinov/courses_students.dir/12/Winter/STAT13.1.dir/HWs.dir/HW06.html

STAT 13, section 1, Winter 2012, UCLA Statistics
HW 6; Problem Solution

- (**HW.6.1**) In a study of the development of the thymus gland, researchers weighted the glands of 10 chick embryos. Five of the embryos had been incubated for 14 days and five had been incubated for 15 days. The weights of the thymus glands are reported below.
  - Use the *T test* to compare the 2 group means at *a = 0.10*.
  - Note that the chicks that were incubated longer had smaller mean thymus gland. Explain this backwards result!
  - Compare your results agains the SOCR T-test Analysis applet.

Index	**Thymus Grand Weight 14 days**	**Thymus Grand Weight 15 days**
1	29.6	32.7
2	21.5	40.3
3	28	23.7
4	34.6	25.2
5	44.9	24.2
n	**5**	**5**
y¯	**31.72**	**29.22**
S	**8.73**	**7.19**

SOLUTION:

We compare 2 group means via the T-test (un-pooled) at alpha = 0.10

Mean of Group A (14 days): μ_A

Mean of Group B (15 days): μ_B

Null Hypothesis: $H_0: \mu_A = \mu_B \;\; or\ equivalently \;\; \mu_B - \mu_A = 0$

Test Statistic under Null Hypothesis:

$$T_0 = \frac{(x_B - x_A) - (\mu_B - \mu_A)}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_b^2}{n_B}}} = \frac{-2.5}{\sqrt{\frac{8.73^2 + 7.19^2}{5}}} = -0.494$$

$T_0 \sim T_{df}\ with\ df\ = n_A + n_B - 2 = 8\ \ and\ \ \alpha = 0.10$

Since $|T_0| < T_{8,0.05} = 1.86$, we do not reject the null hypothesis at 0.10 level. (p value = 0.634 is greater than α = 0.10 , we can't reject the null hypothesis at 0.10 level)

A plausible explanation for the difference in gland development may be due to Thymus Gland development is more critical in the early incubation stage (hence initial rapid gland development) than in the later incubation stages (hence smaller glands).

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- (**HW.6.2**) The table below contains the number of bacteria colonies present in each of several petri dishes after *E. Coli* bacteria were added to the dishes and they were incubated for 24 hours. The "soap" dishes contained a solution prepared from ordinary "soap" the "control" dishes contained a solution of sterile water.
  - Use the *T-test* to investigate soap affects on the number of bacteria colonies that form (use $a = 0.10$).
  - State your conclusions in the context of the study.
  - Compare your results against the SOCR T-test Analysis applet.

SOLUTION:

We compare 2 group means via the T-test (un-pooled)at alpha = 0.10

Mean of Group A (Control): μ_A

Mean of Group B (Soap): μ_B

Null Hypothesis: $H_0: \mu_A = \mu_B$ *or equivalently* $\mu_B - \mu_A = 0$

Test Statistic under Null Hypothesis:

$$T_0 = \frac{(x_B - x_A) - (\mu_B - \mu_A)}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_b^2}{n_B}}} = \frac{-9.4}{\sqrt{\frac{15.6^2}{8} + \frac{22.8^2}{7}}} = -0.91$$

$T_0 \sim T_{df}$ *with* $df = n_A + n_B - 2 = 13$ *and* $\alpha = 0.10$

Since $|T_0| < T_{13,0.05} = 1.771$, we do not reject the null hypothesis at 0.10 level. (p value = 0.380 is greater than α = 0.10 , we can't reject the null hypothesis at 0.10 level)

- (**HW.6.3**) Ferulic acid is a compound that may play a role in disease resistance in corn. A botanist measured the concentration of soluble ferulic acid in corn seedlings grown either in the dark or in a light/dark photo period. The results (nmol acid per g of tissue) are shown in the table.
  - What is a reasonable scientific question to ask for this study? Identify the critical population parameter of interest?
  - Construct a 91% CI(parameter)
  - Construct a 83% CI (Parameter)

	Sample Mean	**Sample Standard Deviation**	**Sample Size**
Dark	92	13	4
Photo period	115	13	4

SOLUTION:

Is the mean concentration of Ferulic acid (found in corn seedlings) different for the two populations? The corn seedlings grown in the dark and the corn seedlings exposed to light/dark photo period.

Mean of Group A (Dark): μ_A

Mean of Group B (Light/Dark): μ_B

We want to construct a Confidence Interval around $\mu_B - \mu_A$

91% C.I. for $\mu_B - \mu_A$

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

(One can approximately use $t_{6,0.05} = 1.943$)

83% C.I. 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 approximately use $t_{6,0.1} = 1.440$)

- (**HW.6.4**) In a field study of mating behavior in the Mormon cricket (Anabrus simplex), a biologist noted that some females mated successfully while others were rejected by the males before coupling was complete. The question arose whether some aspect of body size might play a role in mating success. The data below summarizes (sample size, mean and standard deviation) measurements of head width (mm) for the two female phenotypes (successful or unsuccessful mating).
    - Construct a 90% confidence interval for the difference in population means
    - Interpret your CI in the context of the study.

Mating Behavior Phenotype	SmapleSize	SampleMean	SampleSD
Successful	22	8.500	0.289
Unsuccessful	17	8.441	0.262

SOLUTION:

Mean of Group A (Successful): μ_A

Mean of Group B (Unsuccessful): μ_B

We want to construct a Confidence Interval around $\mu_B - \mu_A$

90% C.I. for $\mu_B - \mu_A$

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

(One can approximately use $t_{30,0.05} = 1.697$)

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