M E 345

Lecture 15

Today, we will:

- Do example problems hypothesis test with two independent samples
- Review the pdf module: Digital Data Acquisition, and do some example problems

Example: Hypothesis testing

Given: [Continuation of previous example] We buy a gadget that is supposed to increase the gas mileage of our car. We take 6 trips *without* the gadget and 8 trips *with* the gadget. We do not attempt to pair up the tests. The results:

x_A (mpg without gadget)	x_B (mpg with gadget)	
25.6	26.2	We ran 2 more
27.3	27.1	tests with the
24.2	24.1	gadget
28.7	29.2	installed
23.6	24.5]
25.1	24.9] /
	26.5	
	25.8]

To do: Determine if there is a statistically significant improvement (increase) in gas mileage.

Solution:

We did this problem "by hand" in the previous lecture. Today I will show you how to do it in Excel, using the built-in macro.

Summary of the "by hand" procedure- see previous lecture notes for details:

- 1. Calculate the critical t statistic using equation in notes. Get $\underline{t = -0.2941}$.
- 2. Calculate df from **Welch's equation**. Get df = 10.
- 3. For these values of t and df, one tail, calculate or look up the p-value. Get p = 0.3873.
- 4. The final conclusion is that we are 61.3% confident that the gadget increases our gas mileage.
- 5. Since 61.3% < 95%, we cannot accept the claim (to standard engineering confidence level) that this gadget increases our gas mileage.

In practice, since these kinds of problems are very common, there is an Excel macro to do all the calculations for us. Click on: <u>Data-Data Analysis-t-Test: Two-Sample Assuming Unequal Variances</u>.

See Excel spreadsheet on website: **Two_samples_t_test_different_n.xls**

[I also do this problem in Matlab – see website for Matlab file.]

See another example Excel file, posted on course website (compare final scores in a course).

Example: Digital data acquisition

Given: The integer 18 (base 10).

To do: Write this integer in 8-bit binary format.

Solution:

Example: Digital data acquisition

Given: The integer 0010 0110 (8-bit binary).

To do: Write this integer in base 10 format.

Solution:

Example: Digital data acquisition

Given:Two integers in 8-bit binary format: $A = 0010\ 0110$ and $B = 1000\ 0100$.To do:Add A + B and write the result in base 10 format and in binary format.ColoridationColoridation

Solution:

Example: Digital data acquisition

Given: A voltage signal ranges from -1.2 to 1.4 volts. A digital data acquisition system is to be chosen – four choices are available:

- (a) 12-bit A/D range = -10 to 10 V
- (b) 8-bit A/D range = -2 to 2 V
- (c) 10-bit A/D range = -5 to 5 V
- (d) 14-bit A/D range = -1 to 1 V

To do: Determine which system is the best choice for this application, assuming that cost is irrelevant (all four are available in the lab).

Solution: