Exploring Significance Tests

Significance tests are used when a claim is to be tested. For example, suppose a manufacturing line produces tires that have tread measurements with a mean of 3 cm. After receiving some complaints, the manager begins to suspect that the tires' tread is actually, on average, smaller than 3 cm. To test this claim, the manager decides to do a significance test. He knows that the tires are supposed to have approximately 3 cm of tread. Based on this known average, he randomly samples 30 tires and measures the tread. Before he samples the tires he determines his hypotheses. The **null hypothesis**, H_0, is the hypothesis based on the "established" mean. The **alternative hypothesis**, H_a, is the hypothesis based on the claim that the mean tire tread is actually less than the "established" mean. When the manager measures the randomly selected 30 tire treads, he gets the measurements found in the following table.

Tire Tread (cm)	Tire Tread (cm)	Tire Tread (cm)
2.808	2.560	2.975
3.056	2.728	2.470
2.780	2.748	2.893
2.702	2.740	2.530
2.990	3.075	2.943
2.697	2.913	2.799
2.804	2.654	2.566
2.794	2.843	3.032
2.591	2.869	2.898
2.625	2.902	2.932

1. Open a new document and add a lists & spreadsheet.
2. Enter the data for tire tread in column A and name it **tiretread**.
3. Add a Data & Statistics page and create an appropriate histogram.

Describe the histogram of the 30 measures.

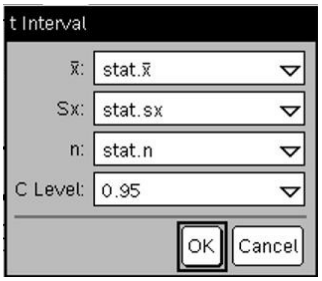
4. Add a Calculator page and calculate the One Variable statistics on **tiretread**.

List the mean, $\bar{x}$ and standard error, s_x. Compare the mean to the known parameter. Do you think the manufacturing line is producing tires with treads less than 3 cm?

Calculate a 95% confidence interval based on $\bar{x}$ and s_x by hand. Show your work here.

5. Verify this interval using the handheld. Go to the Calculator page and press (menu), *Statistics*, *Confidence Intervals*, *t interval*.

6. After selecting t-interval, choose to enter **stats** and (tab) to OK.



7. In the next menu box, select *stat.* $\bar{x}$ for xbar, *stat.sx* for Sx, and 30 (or *stat.n*) for n, and make sure the C level (confidence) is 0.95. (tab) to OK. The confidence interval should now be displayed.

Does your interval match the one calculated by the handheld? If not, make sure the values have been typed in correctly.

Based on this interval, what would your conclusion be concerning the manufacturing line and the tire treads?

When we do a significance test, we need to follow 4 steps: 1) State the hypotheses and identify the population of interest and the parameter you want to make conclusions about, 2) Choose the test and verify the conditions for its use, 3) Calculate the test statistic which is based on the hypothesized mean and find the p-value, and 4) Interpret the results in the context of the problem based on this p-value.

1) **Identify the population and parameter you want to draw conclusions about. State the hypotheses.**

   Population:
   Parameter:
   H_0 :
   H_a :

2) **Choose an appropriate inference procedure. Verify the conditions for using it.**

   Inference procedure?

   Why can we use it?

3) **Calculate the test statistic and find the p-value.**

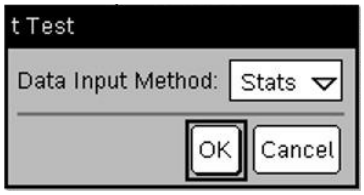
4) **Interpret the results in the context of the problem.**

8. The handheld can help you calculate the p-value from step 3 of a significance test. You can calculate the p-value using the handheld. Once you have calculated the test statistics, using normalcdf(-1E99, z), you will get the p-value.

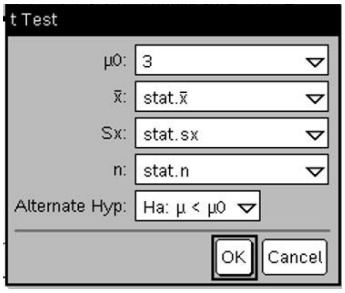
9. You can also use your handheld to do a significance test; **HOWEVER**, it is up to YOU to follow the **full** 4 steps to receive **full** credit.

10. Using your handheld, verify the results from your 3rd step. One the calculator page, press (menu), *Statistics*, *Distributions*, *t test*.

11. Select **stats** and (tab) to OK.



12. In the *t*-test menu enter the values in the box to the right.



13. Press enter and the following output will be displayed.

"Title"	"t Test"
"Alternate Hyp"	"μ < μ0"
"t"	-6.49843
"PVal"	2.04889E-7
"df"	29.
"x̄"	2.7849
"sx := sn-1x"	0.181298
"n"	30.

Notice the test statistics and PVal.

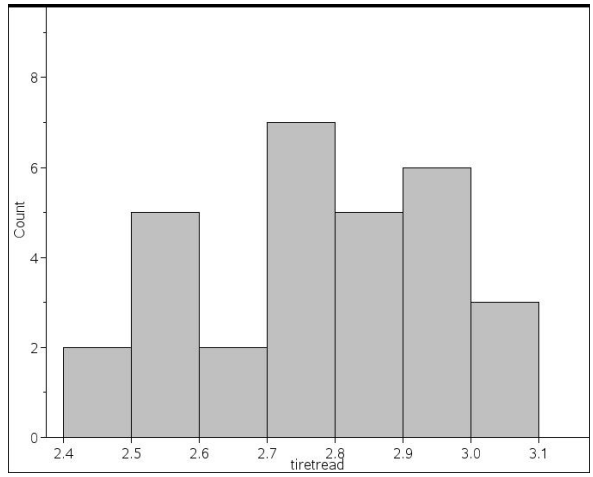
Are these the same as your significance test from above? If not, find your error.

<u>IMPORTANT:</u> Whenever you are asked to provide evidence for or against a claim, or to provide support, you are being asked to complete a ***significance test***.

Here are the screens that the student should generate on their handheld.

	A tiretread	B	C
◆			
1	2.808		
2	3.056		
3	2.78		
4	2.702		
5	2.99		
6	2.697		

A tiretread



OneVar *tiretread*,1: *stat.results*

"Title"	"One−Variable Stat
"x̄"	2.7849
"Σx"	83.547
"Σx²"	233.623
"sx := sn-1x"	0.181298
"σx := σnx"	0.178251
"n"	30.
"MinX"	2.47

3/3

1.1 1.2 1.3 *Significance...sts

"Title"	"t Interval"
"CLower"	2.7172
"CUpper"	2.8526
"x̄"	2.7849
"ME"	0.067698
"df"	29.
"sx := sn-1x"	0.181298
"n"	30.

2/99

1.1 1.2 1.3 *Significance...sts

"Title"	"t Test"
"Alternate Hyp"	"μ < μ0"
"t"	−6.49843
"PVal"	2.04889E−7
"df"	29.
"x̄"	2.7849
"sx := sn-1x"	0.181298
"n"	30.

3/99