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## LESSON 12 - HYPOTHESIS TESTING; LARGE SAMPLE

Suppose the data in the worksheet K:\Minitab16\Sample Data\Bears.MTW is from the bears in a particular state. The mean length of the bears used to be 63 inches, but because of hunting of the larger, more prized bears, the state game warden claims that the mean length is now less than 63 inches. Using the data in the above-named worksheet, test the warden's claim by the P-Value method.

Open the required file. Then clear the session window below the date/time stamp. Type in your name, Lesson 12, Example, and the definition of the variable ( $X$  = the length of a bear). We need to compute the standard deviation before we can do our hypothesis testing, so display the descriptive statistics for the variable Length as we did in Lesson 6. Notice that  $n = 143 > 30$ , so we are justified in using the normal distribution by the Central Limit Theorem.

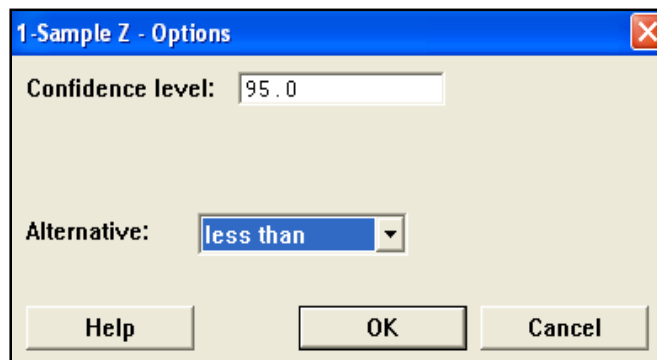
Our hypotheses in this case would be

$$H_0: \mu \geq 63$$

$$H_a: \mu < 63$$

but we will not type them since Minitab will print something equivalent to this in the Session Window when we run the tests.

At this point click on **Stat > Basic Statistics > 1-Sample Z** (recall that we saw this dialog box in Lesson 11). Select Length into the "Samples in columns:" box, type the standard deviation into the "Standard deviation:" box (9.352 in this case), check the "Perform hypothesis test" box and type the value of  $\mu$  from the null



hypothesis into the "Hypothesized mean:" box (63 in this case). Now click on "Options" and make the appropriate choice from the "Alternative:" menu. In this case we choose "less than" because the alternative hypothesis is  $<$ . See image above. The value in the "Confidence level:" box is not relevant since we will be using the P-Value approach, so the reader will determine  $\alpha$ . Click "OK" to close the options dialog box then click "OK" to perform the test.

Notice that Minitab gives us both the value of Z and the P-Value. Since we are using the P-Value approach, there is nothing more for the researcher to do. If we now take the role of the reader, what decision would we make if we choose  $\alpha$  to be:

- a) 10%?
- b) 5%?
- c) 1%?

Type your responses in the Session Window. The results are shown below.

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Lesson 12  
Example

X = length of a bear

**Results for: Bears.MTW**

**Descriptive Statistics: Length**

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3
Length	143	0	61.283	0.782	9.352	36.000	57.000	61.000	67.500

Variable Maximum  
Length 83.000

**One-Sample Z: Length**

Test of mu = 63 vs < 63  
The assumed standard deviation = 9.352

Variable	N	Mean	StDev	SE Mean	95% Upper Bound	Z	P
Length	143	61.283	9.352	0.782	62.569	-2.20	0.014

a) Since  $P = 0.014 < 0.10$ , we would reject  $H_0$  at the 10% level of significance.

b) Since  $P = 0.014 < 0.05$ , we would reject  $H_0$  at the 5% level of significance.

c) Since  $P = 0.014 > 0.01$ , we would not reject  $H_0$  at the 1% level of significance.  
This means there is not enough evidence at the 1% level of significance to conclude that the mean length of bears is significantly less than 63.

As was the case with confidence intervals in Lesson 11, we may find it necessary to use "Summarized data". Consider, for example, Problem 40 on page 392. Start a new instance of Minitab and add your name, etc. as usual. Define the variable  $X$  = caffeine content per 8 ounces. Click Stat > Basic Statistics > 1-Sample Z, then click on "Summarized data". Enter 42 for "Sample size:" 146 for "Mean:" 22 for "Standard deviation:", and 140 for "Test mean:". Finally, "Alternative:" must be set to "not equal" in the "Options" dialog box. The results with an answer are shown below.

————— 8/11/2009 8:31:28 PM —————

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Example

X = Caffeine content per 8 ounces

**One-Sample Z**

Test of mu = 140 vs not = 140  
The assumed standard deviation = 22

N	Mean	SE Mean	95% CI	Z	P
42	146.00	3.39	(139.35, 152.65)	1.77	0.077

Since  $P = 0.077 > 0.05$ , we fail to reject  $H_0$  at the 5% level of significance.  
At the 5% level of significance, there is insufficient evidence to reject the coffee shop's claim that its fresh-brewed drinks have a mean caffeine content of 140 milligrams per 8 ounces.

## MINITAB ASSIGNMENT 12

**See instructions on page 8.**

1. Using the data from Problem 67 on page 322 test the claim that the mean annual precipitation is greater than 15 inches. (Note: You should have this worksheet on your disk or J:\ drive from Minitab Assignment 11.)  
What decision should you make if you choose alpha to be:  
(a) 0.10?  
(b) 0.05?  
(c) 0.01?  
Interpret each of your results in the context of the claim. Type your answers in the session window.
2. Do problem 39 on page 392

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