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MAT 222

Spring 2019

Minitab Lab 2

“What do you do when you’re angry?’ ‘Math’. ‘Ok. . . What about when you’re sad?’ ‘Math’. ‘Happy?’ ‘Ma-aaath!’ ‘So every feeling you have makes you want to do Math?’ ‘I do not know if it is so much cause and effect. . . I do a lot of Math. The feelings come and go.’”

–Phineas & Baljeet, Phineas and Ferb

The following exercises make use of the `abalone.mpj` file. This data is from a study by Dr. Sam Waugh’s Ph.D. thesis at the University of Tasmania. The goal of the study was to study whether one could predict the age of abalone using physical measurements. The variables in the study were sex (male, female, and infant), length (mm), diameter (mm), height (mm), whole weight (g), shucked weight (g), viscera weight (g), shell weight (g), and rings (each ring is 1.5 years). Use Minitab to complete the following exercises.

**Problem 1:** Construct a 97% confidence interval for the variable ‘Rings’. Fill in the results below.

Sample Average:	<u>9.9337</u>	d.o.f.:	<u>4176</u>
Sample StDev:	<u>3.2242</u>	Lower Confidence Value:	<u>9.8254</u>
n:	<u>4177</u>	Upper Confidence Value:	<u>10.0420</u>

**Problem 2:** Write your conclusion from the confidence interval you obtained in the previous problem.

*We are 97% sure that the average number of rings for abalones is between 9.8254 and 10.0420.*

**Problem 3:** Using a significance level of 3%, test the following hypothesis about the variable ‘Rings’:  $H_0 : \mu = 10$  versus  $H_a : \mu > 10$ ; that is, test whether it is likely that the average number of rings an abalone has is 10 or if it is more than 10. Fill in your results below and write your conclusions.

Sample Average:	<u>9.9337</u>	d.o.f.:	<u>4176</u>
Sample StDev:	<u>3.2242</u>	Test Statistic:	<u>-1.33</u>
n:	<u>4177</u>	p-value:	<u>0.908</u>

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C L Blake, C J Merz. UCI repository of machine learning databases University of California, Irvine, Department of Information and Computer Sciences. 1998, Sam Waugh (1995) "Extending and benchmarking Cascade-Correlation", PhD thesis, Computer Science Department, University of Tasmania.

Because  $p \not\leq \alpha = 0.03$ , we fail to reject the null hypothesis that  $\mu = 10$ , i.e. the data is consistent with the possibility that the average number of rings an abalone has is 10.

Now unstack the variable 'Whole Weight' so that you have a column called 'Female Whole Weight' and a column called 'Male Whole Weight'. Use this sorted data to answer the next two questions.

**Problem 4:** Test whether there is a difference in the weight between female and male abalone. To do this, perform a two-sample  $t$ -test using the unstacked columns you created. Test the hypothesis:

$$\begin{cases} H_0 : \mu_{\text{females}} = \mu_{\text{males}} \\ H_a : \mu_{\text{females}} \neq \mu_{\text{males}} \end{cases}$$

Use a significance level of 3%. Fill in the data below and state your conclusions.

Sample Average (Females): 1.047                      Sample Average (Males): 0.991  
 Sample StDev (Females): 0.430                      Sample StDev (Males): 0.471  
 $n$  (Females): 1307                                       $n$  (Males): 1528  
 Difference Estimate: 0.0551                      d.o.f.: 2820  
 Test Statistic: 3.25                       $p$ -value: 0.001

Because  $p < \alpha = 0.03$ , we reject the null hypothesis that on average female and male abalone weight the same.

**Problem 5:** Again, test whether there is a difference in the weight between female and male abalone, using the same significance level and hypotheses as in the previous problem. However, this time used a pooled  $t$ -test. Fill in the data below and state your conclusions. Also, justify why a pooled  $t$ -test may be appropriate in this case.

Sample Average (Females): 1.047                      Sample Average (Males): 0.991  
 Sample StDev (Females): 0.430                      Sample StDev (Males): 0.471  
 $n$  (Females): 1307                                       $n$  (Males): 1528  
 Difference Estimate: 0.0551                      d.o.f.: 2833  
 Test Statistic: 3.23                       $s_p$ : 0.4525  
 $p$ -value: 0.001

Because  $p < \alpha = 0.03$ , we reject the null hypothesis that on average female and male abalone weight the same. We might consider a pooled  $t$ -test in this case because  $0.5 < s_{females}/s_{males} = 0.913 < 2$ .

In the Minitab menu, go to Calc→Calculator. Under ‘Expression’, enter Length–Height and store the results in a column labeled ‘Differences’. We shall use this column to test whether abalone are as tall as they are long.

**Problem 6:** Perform an appropriate statistical test to test the following null and alternative hypotheses:

$$\begin{cases} H_0 : \mu = 0 \\ H_a : \mu \neq 0 \end{cases}$$

Draw your conclusions using  $\alpha = 0.03$ . Fill in the data from your test below and state your conclusions.

Sample Average:	<u>0.38448</u>	d.o.f.:	<u>4176</u>
Sample StDev:	<u>0.08865</u>	Test Statistic:	<u>280.31</u>
$n$ :	<u>4177</u>	$p$ -value:	<u>0.000</u>

Because  $p < \alpha$ , we reject the null hypothesis. The data suggests abalones have different average height and lengths (they seem to be longer than they are tall).

**When turning this assignment in, be sure to provide a Word document print off with all the statistical outputs from Minitab.**