**Math 155, Fall 2016**

**MINITAB Assignment #3 – Solutions & Comments**

**Minitab Assignment #3 Problems**

1. The mean weight of all babies born at Marvadel Hospital last year was 7.6 pounds. A random sample of 35 babies born at this Marvadel Hospital this year was selected, and the weight of each baby was recorded, as shown here:

8.2 9.1 6.9 5.8 6.4 10.3 12.1 9.1 5.9 7.3

11.2 8.3 6.5 7.1 8.0 9.2 5.7 9.5 8.3 6.3

4.9 7.6 10.1 9.2 8.4 7.5 7.2 8.3 7.2 9.7

6.0 8.1 6.1 8.3 6.7

Test at the 5% significance level whether the mean weight of all babies born at Marvadel Hospital this year is actually *higher than* 7.6 pounds.

**a) The hypotheses are as follows:**

$H\_{0}:μ=7.6$ **- The mean weight of all babies born at Marvadel Hospital is 7.6 pounds.**

$H\_{a}:μ> 7.6$ **- The mean weight of all babies born at Marvadel Hospital is higher than 7.6 pounds.**

**b) The alternative hypothesis (“greater than”) indicates a one-tailed test. Since our sample size is “large” (greater than 30), we may use a t-test.**

**c) From the Minitab output, the P-value is 0.145.**(Note: if you got 0.290 – which is double the correct answer – it is because you did not remember to set the alternative hypothesis under “options.” The built-in assumption is of a two-tailed test, unless you tell it otherwise!)

**d) The P-value is not less than 0.05. Therefore, at the** $α=0.05$ **level of significance, we do not have sufficient evidence to conclude that the mean weight of all babies born at Marvadel Hospital is higher than 7.6 pounds.**

2. A past study concluded that adults in America spend an average of 18 hours a week on leisure activities. A researcher wants to test the claim that this result is no longer correct. To do so, he selects a random sample of 20 adults and asks each of them how many hours they spend per week on leisure activities. Their responses are as follows.

 14 25 22 38 16 26 39 23 41 33

 41 38 40 38 1 40 53 2 1 44

Test at the 5% significance level whether the new data contradicts (in either direction) the result of the earlier study.

**a) The hypotheses are as follows:**

$H\_{0}:M=18$ **- Adults in America spend an average (median) of 18 hours a week on leisure activities.**

$H\_{a}:M\ne 18$ **- Adults in America do not spend an average of 18 hours a week on leisure activities.**

**b) The alternative hypothesis (“not equal to”) indicates a two-tailed test. Since none of the criteria for a t-test or a Wilcoxon Signed Rank Test are met, we will use a sign test for the median.** (Note: since we have a “small” sample size less than 30, we’d need to be able to assume a normally distributed population to justify using a t-test, or a symmetric distribution in order to use the Wilcoxon test. Since we’re not given a reason to believe either of these is true, we’re left with the “worst-case scenario,” which is the sign test.)

**c) From the Minitab output, the P-value is 0.0414.**

**d) The P-value is less than 0.05. Therefore, at the** $α=0.05$ **level of significance, we have sufficient evidence to contradict the result of the earlier study. In other words, we may conclude that the adults in America do *not* spend an average of 18 hours a week on leisure activities.**

(Comment: due to the two-tailed design of the test, we may not conclude that the average American adult spends more than 18 hours per week on leisure activities, even though the sample median is 35.5, which is much higher than 18. In order to conclude that the average American adult spends more than 18 hours per week on leisure activities, you’d need to *start* with an alternative hypothesis stating that the average is above 18, and *then* select your random sample to test your hypothesis. You can’t change your alternative hypothesis after the fact!)

3. A convenience-store owner guesses that he sells an average of about 40 snow cones per day. To test this claim, a random sample of 20 days yields the following data for the number of snow cones sold each day.

 18 43 40 16 22

 30 29 32 37 36

 39 34 39 45 28

 36 40 34 39 52

At α = .05, does the data shown here contradict the claim that an average of 40 snow cones are sold per day?

**a) The hypotheses are as follows:**

$H\_{0}:M=40$ **- Adults in America spend an average (median) of 18 hours a week on leisure activities.**

$H\_{a}:M\ne 40$ **- Adults in America do not spend an average of 18 hours a week on leisure activities.**

**b) The alternative hypothesis (“not equal to”) indicates a two-tailed test. Since none of the criteria for a t-test or a Wilcoxon Signed Rank Test are met, we will use a sign test for the median.** (Note: since we have a “small” sample size less than 30, we’d need to be able to assume a normally distributed population to justify using a t-test, or a symmetric distribution in order to use the Wilcoxon test. Since we’re not given a reason to believe either of these is true, we’re left with the “worst-case scenario,” which is the sign test.)

**c) From the Minitab output, the P-value is 0.0075.**

**d) The P-value is less than 0.05. Therefore, at the** $α=0.05$ **level of significance, we have sufficient evidence to contradict the owner’s claim In other words, we may conclude that the convenience store does *not* sell an average of 40 snow cones per day.**

4. A test of race car driving ability was given to a random sample of 10 student drivers before and after they completed a formal driver education course at the Daytona School of Racing. The results follow:

 Before 100 121 93 146 101 109 149 130 127 120

 After 136 129 125 150 110 138 136 130 125 129

The school claims that the course increases scores. Does the data support that claim? Test the school’s claim at the 0.05 significance level. If you want to develop the skills of a race car driver, does this course seem helpful?

Solution: We note that this is a paired samples test, due to the before-and-after setup. Therefore, we will be comparing the sample medians. In the answers below, we’ll use $M\_{1}$ for the “before” median test score, and $M\_{2}$ for the “after” median test score.

**a) The hypotheses are as follows:**

$H\_{0}:M\_{2}-M\_{1}=0$ **- The median score is the same before and after taking the course (in other words, the course does not have an effect on test scores).**

$H\_{a}:M\_{2}-M\_{1}>0$ **- The median score after taking the course is greater than the median score before taking the course (in other words, the course helps to increase test scores).**

**b) The alternative hypothesis (“not equal to”) indicates a two-tailed test. Since none of the criteria for a t-test or a Wilcoxon test are met, we will use a sign test for the differences.** (Note: since we have a small sample size, we’d need to be able to assume a normally distributed population to justify using a t-test, or a symmetric distribution of differences in order to use the Wilcoxon test. Since we’re not given a reason to believe either of these is true, we’re left with the “worst-case scenario,” which is the sign test.)

**c) From the Minitab output, the P-value is 0.0898.**

**d) The P-value is not less than 0.05. Therefore, at the** $α=0.05$ **level of significance, we do not have sufficient evidence to conclude that the driver education course helps to increase test scores.**

5. A researcher is testing to determine whether students who listen to classical music while studying do better on exams than students who listen to heavy metal music. A random sample of students who listen to each type of music while studying is selected; each student is given a standardized test after having studied for two hours while listening to his/her preferred music type. The summarized results are as follows:

Classical music listeners: Sample size: 46; mean score: 84.5; standard deviation of scores: 14.5

Heavy metal listeners: Sample size: 38; mean score: 80.8; standard deviation of scores: 12.3

Test at the 10% significance level whether this data supports the claim that students who listen to classical music while studying perform better on tests than students who listen to heavy metal while studying.

**Solution:** The study design here is two independent samples. Since both samples are “large” (sample sizes are both greater than 30), we may use a two-sample t-test for the difference between population means.

In the answers below, we’ll use $μ\_{1}$ to stand for the population mean score for classical music listeners, and $μ\_{2}$ to stand for the population mean score of heavy metal listeners.

**a) The hypotheses are as follows:**

$H\_{0}:μ\_{1}-μ\_{2}=0$ **- There is no difference between average test scores for classical music listeners and average test scores for heavy metal listeners.**

$H\_{a}:μ\_{1}-μ\_{2}>0$ **- The average test score for classical music listeners is higher than the average test score for heavy metal listeners.**

**b) The alternative hypothesis (“not equal to”) indicates a one-tailed test. Since we have “large” samples (sample sizes greater than 30), we may use a 2-sample t-test.**

**c) From the Minitab output, the P-value is 0.105.**

**d) The P-value is not less than 0.10. Therefore, at the** $α=0.10$ **level of significance, we do *not* have sufficient evidence to conclude that students who listen to classical music perform better on tests than students who listen to heavy metal music.**