Worksheet 10 – Chapter 6 – Hypothesis Testing

Name:______________________ Section: ________________

Use DDXL where appropriate for the following problems.

1. One operation of a steel mill is to cut pieces of steel into parts that are used in the frame for front seats in an automobile. The steel is cut with a diamond saw and requires the resulting parts must be cut to be within ± .005 inch of the length specified by the automobile company. The file STEEL contains a sample of 100 randomly selected steel parts. The measurement reported is the difference, in inches, between the actual length of the steel part, as measured by a laser measurement device, and the specified length of the steel part. For example, a value of -0.002 represents a steel part that is 0.002 inch shorter than the specified length.
   a. USE DDXL. At the 0.10 level of significance, is there evidence that the mean difference is not equal to 0.0 inches? (Give all parts for the hypothesis test: hypotheses, assumptions, testing using DDXL, and Summary).

$$H_0: \mu = 0$$
$$H_A: \mu \neq 0$$

μ = population mean difference between actual length and specified length

Assumptions:

1. Random sample from the population – stated in problem
2. $\bar{x}$ normally distributed → n>30

Count	100	**Ho:**	μ = 0
Mean	-2.3e-4	**Ha:**	2-tailed: μ ≠ 0
Std Dev	0.0017	**df:**	99
Std Error	1.696e-4	**t Statistic:**	-1.36
		p-value:	0.1781

Conclusion

Fail to reject Ho at alpha = 0.10

New Test

At the 5% significance level, the p-value (0.1781) is greater than alpha (0.05) therefore we do not reject H_0. There is insufficient evidence to suggest the population mean difference between actual length and specified length is different from 0.

b. USE DDXL. Construct a 90% confidence interval estimate of the population mean. Interpret this interval. Would it seem reasonable to have a mean difference equal to 0.0 inches? Why?

Count	Mean	Std Dev	df
100	-2.3e-4	0.0017	99

Confidence Interval

With 90% Confidence, $-5.116e-4 < \mu < 5.158e-5$

We are 95% confident that the true mean difference between actual length and specified length lies between -.0005 and .00005.

It would seem reasonable to have a population mean different equal to 0.0 inches since 0.0 is contained in the interval.

c. Compare the conclusions reached in (a) and (b).

The conclusions in part (a) and part (b) are identical. Both concluded that a mean difference of 0.0 is possible based on the sample selected.

2. The file FASTFOOD contains the amount that a random sample of nine customers spent for lunch ($) at a fast-food restaurant.

a. USE DDXL. At the 0.05 level of significance, is there evidence that the mean amount spent for all customers lunch is more than $5.00? (Give all parts for the hypothesis test: hypotheses, assumptions, testing using DDXL, and Summary).

$$H_0: \mu = \$5.00$$
$$H_A: \mu > \$5.00$$

μ = population mean amount spent for lunch in this fast food restaurant

Assumptions:

1. Random Sample selected from the population – stated in problem
2. $\bar{x}$ normally distributed – population approximately normal (see part b)

Count	9	**Ho:**	μ = 5
Mean	7.029	**Ha:**	Upper tail: μ > 5
Std Dev	1.812	**df:**	8
Std Error	0.604	**t Statistic:**	3.36
		p-value:	0.005

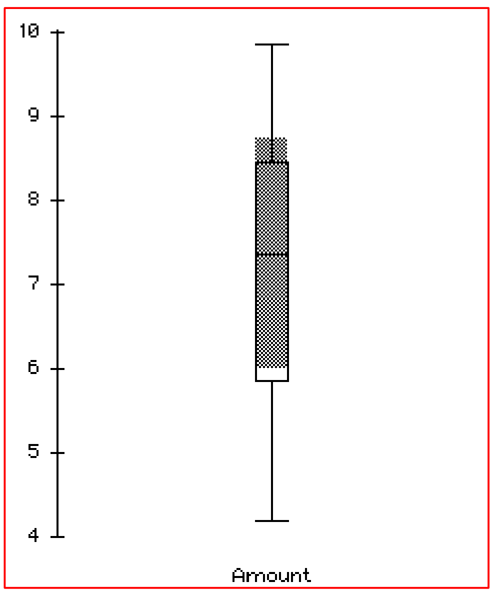
Conclusion

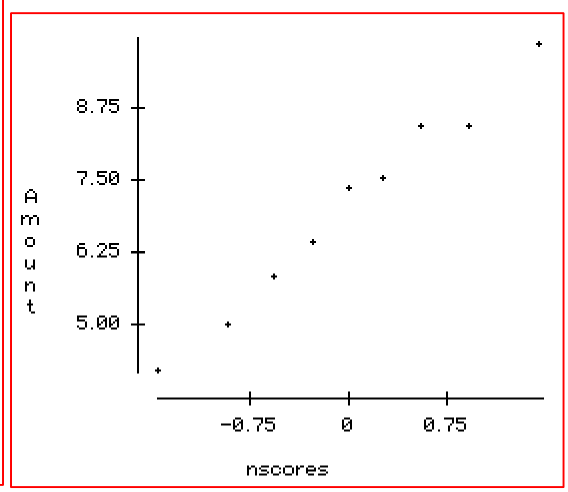
Reject Ho at alpha = 0.05

New Test

At the 5% significance level, the p-value (0.005) is less than alpha (0.05) therefore we reject H_0. There is sufficient evidence that the population mean amount spent for lunch at this fast food restaurant is greater than $5.00.

b. USE DDXL. Construct a boxplot or a normal probability plot to evaluate the assumptions you made.



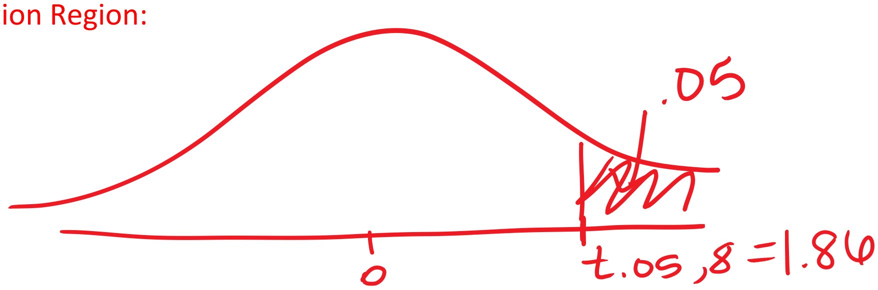


The boxplot does not have any outliers and seems relatively symmetric and the normal probability plot is approximately linear. There is no reason to assume the population amounts spent for lunch at this fast food restaurant.

c. Redo the *testing* step for part (a) using the Rejection Region approach. Do you end up with the same conclusions?

Test statistic: t = 3.36
Degrees of freedom = 8

Rejection Region:



d.f=8

At the 5% significance level my test statistic (3.36) falls in my rejection region therefore I reject H_0.
(Same conclusions as in part (a))

3. The US Department of Education reports that 46% of full-time college students are employed while attending college. A recent survey of 60 full-time students at Miami University found that 29 were employed.
    a. USE EXCEL. Create a file that corresponds to the raw sample data described in this problem.

    b. USE DDXL. Use a hypothesis test to determine whether the proportion of full-time students at Miami University that are employed is different from the national norm of 0.46.

$$H_0: p = 0.46$$
$$H_A: p \neq 0.46$$

p is the population proportion of full-time students for Miami University that are employed

Conditions:

1. Random Sample from the population – assume true (should be stated in problem)
2. $\hat{p}$ *normally distributed* - $np = (60)(0.46) = 27.6 \geq 15; nq = (60)(.54) = 32.4 \geq 15$

n	60	**p0:**	0.46
p-hat	0.483	**Ho:**	p = 0.46
Std Dev	0.0643	**Ha:**	2-tailed: p ≠ 0.46
		z Statistic:	0.36
		p-value:	0.7169

Conclusion

Fail to reject Ho at alpha = 0.05

New Test

At the 5% significance level, the p-value (0.7169) is greater than alpha (0.05) therefore I do not reject H_0. There is insufficient evidence to suggest the population proportion of full-time students at Miami University that are employed is different from .046.

c. If we assume that the study found that 36 out of the 60 full-time students were employed. What parts of part (a) would change? What are those changes? [don't have to give full test again just the parts that change]

$$\hat{p} = \frac{36}{60} = 0.60$$

$$Test\ Statistic: z = \frac{0.60 - 0.46}{0.0643} = 2.178$$

$$p - value = (2)P(z > 2.178) = 0.0292$$

Conclusions would change: At the 5% significance level, p-value is less than alpha (0.05) therefore we reject H_0. There is sufficient evidence to suggest that the population proportion of full-time students at Miami University that are employed is different from 0.46.

4. Many consumer groups feel that the US Food and Drug Administration (FDA) drug approval process is too easy and, as a result, too many drugs are approved that are later found to be unsafe. On the other hand, a number of industry lobbyists have pushed for a more lenient approval process so that pharmaceutical companies can get new drugs approved more easily and quickly. Consider a null hypothesis that a new, unapproved drug is unsafe and an alternative hypothesis that a new, unapproved drug is safe.
   a. In the context of this problem, explain the risks of committing a Type 1 or Type II error.

$$H_0: drug\ unsafe$$
$$H_A: drug\ is\ safe$$

      Type I error – conclude drug is safe when drug is not safe
      Risks – release an unsafe drug; harm patients with drug that is unsafe, lawsuits for the pharmaceutical company; …

      Type II error – conclude drug is unsafe when drug is safe
      Risks – not releasing a safe drug; patients have to wait for help of symptoms or disease

   b. Which type of error are the consumer groups trying to avoid? Explain.

      Consumer groups are trying to avoid Type I error. Consumer groups would not want bad drugs released, want drugs they take to be safe.

   c. Which type of error are the industry lobbyists trying to avoid? Explain.

      Industry lobbyists are trying to avoid Type II error – the companies would have to continue testing even though a safe drug and therefore not earning profits on a safe drug.