Unit 06 – Unit 08 Review

Multiple Choice:

Use the following to answer questions 1 and 2.

A city representative claims that the policemen in the city earn an average of $52,000 per year. The local paper believes that the mean salary is less for the beat cops. A survey conducted by the paper selected a random sample of 20 beat cops and found a mean salary of $51,300 with a standard deviation of $1900. Assume the Normality for the population of the salaries of beat cops is reasonable so a t-test can be conducted using the data.

1. What are the correct null and alternative hypotheses?

D

   a. $H_0: \mu = \$51,300$ $H_A: \mu > \$51,300$
   b. $H_0: \mu > \$51,300$ $H_A: \mu \leq \$51,300$
   c. $H_0: \mu = \$52,000$ $H_A: \mu = \$51,300$
   d. $H_0: \mu = \$52,000$ $H_A: \mu < \$52,000$
   e. $H_0: \mu < \$52,000$ $H_A: \mu \geq \$52,000$

2. What are the value of the test statistic and the p-value of the test?

C

   a. $t = -0.368$, p-value > 0.25
   b. $t = -1.65$, 0.01 < p-value < 0.05
   c. $t = -1.65$, 0.05 < p-value < 0.10
   d. $t = 1.65$, 0.05 < p-value < 0.10
   e. $t = 0.368$, p-value > 0.25

3. Compare the standard Normal distribution to the t-distribution. Which of the following statements are true?

   I. Both distributions have a mean of zero.
   II. Both distributions are symmetric and bell-shaped.
   III. Both distributions have approximately 68% of the data within one standard deviation of the mean.

B

   a. I only
   b. I and II only
   c. III only
   d. I and II only
   e. I, II, and III

Use the following to answer questions 4 and 5.

A particular tire manufacturer recommends 32 pounds per square inch (psi) of pressure for its passenger car tires. Two independent car driving associations A and B wanted to conduct a two-tailed t-test of whether tire owners are really keeping the tires at the recommended pressure. Association A chooses a random sample of 18 owners. Association B chooses a random sample of 30 owners. Plots of both samples showed no strong skewness and no outliers. Surprisingly, both sets of data yielded a mean of 33 psi and standard deviation of 3 psi.

4. Which of the following hypotheses are used in the t-test by each association?
   a. The null hypothesis is that the mean pressure on the tires is less than 32 psi.
   b. The null hypothesis is that the mean pressure on the tires is not 32 psi.
   c. The alternative hypothesis is that the mean tire pressure if greater than 32 psi.
   d. The alternative hypothesis is that the mean tire pressure is less than 32 psi.
   e. The alternative hypothesis is that the mean tire pressure is not 32 psi.

E

5. Which of the following is a true statement about the results of the tests at the 5% level of significance?
   a. Neither test led to a rejection of the null hypothesis.
   b. Both tests led to a rejection of the null hypothesis.
   c. Only Association B's test led to a rejection of the null hypothesis.
   d. Only Association A's test led to a rejection of the null hypothesis.
   e. Both tests had the same p-value.

A

6. Suppose a machine that makes pegs to be used in holes to hold furniture parts together is malfunctioning, but the manufacturer doesn't know it. A quality control test is conducted bimonthly with the null hypothesis stating that the machine works properly. The p-value of the most recent test was 0.185. What probably happens as a result of this test?
   a. The test correctly fails to reject H_0.
   b. The test correctly rejects H_0.
   c. H_0 is rejected, resulting in a Type I error.
   d. H_0 is not rejected, resulting in a Type I error.
   e. H_0 is not rejected, resulting in a Type II error.

E

7. Which sample size and significance level will give a test of highest power?
   a. n = 25, $\alpha = 0.01$
   b. n = 25, $\alpha = 0.05$
   c. n = 50, $\alpha = 0.10$
   d. n = 50, $\alpha = 0.05$
   e. n = 50, $\alpha = 0.01$

C

8. Which of the following statements are false concerning Type I and Type II errors?

   I. A Type I error is always worse than a Type II error.
   II. The higher the probability of a Type I error, the lower the probability of a Type II error.
   III. A Type I error incorrectly rejects a true alternative hypothesis.

   a. I only
   b. II only
   c. III only
   d. I and III only
   e. II and III only

D

9. A t-test should not be used to conduct a hypothesis test for a mean if which of the following is true?
   a. The sample size was only 30.
   b. The standard deviation of the population was unknown.
   c. The data was obtained by random sampling.
   d. A histogram of the data was strongly skewed left.
   e. A boxplot of the data showed no outliers.

D

10. Which of the following is the correction interpretation of a p-value of 0.003?
   a. The probability of seeing the observed statistic or something more extreme, if the alternative hypothesis is true, is 0.003.
   b. The probability of seeing the observed statistic or something more extreme, if the null hypothesis is true, is 0.003.
   c. The probability of failing to reject the null hypothesis is 0.003.
   d. The probability that the null hypothesis is true is 0.003.
   e. The probability that the alternative hypothesis is true is 0.003.

B

11. A study found that 63 of 211 randomly selected men and 130 out of 651 randomly selected women prefer cats to dogs. You want to test the hypothesis that women like cats more. Choose the correct hypothesis and pooled $\hat{p}$.

a.	$H_0: p_M = p_F$;	$H_A: p_M < p_F$;	$\hat{p} = 0.224$
b.	$H_0: p_M = p_F$;	$H_A: p_M > p_F$;	$\hat{p} = 0.249$
c.	$H_0: p_M = p_F$;	$H_A: p_M < p_F$;	$\hat{p} = 0.249$
d.	$H_0: p_M = p_F$;	$H_A: p_M > p_F$;	$\hat{p} = 0.224$
e.	$H_0: p_M < p_F$;	$H_A: p_M > p_F$;	$\hat{p} = 0.224$

A

12. An independent testing lab obtained random samples of new halogen bulbs and standard incandescent bulbs made by the same company to establish the company's claim that, on average, the halogen bulb lasts longer than the incandescent one. Which test would you use?

B

a. A matched pairs t-test
b. A t-test for the difference in two means
c. A z-test for the difference in two proportions
d. A z-test for the slope of the regression line
e. A χ^2-test for homogeneity

13. A certain population follows a Normal distribution with a mean μ and a standard deviation σ. You construct a 95% confidence interval for μ and find it to be 1.1 ± 0.9. Which of the following is true?

D

a. In a test of the hypotheses H_0: $\mu = 1.2$ and H_A: $\mu \neq 1.2$, H_0 would be rejected at the 0.05 level.
b. In a test of the hypotheses H_0: $\mu = 1.9$ and H_A: $\mu \neq 1.9$, H_0 would be rejected at the 0.05 level.
c. In a test of the hypotheses H_0: $\mu = 1.9$ and H_A: $\mu \neq 1.9$, H_0 would be rejected at the 0.025 level.
d. In a test of the hypotheses H_0: $\mu = 0$ and H_A: $\mu \neq 0$, H_0 would be rejected at the 0.05 level.
e. A conclusion about hypotheses cannot be made from a confidence interval.

14. Which of the following is a condition for choosing a t-interval rather than a z-interval when construction a confidence interval for the mean of a population?

A

a. The standard deviation of the population is unknown.
b. There is an outlier in the sample data.
c. The sample may not have been a simple random sample.
d. The population is not Normally distributed.
e. The data are linked so a matched-pairs test is necessary.

15. You want to see whether high school changes children's educational plans. You take a random sample of 6th graders and of 12th graders and ask them whether they plan to get a job right after high school, go to college, or get an advanced degree. Which test do you perform?

A

a. A χ^2-test for homogeneity
b. A two-sample z-test for proportions
c. A matched pairs t-test
d. A χ^2-test for goodness of fit
e. A t-test for the slope of the regression line

16. The Center for Disease Control reports a survey of randomly chosen Americans age 45 and older, which found that 51 of 100 men and 80 of 782 women suffered from some form of arthritis. You want to estimate the difference in the proportions of men and women over 45 who have arthritis with a 95% confidence level. What standard error will you use?

C

a. 0.0192
b. 0.0378
c. 0.0511
d. 0.1485
e. 1.96

17. A two-sided hypothesis test for a population mean is significant at the 1% level of significance. Which of the following is necessarily true?

D

a. The 99% confidence interval of the mean contains 0.
b. The 99% confidence interval of the mean does not contain 0.
c. The 99% confidence interval of the mean contains the hypothesized mean.
d. The 99% confidence interval of the mean does not contain the hypothesized mean.
e. The 99% confidence interval of the mean is not useful here.

18. Which of the following is **not** a characteristic of the χ^2 distribution?

C

a. Its shape is based on the sample size.
b. It is skewed to the right.
c. It approaches a Normal distribution as the degrees of freedom increase.
d. It can never take on negative values.
e. It is always used for one-sided significance tests.

19. Which of the following would be the most appropriate for measuring the association between gender and favorite color based on a random sample of subjects?

C

a. A two-sample t-test
b. A correlation coefficient
c. A χ^2-test for independence
d. A one0sample z-test for a proportion
e. A t-test for the slope of the regression line

20. Sixty senior account executives were classified into three groups, labeled A, B, and C. There were 26 in group A, 19 in group B, and 15 in group C. At the 0.05 significance level, we would like to test if it is reasonable to conclude that the proportion of the population that falls into each group is the same. Which of the following is a correct conclusion?

C

   a. Reject H_0. The proportion in the three groups is not significantly different.
   b. Reject H_0. The proportion in the three groups is not the same.
   c. Do not reject H_0. The proportion in the three groups is not significantly different.
   d. Do not reject H_0. The proportion in the three groups is not the same.
   e. We cannot perform a significance test because there are three groups.

Use the following information to answer questions 21 and 22.

A one-sample t-test yields a test statistic of 2.089. The sample size was 16.

21. The alternative hypothesis was in the form H_A: $\mu > 37.5$. Is there significant evidence at the $\alpha = 0.05$ level to reject the null hypothesis?

E

   a. No, because the p-value is between 0.05 and 0.10.
   b. No, because the p-value is between 0.025 and 0.05.
   c. No, because the sample mean was significantly above 37.5.
   d. Yes, because the p-value is between 0.05 and 0.10.
   e. Yes, because the p-value is between 0.025 and 0.05.

22. If the alternative hypothesis was H_A: $\mu \neq 37.5$ instead, would you reject the null hypothesis at the $\alpha = 0.05$ level?

A

   a. No, because the p-value is between 0.05 and 0.10.
   b. No, because the p-value is between 0.025 and 0.05.
   c. No, because the sample mean was significantly above 37.5.
   d. Yes, because the p-value is between 0.05 and 0.10.
   e. Yes, because the p-value is between 0.025 and 0.05.

Free Response:

1. An English professor at a local community college is disappointed that the average final exam score in her previous Freshman Survey courses has been 78. A friend who is a computer professor suggests that she set up a website containing tutorials created by a local actor and require students to log on for a weekly presentation. There would be no charge for the first semester of the program, but thereafter students would have to pay an extra $50 to enroll in the course. The English professor decides to give the tutorials a try for one semester for a random sample of her students.
   a. Define one parameter of interest and state the null and alternative hypotheses that the English professor is testing.

      $H_0: \mu = 78$ points

      $H_A: \mu > 78$

      where μ = the true mean final exam score for students using the internet tutorials

   b. In the context of the problem, describe a Type I error and the possible consequences to the students.

      The teacher believes the true mean final exam score has increased when really it hasn't. The teacher will incorrectly continue using the internet tutorial program, causing her students to waste money and time.

   c. In the context of the problem, describe a Type II error and the possible consequences to the students.

      The teacher believes the true mean final exam score has not increased but really it has. The teacher discontinues using a helpful program and students miss an opportunity to use a helpful learning tool to improve their grade in the class.

2. An AP Statistics students enjoys eating ChocoChewys, a new chewy candy bar with peanuts, caramel, and chocolate that comes in a 1.45 oz, sealed package. He begins questioning the quality control of the candy maker when he gets a bar that is much smaller than he expected. He decides to buy 10 ChocoChewys at 10 randomly chosen grocery stores in his city and conducts a hypothesis test that he learned about in class. He weighs each bar with a digital scale that is accurate to a thousandth of an ounce.

ChocoChewy bar	1	2	3	4	5	6	7	8	9	10
Weight (oz)	1.432	1.471	1.406	1.443	1.469	1.398	1.439	1.458	1.448	1.429

a. Based on the data that he obtains, is there evidence that the candy maker needs to check his quality control process?

State: $H_0: \mu = 1.45$ oz where μ = the true mean weight of
$H_A: \mu < 1.45$ oz a chocochewy bar (in oz). $\alpha = 0.05$

$\bar{x} = 1.4393$ oz

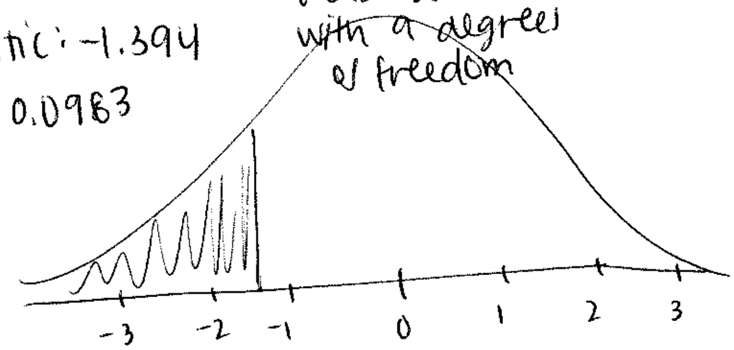
Plan: Random: chocochewys from randomly chosen grocery stores ✓
10% condition: $n=10$ $100 <$ all choco chewy bars
Normal/large: $n=10 < 30$ but a graph of the data shows no strong skewness and no outliers:

Because our conditions are met, we will perform a 1-sample t-test for the population mean μ.

Do: T-Test
μ_0: 1.45
$\bar{x}$: 1.4393
S_x: 0.0243
n: 10
$\mu < \mu_0$

test statistic: −1.394
p-value: 0.0983
df=9

t-distribution with ~~a~~ 9 degrees of freedom



Conclude: Because our p-value = 0.0983 is greater than our significance level, we fail to reject the null. There is not convincing evidence that the true mean weight of Chocochewy bars is less than 1.45 oz, and the candy maker does not need to check his quality control process. :)

3. A fitness trainer wants to know if her weight-lifting program can quickly improve upper body strength in older people. To find out, she has a group of randomly selected people over 55 years old do push-ups for 90 seconds and counts the number each can do. After these people participate in her weight-lifting program for 3 weeks, she tests them again in the same way. Here are the results:

Person	1	2	3	4	5	6	7	8	9	10	11	12
Before	15	12	21	22	17	19	10	25	12	17	8	19
After	17	15	22	22	21	24	11	28	14	16	12	21
Difference (after - before)	2	3	1	0	4	5	1	3	2	-1	4	2

Does the program help?

State: $H_0: \mu = 0$ push-ups where μ = the true mean increase in # of push-ups a person(55+) can do after participating in this weight-lifting program.

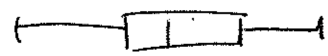
$H_A: \mu > 0$ push-ups

$\alpha = 0.05$

Plan: Random: Our data come from 12 randomly selected people ✓

10% condition: $n = 12$ 120 < all people over 55 ✓

Normal/Large: $n = 12 < 30$ but a graph of the data shows no strong skewness and no outliers: ✓



Because our conditions are met, we will perform a paired-data 1-sample t-test for the population mean μ.

Do: T-Test

$\mu_0 : 0$

$\bar{x} = 2.1\overline{6}$

$S_x : 1.749$

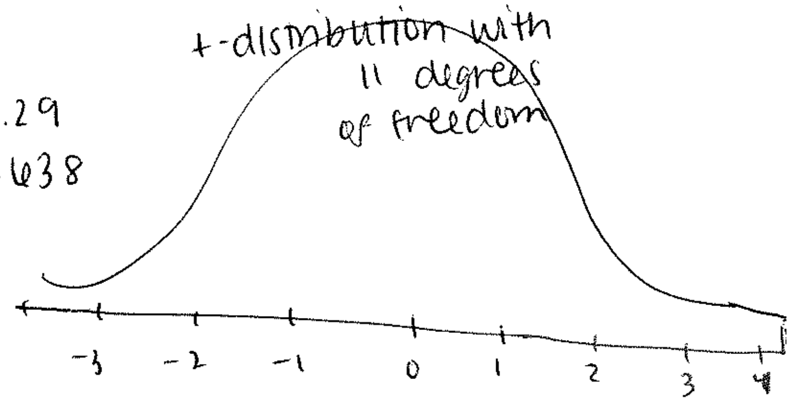
$n = 12$

$\mu > \mu_0$

test statistic: 4.29

p-value: 0.000638

df: 11



Conclude: Because our p-value 0.000638 is less than our significance level $\alpha = 0.05$, we reject the null. There is convincing evidence that the true mean increase in # of push ups a person(55+) can do after the weightlifting program is greater than 0, so the program helps.

4. There are two main dog parks in Dallas, one near White Rock Lake and one near downtown. The downtown dog park is smaller and is located underneath several highway overpasses. There are many apartments, townhomes, and lofts nearby. The White Rock Lake dog park is larger and provides a place for dogs to swim in the lake. The neighborhoods nearby are a mix of single-family homes with some apartments. Jessica believes that since the downtown dog park is near many apartments, many of the dogs there will be smaller breeds, while the White Rock Lake park with attract larger, more active breeds. In order to test this assertion, she chooses random times during a month to visit each park. She categorizes the dogs there by size.

	Toy (< 10lbs)	Small (11-20 lbs)	Medium (21-50 lbs)	Large (51-100 lbs)	Giant (>100 lbs)	Total
Downtown	39	72	101	89	12	313
WRL = **White Rock Lake**	77	158	188	275	51	749
Total	116	230	289	364	63	1062

Does the breed distribution for the downtown dog park differ significantly from the White Rock Lake dog park at the $\alpha = 0.05$ level?

State: H_0: The distribution of dog size is the same for both downtown and at White Rock Lake.

$\alpha = 0.05$ H_A: The distribution of dog size is not the same for both downtown and at White Rock Lake.

Plan: Random: data come from 2 independent random samples ✓

10% condition: $n_{downtown} = 313$ 3130 < all dogs at the downtown dog park ever ✓

$n_{WRL} = 749$ 7490 < all dogs at WRL ever ✓

Large counts:

	toy	small	med.	large	giant
downtown	34.2	67.8	85.2	107.3	18.6
WRL	81.8	162.2	203.8	256.7	44.4

all expected counts are ≥ 5. ✓

Because our conditions are met, we will do a χ^2 test for homogeneity.

DO: $$\chi^2 = \frac{(39-34.2)^2}{34.2} + \frac{(72-67.8)^2}{67.8} + \frac{(101-85.2)^2}{85.2} + \dots = 13.21$$

p-value = 0.0103

df = 4

Conclude: Because our p-value 0.0103 is less than our significance level $\alpha = 0.05$, we reject the null. There is convincing evidence that the distribution of dog size is not the same at the downtown park and White Rock Lake.

5. Are female or male students more likely to attend college outside their home state? In order to find out, random samples of male and female college-bound high school seniors were taken in the Dallas/Fort Worth metropolitan area. In September, following their high school graduations, the students in the samples were contacted to see if they were attending college in Texas or outside of it. Students who were not attending college were eliminated from the study. The results are summarized in the following table.

DFW

	Attending college outside of Texas	Attending college in Texas	total
Female	121	329	450
Male	94	212	306
total	215	541	756

a. Construct and interpret a 95% confidence interval for the difference in proportion of male and female students attending college outside of Texas.

State: we want to estimate the true difference in proportion $p_1 - p_2$ with 95% confidence.

$\hat{p}_2 = 121/450 = 0.268$ p_1 = the true proportion of DFW male HS seniors who attend college out of state.

$\hat{p}_1 = 94/306 = 0.307$ p_2 = the true proportion of DFW female HS seniors who attend college out of state.

Plan: Random: Data come from a random sample of 2 independent populations ✓

10% condition: $n_1 = 306$ 3060 < all DFW male HS seniors (college-bound) ✓

$n_2 = 450$ 4500 < all DFW female HS seniors who are college-bound ✓

Large counts: $n_1\hat{p}_1 = 94 \geq 10$ ✓
$n_1\hat{q}_1 = 212 \geq 10$ ✓
$n_2\hat{p}_2 = 121 \geq 10$ ✓
$n_2\hat{q}_2 = 329 \geq 10$ ✓

Because our conditions are met, we will construct a 2-sample z interval for the difference in 2 proportions $p_1 - p_2$.

Do: 2-PropZInt

x_1: 94
n_1: 306
x_2: 121
n_2: 450

C-level: 0.95
$z^* = 1.96$
$= (-0.0277, 0.10425)$

Conclude: We are 95% confident that the interval from -0.0277 to 0.10425 captures the true difference in proportions $p_1 - p_2$ of male and female DFW HS seniors who are college-bound who will attend college out of state.

b. Based only on your confidence interval, does the data from the random samples indicate that there is a difference in proportion of male and female students attending college outside of Texas? Justify your answer.

Because 0 (no difference) is in the interval of plausible values, there is not strong evidence to support that there definitively is a difference in the true proportion of males and females who will attend college out of texas.

c. Conduct a significance test using a significance level of $\alpha = 0.05$.

State: $H_0: p_1 = p_2$ $\qquad \alpha = 0.05$

$H_A: p_1 \neq p_2$

Plan: Because our conditions are met, we will perform a 2-sample z-test for the difference in 2 proportions $p_1 - p_2$.

DO: 2-prop z Test

$x_1: 94$

$n_1: 306$

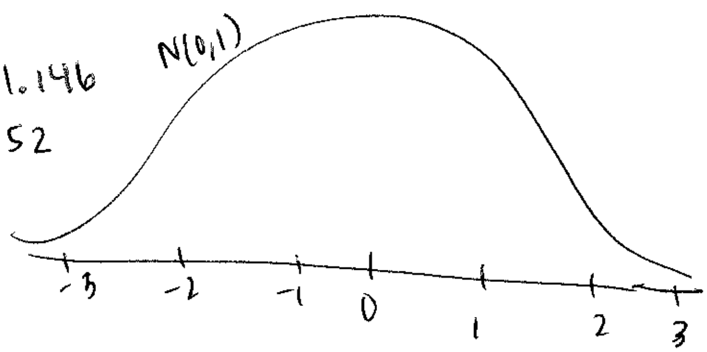
$x_2: 121$

$n_2: 450$

$p_1 \neq p_2$

test statistic: 1.146

p-value: 0.252



Conclude: Because our p-value = 0.252 is greater than our significance level $\alpha = 0.05$, we fail to reject the null. There is not convincing evidence that there is a difference in the true proportion of male and female DFW college-bound HS seniors who will attend college out of Texas.