

## 10.12: Homework

**DIRECTIONS:** For each of the word problems, use a solution sheet to do the hypothesis test. The solution sheet is found in *Appendix E*. Please feel free to make copies of the solution sheets. For the online version of the book, it is suggested that you copy the .doc or the .pdf files.

### NOTE

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78.

The mean number of English courses taken in a two-year time period by men and women college students is believed to be about the same. An experiment is conducted and data are collected from 29 men and 16 women. The men took an average of three English courses with a standard deviation of 0.8. The women took an average of four English courses with a standard deviation of 1.0. Are the means statistically the same?

79.

A student at a four-year college claims that mean enrollment at four-year colleges is higher than at two-year colleges in the United States. Two surveys are conducted. Of the 35 two-year colleges surveyed, the mean enrollment was 5,068 with a standard deviation of 4,777. Of the 35 four-year colleges surveyed, the mean enrollment was 5,466 with a standard deviation of 8,191.

80.

At Rachel's 11<sup>th</sup> birthday party, eight guests were timed to see how long (in seconds) they could hold their breath in a relaxed position. After a two-minute rest, they timed themselves while jumping. The children thought that the mean difference between their jumping and relaxed times would be zero. Test their hypothesis.

Relaxed time (seconds)	Jumping time (seconds)
26	21
47	40
30	28
22	21
23	25
45	43
37	35
29	32

Table 10.27

81.

Mean entry-level salaries for college graduates with mechanical engineering degrees and electrical engineering degrees are believed to be approximately the same. A recruiting office thinks that the mean mechanical engineering salary is actually lower than the mean electrical engineering salary. The recruiting office randomly surveys 50 entry level mechanical engineers and 60 entry level electrical engineers. Their mean salaries were \$46,100 and \$46,700, respectively. Their standard deviations were \$3,450 and \$4,210, respectively. Conduct a hypothesis test to determine if you agree that the mean entry-level mechanical engineering salary is lower than the mean entry-level electrical engineering salary.

82.

Marketing companies have collected data implying that teenage girls use more social media apps on their smartphones than teenage boys do. In one particular study of 40 randomly chosen teenage girls and boys (20 of each) with smartphones, the mean number of social media apps for the girls was 3.2 with a standard deviation of 1.5. The mean for the boys was 1.7 with a standard deviation of 0.8. Conduct a hypothesis test to determine if the means are approximately the same or if the girls' mean is higher than the boys' mean.

Use the information from *Appendix C Data Sets* to answer the next four exercises.

83.

Using the data from Lap 1 only, conduct a hypothesis test to determine if the mean time for completing a lap in races is the same as it is in practices.

84.

Repeat the test in *Exercise 10.83*, but use Lap 5 data this time.

85.

Repeat the test in *Exercise 10.83*, but this time combine the data from Laps 1 and 5.

86.

In two to three complete sentences, explain in detail how you might use Terri Vogel's data to answer the following question. "Does Terri Vogel drive faster in races than she does in practices?"

Use the following information to answer the next two exercises. The Eastern and Western Major League Soccer conferences have a new Reserve Division that allows new players to develop their skills. Data for a randomly picked date showed the following annual goals.

Western	Eastern
Los Angeles 9	D.C. United 9
FC Dallas 3	Chicago 8
Chivas USA 4	Columbus 7
Real Salt Lake 3	New England 6
Colorado 4	MetroStars 5
San Jose 4	Kansas City 3

Table 10.28

Conduct a hypothesis test to answer the next two exercises.

87.

The **exact** distribution for the hypothesis test is:

1. the normal distribution
2. the Student's  $t$ -distribution

3. the uniform distribution
4. the exponential distribution

88.

If the level of significance is 0.05, the conclusion is:

1. There is sufficient evidence to conclude that the **W** Division teams score fewer goals, on average, than the **E** teams
2. There is insufficient evidence to conclude that the **W** Division teams score more goals, on average, than the **E** teams.
3. There is insufficient evidence to conclude that the **W** teams score fewer goals, on average, than the **E** teams score.
4. Unable to determine

89.

Suppose a statistics instructor believes that there is no significant difference between the mean class scores of statistics day students on Exam 2 and statistics night students on Exam 2. They take random samples from each of the populations. The mean and standard deviation for 35 statistics day students were 75.86 and 16.91. The mean and standard deviation for 37 statistics night students were 75.41 and 19.73. The “day” subscript refers to the statistics day students. The “night” subscript refers to the statistics night students. A concluding statement is:

1. There is sufficient evidence to conclude that statistics night students’ mean on Exam 2 is better than the statistics day students’ mean on Exam 2.
2. There is insufficient evidence to conclude that the statistics day students’ mean on Exam 2 is better than the statistics night students’ mean on Exam 2.
3. There is insufficient evidence to conclude that there is a significant difference between the means of the statistics day students and night students on Exam 2.
4. There is sufficient evidence to conclude that there is a significant difference between the means of the statistics day students and night students on Exam 2.

90.

Elijah wants to know whether textbook costs are different for different courses of study. He selects a random sample of 33 sociology textbooks offered on a popular online site. The mean price of his sample is \$74.64 with a standard deviation of \$49.36. He then selects a random sample of 33 math and science textbooks from the same site. The mean price of this sample is \$111.56 with a standard deviation of \$66.90. Is the mean price of a sociology textbook lower than the mean price of a math or science textbook? Test at a 1% significance level.

91.

A powder diet is tested on 49 people, and a liquid diet is tested on 36 different people. Of interest is whether the liquid diet yields a higher mean weight loss than the powder diet. The powder diet group had a mean weight loss of 42 pounds with a standard deviation of 12 pounds. The liquid diet group had a mean weight loss of 45 pounds with a standard deviation of 14 pounds.

92.

Suppose a statistics instructor believes that there is no significant difference between the mean class scores of statistics day students on Exam 2 and statistics night students on Exam 2. They take random samples from each of the populations. The mean and standard deviation for 35 statistics day students were 75.86 and 16.91, respectively. The mean and standard deviation for 37 statistics night students were 75.41 and 19.73. The “day” subscript refers to the statistics day students. The “night” subscript refers to the statistics night students. An appropriate alternative hypothesis for the hypothesis test is:

1.  $\mu_{\text{day}} > \mu_{\text{night}}$
2.  $\mu_{\text{day}} < \mu_{\text{night}}$
3.  $\mu_{\text{day}} = \mu_{\text{night}}$
4.  $\mu_{\text{day}} \neq \mu_{\text{night}}$

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## NOTE

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93.

A study is done to determine if students in the California state university system take longer to graduate, on average, than students enrolled in private universities. One hundred students from both the California state university system and private universities are surveyed. Suppose that from years of research, it is known that the population standard deviations are 1.5811 years and 1 year, respectively. The following data are collected. The California state university system students took on average 4.5 years with a standard deviation of 0.8. The private university students took on average 4.1 years with a standard deviation of 0.3.

94.

Parents of teenage boys often complain that auto insurance costs more, on average, for teenage boys than for teenage girls. A group of concerned parents examines a random sample of insurance bills. The mean annual cost for 36 teenage boys was \$679. For 23 teenage girls, it was \$559. From past years, it is known that the population standard deviation for each group is \$180. Determine whether or not you believe that the mean cost for auto insurance for teenage boys is greater than that for teenage girls.

95.

A group of transfer bound students wondered if they will spend the same mean amount on texts and supplies each year at their four-year university as they have at their community college. They conducted a random survey of 54 students at their community college and 66 students at their local four-year university. The sample means were \$947 and \$1,011, respectively. The population standard deviations are known to be \$254 and \$87, respectively. Conduct a hypothesis test to determine if the means are statistically the same.

96.

Some manufacturers claim that non-hybrid sedan cars have a lower mean miles-per-gallon (mpg) than hybrid ones. Suppose that consumers test 21 hybrid sedans and get a mean of 31 mpg with a standard deviation of seven mpg. Thirty-one non-hybrid sedans get a mean of 22 mpg with a standard deviation of four mpg. Suppose that the population standard deviations are known to be six and three, respectively. Conduct a hypothesis test to evaluate the manufacturers claim.

97.

A baseball fan wanted to know if there is a difference between the number of games played in a World Series when the American League won the series versus when the National League won the series. From 1922 to 2012, the population standard deviation of games won by the American League was 1.14, and the population standard deviation of games won by the National League was 1.11. Of 19 randomly selected World Series games won by the American League, the mean number of games won was 5.76. The mean number of 17 randomly selected games won by the National League was 5.42. Conduct a hypothesis test.

98.

One of the questions in a study of marital satisfaction of dual-career couples was to rate the statement “I’m pleased with the way we divide the responsibilities for childcare.” The ratings went from one (strongly agree) to five (strongly disagree). Table 10.29 contains ten of the paired responses for husbands and wives. Conduct a hypothesis test to see if the mean difference in the husband’s versus the wife’s satisfaction level is negative (meaning that, within the partnership, the husband is happier than the wife).

<b>Wife's Score</b>	2	2	3	3	4	2	1	1	2	4
<b>Husband's Score</b>	2	2	1	3	2	1	1	1	2	4

Table 10.29

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99.

A recent drug survey showed an increase in the use of drugs and alcohol among local high school seniors as compared to the national percent. Suppose that a survey of 100 local seniors and 100 national seniors is conducted to see if the proportion of drug and alcohol use is higher locally than nationally. Locally, 65 seniors reported using drugs or alcohol within the past month, while 60 national seniors reported using them.

100.

We are interested in whether the proportions of conferred physical science degrees for people aged 21 to 24 are the same for White and Black people in the United States. The number of conferred degrees for White people in a given year is 4,930. Five hundred eighty were aged 21 to 24. The estimate for Black people is 330. Forty were aged 21 to 24. We will let people with conferred physical science degrees be our population.

101.

Elizabeth Mjelde, an art history professor, was interested in whether the value from the Golden Ratio formula,  $\left( \frac{\text{larger} + \text{smaller dimension}}{\text{larger dimension}} \right)$  was the same in the Whitney Exhibit for works from 1900 to 1919 as for works from 1920 to 1942. Thirty-seven early works were sampled, averaging 1.74 with a standard deviation of 0.11. Sixty-five of the later works were sampled, averaging 1.746 with a standard deviation of 0.1064. Do you think that there is a significant difference in the Golden Ratio calculation?

102.

A recent year was randomly picked from 1985 to the present. In that year, there were 2,051 Hispanic/Latino students at Cabrillo College out of a total of 12,328 students. At Lake Tahoe College, there were 321 Hispanic/Latino students out of a total of 2,441 students. In general, do you think that the percent of Hispanic/Latino students at the two colleges is basically the same or different?

Use the following information to answer the next three exercises. Some individuals who were exposed to the COVID-19 virus experienced a loss of taste. In a sample of COVID patients during 2022, there were 629 reported cases of loss of taste out of a total of 1,021 reported cases. In 2021, there were 486 reported cases of loss of taste out of a sample of 712 cases. Is the 2022 proportion of loss of taste more than the 2021 proportion? Using a 1% level of significance, conduct an appropriate hypothesis test.

- “2022” subscript: 2022 group.
- “2021” subscript: 2021 group

103.

This is:

1. a test of two proportions
2. a test of two independent means
3. a test of a single mean
4. a test of matched pairs.

104.

An appropriate null hypothesis is:

1.  $p_{2022} \leq p_{2021}$
2.  $p_{2022} \geq p_{2021}$
3.  $\mu_{2022} \leq \mu_{2021}$
4.  $p_{2022} > p_{2021}$

105.

The  $p$ -value is 0.0022. At a 1% level of significance, the appropriate conclusion is

1. There is sufficient evidence to conclude that the proportion of people in the United States in 2022 who experienced loss of taste is less than the proportion of people in the United States in 2021 who experienced loss of taste.
2. There is insufficient evidence to conclude that the proportion of people in the United States in 2022 who experienced loss of taste is more than the proportion of people in the United States in 2021 who experienced loss of taste.
3. There is insufficient evidence to conclude that the proportion of people in the United States in 2022 who experienced loss of taste is less than the proportion of people in the United States in 2021 who experienced loss of taste.
4. There is sufficient evidence to conclude that the proportion of people in the United States in 2022 who experienced loss of taste is more than the proportion of people in the United States in 2021 who experienced loss of taste.

106.

Researchers conducted a study to find out if there is a difference in the use of eReaders by different age groups. Randomly selected participants were divided into two age groups. In the 16- to 29-year-old group, 7% of the 628 surveyed use eReaders, while 11% of the 2,309 participants 30 years old and older use eReaders.

107.

Adults aged 18 years old and older were randomly selected for a survey on working from home. The researchers wanted to determine if the proportion of women who work from home is less than the proportion of men who work from home. The results are shown in Table 10.30. Test at the 1% level of significance.

	Number who work from home	Sample size
Men	42,769	155,525
Women	67,169	248,775

Table 10.30

108.

Two computer users were discussing tablet computers. A higher proportion of people ages 16 to 29 use tablets than the proportion of people age 30 and older. Table 10.31 details the number of tablet owners for each age group. Test at the 1% level of significance.

	16–29 year olds	30 years old and older
Own a Tablet	69	231
Sample Size	628	2,309

Table 10.31

109.

A group of friends debated whether more people aged 21-30 use wearable fitness devices than people aged 31-40. They consulted a research study of wearable fitness devices use among adults. The results of the survey indicate that of the 973 randomly sampled people in their twenties, 379 use wearable fitness devices. For people in their thirties, 404 of the 1,304 who were randomly sampled use wearable fitness devices. Test at the 5% level of significance.

110.

While her husband spent 2½ hours picking out new speakers, a statistician decided to determine whether the percent of men who enjoy shopping for electronic equipment is higher than the percent of women who enjoy shopping for electronic equipment. The population was Saturday afternoon shoppers. Out of 67 men, 24 said they enjoyed the activity. Eight of the 24 women surveyed claimed to enjoy the activity. Interpret the results of the survey.

111.

We are interested in whether children's educational computer software costs less, on average, than children's entertainment software. Thirty-six educational software titles were randomly picked from a catalog. The mean cost was \$31.14 with a standard deviation of \$4.69. Thirty-five entertainment software titles were randomly picked from the same catalog. The mean cost was \$33.86 with a standard deviation of \$10.87. Decide whether children's educational software costs less, on average, than children's entertainment software.

112.

Joan Nguyen recently claimed that the proportion of college-age men with at least one pierced ear is as high as the proportion of college-age women. She conducted a survey in her classes. Out of 107 men, 20 had at least one pierced ear. Out of 92 women, 47 had at least one pierced ear. Do you believe that the proportion of men has reached the proportion of women?

113.

Use the data sets found in [Appendix C Data Sets](#) to answer this exercise. Is the proportion of race laps Terri completes slower than 130 seconds less than the proportion of practice laps she completes slower than 135 seconds?

114.

"To Breakfast or Not to Breakfast?" by Richard Ayore

In the American society, birthdays are one of those days that everyone looks forward to. People of different ages and peer groups gather to mark the 18th, 20th, ..., birthdays. During this time, one looks back to see what they have achieved for the past year and also focuses ahead for more to come.

If, by any chance, I am invited to one of these parties, my experience is always different. Instead of dancing around with my friends while the music is booming, I get carried away by memories of my family back home in Kenya. I remember the good times I had with my brothers and sister while we did our daily routine.

Every morning, I remember we went to the shamba (garden) to weed our crops. I remember one day arguing with my brother as to why he always remained behind just to join us an hour later. In his defense, he said that he preferred waiting for breakfast before he came to weed. He said, "This is why I always work more hours than you guys!"

And so, to prove him wrong or right, we decided to give it a try. One day we went to work as usual without breakfast, and recorded the time we could work before getting tired and stopping. On the next day, we all ate breakfast before going to work. We recorded how long we worked again before getting tired and stopping. Of interest was our mean increase in work time. Though not sure, my brother insisted that it was more than two hours. Using the data in [Table 10.32](#), solve our problem.

Work hours with breakfast	Work hours without breakfast
8	6
7	5
9	5
5	4
9	7
8	7
10	7
7	5
6	6
9	5

Table 10.32

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115.

Ten individuals went on a low-fat diet for 12 weeks to lower their cholesterol. The data are recorded in [Table 10.33](#). Do you think that their cholesterol levels were significantly lowered?

Starting cholesterol level	Ending cholesterol level
140	140
220	230
110	120
240	220
200	190
180	150
190	200
360	300
280	300
260	240

Table 10.33

Use the following information to answer the next two exercises. A new heart disease prevention drug was tried on a group of 224 patients. Forty-five patients developed heart disease after four years. In a control group of 224 patients, 68 developed heart disease after four years. We want to test whether the method of treatment reduces the proportion of patients that develop heart disease after four years or if the proportions of the treated group and the untreated group stay the same.

Let the subscript  $t$  = treated patient and  $ut$  = untreated patient.

116.

The appropriate hypotheses are:

1.  $H_0: p_t < p_{ut}$  and  $H_a: p_t \geq p_{ut}$
2.  $H_0: p_t \leq p_{ut}$  and  $H_a: p_t > p_{ut}$
3.  $H_0: p_t = p_{ut}$  and  $H_a: p_t \neq p_{ut}$
4.  $H_0: p_t = p_{ut}$  and  $H_a: p_t < p_{ut}$

117.

If the  $p$ -value is 0.0062 what is the conclusion (use  $\alpha = 0.05$ )?

1. The method has no effect.
2. There is sufficient evidence to conclude that the method reduces the proportion of patients who develop heart disease after four years.
3. There is sufficient evidence to conclude that the method increases the proportion of patients who develop heart disease after four years.
4. There is insufficient evidence to conclude that the method reduces the proportion of patients who develop heart disease after four years.

Use the following information to answer the next two exercises. An experiment is conducted to show that blood pressure can be consciously reduced in people trained in a "biofeedback exercise program." Six subjects were randomly selected and blood pressure measurements were recorded before and after the training. The difference between blood pressures was calculated (after - before) producing the following results:  $\bar{x}_d = -10.2$ ,  $s_d = 8.4$ . Using the data, test the hypothesis that the blood pressure has decreased after the training.

118.

The distribution for the test is:

1.  $t_5$
2.  $t_6$
3.  $N(-10.2, 8.4)$
4.  $N(-10.2, 8.468, 46)$

119.

If  $\alpha = 0.05$ , the  $p$ -value and the conclusion are

1. 0.0014; There is sufficient evidence to conclude that the blood pressure decreased after the training.
2. 0.0014; There is sufficient evidence to conclude that the blood pressure increased after the training.
3. 0.0155; There is sufficient evidence to conclude that the blood pressure decreased after the training.
4. 0.0155; There is sufficient evidence to conclude that the blood pressure increased after the training.

120.

A golf instructor is interested in determining if her new technique for improving players' golf scores is effective. She takes four new students. She records their 18-hole scores before learning the technique and then after having taken her class. She conducts a hypothesis test. The data are as follows.

	Player 1	Player 2	Player 3	Player 4
Mean score before class	83	78	93	87
Mean score after class	80	80	86	86

Table 10.34

The correct decision is:

1. Reject  $H_0$ .
2. Do not reject the  $H_0$ .

121.

A local cancer support group believes that the estimate for new female breast cancer cases in the south is higher in Year 2 than in Year 1. The group compared the estimates of new female breast cancer cases by southern state in Year 1 and in Year 2. The results are in Table 10.35.

Southern States	Year 1	Year 2
Alabama	3,450	3,720
Arkansas	2,150	2,280
Florida	15,540	15,710
Georgia	6,970	7,310
Kentucky	3,160	3,300
Louisiana	3,320	3,630
Mississippi	1,990	2,080
North Carolina	7,090	7,430
Oklahoma	2,630	2,690
South Carolina	3,570	3,580
Tennessee	4,680	5,070
Texas	15,050	14,980
Virginia	6,190	6,280

Table 10.35

122.

A traveler wanted to know if the prices of hotels are different in the ten cities that he visits the most often. The list of the cities with the corresponding hotel prices for his two favorite hotel chains is in Table 10.36. Test at the 1% level of significance.

Cities	Hyatt Regency prices in dollars	Hilton prices in dollars
Atlanta	107	169
Boston	358	289
Chicago	209	299
Dallas	209	198
Denver	167	169
Indianapolis	179	214
Los Angeles	179	169
New York City	625	459
Philadelphia	179	159
Washington, DC	245	239

Table 10.36

123.

A politician asked their staff to determine whether the underemployment rate in the northeast decreased year over year. The results are in Table 10.37.

Northeastern States	Year 1	Year 2
Connecticut	17.3	16.4
Delaware	17.4	13.7
Maine	19.3	16.1
Maryland	16.0	15.5
Massachusetts	17.6	18.2
New Hampshire	15.4	13.5
New Jersey	19.2	18.7
New York	18.5	18.7
Ohio	18.2	18.8
Pennsylvania	16.5	16.9
Rhode Island	20.7	22.4
Vermont	14.7	12.3
West Virginia	15.5	17.3

Table 10.37

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