Hypothesis Testing of Single Mean and Single Proportion: Homework*

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Abstract

This module provides a homework of Hypothesis Testing of Single Mean and Single Proportion as a part of Collaborative Statistics collection (col10522) by Barbara Illowsky and Susan Dean.

Exercise 1 ***(Solution on p. 14.)***

Some of the statements below refer to the null hypothesis, some to the alternate hypothesis.

State the null hypothesis, H_o, and the alternative hypothesis, H_a, in terms of the appropriate parameter (μ or p).

a. The mean number of years Americans work before retiring is 34.
b. At most 60% of Americans vote in presidential elections.
c. The mean starting salary for San Jose State University graduates is at least $100,000 per year.
d. 29% of high school seniors get drunk each month.
e. Fewer than 5% of adults ride the bus to work in Los Angeles.
f. The mean number of cars a person owns in her lifetime is not more than 10.
g. About half of Americans prefer to live away from cities, given the choice.
h. Europeans have a mean paid vacation each year of six weeks.
i. The chance of developing breast cancer is under 11% for women.
j. Private universities mean tuition cost is more than $20,000 per year.

Exercise 2 ***(Solution on p. 14.)***

For (a) - (j) above, state the Type I and Type II errors in complete sentences.

Exercise 3

For (a) - (j) above, in complete sentences:

a. State a consequence of committing a Type I error.
b. State a consequence of committing a Type II error.

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DIRECTIONS: For each of the word problems, use a solution sheet to do the hypothesis test. The solution sheet is found in 14. Appendix (online book version: the link is "Solution Sheets"; PDF book version: look under 14.5 Solution Sheets). 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: If you are using a student's-t distribution for a homework problem below, you may assume that the underlying population is normally distributed. (In general, you must first prove that assumption, though.)

Exercise 4

A particular brand of tires claims that its deluxe tire averages at least 50,000 miles before it needs to be replaced. From past studies of this tire, the standard deviation is known to be 8000. A survey of owners of that tire design is conducted. From the 28 tires surveyed, the mean lifespan was 46,500 miles with a standard deviation of 9800 miles. Do the data support the claim at the 5% level?

Exercise 5 ***(Solution on p. 14.)***

From generation to generation, the mean age when smokers first start to smoke varies. However, the standard deviation of that age remains constant of around 2.1 years. A survey of 40 smokers of this generation was done to see if the mean starting age is at least 19. The sample mean was 18.1 with a sample standard deviation of 1.3. Do the data support the claim at the 5% level?

Exercise 6

The cost of a daily newspaper varies from city to city. However, the variation among prices remains steady with a standard deviation of 20¢. A study was done to test the claim that the mean cost of a daily newspaper is $1.00. Twelve costs yield a mean cost of 95¢ with a standard deviation of 18¢. Do the data support the claim at the 1% level?

Exercise 7 ***(Solution on p. 14.)***

An article in the **San Jose Mercury News** stated that students in the California state university system take 4.5 years, on average, to finish their undergraduate degrees. Suppose you believe that the mean time is longer. You conduct a survey of 49 students and obtain a sample mean of 5.1 with a sample standard deviation of 1.2. Do the data support your claim at the 1% level?

Exercise 8

The mean number of sick days an employee takes per year is believed to be about 10. Members of a personnel department do not believe this figure. They randomly survey 8 employees. The number of sick days they took for the past year are as follows: 12; 4; 15; 3; 11; 8; 6; 8. Let x = the number of sick days they took for the past year. Should the personnel team believe that the mean number is about 10?

Exercise 9 ***(Solution on p. 14.)***

In 1955, **Life Magazine** reported that the 25 year-old mother of three worked, on average, an 80 hour week. Recently, many groups have been studying whether or not the women's movement has, in fact, resulted in an increase in the average work week for women (combining employment and at-home work). Suppose a study was done to determine if the mean work week has increased. 81 women were surveyed with the following results. The sample mean was 83; the sample standard deviation was 10. Does it appear that the mean work week has increased for women at the 5% level?

Exercise 10

Your statistics instructor claims that 60 percent of the students who take her Elementary Statistics class go through life feeling more enriched. For some reason that she can't quite figure out, most people don't believe her. You decide to check this out on your own. You randomly survey 64 of her past Elementary Statistics students and find that 34 feel more enriched as a result of her class. Now, what do you think?

Exercise 11 ***(Solution on p. 14.)***

A Nissan Motor Corporation advertisement read, "The average man's I.Q. is 107. The average brown trout's I.Q. is 4. So why can't man catch brown trout?" Suppose you believe that the brown trout's mean I.Q. is greater than 4. You catch 12 brown trout. A fish psychologist determines the I.Q.s as follows: 5; 4; 7; 3; 6; 4; 5; 3; 6; 3; 8; 5. Conduct a hypothesis test of your belief.

Exercise 12

Refer to the previous problem. Conduct a hypothesis test to see if your decision and conclusion would change if your belief were that the brown trout's mean I.Q. is **not** 4.

Exercise 13 ***(Solution on p. 14.)***

According to an article in **Newsweek**, the natural ratio of girls to boys is 100:105. In China, the birth ratio is 100: 114 (46.7% girls). Suppose you don't believe the reported figures of the percent of girls born in China. You conduct a study. In this study, you count the number of girls and boys born in 150 randomly chosen recent births. There are 60 girls and 90 boys born of the 150. Based on your study, do you believe that the percent of girls born in China is 46.7?

Exercise 14

A poll done for **Newsweek** found that 13% of Americans have seen or sensed the presence of an angel. A contingent doubts that the percent is really that high. It conducts its own survey. Out of 76 Americans surveyed, only 2 had seen or sensed the presence of an angel. As a result of the contingent's survey, would you agree with the **Newsweek** poll? In complete sentences, also give three reasons why the two polls might give different results.

Exercise 15 ***(Solution on p. 15.)***

The mean work week for engineers in a start-up company is believed to be about 60 hours. A newly hired engineer hopes that it's shorter. She asks 10 engineering friends in start-ups for the lengths of their mean work weeks. Based on the results that follow, should she count on the mean work week to be shorter than 60 hours?

Data (length of mean work week): 70; 45; 55; 60; 65; 55; 55; 60; 50; 55.

Exercise 16

Use the "Lap time" data for Lap 4 (see Table of Contents) to test the claim that Terri finishes Lap 4, on average, in less than 129 seconds. Use all twenty races given.

Exercise 17

Use the "Initial Public Offering" data (see Table of Contents) to test the claim that the mean offer price was $18 per share. Do not use all the data. Use your random number generator to randomly survey 15 prices.

NOTE: The following questions were written by past students. They are excellent problems!

Exercise 18

18. "Asian Family Reunion" by Chau Nguyen

```
    Every two years it comes around
We all get together from different towns.
In my honest opinion
It's not a typical family reunion
Not forty, or fifty, or sixty,
But how about seventy companions!
The kids would play, scream, and shout
One minute they're happy, another they'll pout.
The teenagers would look, stare, and compare
From how they look to what they wear.
```

The men would chat about their business
That they make more, but never less.
Money is always their subject
And there's always talk of more new projects.
The women get tired from all of the chats
They head to the kitchen to set out the mats.
Some would sit and some would stand
Eating and talking with plates in their hands.
Then come the games and the songs
And suddenly, everyone gets along!
With all that laughter, it's sad to say
That it always ends in the same old way.
They hug and kiss and say "good-bye"
And then they all begin to cry!
I say that 60 percent shed their tears
But my mom counted 35 people this year.
She said that boys and men will always have their pride,
So we won't ever see them cry.
I myself don't think she's correct,
So could you please try this problem to see if you object?

Exercise 19 ***(Solution on p. 15.)***

"The Problem with Angels" by Cyndy Dowling

Although this problem is wholly mine,
The catalyst came from the magazine, Time.
On the magazine cover I did find
The realm of angels tickling my mind.

Inside, 69% I found to be
In angels, Americans do believe.

Then, it was time to rise to the task,
Ninety-five high school and college students I did ask.
Viewing all as one group,
Random sampling to get the scoop.

So, I asked each to be true,
"Do you believe in angels?" Tell me, do!

Hypothesizing at the start,
Totally believing in my heart
That the proportion who said yes
Would be equal on this test.

Lo and behold, seventy-three did arrive,
Out of the sample of ninety-five.
Now your job has just begun,
Solve this problem and have some fun.

Exercise 20

"Blowing Bubbles" by Sondra Prull

```
    Studying stats just made me tense,
I had to find some sane defense.
Some light and lifting simple play
To float my math anxiety away.

    Blowing bubbles lifts me high
Takes my troubles to the sky.
POIK! They're gone, with all my stress
Bubble therapy is the best.

    The label said each time I blew
The average number of bubbles would be at least 22.
I blew and blew and this I found
From 64 blows, they all are round!

    But the number of bubbles in 64 blows
Varied widely, this I know.
20 per blow became the mean
They deviated by 6, and not 16.

    From counting bubbles, I sure did relax
But now I give to you your task.
Was 22 a reasonable guess?
Find the answer and pass this test!
```

Exercise 21 ***(Solution on p. 15.)***

21. "Dalmatian Darnation" by Kathy Sparling

```
    A greedy dog breeder named Spreckles
Bred puppies with numerous freckles
The Dalmatians he sought
Possessed spot upon spot
The more spots, he thought, the more shekels.

    His competitors did not agree
That freckles would increase the fee.
They said, ''Spots are quite nice
But they don't affect price;
One should breed for improved pedigree.''

    The breeders decided to prove
This strategy was a wrong move.
Breeding only for spots
Would wreak havoc, they thought.
His theory they want to disprove.
```

```
    They proposed a contest to Spreckles
Comparing dog prices to freckles.
In records they looked up
One hundred one pups:
Dalmatians that fetched the most shekels.

    They asked Mr. Spreckles to name
An average spot count he'd claim
To bring in big bucks.
Said Spreckles, ''Well, shucks,
It's for one hundred one that I aim.''

    Said an amateur statistician
Who wanted to help with this mission.
''Twenty-one for the sample
Standard deviation's ample:

    They examined one hundred and one
Dalmatians that fetched a good sum.
They counted each spot,
Mark, freckle and dot
And tallied up every one.

    Instead of one hundred one spots
They averaged ninety six dots
Can they muzzle Spreckles'
Obsession with freckles
Based on all the dog data they've got?
```

Exercise 22

"Macaroni and Cheese, please!!" by Nedda Misherghi and Rachelle Hall

As a poor starving student I don't have much money to spend for even the bare necessities. So my favorite and main staple food is macaroni and cheese. It's high in taste and low in cost and nutritional value.

One day, as I sat down to determine the meaning of life, I got a serious craving for this, oh, so important, food of my life. So I went down the street to Greatway to get a box of macaroni and cheese, but it was SO expensive! $2.02 !!! Can you believe it? It made me stop and think. The world is changing fast. I had thought that the mean cost of a box (the normal size, not some super-gigantic-family-value-pack) was at most $1, but now I wasn't so sure. However, I was determined to find out. I went to 53 of the closest grocery stores and surveyed the prices of macaroni and cheese. Here are the data I wrote in my notebook:

Price per box of Mac and Cheese:

- 5 stores @ $2.02
- 15 stores @ $0.25
- 3 stores @ $1.29
- 6 stores @ $0.35
- 4 stores @ $2.27
- 7 stores @ $1.50
- 5 stores @ $1.89

- 8 stores @ 0.75.

I could see that the costs varied but I had to sit down to figure out whether or not I was right. If it does turn out that this mouth-watering dish is at most $1, then I'll throw a big cheesy party in our next statistics lab, with enough macaroni and cheese for just me. (After all, as a poor starving student I can't be expected to feed our class of animals!)

Exercise 23 ***(Solution on p. 15.)***

"William Shakespeare: The Tragedy of Hamlet, Prince of Denmark" by Jacqueline Ghodsi

THE CHARACTERS (in order of appearance):

- HAMLET, Prince of Denmark and student of Statistics
- POLONIUS, Hamlet's tutor
- HOROTIO, friend to Hamlet and fellow student

Scene: The great library of the castle, in which Hamlet does his lessons

Act I

(The day is fair, but the face of Hamlet is clouded. He paces the large room. His tutor, Polonius, is reprimanding Hamlet regarding the latter's recent experience. Horatio is seated at the large table at right stage.)

POLONIUS: My Lord, how cans't thou admit that thou hast seen a ghost! It is but a figment of your imagination!

HAMLET: I beg to differ; I know of a certainty that five-and-seventy in one hundred of us, condemned to the whips and scorns of time as we are, have gazed upon a spirit of health, or goblin damn'd, be their intents wicked or charitable.

POLONIUS If thou doest insist upon thy wretched vision then let me invest your time; be true to thy work and speak to me through the reason of the null and alternate hypotheses. (He turns to Horatio.) Did not Hamlet himself say, "What piece of work is man, how noble in reason, how infinite in faculties? Then let not this foolishness persist. Go, Horatio, make a survey of three-and-sixty and discover what the true proportion be. For my part, I will never succumb to this fantasy, but deem man to be devoid of all reason should thy proposal of at least five-and-seventy in one hundred hold true.

HORATIO (to Hamlet): What should we do, my Lord?

HAMLET: Go to thy purpose, Horatio.

HORATIO: To what end, my Lord?

HAMLET: That you must teach me. But let me conjure you by the rights of our fellowship, by the consonance of our youth, but the obligation of our ever-preserved love, be even and direct with me, whether I am right or no.

(Horatio exits, followed by Polonius, leaving Hamlet to ponder alone.)

Act II

(The next day, Hamlet awaits anxiously the presence of his friend, Horatio. Polonius enters and places some books upon the table just a moment before Horatio enters.)

POLONIUS: So, Horatio, what is it thou didst reveal through thy deliberations?

HORATIO: In a random survey, for which purpose thou thyself sent me forth, I did discover that one-and-forty believe fervently that the spirits of the dead walk with us. Before my God, I might not this believe, without the sensible and true avouch of mine own eyes.

POLONIUS: Give thine own thoughts no tongue, Horatio. (Polonius turns to Hamlet.) But look to't I charge you, my Lord. Come Horatio, let us go together, for this is not our test. (Horatio and Polonius leave together.)

HAMLET: To reject, or not reject, that is the question: whether 'tis nobler in the mind to suffer the slings and arrows of outrageous statistics, or to take arms against a sea of data, and, by opposing, end them. (Hamlet resignedly attends to his task.)

(Curtain falls)

Exercise 24

"Untitled" by Stephen Chen

I've often wondered how software is released and sold to the public. Ironically, I work for a company that sells products with known problems. Unfortunately, most of the problems are difficult to create, which makes them difficult to fix. I usually use the test program X, which tests the product, to try to create a specific problem. When the test program is run to make an error occur, the likelihood of generating an error is 1%.

So, armed with this knowledge, I wrote a new test program Y that will generate the same error that test program X creates, but more often. To find out if my test program is better than the original, so that I can convince the management that I'm right, I ran my test program to find out how often I can generate the same error. When I ran my test program 50 times, I generated the error twice. While this may not seem much better, I think that I can convince the management to use my test program instead of the original test program. Am I right?

Exercise 25 ***(Solution on p. 15.)***

Japanese Girls' Names

by Kumi Furuichi

It used to be very typical for Japanese girls' names to end with "ko." (The trend might have started around my grandmothers' generation and its peak might have been around my mother's generation.) "Ko" means "child" in Chinese character. Parents would name their daughters with "ko" attaching to other Chinese characters which have meanings that they want their daughters to become, such as Sachiko – a happy child, Yoshiko – a good child, Yasuko – a healthy child, and so on.

However, I noticed recently that only two out of nine of my Japanese girlfriends at this school have names which end with "ko." More and more, parents seem to have become creative, modernized, and, sometimes, westernized in naming their children.

I have a feeling that, while 70 percent or more of my mother's generation would have names with "ko" at the end, the proportion has dropped among my peers. I wrote down all my Japanese friends', ex-classmates', co-workers, and acquaintances' names that I could remember. Below are the names. (Some are repeats.) Test to see if the proportion has dropped for this generation.

Ai, Akemi, Akiko, Ayumi, Chiaki, Chie, Eiko, Eri, Eriko, Fumiko, Harumi, Hitomi, Hiroko, Hiroko, Hidemi, Hisako, Hinako, Izumi, Izumi, Junko, Junko, Kana, Kanako, Kanayo, Kayo, Kayoko, Kazumi, Keiko, Keiko, Kei, Kumi, Kumiko, Kyoko, Kyoko, Madoka, Maho, Mai, Maiko, Maki, Miki, Miki, Mikiko, Mina, Minako, Miyako, Momoko, Nana, Naoko, Naoko, Naoko, Noriko, Rieko, Rika, Rika, Rumiko, Rei, Reiko, Reiko, Sachiko, Sachiko, Sachiyo, Saki, Sayaka, Sayoko, Sayuri, Seiko, Shiho, Shizuka, Sumiko, Takako, Takako, Tomoe, Tomoe, Tomoko, Touko, Yasuko, Yasuko, Yasuyo, Yoko, Yoko, Yoko, Yoshiko, Yoshiko, Yoshiko, Yuka, Yuki, Yuki, Yukiko, Yuko, Yuko.

Exercise 26

Phillip's Wish by Suzanne Osorio

```
    My nephew likes to play
Chasing the girls makes his day.
He asked his mother
If it is okay
To get his ear pierced.
She said, ''No way!''
To poke a hole through your ear,
Is not what I want for you, dear.
He argued his point quite well,
Says even my macho pal,  Mel,
Has gotten this done.
It's all just for fun.
```

C'mon please, mom, please, what the hell.
Again Phillip complained to his mother,
Saying half his friends (including their brothers)
Are piercing their ears
And they have no fears
He wants to be like the others.
She said, ''I think it's much less.
We must do a hypothesis test.
And if you are right,
I won't put up a fight.
But, if not, then my case will rest.''
We proceeded to call fifty guys
To see whose prediction would fly.
Nineteen of the fifty
Said piercing was nifty
And earrings they'd occasionally buy.
Then there's the other thirty-one,
Who said they'd never have this done.
So now this poem's finished.
Will his hopes be diminished,
Or will my nephew have his fun?

Exercise 27 *(Solution on p. 15.)*

The Craven by Mark Salangsang

Once upon a morning dreary
In stats class I was weak and weary.
Pondering over last night's homework
Whose answers were now on the board
This I did and nothing more.

While I nodded nearly napping
Suddenly, there came a tapping.
As someone gently rapping,
Rapping my head as I snore.
Quoth the teacher, ''Sleep no more.''

''In every class you fall asleep,''
The teacher said, his voice was deep.
''So a tally I've begun to keep
Of every class you nap and snore.
The percentage being forty-four.''

''My dear teacher I must confess,
While sleeping is what I do best.
The percentage, I think, must be less,
A percentage less than forty-four.''
This I said and nothing more.

```
    ``We'll see,'' he said and walked away,
And fifty classes from that day
He counted till the month of May
The classes in which I napped and snored.
The number he found was twenty-four.

    At a significance level of 0.05,
Please tell me am I still alive?
Or did my grade just take a dive
Plunging down beneath the floor?
Upon thee I hereby implore.
```

Exercise 28

Toastmasters International cites a report by Gallop Poll that 40% of Americans fear public speaking. A student believes that less than 40% of students at her school fear public speaking. She randomly surveys 361 schoolmates and finds that 135 report they fear public speaking. Conduct a hypothesis test to determine if the percent at her school is less than 40%. (*Source: http://toastmasters.org/artisan/detail.asp?CategoryID=1&SubCategoryID=10&ArticleID=429&Page=1*[1])

Exercise 29 ***(Solution on p. 15.)***

68% of online courses taught at community colleges nationwide were taught by full-time faculty. To test if 68% also represents California's percent for full-time faculty teaching the online classes, Long Beach City College (LBCC), CA, was randomly selected for comparison. In the same year, 34 of the 44 online courses LBCC offered were taught by full-time faculty. Conduct a hypothesis test to determine if 68% represents CA. NOTE: For more accurate results, use more CA community colleges and this past year's data. (Sources: **Growing by Degrees** by Allen and Seaman; Amit Schitai, Director of Instructional Technology and Distance Learning, LBCC).

Exercise 30

According to an article in **Bloomberg Businessweek**, New York City's most recent adult smoking rate is 14%. Suppose that a survey is conducted to determine this year's rate. Nine out of 70 randomly chosen N.Y. City residents reply that they smoke. Conduct a hypothesis test to determine if the rate is still 14% or if it has decreased. (*Source: http://www.businessweek.com/news/2011-09-15/nyc-smoking-rate-falls-to-record-low-of-14-bloomberg-says.html*[2])

Exercise 31 ***(Solution on p. 15.)***

The mean age of De Anza College students in a previous term was 26.6 years old. An instructor thinks the mean age for online students is older than 26.6. She randomly surveys 56 online students and finds that the sample mean is 29.4 with a standard deviation of 2.1. Conduct a hypothesis test. (*Source: http://research.fhda.edu/factbook/DAdemofs/Fact_sheet_da_2006w.pdf*[3])

Exercise 32

Registered nurses earned an average annual salary of $69,110. For that same year, a survey was conducted of 41 California registered nurses to determine if the annual salary is higher than $69,110 for California nurses. The sample average was $71,121 with a sample standard deviation of $7,489. Conduct a hypothesis test. (*Source: http://www.bls.gov/oes/current/oes291111.htm*[4])

Exercise 33 ***(Solution on p. 16.)***

La Leche League International reports that the mean age of weaning a child from breastfeeding is age 4 to 5 worldwide. In America, most nursing mothers wean their children much earlier.

[1] http://toastmasters.org/artisan/detail.asp?CategoryID=1&SubCategoryID=10&ArticleID=429&Page=1
[2] http://www.businessweek.com/news/2011-09-15/nyc-smoking-rate-falls-to-record-low-of-14-bloomberg-says.html
[3] http://research.fhda.edu/factbook/DAdemofs/Fact_sheet_da_2006w.pdf
[4] http://www.bls.gov/oes/current/oes291111.htm

Suppose a random survey is conducted of 21 U.S. mothers who recently weaned their children. The mean weaning age was 9 months (3/4 year) with a standard deviation of 4 months. Conduct a hypothesis test to determine if the mean weaning age in the U.S. is less than 4 years old. (*Source: http://www.lalecheleague.org/Law/BAFeb01.html*[5])

1 Try these multiple choice questions.

Exercise 34 ***(Solution on p. 16.)***

When a new drug is created, the pharmaceutical company must subject it to testing before receiving the necessary permission from the Food and Drug Administration (FDA) to market the drug. Suppose the null hypothesis is "the drug is unsafe." What is the Type II Error?

A. To conclude the drug is safe when in, fact, it is unsafe
B. To not conclude the drug is safe when, in fact, it is safe.
C. To conclude the drug is safe when, in fact, it is safe.
D. To not conclude the drug is unsafe when, in fact, it is unsafe

The next two questions refer to the following information: Over the past few decades, public health officials have examined the link between weight concerns and teen girls smoking. Researchers surveyed a group of 273 randomly selected teen girls living in Massachusetts (between 12 and 15 years old). After four years the girls were surveyed again. Sixty-three (63) said they smoked to stay thin. Is there good evidence that more than thirty percent of the teen girls smoke to stay thin?

Exercise 35 ***(Solution on p. 16.)***

The alternate hypothesis is

A. $p < 0.30$
B. $p \leq 0.30$
C. $p \geq 0.30$
D. $p > 0.30$

Exercise 36 ***(Solution on p. 16.)***

After conducting the test, your decision and conclusion are

A. Reject H_o: There is sufficient evidence to conclude that more than 30% of teen girls smoke to stay thin.
B. Do not reject H_o: There is not sufficient evidence to conclude that less than 30% of teen girls smoke to stay thin.
C. Do not reject H_o: There is not sufficient evidence to conclude that more than 30% of teen girls smoke to stay thin.
D. Reject H_o: There is sufficient evidence to conclude that less than 30% of teen girls smoke to stay thin.

The next three questions refer to the following information: A statistics instructor believes that fewer than 20% of Evergreen Valley College (EVC) students attended the opening night midnight showing of the latest Harry Potter movie. She surveys 84 of her students and finds that 11 of attended the midnight showing.

Exercise 37 ***(Solution on p. 16.)***

An appropriate alternative hypothesis is

[5] http://www.lalecheleague.org/Law/BAFeb01.html

A. $p = 0.20$
B. $p > 0.20$
C. $p < 0.20$
D. $p \leq 0.20$

Exercise 38 ***(Solution on p. 16.)***

At a 1% level of significance, an appropriate conclusion is:

A. There is insufficient evidence to conclude that the percent of EVC students that attended the midnight showing of Harry Potter is less than 20%.
B. There is sufficient evidence to conclude that the percent of EVC students that attended the midnight showing of Harry Potter is more than 20%.
C. There is sufficient evidence to conclude that the percent of EVC students that attended the midnight showing of Harry Potter is less than 20%.
D. There is insufficient evidence to conclude that the percent of EVC students that attended the midnight showing of Harry Potter is at least 20%.

Exercise 39 ***(Solution on p. 16.)***

The Type I error is to conclude that the percent of EVC students who attended is

A. at least 20%, when in fact, it is less than 20%.
B. 20%, when in fact, it is 20%.
C. less than 20%, when in fact, it is at least 20%.
D. less than 20%, when in fact, it is less than 20%.

The next two questions refer to the following information:

It is believed that Lake Tahoe Community College (LTCC) Intermediate Algebra students get less than 7 hours of sleep per night, on average. A survey of 22 LTCC Intermediate Algebra students generated a mean of 7.24 hours with a standard deviation of 1.93 hours. At a level of significance of 5%, do LTCC Intermediate Algebra students get less than 7 hours of sleep per night, on average?

Exercise 40 ***(Solution on p. 16.)***

The distribution to be used for this test is $\overline{X} \sim$

A. $N\left(7.24, \frac{1.93}{\sqrt{22}}\right)$
B. $N(7.24, 1.93)$
C. t_{22}
D. t_{21}

Exercise 41 ***(Solution on p. 16.)***

The Type II error is to not reject that the mean number of hours of sleep LTCC students get per night is at least 7 when, in fact, the mean number of hours

A. is more than 7 hours.
B. is at most 7 hours.
C. is at least 7 hours.
D. is less than 7 hours.

The next three questions refer to the following information: Previously, an organization reported that teenagers spent 4.5 hours per week, on average, on the phone. The organization thinks that, currently, the mean is higher. Fifteen (15) randomly chosen teenagers were asked how many hours per week they

spend on the phone. The sample mean was 4.75 hours with a sample standard deviation of 2.0. Conduct a hypothesis test.

Exercise 42 ***(Solution on p. 16.)***

The null and alternate hypotheses are:

A. $H_o : \overline{x} = 4.5$, $H_a : \overline{x} > 4.5$
B. $H_o : \mu \geq 4.5$ $H_a : \mu < 4.5$
C. $H_o : \mu = 4.75$ $H_{a:}\mu > 4.75$
D. $H_o : \mu = 4.5$ $H_a : \mu > 4.5$

Exercise 43 ***(Solution on p. 16.)***

At a significance level of $a = 0.05$, what is the correct conclusion?

A. There is enough evidence to conclude that the mean number of hours is more than 4.75
B. There is enough evidence to conclude that the mean number of hours is more than 4.5
C. There is not enough evidence to conclude that the mean number of hours is more than 4.5
D. There is not enough evidence to conclude that the mean number of hours is more than 4.75

Exercise 44 ***(Solution on p. 16.)***

The Type I error is:

A. To conclude that the current mean hours per week is higher than 4.5, when in fact, it is higher.
B. To conclude that the current mean hours per week is higher than 4.5, when in fact, it is the same.
C. To conclude that the mean hours per week currently is 4.5, when in fact, it is higher.
D. To conclude that the mean hours per week currently is no higher than 4.5, when in fact, it is not higher.

Solutions to Exercises in this Module

Solution to Exercise (p. 1)

a. $H_o : \mu = 34$; $H_a : \mu \neq 34$
c. $H_o : \mu \geq 100,000$; $H_a : \mu < 100,000$
d. $H_o : p = 0.29$; $H_a : p \neq 0.29$
g. $H_o : p = 0.50$; $H_a : p \neq 0.50$
i. $H_o : p \geq 0.11$; $H_a : p < 0.11$

Solution to Exercise (p. 1)

a. Type I error: We conclude that the mean is not 34 years, when it really is 34 years. Type II error: We do not conclude that the mean is not 34 years, when it is not really 34 years.
c. Type I error: We conclude that the mean is less than $100,000, when it really is at least $100,000. Type II error: We do not conclude that the mean is less than $100,000, when it is really less than $100,000.
d. Type I error: We conclude that the proportion of h.s. seniors who get drunk each month is not 29%, when it really is 29%. Type II error: We do not conclude that the proportion of h.s. seniors that get drunk each month is not 29%, when it is really not 29%.
i. Type I error: We conclude that the proportion is less than 11%, when it is really at least 11%. Type II error: We do not conclude that the proportion is less than 11%, when it really is less than 11%.

Solution to Exercise (p. 2)

e. $z = -2.71$
f. 0.0034
h. Decision: Reject null; Conclusion: $\mu < 19$
i. $(17.449, 18.757)$

Solution to Exercise (p. 2)

e. 3.5
f. 0.0005
h. Decision: Reject null; Conclusion: $\mu > 4.5$
i. $(4.7553, 5.4447)$

Solution to Exercise (p. 2)

e. 2.7
f. 0.0042
h. Decision: Reject Null
i. $(80.789, 85.211)$

Solution to Exercise (p. 3)

d. t_{11}
e. 1.96
f. 0.0380
h. Decision: Reject null when $a = 0.05$; do not reject null when $a = 0.01$
i. $(3.8865, 5.9468)$

Solution to Exercise (p. 3)

e. -1.64
f. 0.1000
h. Decision: Do not reject null

i. $(0.3216, 0.4784)$

Solution to Exercise (p. 3)

d. t_9
e. -1.33
f. 0.1086
h. Decision: Do not reject null
i. $(51.886, 62.114)$

Solution to Exercise (p. 4)

e. 1.65
f. 0.0984
h. Decision: Do not reject null
i. $(0.6836, 0.8533)$

Solution to Exercise (p. 5)

e. -2.39
f. 0.0093
h. Decision: Reject null
i. $(91.854, 100.15)$

Solution to Exercise (p. 7)

e. -1.82
f. 0.0345
h. Decision: Do not reject null
i. $(0.5331, 0.7685)$

Solution to Exercise (p. 8)

e. $z = -2.99$
f. 0.0014
h. Decision: Reject null; Conclusion: $p < .70$
i. $(0.4529, 0.6582)$

Solution to Exercise (p. 9)

e. 0.57
f. 0.7156
h. Decision: Do not reject null
i. $(0.3415, 0.6185)$

Solution to Exercise (p. 10)

e. 1.32
f. 0.1873
h. Decision: Do not reject null
i. $(0.65, 0.90)$

Solution to Exercise (p. 10)

e. 9.98
f. 0.0000
h. Decision: Reject null

i. $(28.8, 30.0)$

Solution to Exercise (p. 10)

e. -44.7
f. 0.0000
h. Decision: Reject null
i. $(0.60, 0.90)$ - in years

Solution to Exercise (p. 11)
B
Solution to Exercise (p. 11)
D
Solution to Exercise (p. 11)
C
Solution to Exercise (p. 11)
C
Solution to Exercise (p. 12)
A
Solution to Exercise (p. 12)
C
Solution to Exercise (p. 12)
D
Solution to Exercise (p. 12)
D
Solution to Exercise (p. 13)
D
Solution to Exercise (p. 13)
C
Solution to Exercise (p. 13)
B