Chapter 9 Homework Solutions

1. a. \( H_0: \mu = 34 \quad b. \quad H_0: p = 0.60 \quad c. \quad H_0: \mu = 90,000 \quad d. \quad H_0: p = 0.29 \quad e. \quad H_0: p = 0.05 \)
   \[ Ha: \mu \neq 34 \quad Ha: p > 0.60 \quad Ha: \mu < 90,000 \quad Ha: p \neq 0.29 \quad Ha: p < 0.05 \]
   f. \( H_0: \mu = 10 \quad g. \quad H_0: p = 0.50 \quad h. \quad H_0: \mu = 6 \quad i. \quad H_0: p = 0.11 \quad j. \quad H_0: \mu = 20,000 \)
   \[ Ha: \mu > 10 \quad Ha: p \neq 0.50 \quad Ha: \mu \neq 6 \quad Ha: p < 0.11 \quad Ha: \mu > 20,000 \]

2. a. Type I error: We conclude that the mean is not 34 years, when it really is 34 years.
   Type II error: We conclude that the mean is 34 years, when in fact it really is not 34 years.

   b. Type I error: We conclude that more than 60% of Americans vote in presidential elections, when the actual percentage is at most 60%.
   Type II error: We conclude that at most 60% of Americans vote in presidential elections when, in fact, more than 60% do.

   c. Type I error: We conclude that the mean starting salary is less than $90,000, when it really is at least $90,000.
   Type II error: We conclude that the mean starting salary is at least $90,000 when, in fact, it is less than $90,000.

   d. Type I error: We conclude that the proportion of high school seniors who get drunk each month is not 29%, when it really is 29%.
   Type II error: We conclude that the proportion of high school seniors who get drunk each month is 29% when, in fact, it is not 29%.

   e. Type I error: We conclude that fewer than 5% of adults ride the bus to work in Los Angeles, when the percentage that do is really 5% or more.
   Type II error: We conclude that 5% or more adults ride the bus to work in Los Angeles when, in fact, fewer than 5% do.

   f. Type I error: We conclude that the mean number of cars a person owns in his or her lifetime is more than 10, when in reality it is not more than 10.
   Type II error: We conclude that the mean number of cars a person owns in his or her lifetime is not more than 10 when, in fact, it is more than 10.

   g. Type I error: We conclude that the proportion of Americans who prefer to live away from cities is not about half, though the actual proportion is about half.
   Type II error: We conclude that the proportion of Americans who prefer to live away from cities is half when, in fact, it is not half.
3. a. Type I: Pension funds make investments that have maturity greater than 34 years. As a consequence, they do not have sufficient funds available for retirees' payout.
   Type II: Pension funds act conservatively, and make investments that have maturity of at most 34 years (possibly losing out on higher interest earnings).

b. Type I: Too many voting booths are set up, costing tax payers more than required.
   Type II: We do not have adequate voting booths, which result in longer waiting times at some booths.

d. Type I: We place less importance on educating high school seniors about the harmful effects of drinking (if 29% is considered to be too low).
   Type II: (If 29% is considered too high,) more resources than needed are spent to raise public awareness about the dangers of teenage drinking.

e. Type I: Less public transportation is available than the demand necessitates.
   Type II: Resources that could have been spent on education, for instance, get diverted towards providing public transportation in Los Angeles.

f. Type I: Car dealerships end up spending more on advertising new makes and models of cars to induce customers into buying newer cars.
   Type II: Car dealerships choose not to advertise new makes and models as much as they probably should.

g. Type I: Housing supply falls short of demand in the suburbs beyond city limits where Americans prefer to live.
   Type II: Too much housing is available beyond city limits, and not enough within the city limits.

h. Type I: European travel destinations spend less on advertisements to entice tourists than they probably should (if they think paid vacation time is less than six weeks).
   Type II: We (Americans) start feeling resentful about not having six weeks' paid vacation like the Europeans!

4. \( H_0: \mu = 80 \)
   \( H_a: \mu > 80 \)

\[
\begin{align*}
n &= 81 \\
\bar{x} &= 83 \\
s &= 10 \\
\alpha &= 0.05 \\
\bar{X} &\sim t_{80}
\end{align*}
\]

TS: \( t = 2.7 \)

\( P\text{-value} = P(t > 2.7) = 0.0042 < 0.05 \)

Reject \( H_0 \)

There is sufficient evidence to conclude that mothers work more than 80 hours per week.
5. \( H_0: p = 0.50 \)
   \( H_a: p \neq 0.50 \)

\[
n = 64 \\
x = 41 \\
p' = \frac{41}{64} = 0.6406 \\
\alpha = 0.05 \\
p = 0.50 \\
q = 0.50 \\
P' \sim N\left(0.5, \sqrt{\frac{(0.5)(0.5)}{64}}\right)
\]

TS: \( z = 2.25 \)

P-value = \( 2P(z > 2.25) = 0.0244 < 0.05 \)

Reject \( H_0 \)

There is sufficient evidence to conclude that the proportion of statistics students that feel more enriched is different than 50 percent.

It appears that more than half of your professor’s statistics students fee more enriched after taking her class.

6. \( H_0: \mu = 4 \)
   \( H_a: \mu \neq 4 \)

\[
n = 12 \\
\bar{x} = 2.75 \\
\alpha = 0.05 \\
\bar{X} \sim t_{11}
\]

TS: \( t = -3.5626 \)

P-value = \( 2P(t < -3.5626) = 0.0045 < 0.05 \)

Reject \( H_0 \)

There is sufficient evidence to conclude that the mean IQ for brown trout is not 4.

It appears that the mean IQ for brown trout is less than 4.
7. \( H_0: p = 0.13 \)
\( H_a: p < 0.13 \)

\[ n = 79 \]
\[ x = 5 \]
\[ p' = \frac{5}{79} = 0.0633 \]
\[ \alpha = 0.05 \]
\[ p = 0.13 \]
\[ q = 0.87 \]

\[ P' \sim N\left(0.13, \sqrt{\frac{0.13 \times 0.87}{79}}\right) \]

TS: \( z = -1.7631 \)

\[ P-value = P(z < -1.7631) = 0.0389 < 0.05 \]

Reject \( H_0 \)

There is sufficient evidence to conclude that less than 13 percent of Americans have seen or sensed the presence of an angel.

8. \( H_0: p = 0.54 \)
\( H_a: p \neq 0.54 \)

\[ n = 30 \]
\[ x = 13 \]
\[ p' = \frac{13}{30} = 0.4333 \]
\[ \alpha = 0.05 \]
\[ p = 0.54 \]
\[ q = 0.46 \]

\[ P' \sim N\left(0.54, \sqrt{\frac{0.54 \times 0.46}{30}}\right) \]

TS: \( z = -1.1722 \)

\[ P-value = 2P(z < -1.722) = 0.2411 > 0.05 \]

Do Not Reject \( H_0 \)

There is not sufficient evidence to conclude that the proportion of fatal accidents due to driver error is not 0.54.
11. From #4: The P-value 0.0042 is the probability the average number hours mothers work is at least 83, from a sample of 81, if the null hypothesis is true that the population mean number of hours mothers work is 80.

From #5: The P-value of 0.0244 is the probability the percent of your professor’s statistics students who feel more enriched is 64.06 percent or more extreme, from a sample of 64, if the null hypothesis is true that half of all her students feel more enriched after taking her class.

From #6: The P-value of 0.0045 is the probability the mean IQ of brown trout is 2.75 or more extreme, from a sample of 12, if the null hypothesis is true that the population mean IQ of brown trout is 4.

From #7: The P-value of 0.0389 is the probability the percent of Americans who have seen or sensed the presence of an angle, from a sample of 79, is 6.33 percent or less if the null hypothesis is true that 13 percent of all Americans have seen or sensed the presence of an angle.

From #8: The P-value of 0.2411 is the probability the proportion of fatal accidents due to driver error is 0.4333 or more extreme, if the null hypothesis is true that the population proportion of fatal accidents due to driver error is 0.54.