1. Consider a uniform density curve defined from \( x = 1 \) to \( x = 8 \).

a. What is the height of the “curve”?
   Height will be the density function \( f(x) \) \( \frac{1}{\text{max} - \text{min}} \)

   \[ f(x) = \begin{cases} \frac{1}{7} , & 1 \leq x \leq 8 \\ 0 , & \text{otherwise} \end{cases} \]

b. What percent of observations fall between \( x = 2 \) and \( x = 5 \)?
   \[ P(2 < X < 5) = \frac{1}{7}(5) - \frac{1}{7}(2) = \frac{3}{7} \]

c. What percent of observations fall below \( x = 4 \)?
   \[ P(X < 4) = \frac{1}{7}(4-1) = \frac{3}{7} \]

d. What percent of observations fall above \( x = 6 \)?
   \[ P(X > 6) = 1 - P(X < 6) = 1 - \frac{1}{7}(6-1) = \frac{2}{7} \]

e. What percent of observations equal 7?
   \[ P(X = 7) = 0 \] [Since this is a continuous function the probability at exactly one value is zero]

2. A 12-inch bar that is clamped at both ends is to be subjected to an increasing amount of stress until it snaps. Let \( Y \) = the distance from the left end at which the break occurs. Suppose \( Y \) had pdf:

   \[ f(y) = \begin{cases} \frac{1}{24} y \left( 1 - \frac{y}{12} \right) , & 0 \leq y \leq 12 \\ 0 , & \text{otherwise} \end{cases} \]

   Compute the following:

a. The cdf of \( Y \)
   \[ F(Y) = \int_0^y \frac{1}{24} u \left( 1 - \frac{u}{12} \right) du = \frac{1}{24} \int_0^y u - \frac{u^2}{12} du = \frac{1}{24} \left[ \frac{y^2}{2} - \frac{y^3}{36} \right] \]

   \[ F(y) = 0 \text{ for } y \leq 0, \quad F(x) = 1 \text{ for } y \geq 12 \]

b. \( P(Y \leq 4) \), \( P(Y > 6) \) and \( P(4 \leq Y \leq 6) \).

   \[ P(Y \leq 4) = F(4) = \frac{1}{24} \left( \frac{4^2}{2} - \frac{4^3}{36} \right) = 0.2592 \]

   \[ P(Y > 6) = 1 - F(6) = 1 - \frac{1}{24} \left( \frac{6^2}{2} - \frac{6^3}{36} \right) = 1 - 0.5 = 0.5 \]

   \[ P(4 \leq Y \leq 6) = F(6) - F(4) = 0.5 - 0.2592 = 0.2408 \]

c. \( E(Y) \), \( E(Y^2) \), and \( Var(Y) \)

   \[ E(Y) = \int_0^{12} \frac{1}{24} \left( y^2 - \frac{y^3}{12} \right) dy = \frac{1}{24} \left( \frac{y^3}{3} - \frac{y^4}{48} \right) \bigg|_0^{12} = 6 \]

   \[ E(Y^2) = \int_0^{12} \frac{1}{24} \left( y^3 - \frac{y^4}{12} \right) dy = \frac{1}{24} \left( \frac{y^4}{4} - \frac{y^5}{60} \right) \bigg|_0^{12} = 43.2 \]

   \[ Var(Y) = E(Y^2) - E(Y)^2 = 43.2 - 36 = 7.2 \]

d. The probability that the break point occurs more than 2 in. from the expected break point.
   \[ P(X < 4 \text{ or } X > 8) = F(4) + 1 - F(8) = 0.2592 + 1 - 0.74074 = 0.51846 \]

e. The expected length of the shorter segment when the break occurs.

   Let \( Z \) = the length of the shorter segment.
Then $Z(Y) = \begin{cases} y, & 0 \leq Y < 6 \\ 12 - y, & 6 \leq Y \leq 12 \end{cases}$

$$E(Z(Y)) = \int_0^6 \frac{1}{24} (y^2 - \frac{y^3}{12}) + \int_6^{12} (12 - y) \left( \frac{1}{24} \right) (y - \frac{y^2}{12}) = 1.875 + 1.875 = 3.75$$

3. In a certain city, the daily consumption of electric power, in millions of kilowatt-hours, is a random variable $X$ having a gamma distribution with mean $\mu = 6$ and variance $\sigma^2 = 12$.
   a. Find the value of $\alpha$ and $\beta$.
   \[
   \mu = \alpha \beta; \quad \sigma^2 = \alpha \beta^2 \\
   6 = \alpha \beta \rightarrow \alpha = 6/\beta \\
   12 = 6/\beta \times \beta^2 \\
   12 = 6\beta \\
   \beta = 2 \\
   \alpha = 6/2 = 3
   \]
   b. Find the probability that on any given day the daily power consumption will exceed 12 million kilowatt-hours.
   \[
P(X > 12) = 1 - \text{pgamma}(12, \text{shape} = 3, \text{scale} = 2) = 0.0619688
   \]

4. The length of time for one individual to be served at a cafeteria is a random variable having an exponential distribution with a mean of 4 minutes.
   a. Find the value of $\lambda$.
   \[
   \mu = 1/\lambda = 1/4
   \]
   b. What is the probability that a person waits for less than 3 minutes?
   \[
P(X < 3) = \text{pexp}(3, \frac{1}{4}) = 0.5267
   \]

5. Let $X$ be a normal random variable with $\mu = 82$ and $\sigma = 4$. 
a. Sketch the distribution

b. According to the Empirical Rule, the middle 68% of the data falls between what values?
   According to the Empirical Rule 1 standard deviation is 68% that is between 78 and 86.

c. Find $P(X < 83)$
   $P(X < 83) = \text{pnorm}(83, 82, 4) = 0.5987$

d. Find $P(X > 79)$
   $P(X > 79) = 1 - \text{pnorm}(79, 82, 4) = 1 - 0.2266 = 0.7734$

e. Find $P(73 < X < 84)$
   $P(73 < X < 84) = \text{pnorm}(84, 82, 4) - \text{pnorm}(73, 82, 4) = 0.6915 - 0.0122 = 0.6973$

f. Find $x$ such that $P(X < x) = .97725$
   $qnorm(0.97725, 82, 4) = 90$

6. Recall $Z$ is the standard normal random variable.
   a. What is the mean and standard deviation for $Z$?
      $\mu = 0, \sigma = 1$
b. Sketch the distribution

c. Find \( P(Z < 1.2) \)
   From table: \( P(Z < 1.2) = 0.8849 \)
   From R: \( P(Z < 1.2) = \text{pnorm}(1.2) = 0.8849 \)

d. Find \( P(Z < -1.64) \)
   From table: \( P(Z < -1.64) = 0.0505 \)
   From R: \( P(Z < -1.64) = \text{pnorm}(-1.64) = 0.0505 \)

e. Find \( P(Z > -1.39) \)
   From table: \( P(Z > -1.39) = 1 - 0.0823 = 0.9177 \)
   From R: \( P(Z > -1.39) = 1 - \text{pnorm}(-1.39) = 0.9177 \)

f. Find \( P(-0.45 < Z < 1.96) \)
   From table: \( P(-0.45 < Z < 1.96) = 0.9750 - 0.3264 = 0.6486 \)
   From R: \( \text{pnorm}(1.96) - \text{pnorm}(-0.45) = 0.6486 \)

g. Find \( c \) such that \( P(Z < c) = 0.845 \)
   From table: \( c = 1.02 \) (area = 0.8461)
h. Find $c$ such that $P(Z > c) = 0.845$

From R: $\text{qnorm}(0.845) = 1.0152$

From table: use $1 - 0.845 = 0.155$, $c = -1.02$ (area = 0.1539)

From R: $\text{qnorm}(1-0.845) = -1.0152$

i. Find $c$ such that $P(-c < Z < c) = 0.845$

From table: use $\frac{1}{2} (1 - 0.845) = 0.0775$, $-c = -1.42$, $+c = +1.42$

From R: $\text{qnorm}((1-0.845)/2) = -1.422$, $c = +1.422$

7. Suppose a sample of 100 subjects was taken and their scores on an exam recorded. If the population mean for the exam is 67 and population variance is 36,

a. what is the mean and standard error of the sampling distribution, $\bar{X}$?

Mean = $\mu = 67$, Standard Error = $SD(\bar{X}) = \frac{\sigma}{\sqrt{n}} = \frac{\sqrt{36}}{\sqrt{100}} = 0.6$

b. find $P(\bar{X} < 70)$.

$\text{pnorm}(70,67,0.6) \approx 1$

c. find $P(45 < \bar{X} < 74)$.

$\text{pnorm}(74,67,0.6) - \text{pnorm}(45,67,0.6) = 1$

8. What is the difference between the distributions for $X$ and $\bar{X}$?

For the distribution of $\bar{X}$, we have to take the original standard deviation and divide by the square root of the sample size ($n$).


a. For a fixed confidence level, when the sample size increases, the length of the confidence interval for a population mean decreases.

True

b. The $z$ score corresponding to a 98 percent confidence level is 1.96.

False, for 98% confidence $z = 2.33$

c. The best point estimate for the population mean is the sample mean.

True

d. The larger the level of confidence, the shorter the confidence interval.

False

e. The margin of error can be computed from $\pm z^* \cdot \frac{\sigma}{\sqrt{n}}$

True

f. A statement contradicting the claim in the null hypothesis is classified as the power.

False, the statement contradicting the claim in the null hypothesis is the alternative hypothesis.

g. If we want to claim that a population parameter is different from a specified value, this situation can be considered as a one-tailed test.

False, it is two-tail test. Alternative is “not equal to.”

h. In the P-value approach to hypothesis testing, if the P-value is less than a specified significance level, we fail to reject the null hypothesis.

False, if the p-value is less than or equal to the specified level of significance then we would reject the null hypothesis.
i. A 90% confidence interval for a population parameter means that if a large number of confidence intervals were constructed from repeated samples, then on average, 90% of these intervals would contain the true parameter.

True

j. The point estimate of a population parameter is always at the center of the confidence interval for the parameter.

True for means and proportions.

10. A certain beverage company is suspected of under filling its cans of soft drink. The company advertises that its cans contain, on the average, 12 ounces of soda with standard deviation 0.4 ounce. Compute the probability that a random sample of 50 cans produces a sample mean fill of 11.9 ounces or less.

\[ P(\bar{X} \leq 11.9) = P\left( \frac{\bar{X} - \mu}{\sigma/\sqrt{n}} \leq \frac{11.9 - 12}{0.4/\sqrt{50}} \right) = P(Z \leq -1.7677) = 0.0384 \text{ from the Z-table} \]

Using R:

```r
> pnorm(11.9, 12, .4/sqrt(50))
[1] 0.03854994
```

11. A Brinell hardness test involves measuring the diameter of the indentation made when a hardened steel ball is pressed into material under a standard test load. Suppose that the Brinell hardness is determined for each specimen in a sample of size 50, resulting in a sample mean hardness of 64.3 and a sample standard deviation of 6.0. Calculate a 99% confidence interval for the true average Brinell hardness for material specimens of this type.

Point estimate = 64.3
Confidence level = 99%
Critical Value = \( t(\text{df} = 49) = 2.68 \) (In R: \( qt(0.995, 49) \))
Standard error = \( 6/\sqrt{50} = 0.8485 \)
Margin of error = \( 0.8485 \times 2.68 = 2.274 \)
Confidence interval: \((64.3 - 2.274, 64.3 + 2.274) = (62.026, 66.574)\)
Interpret: We are 99% confident that the Brinell hardness for this type of steel ball is between 62.026 and 66.574.

12. The shear strength of anchor bolts has a standard deviation of 1.30. Assuming that the distribution is normal, how large a sample is needed to determine with a precision of ±0.5 the mean length of the produced anchor bolts to 99% confidence?

\[ \sigma = 1.30, C = 99\%, m = 0.5, z = 2.576 \]

\[ n = \left( \frac{z \times \sigma}{m} \right)^2 = \left( \frac{2.576 \times 1.3}{0.5} \right)^2 = 44.85 \]

We need a sample of 45

13. A journal article reports that a sample of size 5 was used as a basis for calculating a 90% confidence interval for the true population mean(population variance not known). The resulting interval was [15.34, 36.66]. You decide that a confidence level of 99% is more appropriate. What are the limits of the 99% confidence interval?

Point Estimate: \((15.34 + 36.66)/2 = 26\)
Confidence level = 0.99
Critical value = $t = qt(1.99/2,4) = 4.604$
Margin of error for 90% confidence: $(36.66 - 15.34)/2 = 10.66$
Critical value for 90% confidence = $qt(1.9/2,4) = 2.132$
To find standard error use the formula for the 90% confidence:
$M = t^* \times SE$
$10.66 = 2.132 \times SE$
$SE = 10.66/2.132 = 5$
Margin of error for 99% confidence = $4.604 \times 5 = 23.02$
Confidence interval $[26 - 23.02, 26 + 23.02] = [2.98, 49.02]$

14. A study of the ability of individuals to walk in a straight line reported the accompanying data on cadence (strides per second for a sample of n = 20 randomly selected men).

| .95 | .85 | .92 | .95 | .93 | .86 | 1.00 | .92 | .85 | .81 |
| .78 | .93 | .93 | 1.05 | .93 | 1.06 | 1.06 | .96 | .81 | .96 |

a. Find a 99% confidence interval for the mean cadence of the population.
b. Test the hypothesis that the mean cadence for the population is less than 0.97 at the 5% significance level.

I did this in R:

```
> walk=c(.95,.85,.92,.95,.93,.86,1,.92,.85,.81,.78,.93,.93,1.05,.93,1.06,1.06,.96,.81,.96)
```

a. `> t.test(walk,conf.level = .99)`

One Sample t-test
data:  walk
t = 51.132, df = 19, p-value < 2.2e-16
alternative hypothesis: true mean is not equal to 0
99 percent confidence interval:
0.8737164 0.9772836
sample estimates:
mean of x
0.9255

b. `> t.test(walk,conf.level=.95,mu=.97,alternative = "less")`

One Sample t-test
data:  walk
t = -2.4585, df = 19, p-value = 0.01186
alternative hypothesis: true mean is less than 0.97
95 percent confidence interval:
-inf 0.9567977
sample estimates:
mean of x
0.9255

H0: µ = 0.97 and Ha: µ < 0.97
Test statistic = -2.4585
Rejection region is any t < -1.729 RH0
P-value = 0.01186
Decision: Since the p-value is less than 0.05, we reject the null hypothesis.
Conclusion: We say that there is significant evidence that the null hypothesis is false and that the mean cadence for men is less than 0.97.

15. Bottles of a popular cola drink are supposed to contain 300 ml of cola. There is some variation from bottle to bottle because the filling machinery is not perfectly precise. The distribution of the contents is normal with standard deviation of 3 ml. A student who suspects that the bottler is under-filling measures the contents of six bottles. The results are:
Is this convincing evidence that the mean contents of cola bottles is less than the advertised 300 ml? Test at the 5% significance level.

H₀: µ = 300 and Hₐ: µ < 300

Test statistic = \( z = \frac{299.033 - 300}{3/\sqrt{6}} = -0.7895 \) (used z because we know the population standard deviation)

Rejection region is any \( z < -1.645 \) FRH₀

P-value = \( P(Z < -0.7895) = 0.2149 \)

Decision: Since the p-value is greater than 0.05, we fail to reject the null hypothesis.

Conclusion: We say that there is not enough evidence that the null hypothesis is false. Thus there is not convincing evidence that the mean contents of cola bottle is less than the advertised 300 ml.

16. It is fourth down and a yard to go for a first down in an important football game. The football coach must decide whether to go for the first down or punt the ball away. The null hypothesis is that the team will not get the first down if they go for it. The coach will make a Type I error by doing what?

Type I error is rejecting the null hypothesis when in fact it is true. So this means that if the coach makes a Type I error that he went for the first down but did not get the first down.

17. In a recent publication, it was reported that the average highway gas mileage of tested models of a new car was 33.5 mpg and approximately normally distributed. A consumer group conducts its own tests on a simple random sample of 12 cars of this model and finds that the mean gas mileage for their vehicles is 31.6 mpg with a standard deviation of 3.4 mpg.

a. Perform a test to determine if these data support the contention that the true mean gas mileage of this model of car is different from the published value.

H₀: µ = 33.5 and Hₐ: µ ≠ 33.5

Test statistic = \( t = \frac{31.6 - 33.5}{3.4/\sqrt{12}} = -1.9358 \)

P-value = \( P(t < -1.9358 \text{ or } t > 1.9358) = 2 \times pt(-1.9358,11) = 0.079 \) FRH₀

Conclusion: there is not enough evidence to conclude that the mean gas mileage of the model of car is different from 33.5

b. Perform a test to determine if these data support the contention that the true mean gas mileage of this model of car is less than the published value.

H₀: µ = 33.5 and Hₐ: µ < 33.5

Test statistic = \( t = \frac{31.6 - 33.5}{3.4/\sqrt{12}} = -1.9358 \)

P-value = \( P(t < -1.9358) = pt(-1.9358,11) = 0.0395 \) RH₀

Conclusion: there is enough evidence to conclude that the mean gas mileage of the model of car is significantly less than 33.5

c. Explain why the answers to part a and part b are different.

The probability of getting the observed value “less than” will be smaller because we are only looking at one side.
18. Suppose that prior to conducting the coin-flipping experiment, we suspect that the coin is fair. How many times would we have to flip the coin in order to obtain a 90% confidence interval of width at most 0.1 for the probability of flipping a head?

For $C = 90\%$, $z^* = 1.645$ (Using table or qnorm(1.9/2)), $p^* = 0.5$, $m = 0.1/2 = 0.05$

\[ n \geq \left( \frac{1.645}{0.05} \right)^2 (0.5)(1 - 0.5) \]

Thus we need at least 271 in the sample.

19. In a sample of 539 households from a certain Midwestern city, it was found that 133 of these households owned at least one firearm. Give a 99% confidence interval for the percentage of families in this city who own firearms.

Point estimate: $\frac{133}{539} = 0.2468$

Confidence level = 99%

Critical value = $z = 2.576$

Standard Error = $\sqrt{\frac{2468 \times (1 - 0.2468)}{539}} = 0.01857$

Margin of error = $2.576 \times 0.01857 = 0.0478$

Confidence Interval: $(0.2468 - 0.0478, 0.2468 + 0.0478) = (0.199, 0.2946)$

Interpret: We are 99% confident that the percent of families in this city who own firearms is between 20% and 29.5%.

\[ > 0.2468 + c(-1,1) \times \text{qnorm}(1.99/2) \times \sqrt{0.2468 \times 0.7532/539} \]
\[ [1] \ 0.1989645 \ 0.2946355 \]

20. A preacher would like to establish that of people who pray, less than 80% pray for world peace. In a random sample of 110 persons who pray, 77 of them said that when they pray, they pray for world peace. Test at the 10% level.

\[ H_0: p = 0.8 \text{ and } H_a: p < 0.8 \]

\[ \hat{p} = \frac{77}{110} = 0.7 \]

Test statistic = $z = \frac{0.7 - 0.8}{\sqrt{\frac{0.8(1 - 0.8)}{110}}} = -2.622$

Rejection Region: $P(Z < c) = 0.1$ qnorm(0.1) = -1.28, reject the null hypothesis if the test statistic is less than -1.28 (draw the normal curve) RH0

P-value = $P(t < -2.622) = \text{pnorm}(-2.622) = 0.0044 \text{ RH0}$ this is less than 0.1.

Conclusion: There is strong evidence that the proportion of people who pray for world peace is significantly less than 80%.

21. A manufacturer of car batteries claims that his batteries will last, on average, 3 years with a variance of 1 year. If 5 of these batteries have lifetimes of 1.9, 2.4, 3.0, 3.5, and 4.2 years, construct a 95% confidence interval for the variance $\sigma^2$ and decide if the manufacturer’s claim that $\sigma^2 = 1$ is valid. Assume the population of battery lives to be approximately normally distributed.

In R-studio:

\[ > \text{batteries = c(1.9,2.4,3,3.5,4.2)} \]
\[ > \text{lcl=4*var(batteries)/qchisq(1.95/2,4)} \]
\[ > \text{ucl=4*var(batteries)/qchisq(0.05/2,4)} \]
\[ > \text{c(lcl,ucl)} \]
\[ [1] \ 0.2925528 \ 6.7297174 \]

The confidence interval for the variance is: $(0.2926, 6.7297)$.

Since $\sigma^2 = 1$ is inside the interval, the manufacturer’s claim is valid.
22. A professor of statistics records the mpg of his car each time he fill the tank. He does this by dividing the miles driven since the last fill-up by the amount of gallons at fill-up. He wants to determine if these calculations differ from what his car’s computer estimates. The following is data from 10 fill-ups

<table>
<thead>
<tr>
<th>Computer</th>
<th>41.5</th>
<th>45</th>
<th>43.2</th>
<th>43.2</th>
<th>48.4</th>
<th>46.8</th>
<th>39.2</th>
<th>43.5</th>
<th>44.3</th>
<th>43.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver</td>
<td>36.5</td>
<td>40.5</td>
<td>41</td>
<td>38.8</td>
<td>45.4</td>
<td>45.7</td>
<td>34.2</td>
<td>39.8</td>
<td>44.9</td>
<td>47.5</td>
</tr>
</tbody>
</table>

a) State an appropriate $H_0$ and $H_a$.
Since it is the same car and the same fill-up this is a paired t-test
$H_0$: $\mu_D = 0$ and $H_a$: $\mu_D \neq 0$

b) Carry out the test. Give the p-value, and then interpret the result.
Using R studio to carry out the test:
```r
> computer=c(41.5,45,43.2,43.2,48.4,46.8,39.2,43.5,44.3,43.3)
> driver=c(36.5,40.5,41,38.8,45.4,45.7,34.2,39.8,44.9,47.5)
> t.test(computer,driver,paired = T)
```

Paired t-test
data:  computer and driver
t = 2.5843, df = 9, p-value = 0.02949
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
0.300418 4.519582
sample estimates:
mean of the differences 2.41

p-value = 0.02949, RH0 there is very strong evidence that the

23. The following situations all require inference about a mean or means. Identify each as (1) a single sample, (2) matched pairs or (3) two independent samples.
   a) Your customers are college students. You want to compare students who live in the dorms and those who live elsewhere with regard to their interest in a new product that you are developing.
      This is (3) two independent samples different groups.
   b) Your customers are college students. You are interested in comparing which of the two new product labels is more appealing.
      This is (2) matched pairs, same group two labels.
   c) Your customers are college students. You are interested in assessing their interest in a new product.
      This is (1) one group one product.

24. A random sample of 200 freshmen and 100 seniors at Upper Wabash Tech are asked whether they agree with a plan to limit enrollment in crowded majors as a way of keeping the quality of instruction high. Of the students sampled, 160 freshmen and 20 seniors opposed the plan. We want to determine if there is any difference between the proportion of freshmen who oppose the plan and the proportion of seniors who oppose it.
   a. Formulate the null and alternative hypothesis.
      $H_0$: $p_{freshman} = p_{seniors}$ $H_a$: $p_{freshman} \neq p_{seniors}$
   b. Compute the appropriate test statistic.
      $$p_{freshman} = 160/200 = 0.8, p_{seniors} = 20/100 = 0.2$$
      $$z = \frac{0.8 - 0.2}{\sqrt{\frac{0.8 \times 0.2}{200} + \frac{0.2 \times 0.8}{100}}} = 12.2475$$
   c. Determine the p-value.
      p-value = 2*pnorm(-12.2475) ≈ 0
   d. Do you reject $H_0$ or fail to reject $H_0$? Explain.
      Reject $H_0$ because the p-value is very small.
e. Describe your results for someone who has no training in statistics.

There is very strong evidence that the proportion of freshman who oppose the plan is significantly different than the proportion of seniors that oppose the plan.

f. Find a 95% confidence interval for the difference between the population proportions.

\[ (0.8 - 0.2) + (1.1) \times \text{qnorm}(1.95/2) \times \text{sqrt}(0.8 \times 0.2/100 + 0.2 \times 0.8/200) \]

\[
\begin{array}{c}
0.5039818 \\
0.6960182
\end{array}
\]

We are 95% confident that the difference in the proportions between freshman and seniors who oppose the plan is between 50.4% and 69.6%.

25. A sample of 97 Duracell batteries produces a mean lifetime of 10.40 hours and standard deviation 4.83 hours. A sample of 148 Energizer batteries produces a mean lifetime of 9.26 hours and a standard deviation of 4.68 hours. At a 5% significance level, can we assert that the average lifetime of Duracell batteries is greater than the average lifetime of Energizer batteries?

Since this is two different batteries we want a two-sample t-test.

H0: \( \mu_{\text{Duracell}} = \mu_{\text{Energizer}} \); Ha: \( \mu_{\text{Duracell}} > \mu_{\text{Energizer}} \)

\[ t = \frac{10.4 - 9.26}{\sqrt{\frac{4.83^2}{97} + \frac{4.68^2}{148}}} = 1.829 \]

\[ \text{df} = \frac{\frac{4.83^2}{97} + \frac{4.68^2}{148}}{\frac{1}{96} + \frac{1}{147}} = 200.8322 \]

p-value = 1 – pt(1.829, 200.8322) = 0.0344, This is greater than 0.05 thus RH0.

There is strong evidence that the Duracell batteries have a larger mean lifetime than the Energizer batteries.