Gallup tracks daily the percentage of Americans who approve or disapprove of the job Donald Trump is doing as president. Weekly results are based on telephone interviews with approximately 1,500 national adults, with a maximum margin of error is ±3 percentage points.

**Percentage "proportions" \( p \)**

**CI:** \( \hat{p} \pm \text{margin of error} \)

**Margin of error = Critical value \times SE**

\[
SE(\hat{p}) = SD(\hat{p}) = \sqrt{\frac{p(1-p)}{n}}
\]

**Critical value = \( z^* \)**

where \( P(-z^* \leq Z \leq z^*) = c \)

**Confidence levels:** \( c = 95\% \)

\[
P(Z \leq z^*) = 0.95 + 0.025 = 0.975
\]

Find \( z^* = \text{qnorm}(0.975) = 1.96 = \frac{\text{qnorm}(1.95/2)}{\text{qnorm}(1.95/2)}\)

\[
\frac{1}{2}(1.95) = \frac{1.95}{2} = 0.975
\]

**Margin of error = \( z^* \sqrt{\frac{p(1-p)}{n}} \)

\[
= 1.96 \sqrt{\frac{0.5(1-0.5)}{1500}} = 0.0253 \approx 0.03 \text{ or } 3\% 	ext{ points}
\]

40\% ± 3\% \( \Rightarrow [37\%, 43\%] \) confidence interval.

We are 95\% confident that between 37\% and 43\% of Americans...
Question 1

The z-score associated with the 96.5 percent confidence interval is

a) 2.108
b) 1.812
c) 1.767
d) 2.012
e) 2.611
f) None of the above

Question 2

What will reduce the width of a confidence interval?

a) Increase variance.
b) Increase confidence level.
c) Decrease variance.
d) Decrease number in sample.

Question 3

A simple random sample of 49 8th graders at a large suburban middle school indicated that 88% of them are involved with some type of after school activity. Find the margin of error associated with a 90% confidence interval that estimates the proportion of them that are involved in an after school activity.

a) 0.046
b) 0.076
c) 0.060
d) 0.260
e) 0.126
Question 4

A simple random sample of 100 8th graders at a large suburban middle school indicated that 82% of them are involved with some type of after school activity. Find the 95% confidence interval that estimates the proportion of them that are involved in an after school activity.

\[ n = 100 \quad \hat{p} = 0.82 \quad C = 95\% \quad z^* = \text{qnorm}(1.95/2) \]

Confidence interval for one sample proportion:

\[ \hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \]

\[ 0.82 \pm \text{qnorm}(1.95/2) \sqrt{\frac{0.82(1-0.82)}{100}} \]

\[ > 0.82 + c(-1,1)*\text{qnorm}(1.95/2)*\text{sqrt}(0.82*0.18/100) \]

\[ [0.747006, 0.8952994] \]

a) [0.745, 0.895]

b) [0.745, 0.695]

c) [0.795, 0.800]

d) [0.645, 0.845]

e) [0.665, 0.895]

f) None of the above

Question 5

Mars Inc. claims that they produce M&Ms with the following distributions:

<table>
<thead>
<tr>
<th>Color</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>30%</td>
</tr>
<tr>
<td>Red</td>
<td>20%</td>
</tr>
<tr>
<td>Yellow</td>
<td>20%</td>
</tr>
<tr>
<td>Orange</td>
<td>10%</td>
</tr>
<tr>
<td>Green</td>
<td>10%</td>
</tr>
<tr>
<td>Blue</td>
<td>10%</td>
</tr>
</tbody>
</table>

A bag of M&Ms was randomly selected from the grocery store shelf, and the color counts were:

<table>
<thead>
<tr>
<th>Color</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>23</td>
</tr>
<tr>
<td>Red</td>
<td>21</td>
</tr>
<tr>
<td>Yellow</td>
<td>22</td>
</tr>
<tr>
<td>Orange</td>
<td>14</td>
</tr>
<tr>
<td>Green</td>
<td>17</td>
</tr>
<tr>
<td>Blue</td>
<td>14</td>
</tr>
</tbody>
</table>

Find the 97% confidence interval for the proportion of yellow M&Ms in that bag.

\[ \hat{p} = \frac{\text{count of yellow}}{n} = \frac{22}{111} = 0.1982 \]

\[ 1 - \hat{p} = 1 - 0.1982 = 0.8018 \]

\[ C = 97 \]

\[ \hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \]

\[ 0.1982 \pm \text{qnorm}(1.97/2) \sqrt{\frac{0.1982(0.8018)}{111}} \]

\[ > 0.1982 + c(-1,1)*\text{qnorm}(1.97/2)*\text{sqrt}(0.1982*0.8018/111) \]

\[ [0.116089, 0.280311] \]

a) [0.116, 0.280]

b) [0.016, 0.230]

c) [0.166, 0.171]

d) [0.116, 0.080]

e) [0.036, 0.280]

f) None of the above

Question 6
Mars Inc. claims that they produce M&Ms with the following distributions:

<table>
<thead>
<tr>
<th></th>
<th>Brown</th>
<th>Red</th>
<th>Yellow</th>
<th>Orange</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>30%</td>
<td>20%</td>
<td>20%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

A bag of M&Ms was randomly selected from the grocery store shelf, and the color counts were:

<table>
<thead>
<tr>
<th></th>
<th>Brown</th>
<th>Red</th>
<th>Yellow</th>
<th>Orange</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>24</td>
<td>24</td>
<td>19</td>
<td>14</td>
<td>16</td>
<td>15</td>
</tr>
</tbody>
</table>

Find the 99% confidence interval for the proportion of blue M&Ms in that bag.

\[ z^∗ = \text{qnorm}(1.99/2) = 2.576 \]
\[ \hat{p} = \frac{15}{112} = 0.1339 \quad 1 - \hat{p} = 1 - 0.1339 = 0.8661 \]
\[ 0.1339 ± \text{qnorm}(1.99/2) \sqrt{\frac{0.1339(0.8661)}{112}} \]

a) [0.101, 0.106]
b) [0.051, 0.017]
c) [0.051, 0.217]
d) [-0.029, 0.217]
e) [-0.049, 0.167]
f) None of the above

Question 7

Mars Inc. claims that they produce M&Ms with the following distributions:

<table>
<thead>
<tr>
<th></th>
<th>Brown</th>
<th>Red</th>
<th>Yellow</th>
<th>Orange</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>30%</td>
<td>20%</td>
<td>20%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

How many M&Ms must be sampled to construct the 98% confidence interval for the proportion of brown M&Ms in that bag if we want a margin of error of ± 0.15?

a) 51
b) 40
c) 53
d) 39
e) 50
f) None of the above

Question 8
An experimenter flips a coin 100 times and gets 56 heads. Find the 96.5% confidence interval for the probability of flipping a head with this coin.

\[ n = 100 \quad \hat{p} = \frac{56}{100} = 0.56 \quad z^* = \text{norm}(1.95/2) \]

\[ z^* = 2.083 \]

\[ C.I. \quad \hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \]

\[ 0.56 \pm 2.083 \sqrt{\frac{0.56(1-0.56)}{100}} \]

a) [0.355, 0.615]  

b) [0.375, 0.665]  

c) [0.455, 0.665]  

d) [0.505, 0.510]  

e) [0.455, 0.465]  

f) None of the above

Question 9
Suppose that prior to conducting a 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 85% confidence interval of width of at most .11 for the probability of flipping a head?

\[ P = 0.5 \quad C = 85\% \quad \text{Width} = 0.11 \quad m = 0.11 = 0.055 \]

\[ n > \left( \frac{z^*}{m} \right)^2 P(1-P) \]

\[ z^* = \text{norm}(1.95/2) \]

\[ z^* = 1.4395 \]

\[ n > \left( \frac{1.4395}{0.055} \right)^2 (0.5)(1-0.5) \]

\[ n > 171.25 \]

a) 89  

b) 88  

c) 172  

d) 177  

e) 171  

f) None of the above

Question 10
It has been observed that some persons who suffer renal failure are diagnosed with it again within one year of the first episode. This is due, in part, to damage from the first episode. In order to examine the percentage of the persons who suffer renal failure a second time, a random sample of 1100 people who suffered renal failure was collected. It was observed that 17 of them again suffered renal failure within one year. Select a 90% confidence interval for the true proportion of those who suffer a second episode.

\[ n = 1100 \quad \hat{p} = \frac{17}{1100} = 0.01545 \]

\[ C = 90\% \]

\[ > 0.01545 + c(-1,1) * \text{norm}(1.9/2) * \text{sqrt}(0.01545 * 0.98455 / 1100) \]

\[ c = 0.00333344 \]

\[ 0.021566666 \]

a) [0.0114, 0.0516]  

b) [0.0144, 0.0716]  

c) [0.0124, 0.0416]  

d) [0.00936, 0.0216]  

e) [0.0104, 0.0616]  
Question 11

When solving for the sample size required to estimate $p$ to within a particular margin of error, under what circumstances do we use $\hat{p} = .5$?

a) When the variance is equal to .5 or when we desire a most conservative sample size.

b) When the computed value of $\hat{p} = .5$

c) When $\hat{p} = .4$ and $1 - \hat{p} = .6$

d) When we have no prior information on the approximate value of $\hat{p}$ or $p$.

e) When the margin of error desired is less than or equal to .5

f) None of the above

Question 12

Television viewers often express doubts about the validity of certain commercials. In an attempt to answer their critics, a large advertiser wants to estimate the true proportion of consumers who believe what is shown in commercials. Preliminary studies indicate that about 40% of those surveyed believe what is shown in commercials. What is the minimum number of consumers that should be sampled by the advertiser to be 95% confident that their estimate will fall within 3% of the true population proportion?

a) 1036

b) 1017

c) 1010

d) 1031

e) 1025

f) None of the above

Question 13

An oil company is interested in estimating the true proportion of female truck drivers based in five southern states. A statistician hired by the oil company must determine the sample size needed in order to make the estimate accurate to within 2% of the true proportion with 90% confidence. What is the minimum number of truck drivers that the statistician should sample in these southern states in order to achieve the desired accuracy?

a) 1710

b) 1699
Question 14

It has been observed that some persons who suffer colitis, again suffer colitis within one year of the first episode. This is due, in part, to damage from the first episode. The performance of a new drug designed to prevent a second episode is to be tested for its effectiveness in preventing a second episode. In order to do this two groups of people suffering a first episode are selected. There are 112 people in the first group and this group will be administered the new drug. There are 147 people in the second group and this group will be administered a placebo. After one year, 13% of the first group has a second episode and 20% of the second group has a second episode. Select a 99% confidence interval for the difference in true proportion of the two groups.

\[
\begin{align*}
\hat{p}_1 &= 0.13, \quad n_1 = 112 \\
\hat{p}_2 &= 0.20, \quad n_2 = 147
\end{align*}
\]

\[z^* = \text{norm}(1, 99/2) = 2.576\]

\[
\hat{p}_1 - \hat{p}_2 = 0.13 - 0.20 = -0.07
\]

\[
\text{CI} = \left( \hat{p}_1 - \hat{p}_2 \right) \pm z^* \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}} = (-0.07, 0.06)
\]

\[
\left(0.13 - 0.20\right) \pm 2.576\sqrt{\frac{0.13(0.87)}{112} + \frac{0.2(0.8)}{147}} = (-0.07, 0.06)
\]
Confidence interval and hypothesis test for means

Use $\frac{z}{\overline{X}}$ only when the standard deviation is from the population.

Use $t$ when the standard deviation is from the sample or you calculate the SD.
Quiz 11

Question 1

As the length of the confidence interval for the population mean decreases, the degree of confidence in the interval's actually containing the population mean

a) decreases

b) does not change

c) increases

Question 2

The gas mileage for a certain model of car is known to have a standard deviation of 6 mi/gallon. A simple random sample of 64 cars of this model is chosen and found to have a mean gas mileage of 27.5 mi/gallon. Construct a 97.5% confidence interval for the mean gas mileage for this car model.

a) [15.740, 39.260]

b) [25.819, 29.181]

c) [27.290, 27.710]

d) [26.030, 28.970]

e) [14.054, 40.946]

f) None of the above

Question 3

If the 90% confidence limits for the population mean are 57 and 63, which of the following could be the 98% confidence limits

a) [56, 61]

b) [56, 64]

c) [60, 60]

d) [59, 63]

e) [58, 65]

f) None of the above
**Question 4**

A 95% confidence interval for the mean of a population is to be constructed and must be accurate to within 0.3 unit. A preliminary sample standard deviation is 1.5. The smallest sample size n that provides the desired accuracy is

\[ C = 95\% \quad z^* = \text{norm}(1.96) = 1.96 \quad m = 0.3 \quad \sigma = 1.5 \]

\[ m = z^* \frac{\sigma}{\sqrt{n}} \quad \text{solve for } n \]

\[ n > \left( \frac{z^* \sigma}{m} \right)^2 \]

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>97</td>
</tr>
<tr>
<td>b)</td>
<td>91</td>
</tr>
<tr>
<td>c)</td>
<td>109</td>
</tr>
<tr>
<td>d)</td>
<td>101</td>
</tr>
<tr>
<td>e)</td>
<td>93</td>
</tr>
<tr>
<td>f)</td>
<td>None of the above</td>
</tr>
</tbody>
</table>

\[ n > 94.04 \]

**Question 5**

An SRS of 24 students at UH gave an average height of 6.1 feet and a standard deviation of .3 feet. Construct a 90% confidence interval for the mean height of students at UH.

\[ n = 24 \quad \bar{x} = 6.1 \quad s = 0.3 \quad \text{sample SD} \]

\[ z^* = \text{norm} \quad n-1 \quad \text{use } t^* \]

\[ t^* = \text{t}(1.96, 23) = 1.7139 \]

\[ \bar{x} \pm t^* \frac{s}{\sqrt{n}} \]

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>[4.600, 7.900]</td>
</tr>
<tr>
<td>b)</td>
<td>[6.079, 6.121]</td>
</tr>
<tr>
<td>c)</td>
<td>[5.995, 6.205]</td>
</tr>
<tr>
<td>d)</td>
<td>[5.586, 6.614]</td>
</tr>
<tr>
<td>e)</td>
<td>[4.850, 7.550]</td>
</tr>
<tr>
<td>f)</td>
<td>None of the above</td>
</tr>
</tbody>
</table>

**Question 6**

Which test statistic should be used when computing a confidence interval given only the number in a sample, the population standard deviation and sample mean?

\[ \text{Sample } \Rightarrow b \]

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>μ</td>
</tr>
<tr>
<td>b)</td>
<td>t</td>
</tr>
<tr>
<td>c)</td>
<td>z</td>
</tr>
</tbody>
</table>

**Question 7**

Location is known to affect the number, of a particular item, sold by Walmart. Two different locations, A and B, are selected on an experimental basis. Location A was observed for 18 days and location B was observed
for 18 days. The number of the particular items sold per day was recorded for each location. On average, location A sold 39 of these items with a sample standard deviation of 9 and location B sold 55 of these items with a sample standard deviation of 6. Select a 99% confidence interval for the difference in the true means of items sold at location A and B.

\[
A = \text{pop } 1, \quad B = \text{pop } 2, \quad C = 99\% \quad n-1
\]

\[
\begin{align*}
\bar{x}_1 &= 39, \quad n_1 = 18, \\
\bar{x}_2 &= 55, \quad n_2 = 18
\end{align*}
\]

\[
t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = 2.8982
\]

Two-Sample t-Confidence interval:

\[
(\bar{x}_1 - \bar{x}_2) \pm t_0 s_t(\sqrt{\frac{1}{n_1} + \frac{1}{n_2}})
\]

Question 8

An auditor for a hardware store chain wished to compare the efficiency of two different auditing techniques. To do this he selected a sample of nine store accounts and applied auditing techniques A and B to each of the nine accounts selected. The number of errors found in each of techniques A and B is listed in the table below:

<table>
<thead>
<tr>
<th>Store 1</th>
<th>Store 2</th>
<th>Store 3</th>
<th>Store 4</th>
<th>Store 5</th>
<th>Store 6</th>
<th>Store 7</th>
<th>Store 8</th>
<th>Store 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Errors in A</td>
<td>Errors in B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Select a 90% confidence interval for the true mean difference in the two techniques.

a) [3.050, 5.838]
b) [-4.183, 4.183]
c) [2.584, 6.304]
d) [2.195, 6.693]
e) [0.261, 8.627]
f) None of the above
Question 9

A toy maker claims his best product has an average lifespan of exactly 14 years. A skeptical quality control specialist asks for evidence (data) that might be used to evaluate this claim. The quality control specialist was provided data collected from a random sample of 45 people who used the product. Using the data, an average product lifespan of 19 years and a standard deviation of 4 years was calculated. Select the 99%, confidence interval for the true mean lifespan of this product.

\[ n = 45 \quad \bar{x} = 19 \quad s = 4 \quad \text{Sample SD} \]

\[ C = 99\% \]

\[ t^* = q_{(0.99/2, 44)} = 2.692278 \]

\[ \bar{x} \pm t^* \frac{s}{\sqrt{n}} \]

\[ 19 \pm 2.692278 \left( \frac{4}{\sqrt{45}} \right) \]

\[ (17.4, 20.6) \]

- a) [17.462, 20.538]
- b) [12.462, 15.538]
- c) [17.211, 20.789]
- d) [17.462, 20.538]
- e) [18.771, 19.229]
- f) None of the above

Question 10

An important problem in industry is shipment damage. A pottery producing company ships its product by truck and determines that it cannot meet its profit expectations if, on average, the number of damaged items per truckload is greater than 11. A random sample of 15 departing truckloads is selected at the delivery point and the average number of damaged items per truckload is calculated to be 11.3 with a calculated sample of variance of 0.64. Select a 90% confidence interval for the true mean of damaged items.

\[ n = 15 \quad \bar{x} = 11.3 \quad s^2 = 0.64 \quad C = 90\% \]

\[ \text{Sample} \]

\[ t^* = q_{(0.95/2, 14)} = 1.76131 \]

\[ 11.3 \pm 1.76131 \sqrt{\frac{0.64}{15}} \]

\[ (10.94, 11.66) \]

- a) [10.68, 11.92]
- b) [10.64, 11.36]
- c) [53.67, -33.86]
- d) [-0.3635, 0.3635]
- e) [10.94, 11.66]
- f) None of the above

> 11.3+0.3635*1.76131*sqrt(0.64/15)

We think that the mean body temperature for a healthy person is less than 98.6°F.

Take a sample of 100 healthy adults and find a sample mean of 98.2°F. Assume a population standard deviation of 0.62°F.

Can we say that the mean body temperature is significantly less than 98.6°F? At 1% level of significance \( \alpha = 0.01 \)

In order to answer this question we do a hypothesis test.

1. Hypotheses:

\[ H_0: \mu = 98.6 \quad H_A: \mu < 98.6 \]

2. Rejection region

If \( H_A: < \)

\[ z^* = gnorm(0.01) = -2.326 \]

Reject \( H_0 \) if \( z \leq -2.326 \)

If \( H_A: > \)

\[ z^* = gnorm(1 - 0.01) = 2.326 \]

Reject \( H_0 \) if \( z \geq 2.326 \)

If \( H_A: \neq \)

\[ z^* = gnorm(0.005) = 2.576 \]

\[ z^* = gnorm(0.005) = -2.576 \]

Reject \( H_0 \) if \( z \leq -2.576 \) or \( z \geq 2.576 \)

3. Test statistic:

\[ z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \frac{(98.2 - 98.6)}{0.62 / \sqrt{100}} = -6.45 \quad \text{ Reject } H_0 \]
4. $P$-value $= P(Z \leq -6.45) = \Phi_{\text{norm}}(-6.45)$

$$\uparrow$$

$H_A$ $0.0000000000559 \approx 0$

Assuming $\mu = 98.6$, the chance of use getting a sample mean of 98.2 for 100 healthy adults is 0.

If $P$-value $\leq \alpha$ RE $H_0$

If $P$-value $> \alpha$ RE $H_0$

$P$-value $\approx 0$ $\alpha = 0.01$ REject $H_0$.

5. Conclusion:

There is extremely strong evidence to conclude that the mean body temperature is less than 98.6°F.
# Quiz 12

**Question 1**

In a hypothesis test, if the computed P-value is greater than a specified level of significance, then we

- a) reject the null hypothesis.
- b) **fail to reject the null hypothesis.**
- c) retest with a different sample.

**Question 2**

A one-sided significance test gives a P-value of .05. From this we can

- a) Reject the null hypothesis with 94% confidence.
- b) **Say that the probability that the null hypothesis is true is .05.**
- c) **Reject the null hypothesis with 95% confidence.**
- d) Say that the probability that the null hypothesis is false is .05.

**Question 3**

It is believed that the average amount of money spent per U.S. household per week on food is about $98, with standard deviation $10. A random sample of 100 households in a certain affluent community yields a mean weekly food budget of $100. We want to test the hypothesis that the mean weekly food budget for all households in this community is higher than the national average. State the null and alternative hypotheses for this test.

- a) $H_0: \mu = 98, H_a: \mu > 98$
- b) $H_0: \mu = 98, H_a: \mu < 98$
- c) $H_0: \mu = 100, H_a: \mu < 100$
- d) $H_0: \mu = 100, H_a: \mu > 100$
- e) $H_0: \mu = 98, H_a: \mu \neq 98$

**Question 4**

It is believed that the average amount of money spent per U.S. household per week on food is about $98, with standard deviation $10. A random sample of 100 households in a certain affluent community yields a
mean weekly food budget of $100. We want to test the hypothesis that the mean weekly food budget for all households in this community is higher than the national average. Are the results significant at the 5% level?

a) No, we should fail to reject $H_0$.

b) Yes, we should reject $H_0$.

**Question 5**

Based on information from a large insurance company, 66% of all damage liability claims are made by single people under the age of 25. A random sample of 52 claims showed that 42 were made by single people under the age of 25. Does this indicate that the insurance claims of single people under the age of 25 is higher than the national percent reported by the large insurance company? State the null and alternate hypothesis.

a) $H_0$: $p = .81$, $H_a$: $p > .81$

b) $H_0$: $p = .66$, $H_a$: $p < .66$

c) $H_0$: $p = .66$, $H_a$: $p > .66$

d) $H_0$: $p = .81$, $H_a$: $p < .81$

e) $H_0$: $p = .66$, $H_a$: $p \neq .66$

**Question 6**

Based on information from a large insurance company, 67% of all damage liability claims are made by single people under the age of 25. A random sample of 51 claims showed that 43 were made by single people under the age of 25. Does this indicate that the insurance claims of single people under the age of 25 is higher than the national percent reported by the large insurance company? Give the test statistic and your conclusion.

a) $z = 2.130$; reject $H_0$ at the 5% significance level

b) $z = -2.130$; fail to reject $H_0$ at the 5% significance level

c) $z = 2.630$; fail to reject $H_0$ at the 5% significance level

d) $z = 2.630$; reject $H_0$ at the 5% significance level

e) $z = -2.630$; reject $H_0$ at the 5% significance level

**Question 7**

Let $x$ represent the hemoglobin count (HC) in grams per 100 milliliters of whole blood. The distribution for HC is approximately normal with $\mu = 14$ for healthy adult women. Suppose that a female patient has taken 12 laboratory blood samples in the last year. The HC data sent to her doctor is listed below. We would like to know if the data indicates this patient has significantly high HC compared to the population.

(19, 14, 23, 20, 15, 19, 21, 16, 18, 18, 16, 21)

State the null and alternate hypothesis.
Question 8

Let \( x \) represent the hemoglobin count (HC) in grams per 100 milliliters of whole blood. The distribution for HC is approximately normal with \( \mu = 14 \) for healthy adult women. Suppose that a female patient has taken 12 laboratory blood samples in the last year. The HC data sent to her doctor is listed below. We would like to know if the data indicates this patient has significantly high HC compared to the population.

\[
(19, 14, 23, 20, 15, 19, 21, 16, 18, 16, 21)
\]

Give the p-value and interpret the results.

a) \( p = .0762 \); Based on 5% significance level, I will fail to reject the null hypothesis and conclude this patient does not have a high HC level.

b) \( p = .1053 \); Based on 5% significance level, I will fail to reject the null hypothesis and conclude this patient does not have a high HC level.

c) \( p = .0001 \); Based on 5% significance level, I will reject the null hypothesis and conclude this patient has a high HC level.

d) \( p = .001 \); Based on 5% significance level, I will reject the null hypothesis and conclude this patient has a high HC level.

e) \( p = .0562 \); Based on 5% significance level, I will fail to reject the null hypothesis and conclude this patient does not have a high HC level.

Question 9

An experimenter flips a coin 100 times and gets 44 heads. Test the claim that the coin is fair against the two-sided claim that it is not fair at the level \( \alpha = .01 \).

a) \( H_0 : p = .5, H_a : p \neq .5; z = -1.20 \); Reject \( H_0 \) at the 1% significance level.

b) \( H_0 : p = .5, H_a : p \neq .5; z = -1.21 \); Fail to reject \( H_0 \) at the 1% significance level.

c) \( H_0 : p = .5, H_a : p \neq .5; z = -1.20 \); Fail to reject \( H_0 \) at the 1% significance level.

d) \( H_0 : p = .5, H_a : p < .5; z = -1.20 \); Reject \( H_0 \) at the 1% significance level.

e) \( H_0 : p = .5, H_a : p < .5; z = -1.21 \); Fail to reject \( H_0 \) at the 1% significance level.
Question 10

In a experiment on relaxation techniques, subject's brain signals were measured before and after the relaxation exercises with the following results:

<table>
<thead>
<tr>
<th>Person</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>37</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>66</td>
<td>58</td>
</tr>
<tr>
<td>4</td>
<td>52</td>
<td>51</td>
</tr>
<tr>
<td>5</td>
<td>28</td>
<td>26</td>
</tr>
</tbody>
</table>

Assuming the population is normally distributed, is there sufficient evidence to suggest that the relaxation exercise slowed the brain waves? (Use α=0.05)

a) ○ Fail to reject the null hypothesis which states there is no change in brain waves.

b) ○ Reject the null hypothesis which states there is no change in brain waves in favor of the alternate which states the brain waves slowed after relaxation.

c) ○ There is not enough information to make a conclusion.

Question 11

An auditor for a hardware store chain wished to compare the efficiency of two different auditing techniques. To do this he selected a sample of nine store accounts and applied auditing techniques A and B to each of the nine accounts selected. The number of errors found in each of techniques A and B is listed in the table below:

<table>
<thead>
<tr>
<th>Errors in A</th>
<th>Errors in B</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>25</td>
<td>30</td>
</tr>
</tbody>
</table>

Does the data provide sufficient evidence to conclude that the number of errors in auditing technique A is greater than the number of errors in auditing technique B at the 0.1 level of significance? Select the [Alternative Hypothesis, Value of the Test Statistic]. (Hint: the samples are dependent)

a) ○ [A > B, 1.976]

b) ○ [μD > 0, 1.976]

c) ○ [μD = 0, 1.976]

d) ○ [μD ≥ 0, 1.976]
Question 12

An auditor for a hardware store chain wished to compare the efficiency of two different auditing techniques. To do this he selected a sample of nine store accounts and applied auditing techniques A and B to each of the nine accounts selected. The number of errors found in each of techniques A and B is listed in the table below:

<table>
<thead>
<tr>
<th>Errors in A</th>
<th>Errors in B</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>25</td>
<td>30</td>
</tr>
</tbody>
</table>

Does the data provide sufficient evidence to conclude that the number of errors in auditing technique A is greater than the number of errors in auditing technique B at the 0.1 level of significance? Select the [Rejection Region, Decision of Reject (RH\_0) or Failure to Reject (FRH\_0)]. (Hint: the samples are dependent)

a) \[ t < -1.4 \text{ or } -t < -1.4, RH_0 \]

b) \[ t > 1.4, RH_0 \]

c) \[ -t < 1.4 \text{ and } t < 1.4, RH_0 \]

d) \[ z < -1.4 \text{ and } -z < -1.4, FRH_0 \]

e) \[ t < -1.4, FRH_0 \]

f) None of the above

Question 13

Failing to reject a false null hypothesis is classified as a

a) Type II error

b) Power

c) Type I error