Problem 1

For parts (a) - (c), state the null and alternative hypotheses.

a) The mean annual income of workers who have studied statistics is greater than $50,000.

\[ H_0: \mu \leq 50000 \]
\[ H_a: \mu > 50000 \]

b) More than one half of all internet users make online purchases.

\[ H_0: p \leq 0.5 \]
\[ H_a: p > 0.5 \]

\( \Rightarrow \)

c) The mean amount of rubbing alcohol in containers is at least 12 oz.

\[ H_0: \mu \geq 12 \]
\[ H_a: \mu < 12 \]

Problem 2

Find the critical z values. In each case, assume that the normal distribution applies.

a) Two-tailed test; \( \alpha = 0.05 \)

\[ \frac{\alpha}{2} = 0.025 \]
\[ 1 - \alpha = 0.95 \]

Critical values are -1.96 and 1.96

b) Right-tailed test; \( \alpha = 0.01 \)

\[ \alpha = 0.01 \]

Critical value is 2.33
Problem 3

Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) and state the conclusion of the test.

\[ \hat{p} = \frac{65}{100} = 0.65 \quad p = 0.5 \quad n = 100 \]

Among 100 babies born to 100 couples using a gender-selection method to increase the likelihood of a baby girl, 65 of them are girls. Use a 0.01 significance level to test the claim that for couples using this method, the proportion of girls is greater than 0.5.

\[ H_0: p \leq 0.5 \]
\[ H_a: p > 0.5 \]

Right Tail Test
\[ \alpha = 0.01 \]

\[ Z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} = \frac{0.65 - 0.5}{\sqrt{\frac{0.5(0.5)}{100}}} = 3 \quad \text{test statistic} \]

Since our test statistic is inside the critical region, we \textbf{REJECT} \( H_0 \).

Conclusion: There is sufficient evidence to support the claim that for couples using this method, the proportion of girls is greater than 0.5.

Problem 4

Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) and state the conclusion of the test.

\[ \hat{p} = 0.09 \]

In a Gallup poll of 1012 randomly selected adults, 9% said that cloning of humans should be allowed. Use a 0.05 significance level to test the claim that less than 10% of adults say that cloning to humans should be allowed. Can a newspaper run a headline that “less than 10% of adults say that cloning of humans should be allowed?”

\[ H_0: p \geq 0.10 \]
\[ H_a: p < 0.10 \]

Left Tail Test
\[ \alpha = 0.05 \]

\[ Z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} = \frac{0.09 - 0.10}{\sqrt{\frac{0.10(0.10)}{1012}}} = -1.06 \quad \text{test statistic} \]

Since our test statistic is outside the critical region, we \textbf{fail to reject} \( H_0 \).

Conclusion: There is not sufficient evidence to support the claim that less than 10% of all adults say that cloning of humans should be allowed. It would be misleading for the newspaper to run the headline.
Problem 5

Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) and state the conclusion of the test.

In order to monitor the ecological health of the Florida Everglades, various measurements are recorded at different times. The bottom temperatures are recorded at Garfield Bight station and the mean of 30.4°C is obtained for 61 temperatures recorded on 61 different days. Assuming that $\sigma = 1.7^\circ C$, test the claim that the population mean is greater than 30.0°C. Use a 0.05 significance level.

$H_0: \mu \leq 30$
$H_a: \mu > 30$

Right Tail Test

$\alpha = 0.05$

$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}} = \frac{30.4 - 30}{1.7/\sqrt{61}} = 1.84 \quad \text{Test Statistic}$

Since our test statistic is inside the critical region, we shall reject $H_0$

Conclusion: There is sufficient evidence to support the claim that the mean is greater than 30.0°C

Problem 6

Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) and state the conclusion of the test.

When people smoke, the nicotine they absorb is converted to cotinine, which can be measured. A sample of 40 workers has a mean cotinine level of 172.5. Assuming that $\sigma$ is known to be 119.5, use a 0.01 significance level to test the claim that the mean cotinine level of all smokers is equal to 200.0.

$H_0: \mu = 200$
$H_a: \mu \neq 200$

Two Tail Test

$\alpha = 0.01$

$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}} = \frac{172.5 - 200}{119.5/\sqrt{40}} = -1.46 \quad \text{Test Statistic}$

Since our test statistic is outside of the critical regions, we shall fail to reject $H_0$

Conclusion: There is not sufficient evidence to warrant rejection of the claim that the mean cotinine level of smokers is equal to 200.
Problem 7

Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) and state the conclusion of the test.

A sample of cereal boxes is randomly selected and the sugar contents (grams of sugar per gram of cereal) are recorded. These amounts are summarized with these statistics: \( n = 16, \bar{x} = 0.295, s = 0.168 \). Use a 0.05 significance level to test the claim of a cereal lobbyist that the mean for all cereals is less than 0.3g.

\[
H_0: \mu \geq 0.3 \\
H_a: \mu < 0.3
\]

Left Tail Test

\[
t = \frac{\bar{x} - \mu}{s / \sqrt{n}} = \frac{0.295 - 0.3}{0.168 / \sqrt{16}} = -0.119 \quad \text{Test Statistic}
\]

\[
\alpha = 0.05 \quad df = n-1 = 15
\]

Since our test statistic is outside the critical region, we fail to reject \( H_0 \).

Conclusion: There is not sufficient evidence to support the claim that the mean sugar content for all cereals is less than 0.3 grams.

Problem 8

Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) and state the conclusion of the test.

A random sample of 90 Norwegian babies is obtained, and the mean birth weight is 3570 g with a standard deviation of 498 g. Use a 0.05 level of significance to test the claim that Norwegian newborn babies have weights with a mean greater than 3420 g, which is the mean for American newborn babies.

\[
H_0: \mu \leq 3420 \\
H_a: \mu > 3420
\]

Right Tail Test

\[
t = \frac{\bar{x} - \mu}{s / \sqrt{n}} = \frac{3570 - 3420}{498 / \sqrt{90}} = 2.857 \quad \text{Test Statistic}
\]

\[
\alpha = 0.05 \quad df = n-1 = 89
\]

Since our test statistic is inside the critical region, we reject \( H_0 \).

Conclusion: There is sufficient evidence to support the claim that Norwegian newborn babies have weights with a mean greater than 3420 grams.