Question 1

a) Output from Minitab

One-Sample T: C1

Test of mu = 12 vs < 12

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>Bound</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>20</td>
<td>11.9850</td>
<td>0.0872</td>
<td>0.0195</td>
<td>12.0187</td>
<td>-0.77</td>
<td>0.226</td>
</tr>
</tbody>
</table>

The $\text{SE MEAN} = \frac{\sigma}{\sqrt{N}} = 0.0195$.

b) $H_0: \mu = 12$ VS. $H_a: \mu < 12$

c) Since $P$-value = 0.226 > 0.05 = $\alpha$, we cannot reject $H_0$.
Thus we don't have strong evidence to say that the true average weight is less than 12 ounces.

d) $P$-value = 0.226

t-curve with d.f. = $N - 1$ = 19

$-0.77$

e) In this problem, Type I error means we decide Company is understfiling the boxes when everything is OK (i.e., false ad.) Type II error means that Company is understfiling boxes but you fail to detect this. Don't file false advertising suit but you should have

The means change to $\frac{11.985}{16}$, s.d. $\frac{0.087}{16}$

Hypothesis $H_0: \mu = \frac{12}{16}$

$H_a: \mu < \frac{12}{16}$

t-statistics stays as before

$$T' = \frac{\bar{X} - \mu'}{\frac{\sigma'}{\sqrt{N}}} = \frac{\bar{X} - \mu/16}{\frac{S}{\sqrt{16}}} = \frac{\bar{X} - \mu}{s} = T$$

$= 1$
Question 2

Output from Minitab

Inverse Cumulative Distribution Function

Normal with mean = 0 and standard deviation = 1

\[
P(X \leq x) = x
\]

\[
0.99 \quad 2.32635
\]

Inverse Cumulative Distribution Function

Student's t distribution with 23 DF

\[
P(X \leq x) = x
\]

\[
0.025 \quad -2.06866
\]

Inverse Cumulative Distribution Function

Student's t distribution with 10 DF

\[
P(X \leq x) = x
\]

\[
0.975 \quad 2.22814
\]

Inverse Cumulative Distribution Function

F distribution with 6 DF in numerator and 10 DF in denominator

\[
P(X \leq x) = x
\]

\[
0.95 \quad 3.21717
\]

From table

\[
z(0.99) = 2.33
\]

\[
t(0.025, 23) = -2.069
\]

\[
t(0.975, 10) = 2.228
\]

\[
F(0.95, 6, 10) = 3.22
\]
Question 3

Output from Minitab

Two-Sample T-Test and CI: Nurse, Bottle feed

Two-sample T for Nurse vs Bottle feed

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse</td>
<td>10</td>
<td>47.94</td>
<td>1.95</td>
<td>0.62</td>
</tr>
<tr>
<td>Bottle feed</td>
<td>10</td>
<td>44.93</td>
<td>1.58</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Difference = mu (Nurse) - mu (Bottle feed) = \( \mu_1 - \mu_2 \)
Estimate for difference: 3.01000
95% lower bound for difference: 1.63454
99% lower bound for difference: 0.98545
T-Test of difference = 0 (vs >): T-Value = 3.79 P-Value = 0.001 DF = 18
Both use Pooled StDev = 1.7736

(a) \( H_0: \mu_1 - \mu_2 = 0 \) VS. \( H_a: \mu_1 - \mu_2 > 0 \)

\[ P \text{-value} = 0.001 < 0.01 < 0.05 \]

So at both levels 0.05 and 0.01, we reject \( H_0 \). We have strong evidence to say that women who nurse their babies feel warmer and more receptive towards the infants than mothers who bottle feed.

(b) This is an observational study, because the researchers did not control any variables.

Controlling factors might be: women feeling more warm & receptive may be those that choose to nurse as well.

Coned conclusion: without controlling for outside variables, the study showed that on average, women who nurse their children were more warm and receptive to the infant than mothers who bottle feed.

(c) It wouldn't affect my decision, since

1. Controlling factors exist
2. Sample size is small
3. Beside the two factors, there are many other factors
   dominant my decision such as time, nutrition etc.
Question 4

1. \( \bar{x} \sim N(\mu_1, \sigma_1^2/m) \)
2. \( \bar{y} \sim N(\mu_2, \sigma_2^2/n) \)

So

3. \( \bar{x} + \bar{y} \sim N(\mu_1 + \mu_2, \frac{\sigma_1^2}{m} + \frac{\sigma_2^2}{n}) \)
4. \( \bar{x} - \bar{y} \sim N(\mu_1 - \mu_2, \frac{\sigma_1^2}{m} + \frac{\sigma_2^2}{n}) \)
5. \( 4\bar{x} + 8\bar{y} \sim N(4\mu_1 + 8\mu_2, \frac{16\sigma_1^2}{m} + \frac{64\sigma_2^2}{n}) \)