1. List all the assumptions that need met in order for a \( t \) distribution based inference to be valid.

**Correct:**
- data must be from a random sample from a large population
- observations within the sample must be independent
- \( n \) small - population distribution must be approximately normal
- \( n \) large - population distribution need not be approximately normal (CLT kicks in)

2. The blood pressure (average of systolic and diastolic measurements) of each of 38 randomly selected persons was measured. The average was 94.5 mm Hg and the standard deviation 8.0497 mm Hg.

a. Construct a 95% confidence interval for the true mean blood pressure.

**Correct:**

**TI-84**

STAT->TESTS and T-interval->Enter->Stats->Enter->Scroll down to enter sample mean, sample sd, and sample size, C-Level: .95->highlight Calculate->Enter

yields (91.854, 97.146)

b. Interpret the interval you just computed in part (a).

**Correct:**

We are 95% confident that true mean blood pressure for people like the ones used in this study is at least 91.854 mm Hg and at most 97.146 mm Hg.

c. Use the QQ plot to comment on whether it appears the assumption of normality has been violated.

**Correct:**

Goal: We need to check the assumption that \( \bar{x} \) has a normal distribution. We get that one of two ways:

1) Either the data that created \( \bar{x} \) is from a normal distribution

2) Or the sample size is large enough for the CLT to “kick in”

**Step 1 – Check the QQ plot**

I see no systematic departure from the line, except for that little blip in the upper end of the distribution.

**Step 2 – Can we call the CLT?**

Mainly, the points form a linear pattern and our sample size is 38, so the CLT should kick in anyway.

**Conclusion:** I do not see evidence against normality of \( \bar{x} \) - it should be just fine to proceed with this \( t \) distribution based procedure.
3. The wing lengths (in.) of \( n = 7 \) randomly chosen fledglings from an avian nesting site are
3.14  2.37  2.94  3.60  1.70  3.99  1.85
a. Find a 90% confidence interval for the true mean wing length in fledglings like these.

**Correct:**

**TI-84**
Enter Data in L1->STAT->TESTS and T-interval->Enter->Data->Enter->Scroll down to enter List:L1 CLevel:.90->highlight Calculate->Enter
yields (2.163, 3.434)
b. Interpret the interval you just computed in part (a).

**Correct:**
We are 90% confident that true mean wing length in fledglings like these is at least 2.163 inches and at most than 3.434 inches.

c. Use the QQplot to comment on whether it appears the assumption of normality has been violated.

**Correct:**
Goal: We need to check the assumption that \( \bar{x} \) has a normal distribution. We get that one of two ways:
3) Either the data that created \( \bar{x} \) is from a normal distribution
4) Or the sample size is large enough for the CLT to “kick in”

**Step 1 – Check the QQ plot**
This QQplot is not perfectly linear. The second and third points are falling below the line and I see a hint of an "S" shape forming in this plot, which could be indicative of a “light-tailed” distribution. These data may not have been drawn from a normal distribution.

**Step 2 – Can we call the CLT?**
I only have 7 points, so the bottom line is - I need more data points to draw a conclusion here.

**Conclusion about \( t \) distribution based inference:**
With only 7 data points on our QQplot, we cannot tell whether this departure from the line is systematic and we certainly don't have enough data points to invoke the CLT, \( \bar{x} \) might not be normally distributed, so proceed with caution.
4. For each of the following situations, suppose $H_0: \mu = 0$ is being tested against $H_A: \mu \neq 0$. State whether or not $H_0$ would be rejected.

a. $\alpha = 0.05$, $P = 0.02$
Correct:
$P < \alpha$, so reject $H_0$ (find significant evidence for $H_A$)

b. $t_s = 2.2$ with $df = 23$; $\alpha = 0.02$
Correct:
TI-84
$P = \frac{\text{Pr\{t_{df=23} < -2.2\}} + \text{Pr\{t_{df=23} > 2.2\}}}{2} = \text{tcdf}(2.2, E99, 23)$
$= 0.0381$
$P > \alpha (0.0381 > 0.02)$, so fail to reject $H_0$ (do not find significant evidence for $H_A$)

c. $t_s = -2.7$ with $df = 27$; $\alpha = 0.05$
Correct:
TI-84
$P = \frac{\text{Pr\{t_{df=27} < -2.7\}} + \text{Pr\{t_{df=27} > 2.7\}}}{2} = \text{tcdf}(-E99, -2.7, 27)$
$= 0.0118$
$P < \alpha (0.0118 < 0.05)$, so reject $H_0$ (find significant evidence for $H_A$)

5. For each of the following situations, suppose $H_0: \mu = 0$ is being tested against $H_A: \mu < 0$. State whether or not $H_0$ would be rejected.

a. $t_s = -2.9$ with $df=15$; $\alpha = 0.05$
Correct:
TI-84
$P = \text{Pr\{t_{df=15} < -2.9\}} = \text{tcdf}(-E99, -2.9, 15)$
$= 0.0055$
$P < \alpha (0.0055 < 0.05)$, so reject $H_0$ (find significant evidence for $H_A$)

b. $t_s = 2.9$ with $df=15$; $\alpha = 0.05$
Correct:
TI-84
$P = \text{Pr\{t_{df=15} < 2.9\}} = \text{tcdf}(-E99, 2.9, 15)$
$= 0.9945$
$P > \alpha (0.9945 > 0.05)$, so fail to reject $H_0$ (do not find significant evidence for $H_A$)
6. In recent years, female athletes have been identified as a population particularly at risk for developing eating disorders. The article "Disordered Eating in Female Collegiate Gymnasts" (J. of Sport and Exercise Psychology (1993): 424-436) reported that for a sample of 17 gymnasts who were classified as binge eaters, the sample mean difference between current weight and ideal weight was 6.65 pounds with the sample standard deviation of this difference as 2.97 pounds. Suppose that the true mean weight difference for female gymnasts with normal eating habits is 4.5 pounds.

Is there evidence to suggest that the mean difference between current and ideal weight is significantly more than 4.5 pounds for female gymnasts who are binge eaters? You may proceed at the 0.05 significance level as though the assumptions have been checked and deemed acceptable.

**Correct:**

1. Set $\alpha = 0.05$.
2. $H_0: \mu = 4.5$
   $H_A: \mu > 4.5$

**TI-84**

STAT->TESTS and T-Test->ENTER->Stats->ENTER->scroll down to input
$\mu_0: 4.5, \bar{x}: 6.65, s_x: 2.97, n: 17, >\mu_0$
-> Calculate

3. $t_s = 2.985$
4. $P=0.0044$
5. Since $P \leq \alpha$, we reject $H_0$.
6. There is significant evidence (at the 0.05 significance level) to conclude that the true mean difference between current and ideal weight for female gymnasts who are binge eaters is more than 4.5 pounds.

7. Human beta-endorphin (HBE) is a hormone secreted by the pituitary gland under conditions of stress. A researcher conducted a study to investigate whether a program of regular exercise might affect the resting (unstressed) concentration of HBE in the blood. He measured blood HBE levels, in January and again in May, in ten participants in a physical fitness program. The results were as shown in the table.

The results were as shown in the table.

<table>
<thead>
<tr>
<th>Participant</th>
<th>HBE Level (pg/mL)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>January</td>
<td>May</td>
<td>Difference</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>42</td>
<td>22</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>47</td>
<td>29</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>37</td>
<td>9</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>26</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>70</td>
<td>36</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>54</td>
<td>38</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>27</td>
<td>32</td>
<td>-5</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>41</td>
<td>33</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>18</td>
<td>14</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>37.8</td>
<td>24.8</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>17.6</td>
<td>10.9</td>
<td>12.4</td>
<td></td>
</tr>
</tbody>
</table>
a. Conduct a test of hypothesis, using $\alpha = 0.05$, to investigate whether there is an effect of exercise on HBE levels (i.e., is there a difference in HBE levels between January (unstressed level) and May (HBE level possibly perturbed by exercise)). *(Hint: You need to use only the values in the right-hand column and your $H_0$ will be $\mu = 0$.)

**Correct:**

$X = 13.0; s = 12.4; n = 10.$

The degrees of freedom are $n - 1 = 10 - 1 = 9$.

1. Set $\alpha = 0.05$.
2. $H_0: \mu = 0$
3. $H_A: \mu \neq 0$

**TI-84**

STAT->TESTS and T-Test->ENTER->Stats->ENTER->scroll down to input $\mu_0: 0$, $x: 13$, $sx: 12.4$, $n: 10$, $\neq \mu_0$ -> Calculate

4. $t_s = 3.315$
5. $P = 0.0090$
6. Since $P \leq \alpha$, we reject $H_0$.

There is significant evidence (at the 0.05 level) to conclude that the true mean HBE level for the resting group is different from the true mean HBE level for the fitness group.

b. Use the QQplot to comment on whether it appears the assumption of normality has been violated.

**Correct:**

I see no systematic departure from the line on this QQplot. It's not perfectly linear, so normally we'd like to invoke the CLT at this point, which may be feasible in this case since we have 10 observations that aren't too far from looking like they are from a normal distribution.

**Conclusion:** I see no glaring evidence against normality and the possible slight deviation in the x’s from normality will likely be corrected for (when thinking about the distribution of $\bar{x}$) by the CLT - it is probably OK to proceed.

8. Jose is studying a population of hospital patients. He rejects the null hypothesis that the mean age of the patients is 40 years in favor of the alternative hypothesis that the mean age is greater than 40 years. Which of the following statements is correct?

Jose may have made a Type I error.

Jose has definitely made a Type I error.

Jose may have made a Type II error.

Jose has definitely made a Type II error.

Jose has definitely not made either a Type I or a Type II error.