1. What is a Type I error? (5)

2. Under what conditions does the Central Limit Theorem permits us to assume the sample means are normally distributed. (5)

3. Find the 95% confidence interval for \( \mu \) for the following sample: (15)
   \[ n = 100, \quad \bar{X} = 12, \quad s = 5 \]

4. The hypothesis \( H_0: \mu = 15 \) is to be tested against: \( H_A: \mu \neq 15 \) with \( \alpha = 0.05 \). A random sample results in:
   \[ n = 20, \quad \bar{X} = 17.5, \quad s = 5.9 \]
   a. Which distribution should be used? Why? (5)
   b. What is the P-value? (10)
   c. What is your conclusion regarding the null hypothesis? (5)

5. A researcher wants to be thorough. She takes several samples to test her belief that the population mean is a certain value: \( \mu = 120 \). To do so she forms an appropriate null hypothesis and alternative hypothesis:
   \[ H_A: \mu > 120 \]
   and selects an \( \alpha = 0.05 \).
   a. State the null hypothesis. (5)
   b. She repeats the sampling process 40 times. How many times would you expect that she would make an error in her conclusion if indeed the population mean is 120? (5)

6. A Little League team is being formed. The coach wants to select an appropriate name. There are three names under consideration. He believes that each is equally preferred, but samples the players and parents to test his belief at the \( \alpha = 0.10 \) level of significance.

<table>
<thead>
<tr>
<th>angels</th>
<th>braves</th>
<th>cubs</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>22</td>
<td>17</td>
</tr>
</tbody>
</table>

   a. State an appropriate null hypothesis: (5)
   b. What are the expected frequencies? (5)
   c. What is \( \chi^2 \)? (5)
   d. What is the degrees of freedom? (5)
   e. What is the P-value? (5)
   f. What is your conclusion concerning the null hypothesis? (5)

7. We used a \( z \) distribution to test the null hypothesis when we had two categories with proportions or frequencies. We used a \( \chi^2 \) distribution when we had three or more categories of observed frequencies. What happens if we used a \( \chi^2 \) distribution on the case with just two frequencies? Can it even be done? Is it wrong? Briefly explain. (5)
8. A researcher polled a number of people to determine their pie preferences and found the following frequencies:

<table>
<thead>
<tr>
<th></th>
<th>apple</th>
<th>berry</th>
<th>cherry</th>
<th>pecan</th>
<th>pumpkin</th>
</tr>
</thead>
<tbody>
<tr>
<td>male</td>
<td>12</td>
<td>10</td>
<td>15</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>female</td>
<td>26</td>
<td>20</td>
<td>9</td>
<td>15</td>
<td>24</td>
</tr>
</tbody>
</table>

The null hypothesis is: there is no difference in the preferences for these pies, \( \alpha = 0.05 \)

a. What is the expected frequency for male and apple (just the single cell)? (5)

b. What is the appropriate degrees of freedom? (5)

c. What is the critical value for \( \chi^2 \)? (5)

d. The value of \( \chi^2 \) obtained is 7.378. What is your conclusion regarding the null hypothesis? (5)

\[
\sigma_p = \sqrt{\frac{p(1-p)}{n}} \quad \chi^2 = \sum \frac{(o-e)^2}{e}
\]

\( p \)