Instructions: Show Your Work. Each part of each question is worth 4 points.

On the hypothesis testing problems: Make sure you answer the question asked in the space provided. When hypothesis testing you will need to know how to do the following:

a. State your hypotheses.
b. Show which function you used on your calculator.
c. Make a statistical conclusion (reject or fail to reject). Explain why.
d. Summarize your conclusion in a complete sentence relevant to the application.

Example
A team of eye surgeons has developed a new technique for a risky eye operation to restore the sight of people blinded from a certain disease. Under the old method, only 30% of the patients recovered their eyesight. Surgeons have performed the new technique 225 times and 88 of those patients have recovered their sight. Can we justify the claim that the new technique is better than the old one at a 1% level of significance?

a. State your hypotheses. \( H_0 : p = 0.30 \); \( H_1 : p > 0.30 \)

b. Show which function you used on your calculator. \( \boxed{1-PropZTest} \)

c. Make a statistical conclusion. Explain why. Since \( p = 0.0014 < \alpha = 0.01 \), Reject \( H_0 \).

d. Summarize your conclusion in a complete sentence relevant to the application. At a 1% level of significance, the data is significant and suggests the new procedure has a better recovery rate.
1. The Nero Match Company sells matchboxes that are supposed to have an average of 40 matches per box with $\sigma = 9$. A random sample of 94 Nero matchboxes shows the average number of matches per box to be 43.1. At a 1% level of significance, can you say that the average number of matches per box is more than 40?
   a. Establish your hypotheses.
   b. Find the $p$-value without using the Ztest. Draw and label the normal distribution showing the $p$-value.
   c. Make a statistical conclusion. Explain why.
   d. Summarize your conclusion in a complete sentence relevant to the application.

2. A study is made of residents in Phoenix and its surrounding area concerning the proportion of residents that subscribe to Sporting News. A random sample of 88 urban residents showed that 12 subscribed, and a random sample of 97 suburban residents showed that 18 subscribed. Does this indicate that a higher proportion of suburban residents subscribe to Sporting News? Use a 1% level of significance.
   a. State your hypotheses.
   b. Show which function you used on your calculator.
   c. Make a statistical conclusion. Explain why.
   d. Summarize your conclusion in a complete sentence relevant to the application.
3. The medical profession tells us that we should be concerned about not only the calorie content of food, but also the amount of cholesterol. In the data tabulated, \( x \) = total calories and \( y \) = milligrams of cholesterol in 3.5 oz. servings of different kinds of fish. Use the 5% significance level to test for a positive population correlation between the amount of cholesterol and the total calories.

a. State your hypotheses.

b. Show which function you used on your calculator.

c. Make a statistical conclusion. Explain why.

d. Find the coefficient of determination and explain its meaning in this application.

e. Make a scatter diagram of the data. Label and scale the axes.

f. Find the equation of the least squares regression line. Graph the line and list at least two points on the line.

g. Use the least squares equation to predict the amount of cholesterol in a 3.5 mg serving of fish that has 220 calories.
4. Six sets of identical twins were randomly selected. One child was taken at random from each pair to form an experimental group. These children participated in a program designed to promote creative thinking. The other child from each pair was part of the control group and did not participate in the program. At the end of the program, a creative problem-solving test was given with the following results.

<table>
<thead>
<tr>
<th>Twin Pair</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group</td>
<td>53</td>
<td>35</td>
<td>12</td>
<td>25</td>
<td>23</td>
<td>47</td>
</tr>
<tr>
<td>Control Group</td>
<td>39</td>
<td>21</td>
<td>5</td>
<td>18</td>
<td>21</td>
<td>42</td>
</tr>
</tbody>
</table>

Higher scores indicate better performance. Do the data indicate that the program promoted creative problem solving. Use a 1% level of significance.

a. State your hypotheses.

b. Show which function you used on your calculator.

c. Make a statistical conclusion. Explain why.

d. Summarize your conclusion in a complete sentence relevant to the application.

5. Archeologists become excited when they find an anomaly in a newly discovered artifact. The anomaly may or may not indicate a new trading region or a new method of craftsmanship. Suppose the lengths of arrowheads at a certain site have a mean length of $\mu = 2.6$ cm. A random sample of 61 recently discovered arrowheads in an adjacent cliff dwelling had a sample mean of 2.92 cm and the sample standard deviation of 0.85 cm, where $x$ is a random variable representing the lengths (in cm) of the arrowheads. Do these data indicate that the mean length of arrowheads in the adjacent cliff dwelling is longer than 2.6 cm? Use a 1% level of significance.

a. State your hypotheses.

b. Show which function you used on your calculator.

c. Make a statistical conclusion. Explain why.
6. Two competing headache remedies claim to give fast-acting relief. An experiment was performed to compare the mean lengths of time required for bodily adsorption of Brand A and Brand B (see table). Assuming both distributions are approximately normal, test the claim that Brand B absorbed more rapidly. Use a 5% level of significance.

a. State your hypotheses.

b. Show which function you used on your calculator.

c. Make a statistical conclusion. Explain why.

<table>
<thead>
<tr>
<th>Brand</th>
<th>( \bar{x}_1 )</th>
<th>( s_1 )</th>
<th>( n_1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand A</td>
<td>21.8 min</td>
<td>8.7 min</td>
<td>12</td>
</tr>
<tr>
<td>Brand B</td>
<td>18.9 min</td>
<td>7.5 min</td>
<td>19</td>
</tr>
</tbody>
</table>

7. The Macek County Clerk wishes to improve voter registration. One method under consideration is to send reminders in the mail to all citizens in the county who are eligible to register. A random sample of 1250 potential register voters was taken.

Group 1: There were 625 people in this group. No reminders to register were sent to them. The number of potential voters from this group who registered was 295.

Group 2: There were 625 people in this group. Reminders to register were sent to them. The number of potential voters from this group who registered was 350.

At a 5% level of significance, did reminders improve voter registration?

a. State your hypotheses.

b. Show which function you used on your calculator.

c. Make a statistical conclusion. Explain why.

d. In terms of the number of trials \( n \), what assumptions are made when using the test/function identified in part b.
1. $H_0: \mu = 40$ matches/box $H_1: \mu > 40$ matches/box.

$p = \text{normalcdf}(43.1, 1000, 40, 9 / \sqrt{94}) = 0.0004 < \alpha = 0.01$. So, reject $H_0$. At a 1% level of significance, the data is significant and indicates the number of matches/box is more than 40. Note that the sketch of the distribution is not shown.

2. $H_0: p_1 = p_2$ $H_1: p_1 < p_2$

The 2PropZTest gives $p = 0.182 > \alpha = 0.01$. So, fail to reject $H_0$. At a 1% level of significance, the data is insufficient to indicate a difference in subscription rates of Sporting News for urban and suburban residents.

3a-d. $H_0: \rho = 0$ $H_1: \rho > 0$

The LinRegTTest gives $p = 0.0301 > \alpha = 0.05$. So, fail to reject $H_0$. At a 5% level of significance, the data is insufficient to suggest calories in fish and its cholesterol content are positively correlated.

3e. $r^2 = 0.628$. 63% of the variation in cholesterol is explained by the variation in calories and the least-squares model.

4. This is a dependent set of data that uses the Ttest on the list of differences. If $d = \text{Experimental} - \text{Control}$, then $H_0: \mu_d = 0$ $H_1: \mu_d > 0$ $p = 0.0047 < \alpha = 0.01$. So, reject $H_0$. At a 1% level of significance, the data is significant and indicates the children that took the creative thinking program scored better.

5. $H_0: \mu = 2.6 \text{ cm}$ and $H_1: \mu > 2.6 \text{ cm}$. The TTest gives $p = 0.0023 < \alpha = 0.01$. So, reject $H_0$.

6. $H_0: \mu_A = \mu_B$ and $H_1: \mu_A > \mu_B$. The 2SampTTest gives $p = 0.166 > \alpha = 0.01$. So, fail to reject $H_0$.

7. $H_0: p_1 = p_2$ and $H_1: p_1 < p_2$ $\mu_A > \mu_B$. The 2SampZTest gives $p = 0.0009 < \alpha = 0.01$. So, reject $H_0$. The sample size has to be large, meaning $n_1 p_1 > 5$, $n_1 q_1 > 5$, $n_2 p_2 > 5$ and $n_2 q_2 > 5$. 