Carefully Read The Instructions!

Instructions: This exam is a take-home exam. Provide solutions to the problems in the space provided. All solutions must be sufficiently justified to receive credit. You may use a calculator, your notes, and the textbook, but you may not work with other students or discuss the questions with them. Good Luck!

Advice: If you get stuck on a problem don’t panic! Move on and come back to it later.
1. A random sample of 150 recent donations at a certain blood bank reveals that 82 were type A blood. Does this suggest that the actual percentage of type A donations differs from 40%, the percentage of the population having type A blood? Carry out a test of the appropriate hypotheses using a significance level of 0.01. Would your conclusions have been different if a significance level of 0.05 had been used?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U</strong></td>
<td>36.4</td>
<td>55.0</td>
<td>51.5</td>
<td>38.7</td>
<td>43.2</td>
<td>48.8</td>
<td>25.6</td>
<td>49.8</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>28.5</td>
<td>20.0</td>
<td>36.0</td>
<td>34.5</td>
<td>36.5</td>
<td>52.5</td>
<td>26.5</td>
<td>46.5</td>
</tr>
<tr>
<td><strong>Diff.</strong></td>
<td>7.9</td>
<td>35.0</td>
<td>15.5</td>
<td>4.2</td>
<td>6.7</td>
<td>-3.7</td>
<td>-0.9</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Do these data provide evidence that there is a difference in the mean breaking strength of the fabric under the two treatments?
3. Statistician Karl Pearson tossed a coin 24000 times and counted 12012 flips of “heads.”

(a) Construct a 95% confidence interval for the true population proportion of heads.

(b) Perform a hypothesis test to see if you have a “fair” coin.
4. To test whether men who major in sociology are taller than average men, you take a random sample of sociology majors from the University and record their heights. The data is collected below:

| 69.1 | 72.2 | 70.4 | 70.4 | 65.0 | 70.3 | 68.0 |
| 68.5 | 66.6 | 73.3 | 69.4 | 72.4 | 73.7 | 67.3 |
| 68.7 | 72.4 | 68.7 | 69.9 | 65.5 | 67.0 | 67.8 |
| 76.8 | 70.8 | 67.8 | 64.8 | 74.0 | 71.4 | 71.5 |
| 64.2 | 69.8 | 72.2 | 72.7 | 71.0 | 67.7 | 68.2 |

Use this data to test whether the average height of men who major in sociology is greater than 69.3 inches, the average height of men in the United States.
5. The observed time that 20 individuals spend standing and walking per day is reported in the following table.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean $\bar{x}$</th>
<th>Std. dev. $s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (lean)</td>
<td>10</td>
<td>525.751</td>
<td>107.121</td>
</tr>
<tr>
<td>Group 2 (obese)</td>
<td>10</td>
<td>373.269</td>
<td>67.498</td>
</tr>
</tbody>
</table>

(a) Test the null hypothesis that there is no difference in mean time per day spend standing or walking between the two groups against a two sided alternative at $\alpha = 0.01$ significance. Report your test statistic, a bound for your p-value, and your conclusions regarding the null hypothesis.

(b) Verify your results with an appropriate confidence interval. Does this confidence interval support your conclusions in part (a)?
6. Low-back-pain (LBP) is a serious health problem in many industrial settings. The article “Isodynamic Evaluation of Trunk Muscles and Low-Back Pain Among Workers in a Steel Factory” (Ergonomics, 1995) reported the accompanying summary data on lateral range of motion (degrees) for a sample of workers without a history of LBP and another sample with a history of this malady.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sample Size</th>
<th>Sample Mean</th>
<th>Sample SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No LBP</td>
<td>28</td>
<td>91.5</td>
<td>5.5</td>
</tr>
<tr>
<td>LBP</td>
<td>31</td>
<td>88.3</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Calculate a 90% confidence interval for the difference between population mean extent of lateral motion for the two conditions.

(a) Does the interval suggest that population mean lateral motion differs for the two conditions?

(b) Is the conclusion different if a confidence level of 95% is used?
7. To obtain information on the corrosion-resistance properties of a certain type of steel conduit, 45 specimens are buried in soil for a 2-year period. The maximum penetrations (in mls) for each specimen is then measured, yielding a sample average penetration of $\bar{x} = 52.7$ and a sample standard deviation of $s = 4.8$. The conduits were manufactured with the specification that true average penetration be at most 50 mls. They will be used unless it can be demonstrated conclusively that the specification has not been met. What would you conclude? Perform a hypothesis test at $\alpha = 0.05$ and $\alpha = 0.01$. Clearly state your conclusions.