1. The journal *Human Factors (1962, pp. 375-380)* reports a study that was carried out to determine the relative controllability of vehicles different in lengths, wheelbases and turning radii. The following table contains times in seconds required for 14 subjects to parallel park each of two cars A and B quite dissimilar in the above characteristics:

<table>
<thead>
<tr>
<th>Subject:</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>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car A:</td>
<td>37.0</td>
<td>25.8</td>
<td>16.2</td>
<td>24.2</td>
<td>22.0</td>
<td>33.4</td>
<td>23.8</td>
<td>58.2</td>
<td>33.6</td>
<td>24.4</td>
<td>23.4</td>
<td>21.2</td>
<td>36.2</td>
<td>29.8</td>
</tr>
<tr>
<td>Car B:</td>
<td>17.8</td>
<td>20.2</td>
<td>16.8</td>
<td>41.4</td>
<td>21.4</td>
<td>38.4</td>
<td>16.8</td>
<td>32.2</td>
<td>27.8</td>
<td>23.2</td>
<td>29.6</td>
<td>20.6</td>
<td>32.2</td>
<td>53.8</td>
</tr>
</tbody>
</table>

Note: Do all computations for parts (b), (c), and (d) using hand calculation. Use the output from a JMP analysis to provide answers to parts (a), (e) and (f). **Turn in the marked JMP output and show work.**

(a) Do the Normal probability plot and the boxplot (from the JMP output) provide evidence to support doing a paired t-test? Explain. What is the p-value for the Shapiro-Wilk test? Would reject the null hypothesis of normality of the differences based on this test?

(b) Compute the paired t-statistic to test the research hypotheses that the average person will more easily parallel park one car than the other. State your hypotheses clearly using symbols you first define. Make your decision using a rejection region with $\alpha = .05$.

(c) Give the definition of the p-value for the test you stated in part (b). Bound the p-value of the above test using the t-table.
(d) Use a 90% confidence interval to estimate the difference in mean parking times. Test the hypothesis in part (b) using this interval stating the $\alpha$ level of this test clearly. State your conclusion.

(e) Extract the t-statistic from the JMP output for testing the hypothesis you stated in part (b). Circle it in the JMP output. State the p-value associated with this test extracted from the JMP output.

(f) Extract the 90% confidence interval for the difference in population means of mean parking times from the JMP output. Copy it here and circle it in the JMP output.

2. The sprinkler activation times, $y$, for a series of tests with fire prevention sprinkler systems using an aqueous film-forming foam were (in sec) 27, 32, 22, 27, 23, 35, 30, 33, 24, 27, 21, 22, 24 with $\sum y = 347$ and $\sum y^2 = 9515$. The system has been manufactured under the design specification that the true standard deviation of the activation time will not exceed 5 sec under normal conditions. Given

Note: Use hand calculation for parts (b) and (c) and show work. Use a JMP analysis of the data for answering parts (a), (d) and (e). Turn in the JMP output.

(a) Do the box plot or the normal probability plot indicate any violation of the conditions underlying the use of the chi-square procedures for constructing confidence intervals or testing hypotheses about $\sigma$?
(b) Is there sufficient evidence in the data to determine that the standard deviation of the sprinkler activation time meets the design specification? State appropriate hypotheses and perform a test with $\alpha = .05$. State the rejection region clearly.

(c) Estimate the standard deviation of the sprinkler activation time using a 98% confidence interval. Test the hypotheses in part (b) using this interval stating the $\alpha$-level of the test clearly.

(d) Extract the statistic from the JMP output for testing the hypothesis you stated in part (b). Circle it in the JMP output. State the $p$-value associated with this test extracted from the JMP output.

(e) Extract the 98% confidence interval for the standard deviation of the sprinkler activation time from the JMP output. Copy it here and circle it in the JMP output.
3. The overall distance traveled by a golf ball is tested by hitting the ball with Iron Byron, a mechanical golfer with a swing that is said to emulate the legendary American golf champion, Byron Nelson. Ten randomly selected balls of two different brands are tested on the machine and the resulting overall distances measured. In addition to the mean distances traveled by the two brands of golf balls, experimenters are also interested to find out if there is a significant difference in the variation of these distances. The data follow:

<table>
<thead>
<tr>
<th>Brand</th>
<th>Overall Distance (in yards)</th>
<th>$\sum y$</th>
<th>$\sum y^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>275 286 287 271 283 279 275 263 267</td>
<td>2,757</td>
<td>760,685</td>
</tr>
<tr>
<td>2</td>
<td>258 244 260 265 273 281 271 270 263 268</td>
<td>2,653</td>
<td>704,749</td>
</tr>
</tbody>
</table>

Note: Do all computations for part (b),(c), and (d) using hand calculation. Use the output from a JMP analysis to provide the answer to part (e). Turn in the marked JMP output and show work.

(a) Use the boxplot and the normal probability plot output from the JMP program to comment on whether assuming normality of the two overall distance populations is reasonable. Do these also indicate that the population variances are the same for the two populations? Explain.

(b) Compute the sample variances $s_1^2$ and $s_2^2$, respectively, of the two samples using the above summary statistics.

(c) Compute a statistic to test the research hypothesis that the population variances of the overall distances for the two brands $\sigma_1^2$ and $\sigma_2^2$, respectively, are different using $\alpha = .05$. State your hypotheses, the rejection region and your conclusion.

(d) Compute a 99% confidence interval on the ratio $\sigma_1^2/\sigma_2^2$. Use this interval to test the hypothesis you stated part (b), stating the $\alpha$-level of the test.

(e) Extract the statistic from the JMP analysis for testing the hypothesis you stated in part (b). Circle it in the JMP output. State the p-value associated with this test extracted from the JMP output.

Due Tuesday, March 25th, 2014 (turn-in during the first 20 min. of the lab)