Stat 401G Lab 4
Group Activity on Regression

Names of Group Members: _ANSWER KEY_, _______________, _______________ 
________________, _______________, _______________

How long does a bar of soap last? The data consists of the weight (grams) of a bar of soap and the number of days since the bar was first used.

<table>
<thead>
<tr>
<th>Days in use</th>
<th>1</th>
<th>4</th>
<th>7</th>
<th>9</th>
<th>12</th>
<th>17</th>
<th>20</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>121</td>
<td>103</td>
<td>84</td>
<td>71</td>
<td>50</td>
<td>27</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

We wish to be able to predict the weight of the bar given the number of days since the bar was first used. Use JMP to analyze these data. Use the JMP output that you generate and your knowledge of regression analysis to answer the following questions. Group members should discuss the questions and come up with answers that are agreed upon by all the group members. Turn in this group answer sheet and one copy of your JMP output at the end of lab today.

1. Give the prediction equation for the line relating days in use to weight.

   Predicted weight = 124.54 – 5.754*Days

2. Give an interpretation, within the context of the problem, of:
   a. the estimated slope, \( \hat{\beta}_1 \).

   For each additional day the bar of soap is used, the weight decreases by 5.754 grams, on average.

   b. the estimated Y-intercept, \( \hat{\beta}_0 \).

   For a new bar of soap (Days = 0) the predicted weight of the bar is 124.54 grams.

3. Is there a significant linear relationship between the days in use and the weight of the bar? Support your answer with a test of hypothesis.

   The t-test statistics is \( t = –29.57 \) with an associated P-value of less than 0.0001. Such a small P-value indicates that such an extreme value of the test statistic could not have happened by chance, therefore there is a statistically significant linear relationship between days in use and weight of a bar of soap.
4. Give the value of $R^2$ and an interpretation of this value.

$$R^2 = 0.994.$$ 99.4% of the variation in the weight of the bar of soap can be explained by the linear relationship with the day in use.

5. The labeled weight of a new bar of soap is 4.25 oz (120.5 g). Based on your prediction equation, is 120.5 g a plausible value for the mean weight of a new bar of soap? Support your answer with an appropriate 95% confidence interval.

A 95% confidence interval for the Y-intercept, $\beta_0$, goes from 118.62 g to 130.45 g. Because 120.5 grams falls within this interval it is a possible value for the mean weight of a new bar of soap.

6. What is the predicted value and residual for a bar of soap used 7 days?

The predicted weight is 84.26 g. The residual is $84 - 84.26 = -0.26$ g.

7. What is the estimated mean weight for bars of soap used 14 days? Also give a 95% confidence interval for this mean weight.

The estimated mean weight for bars of soap used 14 days is 43.99 g. A 95% confidence interval for the mean weight goes from 40.24 g to 47.73 g.

8. How does the 95% prediction interval for a bar of soap used 14 days differ from the confidence interval in 7? Be sure to indicate differences in interpretation as well as value.

The 95% prediction interval is wider (34.82 g to 53.15 g). The prediction interval identifies plausible weights for an individual bar of soap used 14 days. The confidence interval identifies plausible mean weights for bars of soap used 14 days.

9. Comment on the plot of residuals versus day in use. Specifically what does this plot tell you about:

a. the adequacy of the linear model?

There appears to be a pattern in the residuals. The residuals start above zero then go below zero then end above zero. This above/below/above pattern indicates possible curvature. Although the linear model is good, we may be able to do better by adding a term for curvature.

b. the equal standard deviation (variance) condition?

The spread around the zero line is about the same for all values of days. Therefore the equal standard deviation (variance) condition should be met.