1. (a) There are \( k = 4 \) treatments and \( n_1 = \cdots = n_4 = 7 \) observations per treatment. The ANOVA table is:

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trt</td>
<td>3</td>
<td>811.21</td>
<td>270.40</td>
</tr>
<tr>
<td>Error</td>
<td>24</td>
<td>1047.30</td>
<td>43.64</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>1858.51</td>
<td></td>
</tr>
</tbody>
</table>

The observed \( F = \frac{MS_{Trt}}{MS_{Err}} = 270.40/43.64 = 6.20 \). The reference is \( F_{24,24} \) and we have 0.001 < \( p \) - value < 0.005. There is strong evidence against the null that the population means are the same for all 4 treatments.

(b) The contrast is \( \bar{y}_{contr} = \frac{1}{2}(\bar{y}_{glu} + \bar{y}_{fru} + \bar{y}_{suc}) \); thus \( \lambda_C = 1, \lambda_{C'} = -1/3, \lambda_F = -1/3, \lambda_S = -1/3 \). The sample value for the contrast is 9.90; the standard error is

\[
sp = \sqrt{\frac{1}{\hat{b}_1} + \frac{1}{\hat{b}_2} + \frac{1}{\hat{b}_3} + \frac{1}{\hat{b}_4}} = 2.883;
\]

where \( sp = \sqrt{MSErr} = 6.606 \). Since \( P(T_{24} \geq 2.064) = 0.025 \), the 95\% confidence interval is given by

\[
9.90 \pm 2.064 \times 2.88 = 9.90 \pm 5.95 = (3.95, 15.85) .
\]

The range of plausibility for the difference between the control treatment and the average of the 3 sugar treatments is from 3.95 to 15.85. Note that a difference of 0 is not a plausible value.

(c) Two population means are found to be significantly different with a comparison-wise error rate of 0.05 if the corresponding sample means differ by more than \( LSD = \sqrt{\frac{q F_{0.05} \sigma^2}{n}} \). Since \( \sqrt{\frac{q F_{0.05} \sigma^2}{n}} = \sqrt{\frac{q \times 2.046 \sigma^2}{n}} = 2.728 \), the table gives

\[
55.7 \quad 56.4 \quad 64.0 \quad 68.6
\]

Treatments not connected by an underline are significantly different.

2. (a) The slope is estimated by

\[
\hat{b}_1 = \frac{\sum x_i y_i - (\sum x_i \sum y_i)/n}{\sum x_i^2 - (\sum x_i)^2/n} = -0.0653;
\]

the intercept is estimated by \( \hat{b}_0 = \bar{y} - \hat{b}_1 \bar{x} = 8.967 \).

(b) First, note that \( SSErr = SSTotal - SSRgression \), where \( SSTotal = \sum y_i^2 - (\sum y_i)^2/n \) and \( SSRgression = \hat{b}_1(\sum x_i y_i - (\sum x_i \sum y_i)/n) \). Therefore, \( SSErr = 0.8213 \). Since \( df = n - 2 = 4 \), the underlying regression variance \( \sigma^2 \) is estimated by \( \hat{s}^2 = \frac{SSErr}{4} = 0.205 \). Note for \( df = 4, P(V^2 \geq 11.14) = P(V^2 \leq 0.48) = 0.025 \), so a 95\% confidence interval for \( \sigma^2 \) is given by

\[
\frac{SSErr}{11.14} = \frac{\hat{s}^2}{0.48} = 0.074 = \sigma^2 \leq 1.71 .
\]

(c) The standard error of \( \hat{b}_1 \) is

\[
se = \sqrt{\frac{\hat{s}^2}{\sum x_i^2 - (\sum x_i)^2/n}} = 0.007221 ;
\]

and therefore \( t = \frac{(\hat{b}_1 - (-0.1))}{0.007221} = 4.81 \). Since the reference \( T \)-distribution has 4 df, the \( p \)-value is between 0.002 and 0.01. There is strong evidence that \( b_1 \) is different from \(-0.1\).

3. (a) Since there are two hypotheses of interest, to maintain an experiment-wise error rate of 0.05, each hypothesis should be tested at level 0.025. Since the normal approximation to the binomial is justified, both null hypotheses can be tested by

\[
z = \frac{\hat{p} - 0.5}{\sqrt{0.5 \times 0.5/100}} = \frac{\hat{p} - 0.5}{0.05} .
\]

For the green coin, \( z = -2.6 \); for the red coin, \( z = 2.0 \). The corresponding \( p \)-values are 0.0094 and 0.0456. Thus, \( H_0 \) is rejected for the green coin but not for the red coin.

(b) The observed counts are given by

\[
\begin{array}{ccc}
& A & B & C \\
Healthy & 12 & 5 & 23 \\
Diseased & 45 & 58 & 57
\end{array}
\]

The expected counts are given by

\[
\begin{array}{ccc}
& A & B & C \\
Healthy & 11.4 & 12.6 & 16.0 \\
Diseased & 45.6 & 50.4 & 64.0
\end{array}
\]

Because the expected values are all > 5, the \( \chi^2 \) approach is appropriate. The test statistic \( \chi^2 \) is given by

\[
\chi^2 = \sum (\text{obs} - \text{exp})^2/\text{exp} = 9.598 \text{ on 2 df} .
\]

The \( p \)-value is between 0.005 and 0.01. There is strong evidence that the three fungicides are not equally effective.

4. (a) False. Since one well is dug in the uplands and one in the valley, this does not give a good indication of contamination overall in the two regions; there is no measure of variability within each region. Furthermore, the weekly readings from these wells may be correlated.

(b) True. The weight of a randomly selected mouse is predicted by \( \bar{y} \). The variance of \( \bar{y} \) is \( \sigma^2/(1+1/n) \), where the “1/16” comes from the variability of \( y \) and the “1” comes from the uncertainty in the new observation. Thus, the standard error of \( \bar{y} \) is \( \sqrt{1+1/16} = 20.61 \). Note that \( P(T_{15} \geq 2.131) = 0.975 \) and 43.9 = 2.131 \( \times 20.61 \).

5. We need to find \( n \) so that \( P(\hat{p}_A - \hat{p}_B > 0.12|p_A = 0.8, p_B = 0.6) = 0.95 \). Note that \( \text{Var}(\hat{p}_A - \hat{p}_B) = (0.8 \times 0.2)/n + (0.6 \times 0.4)/n = 0.4/n \).

\[
\frac{0.12 - 0.2}{\sqrt{0.4/n}} = -1.645 \quad (\text{since } P(Z \geq -1.645) = 0.95).
\]

Solving for \( n \) gives \( n = \sqrt{0.1(1.645)/0.08} = 13.005 \) so that \( n = 169.13 \). Rounding up results in \( n = 170 \).

Grade Distribution:

\[
\begin{array}{ccc}
90's & 10 & \text{mean}=63.8; \text{median}=63 \\
80's & 22 & \\
70's & 28 & \\
60's & 28 & \\
50's & 25 & \\
40's & 23 & \\
\text{below} 14 & & \\
\end{array}
\]