3) The homogeneity of variance assumption specifies that $\sigma_1^2 = \sigma_2^2$ for the two populations from which samples were obtained. If this assumption is violated, the $t$-statistic can cause misleading conclusions for a hypothesis test.

4) As the difference between the two sample means increases, the value of the $t$-statistic also increases. As the variability of the scores increases, the value of $t$ decreases.

5) Both experiments show a 10 point difference between the two sample means. But the variability in Exp. II is greater than Exp. I. The smaller variability in Exp I. will make the mean difference more apparent, and is more likely to produce a significant $t$-statistic.

11. a) $s_1^2 = \frac{SS}{df}$

    Treatment 1: $s_1^2 = \frac{84}{4-1} = 28$

    Treatment 2: $s_2^2 = \frac{108}{4-1} = 36$

    Pooled variance $s_p^2 = \frac{SS_1 + SS_2}{df_1 + df_2} = \frac{84 + 108}{3 + 3} = 32$
11) b) \[ s_{x_1-x_2} = \sqrt{\frac{32}{16} + \frac{32}{16}} = 4 \]

\[ t = \frac{(58 - 52) - 0}{4} = 1.5 \]

\[ q = .05 \text{ 2-tailed critical t-stat: } \pm 2.447 \]

*Fail to Reject \( H_0 *\)

12) a) Treatment 1: \[ s^2 = \frac{420}{16 - 1} = 28 \]

Treatment 2: \[ s^2 = \frac{540}{16 - 1} = 36 \]

Pooled Variance:
\[ s_p^2 = \frac{420 + 540}{15 + 15} = 32 \]

b) \[ s_{x_1-x_2} = \sqrt{\frac{32}{16} + \frac{32}{16}} = 2 \]

\[ t = \frac{(58 - 52) - 0}{2} = 3 \]

\[ q = .05 \text{ 2-tailed critical t-stat: } \pm 2.042 \]

[Reject \( H_0 \)]

c) The samples in this problem are much larger than the samples in problem 11. The larger samples produce a smaller standard error so that the sample mean difference is now significant.
19) \[ \text{Group 1} \quad n = 8 \quad \bar{x} = 4.9 \quad SS = 3100 \]
\[ \text{Group 2} \quad n = 8 \quad \bar{x} = 2.7 \quad SS = 2500 \]
\[ s_p^2 = \frac{3100 + 2500}{7 + 7} = 400 \]
\[ s_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{400}{8} + \frac{400}{8}} = 10 \]
\[ t = \frac{(4.9 - 2.7) - 0}{10} = 2.10 \]
\[ q = 0.01 \quad \pm 2.62 \text{ d.f.} \]
\[ \text{One tailed} \]

Fail to reject H₀

21) a) Treatment 1 \[ \bar{x} = 4 \]

Treatment 2 \[ \bar{x} = 11 \]

b) Treatment 1

<table>
<thead>
<tr>
<th>X</th>
<th>(X - \bar{X})</th>
<th>(X - \bar{X})^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>-3</td>
<td>9</td>
</tr>
</tbody>
</table>

\[ \sum (X - \bar{X})^2 = 20 = SS \]

Pooled variance \[ \frac{20 + 20}{3 + 3} = 6.67 \]

\[ s_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{6.67 + 6.67}{4 + 4}} = 1.83 \]

\[ t = \frac{(4.9 - 11) - 0}{1.83} = -3.83 \]

Reject H₀

\[ df = 6 \quad q = 0.05 \quad \pm 2.44 \text{ d.f.} \]

\[ t(b) = -3.83 \]
(22) Treatment 1: \( \bar{x} = 4 \)

b) Treatment 1

\[
\begin{array}{c|c|c}
X & (x-\bar{x}) & (x-\bar{x})^2 \\
0 & 0-4=-4 & 16 \\
4 & 4-4=0 & 0 \\
0 & 0-4=-4 & 16 \\
12 & 12-4=8 & 64 \\
SS & & 96 \\
\end{array}
\]

Treatment 2

\[
\begin{array}{c|c|c}
X & (x-\bar{x}) & (x-\bar{x})^2 \\
12 & 12-11=1 & 1 \\
10 & 10-11=-1 & 1 \\
4 & 4-11=-7 & 49 \\
18 & 18-11=7 & 49 \\
SS & & 100 \\
\end{array}
\]

Pooled Variance = \( \frac{96 + 100}{3 + 3} = \frac{196}{6} = 32.67 \)

\[
\bar{x}_1 - \bar{x}_2 = \sqrt{\frac{32.67 + 32.67}{4 + 4}} = 4.04
\]

C) \( df = 6 \) 2-tailed, \( t = 2.447 \)

\[
t = \frac{(4-11)-0}{4.04} = -1.73 \quad \text{Fail Reject } H_0
\]

d) The standard error is larger in this problem due to the larger variance. Therefore, the difference between sample means is not significant.

[Ch. 11]

(1) a) This is an independent measures experiment with two separate samples.

b) Repeated measures - same sample is measured twice.

c) Matched subjects design. The repeated measures statistic is appropriate.
4) a) An independent measures design would require two separate samples, each with 10 subjects, for a total of 20 subjects.
   b) Repeated measures design would use the same sample of n=10 subjects in both treatment conditions.
   c) Matched subjects design would require two separate samples with n=10 in each, for a total of n=20.

5) a) $\bar{x} = 4$  

<table>
<thead>
<tr>
<th>X</th>
<th>$(X - \bar{x})$</th>
<th>$(X - \bar{x})^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4-4=0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>5-4=1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>4-4=0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2-4=-2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>4-4=0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>5-4=1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3-4=-1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>5-4=1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>4-4=0</td>
<td>0</td>
</tr>
</tbody>
</table>

$SS = 8$

* A higher degree of consistency means a lower variance.

b) $S_0 = \sqrt{\frac{s^2}{n}}$

Sample 1  
$S_0 = \sqrt{\frac{1}{9}} = 0.33$

Sample 2  
$S_0 = \sqrt{\frac{100}{9}} = 3.33$

* A higher degree of consistency means a lower standard error.
c) The sample mean difference, $\bar{D} = 4$, is substantially greater than the error for sample 1, but not much greater than the error for sample 2. Therefore, sample 1 is more likely to produce a significant difference.

\[ t = \frac{\bar{D} - 0}{S_D} = \frac{4}{2} = 2 \]

\[ t = 2 \text{ does not fall in the critical region.} \]

11) \( q = 0.05 \)

\[ t = 2.306 \]

\[ S^2 = \frac{288}{8} = 36 \]

\[ S_D = \sqrt{\frac{288}{8}} = 6 \]

\[ t = \frac{6 - 0}{6} = 1 \]

Fail to reject \( H_0 \)

13) mean during heartbeats = 92.67

mean between heartbeats = 95.5

\[ S = \frac{2.83}{5} = 0.567 \]

\[ t = \frac{2.83 - 0}{0.567} = 5.0 \]

\[ t = 2.571 \]

Reject \( H_0 \)

\[ \sum D^2 = \frac{2D^2 - (\sum D)^2}{n} \]

\[ SS = \frac{2(85) - (70)^2}{6} = 85 - 289 = 34.83 \]

\[ S = \frac{34.83}{5} = 6.97 \]

\[ S_D = \sqrt{\frac{6.97}{6}} = 1.08 \]

\[ t = \frac{2.83 - 0}{1.08} = 2.62 \]
\( n = 6 \quad \alpha = 0.01 \quad df = 5 \quad t = \pm 4.032 \)

<table>
<thead>
<tr>
<th>X</th>
<th>X^2</th>
<th>D</th>
<th>( D^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>224</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>15</td>
<td>225</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>19</td>
<td>361</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>144</td>
<td>7</td>
<td>49</td>
</tr>
<tr>
<td>17</td>
<td>289</td>
<td>11</td>
<td>121</td>
</tr>
<tr>
<td>15</td>
<td>225</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

\[ s^2 = \frac{47.33}{5} = 9.47 \]

\[ s_0 = \sqrt{\frac{9.47}{6}} = 1.26 \]

\[ t = \frac{6.33 - 0}{1.26} = 5.02 \]

Project \( H_0 \)