Practice Set 19  Two-Factor Analysis of Variance

I. Practice Set 18 will be expanded by assuming the data was randomly collected at hourly intervals. Page 110 data has been arranged accordingly. Darin wants to determine whether samples taken later in a shift are less likely to pass inspection. People using statistics software should skip to part D.

A. Complete this chart to begin an ANOVA study of the production process producing these parts.

<table>
<thead>
<tr>
<th>Time</th>
<th>Parts Sample 1 is T₁</th>
<th>Parts Sample 2 is T₂</th>
<th>Parts Sample 3 is T₃</th>
<th>Row Totals Required for Calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X₁ X₁²</td>
<td>X₂ X₂²</td>
<td>X₃ X₃²</td>
<td>ΣXₜ (ΣXₜ)² (ΣXₜ)² / t</td>
</tr>
<tr>
<td>9:15 AM</td>
<td>8.90 79.2100</td>
<td>9.05 81.9025</td>
<td>9.05 81.9025</td>
<td>27.00 729.0000 243.0000</td>
</tr>
<tr>
<td>10:20 AM</td>
<td>8.90 79.2100</td>
<td>9.05 81.9025</td>
<td>9.10 82.8100</td>
<td>27.05 731.7025 243.9008</td>
</tr>
<tr>
<td>11:10 AM</td>
<td>8.95 80.1025</td>
<td>9.10 82.8100</td>
<td>9.15 83.7225</td>
<td>27.20 739.8400 246.6133</td>
</tr>
</tbody>
</table>

ΣXₜ = 26.75 27.20 27.30

(ΣXₜ)² = 715.5625 739.84 745.29

ΣXₜ² = 238.521 246.613 248.430

ΣXₜ² / b = 238.5225 246.6150 248.4350

ΣXₜ² = 733.5725

B. Using the above data, calculate the following values.

\[
SS_T = \sum \left( \frac{(\sum x_t)^2}{b} \right) - \frac{(\sum x)^2}{N} = 733.564 - \frac{81.25^2}{9} = 733.564 - 733.507 = .057
\]

\[
SS_B = \sum \left[ \frac{(\sum x_B)^2}{t} \right] - \frac{(\sum x)^2}{N} = 733.5141 - \frac{81.25^2}{9} = 733.5141 - 733.5070 = .0071
\]

\[
SS_{TOTAL} = \sum x^2 - \frac{(\sum x)^2}{N} = 733.5725 - 733.5070 = .0655
\]

\[
SS_E = SS_{TOTAL} - (SS_T + SS_B) = .0655 - (.057 + .0071) = .0655 - .0641 = .0014
\]

Unexplained variability is down from .0085 (see page PS 111) to .0014.