The Process of Experimental design and results analysis

1. Automatic design

(1) Selecting Orthor Arrays
(3) Inputing factors and levels

![Inputing factors and levels](image)

In the image, there are two windows showing the input of factors and their levels. The top window is titled "4 Level Factor Descriptions" and contains a table with factors and their corresponding levels across five levels. The bottom window is titled "Inner Array Design" and shows a similar table for a different array design. The tables indicate the input of factors and their levels, with values ranging from 0 to 0.3.
2. Inputing experimental results
3. Analysis of experimental data

[Image of experimental data analysis interface]

- Table listing experimental factors and results.
- Quality Characteristics Selection window.
- Options for experiment type, data type, and quality characteristic selection.
- Buttons for selection of quality characteristics for analysis (Nominal, Smaller, Bigger).
1. Main effects

The plot of the factor effects can be examined from SINGLE or MULTI Plots.

2. The MAGNITUDE of difference between the average effects (L2 - L1) represents the relative influence of the factor or interaction to the variability of the results. This value should be proportional to the influence computed in the last column of ANOVA (shown next).

3. For factors with larger than two levels (3-level and 4-level), review difference between other levels such as (L3 - L2), (L3 - L1), etc.
(2) Statistical analysis (ANOVA table)

**Table:**

<table>
<thead>
<tr>
<th>Col/No</th>
<th>Factor</th>
<th>DOF</th>
<th>Sum of Squares (S)</th>
<th>Variance (S^2)</th>
<th>F-Ratio</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Be</td>
<td>3</td>
<td>29.119</td>
<td>9.766</td>
<td>20.110</td>
<td>0.0001</td>
</tr>
<tr>
<td>2</td>
<td>Ce</td>
<td>3</td>
<td>47.604</td>
<td>15.882</td>
<td>12.846</td>
<td>0.0001</td>
</tr>
<tr>
<td>3</td>
<td>Dv</td>
<td>3</td>
<td>27.377</td>
<td>9.123</td>
<td>27.377</td>
<td>0.0001</td>
</tr>
<tr>
<td>4</td>
<td>Li</td>
<td>3</td>
<td>3.922</td>
<td>1.307</td>
<td>3.922</td>
<td>0.0333</td>
</tr>
<tr>
<td>5</td>
<td>HEB03</td>
<td>3</td>
<td>143.855</td>
<td>48.619</td>
<td>143.855</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

**Options and Activities:**

1. Review the rightmost column of ANOVA which represents the relative influence of factors and interactions to the variability of results. Review BAR GRAPAH and PIE CHART for this affect.

2. Examine the last row with effects of ERROR. Other. Keep a close watch on the DOF and the percent influence of the ERROR term.

3. No matter the size of the experiment and nature of results, you should consider POOLING (column effects, factors or interactions). POOLING is strongly urged as it reduces the chances of obtaining something important while it is not. You should continue pooling until the DOF of the error term is approximately the total DOF of the.
(3) Optimum conditions and performance

(4) Estimate of performance
(5) Variation

Input for Variation and Capability Statistics

This option allows you to plot variation reduction achievable from the Optimum design condition. The improved S/N ratio at the optimum condition corresponds to a reduction in the standard deviation. The assumed normal distributions for the current and improved conditions are plotted. When there is no target/nominal value, average of the trials results is used as the target value. Std deviation of the improved condition is assumed to be proportional to the change in S/N ratio. (Graph, Cp, and Cpk values are best estimates)

SAVINGS CALCULATION: Reduction of variation is expected to lower the rejection and warranty items. The resulting cost saving is expressed in terms of percentage of the Loss at the current condition (expressed as Cent/ft of Loss, shown with the Variation Reduction Plot).

Note: All entries must consist of experimental or theoretically valid data

<table>
<thead>
<tr>
<th>Current Status</th>
<th>Average Performance</th>
<th>S/N Ratio (SN1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal/Target</td>
<td>43.23</td>
<td>33.621</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Improved Status</th>
<th>S/N Ratio (SN2)</th>
<th>Quality Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42.777</td>
<td>Bigger is Better</td>
</tr>
</tbody>
</table>

Specifications (or Control Limits)

- LSL: 13.397
- USL: 111.958

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APPLICATION TIPS

1. A number of assumptions are made for creating VARIATION DIAGRAM (VD): (Click PLOT to display VD)
   - optimum performance is assumed to be on TARGET for plotting purpose
   - Loss before experiments assumed to be $1 (100 cents) for calculation of SAVINGS
   - USL and LSL are assumed to be ±3 SdDev from TARGET for calculation of Cpk and Cp values.
   - etc.

2. To plot VD, Click PLOT.

3. Most data shown by default are those relatives to your experiment. Review and modify as desired and Click PLOT to display VD.

Performance Distributions - Current & Improved

Variation Reduction Plot (Based on Assumed Normal Performance Distributions: Current vs. Improved)

Plotting Parameters

Current Condition
- S/N ratio: 33.21
- Average: 43.23
- Std Deviation: 6.756
- Cp: 1
- Target Value: 43.23
- QC: Bigger is Better

Improved Condition
- S/N ratio: 42.774
- Average: 49.23
- Std Deviation: 5.791
- Cp: 1.073
- Target Value: 49.23
- QC: Bigger is Better

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Savings: 8.4 Cents/ft of Loss
(6) Results after POOLing the factor of Li⁺
Significant Factor and Interaction Influences

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