Graphical Methods for Selecting Factorial Effects: What’s In It for You

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Maximizing this educational opportunity

Welcome everyone! To make the most from this webinar:

- Attendees on mute
- Chat addressed afterward
- Send further questions to mark@statease.com

PS Presentation posted to www.statease.com/webinars/

Please press the raise-hand button if you are with me.
This Webinar:
What’s In It for You

See how graphical approaches help you assess effects at a glance—a huge advantage over off-putting tables of statistics.

Also, gain an appreciation for how our software provides plots

| ✔ | For two-level designs, multilevel categoric (general factorials) and split plots (for hard-to-change inputs), |
|   | With or without actual replication, |
|   | Irrespective of missing data and non-orthogonal levels. |

*Make better decisions sorting out the vital few effects from the trivial many.*

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The Half-Normal (aka “Daniel”) Plot (1/2)

In 1959, Cuthbert Daniel introduced an innovative way to graphically judge the “reality of the observed effects” from two-level factorial designs.

Minding the gap, see at a glance how to separate the vital-few big effects from the trivial-many little ones lined up near zero.
Half-Normal Plots What’s In It for You (2/2)

Half-Normal plots (aka “Daniel”) provide many advantages as enumerated* by David Steinberg, Prof Stats, Tel Aviv U, who achieved his PhD at U Wisconsin under the supervision of George Box:

- Easy to produce
- Gives a quick visual of important effects
- Effects can be compared to a reference—the near-zero contrasts that emanate from the origin
- Adapts to split-plot experiments

“The greatest single advantage of the Daniel plot is its ability to stimulate discussion by encapsulating, in a single display, such a variety of information.”

* ("Discussion: On Daniel Plots,” Journal of Quality Technology, V47, N2, April 2015, p110.)

Pareto Chart of Effects (1/2)

A perfect companion to the half-normal plot

Ordered bar charts work wonderfully for CQE’s like me wanting to focus their team on the 20% of causes creating 80% of problems per the Pareto principle.

In the 1980s Don Wheeler advised looking for the “elbow” on “scree” plots of factorial effects—those above this point of inflection being chosen, with the remaining “rubble” relegated to the error pool.

Pareto Chart of Effects (2/2)

*A perfect companion to the half-normal plot*

Stat-Ease software makes it far easier than an elbow to interpret the ordered chart of effects by its innovative enhancements:

- Two limit lines
- Color coding*
- Interactivity*

* Also featured on half-normal

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**Completing the trifecta for effect selection:**

ANOVA’s p-Values

Analysis of variance table

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*Graphs and stats can all get along—best of both worlds!*
Half-Normal Plot Revisited
*My favorite software innovations*

- Presets line to the smallest 50% of effects makes it easy to see where (if any) gap separates the vital few from trivial many
- Synchs up picked effects with Pareto Plot (or vice versa)
- Displays pure error (reinforces line-up of trivial effects!)
- Preselects effects for multilevel-categoric factorials
- Dual plots for split plots

*BHH325C (w Cp’s), Battery tutorial (GenFac), Paper-helicopter (Split Plot)*

Other Clever Statistical Features & Nifty Touches for Graphical Selection of Factorial Effects

- Standardization to handle missing data and/or altered independent factors, as well as non-orthogonality by design (e.g., minimum-run screening and characterization, Plackett-Burman).
- Forward selection of effects by order (i.e., main effects, then two factor interactions, etc.) to provide the most from every experiment, even ones that get botched.
- Right click on a selected effect to reveal aliasing. Then, if you like, substitute aliased effects. (These may look quite different!)

*Reactor half fraction (1 run ignored on R2, yet DE emerges) Biker tutorial file (substituting aliases)*
This Webinar:  
What’s In It for You (Conclusion)

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Graphical Selection
Factorial Effects

Not to be overlooked: Scatterplots

“Of all the graphic forms used today, the scatterplot is arguably the most versatile...and useful invention in the history of statistical graphics.”

Stat-Ease software provides via its “graph columns” a great way to see effects simply displayed on scatterplots. Let’s circle back to a prior example and see how this tool makes the effects graphs easy.


Graphical Selection
Factorial Effects
References

DOE/RSM/Formulation Simplified Series*


Stat-Ease Training:
Sharpen Up Your DOE Skills

- Modern DOE for Process Optimization (public or private)
- Mixture Design for Optimal Formulations (public or private)
- Designed Experiments for Specific Industries (private only)

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<thead>
<tr>
<th>Individuals</th>
<th>Teams (6+ people)</th>
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<td>Improve your DOE skills</td>
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<td>Customize via select case studies</td>
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Via Graphical Methods for Selecting Factorial Effects

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