stat-teaser

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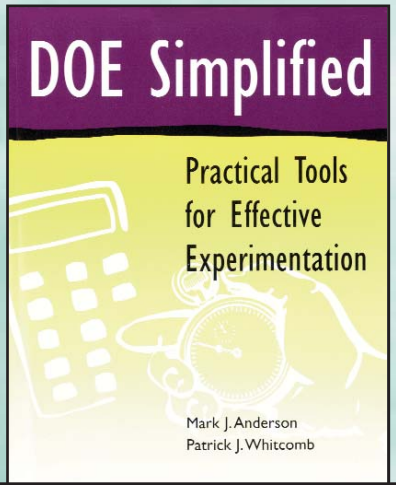
*Includes a $95 student materials charge which is subject to state and local taxes.

Attendance is limited to 20. Contact Elicia at 612.746.2038 or workshops@statease.com.

Stat-Ease statistics made easy™

Bonferroni Draws the Line on Over-Selection of Effects

Bonferroni brings to mind something enticing with an Italian twist like a Ferrari or gelato, but it's actually a clever statistic that Stat-Ease utilizes for assessing effects from two-level factorial experimental designs—better yet! Those of you who lag behind on upgrading your software and still own version 6 or earlier of Design-Ease® or Design-Expert® software will not see this feature (for more information on the new version 7.1 see page 3), and others using newer versions may not realize what you've got.



DOE Simplified by Mark and Pat on design of experiments

A prime example of what I mean in the title by "over-selection of effects" is provided by Pete Loebs of Oldcastle Glass. Pete attended my latest semi-annual presentation on DOE at Fisher College of Management, the Ohio State University, for their web-leveraged Six Sigma Black Belt Program. He'd already read *DOE Simplified* (above right) and, using the Design-Ease software provided, designed, executed and analyzed a two-level factorial screening experiment to troubleshoot a glass-making process at his company's plant in Missouri. (I must say that Pete's initiative impressed me mightily!) He showed me the selection of effects shown in Figure 1.

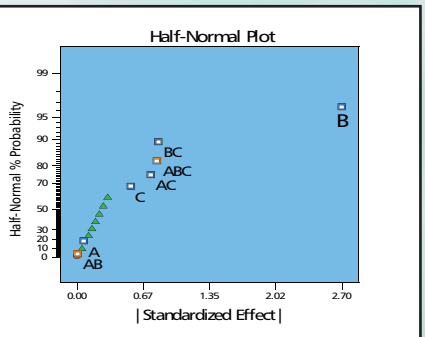


Fig. 1: Pete's initial selection of effects

It turns out that this design is one with three production factors each at two levels that Pete replicated over two blocks. The green triangles represent measures of error derived from the repeated conditions. Obviously the main effect B stands out from these error terms emanating from the zero origin of the effects axis. This factor, a switch setting, was one that Pete could see having a big effect. However, where he started to stretch statistically was when he picked the next grouping of effects led

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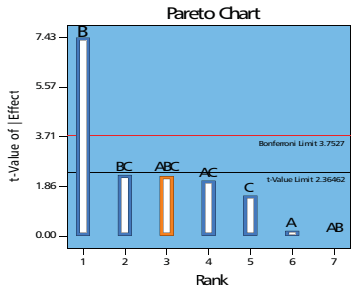

Fig. 2: Pete's Pareto plot

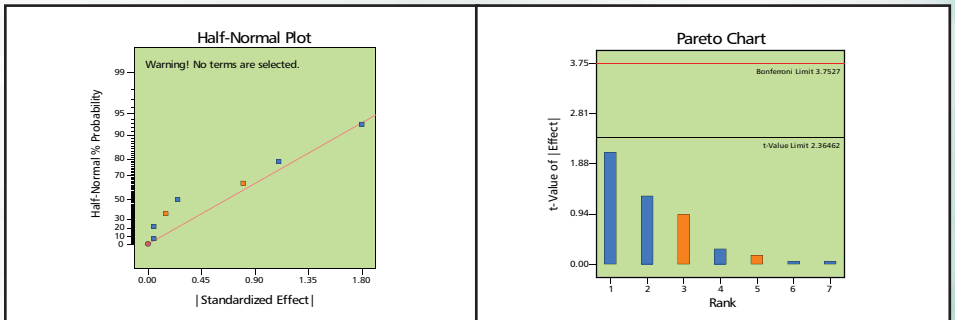

Fig. 3: Half-normal and Pareto plots of effects from popcorn experiment

by BC. I did not like the looks of this, especially seeing the three-factor interaction ABC—an unlikely effect, so at this point I suggested that Pete click the option for Pareto. (You may be wondering why A and AB were selected: These came in automatically from Design-Ease to maintain model hierarchy for the ABC term.)

Side note: A general rule for two-level factorials called "Sparsity of Effects" may curb your enthusiasm for over-selection. It suggests that only about 20 percent of main effects and two-factor interactions (2FI) are likely to stand out for any given response that you screen with a two-level factorial. Keeping this in mind and also being leery of 3FI's will help you be more selective.

This ordered bar chart (see Figure 2) provides a clear visual on the overwhelming magnitude of the main effect of B—it towers above the Bonferroni-corrected limit. On the other hand, it provides underwhelming evidence that any other effects ought to be picked—they all fall below the lower threshold of uncorrected t-value at a p-value of 0.05. This convinced Pete to keep things simple by focusing on the effect of B only.

Statistical details on how to calculate the t-value and Bonferroni correction can be found in the sample chapter excerpt posted by Stat-Ease at *http://www.statease.com/pubs/doesimp2excerpt--chap3.pdf* from the soon to be published *DOE Simplified: Practical Tools for Effective Experimentation, Second Edition* by Mark J. Anderson and Patrick J. Whitcomb. Scroll down to page 29 and see the appendix showing "How to Make a More Useful Pareto Chart." As shown in Pete's case, a Pareto chart with these features can be a very useful companion to the half-normal plot of effects for assessing which factors may truly be impacting your system.

Side note: Version 7 of Stat-Ease software introduced a new feature called "screen tips." Press the light-bulb icon to be enlightened about any particular screen. Ex: The screen tips on the Pareto chart provide handy how-to's, including helpful graphics, on using this new tool for selecting effects.

What makes the Stat-Ease Pareto plot really unique is its interactivity. For example, consider the effects of brand, time and power on unpopped kernels from my oft-cited microwave popcorn experiment pictured side-by-side above with both the half-normal and the Pareto plot (see Figure 3).

Using V7 of Stat-Ease software, it would be a simple matter to lasso the three effects off to the right on the effects scale for the half-normal. However, an optional approach is to click the biggest (left-most) bar on the Pareto and continue clicking bars until none exceed the lower threshold (t-value at p=0.05). See Figure 4 below.

In this case the limits, re-calculated to reflect the chosen model, make a clear distinction between the vital few effects, all exceeding the Bonferroni threshold, tow-

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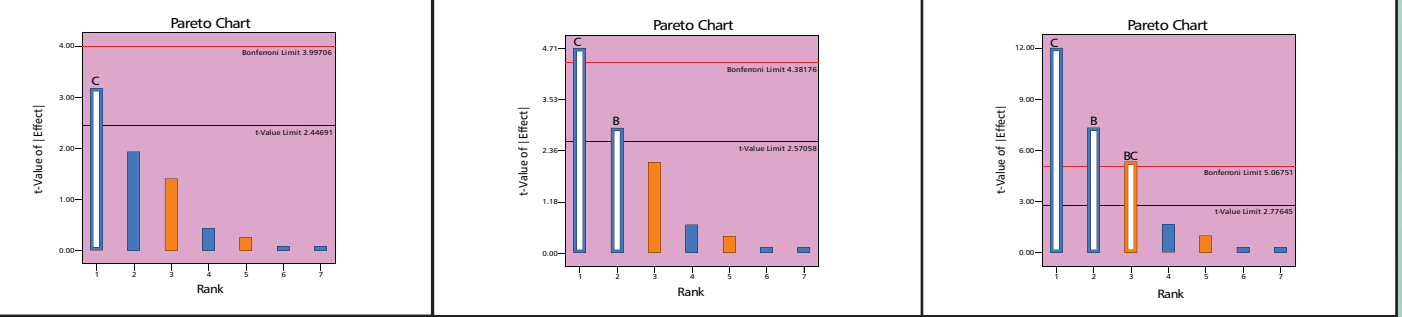


Fig. 4: Using the Pareto plot to select effects

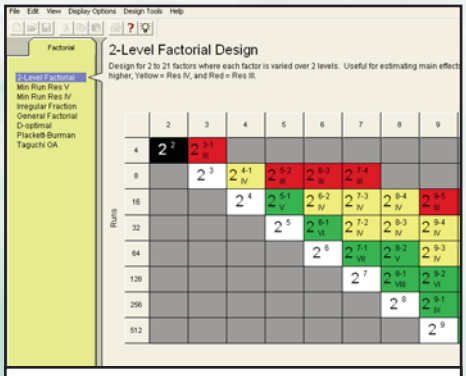
Announcing Design-Ease 7.1 Software

Stat-Ease announces its newest release, version 7.1 of Design-Ease® software for design of experiments (DOE). With this easy-to-use software you can find interactions between product or process factors that lead to breakthroughs in cost, quality, time, etc. Streamlined and affordable, Design-Ease software is ideal for users that don't need the extra bells and whistles found in the expert version.

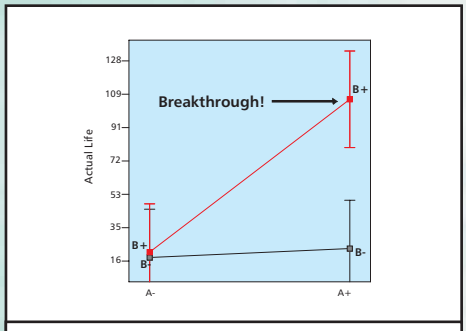
This package contains all of the basic features you will find in Design-Expert 7.1 software, and is suited for beginners or those who don't need to do response surface methods (RSM) or mixture design. An added benefit of Design-Ease software is that if at any point in the future you decide that you would like to upgrade to Design-Expert, the software is completely compatible and you can purchase the more powerful version at a significant discount.

Some of the new features you will find in Design-Ease 7.1 software include:

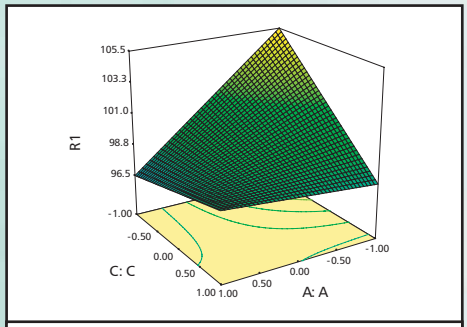
- Upfront power calculation for factorial designs: In the design builder this provides a 'heads-up' on the percent probability of seeing the desired difference in each response—the signal, based on the underlying variability—the noise.
- "Min-Run Res V" designs are now available for 6 to 50 factors: Resolve two-factor interactions (2FI's) in the least runs possible while maintaining a balance in low versus high levels.
- Design layout can now be modified via a right-click list with added columns for point type and other alternative attributes.
- Bookmarks for reports with a toolbox to facilitate selection: This will save you a lot of time scrolling through long statistical outputs such as the design evaluation and analysis of variance.
- Display grid lines on 3D-graph backplanes: This feature provides a better perspective on the varying height of a response surface.
- Save graphs to files in enhanced Windows metafile (EMF), PNG, TIFF, GIF, BNP, JPEG, and encapsulated Postscript (EPS) formats.
- More flexibility in handling various file types when opening files: Very helpful default that automatically recognizes any data in the Design-Ease (.de*) or Design-Expert (.dx*) format–including ones produced from older versions.
- Import and export text files to get responses.
- "Design model" choice added for statistical analysis: This is handy for data from experiments based on a computer-generated D-optimal design.



The two-level factorial build screen helps you select a design



The level of one factor can change the effect of another — an interaction detected only with DOE



Rotatable 3D plots produce high quality reports

For more information on Design-Ease 7.1 software, please contact us via:

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Give Design-Ease 7.1 software a try. Download the free 45-day trial version at *http://www.statease.com/de7trial.html*. To purchase the software, fax us the order form on page 4 or contact us by phone or e-mail.

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ering above the trivial many—all of which fall below the lower threshold. Now that you know about this statistical feature, go ahead and impress your non-statistician friends by saying that you have a Bonferroni. Enjoy their reaction of confusion tinged with envy and be on your way before the questions start coming.

—Mark Anderson (mark@statease.com)

Acknowledgment: Thank you Pete Loeb for being such a good sport and allowing me to use your first attempt at analyzing a two-level factorial as a learning experience. I predict you will go far with this tool on your six sigma black belt.

Place Your Order Now for DE7.1 Software

06/07

Order your copy of Design-Ease (DE) 7.1 software today and experience the functionality and ease-of-use that makes DE7.1 the best choice for anyone doing factorial designs. Visit the Stat-Ease web site at **http://www.statease.com** for product details and to download a free 45-day trial.

To place your order, fax this form to 1.612.378.2152 or mail it to the address below. Thank you for your business!

Qty	Item	Other Required Information	Unit Cost	Ext. Cost
	Design-Ease 7.1 Annual Network [**3-seat** annual license (includes free upgrades and updates)]		$525/year	
	Design-Ease 7.1 Single-User Perpetual (DE7.1) [for quantity discounts (3+ copies), call for a quote]		$495	
	Upgrade to DE7.1 from DE7.0	**Old Serial # required:**	$95	
	Upgrade to DE7.1 from DE6 or older	**Old Serial # required:**	$295	
	***DOE Simplified* Book** (Comes with a 180-day CD-ROM of Design-Ease 7 software)		$39.95	
	***RSM Simplified* Book** (Comes with a 180-day CD-ROM of Design-Expert 7 software)		$50	
	Shipping within the USA—Add $15 for each software package & $5 for each book. All others, please call for a quote.			
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