stat-teaser

ABOUT STAT-EASE® SOFTWARE, TRAINING, AND CONSULTING FOR DOE
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Workshop Schedule

Experiment Design Made Easy

January 22–24, 2008: San Diego, CA
February 12–14, 2008: Minneapolis, MN
March 4–6, 2008: Philadelphia, PA

Study the practical aspects of design of experiments (DOE). Learn about simple, but powerful, two-level factorial designs. $1495* ($1195 each, 3 or more)

Response Surface Methods for Process Optimization

February 26–28, 2008: Minneapolis, MN
September 23–25, 2008: Minneapolis, MN

Maximize profitability by discovering optimal process settings via RSM. $1495* ($1195 each, 3 or more)

Mixture Design for Optimal Formulations

January 29–31, 2008: Minneapolis, MN
April 8–10, 2008: Minneapolis, MN

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DOE for DFSS: Variation by Design

March 11–12, 2008: Minneapolis, MN
November 11-12, 2008: Minneapolis, MN

Use DOE to create products and processes robust to varying conditions, and tolerance analysis to assure your specifications are met. A must for Design for Six Sigma (DFSS). $995* ($795 each, 3 or more)

PreDOE: Basic Statistics for Experimenters (Web-Based)

PreDOE is an entry-level course for those who need to go back to the basics. See *http://www.statease.com/clas_pre.html* for more information. $95

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

Attendance is limited to 16. Contact Elicia at **612.746.2038** or **workshops@statease.com**.

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statistics made easy™

A Crash Course on DOE for Sales and Marketing

"He who has a product to sell and goes and whispers in a well is not so apt to get the dollars as one who climbs up a tree and hollers."
–Author unknown

"The time has come when advertising in some hands has reached the status of a science."
–Claude C. Hopkins (1866-1932)

When Claude Hopkins, author of "Scientific Advertising" (1923), invented market testing he never could have imagined a communications network like the Internet, or a company like Google that dominates its market by experimenting "quickly and often" (John Hunter, "Curious Cat Management Improvement" blog).

What if people with products or services to sell could test more than one factor at a time? They can with the tools of design of experiments (DOE)! A newly developed "Crash Course on DOE for Sales and Marketing" (SMDOE) explains how.

SMDOE is the product of a stimulating collaboration with Paul Selden, author of *Sales Process Engineering* (ASQ Quality Press). Paul developed a one-day version of SMDOE that Stat-Ease hosted in the fall of 2005. It earned rave reviews from a small, but very solid class of marketing professionals.

Encouraged by this, Paul added another

Mark Anderson, Principal
Stat-Ease, Inc.

day of content that delved deeply into two-level factorial design and critical issues, such as statistical power. I provided him with a sounding board off which he could bounce ideas, and offered advice on how to make best use of Stat-Ease software for design and analysis of fact-based case studies that detailed the application of statistically-sound experimental plans.

DOE is a proven, documented[1] method for accelerating testing in marketing and sales. Stat-Ease has practiced what it preaches by trying differing approaches to direct-mail advertising of its statistical workshops. For example, in one experiment[2] we varied the following three factors each at two levels:

A. Color: 2 vs. 4

—*Continued on page 2*

—*Continued from page 1*

B. Card size: standard vs. oversize (per US Post Office regulations)

C. Stock: standard vs. deluxe

We mailed these postcards to 8 randomly-selected segments of our house list and counted responses. The results, illustrated in the cube plot produced by Design-Ease® software (see Fig. 1), revealed an interaction between color and stock (AxC). Investing in 4-color printing paid off only for the deluxe stock. The card size, factor B, did not significantly affect response. So to maximize our return on investment in direct mail advertising we chose small, deluxe cards printed in 4 colors.

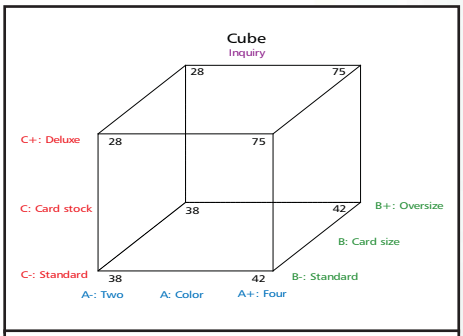

Fig. 1: Cube plot of predicted response

We've dabbled a bit with purchased mail lists. However, this can become very perilous due to the loss of control in executing a properly randomized plan. For example, one direct-mail broker unwittingly undermined the relevance of any end results by unilaterally mixing in several sources of names that should have been homogeneous—a confounding variable. He meant well! Also, despite being asked to do so, this same broker did not randomize names—leaving them clumped geographically. For example, for convenience sake he sent one list to "sales" people on the Eastern Seaboard and the other to the West Coast "marketers," thus these two variables—job function versus region—became confounded.

Another word to the wise when doing any DOE, but especially ones on sales that require big investments, is to conduct a pilot run. For example, let's say you are targeting a new market segment that requires purchasing names from a trade publication. By buying only a limited sample and mailing a prototype, you can get a feel for the expected response. From this estimate, you can do power calculations* that determine the size of the experimental design needed to detect when a genuinely important factor is present (statistically significant). This may save you a great deal of money otherwise wasted on running a test whose apparent returns look so meager that they cannot achieve statistically significant factor effects. Spending a lot of time and money on running a test, then missing a real signal just because a design was flawed, is not a credibility builder.

One more suggestion: Watch out for get-rich-quick experiment designs that make use of saturated Taguchi or Plackett-Burman arrays, for example, 11 factors in only 12 runs. As George Box once said, these are like kicking your TV to make it work (do not try this on your new high-def screen!). Consider making use of the new minimum-run resolution IV (MR4) or V (MR5) designs invented by Stat-Ease for its latest versions of DOE software.

The new, two-day "Crash Course on DOE for Sales and Marketing" is designed to cover many practical tools and techniques, in a fast-paced format containing lots of examples. Participants will leave with many new ideas—even more confidence that yes, DOE really works in the world of marketing and sales, too!

-- Mark J. Anderson (mark@statease.com)

[1] "Using a Fractional-Factorial Design to Increase Direct Mail Response at Mother Jones Magazine" by Johannes Ledolter (University of Iowa) and Arthur J. Swersey (Yale School of Management), *Quality Engineering*, 18:469–475, 2006.

[2] "New Spin on DOE from Forbes Inspires Case Study by Stat-Ease Marketers" by Mark J. Anderson, *Stat-Teaser*, Summer 1996.

*Email me at mark@statease.com for a free sample-size calculator (Microsoft Excel) and an associated guide on how to use this.

The two-day "Crash Course on DOE for Sales and Marketing" workshop is available exclusively for on-site presentation. These private presentations allow for more confidential discussion and application to real-life marketing and sales situations than a typical public session. Contact Mark for details.

2nd European DOE User Meeting Coming in March!

The Second European DOE User Meeting will be held March 10–12 in Berlin, Germany. Come to increase your understanding of design of experiments (DOE) techniques, learn of successful real-life applications of DOE, and also attend presentations specific to Stat-Ease software and its features. To receive more information when it is available, send an e-mail to Heidi Hansel at heidi@statease.com. We hope to see you in Berlin!

When Power is Too Low in Factorial Designs (Part 2 of 2)

Welcome to the second article of a two-part series. Part one, featured in the September 2007 Stat-Teaser newsletter, described how to use the new upfront power calculation in Design-Expert® 7.1 software. As a follow-up to that article, let's take a look at a case study demonstrating a design which lacks sufficient power and discuss how it should be dealt with.

	Name	Units	Diff. to detect Delta("Signal")	Est. Std. Dev. Sigma("Noise")	Delta/Sigma (Signal/Noise Ratio)
-	R1		3	2.3	1.30435

Fig. 1: Power calculation screen

Power is reported at a 5.0% alpha level to detect the specified signal/noise ratio.
Recommended power is at least 80%.

R1

Signal (delta) = 3.00 Noise (sigma) = 2.30 Signal/Noise (delta/sigma) = 1.30

A	B	C	D	E
65.3 %	65.3 %	65.3 %	65.3 %	65.3 %

Fig. 2: This design yields power at 65% instead of the 80% desired

This DOE will be run on a process in which the output is yield, measured in percent. The current yield is 80% and the organization would get excited about an increase in yield as small as 3%. The higher the better, but a change of even 3% would be financially worthwhile. Long-term measurements of yield provide an estimate of the standard deviation of yield at about 2.3%, giving a signal-to-noise ratio of 1.3 (see Fig. 1). The design chosen is the ½ fraction of 5 factors in 16 runs. Unfortunately, this results in a power of only about 65% (see Fig. 2), well below the desired 80%.

What are our options? Power can be increased in the following ways:

1. Lessen expectations (increase the signal): Change your expectations of the design and decide that it is okay if the design could simply detect a 5% change in yield (rather than 3%), thereby changing the signal-to-noise ratio to 5/2.3 = 2.17. This would increase the power of this ½ fraction design to 97.4%.

2. Decrease the noise: Is there a way to control the process variation so that during the experiment, the noise is lower than normal? If you have good subject matter knowledge, you may understand which portion of the process is the largest source of variability and you can add repeats at that point. For example, if the measurement system is the noisiest part of the system, take the yield measurement multiple times and enter the average yield as the response value. This will decrease the noise roughly by the square root of the number of repeated measurements.

3. Increase the alpha value: We typically use an alpha value of 5% to minimize our risk of making false positive errors. This can be increased to 10% if the consequence of making incorrect decisions is not severe. Dr. Fisher even used 20% in his agricultural experiments because there was little negative consequence to declaring an effect significant when it was not.

4. Change the design to increase the number of runs: As sample size is increased, the ability of the design to detect effects will improve. If the design is already a full factorial, then replication makes sense. This design is a fractional factorial, a ½ fraction, so don't replicate it. Instead, increase it to the full factorial. This will allow you to both estimate more effects and gain power (the 32-run design has a power of 94.4%).

I encourage you to take advantage of the new upfront power calculations that are in Design-Expert v7.0 and later. Don't spend the time and effort to run a design that is not capable of detecting the effects of interest. This is discouraging and causes others to second-guess how much DOE can help them learn about their product or process. Choose a design that fits the problem and success will come easily!

If you have questions about power or other DOE-related topics, don't hesitate to ask. Statistical support is available at stathelp@statease.com.

--Shari Kraber (shari@statease.com)

P.S. To learn more about power, attend our "Experiment Design Made Easy" workshop, www.statease.com/clas_edme.html.

Can I Use Power for Mixture or RSM?

The power calculation is inappropriate for response surface (RSM) and mixture (MIX) design objectives, often reporting very low values. Watch for a future article on Fraction of Design Space (FDS) graphs which are a better tool to assess the capability of RSM and MIX designs.

Newsletter Subscription Preferences

12/07

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