

stat teaser

Workshop Schedule

Experiment Design Made Easy

July 8–10, 2008: San Francisco, CA
August 19–21, 2008: Minneapolis, MN
September 30–Oct. 2, 2008: Philadelphia, PA
December 2008: Dallas, TX

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

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

July 29–31, 2008: Minneapolis, MN
Find the ideal recipes for your mixtures with high-powered statistical tools. \$1495 (\$1195 each, 3 or more)

DOE for DFSS: Variation by Design

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). \$1195 (\$995 each, 3 or more)

Designed Experiments for Life Sciences

August 5–7, 2008: Minneapolis, MN
Learn how to apply DOE to Life Science problems. \$2050 (\$1650 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

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



ABOUT STAT-EASE® SOFTWARE, TRAINING, AND CONSULTING FOR DOE
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How DOE Saved My Life and Made it Worth Living

That got your attention, didn't it? I'll tell you what caught my eye—the computerized diagnostic on the EKG unrolled by my doctor: “Possible infarction of left ventricle.” I will not repeat my epithet after getting the sort of look from the doc that you never want to see. This myocardial infarction, or “M.I.” as cardiologists refer to it, set me back a bit in December of 2004. It was what some people call a mild heart attack—an oxygen-like statistics made easy. My goal now is to prevent or at least survive a second one, which I euphemize as the HA HA, that is—heart attack on top of heart attack.

I am being overly dramatic to say that design of experiments (DOE) saved my life. At the time of my MI I was only 51 years old and still in prime physical shape—never smoked, exercised excessively and tested normal for cholesterol. That's what allowed me to endure the painful heart attack and feel just fine afterwards. My younger brother had suffered an MI so I knew enough to drive in and see a doctor—thank goodness.

What DOE did for me was remove all fear about the angioplasty done to open up my blocked artery. I'd first seen a heart stent and their associated devices, catheters and so forth, in the early 1990s when I taught statistics at Advanced Cardiovascular Systems in California (now owned by Abbott). About that



Mark Anderson
Principal of Stat-Ease, Inc.

same time I also ran a couple of workshops for Scimed in the Twin Cities, which later became Boston Scientific. I knew what I was in for and how much well-planned experimentation went into the development of this life-saving and life-enhancing medical device. I'd even taught a series of DOE classes for the company, Surmodics, who developed the coating for my particular stent (made by Johnson & Johnson).

The human heart is an amazing system. Consider for example that at the typical pulse rate of 75 it beats 39 million times per year. Quality expert Joseph M. Juran, who lived to age 103, had a heart that worked unfailingly for upwards of 4 billion cycles. That is remarkable! For people like me that suffer a breakdown in this pumping system, the cardi-

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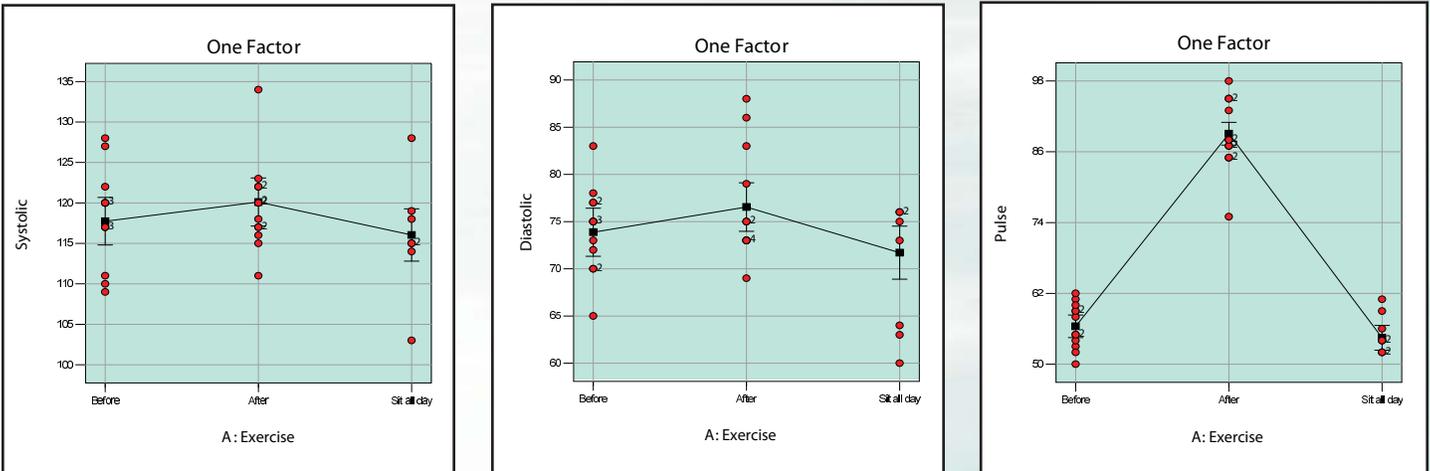


Figure 1: Blood pressure readings before exercise, after exercise, and after sitting all day for (from left to right) Systolic (high end), Diastolic (low end) readings in mm of Hg, and Pulse (heart beats per minute)

ologists invariably prescribe a medicine that makes the heart beat slower and more vigorously, thus preventing congestive failure from progressive weakening of the remaining muscle (some damage always occurs—that’s what myocardial infarction means medically).

I’ve struggled slightly in getting one of my heart ‘meds’ (Atenelol) calibrated for my metabolism. That caused my general practitioner (GP) to suggest I monitor my blood pressure and pulse before and after my regular cardio workout at home on an elliptical machine. He also wanted the same data later in the day after I drive home from my desk job—a time when I often feel a bit light-headed. Could this be due to a drop in blood pressure and circulation? This was a perfect setup for someone like me that loves to experiment. Furthermore, my partner Pat Whitcomb had just given me his first draft of the new Stat-Ease workshop on “Designed Experiments for Life Sciences” (see details on page 3). The timing could not have been better!

The experimental design is a simple comparison blocked by day. Even so, I could probably spend half a day

explaining all the ins and outs of the methodology originally developed by Ronald Fisher the better part of a century ago for agricultural applications. Therefore, I will only show the end results. However, do not hesitate to e-mail me for my Design-Expert[®] file (.dx7) showing the raw data, analysis of variance (ANOVA), and diagnostics. It incorporates some details that I recorded under the Notes node of the program. For background on the design and analysis of this experiment see the first few sections in my book (co-authored by Pat Whitcomb) *DOE Simplified, 2nd edition* (2007, Productivity Press)—available from the Stat-Ease web site.

The effects plots show the actual results as red dots (see Figure 1—numbers at their side indicate multiple readings at the same level). The black squares represent (from left to right on each plot) the mean level of response before exercise, after exercise, and after sitting all day (at work and driving home). The bars show the least significant differences at 95 percent confidence.

These displays make it immediately obvious that my pulse increases significantly after my morning exercise (the peak seen in the middle of the far right

graph), but it does not differ much from the start of my day to the end (left vs right treatment on this plot). To be more precise, given the relatively limited amount of data I collected—13 day’s worth, no significant difference could be detected. The blood pressures (systolic over diastolic—left and middle plot, respectively) show no significant differences—the LSD bars overlap. However, I’d guess that the observed trends of slight elevation after exercise and a small drop-off at the end of the day would become statistically significant after sufficient replication, perhaps a year’s worth. It would be fairly easy for me to do a power calculation on this, but I really do not care because the potential differences seem unimportant.

So, despite the damage to my heart, I feel just fine and all the cardiology indicators seem to be right, but ultimately my doctors will be the judge of that! I’m guessing that not many of their patients provide them with data like this. It’s fun to see how these medical professionals take a dose of stats. They typically grimace like one does when swallowing a bitter tonic—tastes terrible but good for you.

—Mark (mark@statease.com)

New Class! Designed Experiments for Life Sciences

Stat-Ease, Inc. is proud to announce a brand-new workshop, "Designed Experiments for Life Sciences," debuting August 5–7, 2008 in Minneapolis, MN. Developed due to popular demand, this class is a must for anyone in this field who wants to improve a product or process.

In this one-of-a-kind workshop, learn how to apply DOE to life science problems. We welcome scientists, engineers, and technical professionals working in the pharmaceutical, biomedical technology and biomedical device fields, as well as organizations and institutions that devote the majority of their efforts to research, development, technology transfer, or commercialization of these fields. Throughout this course you will explore cases that come directly from this industry!

In a fast-paced three days, learn how to use fractional factorial designs for the screening and characterization of products or processes. Also see how to achieve

top performance via response surface designs, mixture designs, and multiple response optimization. Practice applying all of these DOE tools while working through cases involving titration curves, medical device design, assay optimization, expiry dating, and much more.

This computer-intensive workshop is filled with extras. Two fun and easy-to-read texts, *DOE Simplified* and *RSM Simplified*, authored by Mark Anderson and Pat Whitcomb, are included and provide supplemental background reading for all DOE topics covered. More importantly, Stat-Ease's highly experienced DOE experts will provide you with individualized guidance and support after class to help you get started on your next project—at no extra cost!

Prerequisites

Math skills, knowledge of basic statistics, and exposure to simple comparative experiments (e.g. two-sample t-test) are recommended. Assess your abilities by taking the free Self-Assessment Questionnaire avail-



able at <http://www.statease.net>. If you aren't ready for the Designed Experiments for Life Sciences workshop, take the online PreDOE course first for only \$95.00 (takes 3-6 hours to complete, you can work at your own pace). For more information go to http://www.statease.com/clas_dels.html.

How DOE Saved My Life Appendix

Notes on experimental design setup and background info:

- ♦ Blood pressures and pulse taken with Panasonic Precise Logic™.
- ♦ Ideals according to Wikipedia for systolic/diastolic/pulse are 110-140, 70-90, and 50-100; respectively.
- ♦ Sphygmomanometer is the medical term for the mercury-filled device typically used by medical professionals for taking blood pressure. I do not know how well my Panasonic would agree with these more acceptable medical devices. However, since my purpose was to do a comparative study, I do not think this matters.
- ♦ I tried keeping the same cool down

time and protocol (drinking a glass of orange juice), but it varied more than I would consider ideal. If only I could afford a personal trainer!

Details on data collection and response modeling:

- ♦ I sometimes forgot to take the "after exercise" readings and even more often the "sit all day" data, so a number of treatments remain missing. So it goes... Fortunately, the software is built to handle this.
- ♦ The diagnostic DFFITS flagged the March 31st "after exercise" systolic result. I then went back to my data log (Excel spreadsheet) and saw the com-

ment "20 vs 40 min. on elliptical," which provided support to ignore this day's worth of data—highlighted on the data set.

♦ Design-Expert also flagged:

♦ Diastolic after my exercising on April 11th. I'd entered 183 for this day on this lower pressure reading! Obviously, my finger slipped by entering the "1."

♦ Pulse of 95 on May 15th after sitting all day at work and driving home. I mistakenly entered the number recorded after exercising in the morning. The actual result, still on record, was 56, which I entered as the correct response value.

Check Out the "Stats Made Easy" Blog!

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For fun statistical commentary on a variety of subjects, check out the "Stats Made Easy" blog at <http://statsmadeeasy.blogspot.com/>. Maintained by Mark Anderson, Principal of Stat-Ease, Inc. and author of the "DOE FAQ Alert" monthly e-mail newsletter (<http://www.statease.com/doealert.html>), the blog is both entertaining and thought-provoking.

Recent posts include such diverse topics as:

1. Sign for physics students still unclear on the concepts
2. GPA mongers lose out to students willing to take on tougher classes
3. Advice from famous physicist Feynman: "You must not fool yourself"
4. Duck named DOE (pronounced "Dewie"). (See the photo at right)
5. What would Deming say about the demise of testing in education?
6. Baseball batting averages throw some curves at statisticians
7. Musings on matrices
8. Could a butterfly in Brazil cause a twister in Texas?
9. The action bias drives one to go left or right—not sit tight
10. Catapulting into the world of Second Life

To view the "Stats Made Easy" blog, click on the link in the "What's New" box on the Stat-Ease home page at <http://www.statease.com>, or receive regular links to the latest postings in the "DOE FAQ Alert" monthly e-mail newsletter. Subscribe at <http://www.statease.com/doealertreg.html>. We invite you to comment on posts or send your own interesting ideas to Mark (mark@statease.com).



A Duck named DOE

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