

STATeaser

ABOUT STAT-EASE® SOFTWARE, TRAINING, &
CONSULTING FOR DOE

Workshop Schedule

Experiment Design Made Easy (EDME)

Jun 16-17: Edison, NJ
Aug 5-6: Minneapolis, MN
Sep 29-30: San Francisco, CA
\$1295 (\$1095 each, 2 or more)

Factorial Split-Plot Designs for Hard-to-Change Factors (FSPD—Half Day)

May 20 & 22: Two Live Web Sessions
Aug 7: Minneapolis, MN
Oct. 1: San Francisco, CA
\$395 (\$295 each, 2 or more)

Response Surface Methods for Process Optimization (RSM)

Jun 18-19: Edison, NJ
\$1295 (\$1095 each, 2 or more)

Mixture Design for Optimal Formulations (MIX)

Apr 29-30: Minneapolis, MN
Aug 18-19: Edison, NJ
Nov 4-5: Minneapolis, MN
\$1295 (\$1095 each, 2 or more)

Advanced Formulations: Combining Mixture & Process Variables (MIX2)

Nov 6-7: Minneapolis, MN
\$1495 (\$1195 each, 2 or more)

PreDOE: Basic Statistics for Experimenters Online Course

Free (a \$95 value). Learn more at:
www.statease.com/training/workshops/class-pre.html.

5th European DOE User Meeting

July 9-11, 2014: Cambridge, UK
Learn more at:
www.prismtc.co.uk/doe-user-mtg-keep-me-posted/.

Workshops limited to 16. Multi-class & multi-student discounts are available. Contact Rachel at 612.746.2038 or workshops@statease.com.



Introducing Design-Expert® Software, v9, with Split Plots!

Stat-Ease, Inc. announces the release of Design-Expert software, version 9 (DX9). A long time in the making for the split plot capability alone, this is our most important release since switching from DOS to Windows more than two decades ago!

Enhancements in DX9 include new designs and design capabilities, a much improved ability to confirm or verify model predictions, better graphics, greater flexibility in data display and export, powerful new modeling tools, more custom design choices, improved numerical optimization capabilities, enhanced design evaluation, plus many more features that make Design-Expert more powerful and easier to use than ever before.

Some of the great new features you'll find in DX9 include:

- Two-level, multilevel categorical and optimal factorial split-plot designs for hard-to-change factors (see image below): *Make it far easier, as a practical matter, to experiment when some factors cannot be easily randomized.*

Total factors	Hard-to-change factors
3	1
Runs	Replicates
8	2
No blocks, 16 runs	
<input type="checkbox"/> Assign one block per replicate	

- Half-normal selection of effects



Figure 1: Design-Expert® Software, Version 9

from split-plot experiments with test matrices that are balanced and orthogonal: *The vital effects, both whole-plot (created for the hard-to-change factors) and subplot (factors that can be run in random order), become apparent at a glance!*

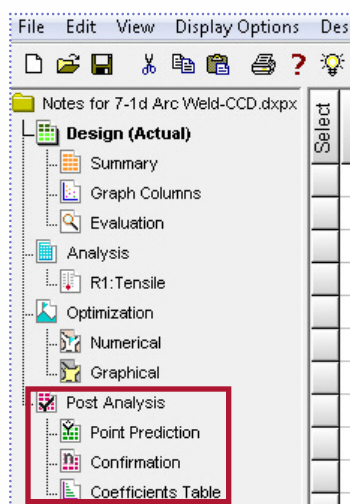
- Power calculated for split plots versus the alternative of complete randomization: *See how accommodation of hard-to-change factors degrades the ability to detect certain effects.*
- Definitive screening designs: *If you want to cull out the vital few from many numeric process factors, this fractional three-level DOE choice resolves main effects clear of any two-factor interactions and squared terms.*
- On the Factorial tab select a simple-sample design for mean-model only: *Take advantage of powerful features in Design-Expert software for data characterization, diagnostics*

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—Continued from page 1

and graphics—for example with raw outputs from a process being run at steady-state.

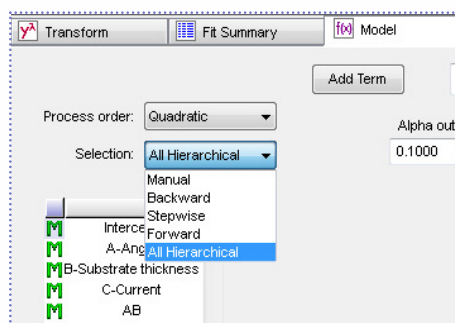
- New Post Analysis Node (at bottom of the handy tree structuring of Design, Analysis and Optimization) contains Point Prediction, Confirmation and Coefficients Table reports: *Old and new features gathered in a logical place at the end of the natural progression from design through analysis.*



- Entry fields for confirmation data and calculation of mean results: *Makes it really easy to see if follow-up runs fall within the sample-size-adjusted prediction intervals.*
- Enter verification runs embedded within blocks as controls or appended to your completed design: *Lend veracity to your ultimate model by these internal checks.*
- Verification points displayed on model graphs and raw residual diagnostics: *See how closely these agree to what's predicted by your model.*
- Adjustably-tuned LOESS* fit line for Graph Columns: *Draw a curve through a non-linear set of points as you see fit. *(Locally weighted scatterplot smoothing.)*
- Color-coded correlation grid for graph columns: *Identify at a glance any factors that are not controlled independently of each other, that is,*

orthogonally; also useful for seeing how one response correlates to another.

- Journal feature to export data directly to Microsoft Word or Powerpoint: *Fast and formatted for you to quickly generate a presentable report on your experimental results.*
- Improved copy/paste of the Final Equation from the analysis of variance (ANOVA) report to Microsoft Excel: *This not only saves tedious transcription of coefficients but it also sets up a calculator for you to 'plug and chug', that is, enter into the spreadsheet cells what values for the inputs you'd like to evaluate and see what the model predicts for your response.*
- New XML script commands for exporting point predictions: *Helpful for situations where one wants to automate the transfer of vital outputs from Design-Expert to other programs.*
- All-hierarchical model (AHM) selection: *Sort through all possible models up to the one you designed the experiment for, but all the while maintain hierarchy of terms so you do not end up with something ill-formulated.*



- Special quartic Scheffé polynomial included in automatic selection for mixture modeling: *Sometimes this added degree (4th!) of non-linear blending helps to better shape the response surface—making it better for predictive purposes.*
- Enter a single factor constraint for response surface designs: *Creates a 'hard' limit on inputs that cannot go*

beyond a certain point (such as zero time) physically or operationally.

- Include Cpk as a goal: *Meet quality goals explicitly.*
- One-sided option added to FDS* graph: *Size your design properly for a verification experiment done to create a QbD (Quality by Design) design space. *(Fraction of design space)*
- Diagnostics report now can be sorted by any of the statistics listed: *This enables a more informative ordering than by run number (the default).*
- Mean correction for transformation bias when responses are displayed in original scale: *All you need to know is that our statisticians figured out how to eliminate a tricky, little-known bias!*
- Propagation of error (POE) carried out to the second derivative: *Makes POE more accurate—that's a good thing!*
- Allow averaging of categorical factors when viewing a graph: *Convenient for getting the big picture of where to find robust operating settings.*
- Display confidence bands with or without POE added: *Easier to match output with other programs that do not offer POE features like this.*
- Add unblocked results to evaluation of blocked experiments: *Aids in comparing designs on the basis of matrix measures.*
- New, more flexible and easier-to-use license manager with greater power to serve enterprise users: *For example, network 'seats' can be checked out to individual laptops and multiple openings of the program on a specific computer will only use one seat.*

Try DX9 software free for 45 days at www.statease.com/software/dx9-trial.html. To purchase, you may use the enclosed order form, visit the web site, or contact Stat-Ease at info@statease.com or [612.378.9449](tel:6123789449) to order directly. Special pricing ends May 31st so don't delay!

Regressing the Rupee – Part II – Two of DX9's New Tools

In the last *Stat-Teaser*, we explored the dangers of happenstance regression using some economic data comparing the U.S. Dollar (USD) to the Indian Rupee (INR). The goal was to use other economic indicators to determine why the Rupee has plunged to historical lows vs. the USD. We learned that this is not an easy task. To see the details, be sure to go back and read the September 2013 Stat-Teaser article (available at www.statease.com/news/news1309.pdf). This article details two of the new tools available in Design-Expert® software, version 9 (DX9) that were used to reach the conclusions in the previous article.

The first of the tools is the use of verification runs. In the article, we used data-splitting. We set aside half of the available historical data from the model fitting. That data was only used to check the model, not to fit the model. Verification runs are the perfect tool for doing this.

In DX9, you can change any run in the design to a verification run by right-clicking on the row header and choosing Set Row Status->Verification. There will now be [square brackets] around the run numbers for these verification runs. The verification runs will be ignored for model fitting, but will show up on the residual plots and graphs. That way, you can check whether the model does a good job of predicting the verification runs accurately. Verification runs will show up as a checkmark (☑) on the graphs. In Figure 1, you will see the externally studentized residuals plot for the model. This plot is good for finding statistical outliers. All of the runs used in the model are within the red limits. However, all the verification runs (☑) fall outside of the limits, having large negative residuals. That means that these runs are being over-predicted by

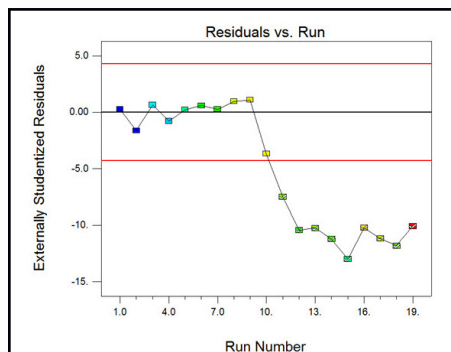


Figure 1: Externally Studentized residuals plot for 50% data model with verification runs.

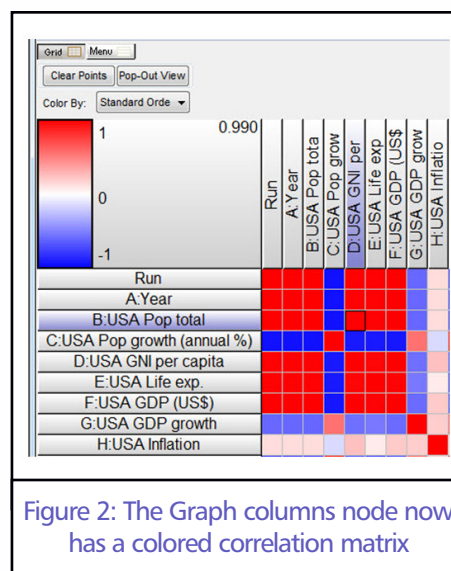


Figure 2: The Graph columns node now has a colored correlation matrix

the model, resulting in a negative residual (actual—predicted).

Another new DX9 tool used in the previous article was the correlation matrix (grid). Recall that when all of the economic factors collected were used in the model, there was a lot of collinearity among the factors and many different models could be fit by just using different subsets of these correlated factors. It was impossible to tell what the real cause was, because many factors were correlated with one another. The best tool to look at this correlation is the correlation matrix (see Figure 2). This matrix lists

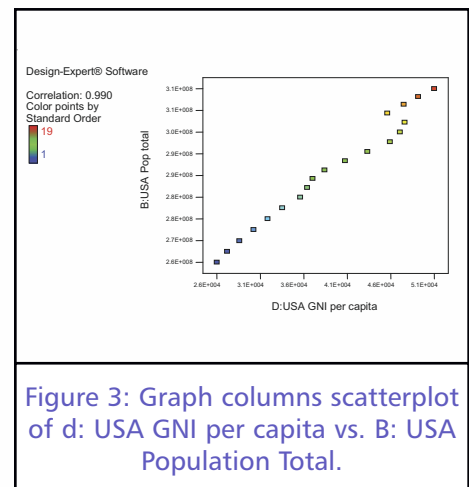


Figure 3: Graph columns scatterplot of d: USA GNI per capita vs. B: USA Population Total.

all of the factors and responses in a grid pattern, indicating the correlation coefficient (-1 to +1) by color.

A perfect positive correlation (1.0) means that the two things you are comparing have the exact same positive slope. So, there is a red diagonal in the correlation matrix along which things have a 1.0 correlation, starting in the upper left corner (run vs run) and going to the lower right hand corner (H vs. H). Since the boxes on this diagonal are comparing the same variable, there is a perfect correlation of 1.0. The interesting parts of the matrix are the off-diagonal squares. You will see many dark red squares, indicating a correlation between factors of almost perfect (1.0). For instance, look at B: USA Pop total vs. D: USA GNI per capita (highlighted in Figure 2). By clicking on that bright red box in the matrix, you can see a scatter plot (see Figure 3) of these two variables, which also indicates the correlation coefficient of 0.99.

These are just a couple of the new tools that are available in DX9. Give them a try! They should help you more easily explore and interpret your data, leading to quicker real world improvements. —Brooks Henderson, brooks@statease.com



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Order New Design-Expert 9 Software Today & Save!

4/14

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Stat-Teaser Moving to an All-Digital Format

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