

## v10 of Design-Expert® Software: Top Tool for Design of Experiments (DOE)

“Theory guides, experiment decides.” -- I. M. Kolthoff

### Rave reviews from the expert evaluators

- ✓ Design Wizard (new): *“Great for newbies or just to confirm my own independent selection.” “It helps the novice quickly and wisely build a design to suit their needs.”*
- ✓ Multiple Graphs view (new): *“Excellent! Very useful. Love this! All factors profiles plot definitely is a good option.”*
- ✓ RSM split-plot optimal designs (new): *“Excellent! Great addition! It is very important that this is now possible. Love the Autoselect tool!”*
- ✓ Automatic Model Selection tool (new): *“Excellent! AICc is a very useful new feature, it worked better than other software.”*
- ✓ Power calculator for pass-fail (binomial) responses (new): *“Huge kudos!”*

### What’s in it for You

Stat-Ease, Inc. welcomes you to version 10 (v10) of Design-Expert software (DX10) for design of experiments (DOE). Our programmer team code-named this major new release “Kolthoff” in honor of the renowned Dutch chemist and educator who taught at University of Minnesota for more than 60 years. Use this Windows®-based program to optimize your product or process. It provides many powerful statistical tools, such as:

- Two-level factorial screening designs: *Identify the vital factors that affect your process or product so that you can make breakthrough improvements.*
- General factorial studies: *Discover the best combination of categorical factors, such as source versus type of raw material supply.*
- Response surface methods (RSM): *Find the optimal process settings to achieve peak performance.*
- Mixture design techniques: *Discover the ideal recipe for your product formulation.*
- Combinations of process factors, mixture components, and categorical factors: *Mix your cake (with different ingredients) and bake it too!*
- Design and analysis of split plots: *Make your experiment far easier by grouping hard-to-change process factors and/or mixture components.*

Your Design-Expert program offers rotatable 3D plots to easily view response surfaces from all angles. Use your mouse to set flags and explore the contours on interactive 2D graphs. Our numerical optimization function finds maximum desirability for dozens of responses simultaneously!

You’ll find a wealth of statistical details within the program itself via various Help screens. Take advantage of this information gold-mine that is literally at your fingertips. Also, do not overlook the helpful annotations provided on all reports.

For a helpful collection of checklists and ‘cheat sheets,’ see the *Handbook for Experimenters*. It’s free to all registered users. Furthermore, for a quick start on design and analysis of experiments—keeping things simple and fun (unlike most other statistics texts), we recommend you read:

- *DOE Simplified: Practical Tools for Effective Experimentation* (now in 3<sup>rd</sup> Edition!),
- *RSM Simplified: Optimizing Processes Using Response Surface Methods for Design of Experiments*.

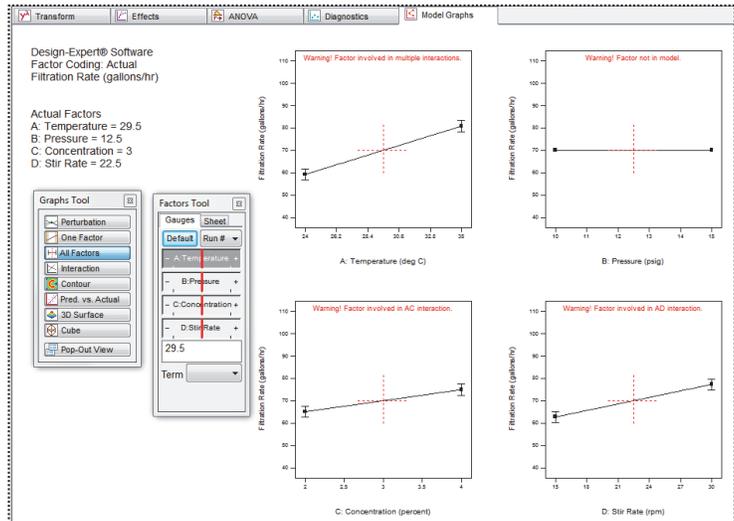
They are available for purchase via the Publications menu at [www.statease.com](http://www.statease.com), via Amazon, or directly from the publisher—Taylor&Francis/CRC/Productivity Press (New York, NY). The authors, Stat-Ease Principals Mark Anderson and Pat Whitcomb, also wrote a *Primer on Mixture Design*, which is posted free for all to read via the “I’m a Formulator” link on the Stat-Ease home page.

## What's New

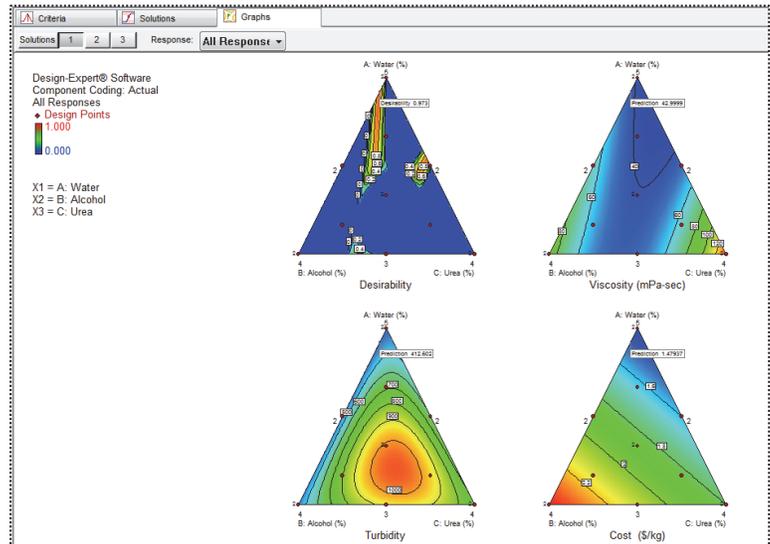
Those of you who've used previous versions of Design-Expert software will be impressed with the many improvements in Version 10. Do not hold off: Upgrade now! Here are the highlights:

### Graphs greatly upgraded to more quickly get you the picture of your experimental outcome

- Multiple Graphs view (factor profiler): *Seeing effects from input variables side by side shouts out their relative impacts.*



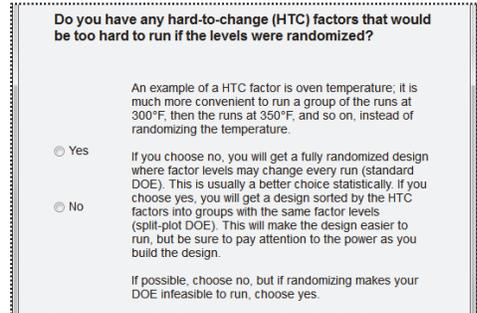
- All Responses choice in Numerical Optimization: *Compare side by side the overall desirability with the individual optimum results so you get the complete view from the peak of performance.*



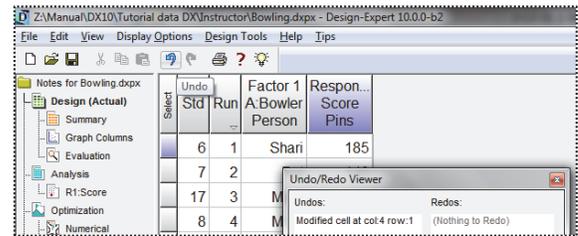
That is not all! Many more enhancements to Design-Expert graphics are detailed in the “Last, but Not Least” appendix on additional features in v10.

### User interface far more engaging

- The Design Wizard provides guidance for less sophisticated users: *If you are not sure where to start with your experiment, follow through with this short series of questions to get an answer.*



- Expanded Undo/Redo option in Design Layout with new viewer toolbox: *Oops, you typed in the wrong number, but now that is no problem: get a do-over by pressing the undo button.*



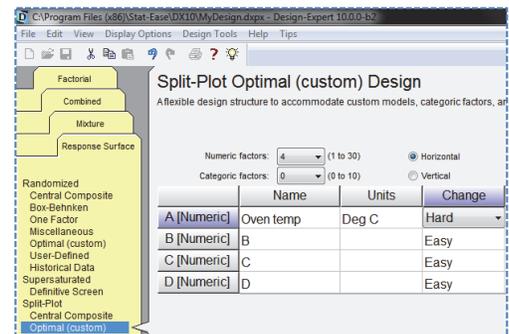
That is not all! Many more interface improvements to Design-Expert are listed in the “Last, But Not Least” appendix.

### Computational capabilities greatly improved

- 64-bit version now available: *Take full advantage of the technology built into your CPU for faster performance for statistical calculations, rendering of graphics and so forth.*
- Math engine retooled for far-faster computations: *Why wait?*
- Optimal builds now run in parallel making them 3 to 17 times faster: *Smart!*
- Designs no longer limited to 32K runs: *This frees up very large experiments done via computer simulations or with robotic apparatus.*

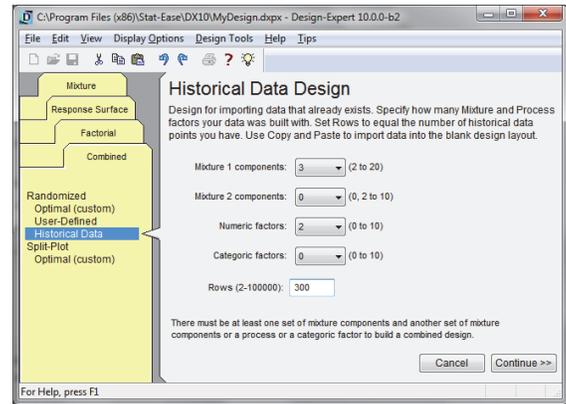
### Many designs added and made more versatile

- Optimal split plots for Response Surface and Combined (mixture-process) designs: *They make it far easier as a practical matter to experiment when some factors cannot be easily randomized, e.g., first mix your cakes by batches (hard) and then bake them at varying temperatures (hard) for differing times (easy).*



- Blocking for Definitive Screening Designs (DSDs): *DSDs offer a fast track to optimization (thus in v10 they are provided on the Response Surface tab)—these newly-invented designs are now even better with the option to break them up into blocks.*
- Restricted Randomization Central Composite Designs (CCD): *Convert this tried and true response surface method (RSM) design into a split plot so it can deal with hard-to-change factors.*

- Historical data choice for Combined designs: *Take advantage of all the tools in Design-Expert—evaluation, model fitting, statistics, diagnostics, graphing and numerical optimization—to see if a sweet spot can be found in your collection of happenstance data, even if it includes both process factors and mixture components.*

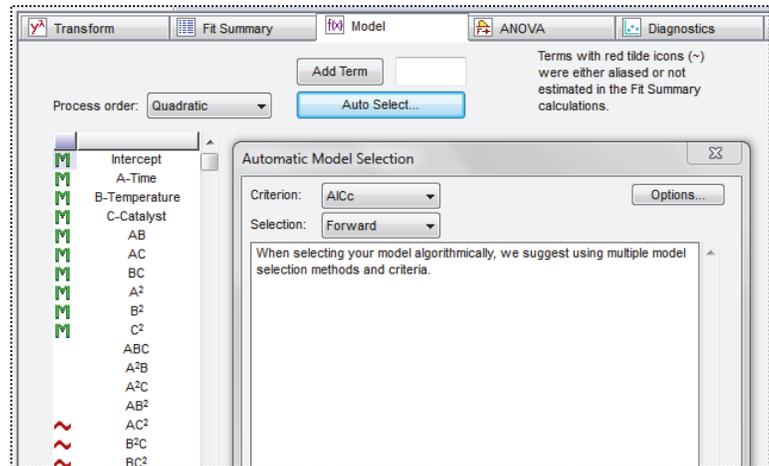


- Power and sample size calculator for binomial responses during build: *Design an experiment with sufficient runs to be fairly certain that you will not overlook an important discovery.*

That is not all! Several more design build and evaluation improvements to Design-Expert are listed in the “Last, But Not Least” appendix!

### **Modeling tools supercharged**

- Definitive Screening Designs (DSD) moved to the Response Surface tab where they can be analyzed as a supersaturated matrix for quadratic modeling: *DSDs provide a potential shortcut from screening through optimization, so this is a good place to put them—paving the way to apply Design-Expert’s powerful tools for regression modeling.*
- AICc, BIC and Adjusted R-squared criteria in algorithmic selection: *Take advantage of refinements developed by statisticians to produce a better predictive model.*
- Automatic Model Selection tool for choosing Criterion and Selection method: *Let Design-Expert work out what approach will be best depending on the type of experiment you conducted.*



That is not all! Many more modeling enhancements to Design-Expert are listed in the “Last, But Not Least” appendix!

## **Last, But Not Least—Many More Features in Design-Expert v10!**

### **Graphs**

- ❖ Interactive LSD (least significant difference) bars
- ❖ Improved flexibility in sizing and placement of flags on graphs
- ❖ Show ignored values on Predicted vs Actual graphs
- ❖ Ability to turn off the factor names on plots
- ❖ Select a point after adding a comment on a graph

### **Interface**

- ❖ Smoother scrolling of reports and spreadsheets
- ❖ Enhanced copy-paste for equations
- ❖ Improved export to Excel, Word and Powerpoint
- ❖ Support for different decimal point characters (localization)
- ❖ LOESS Tool for Fit line in Graph Columns
- ❖ Improved Graph Columns correlation grid tool with more intuitive layout
- ❖ Enhanced constraint tool with simplified result equations and a clear button
- ❖ Remember and restore position in design layout when returning to view
- ❖ Insert runs both before and after the selected run
- ❖ Double-click to resize reports
- ❖ Splash screen upon start (replaces About Box)
- ❖ Watermark added to example pictures on the transformation screen
- ❖ Better handling of progress bars including threading

### **Designs**

- ❖ New expanded and redesigned Evaluation Report for split-plot designs
- ❖ Run column “Reorder as currently displayed” option for split-plot designs
- ❖ Column sort from View menu for Design Layout
- ❖ Variance ratio displayed on the power response-entry screen for split-plots

### **Modeling**

- ❖ Select by Degree option prioritizes the criteria comparisons by term order
- ❖ Model Selection Log in Automatic Model Selection and in ANOVA
- ❖ Likelihood ratio p-values for split-plot designs
- ❖ Forward selection for REML/ML analysis
- ❖ Aliases reported and selectable in Effects List (makes Alias List unnecessary)
- ❖ Curvature term removed for DSDs (or other SDs that model squared terms)

### **Analysis**

- ❖ Option to ignore groups for split-plot designs
- ❖ Equations section on the split-plot ANOVA
- ❖ Split-plot designs analyzed using either Maximum Likelihood (ML) or REML
- ❖ Tolerance Intervals for predictions in split-plot designs
- ❖ VIFs in split-plot ANOVA
- ❖ Adjustable REML/ML stopping rule and maximum iterations
- ❖ Negative variances excluded when calculating REML/ML
- ❖ Variance components in mixed-models are zeroed out below a threshold
- ❖ Improved computation of  $R^2$  in split-plot designs
- ❖ Block variance no longer included when calculating LSD values
- ❖ Option to choose between one-sided and two-sided tests for intervals
- ❖ New toolbox to view the V-matrix used in Mixed Model calculations

## ***Diagnostics***

- ❖ Box-Cox plot for mixed models, e.g., split plots
- ❖ Externally studentized residuals and influence graphs for mixed models (Cook's Distance, DFFITS, Covariance Trace and Covariance Ratio)
- ❖ Limit lines on diagnostic graphs are labeled
- ❖ Color by Group in the Residual vs Factor diagnostic graph
- ❖ Control limit default values for DFFITs and DFBETAs with the option not to display them on the graph
- ❖ Better footnoting in the Diagnostics Report