Section 7 – Advanced Analysis Features

This section discusses a few selected topics on advanced tools for data analysis available in Design-Ease® software:

- Responses generated by an equation, for example: cost
- Propagation of error for robust response results

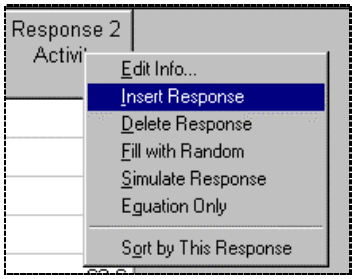
We encourage you to explore various features encountered as you work through this section. You're an experimenter, so it's good to be adventurous!

You may find more information in the Statistical Details: Analysis section of this manual. Also, check out the on-line Help system in the Design-Ease program. If you still need help, then give Stat-Ease a call. Our telephone number is in the Introduction.

Adding Responses via Equation

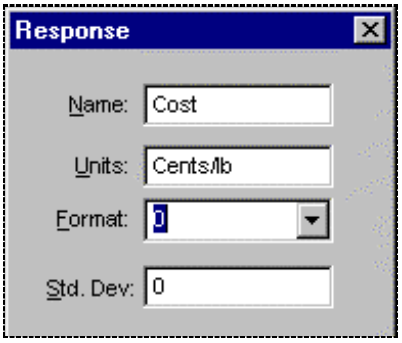
Design-Ease allows you to construct responses from your own models, computed exactly via equation-only or with error via simulation. The equation-only option will be especially useful for consideration of cost relationships. The simulation option allows you to test your skills at analysis. Stat-Ease uses this feature for its workshops. In either case you will be limited to standard polynomial forms. These can be modified by various transformations.

To enter an equation-only response, first insert an empty response column by right clicking on an existing response heading, and selecting Insert Response.



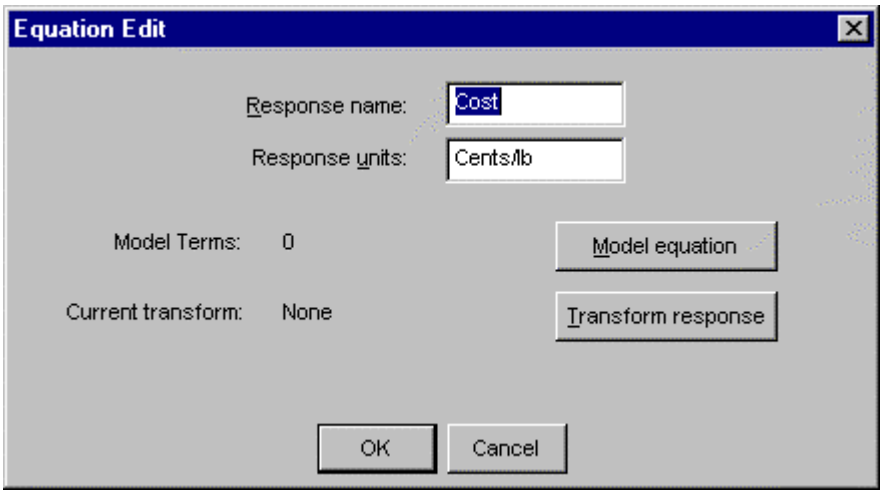
Inserting a Response Column

Right click on the new response column header and choose Edit Info. Then enter the name and units.



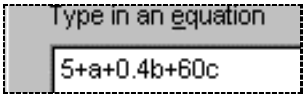
Edit Information Dialog Box for New Response

Press OK. Then right click again on the new response heading. This time select Equation Only.



Dialog Box for Entering an Equation

Now click on the **Model equation** button to bring up a form to enter/edit the model coefficients that describe the equation. Leave the defaults for variable coding as **Actual**. Now you enter the coefficients for the model.



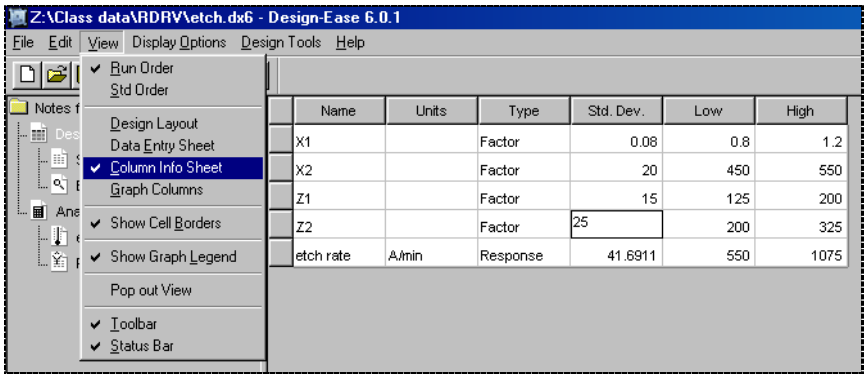
Actual Cost Equation: Completed Entry

Accept the edited equation and subsequent screens by pressing **OK** twice. Design-Ease then inserts the calculated cost data into the response column.

Propagation of Error

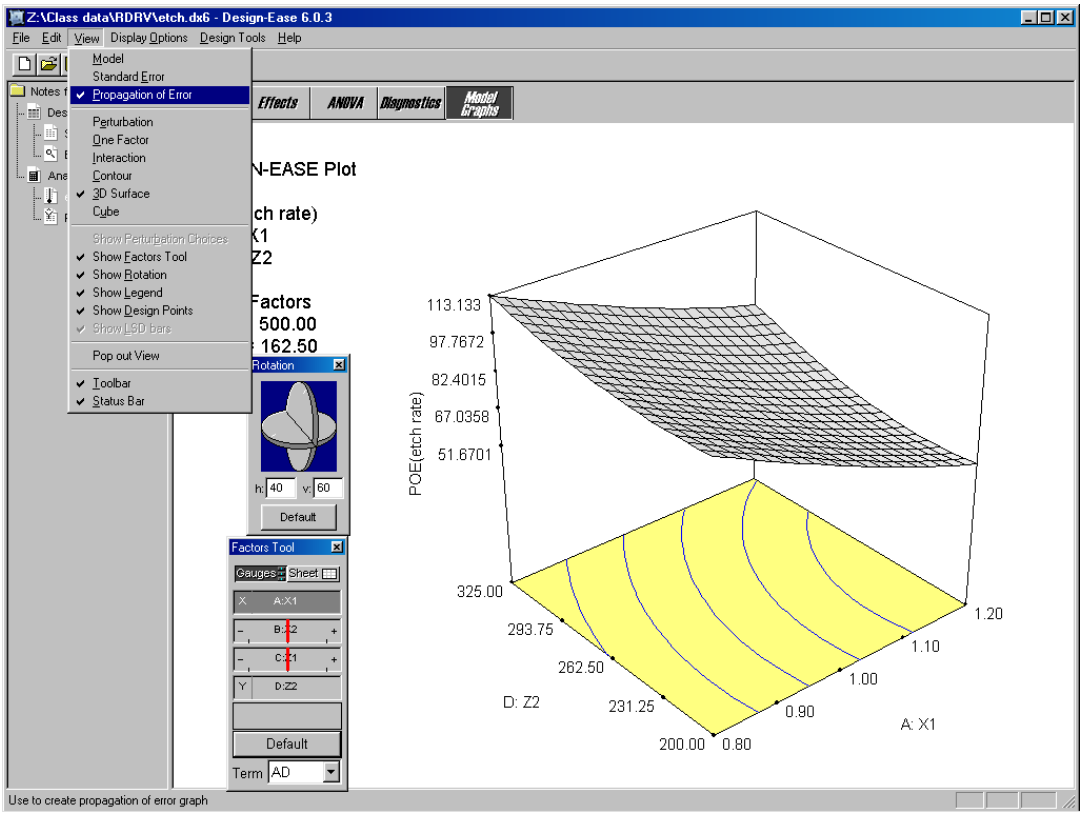
Propagation of error (POE) is a tool for finding regions in your response surface that are robust to variations in the input factors. POE finds application primarily in conjunction

with response surface methods (RSM), which you can obtain by upgrading your Design-Ease software to the more advanced Design-Expert package (contact Stat-Ease for a quote). However, if you have prior knowledge of the variation in your input factors, this data can be inputted to Design-Ease via the View, Column Info Sheet form (see example below).



Entering Data on Variability of Input Factors

You can leave the standard deviations for the responses at their default levels, entered automatically from previous statistical analysis. With this information on variation, the software can produce an effects plot of transmitted variation (accessible via View, Propagation of Error).



Propagation of Error Model Graph (3D Surface)

Look for factor settings that get your response on target with minimal POE. (The data shown above comes from a POE case study on a single-wafer plasma-etcher. Stat-Ease goes over all the details in its Robust Design, Tools for Reducing Variation workshop.)

The POE method involves application of partial derivatives to locate flat areas on the response surface, preferably high plateaus. For details on the mathematics, see "Robust Design - Reducing Transmitted Variation," a paper by Whitcomb and Anderson presented at the 50th Annual Quality Congress in 1996. (Contact Stat-Ease for a reprint.) For factorial models, POE only works when:

- Factors are numerical
- The model contains interaction terms.

Note that for linear responses (main effects only), Design-Ease will not allow you to select Propagation of Error, because the calculations yield a constant value. However, linear responses can be useful as adjustment factors to get your response back on target after you reduce transmitted variation. To learn more on how this works, attend the Robust Design, DOE Tools for Reducing Variation workshop. Call for details and schedule.

This completes the guided tour of advanced features. But don't stop exploring. You may find other handy features not deemed important enough to be included in this manual. You will find complete documentation at your fingertips via the Help system. You can then wander through the labyrinth of hypertext links to learn everything you want to know about Design-Ease but were afraid to ask. Enjoy!