Definitive Screening Design (DSD): Characteristics and Analysis Methods

DSD's require a more thoughtful approach to the analysis than is typical for other designs produced by Design-Expert® software. By including the word "screening" in the name of the design, it is implied that they would be limited to only finding factors with significant linear effects. Because they are built with three levels, of all the numeric factors, there are circumstances where a good approximation of the true response surface can be found.

The concept behind screening designs is that there are too many factors of interest to fit the complete polynomial model with a reasonable number of runs. A design capable of fitting a small subset of the terms, including all of the linear terms, of the complete polynomial is used to choose a few important factors for further study. Factors that are known to have important effects should not be part of a screening design as they would only serve to increase the number of runs required for the design without improving the knowledge of the true response surface.

Given the above, DSD's fit the requirements of a screening design. They have good properties for finding the significant linear effects, regardless of active second-order effects.

Significant linear effects are more readily identified with factorial screening designs (Resolution IV regular factorials, and Min Run Screening) because they have somewhat higher power for the linear model than a similarly sized DSD.

What separates the DSD's from factorial screening designs, and the reason they are on the response surface tab, is their ability to fit unaliased subsets of second-order model terms. The subsets can have no more than three factors active in the two-factor interactions and quadratic terms. When there are three or fewer active factors, the DSD can provide a shortcut to go directly from screening to finding optimized settings.

Design-Expert's default analysis starts with the full quadratic model and a recommendation to reduce the number of terms to an unaliased subset. This can be done either manually picking terms or by using the automatic selection algorithm. The problem with single model selection is there is no built in check to ensure that only three factors are active in the second-order effects. If there are more than three factors, then the aliasing present in DSD's may produce a meaningless model.

A more conservative model can be chosen from only the linear effects. Estimates of linear coefficients are unbiased by other linear or second-order effects. If the linear effects are significant they can be combined with the known factors (set aside before screening) and examined more thoroughly in the next phase of experimentation.

The safest approach when analyzing DSD's is to treat significant second-order effects as evidence to augment the design to fit the complete quadratic model. Click the Design Tools menu, select Augment Design, and then Augment to add the necessary runs.