

## ESD's: a Powerful Aid in Design & Analysis of Complex Experiments

Many experimenters believe that an experimental design can be selected from a book on experimental design (or even a computer menu!). However, most experimental-design texts, by necessity, show only a narrow slice of designs. In my experience, only a small fraction of experiments that experimenters would *like* to run, or statisticians would *like* to design, are in this slice. As a result, too many experimental designs are simply pigeon-holed to fit into a pre-existing list. Or sometimes, experimenters manage to create a good design but then find it difficult to analyze.

But there is a better way. A large class of experimental designs are balanced and complete—this includes most

- Simple and complex measurement-system studies
- Variance component studies
- Full factorials
- Many fractional factorials (with a simple trick)
- Standard and more complex split-plot, strip-plot, split-split-plot designs
- And much more.

This course offers a powerful method—Extended Structure Diagrams, or ESD's—that allows experimenters first to *visualize* any balanced and complete design and second to find the *natural corresponding ANOVA model*. With this model, insightful and in-depth analysis may be done. In addition, from past experience, I have found that thinking correctly about how to construct the appropriate ESD for complex designs is not as simple as one might believe. This course is designed to help.

Course topics include

- The basics of ESD
- ESD vs. other diagram methods
- The three basic structures of experimental designs
- From ESD's to models
- Math models vs. software models
- Some common designs illustrated by ESD's
- Variance components, including those of certain fixed effects
- More complex designs
- Illustrative examples
- Some demonstrations using Minitab® and other software.

Participants should have experience designing and analyzing experiments and be familiar with ANOVA.

Bring a laptop with Minitab to do some examples yourself—feel free to bring your data as well (complete and balanced!). Send to me ahead of time ([joseph.voelkel@rit.edu](mailto:joseph.voelkel@rit.edu)) if you want share it with the class.

A simpler version of this presentation was the highest-rated talk at a Six-Sigma conference several years ago.