Panel Discussion Points

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June 7, 2006

"Classical Designs *are* Optimal"

- All two-level fractional factorial designs are optimal by every variance criterion – given an appropriate model…
- Latin Square, BIBs etc. are also D-optimal for the additive model…
- If all the specific design requirements are absolutely standard, then use textbook designs.
- But…

Elegance vs. Practical Necessity

- Would you rather specify the number of runs you can do instead of having the sample size dictated to you?
- Do you ever need to avoid certain combinations of factor settings?
- Would you like to be able to augment a design without doubling the number of runs you have already done?
- Do you ever want to do response surface experiments with categorical factors?

“Alphabet Soup” Criticism

- Optimal designs are limiting because they focus on one number (D, A, I, G)
- “Good” designs need to have several desirable characteristics.

Box and Draper 14 Points

1. Generate satisfactory distribution of information.
2. Make unbiased predictions.
3. Detect lack of fit.
4. Allow transformations to be estimated.
5. Allow for blocking.
6. Allow for sequential design.
7. Provide and internal estimate of error.
8. Be robust to outliers and other violations of assumptions.

Box and Draper 14 Points (cont.)

9. Require a minimum number of experimental runs.
10. Provide simple data patterns.
11. Ensure simplicity of calculation.
12. Behave well when errors occur in the x settings.
13. Don’t use too many levels in the x settings
14. Provide a check on the constancy of variance assumption.

Conflicting Advice

9. Require a minimum number of experimental runs.

versus

7. Provide an internal estimate of error.

3. Detect of lack of fit.

14. Check constancy of variance assumption.

Alternative

Multi-criterion optimization.

Example: Model robust design

Li & Nachtsheim (2000) *Technometrics*

Matters of Style…

One size fits all.

versus

Build to suit.

My own style…

1. Learn as much as possible about the unique setting of each problem.
2. Ask questions to tease out constraints.
    1. Factor combination restrictions
    2. Block size restrictions
    3. Need to group runs to make fewer changes in some factors
    4. Budget
3. Rely on software to design and analyze a study that matches the requirements.

Summary

1. Classical designs are optimal.
2. Classical designs are *not* flexible.
3. Optimal designs *can* make principled trade-offs among competing objectives.
4. It is preferable to build a design to suit the problem rather than alter the problem to match a design *and this is possible given modern software*.

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