Optimum experiments with sets of treatment combinations: univariate or multivariate?

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The motivation is an experiment in deep-brain therapy in which each patient receives a set of eight distinct treatment combinations and provides a response to each. The experimental region contains sixteen different sets of eight treatments. With only six parameters in the linear model, it is unlikely that all sixteen points in the design region need to be included in the experiment. The structure of such experiments is initially elucidated in a response surface setting where each choice of an experimental setting provides a response at each of s distinct settings of the explanatory variables. An extension of the "General Equivalence Theorem" for D-optimum designs with multivariate responses is provided for experiments with sets of treatment combinations. This equivalence theorem is used to elucidate the structure of the optimum design for the experiment in deep-brain therapy. There are many possibilities, all with the same optimum properties.

In practice, patients arrive sequentially, each with an individual set of prognostic factors. Patient allocation should have a random component, to avoid selection bias. However, efficient estimation requires that the allocations be balanced over the distribution of the prognostic factors. These two requirements are in conflict. The talk will describe the application of some of the restricted randomization rules surveyed by [1] that seek a compromise between bias and information. An important measure of loss of information due to imbalances resulting from randomization is that introduced by [2]. Theory and simulation will be used to provide graphical illustration of the loss and bias of the various rules; these comparisons lead to the definition of an admissible rule.

References

[1] Atkinson, A. C. (2014). Selecting a biased-coin design. *Statistical Science* **29**, 144–163.

[2] Burman, C.-F. (1996). *On Sequential Treatment Allocations in Clinical Trials.* Department of Mathematics, Göteborg.