742 Project proposal

Literature review: The paper I chose for the project is “Tips for Analyzing Nonregular Fractional Factorial Experiments”. In this paper, the author illustrated several examples to analyze nonregular fractional factorial experiments. In the process of analysis, the author presented three different methods applied into the experiments that are Lenth’s method, forward selection with weak-effect heredity and simulated annealing model research (SAMS). The focus on this paper is analyzing strength-2 screening designs, strength-3 designs, strength-2 designs with n 2k and all-subset regression model. The purpose of this paper is to find out some useful interactions with increasing the number of runs of designs if possible rather than double the number of factors.

Research plan: In this project, the primary purpose will focus on evaluating the results of experiments shown in this paper and investigate further on the research. The main parts will be included as following:

1)Reproducing the strength-2 screening designs, strength-3 screening designs and strength-2 designs with n2k with three methods applied in this paper implemented by JMP.

* For the first design, it will be constructed with 19 factors in 20-run Plackett-Burman experiment. First analysis will be focused on Lenth’s method for a main effects model where factors 1, 2, 4, 6 and 11 are active. Second analysis with forward selection is conducted by a supersaturated model. The third method simulated annealing model search (SAMS) is a procedure that fits many models by specifying the maximum size models. Here, the maximum size model includes eight terms. In this analysis, it turns out that there is confusion between x1\*x4 and main effect x6.
* In the second design Bell et al.’s credit-card-offer experiment, there are also 19 factors in 20 runs. Lenth’s method identifies five main effects x2, x3, x11, x12 and x14 in the model. The forward selection includes the interaction x2\*x14 rather than x3 main effect. And there are some confusions in this analysis. SAMS prefers to replace x11 main effect with x2\*x15 interaction.
* In Yi et al.’s computer-architecture experiment, the 88-run 41-factor design is evaluated as the smallest strength-3 design for k=41, a foldover of the 44-run PB design. The Lenth’s method identifies 11 main effects (6,7,12,13,14,24,27,29,30,33,40) that are active. JMP added all 36 two-factor interactions and 7 more involving x27 for 43 degrees of freedom in this OA(88, 241, 3). There are three interactions 12\*24, 6\*7, 12\*29 are important. For the implement of forward selection, there are two stages illustrated by Lenth’s method and forward selection. The first stage gives the main effects and the second stage distinguishes the interactions. SAMS has different conclusion that contains only main effects.
* In TNO’s mirror-polishing experiment, it contains 13 factors in 48-run design that is not a foldover design. All 47 degrees of freedom are utilized by the implementation of JMP’s Modeling Screening of Lenth’s method, which identifies six main effects (B, D, E, G, I, A) and three interactions (A\*D, G\*I, B\*E). Forward selection approach found out four mian effects (B, G, I, A) and three interactions (A\*D, G\*I, B\*E). SAMS produced a maximum size model with 18 terms, which has the same model as was chosen by forward selection.
* For a 7-factor, 24-run design, two known models are discussed in this section. For this first model, Lenth’s method identifies the main effect A; forward selection approach identifies A and interaction AB; SAMS also suggests A and AB should be included. For the second model, JMP’s Modeling Screening found out B I is involved in every simulation; forward selection identifies the B and B\*C; SAMS found out C and B\*C could be included in the model.

2) Simulating ¾ nonregular fractional factorial design obtained from algorithm based on optimal criterion.

* Using exchange algorithm to find out ¾ fraction run size of the designs described above respectively, based on the optimal criterions.
* Applying three approaches Lenth’s method, forward selection and SAMS to identify active main effects and/or interactions of ¾ fraction designs according to R2, RMSE, p-value and PSE et al.

3) Comparing the results in the two different type design in terms of active terms in the models.

* Firstly, the simulation results could be compared with the basic statistics mentioned above to the original designs in this paper.
* Generalized word length pattern and minimum aberration are widely used in the nonregular designs.
* Using stepwise regression to fit a model for estimating interactions would be alternative way.

4) The new criteria minimum moment aberration proposed by Xu (2003) for nonregular designs and supersaturated designs could be used here.

* Xu (2003) proposed minimum moment aberration for assessing the nonregular designs and supersaturated designs by minimizing the power moments of the number of coincidences sequentially. In this project, I would also want to explore the minimum moment aberration to evaluate the ¾ fraction nonregular designs.

References:

Xu, H. (2003). MINIMUM MOMENT ABERRATION FOR NONREGULAR DESIGNS AND SUPERSATURATED DESIGNS. Statistica Sinica, 13(3), 691-708.