Section 1

MANE 6313

Subsection 1

Week 10, Module A

Student Learning Outcome

- Select an appropriate experimental design with one or more factors,
- Select an appropriate model with one or more factors,
- Evaluate statistical analyses of experimental designs,
- Assess the model adequacy of any experimental design, and
- Interpret model results.

Module Learning Outcome

Describe fractional factorial designs, generators, defining relation and aliasing schemes for a one-half fraction.

Fractional Factorial Designs

- As the number of factors grows in a 2^k experiment, the number of runs often exceeds our ability to conduct the experiments. e.g. 2^6 experiment requires 64 runs.
- Often we are only interested in a few effects. E.g. in the 2^6 experiment, there are 6 main effects and 15 two-factor interactions. The remaining 42 degrees of freedom are associated with three-factor or higher interactions.
- Often we can get the information we need by running only a fraction of the factorial experiment
- Fractional factorials are often used as *screening experiments*.

Key Ideas for Fractional Factorial Experiments

- *The sparsity of effects principle.* The system or process is likely to be primarily driven by some of the main effects and low-order interactions.
- *The projection property.* When we identify unimportant variables and remove them from the model, the resulting model is stronger (larger) designs.
- *Sequential Experimentation.* It is possible to combine the runs of two (or more) fractional factorials to assemble sequentially a larger design to estimate the factor effects and interactions of interest.

The one-half fraction of a 2^k design

- This design results in a 2^{k-1} experiment, a half-fraction.
- You must select an effect to generate the two fractions. This effect is called the generator. E.g. in a 2^3 design select ABC as the *generator*. The other fraction is $-ABC$.
- We always associate I with the positive fraction. Thus, $I = ABC$ and we call this quantity the *defining relation* for the fractional factorial experiment.
- The fraction containing the positive generator is called the *principal fraction*. The other fraction is called the alternate or complementary fraction.

Fraction Generators

- The defining relationship can also to generate the fractions
- One-half fraction of a 3 factor design
  - Defining relation is $I=ABC$
  - First fraction generator: $C=AB$
  - Second fraction generator: $C=-AB$

2^(3-1) Example

Aliasing Scheme from Principal Fraction

Aliasing Scheme from the Complementary Fraction

Combining Aliasing Schemes