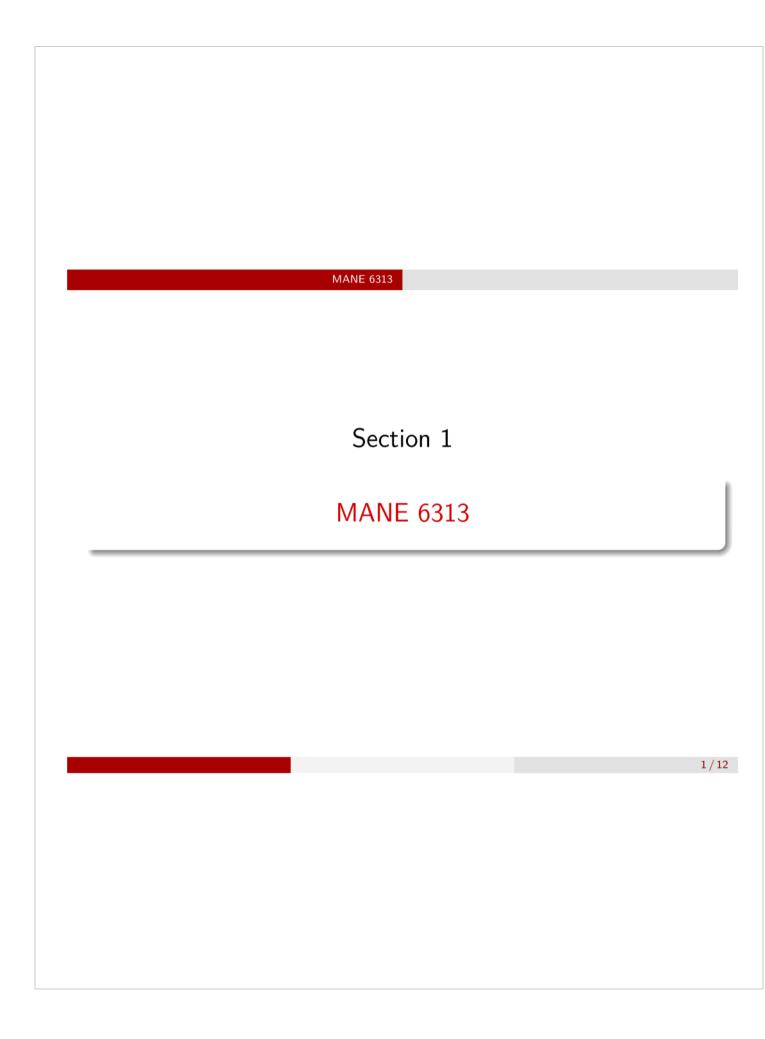
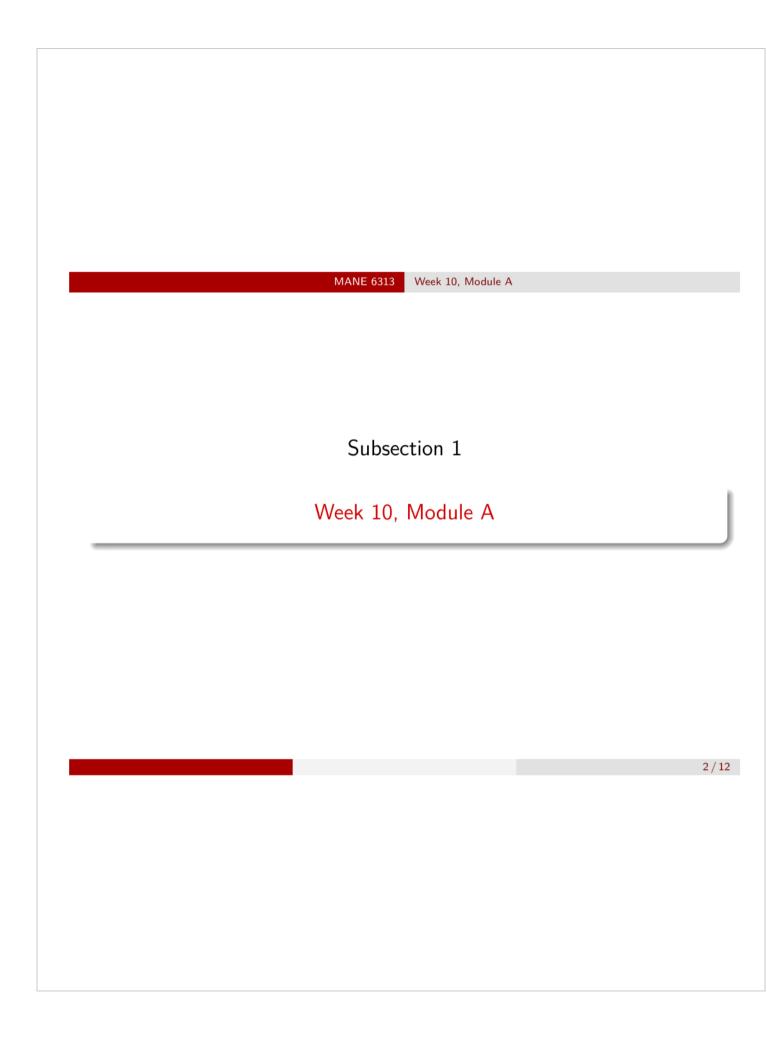
Printout

Friday, March 17, 2023

12:58 PM



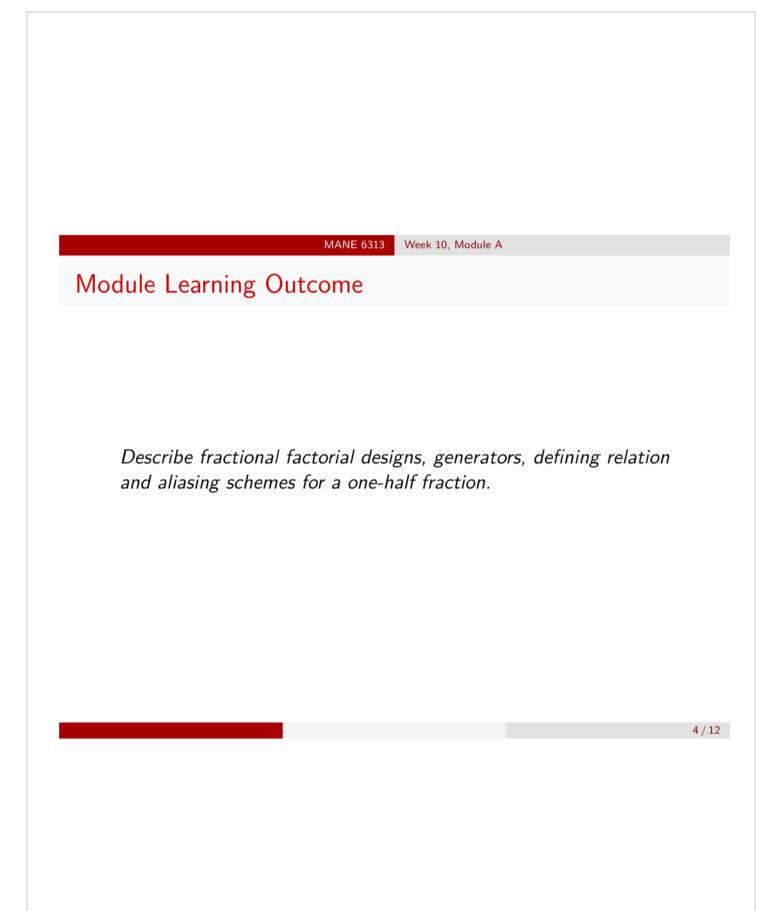


MANE 6313

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.



Fractional Factorial Designs

- As the number of factors grows in a 2^k experiment, the number of rung 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 2⁶ 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.

Week 10, Module A

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.

6 / 12

Le (aution)

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 <u>defining relation</u> 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



MANE 6313

Week 10, Module A

2⁽³⁻¹⁾ Example

$$\frac{A}{A} \frac{B}{A} \frac{C=-AB}{-AB} \frac{4r^{+}}{AC}$$

$$\frac{A}{A} \frac{B}{A} \frac{C=-AB}{-AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac{B}{A} \frac{AC}{AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac{B}{A} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac{B}{A} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB} \frac{AC}{AB}$$

$$\frac{A}{A} \frac$$

Aliasing Scheme from Principal Fraction

LBC:
$$BC = A$$

$$C = AB$$

$$C = A$$

MANE 6313

Week 10, Module A

 $0'_{A}$: $A(I) = -ABD = 7 A = -A^{2}BC = 7 A = -BC$ $0'_{B}$: B(I = -ABC) = 7 B = -AC $0'_{C}$: C(I = -ABC) = 7 C = -AB

Combining Aliasing Schemes

$$\frac{QA + Q'A}{2} = \frac{(A+BC) + (A-BC)}{2} = \frac{2A + 6}{2} = A$$

$$\frac{QA - Q'A}{2} = \frac{(A+BC) - (A-BC)}{2} = \frac{26C}{2} = BC$$