PART 4: DoE

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TMA4267

Fractional factorial designs (cont.)

we focus on 2^k design

not all possible experiments are performed – but a fraction $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \dots$

$$2^{k-p}_{\text{resolution}: \{III, IV, V, \dots\}}$$

p fraction: $\{1, \dots, k-1\}$

Ex: reactor data

$I = ABCDE$ defining relation ← we do row 2, 3, 5, ..., 32

$2^4 \rightarrow E = ABCD$ generator ←

Either think to start with full factorial in A,B,C,D and then add E = ABCD, or just do the runs with ABCDE = 1 = I.

Resolution: V

Alias: $A \cdot I = BCDE$
$B \cdot I = ACDE$

$AB \cdot I = AB \cdot ABCDE = CDE$

$\vdots$

→ see R-code L20.R

Interpretation of confounding

1) $y = 70 + 4z_1 + 10z_2 + 1z_3 + 2z_{12} + 3z_{23} + 2z_{123}$

2) $C = AB$, $A = BC$, $B = AC$, $ABC = I$

3) $y = 72 + 7z_1 + 11z_2 + 3z_3$

4) $$\left.\begin{array}{ll} \hat{A} = 2 \cdot \hat{\beta}_1 = 2 \cdot 7 & \Rightarrow \hat{\beta}_1 = 7 \\ \hat{BC} = 14 & \Rightarrow \hat{\beta}_{23} = 7 \end{array}\right\} \text{but really } \hat{A} = 8,\ \hat{BC} = 6$$

We think we estimate A, but really estimate

$$\hat{A} + \hat{BC} = 14.$$

Finally: bicycle example

Have 7 factors and perform 8 experiments $\Rightarrow$ 2^{7-4} design. Think: full factorial in A, B, C and add generators

$D =$
$E =$
$F =$
$G =$

see L20.R for R-code.