HW8 STAT512 Fall2014

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1. Problem 3

(a) The generating relation for the desing used is

$$I = +ABC = -ADE (= -BCDE)$$

(b) The estimable strings for the experiment are

$$\begin{aligned} &A + BDE + ABCE + CD \\ &B + ADE + CE + ABCD \\ &C + ABCDE + BE + AD \\ &D + ABE + BCDE + AC \\ &E + ABD + BC + ACDE \\ &AB + DE + ACE + BCD \\ &BD + AE + CDE + ABC \end{aligned}$$

```
library(xtable)
## data
X <-as.data.frame( matrix(c(-1, -1, -1, 1, 1,
              1, -1, -1, -1, 1,
              -1, 1, -1, 1, -1,
              1, 1, -1, -1, -1,
              -1, -1, 1, -1, -1,
              1, -1, 1, 1, -1,
              -1, 1, 1, -1, 1,
              1, 1, 1, 1, 1),
            byrow = T, ncol = 5))

colnames(X) <- c("A", "B", "C", "D", "E")
# Calculate estimates of the five strings that
# include main effects for the strains A
data <- cbind(X, y = c(0,2.9,2.44,3.35,
                       3.35,2.14,2.6,1.3))
```

```r
xtable(summary(lm(y ~ A+B+C+D+E, data = data))$coef,
       caption = "Calculate estimates of the
       five strings that
       include main effects
       for the strains B.")
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	2.26	0.25	9.08	0.01
A	0.16	0.25	0.65	0.58
B	0.16	0.25	0.65	0.58
C	0.09	0.25	0.35	0.76
D	-0.79	0.25	-3.17	0.09
E	-0.56	0.25	-2.25	0.15

Table 1: Calculate estimates of the five strings that include main effects for the strains B.

```r
# Calculate estimates of the five strings that
# include main effects for the strains B

datb <- cbind(X, y = c(2.44, 5.05, 4.1, 7.03,
                       5.28, 3.95, 4.82, 2.74))
xtable(summary(lm(y ~ A+B+C+D+E, data = datb))$coef,
       caption = "Calculate estimates of the
       five strings that
       include main effects
       for the strains B.")
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	4.43	0.10	43.43	0.00
A	0.27	0.10	2.61	0.12
B	0.25	0.10	2.42	0.14
C	-0.23	0.10	-2.24	0.15
D	-1.12	0.10	-10.98	0.01
E	-0.66	0.10	-6.51	0.02

Table 2: Calculate estimates of the five strings that include main effects for the strains B.

From those results, it seems that main effects D and E are significant for response B. For response A, only D is significant (if the significant level is .1).

(c) From the part b) if consider response A: only effect D is significant. Hence, I would recommend the next 2^{5-2} fraction is

$$I = -ABDE = BCE = -ACD$$

so that this combine with the other fraction $I = ABDE = BDE = ACD$ will imply a 2^{5-1} fraction $I = BCE$, which contain no effects involving D. As a result, the aliases of the main effect for D is $D = BCDE$ which is a four-factor interaction.

On the other hand, if consider response B: effect D and E are significant. Hence, I would recommend the next 2^{5-2} fraction is

$$I = +ABDE = -BCE = -ACD$$

so that this combine with the other fraction $I = ABDE = BDE = ACD$ will imply a 2^{5-1} fraction $I = ABDE$, which contain no effects involving D. As a result, the aliases of the main effect for D is $D = ABE$, for C is $C = ABD$ which are a three-factor interaction.

2. Problem 5

(a) The number of parameter in this case is : 1(intercept) + 8 (main effects) + 28 (two-factor interactions) = 37. Since this is a regular fractional factorial design, the number of treatment is at least 2^6 =64 which is the smallest power of 2 larger than 37.

(b) Suppose the 8 factors are A, B, C, D, E, F, G, H. then a generating relation that cab be used to construct a resolution V fraction of this size is

$$I = +ABCDE = +ABFGH(= +CDEFGH).$$

The liased string of main effects, for example A, do not contain 2-factor interaction:

$$A = +BCDE = +BFGH(= +ACDEFGH).$$

Similarly, the strings of 2-factor interactions do not contain any main effects or intercept. Therefore, intercept, main effects, and 2-factor interactions are estimable.

3. Problem 8

$$I = +ABC = +DEF(= +ABCDEF)$$