

HW8 STAT512 Fall2014

Yet Nguyen

November 12, 2014

1. Problem 3

- (a) The generating relation for the desing used is

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

- (b) The estimable strings for the experiment are

$$A + BDE + ABCE + CD$$

$$B + ADE + CE + ABCD$$

$$C + ABCDE + BE + AD$$

$$D + ABE + BCDE + AC$$

$$E + ABD + BC + ACDE$$

$$AB + DE + ACE + BCD$$

$$BD + AE + CDE + ABC$$

```
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))
```

```
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.

```
# 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 fractional factorial design of resolution V allows estimation of all parameters in a model containing an intercept, main effects, and two factor interaction. Therefore the number of treatment included in the design must be at least as large as the number of parameter in this model. Using this information to:

- (a) Find a lower bound of the number of treatment in a regular fractional factorial of resolution V for 8 factors
- (b) Find a generating relation that can be used to construct a resolution V fraction of this size.

3. Problem 8

It discussed the use of product arrays in industrial experiments. An example of a product array in six factors can be constructed by generating the 3-factor fraction associated with $I = +ABC$ and the 3-factors associated with $I = +DEF$ and constructing the 16 treatment design comprised of every combination of the four treatment in a regular fractional factorial design in all 6 factors. What is the generating relation of this product array design?