HW6 STAT512 Fall2014

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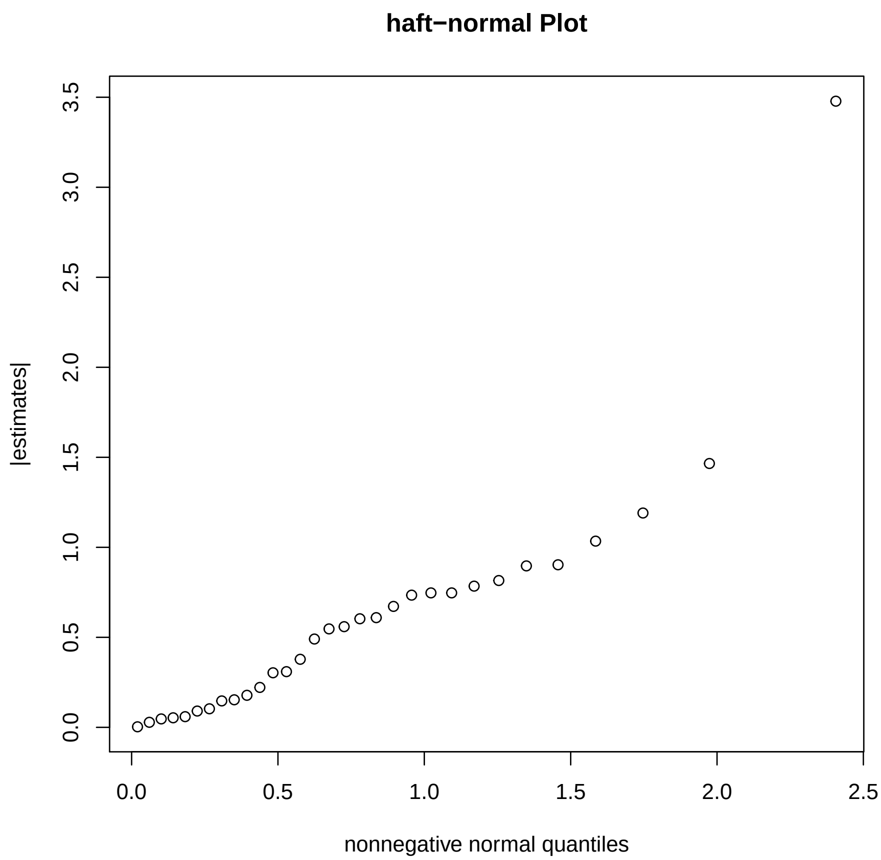
1.

```
setwd("~/Desktop/tk512/hw6")
dat <- read.table("HW6_data_2014.txt")
dat[,1:5][dat[,1:5]==1] <- -1
dat[,1:5][dat[,1:5]==2] <- 1
coef <- summary(lm(V6~V1*V2*V3*V4*V5, data = dat))$coef[,1]
sort.coef <- abs(coef[order(abs(coef))])
sort.coef
```

```
##          V3:V4          V2:V3       V1:V2:V5       V1:V4:V5
##       0.003125       0.028125       0.046875       0.053125
##          V4:V5       V2:V3:V4          V1:V4    V1:V2:V4:V5
##       0.059375       0.090625       0.103125       0.146875
##             V1          V2:V5          V2:V4       V2:V4:V5
##       0.153125       0.178125       0.221875       0.303125
##             V3    V1:V2:V3:V4       V2:V3:V5             V4
##       0.309375       0.378125       0.490625       0.546875
##    V1:V3:V4:V5       V1:V3:V4          V1:V3 V1:V2:V3:V4:V5
##       0.559375       0.603125       0.609375       0.671875
##       V1:V2:V4          V1:V5       V3:V4:V5       V1:V2:V3
##       0.734375       0.746875       0.746875       0.784375
##    V1:V2:V3:V5    V2:V3:V4:V5       V1:V3:V5             V5
##       0.815625       0.896875       0.903125       1.034375
##          V1:V2          V3:V5             V2    (Intercept)
##       1.190625       1.465625       3.478125      75.321875
```

```
n <- 31
p <- 1/2+ (1:n-1/2)/(2*n)
q <- qnorm(p)
plot(q, sort.coef[-32], main = "haft-normal Plot",
     xlab = "nonnegative normal quantiles",
     ylab = "|estimates|")
```



Based on the plot, I think the factorial effects are non-zero are V2, V3:V5.

2.

```
B <- sort.coef[-32]
# initial robust estimate of sigma/N
s0 <- 1.5*median(B)
# Let Bs be the subset of B less than 2.5 * s0
Bs <- B[B<=2.5*s0]
# compute the pseudo standard error
PSE <- 1.5 * median(Bs)
PSE

## [1] 0.7781

# which coeficients greater  than t*PSE
```

```
t <- 1.8
which(B>=t*PSE)

## V3:V5    V2
##    30    31
```

3.

If V2 and V3:V5 are included in the model, then

- to sastify the hierachy principle, we need to include factors V3, V5.
- to sastify the heredity principle, we need to include either V3 or V5.

4.

```
N <- 64
SSE <- 1000
s2.p <- SSE/32
# The value of actual standard error against which each factorial effect estimat should be c
sigma <- sqrt(s2.p/N)
sigma

## [1] 0.6988
```

5.

```
theta2 <- coef[-c(1:16)]
theta2

##       V1:V2:V3       V1:V2:V4       V1:V3:V4       V2:V3:V4
##        0.78438       -0.73438       -0.60313       -0.09063
##       V1:V2:V5       V1:V3:V5       V2:V3:V5       V1:V4:V5
##       -0.04687       -0.90312       -0.49062        0.05312
##       V2:V4:V5       V3:V4:V5    V1:V2:V3:V4    V1:V2:V3:V5
##        0.30312        0.74687        0.37813        0.81562
##    V1:V2:V4:V5    V1:V3:V4:V5    V2:V3:V4:V5 V1:V2:V3:V4:V5
##        0.14688       -0.55937       -0.89687        0.67187

r <- 2
f <- 5
```

```
SST <- r*2^f*as.vector(t(theta2)%*%theta2)
## Degree of freedom of the numerator
p2 <- length(theta2)
p2

## [1] 16

## Degree of freedom of the denominator
p1 <- 2^f*(r-1)
p1

## [1] 32

## F test value
Ftest <- (SST/p2)/sigma^2

Ftest

## [1] 46.17

## pvalue of the test
1 - pf(Ftest, p2, p1)

## [1] 0
```

6.

This is a nested-design or split-split-split plot design.

- The largest plot (whole plot) factor is NaOH, denoted as factor "A" with $a = 2$ levels, number of the replicates is $r = 2$. Hence, degree freedom for construct a standard error for A main effect is $a(r-1) = 2$.
- The next largest plot (split plot) factor is Na2SO3, denoted as "B", with $b = 2$ levels. Hence, degree freedom for construct a standard error for A main effect is

$$(abr-1)-(ar-1)-(b-1)-(a-1)(b-1) = a(b-1)(r-1) = 2.$$

- The next largest plot (split-split plot) factor is dispersant, denoted as "C", with $c = 2$ levels. Hence, degree freedom for construct a standard error for C main effect is

$$\begin{aligned}(abcr-1)-&(abr-1)-(c-1)-(c-1)(a-1)\\ &-(c-1)(b-1)-(a-1)(b-1)(c-1)\\ &= abr(c-1)-(c-1)ab\\ &= ab(c-1)(r-1) = 4.\end{aligned}$$

- The last plot (split-split-split plot) factos are pressuare and time, denoted as "D", "E" with levels $d = e = 2$. Hence, degree freedom for construct a standard error for D, E main effects is

$$
\begin{aligned}
(abcder - 1) - (abcr - 1) &- (d-1) - (e-1) - (d-1)(e-1) \\
&- (d-1)[(a-1) + (b-1) + (c-1)] \\
&- (d-1)[(a-1)(b-1) + (a-1)(c-1) + (b-1)(c-1)] \\
&- (d-1)(a-1)(b-1)(c-1) \\
&- (e-1)[(a-1) + (b-1) + (c-1)] \\
&- (e-1)[(a-1)(b-1) + (a-1)(c-1) + (b-1)(c-1)] \\
&- (e-1)(a-1)(b-1)(c-1) \\
&- (d-1)(e-1)[(a-1) + (b-1) + (c-1)] \\
&- (d-1)(e-1)[(a-1)(b-1) + (b-1)(c-1) + (c-1)(a-1)] \\
&- (d-1)(e-1)(a-1)(b-1)(c-1) \\
&= abcr(de-1) - abc(de-1) \\
&= abc(de-1)(r-1) \\
&= 2*2*2*(2*2-1)*(2-1) = 24.
\end{aligned}
$$