Homework 6

I found this half-normal quantile plot written by professor TODO

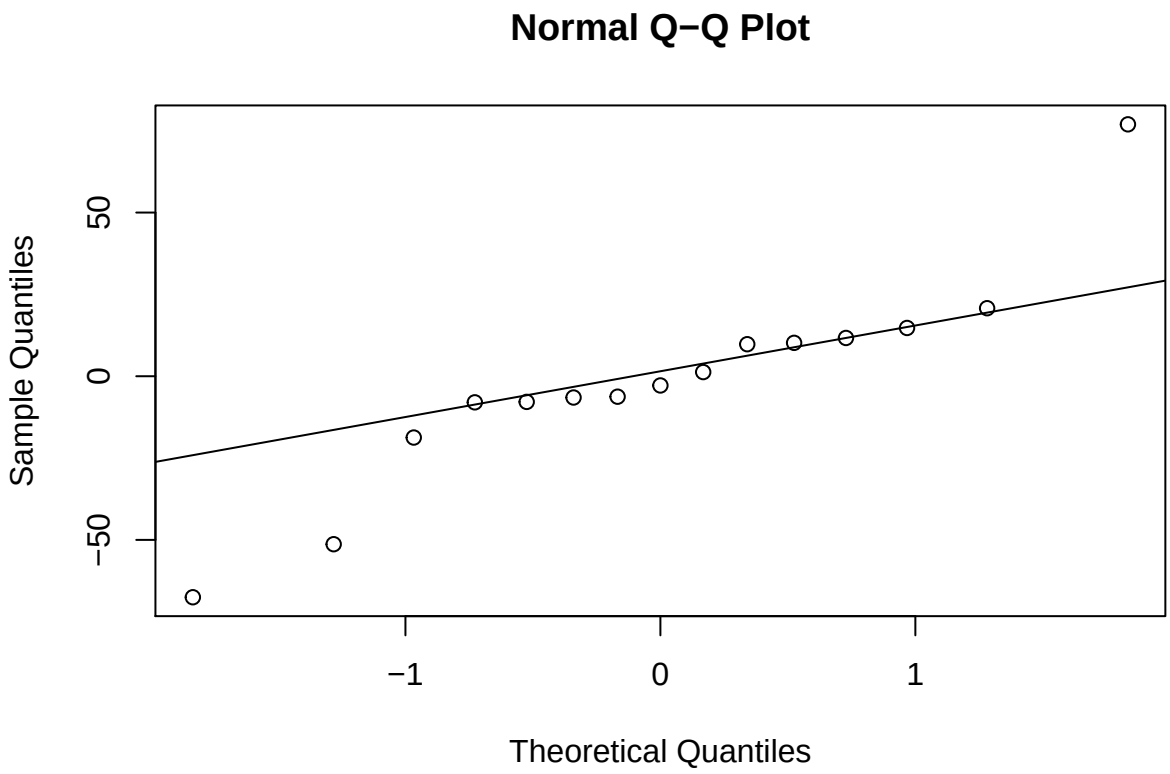
```
halfnormalplot <- function(y, label=F, n=length(y), fac.names=NULL,
                           xlim=c(-.1, 2.5), main="Half-Normal Plot",
                           ...)
  { # label the most singificant n effects
    m <- length(y)
    x <- seq(0.5+0.25/m, 1.0-0.25/m, by=0.5/m)
    x <-  qnorm(x)
    y <-  sort(abs(y))
    qqplot(x, y, xlab="half-normal quantiles", ylab="absolute effects",
           xlim=xlim, main=main, ...)
    if(is.null(fac.names)) fac.names <-  names(y)
    else fac.names <-  rev( c(fac.names, rep("", length(y)-length(fac.names)) ) )
    if(label) for(i in (m-n+1):m) text(x[i]+.2,y[i], fac.names[i])
  }
```

6.17

```
effects <- c("A","B","C","D","AB","AC","AD","BC",
             "BD","CD","ABC","ABD","ACD","BCD","ABCD")
values <- c(76.95,-67.52,-7.84,-18.73,-51.32,
            11.69,9.78,20.78,14.74,1.27,-2.82,
            -6.5,10.2,-7.98,-6.25)
df1 <- data.frame(effects, values)
```

a

```
qqnorm(df1$values)
qqline(df1$values)
```



b

The effects A, B, and AB are significant according to the Normal QQ plot. Therefore a model could include these effects only.

6.24

```
A <- c("3rd","3rd","1st","1st","3rd","3rd","1st",
       "1st","3rd","3rd","1st","1st","3rd","3rd",
       "1st","1st")

B <- c("BW","BW","BW","BW","Color","Color","Color",
       "Color","BW","BW","BW","BW","Color","Color",
       "Color","Color")

C <- c(19.95,19.95,19.95,19.95,19.95,19.95,19.95,
       19.95,24.95,24.95,24.95,24.95,24.95,24.95,
       24.95,24.95)
C <- as.factor(C)

Number_of_Orders <- c(50,54,44,42,46,48,42,43,49,
                      46,48,45,47,48,56,54)
```

```r
df2 <- data.frame(A, B, C, Number_of_Orders)

options(contrasts=c("contr.sum","contr.poly"))
```

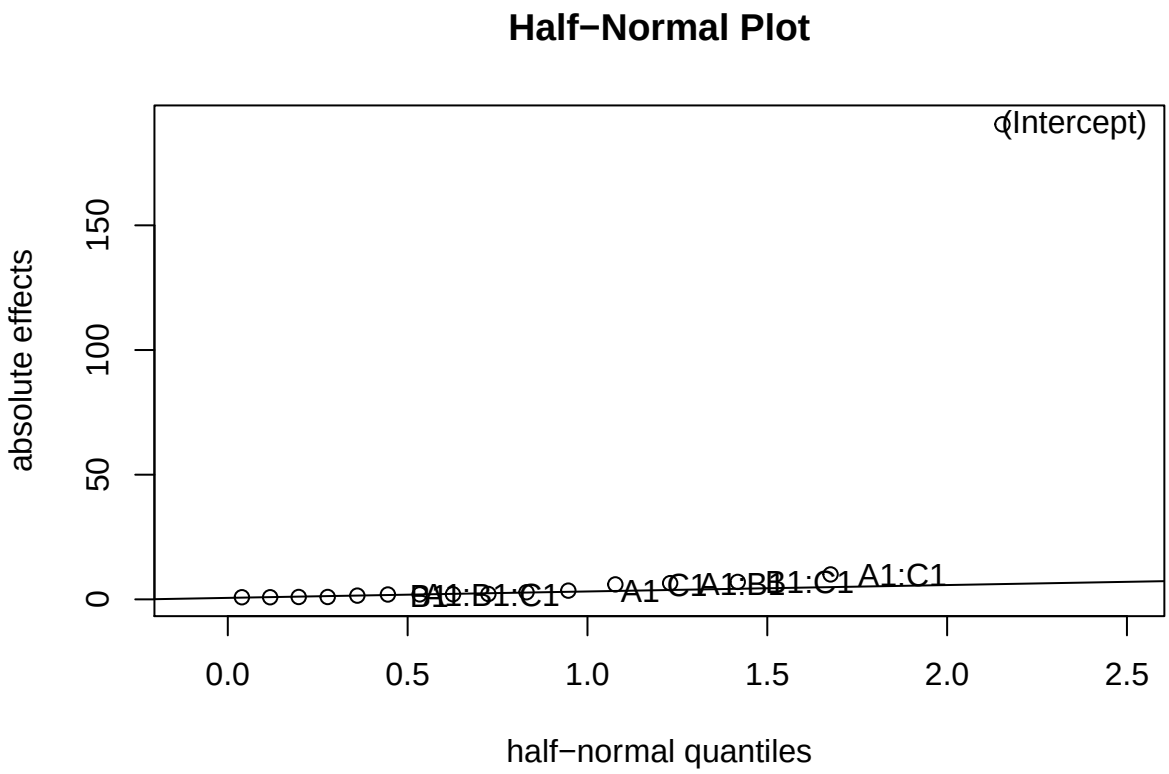
a

The factors which are significant are C, AB, AC, BC with p-values: 0.0085163, 0.0056019, 0.0004176, and 0.0037282 respectively.

```r
m1 <- lm(Number_of_Orders ~ A*B*C,df2)
anova(m1)
```

```
## Analysis of Variance Table
##
## Response: Number_of_Orders
##           Df Sum Sq Mean Sq F value    Pr(>F)
## A          1  12.25   12.25  4.0833 0.0779708 .
## B          1   2.25    2.25  0.7500 0.4116944
## C          1  36.00   36.00 12.0000 0.0085163 **
## A:B        1  42.25   42.25 14.0833 0.0056019 **
## A:C        1 100.00  100.00 33.3333 0.0004176 ***
## B:C        1  49.00   49.00 16.3333 0.0037282 **
## A:B:C      1   4.00    4.00  1.3333 0.2815369
## Residuals  8  24.00    3.00
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

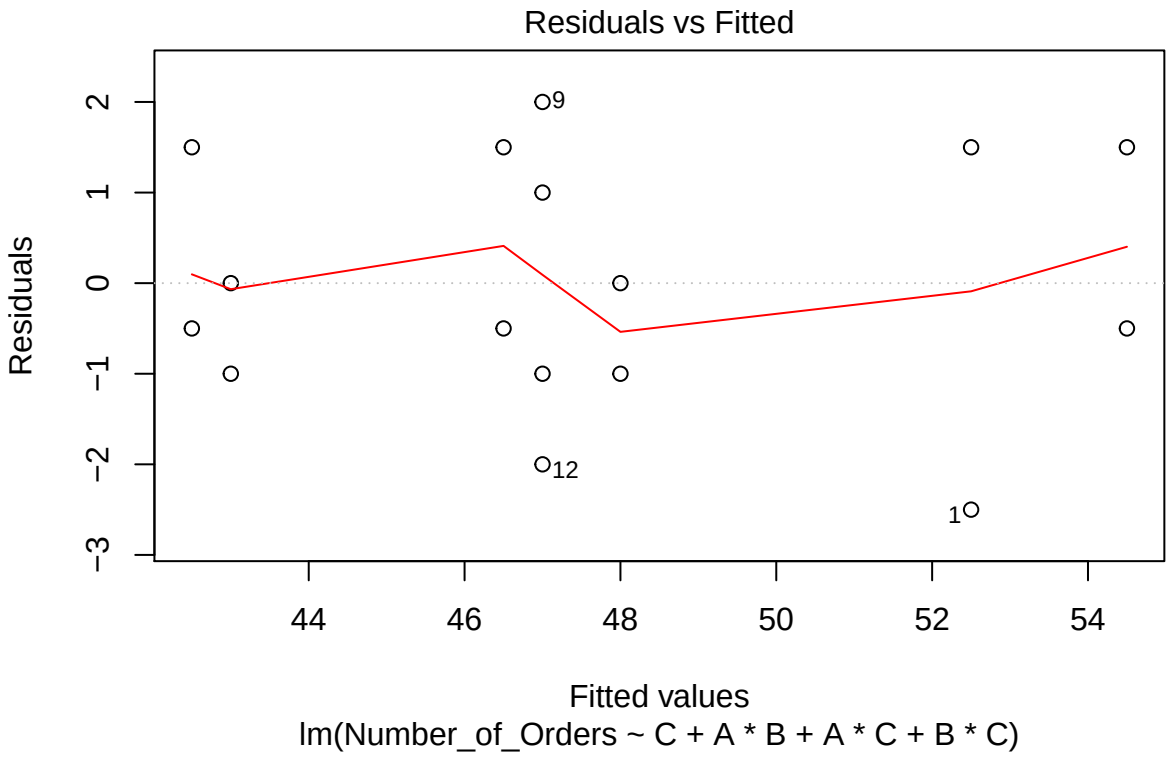
```r
#par(mfrow=c(2,2))
halfnormalplot(m1$effects,label=T)
qqline(m1$effects)
```

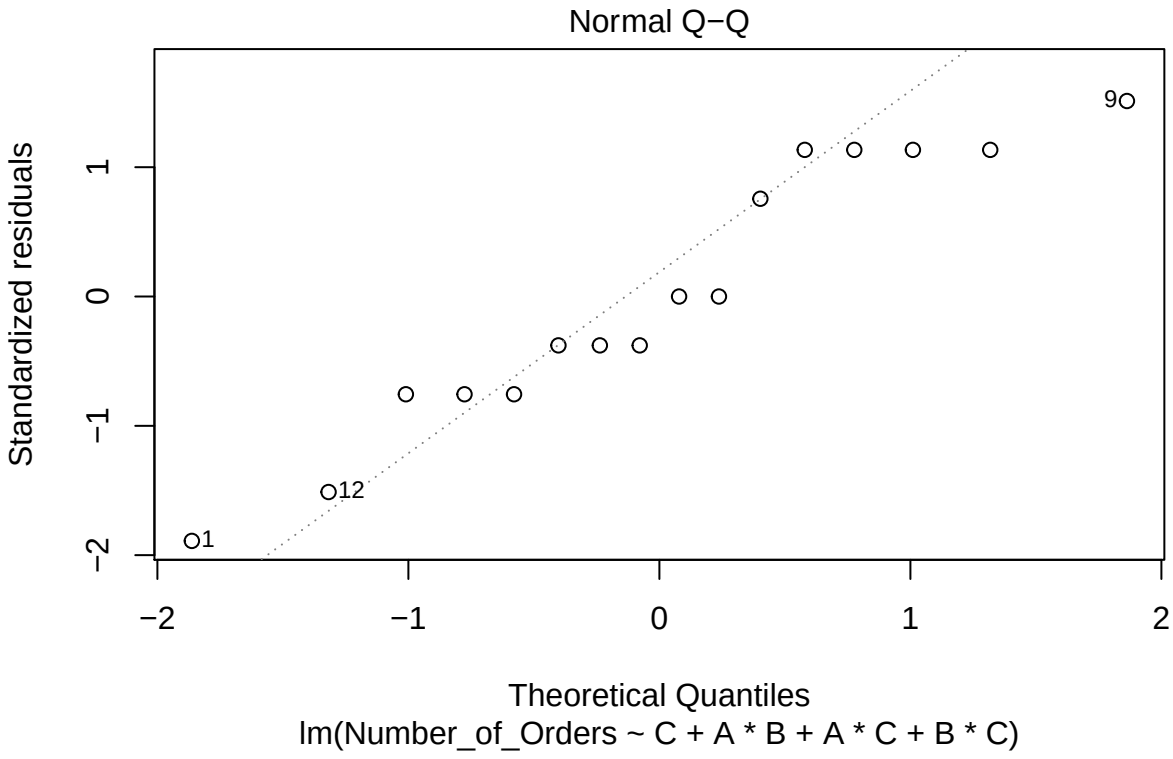


b

The Residual plot does not show any indication of non-constant variance. The normal Q-Q plot shows that the residuals are not following the normal distribution.

```
#par(mfrow=c(2,2))
m2 <- lm(Number_of_Orders ~ C + A*B + A*C + B*C,df2)
plot(m2,1:2)
```

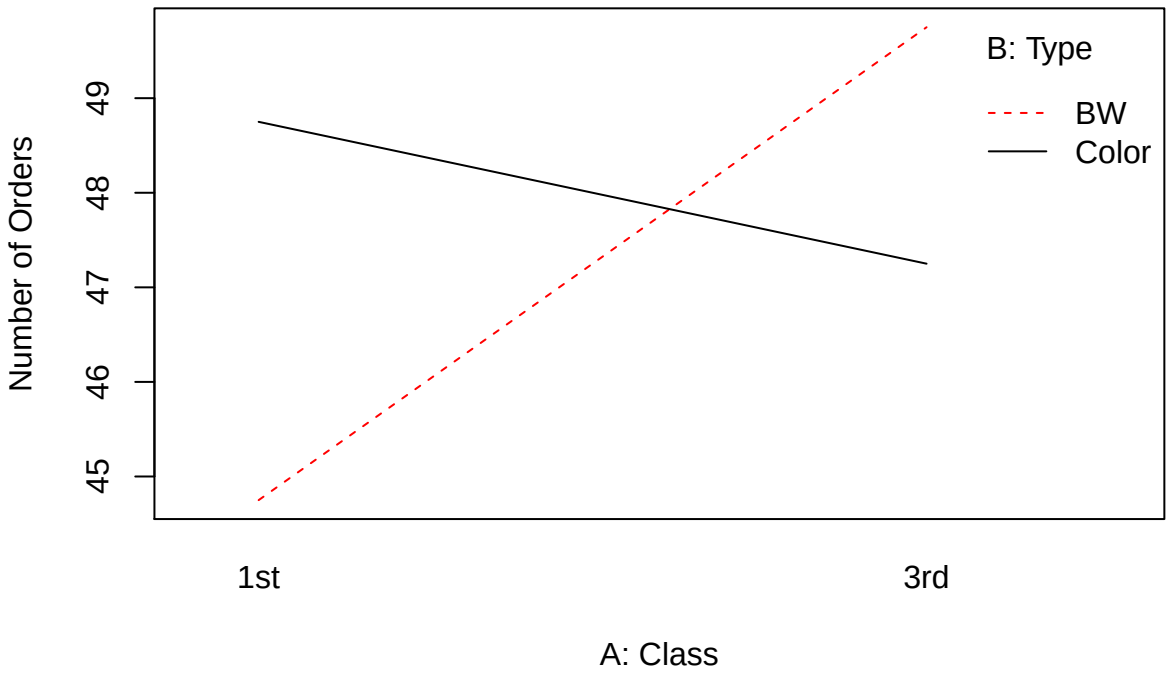

Residuals vs Fitted
Residuals
Fitted values
lm(Number_of_Orders ~ C + A * B + A * C + B * C)
9
12
1
44
46
48
50
52
54
−3
−2
−1
0
1
2


Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(Number_of_Orders ~ C + A * B + A * C + B * C)
9
12
1
−2
−1
0
1
2

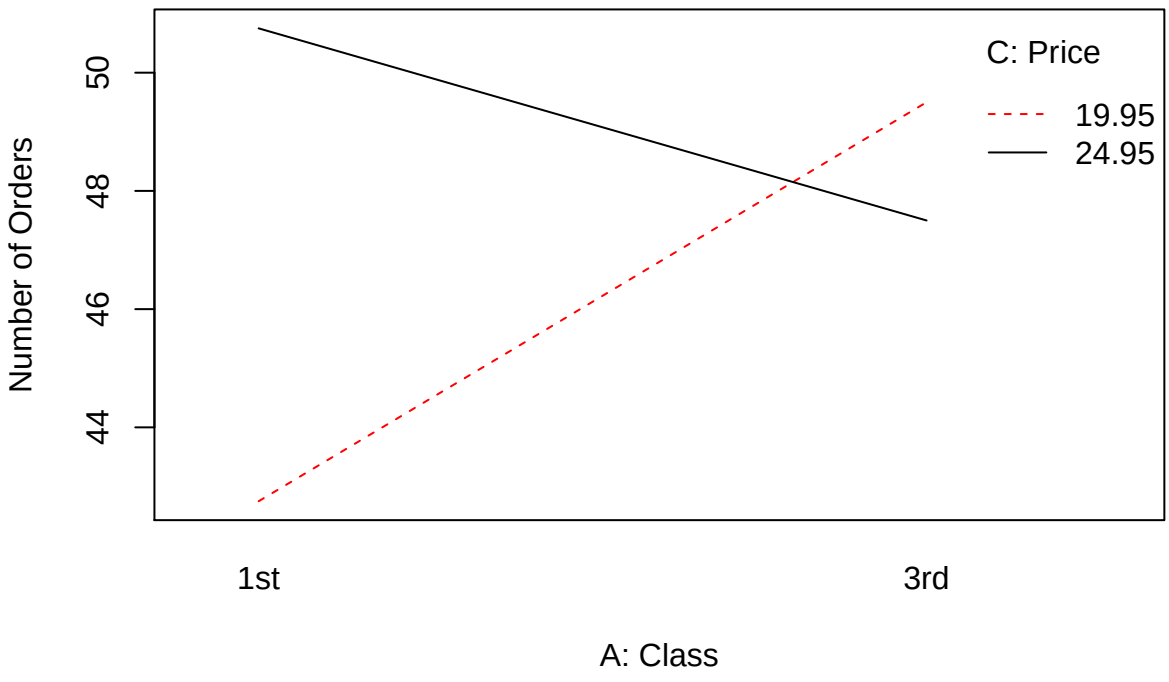
c

According to the interaction plots, I recommend 3^{rd} class mail with black and white brochures, and a price of \$19.95 this would create the highest number of orders.

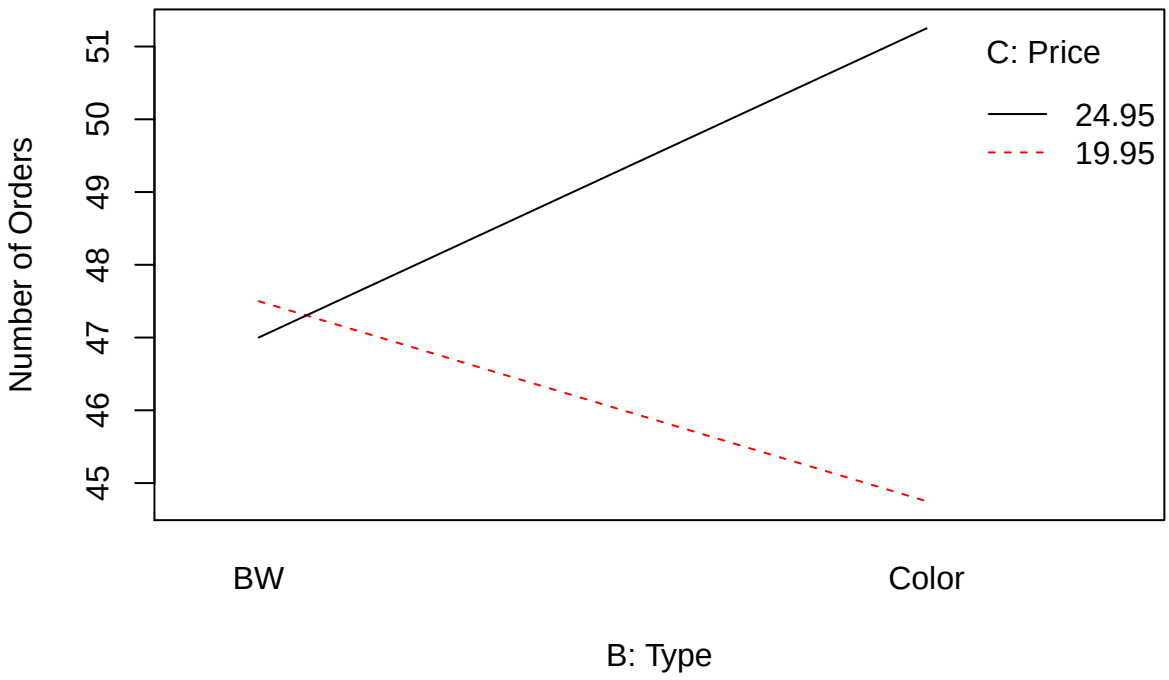
```
#par(mfrow=c(2,2))
interaction.plot(df2$A,df2$B,df2$Number_of_Orders,
                 xlab = "A: Class", ylab="Number of Orders",
                 trace.label = "B: Type",col=c("red", "black"))
```




```
interaction.plot(df2$A,df2$C,df2$Number_of_Orders,
                 xlab = "A: Class", ylab="Number of Orders",
                 trace.label = "C: Price",col=c("red", "black"))
```




```
interaction.plot(df2$B,df2$C,df2$Number_of_Orders,
                 xlab = "B: Type", ylab="Number of Orders",
                 trace.label = "C: Price",col=c("red", "black"))
```



6.30

```
library(readxl)
df3 <-  read_excel("/Users/Earle/Downloads/Test_book_prob.xlsx")
```

a)

b)

6.35

6.45

7.14