Stat 207 HW4

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1 27.6

(a)
```
require("lme4")

## Loading required package:  lme4

## Warning:  package 'lme4' was built under R version 3.1.2

## Loading required package:  Matrix

## Warning:  package 'Matrix' was built under R version 3.1.2

## Loading required package:  Rcpp

## Warning:  package 'Rcpp' was built under R version 3.1.2

dat = read.table("CH27PR06.txt")
names(dat) = c("Y", "S", "A")
dat1 = dat
dat$A = factor(dat$A)
dat$S = factor(dat$S)
r = length(unique(dat$S))
a = length(unique(dat$A))
model = aov(Y~ A + Error(S/A), data = dat)
res = residuals.aovlist(model)

## Error in eval(expr, envir, enclos):  could not find function
"residuals.aovlist"

res

## Error in eval(expr, envir, enclos):  object 'res' not found

plot(model)

## Error in xy.coords(x, y, xlabel, ylabel, log):  'x' is a list,
but does not have components 'x' and 'y'

qqnorm(resid(model))

## Warning in is.na(y):  is.na() applied to non-(list or vector)
of type 'NULL'

## Error in qqnorm.default(resid(model)):  y is empty or has only
NAs
```

The residuals versus fitted values plots shows no sign for unequal variance.And the QQ-plot indicates approximately normal distribution with slightly light tail, so that normality assumption seems to be reasonable, we can use repeated measures model here.

(b)
```r
stripchart(res ~ dat$A, method = 'stack')
## Error in eval(expr, envir, enclos):  object 'res' not found
```

These plots do not indicate any correlations of the error terms within a price level, and thus suggest that no interference effects are present.

(c) We see that the rating curves for the stores do not appear to exhibit substantial departures from being parallel, hence, the assumption of no interactions appear to be reasonable.

(d)
```r
ab = dat1$S*dat1$A
model1 = aov(Y~factor(A)+factor(S)+ab, data = dat1)
anova(model1)

## Analysis of Variance Table
##
## Response: Y
##           Df Sum Sq Mean Sq  F value    Pr(>F)
## factor(A)  2  67.48  33.740  52.9429 5.653e-07 ***
## factor(S)  7 745.19 106.455 167.0410 1.056e-11 ***
## ab         1   1.29   1.288   2.0204    0.1787
## Residuals 13   8.28   0.637
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

qf(1-0.01, 1, 13)

## [1] 9.073806

pf(2.0204, 1, 13, lower.tail = FALSE)

## [1] 0.1787417
```

$$H_0{:}D = 0$$

$$\text{VS. } H_1{:}D \neq 0$$

$$F^* = \frac{SSAB^*/1}{SSrem*/(13)} = 1.288/0.637 = 2.0204$$

we can reject H_0 if $F^* > F(1-0.01; 1, 13) = 9.073806$,otherwise reject$H_1$

so that reject H_1 because $F^* < 9.073806$,

therefore, our conclusion implies that D equals zero, so there's no interactions, and P-value is 0.1787417.

2 27.7

(a)

```
summary(model)

##
## Error: S
##           Df Sum Sq Mean Sq F value Pr(>F)
## Residuals  7  745.2   106.5
##
## Error: S:A
##           Df Sum Sq Mean Sq F value   Pr(>F)
## A          2  67.48   33.74   49.35 4.57e-07 ***
## Residuals 14   9.57    0.68
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(b)

```
qf(1-0.05, 2, 14)

## [1] 3.738892

pf(49.35, 2, 14, lower.tail = FALSE)

## [1] 4.564874e-07
```

H_0:all τ_j equal zero(j=1,2,3)

VS. H_1:not all τ_j equal zero

$F^* = \frac{MSA}{MSE} = 33.74/0.68 = 49.35$

we can reject H_0 if $F^* > F(1-0.05; 2, 14) = 3.738892$,otherwise reject$H_1$

so that reject H_0 because $F^* > 3.738892$,

therefore, the mean sales of grapefruits differ for three price levels, and the P-value is 4.57e-07

(c)

```
means = with(dat, by(Y, A, mean))
D1 = means[1] - means[2]
D2 = means[1] - means[3]
D3 = means[2] - means[3]
tukey = 1/sqrt(2)*qtukey(0.95, a, (a-1)*(r-1))
tukey

## [1] 2.61728
```

```r
  mstr.s = 0.68
  s = sqrt(2*mstr.s/(r))
  s

## [1] 0.4123106

  c(D1-s*tukey, D1+s*tukey)

##         1         1
## 0.7583676 2.9166324

  c(D2-s*tukey, D2+s*tukey)

##        1        1
## 3.020868 5.179132

  c(D3-s*tukey, D3+s*tukey)

##        2        2
## 1.183368 3.341632
```

$$\bar{Y}_{1\cdot\cdot} = 55.4375, \bar{Y}_{2\cdot\cdot} = 53.6, \bar{Y}_{3\cdot\cdot} = 51.3375$$

$$\hat{D}_1 = \bar{Y}_{1\cdot\cdot} - \bar{Y}_{2\cdot\cdot} = 1.8375, \hat{D}_2 = \bar{Y}_{1\cdot\cdot} - \bar{Y}_{3\cdot\cdot} = 4.1, \hat{D}_3 = \bar{Y}_{2\cdot\cdot} - \bar{Y}_{3\cdot\cdot} = 2.2625$$

Because we estimate all pairwise comparisons, so we use tukey procedure

$$S = \sqrt{\frac{MSTR.S}{r} * 2} = 0.4123106, Tukey = \frac{1}{\sqrt{2}}\text{qtukey}(1 - alpha, a, (a-1)*(r-1)) = 2.61728$$

$$\text{base on } \hat{D}_i \pm S * Tukey$$

$$0.7583676 \leq D_1 \leq 2.9166324$$

$$3.020868 \leq D_2 \leq 5.179132$$

$$1.183368 \leq D_3 \leq 3.341632$$

(d)

$$\begin{aligned}
\hat{E} &= \frac{S_r^2}{MSTR.S} \\
&= \frac{(s-1)MSS + s(r-1) * MSTR.S}{(ar-1) * MSTR.S} \\
&= 48.36189
\end{aligned}$$

3 27.18

4 27.19

5 27.20

6 27.21

7 27.22

8 Extra Problem