Chapter 19 output bakery data

```
############################ Example: Castle Bakery#################################################
#page 833, The Castle Bakery Company supplies wrapped Italian bread to a large number of supermarkets
#in a metropolitan area. An experimental study was made of the effects of height of the shelf display
#(factor A: bottom, middle, top) and the width of the shelf display (factor B: regular, wide) on sales
#of this bakery's bread serving the experimental period (Y,measured in cases).
#Twelve supermarkets, similar in terms of sales volume and clientele, were utilized in the study.
#The six treatments were assigned at random to two stores each according to a completely randomized des
#and the display of the bread in each store followed the treatment specifications for that store.
#Sales of the bread were recorded, and these results
#are presented in Table 19.7.

bakery<- read.table(file="~/Desktop/jenn/teaching/stat445545/data/CH19TA07.txt",
                    col.names=c("y","height","width","obs"))
nt<-nrow(bakery)
nt
```

```
## [1] 12
```

```
bakery
```

```
##     y height width obs
## 1  47      1     1   1
## 2  43      1     1   2
## 3  46      1     2   1
## 4  40      1     2   2
## 5  62      2     1   1
## 6  68      2     1   2
## 7  67      2     2   1
## 8  71      2     2   2
## 9  41      3     1   1
## 10 39      3     1   2
## 11 42      3     2   1
## 12 46      3     2   2
```

```
bakery$height <- factor(bakery$height,label=c("bottom","middle","top"))
bakery$width <- factor(bakery$width,label=c("regular","wide"))
attach(bakery)

#summary statistics
tapply(y,height, data=bakery, mean) #row means
```

```
## bottom middle    top
##     44     67     42
```

```
tapply(y,width, data=bakery, mean) #column means
```

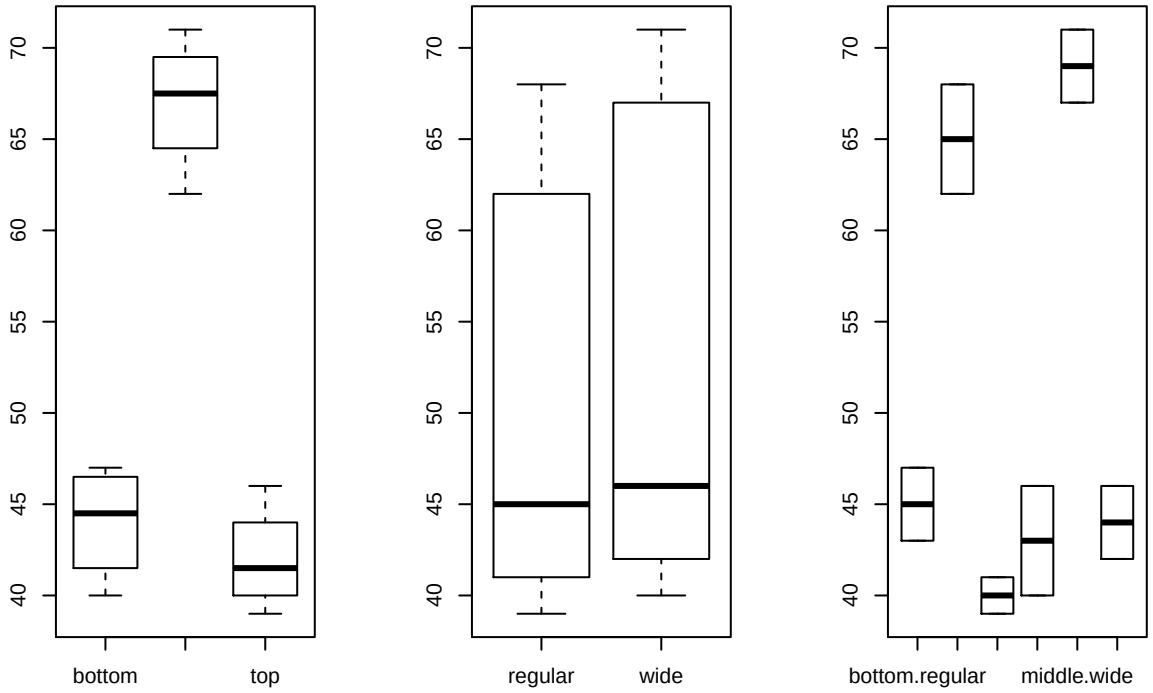
```
## regular    wide
##      50      52
```

```
aggregate(y~height*width, data=bakery, mean) #cell means
```

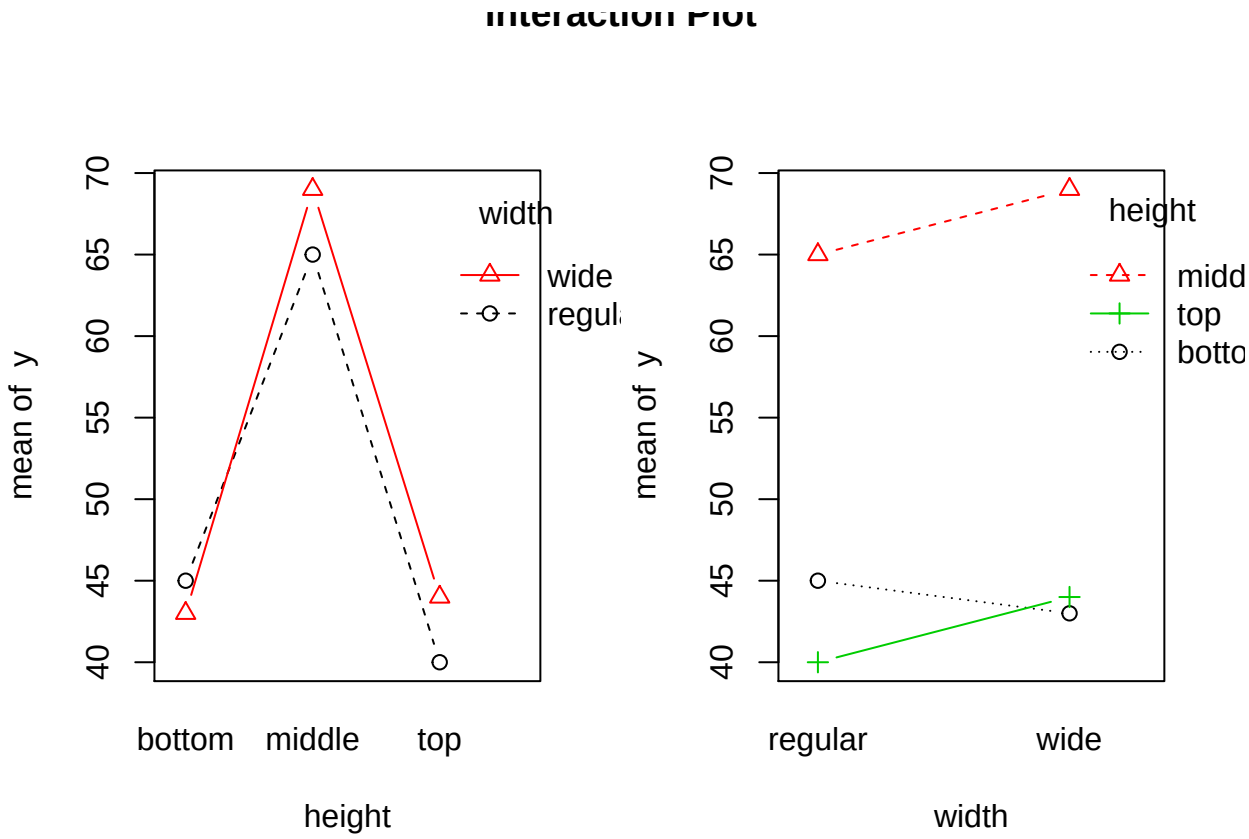
```
##   height   width  y
## 1 bottom regular 45
## 2 middle regular 65
```

```
## 3    top regular 40
## 4 bottom    wide 43
## 5 middle    wide 69
## 6    top    wide 44
```

```
par(mfrow=c(1,3))
boxplot(y ~ height, data=bakery)
boxplot(y ~ width, data=bakery)
boxplot(y ~ height + width, data=bakery)
```




```
##View interaction plots, also called profile plots
par(mfrow=c(1,2))
interaction.plot(height,width,y,type='b',
                 col=1:2, pch=1:2)
#pch: a vector of plotting symbols or characters, with sensible default.
interaction.plot(width,height,y,type='b',
                 col=1:3, pch=1:3)
title(main="Interaction Plot", outer=TRUE)
```




```
##fit anova model and summary statistics
myfit = aov(y~height*width)
summary(myfit) #page 842 figure 19.9, ANOVA table
```

```
##              Df Sum Sq Mean Sq F value   Pr(>F)
## height        2   1544   772.0  74.710 5.75e-05 ***
## width         1     12    12.0   1.161    0.323
## height:width  2     24    12.0   1.161    0.375
## Residuals     6     62    10.3
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##notice that interaction effect is not significant (p value =0.375)
#report row, column and cell means
print(model.tables(myfit,"means"),digits=3)
```

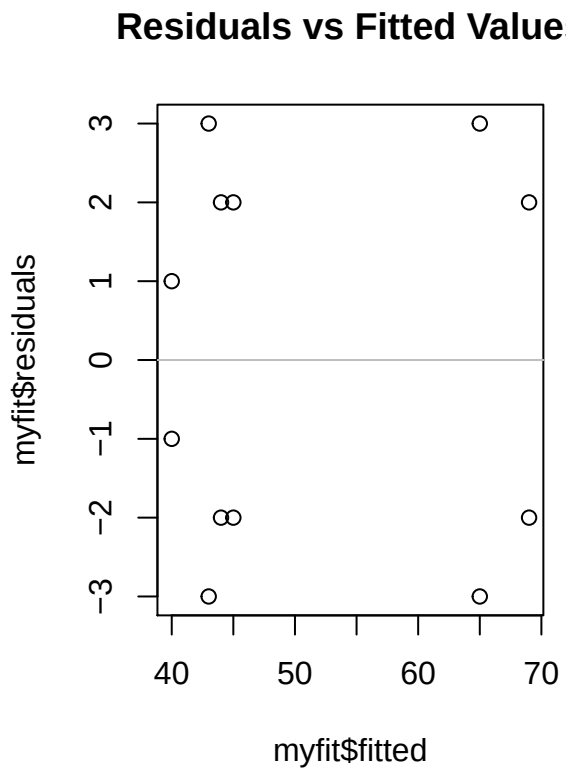
```
## Tables of means
## Grand mean
##
## 51
##
##  height
## height
## bottom middle    top
##     44     67     42
##
##  width
## width
```

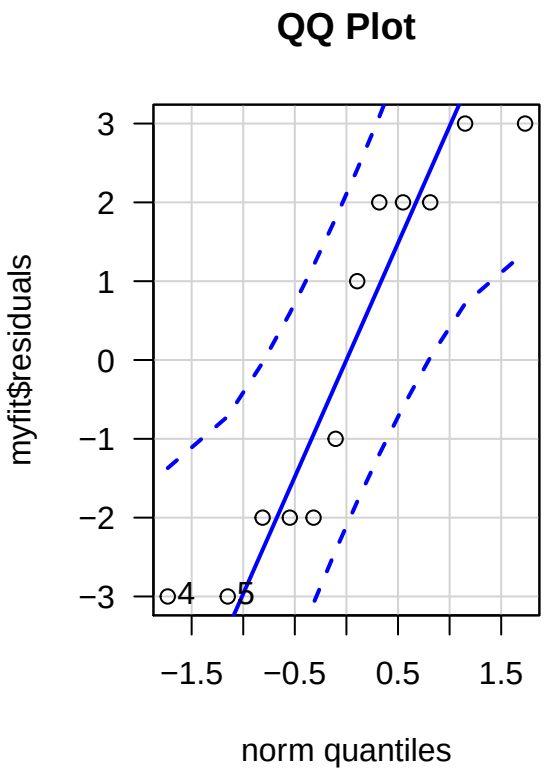
```
## regular    wide
##      50      52
##
##  height:width
##         width
## height   regular wide
##   bottom 45      43
##   middle 65      69
##   top    40      44
```

```
#Diagnostics
#residual vs fitted value
plot(myfit$fitted, myfit$residuals, main="Residuals vs Fitted Values")
abline(h = 0, col = "gray75")
# Normality of Residuals
library(car)
```

```
## Loading required package: carData
```

```
qqPlot(myfit$residuals, las = 1, main="QQ Plot")
```






```
## [1] 4 5
```

```
##interaction not significant, display width is also not significant, may not have any effect.
##our interest now is in examining the nature of the display height effects
#Tukey's multiple comparison
myfitTukey<-TukeyHSD(myfit,"height",ordered=TRUE, conf.level=.95)
myfitTukey
```

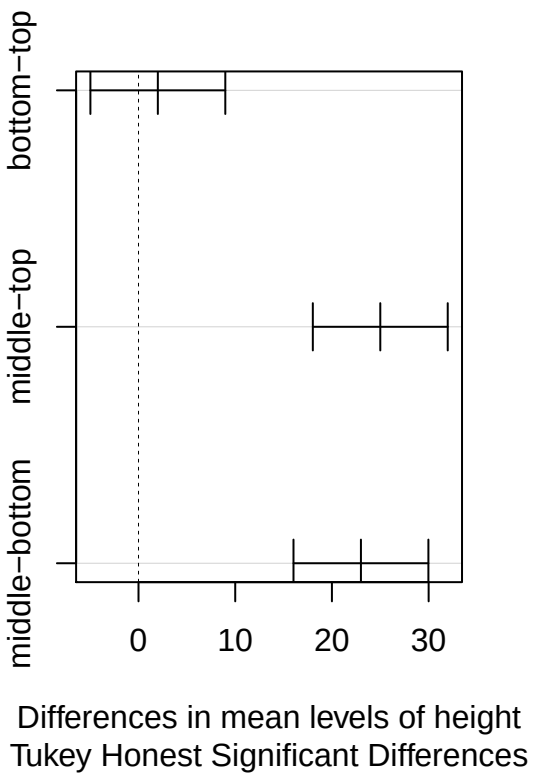
```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##     factor levels have been ordered
```

```
##
## Fit: aov(formula = y ~ height * width)
##
## $height
##                diff       lwr       upr     p adj
## bottom-top       2 -4.974281  8.974281 0.6714131
## middle-top      25 18.025719 31.974281 0.0000829
## middle-bottom   23 16.025719 29.974281 0.0001335
```

```r
plot(myfitTukey, sub="Tukey Honest Significant Differences")

##Scheffee comparison
library(agricolae)
scheffe.test(myfit,"height", group=TRUE,console=TRUE,
             main="Scheffee comparison with different height")
```

```
##
## Study: Scheffee comparison with different height
##
## Scheffe Test for y
##
## Mean Square Error  : 10.33333
##
## height,  means
##
##         y      std r Min Max
## bottom 44 3.162278 4  40  47
## middle 67 3.741657 4  62  71
## top    42 2.943920 4  39  46
##
## Alpha: 0.05 ; DF Error: 6
## Critical Value of F: 5.143253
##
## Minimum Significant Difference: 7.290195
##
## Means with the same letter are not significantly different.
##
##         y groups
## middle 67      a
## bottom 44      b
## top    42      b
```


95% family−wise confidence leve
bottom−top
middle−top
middle−bottom
0
10
20
30
Differences in mean levels of height
Tukey Honest Significant Differences