STATS 101B final project

5/22/2019

I. Random Assignment

```
dat <- read_excel("198 samples.xlsx")
```

```
## Warning in strptime(x, format, tz = tz): unknown timezone 'zone/tz/2019a.
## 1.0/zoneinfo/America/Los_Angeles'
```

```
## New names:
## * `` -> `..8`
```

```
groups <- rep(1:9, 11)
set.seed(27)
random_assignment1 <- sample(groups)
random_assignment2 <- sample(groups)

dat$assignment <- numeric(198)

dat$assignment[dat$Gender == "F"] <- random_assignment1
dat$assignment[dat$Gender == "M"] <- random_assignment2

dat$group <- character(198)

for (i in 1:198){
  if (dat$assignment[i] == 1){
    dat$group[i] <- "Room Temperatureerature & No Memory"
  } else if (dat$assignment[i] == 2){
    dat$group[i] <- "Room Temperatureerature & Happy Memory"
  } else if (dat$assignment[i] == 3){
    dat$group[i] <- "Room Temperatureerature & Sad Memory"
  } else if (dat$assignment[i] == 4){
    dat$group[i] <- "5 & No Memory"
  } else if (dat$assignment[i] == 5){
    dat$group[i] <- "5 & Happy Memory"
  }
  else if (dat$assignment[i] == 6){
    dat$group[i] <- "5 & Sad Memory"
  } else if (dat$assignment[i] == 7){
    dat$group[i] <- "40 & No Memory"
  } else if (dat$assignment[i] == 8){
    dat$group[i] <- "40 & Happy Memory"
  } else if (dat$assignment[i] == 9){
    dat$group[i] <- "40 & Sad Memory"
  }
}

# Check Everyting is correct
table(dat$group)
```

```
##
##                       40 & Happy Memory
##                                      22
##                          40 & No Memory
##                                      22
##                         40 & Sad Memory
##                                      22
##                          5 & Happy Memory
##                                      22
##                            5 & No Memory
##                                      22
##                           5 & Sad Memory
##                                      22
## Room Temperatureerature & Happy Memory
##                                      22
##    Room Temperatureerature & No Memory
##                                      22
##   Room Temperatureerature & Sad Memory
##                                      22
```

```
table(dat$group [dat$Gender == "F"])
```

```
##
##                       40 & Happy Memory
##                                      11
##                          40 & No Memory
##                                      11
##                         40 & Sad Memory
##                                      11
##                          5 & Happy Memory
##                                      11
##                            5 & No Memory
##                                      11
##                           5 & Sad Memory
##                                      11
## Room Temperatureerature & Happy Memory
##                                      11
##    Room Temperatureerature & No Memory
##                                      11
##   Room Temperatureerature & Sad Memory
##                                      11
```

```
table(dat$group [dat$Gender == "M"])
```

```
##
##                       40 & Happy Memory
##                                      11
##                          40 & No Memory
##                                      11
##                         40 & Sad Memory
##                                      11
##                          5 & Happy Memory
##                                      11
##                            5 & No Memory
##                                      11
```

```
##                          5 & Sad Memory
##                                      11
## Room Temperatureerature & Happy Memory
##                                      11
##    Room Temperatureerature & No Memory
##                                      11
##   Room Temperatureerature & Sad Memory
##                                      11
```

```
# Output
write_xlsx(dat, "Random Assignment.xlsx")
```

II. ANOVA Model

```
dat2 <- read_excel("Data Collection.xlsx")[-c(4,5,6,7,8,12,13)]

dat2$Temperature <- character(198)
dat2$Emotion <- character(198)

for (i in 1:198){
  if (dat2$assignment[i] == 1){
    dat2$Temperature[i] <- "Room"
    dat2$Emotion[i] <- "Normal"
  } else if (dat2$assignment[i] == 2){
    dat2$Temperature[i] <- "Room"
    dat2$Emotion[i] <- "Happy"
  } else if (dat2$assignment[i] == 3){
    dat2$Temperature[i] <- "Room"
    dat2$Emotion[i] <- "Sad"
  } else if (dat2$assignment[i] == 4){
    dat2$Temperature[i] <- "Cold (5 degree)"
    dat2$Emotion[i] <- "Normal"
  } else if (dat2$assignment[i] == 5){
    dat2$Temperature[i] <- "Cold (5 degree)"
    dat2$Emotion[i] <- "Happy"
  }
  else if (dat2$assignment[i] == 6){
    dat2$Temperature[i] <- "Cold (5 degree)"
    dat2$Emotion[i] <- "Sad"
  } else if (dat2$assignment[i] == 7){
    dat2$Temperature[i] <- "Hot (40 degree)"
    dat2$Emotion[i] <- "Normal"
  } else if (dat2$assignment[i] == 8){
    dat2$Temperature[i] <- "Hot (40 degree)"
    dat2$Emotion[i] <- "Happy"
  } else if (dat2$assignment[i] == 9){
    dat2$Temperature[i] <- "Hot (40 degree)"
    dat2$Emotion[i] <- "Sad"
  }
}

dat2$Difference <- dat2$`After Treatment` - dat2$`Before Treatment`
```

```r
m1 <- aov(`After Treatment` ~ Gender + Temperature * Emotion, data = dat2)
m2 <- lm(`After Treatment` ~ Gender + Temperature * Emotion, data = dat2)
summary(m1)
```

```
##                      Df Sum Sq Mean Sq F value Pr(>F)
## Gender                1   1125    1125   1.256 0.2639
## Temperature           2   1187     594   0.662 0.5168
## Emotion               2   6646    3323   3.708 0.0263 *
## Temperature:Emotion   4   1653     413   0.461 0.7642
## Residuals           188 168471     896
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
summary(m2)
```

```
##
## Call:
## lm(formula = `After Treatment` ~ Gender + Temperature * Emotion,
##     data = dat2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -82.980 -16.884   0.884  21.025  70.162
##
## Coefficients:
##                                          Estimate Std. Error t value
## (Intercept)                              159.0707     6.7275  23.645
## GenderM                                    4.7677     4.2548   1.121
## TemperatureHot (40 degree)                -0.3182     9.0258  -0.035
## TemperatureRoom                           -2.2273     9.0258  -0.247
## EmotionNormal                            -12.5909     9.0258  -1.395
## EmotionSad                               -10.9545     9.0258  -1.214
## TemperatureHot (40 degree):EmotionNormal  -1.0000    12.7645  -0.078
## TemperatureRoom:EmotionNormal             -3.0909    12.7645  -0.242
## TemperatureHot (40 degree):EmotionSad     14.1818    12.7645   1.111
## TemperatureRoom:EmotionSad                 4.4545    12.7645   0.349
##                                          Pr(>|t|)
## (Intercept)                                <2e-16 ***
## GenderM                                     0.264
## TemperatureHot (40 degree)                  0.972
## TemperatureRoom                             0.805
## EmotionNormal                               0.165
## EmotionSad                                  0.226
## TemperatureHot (40 degree):EmotionNormal    0.938
## TemperatureRoom:EmotionNormal               0.809
## TemperatureHot (40 degree):EmotionSad       0.268
## TemperatureRoom:EmotionSad                  0.727
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 29.94 on 188 degrees of freedom
## Multiple R-squared:  0.05925,    Adjusted R-squared:  0.01422
## F-statistic: 1.316 on 9 and 188 DF,  p-value: 0.2311
```

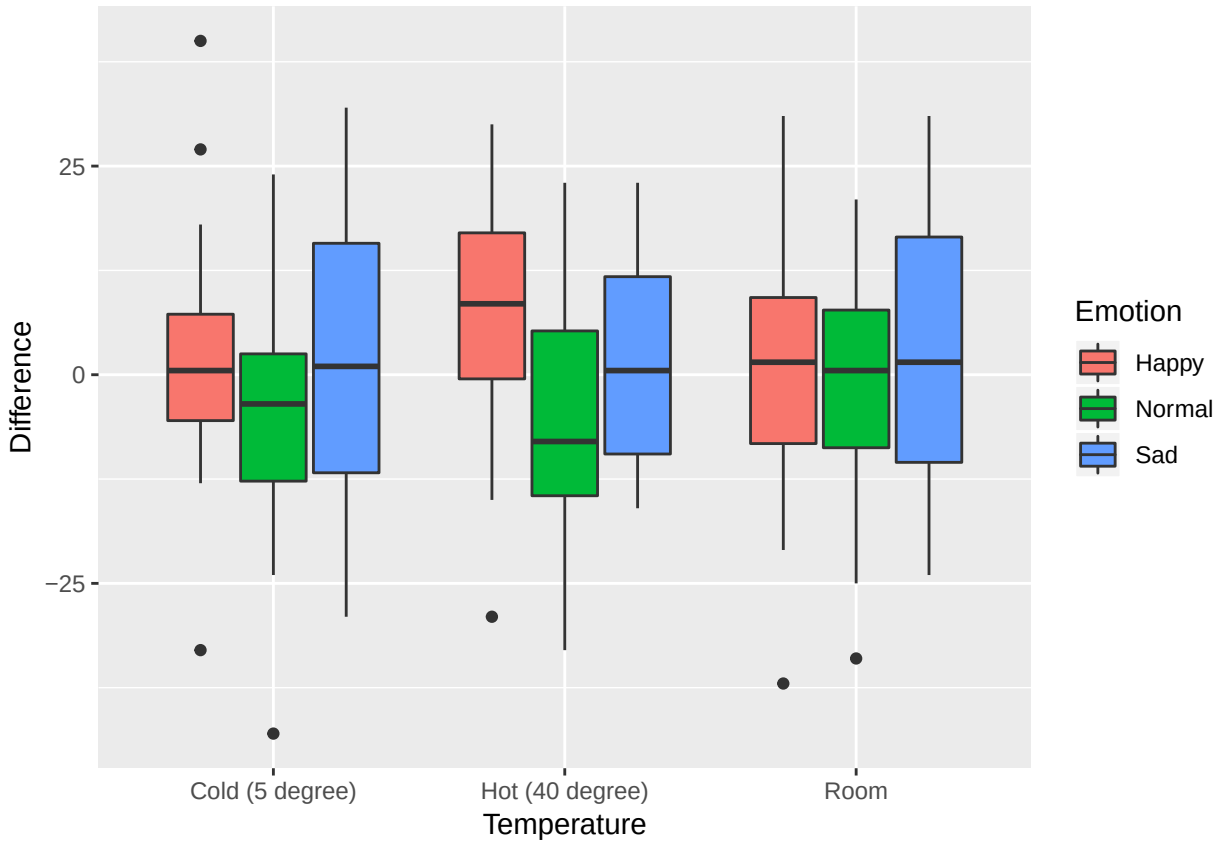
```r
m3 <- aov(Difference ~ Gender + Temperature * Emotion, data = dat2)
m4 <- lm(Difference ~ Gender + Temperature * Emotion, data = dat2)
summary(m3)
```

```
##                      Df Sum Sq Mean Sq F value Pr(>F)
## Gender                1    425   424.7   1.860  0.174
## Temperature           2     53    26.4   0.116  0.891
## Emotion               2   1718   859.2   3.763  0.025 *
## Temperature:Emotion   4    818   204.6   0.896  0.468
## Residuals           188  42931   228.4
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
summary(m4)
```

```
##
## Call:
## lm(formula = Difference ~ Gender + Temperature * Emotion, data = dat2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -37.510  -9.862  -0.056  10.896  36.035
##
## Coefficients:
##                                          Estimate Std. Error t value
## (Intercept)                                1.0354     3.3960   0.305
## GenderM                                    2.9293     2.1478   1.364
## TemperatureHot (40 degree)                 4.5455     4.5563   0.998
## TemperatureRoom                           -2.4091     4.5563  -0.529
## EmotionNormal                             -7.4545     4.5563  -1.636
## EmotionSad                                -0.8182     4.5563  -0.180
## TemperatureHot (40 degree):EmotionNormal  -4.9545     6.4435  -0.769
## TemperatureRoom:EmotionNormal              6.7727     6.4435   1.051
## TemperatureHot (40 degree):EmotionSad     -5.0000     6.4435  -0.776
## TemperatureRoom:EmotionSad                 3.0909     6.4435   0.480
##                                          Pr(>|t|)
## (Intercept)                                 0.761
## GenderM                                     0.174
## TemperatureHot (40 degree)                  0.320
## TemperatureRoom                             0.598
## EmotionNormal                               0.103
## EmotionSad                                  0.858
## TemperatureHot (40 degree):EmotionNormal    0.443
## TemperatureRoom:EmotionNormal               0.295
## TemperatureHot (40 degree):EmotionSad       0.439
## TemperatureRoom:EmotionSad                  0.632
##
## Residual standard error: 15.11 on 188 degrees of freedom
## Multiple R-squared:  0.06561,    Adjusted R-squared:  0.02087
## F-statistic: 1.467 on 9 and 188 DF,  p-value: 0.163
```

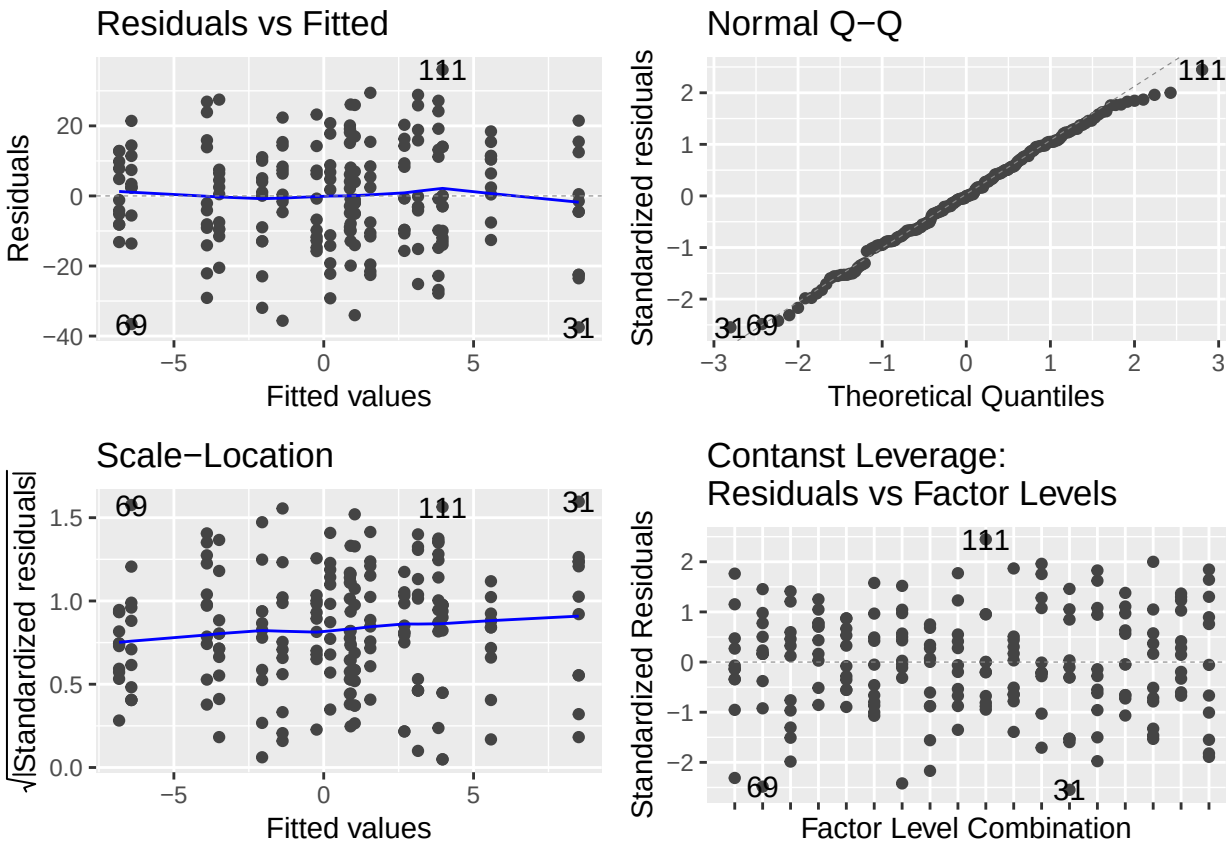
```r
# Boxplots
boxplots <- ggplot(dat2, aes(x = Temperature, y = Difference, fill = Emotion)) +
  geom_boxplot()
boxplots
```




```
# Diagnostic Plots
diagnostics <- autoplot(m3)
```

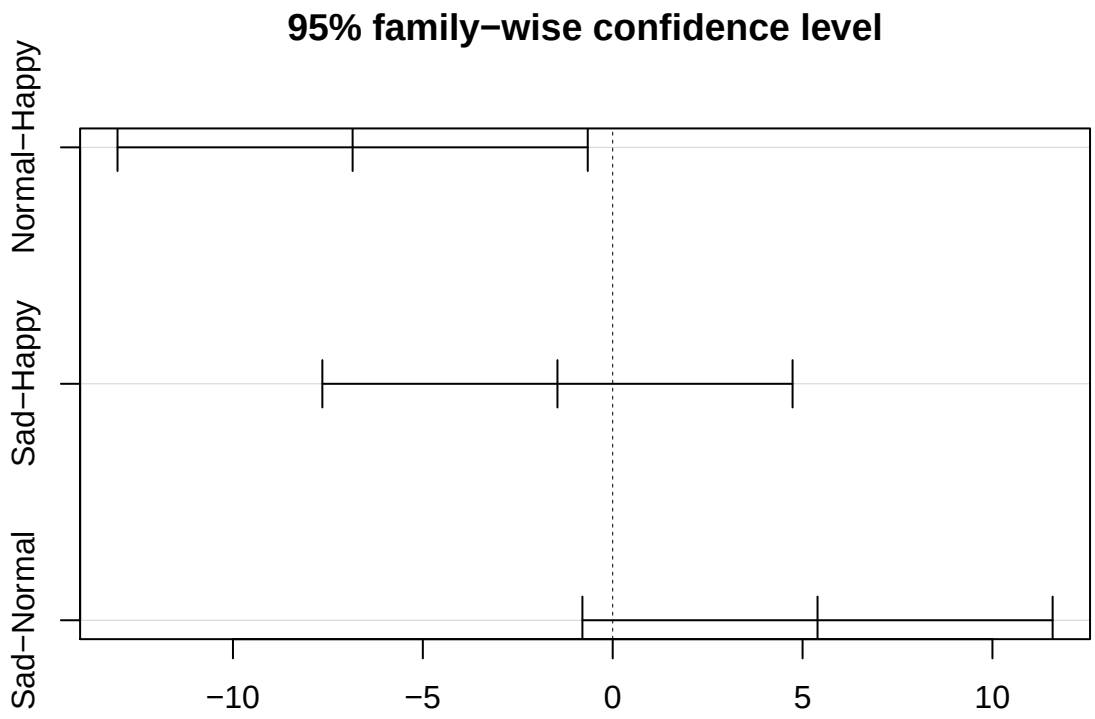
```
## Warning: package 'bindrcpp' was built under R version 3.4.4
```

```
diagnostics[[4]] <- diagnostics[[4]] +
  theme(axis.text.x=element_blank())
diagnostics
```



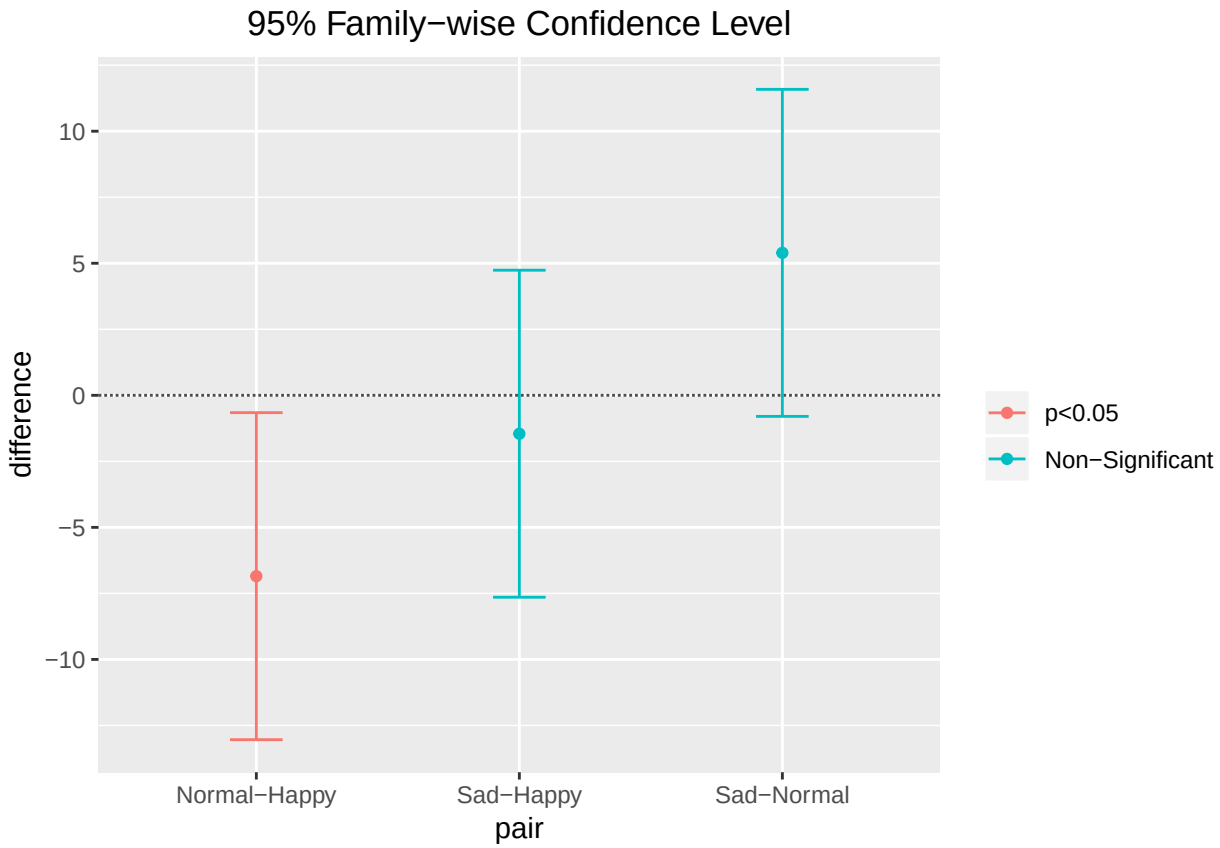
III. Multiple Comparison

```
# Multiple Comparison using TukeyHSD
m5 <- aov(Difference ~ Emotion, data = dat2)
Tukey1 <- TukeyHSD(m5)
plot(Tukey1)
```




```
Tukey2 <- as.data.frame(TukeyHSD(m5)$Emotion)
Tukey2$pair <- rownames(Tukey2)

ggplot(Tukey2, aes(colour=cut(`p adj`, c(0, 0.01, 0.05, 1),
                          label=c("p<0.01","p<0.05","Non-Significant")))) +
  geom_hline(yintercept=0, lty="11", colour="grey30") +
  geom_errorbar(aes(pair, ymin=lwr, ymax=upr), width=0.2) +
  geom_point(aes(pair, diff)) +
  ylab("difference") +
  labs( colour="", title = "95% Family-wise Confidence Level") +
  theme(plot.title = element_text(hjust = 0.5))
```




```
# Differences
with(dat2, tapply(Difference, Emotion, mean))
```

```
##     Happy    Normal       Sad
##  3.212121 -3.636364  1.757576
```