R Module 6 Rubric

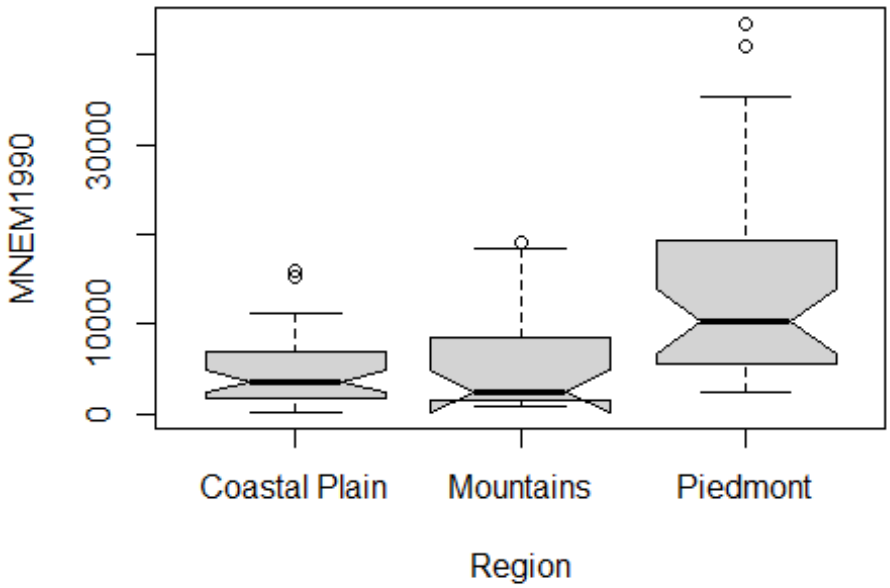
Question 1: Boxplot

Notched boxplot of your regions

Base R:

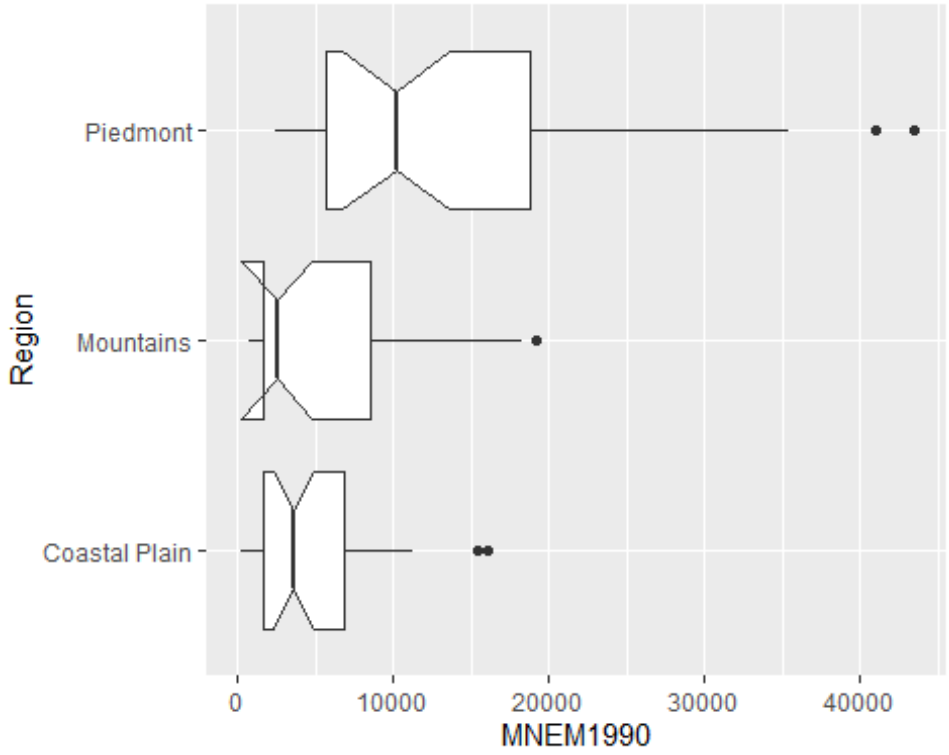
```
library(sf)
NC <- read_sf("data/NC_REGION.shp")

boxplot(MNEM1990 ~ Region, data = NC, notch = TRUE)
```

```
## Warning in (function (z, notch = FALSE, width = NULL, varwidth = FALSE, :
some notches went outside hinges
## ('box'): maybe set notch=FALSE
```



ggplot2:

```
library(ggplot2)

ggplot(NC, aes(x = MNEM1990, y = Region)) +
  geom_boxplot(notch = TRUE)
```



Question 2: ANOVA

Report your F-Statistic and if you should reject or fail to reject the null hypothesis

```
anova <- aov(MNEM1990 ~ Region, data = NC)

print(anova)
```

```
## Call:
##    aov(formula = MNEM1990 ~ Region, data = NC)
##
## Terms:
##                     Region  Residuals
## Sum of Squares  2127131896 6155559536
## Deg. of Freedom          2         97
##
## Residual standard error: 7966.139
## Estimated effects may be unbalanced
```

```
summary(anova)
```

```
##             Df    Sum Sq   Mean Sq F value  Pr(>F)
## Region       2 2.127e+09 1.064e+09   16.76 5.6e-07 ***
## Residuals   97 6.156e+09 6.346e+07
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Question 3: `oneway.test`, Equal Variance

```
oneway.test(MNEM1990 ~ Region, data = NC, var.equal = TRUE)

##
##  One-way analysis of means
##
## data:  MNEM1990 and Region
## F = 16.76, num df = 2, denom df = 97, p-value = 5.6e-07
```

Question 4: Bartlett K-Squared

```
bartlett.test(MNEM1990 ~ Region, data = NC)

##
##  Bartlett test of homogeneity of variances
##
## data:  MNEM1990 by Region
## Bartlett's K-squared = 38.195, df = 2, p-value = 5.083e-09
```

Question 5: `oneway.test`, Unequal Variance

```
oneway.test(MNEM1990 ~ Region, data = NC, var.equal = FALSE)

##
##  One-way analysis of means (not assuming equal variances)
##
## data:  MNEM1990 and Region
## F = 11.66, num df = 2.000, denom df = 47.748, p-value = 7.526e-05
```

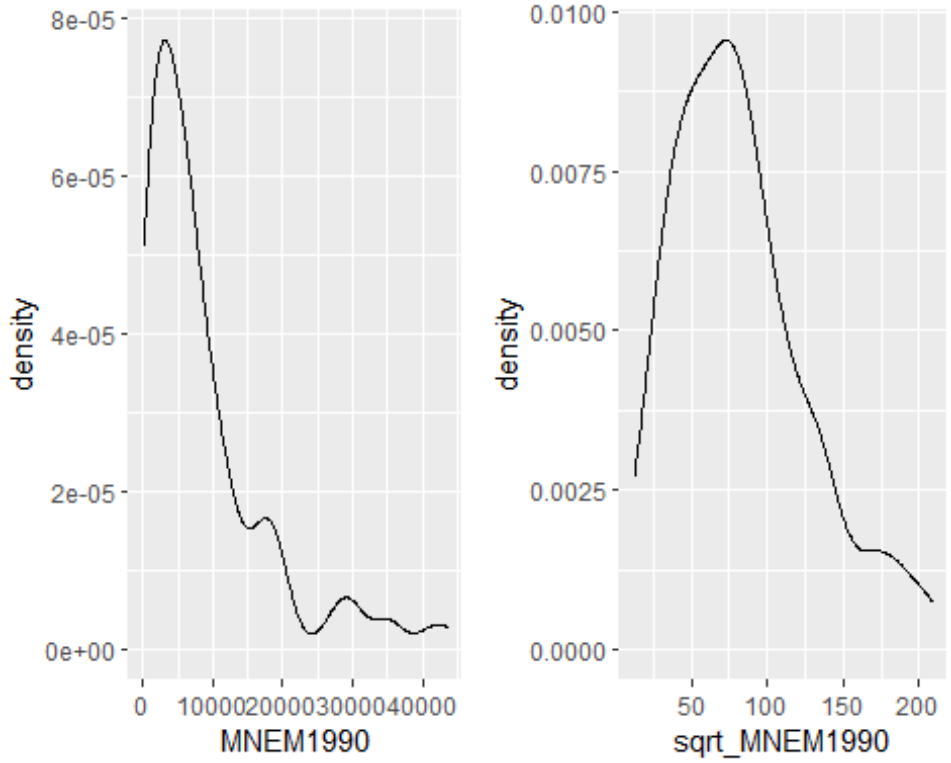
Question 6: Shapiro-Wilk Normality Test

```
# Student's don't need to use dplyr or even transform the data, as long as
the
# distribution is normal.

library(dplyr)
NC <- NC %>%
  mutate(
    sqrt_MNEM1990 = sqrt(MNEM1990)
  )

shapiro.test(NC$sqrt_MNEM1990)

##
##  Shapiro-Wilk normality test
##
## data:  NC$sqrt_MNEM1990
## W = 0.94203, p-value = 0.0002569
```

Illustrate data using density plot for both un-transformed and transformed data

```
unt <- ggplot(NC, aes(x = MNEM1990)) +
  geom_density()
```

```
tra <- ggplot(NC, aes(x = sqrt_MNEM1990)) +
  geom_density()


# This is just to get two plots side-by-side
cowplot::plot_grid(unt, tra)
```

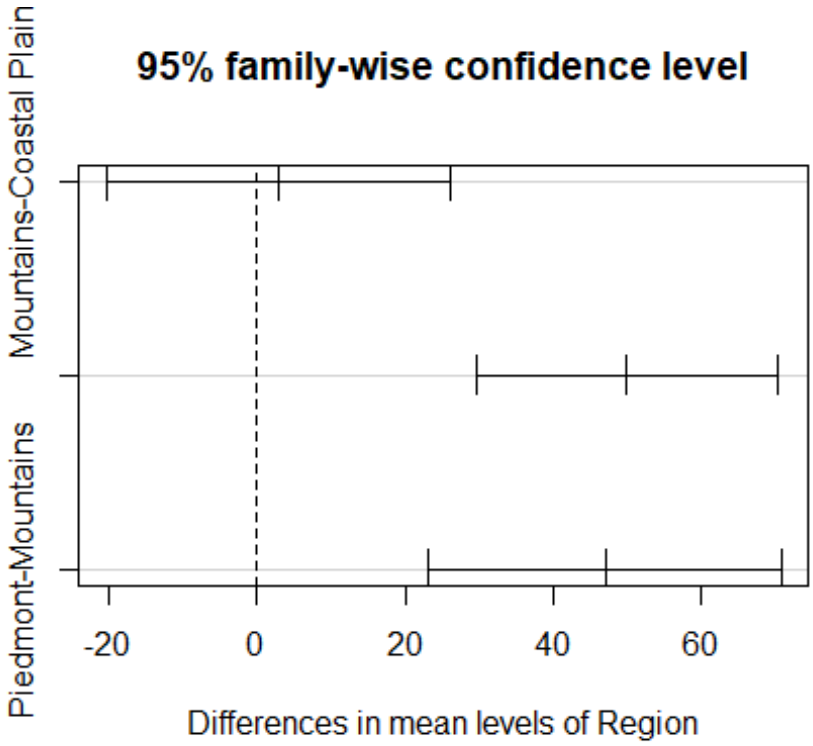


Question 7: Tukey Test

```
aov <- aov(sqrt_MNEM1990 ~ Region, data = NC)

tukey <- TukeyHSD(aov)
tukey
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = sqrt_MNEM1990 ~ Region, data = NC)
##
## $Region
##                              diff       lwr      upr     p adj
## Mountains-Coastal Plain  2.87440 -20.29441 26.04321 0.9530922
## Piedmont-Coastal Plain  49.85867  29.54578 70.17157 0.0000002
## Piedmont-Mountains      46.98427  23.24429 70.72426 0.0000244
```

```
plot(tukey)
```


95% family-wise confidence level
Mountains-Coastal Plain
Piedmont-Mountains
-20
0
20
40
60
Differences in mean levels of Region