Assignment_3

Ajay Kanubhai Patel

2022-10-21

#Loading the package

```
#Load packages to convert file in PDF.

if(!require(tinytex)){install.packages("tinytex")}

## Loading required package: tinytex
```

#This sets the working directory

This section is for the basic set up. It will clear all the plots, the console and the workspace. It also sets the overall format for numbers.

```
if(!is.null(dev.list())) dev.off()

## null device
##           1

cat("\014")
```

```
rm(list=ls())
options(scipen=9)
```

#To read Excel file in R data frame.

```
if(!require(readxl)){install.packages("readxl")}

## Loading required package: readxl

library("readxl")
```

#This sets the working directory

```
knitr::opts_chunk$set(echo = TRUE)
knitr::opts_knit$set(root.dir = 'D:/Final Assignment/DATA/Assignment3')
```

This section is for the basic set up. It will clear all the plots, the console and the workspace. It also sets the overall format for numbers.

#To read Excel file in R data frame.

```
if(!require(readxl)){install.packages("readxl")}
library("readxl")

if(!require(pastecs)){install.packages("pastecs")}

## Loading required package: pastecs

library("pastecs")

if(!require(lattice)){install.packages("lattice")}

## Loading required package: lattice

library("lattice")

if(!require(vcd)){install.packages("vcd")}

## Loading required package: vcd

## Loading required package: grid

library("vcd")

if(!require(HSAUR)){install.packages("HSAUR")}

## Loading required package: HSAUR

## Loading required package: tools

library("HSAUR")

if(!require(rmarkdown)){install.packages("rmarkdown")}
```

```
## Loading required package: rmarkdown

library("rmarkdown")


if(!require(ggplot2)){install.packages("ggplot2")}

## Loading required package: ggplot2

library("ggplot2")

getwd()

## [1] "D:/Final Assignment/DATA/Assignment3"

Assignment03_AP <- read_excel("PROG8430_Assign03_22F.xlsx")


Assignment03_AP  <- as.data.frame(Assignment03_AP )
```

Initial Transformation

a. Rename all variables with your initials appended.

to change all column name by appending my initials (Ajay Patel = AP) and separate it by "_". # head(data,n) displays 1st n rows present in our excel file.
head(Assignment03_BDSA,08)= shows first 8 rows. If number is not provided by default is shows 1st 6 rows

```
colnames(Assignment03_AP) <- paste(colnames(Assignment03_AP), "AP", sep =
"_")


head(Assignment03_AP)

##   ID_AP gender_AP HR_AP BP_AP Wgt1_AP Wgt2_AP Exercise_AP Hgt_AP Smoke_AP
## 1     1    female  Norm  Norm   118.6   121.5         158   67.8        N
## 2     2    female  Norm  Norm   143.1   146.6         152   65.9        N
## 3     3    female  Norm  High   105.3   107.3         205   69.3        N
## 4     4    female  Norm  Norm   119.5   120.9         151   65.4        N
## 5     5    female  Norm  High   130.9   132.1         178   65.8        N
## 6     6    female  Norm  High    90.0    91.4         204   63.1        N
##   Drink_AP Group_AP WBC_AP Income_AP
## 1        Y  Control   5193    125000
## 2        Y  Control   5705        NA
## 3        N     Test   7680        NA
## 4        Y  Control   7342        NA
## 5        N  Control   7714        NA
## 6        Y  Control   3851        NA
```

b. Transform character variables to factor variables.

first we analyze structure of our data and then perform required operation.

```
str(Assignment03_AP)
```

```
## 'data.frame':    500 obs. of  13 variables:
##  $ ID_AP      : num  1 2 3 4 5 6 7 8 9 10 ...
##  $ gender_AP  : chr  "female" "female" "female" "female" ...
##  $ HR_AP      : chr  "Norm" "Norm" "Norm" "Norm" ...
##  $ BP_AP      : chr  "Norm" "Norm" "High" "Norm" ...
##  $ Wgt1_AP    : num  119 143 105 120 131 ...
##  $ Wgt2_AP    : num  122 147 107 121 132 ...
##  $ Exercise_AP: num  158 152 205 151 178 204 91 160 246 153 ...
##  $ Hgt_AP     : num  67.8 65.9 69.3 65.4 65.8 63.1 67.9 61.7 69.2 72.2 ...
##  $ Smoke_AP   : chr  "N" "N" "N" "N" ...
##  $ Drink_AP   : chr  "Y" "Y" "N" "Y" ...
##  $ Group_AP   : chr  "Control" "Control" "Test" "Control" ...
##  $ WBC_AP     : num  5193 5705 7680 7342 7714 ...
##  $ Income_AP  : num  125000 NA NA NA NA NA NA NA NA NA ...
```

to transform chr variables into factor variables.

There are total 6 varibles in character form.

```
Assignment03_AP$gender_AP <- as.factor(Assignment03_AP$gender_AP)
Assignment03_AP$HR_AP <- as.factor(Assignment03_AP$HR_AP)
Assignment03_AP$BP_AP <- as.factor(Assignment03_AP$BP_AP)
Assignment03_AP$Smoke_AP <- as.factor(Assignment03_AP$Smoke_AP)
Assignment03_AP$Drink_AP <- as.factor(Assignment03_AP$Drink_AP)
Assignment03_AP$Group_AP <- as.factor(Assignment03_AP$Group_AP)
str(Assignment03_AP)
```

```
## 'data.frame':    500 obs. of  13 variables:
##  $ ID_AP      : num  1 2 3 4 5 6 7 8 9 10 ...
##  $ gender_AP  : Factor w/ 1 level "female": 1 1 1 1 1 1 1 1 1 1 ...
##  $ HR_AP      : Factor w/ 3 levels "High","Low","Norm": 3 3 3 3 3 3 3 3 3
3 ...
##  $ BP_AP      : Factor w/ 3 levels "High","Low","Norm": 3 3 1 3 1 1 3 3 3
3 ...
##  $ Wgt1_AP    : num  119 143 105 120 131 ...
##  $ Wgt2_AP    : num  122 147 107 121 132 ...
##  $ Exercise_AP: num  158 152 205 151 178 204 91 160 246 153 ...
##  $ Hgt_AP     : num  67.8 65.9 69.3 65.4 65.8 63.1 67.9 61.7 69.2 72.2 ...
##  $ Smoke_AP   : Factor w/ 2 levels "N","Y": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Drink_AP   : Factor w/ 2 levels "N","Y": 2 2 1 2 1 2 1 2 2 2 ...
##  $ Group_AP   : Factor w/ 2 levels "Control","Test": 1 1 2 1 1 1 2 1 1 1
...
##  $ WBC_AP     : num  5193 5705 7680 7342 7714 ...
##  $ Income_AP  : num  125000 NA NA NA NA NA NA NA NA NA ...
```

Q1 (2).

Reduce Dimensionality

a. Apply the Missing Value Filter to remove appropriate columns of data.

To identify missing values we apply summary()func and observe NA's for

#each column.

#There are 492 records (almost 98.4%) in Income_AP which are NA(Not Available).

#To drop Income_AP column Assignment03_AP[-c(13)].

```
summary(Assignment03_AP)
```

```
##      ID_AP        gender_AP    HR_AP      BP_AP        Wgt1_AP
##  Min.   :  1.0   female:500   High: 77   High: 94   Min.   : 49.2
##  1st Qu.:125.8                Low : 18   Low : 34   1st Qu.:114.3
##  Median :250.5                Norm:405   Norm:372   Median :131.7
##  Mean   :250.5                                      Mean   :131.0
##  3rd Qu.:375.2                                      3rd Qu.:149.6
##  Max.   :500.0                                      Max.   :199.3
##
##     Wgt2_AP       Exercise_AP        Hgt_AP      Smoke_AP Drink_AP
##  Min.   : 50.2   Min.   : 67.0   Min.   :59.80   N:427    N:140
##  1st Qu.:115.2   1st Qu.:147.0   1st Qu.:65.00   Y: 73    Y:360
##  Median :133.7   Median :175.5   Median :67.05
##  Mean   :132.9   Mean   :176.9   Mean   :67.01
##  3rd Qu.:151.6   3rd Qu.:207.0   3rd Qu.:69.00
##  Max.   :201.5   Max.   :297.0   Max.   :78.90
##
##     Group_AP       WBC_AP        Income_AP
##  Control:250   Min.   : 3851   Min.   :  2000
##  Test   :250   1st Qu.: 6195   1st Qu.:  7000
##                Median : 6902   Median : 53500
##                Mean   : 6896   Mean   : 66625
##                3rd Qu.: 7532   3rd Qu.:128000
##                Max.   :10652   Max.   :148000
##                                NA's   :492
```

```
Assignment03_AP <- Assignment03_AP[-c(13)]

head(Assignment03_AP)
```

```
##   ID_AP gender_AP HR_AP BP_AP Wgt1_AP Wgt2_AP Exercise_AP Hgt_AP Smoke_AP
## 1     1    female  Norm  Norm   118.6   121.5         158   67.8        N
## 2     2    female  Norm  Norm   143.1   146.6         152   65.9        N
## 3     3    female  Norm  High   105.3   107.3         205   69.3        N
```

```
## 4     4    female  Norm  Norm   119.5   120.9         151   65.4        N
## 5     5    female  Norm  High   130.9   132.1         178   65.8        N
## 6     6    female  Norm  High    90.0    91.4         204   63.1        N
##   Drink_AP Group_AP WBC_AP
## 1        Y  Control   5193
## 2        Y  Control   5705
## 3        N     Test   7680
## 4        Y  Control   7342
## 5        N  Control   7714
## 6        Y  Control   3851
```

b. Apply the Low Variance Filter to remove appropriate columns of data.

#only for numerical columns.

```
stat.desc(Assignment03_AP) #Consider coef of var for the low variance,

##                      ID_AP gender_AP HR_AP BP_AP       Wgt1_AP
Wgt2_AP
## nbr.val         500.0000000        NA    NA    NA   500.0000000
500.000000
## nbr.null          0.0000000        NA    NA    NA     0.0000000
0.000000
## nbr.na            0.0000000        NA    NA    NA     0.0000000
0.000000
## min               1.0000000        NA    NA    NA    49.2000000
50.200000
## max             500.0000000        NA    NA    NA   199.3000000
201.500000
## range           499.0000000        NA    NA    NA   150.1000000
151.300000
## sum          125250.0000000        NA    NA    NA 65478.0000000
66452.900000
## median          250.5000000        NA    NA    NA   131.6500000
133.700000
## mean            250.5000000        NA    NA    NA   130.9560000
132.905800
## SE.mean           6.4614240        NA    NA    NA     1.1942880
1.198161
## CI.mean.0.95     12.6949496        NA    NA    NA     2.3464527
2.354061
## var           20875.0000000        NA    NA    NA   713.1618677
717.794415
## std.dev         144.4818328        NA    NA    NA    26.7050907
26.791686
## coef.var          0.5767738        NA    NA    NA     0.2039241
0.201584
##                Exercise_AP         Hgt_AP Smoke_AP Drink_AP Group_AP
## nbr.val         500.0000000   500.00000000       NA       NA       NA
## nbr.null          0.0000000     0.00000000       NA       NA       NA
## nbr.na            0.0000000     0.00000000       NA       NA       NA
```

```
## min             67.0000000    59.80000000       NA       NA       NA
## max            297.0000000    78.90000000       NA       NA       NA
## range          230.0000000    19.10000000       NA       NA       NA
## sum          88440.0000000 33503.40000000       NA       NA       NA
## median         175.5000000    67.05000000       NA       NA       NA
## mean           176.8800000    67.00680000       NA       NA       NA
## SE.mean          1.8917697     0.13089697       NA       NA       NA
## CI.mean.0.95     3.7168156     0.25717712       NA       NA       NA
## var           1789.3963928     8.56700778       NA       NA       NA
## std.dev         42.3012576     2.92694513       NA       NA       NA
## coef.var         0.2391523     0.04368131       NA       NA       NA
##                      WBC_AP
## nbr.val          500.0000000
## nbr.null           0.0000000
## nbr.na             0.0000000
## min             3851.0000000
## max            10652.0000000
## range           6801.0000000
## sum          3447776.0000000
## median          6902.0000000
## mean            6895.5520000
## SE.mean           46.1807869
## CI.mean.0.95      90.7327494
## var          1066332.5403768
## std.dev         1032.6337881
## coef.var           0.1497536
```

```
summary(Assignment03_AP)
```

```
##      ID_AP        gender_AP    HR_AP      BP_AP        Wgt1_AP
##  Min.   :  1.0   female:500   High: 77   High: 94   Min.   : 49.2
##  1st Qu.:125.8                Low : 18   Low : 34   1st Qu.:114.3
##  Median :250.5                Norm:405   Norm:372   Median :131.7
##  Mean   :250.5                                      Mean   :131.0
##  3rd Qu.:375.2                                      3rd Qu.:149.6
##  Max.   :500.0                                      Max.   :199.3
##     Wgt2_AP       Exercise_AP        Hgt_AP      Smoke_AP Drink_AP
##  Min.   : 50.2   Min.   : 67.0   Min.   :59.80   N:427    N:140
##  1st Qu.:115.2   1st Qu.:147.0   1st Qu.:65.00   Y: 73    Y:360
##  Median :133.7   Median :175.5   Median :67.05
##  Mean   :132.9   Mean   :176.9   Mean   :67.01
##  3rd Qu.:151.6   3rd Qu.:207.0   3rd Qu.:69.00
##  Max.   :201.5   Max.   :297.0   Max.   :78.90
##     Group_AP       WBC_AP
##  Control:250   Min.   : 3851
##  Test   :250   1st Qu.: 6195
##                Median : 6902
##                Mean   : 6896
##                3rd Qu.: 7532
##                Max.   :10652
```

```
# we can observe that  Hgt_AP has low variance.

table(Assignment03_AP$Hgt_AP) # It displays how many records has same value

##
## 59.8 59.9 60.3 60.6 60.7 60.8 60.9 61.2 61.5 61.6 61.7 61.8 61.9 62.1 62.2
62.4
##    1    1    1    1    1    2    3    2    1    2    2    1    4    2    2
1
## 62.5 62.6 62.7 62.9   63 63.1 63.2 63.3 63.4 63.5 63.6 63.7 63.8 63.9   64
64.1
##    1    1    2    4    4    3    6    3    4    3    4    2    3    9    2
5
## 64.2 64.3 64.4 64.5 64.6 64.7 64.8   65 65.1 65.2 65.3 65.4 65.5 65.6 65.7
65.8
##    5    4    7    8    7    7    3    3    6    9    8    1    4    8    5
11
## 65.9   66 66.1 66.2 66.3 66.4 66.5 66.6 66.7 66.8 66.9   67 67.1 67.2 67.3
67.4
##    6    7    7    8    4    6    5    5    5   10    3    5    9    8    4
6
## 67.5 67.6 67.7 67.8 67.9   68 68.1 68.2 68.3 68.4 68.5 68.6 68.7 68.8 68.9
69
##   10    8    7    7    9    3    6    2    5    4    9    5    5    8    7
5
## 69.1 69.2 69.3 69.4 69.5 69.6 69.7 69.8 69.9   70 70.1 70.2 70.3 70.4 70.5
70.6
##    4   11    5    7   12    2    4    4    5    4    2    2    4    6    1
1
## 70.7 70.8 70.9   71 71.1 71.2 71.3 71.4 71.5 71.6 71.7 71.8 71.9 72.1 72.2
72.3
##    3    3    3    2    1    3    2    2    2    2    2    2    1    2    2
2
## 72.4 72.5 72.6 72.8 72.9   73 74.1 74.7 75.6 77.5 78.4 78.9
##    3    1    1    1    1    1    1    2    1    1    1    1

# For example, 9 records has 67.1 value in Hgt_AP column.

Assignment03_AP <- Assignment03_AP[-c(8)] #removes Hgt_AP column.

head(Assignment03_AP)

##   ID_AP gender_AP HR_AP BP_AP Wgt1_AP Wgt2_AP Exercise_AP Smoke_AP
Drink_AP
## 1     1    female  Norm  Norm   118.6   121.5         158        N
Y
## 2     2    female  Norm  Norm   143.1   146.6         152        N
Y
## 3     3    female  Norm  High   105.3   107.3         205        N
N
```

```
## 4     4    female  Norm  Norm   119.5   120.9         151        N
Y
## 5     5    female  Norm  High   130.9   132.1         178        N
N
## 6     6    female  Norm  High    90.0    91.4         204        N
Y
##   Group_AP WBC_AP
## 1  Control   5193
## 2  Control   5705
## 3     Test   7680
## 4  Control   7342
## 5  Control   7714
## 6  Control   3851
```

c. Apply the High Correlation Filter to remove appropriate columns of data.

#High correlation between two variables means they have similar trends and are #likely to carry similar information.

#No correlation available between numerical and nominal columns.

#pearson, spearman,kendall methos can be used to measure the degree of #association between two variables.

can only check for numerical and we have 4 column with numeric data so

#n(n-1)/2 (4*3/2 = 6) combination should be checked.

I have checked by three methods just for knowledge.

```
#by spearman method
#Speaman is non-parametric and therefore makes no normalacy assumption

cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$Wgt2_AP,method = "spearman")

## [1] 0.9990139

cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$Exercise_AP,method = "spearman")

## [1] -0.1848344

cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$WBC_AP,method = "spearman")

## [1] -0.002327948

cor(Assignment03_AP$Wgt2_AP,Assignment03_AP$Exercise_AP,method = "spearman")

## [1] -0.1808802
```

```r
cor(Assignment03_AP$Wgt2_AP,Assignment03_AP$WBC_AP,method = "spearman")
```

```
## [1] -0.001722567
```

```r
cor(Assignment03_AP$Exercise_AP,Assignment03_AP$WBC_AP,method = "spearman")
```

```
## [1] 0.08459301
```

```r
#by pearson method
#assumes normalacy

cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$Wgt2_AP,method = "pearson")
```

```
## [1] 0.9993236
```

```r
cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$Exercise_AP,method = "pearson")
```

```
## [1] -0.2027378
```

```r
cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$WBC_AP,method = "pearson")
```

```
## [1] 0.00158806
```

```r
cor(Assignment03_AP$Wgt2_AP,Assignment03_AP$Exercise_AP,method = "pearson")
```

```
## [1] -0.1998686
```

```r
cor(Assignment03_AP$Wgt2_AP,Assignment03_AP$WBC_AP,method = "pearson")
```

```
## [1] 0.001131027
```

```r
cor(Assignment03_AP$Exercise_AP,Assignment03_AP$WBC_AP,method = "pearson")
```

```
## [1] 0.07299489
```

```r
# by kendall method
#Kendall rank correlation (non-parametric) is an alternative to Pearson's
#correlation (parametric)

cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$Wgt2_AP,method = "kendall")
```

```
## [1] 0.9767528
```

```r
cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$Exercise_AP,method = "kendall")
```

```
## [1] -0.1257533
```

```r
cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$WBC_AP,method = "kendall")
```

```
## [1] -0.000344912
```

```r
cor(Assignment03_AP$Wgt2_AP,Assignment03_AP$Exercise_AP,method = "kendall")
```

```
## [1] -0.1230769
```

```
cor(Assignment03_AP$Wgt2_AP,Assignment03_AP$WBC_AP,method = "kendall")

## [1] 0.0003930487

cor(Assignment03_AP$Exercise_AP,Assignment03_AP$WBC_AP,method = "kendall")

## [1] 0.05623635
```

#Wgt1_AP and Wgt2_AP are highly correlated to each other so going to drop # Wgt2_AP column

```
Assignment03_AP <- Assignment03_AP[-c(6)]
head(Assignment03_AP)

##   ID_AP gender_AP HR_AP BP_AP Wgt1_AP Exercise_AP Smoke_AP Drink_AP
Group_AP
## 1     1    female  Norm  Norm   118.6         158        N        Y
Control
## 2     2    female  Norm  Norm   143.1         152        N        Y
Control
## 3     3    female  Norm  High   105.3         205        N        N
Test
## 4     4    female  Norm  Norm   119.5         151        N        Y
Control
## 5     5    female  Norm  High   130.9         178        N        N
Control
## 6     6    female  Norm  High    90.0         204        N        Y
Control
##   WBC_AP
## 1   5193
## 2   5705
## 3   7680
## 4   7342
## 5   7714
## 6   3851
```

d. Drop any variables that do not contribute any useful analytical information at all.

Answer: Here, I am going to drop gender_AP columns as it contains only Females so it is not quite useful for analytic purpose.

```
Assignment03_AP <- Assignment03_AP[-c(2)]
head(Assignment03_AP)

##   ID_AP HR_AP BP_AP Wgt1_AP Exercise_AP Smoke_AP Drink_AP Group_AP WBC_AP
## 1     1  Norm  Norm   118.6         158        N        Y  Control   5193
## 2     2  Norm  Norm   143.1         152        N        Y  Control   5705
## 3     3  Norm  High   105.3         205        N        N     Test   7680
## 4     4  Norm  Norm   119.5         151        N        Y  Control   7342
## 5     5  Norm  High   130.9         178        N        N  Control   7714
## 6     6  Norm  High    90.0         204        N        Y  Control   3851
```

Q1 (3).

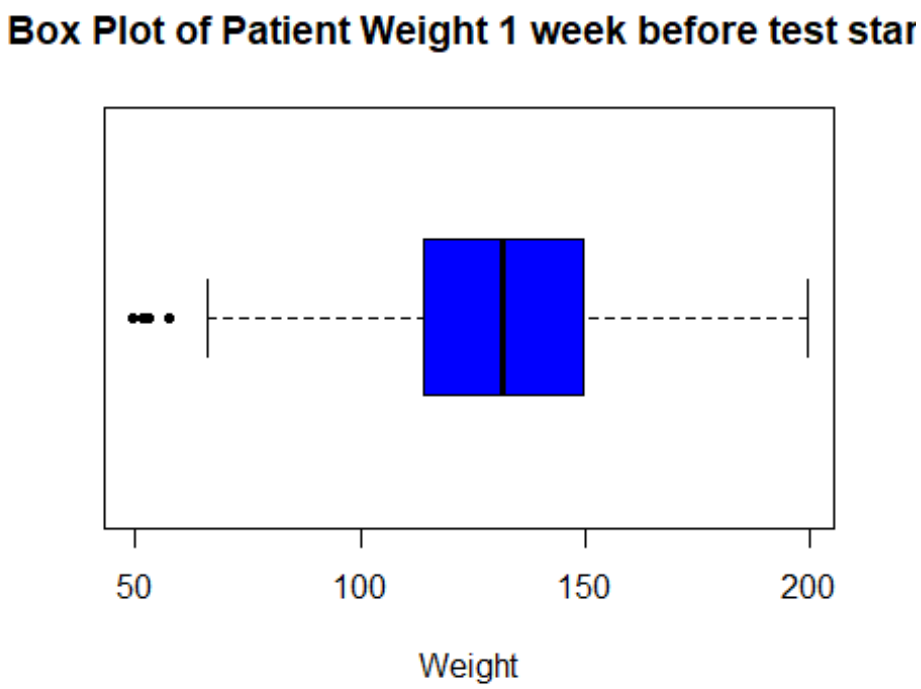
Outliers

a. Create boxplots of all relevant variables (i.e. numeric, non-binary) to determine outliers.

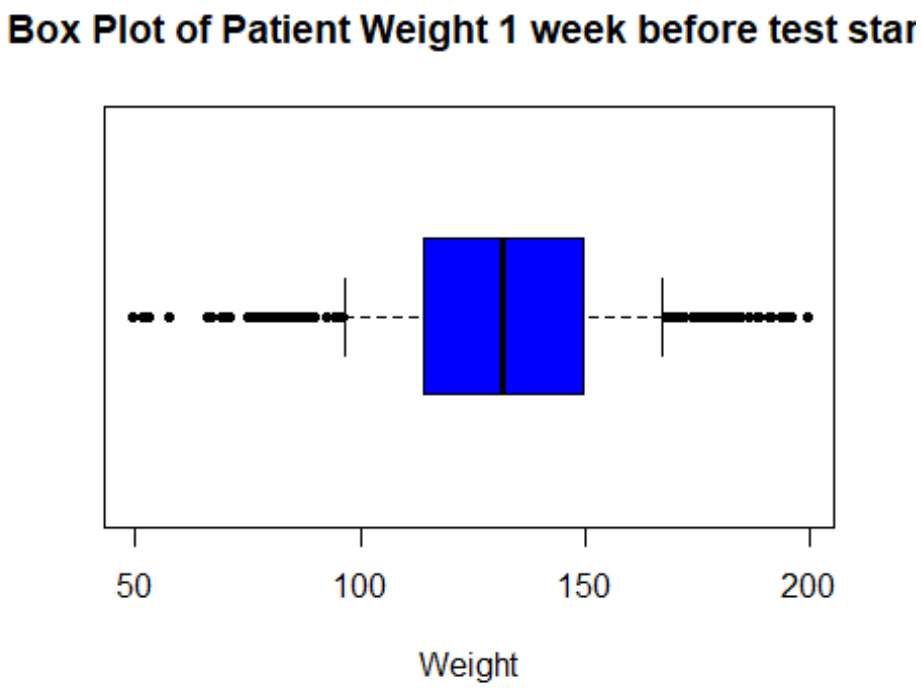
```
str(Assignment03_AP)
```

```
## 'data.frame':    500 obs. of  9 variables:
##  $ ID_AP      : num  1 2 3 4 5 6 7 8 9 10 ...
##  $ HR_AP      : Factor w/ 3 levels "High","Low","Norm": 3 3 3 3 3 3 3 3 3
3 ...
##  $ BP_AP      : Factor w/ 3 levels "High","Low","Norm": 3 3 1 3 1 1 3 3 3
3 ...
##  $ Wgt1_AP    : num  119 143 105 120 131 ...
##  $ Exercise_AP: num  158 152 205 151 178 204 91 160 246 153 ...
##  $ Smoke_AP   : Factor w/ 2 levels "N","Y": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Drink_AP   : Factor w/ 2 levels "N","Y": 2 2 1 2 1 2 1 2 2 2 ...
##  $ Group_AP   : Factor w/ 2 levels "Control","Test": 1 1 2 1 1 1 2 1 1 1
...
##  $ WBC_AP     : num  5193 5705 7680 7342 7714 ...
```

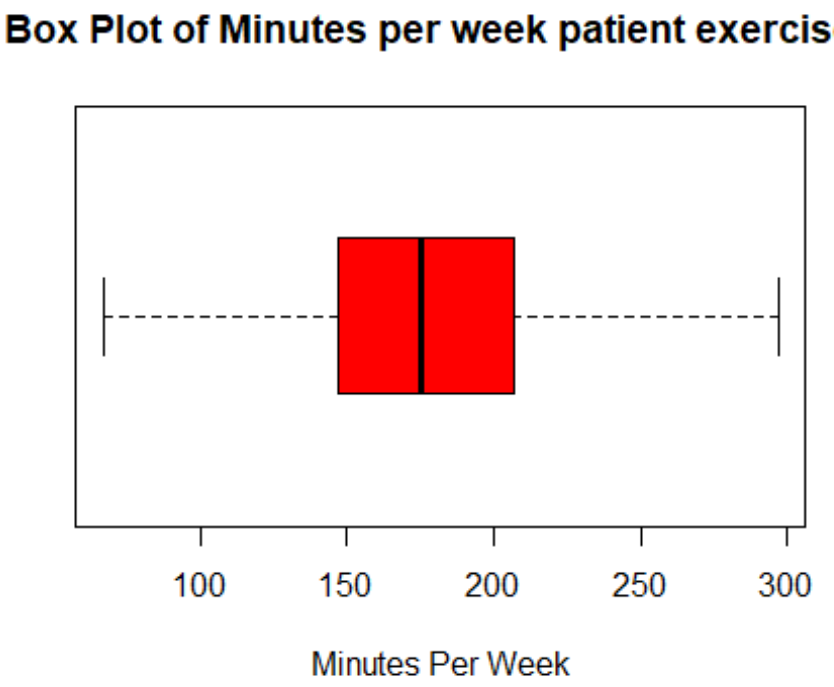
```
boxplot(Assignment03_AP$Wgt1_AP,
       main="Box Plot of Patient Weight 1 week before test start",
        xlab="Weight",
        col="blue", horizontal=TRUE, pch=20)
```



```r
# let's shrink the graph and observe

boxplot(Assignment03_AP$Wgt1_AP,
       main="Box Plot of Patient Weight 1 week before test start",
        xlab="Weight",
        col="blue", horizontal=TRUE, pch=20, range = 0.5)
```

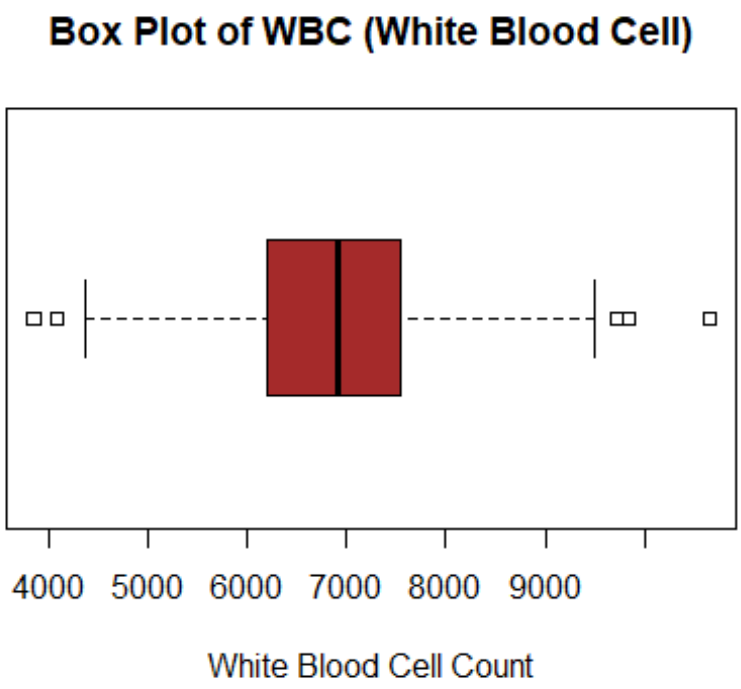



```r
boxplot(Assignment03_AP$Exercise_AP,
        main="Box Plot of Minutes per week patient exercises",
        xlab="Minutes Per Week",
        col="red", horizontal=TRUE, pch=21)
```

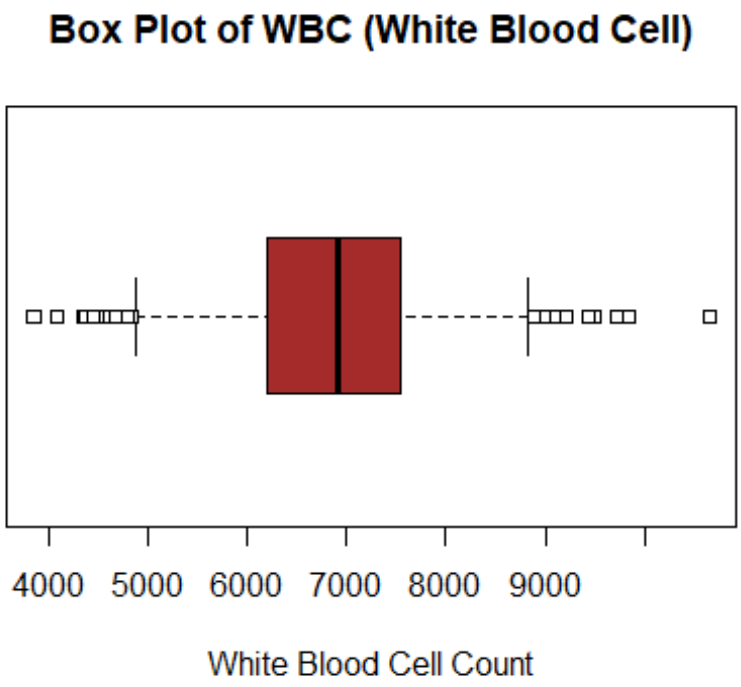



```
# let's shrink the graph and observe

boxplot(Assignment03_AP$Exercise_AP,
        main="Box Plot of Minutes per week patient exercises",
        xlab="Minutes Per Week",
        col="red", horizontal=TRUE, pch=21, range = 1)
```

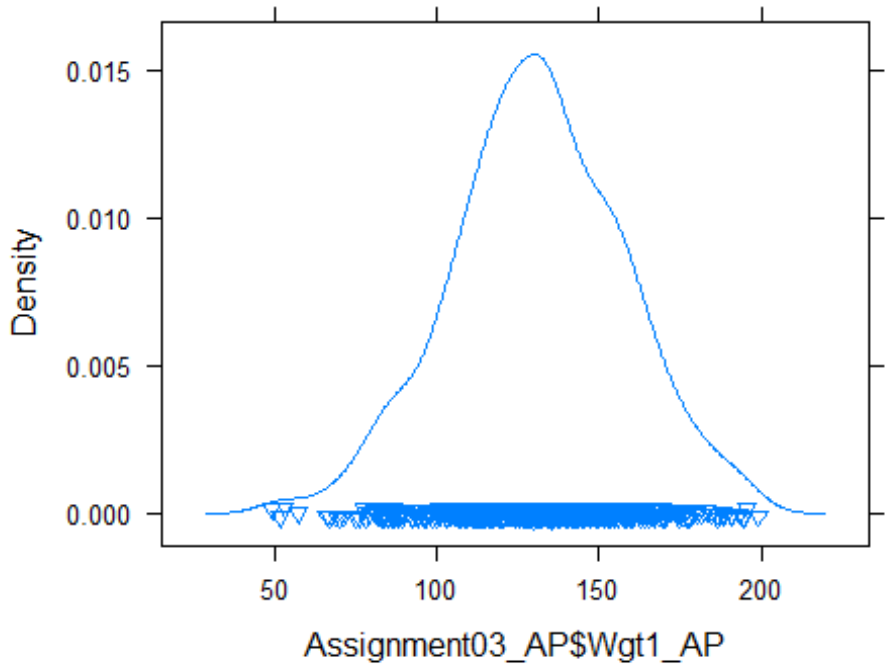

```
boxplot(Assignment03_AP$WBC_AP,
        main="Box Plot of WBC (White Blood Cell)",
        xlab="White Blood Cell Count",
        col="brown",horizontal=TRUE, pch=22)
```



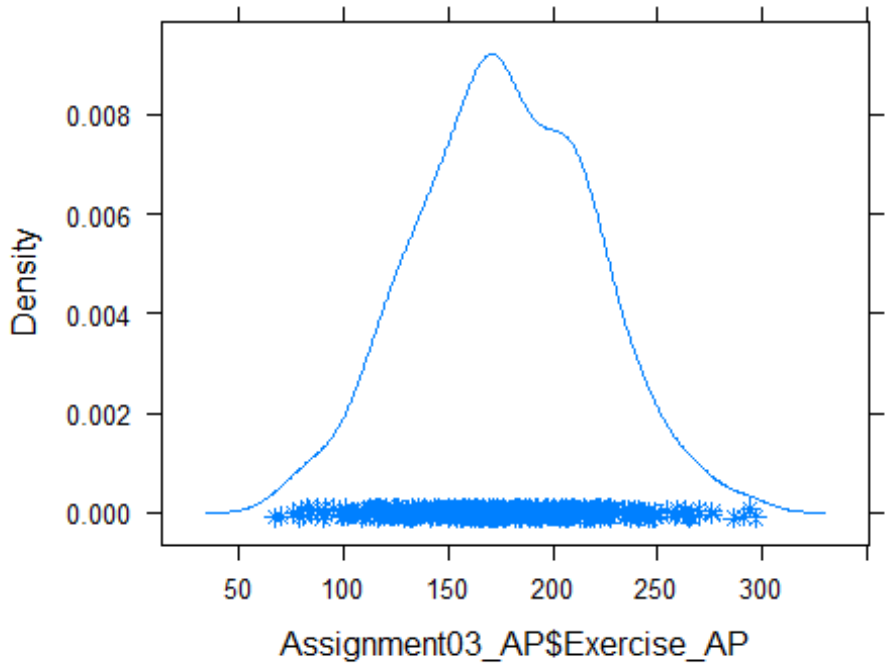

```
# let's shrink the graph and observe

boxplot(Assignment03_AP$WBC_AP,
        main="Box Plot of WBC (White Blood Cell)",
        xlab="White Blood Cell Count",
        col="brown",horizontal=TRUE, pch=22, range = 1)
```



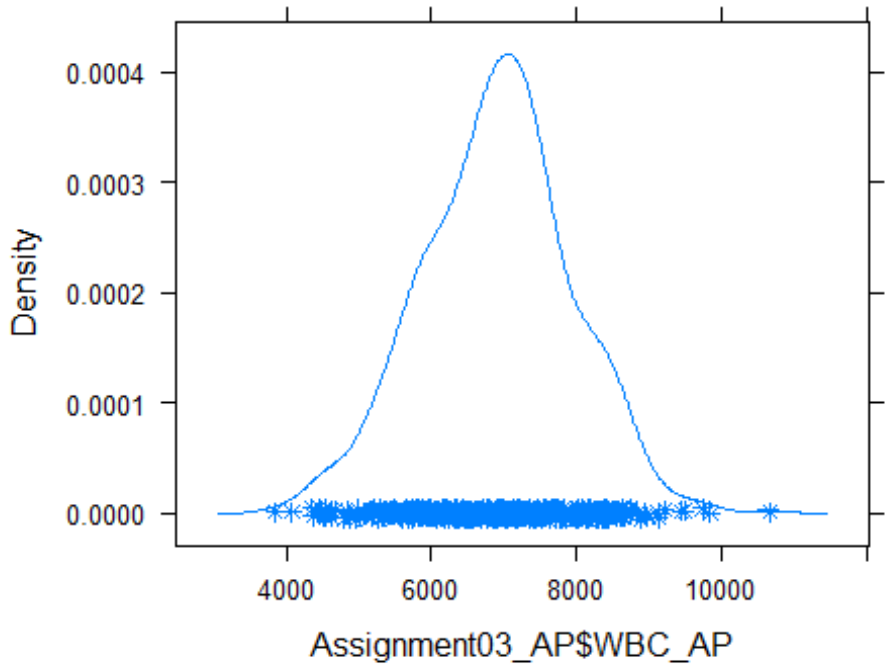

```
densityplot( ~ Assignment03_AP$Wgt1_AP, pch=6)
```




```
densityplot( ~ Assignment03_AP$Exercise_AP, pch=8)
```

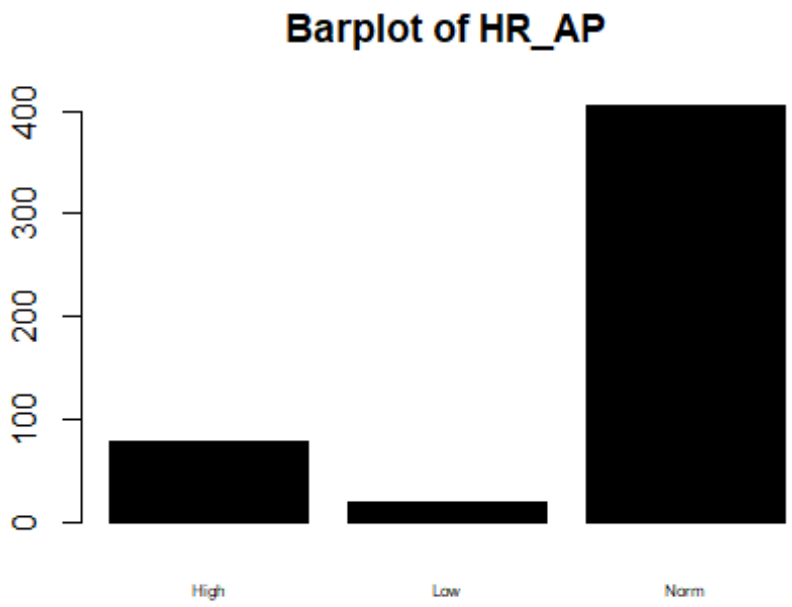



```
densityplot( ~ Assignment03_AP$WBC_AP, pch=8)
```

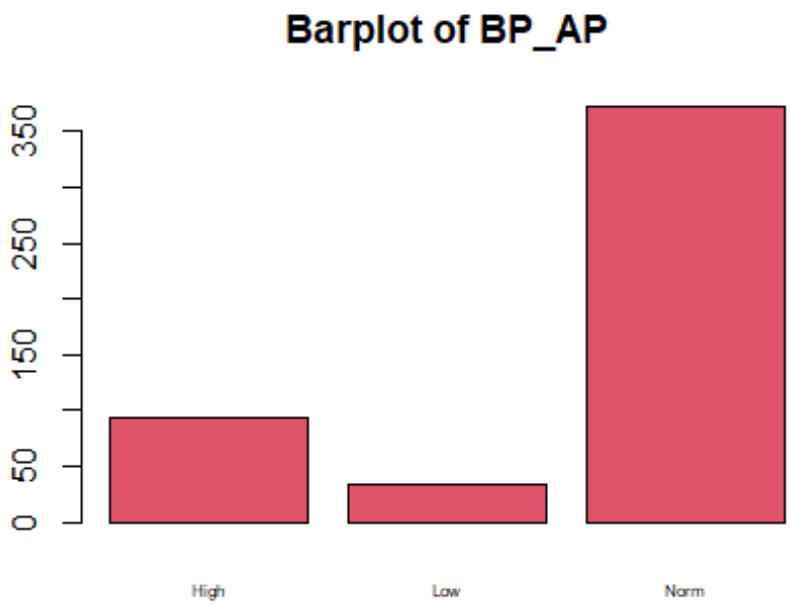


For factor variables.(for non-binary variables only)

```
Assignment03_AP$HR_AP <- as.factor(Assignment03_AP$HR_AP)
Assignment03_AP$BP_AP <- as.factor(Assignment03_AP$BP_AP)


barplot(table(Assignment03_AP$HR_AP), cex.names=0.5, main="Barplot of HR_AP",
        col = 1)
```




```
barplot(table(Assignment03_AP$BP_AP), cex.names=0.5, main="Barplot of BP_AP",
        col = 2)
```

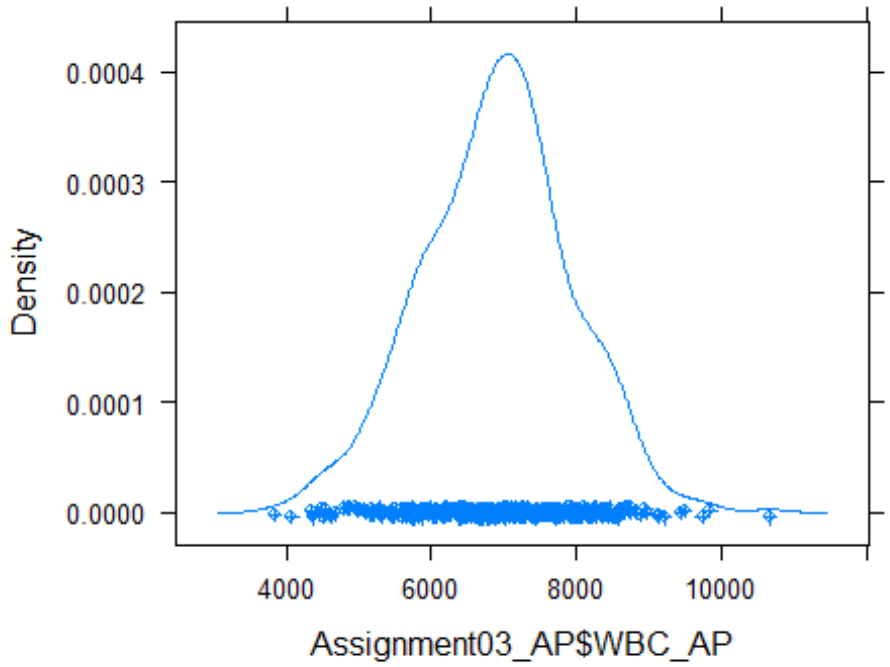


b. Comment on any outliers you see and deal with them appropriately.

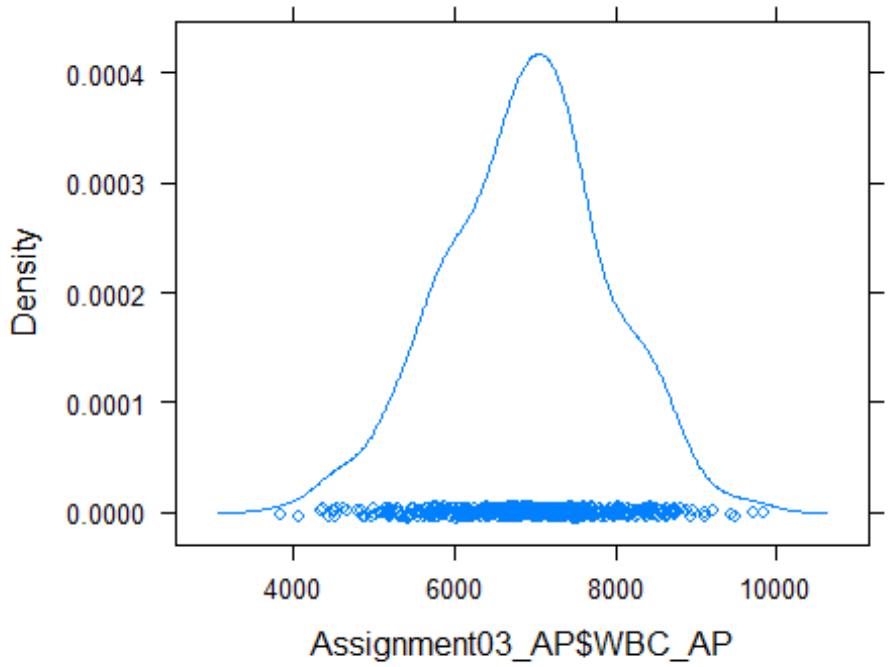
Conclusion:1. wgt1_AP looks good. 2. Exercise_AP looks good. 3. WBC_AP has one outlier. low HR_AP and low BP_AP categories as comparatively small values than that of normal category still they are useful.

#To remove a outlier of WBC_AP at its max value.

```
densityplot( ~ Assignment03_AP$WBC_AP, pch=10)
```




```
nr <- which(Assignment03_AP$WBC_AP == max(Assignment03_AP$WBC_AP))
#above code is to detect Row number with max value
Assignment03_AP <- Assignment03_AP[-c(nr),]
densityplot( ~ Assignment03_AP$WBC_AP, pch=21)
```



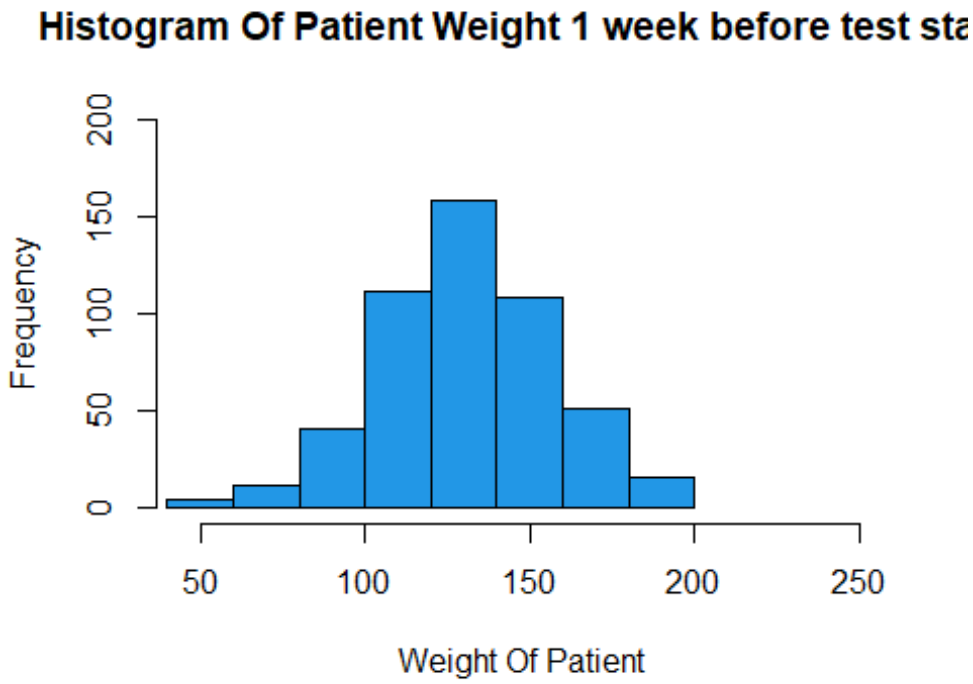
Q2.

Organizing Data

1. Scatter Plots

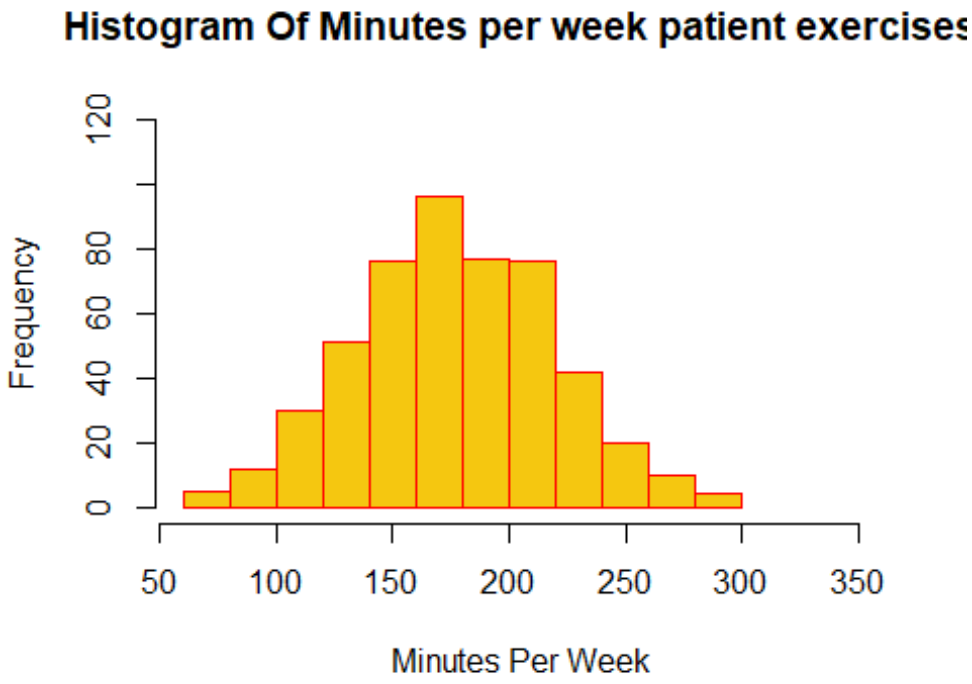
a. Create a histogram for one of the Weight variables.

```
hist(Assignment03_AP$Wgt1_AP,
     main = "Histogram Of Patient Weight 1 week before test start",
     xlab = "Weight Of Patient",
     xlim = c(45,250),
     ylim = c(0,200),
     col = 4, border = "black")
```



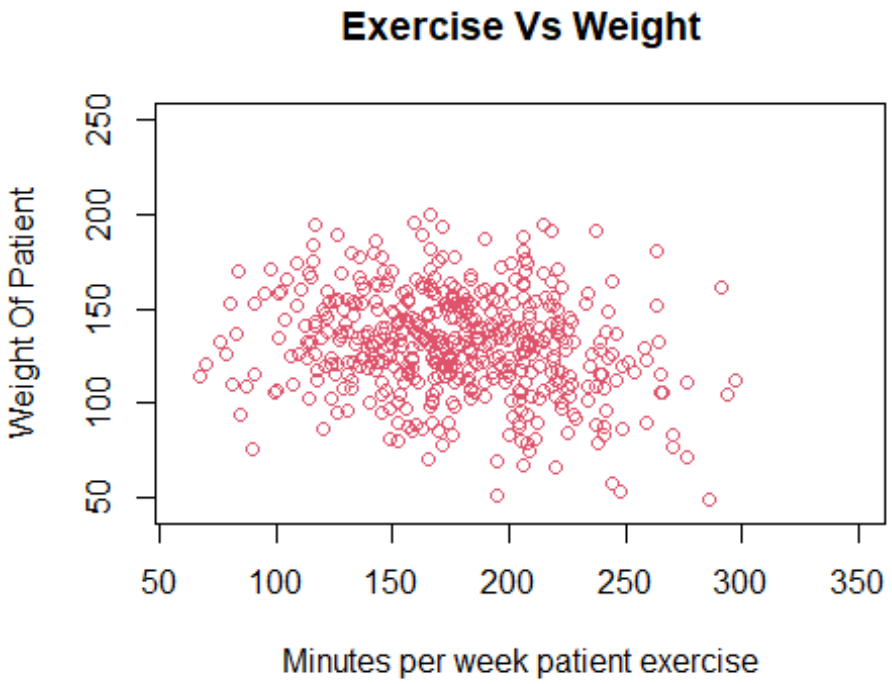
b. Create a histogram for Exercise.

```
hist(Assignment03_AP$Exercise_AP,
     main = "Histogram Of Minutes per week patient exercises",
     xlab = "Minutes Per Week",
     xlim = c(60,350),
     ylim = c(0,120),
     col = 7, border="red")
```



c. Create a scatter plot showing the relationship between Exercise and Weight. (note: Exercise should be on the x-axis, Weight should be the y-axis)

```
plot(Assignment03_AP$Wgt1_AP~Assignment03_AP$Exercise_AP,
     main = "Exercise Vs Weight",
     xlab = "Minutes per week patient exercise",
     ylab =  "Weight Of Patient",
     xlim = c(60,350),
     ylim = c(45,250),
     col = 2)
```

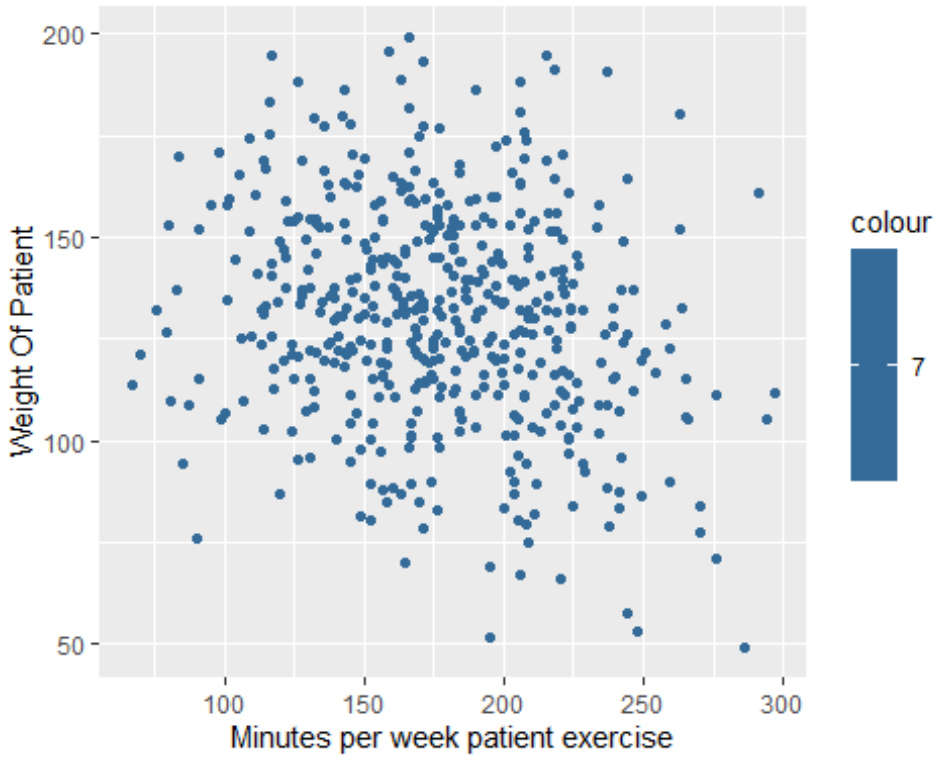


d. What conclusions, if any, can you draw from the chart? From the above chart (scatter plot), we can see that there is not any linear relation between these two variables.

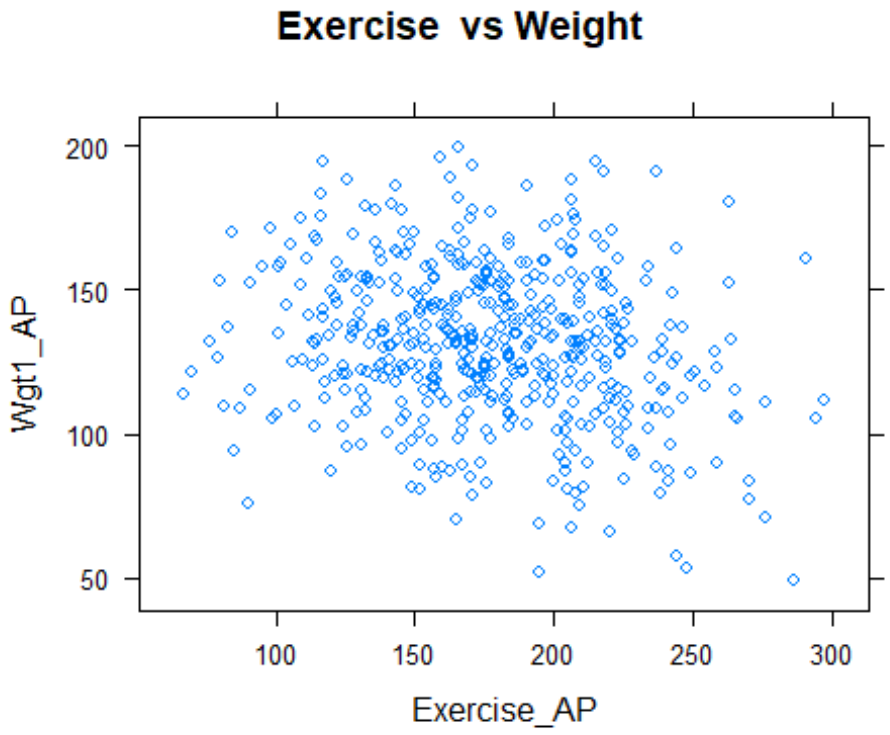
---

e. Calculate a correlation coefficient between these two variables (Wgt1_AP & Exercise_AP) What conclusion you draw from it?

```
ggplot(data = Assignment03_AP, aes(x = Exercise_AP,
                                   y = Wgt1_AP,
                                   color = 7)) +
 geom_point()+ labs(y = "Weight Of Patient",
x = "Minutes per week patient exercise")
```




```
xyplot(Wgt1_AP~Exercise_AP, data=Assignment03_AP, main="Exercise  vs Weight",
       colors=TRUE)
```



```
cor(Assignment03_AP$Wgt1_AP,Assignment03_AP$Exercise_AP)

## [1] -0.1993163

cor.test(Assignment03_AP$Wgt1_AP,Assignment03_AP$Exercise_AP,
         method="spearman")

## Warning in cor.test.default(Assignment03_AP$Wgt1_AP,
## Assignment03_AP$Exercise_AP, : Cannot compute exact p-value with ties

##
##  Spearman's rank correlation rho
##
## data:  Assignment03_AP$Wgt1_AP and Assignment03_AP$Exercise_AP
## S = 24468852, p-value = 0.00004502
## alternative hypothesis: true rho is not equal to 0
## sample estimates:
##        rho
## -0.1815849
```

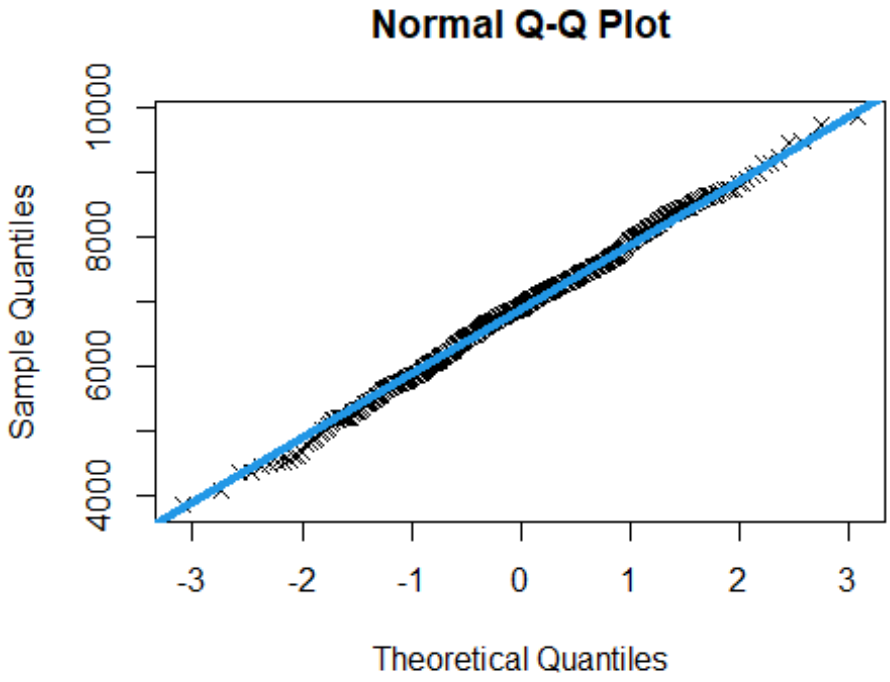
Conclusion: There is no linear relationship as our $0.00 \leq |r| < 0.25$.

Q3 Inference

1. Normality

a. Create a QQ Normal plot of White Blood Cell counts.

```
qqnorm(Assignment03_AP$WBC_AP, pch=4, frame=TRUE)
qqline(Assignment03_AP$WBC_AP, col=4, lwd=4)
```



b. Conduct a statistical test for normality on White Blood Cell counts.

```
shapiro.test(Assignment03_AP$WBC_AP) #Shapiro-Wilk Normality Test

##
##  Shapiro-Wilk normality test
##
## data:  Assignment03_AP$WBC_AP
## W = 0.99738, p-value = 0.6203
```

c. Is White Blood Cell count normally distributed? What led you to this conclusion?

Yes, White Blood Cell Count is normally distributed.

1.as p-value = 0.6 which is GREATER THAN 0.05 (P>0.05) that means we cannot reject Null hypothesis which state that variable is normally distributed.

2.From QQ Normal Plot and qq line all the points are on and close to line which indicates normality of variable.(from Q3 a)

Statistically Significant Differences

a. Compare White Blood Cell counts between the treatment and control group using a suitable hypothesis test.

```
# to perform F test to see whether variance are equal or not.
```

```
Ftest_AP <- var.test(WBC_AP~Group_AP, data = Assignment03_AP)
Ftest_AP

##
##  F test to compare two variances
##
## data:  WBC_AP by Group_AP
## F = 1.0601, num df = 248, denom df = 249, p-value = 0.6456
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##  0.8262879 1.3602413
## sample estimates:
## ratio of variances
##           1.060132

# from F-test p > 0.05 that means no significant difference in variances or
# variance of variables are almost same.

# I have described reasons behind choosing this test below.

Ttest_AP <- t.test(WBC_AP~Group_AP, data = Assignment03_AP, var.equal=TRUE)
Ttest_AP

##
##  Two Sample t-test
##
## data:  WBC_AP by Group_AP
## t = -2.4461, df = 497, p-value = 0.01479
## alternative hypothesis: true difference in means between group Control and
group Test is not equal to 0
## 95 percent confidence interval:
##  -400.7539  -43.7367
## sample estimates:
## mean in group Control    mean in group Test
##              6776.679              6998.924
```

b. Explain why you chose the test you did.

   a. Data is Independent
   b. Data is normally distributed (From Shapiro-Wilks Test)
   c. Variance is unknown, but equal (From F-Test)

   A t-test is a statistical test that is used to compare the means of two groups. It is often used in hypothesis testing to determine whether a process or treatment actually has an effect on the population of interest, or whether two groups are different from one another.

   Reference:Bevans, R. (2022, July 9). An introduction to t-tests. Scribbr. Retrieved October 20, 2022, from #https://www.scribbr.com/statistics/t-test/

c. Do you have strong evidence that White Blood Cell counts are different between the treatment and control groups?

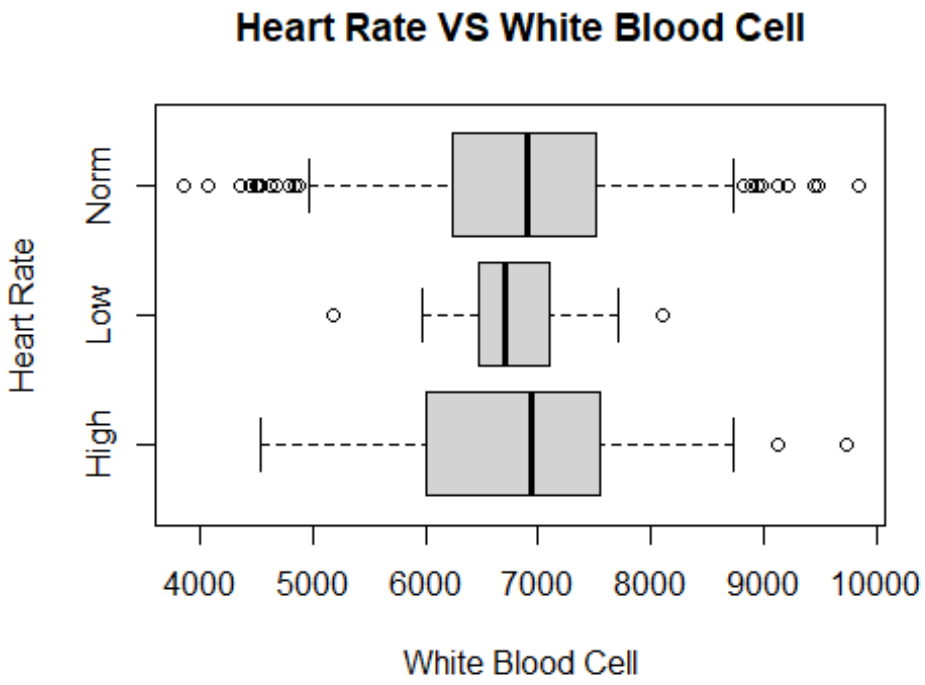
Yes, From the T-Test, I can say that White Blood Cell Counts are different between the treatment and control groups as p-value is less than 0.05 which provide evidence against Null Hypothesis.

---

3. Multiple Statistical Differences

a. Determine if White Blood Cell count varies by Heart Rate Level using ANOVA (statistical) and a sequence of boxplots (graphical).

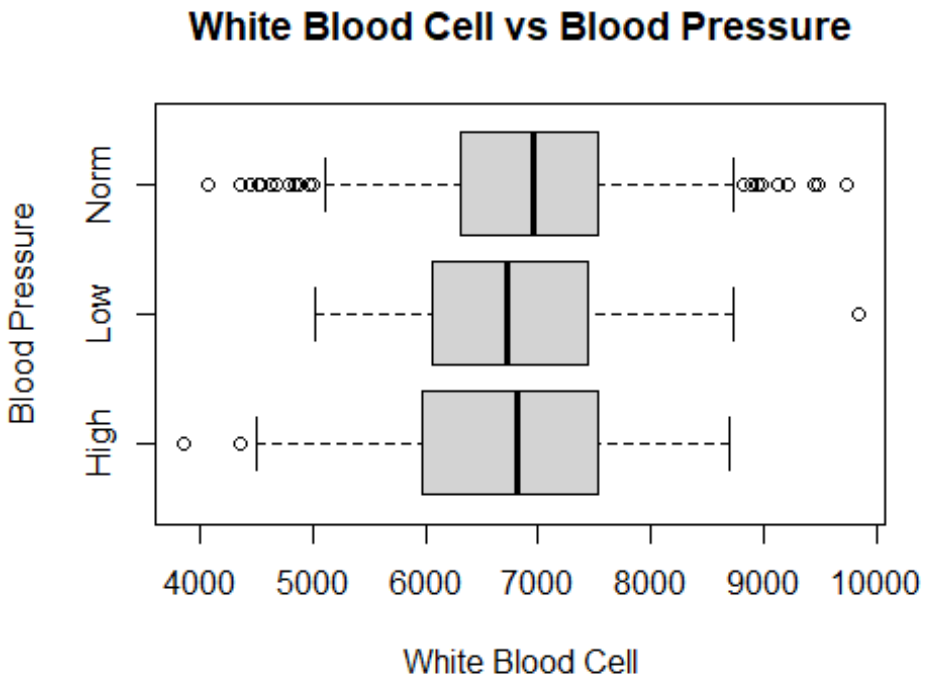
```
summary(aov(WBC_AP~HR_AP, data = Assignment03_AP))

##              Df    Sum Sq Mean Sq F value Pr(>F)
## HR_AP         2    303459  151729   0.145  0.865
## Residuals   496 517657299 1043664

boxplot(WBC_AP~HR_AP, data = Assignment03_AP,
        main = "Heart Rate VS White Blood Cell",
        ylab = "Heart Rate",
        xlab = "White Blood Cell", horizontal = TRUE,
        range = 1)
```



Conclusion: No, White Blood Cell count do not vary by Heart Rate Level as p-value is greater than 0.05 so mean of all the groups is almost same.

b. Determine if White Blood Cell count varies by Blood Pressure Level using ANOVA and a sequence of boxplots.

```
summary(aov(WBC_AP~BP_AP, data = Assignment03_AP))

##              Df    Sum Sq Mean Sq F value Pr(>F)
## BP_AP         2   2231837 1115918   1.073  0.343
## Residuals   496 515728921 1039776

boxplot(WBC_AP~BP_AP, data = Assignment03_AP,
        main = "White Blood Cell vs Blood Pressure",
        ylab = "Blood Pressure",
        xlab = "White Blood Cell", horizontal = TRUE,
        range = 1)
```



Conclusion: No, White Blood Cell count do not vary by Blood Pressure Level as we can see p-value derived from ANOVA Test is greater than 0.05 which indicates that means of all BP categories are probably same. Moreover, Boxplot also indicates same result.