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**No** :15011702 **Signature** :

HOME WORK 1 (Return by 09.01.2021)

## BLM3590 – Statistical Data Analysis

| T1(10) | T2(15) | T3(15) | T4(15) | T5(15) | T6(15) | T7(15) | | | | Total(100) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

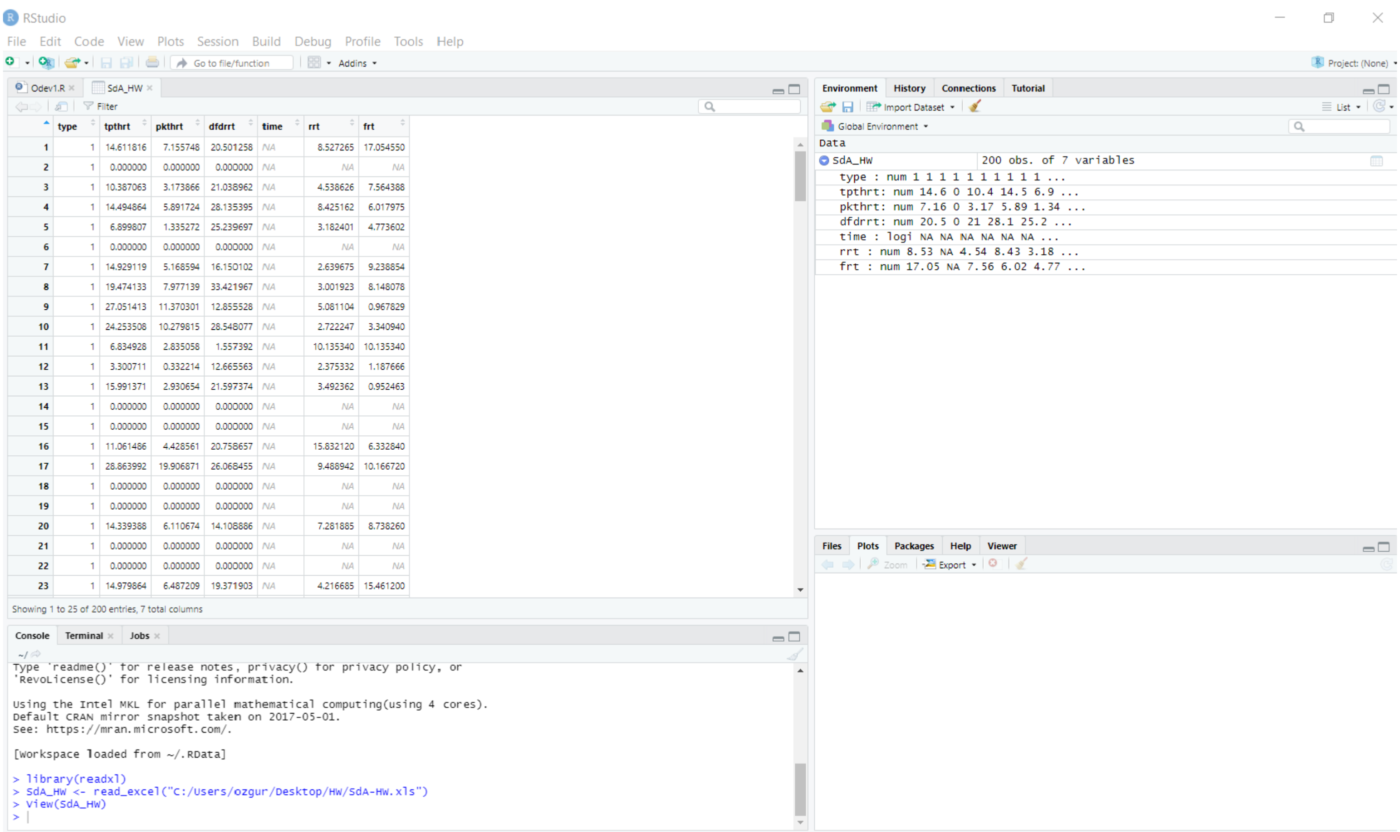
The attached Excel file (**SdA-HW**) consists of two data types (embolic signals (**type 1**), and Doppler speckle (**type 2**)) recorded from stroke patients and some relevant numerical variables (**tpthrt**, **pkthrt**, **dfdrrt**, **time**, **rrt**, **frt**). Using this data file, implement the following tasks in **R**. You must include the **R** scripts in your answers.

==============================================================================

**T1:** Show how to read this Excel datafile into **R** environment.

------------------------------------------------------------------------------

```
library(readxl)
SdA_HW <- read_excel("C:/Users/ozgur/Desktop/HW/SdA-HW.xls")
View(SdA_HW)
```



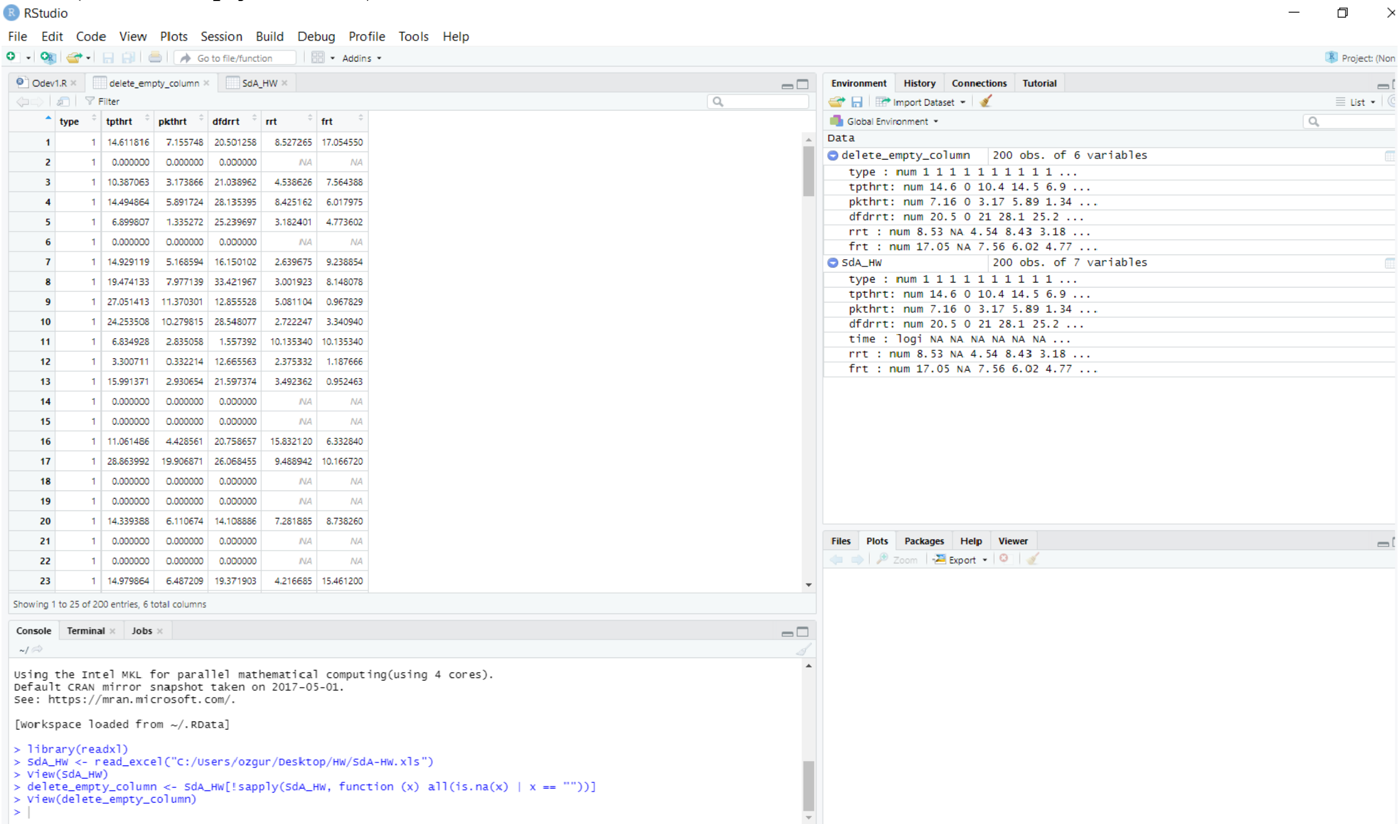
==================================================================================

**T2:** This data file requires some preprocessing as it inludes a column with no value, some cells with no numerical value (divide by 0 error, etc.), and some cells with zero. Write required script in **R** to remove the empty column and correct the cells with no numerical value and zero by using simple interpolation.

---

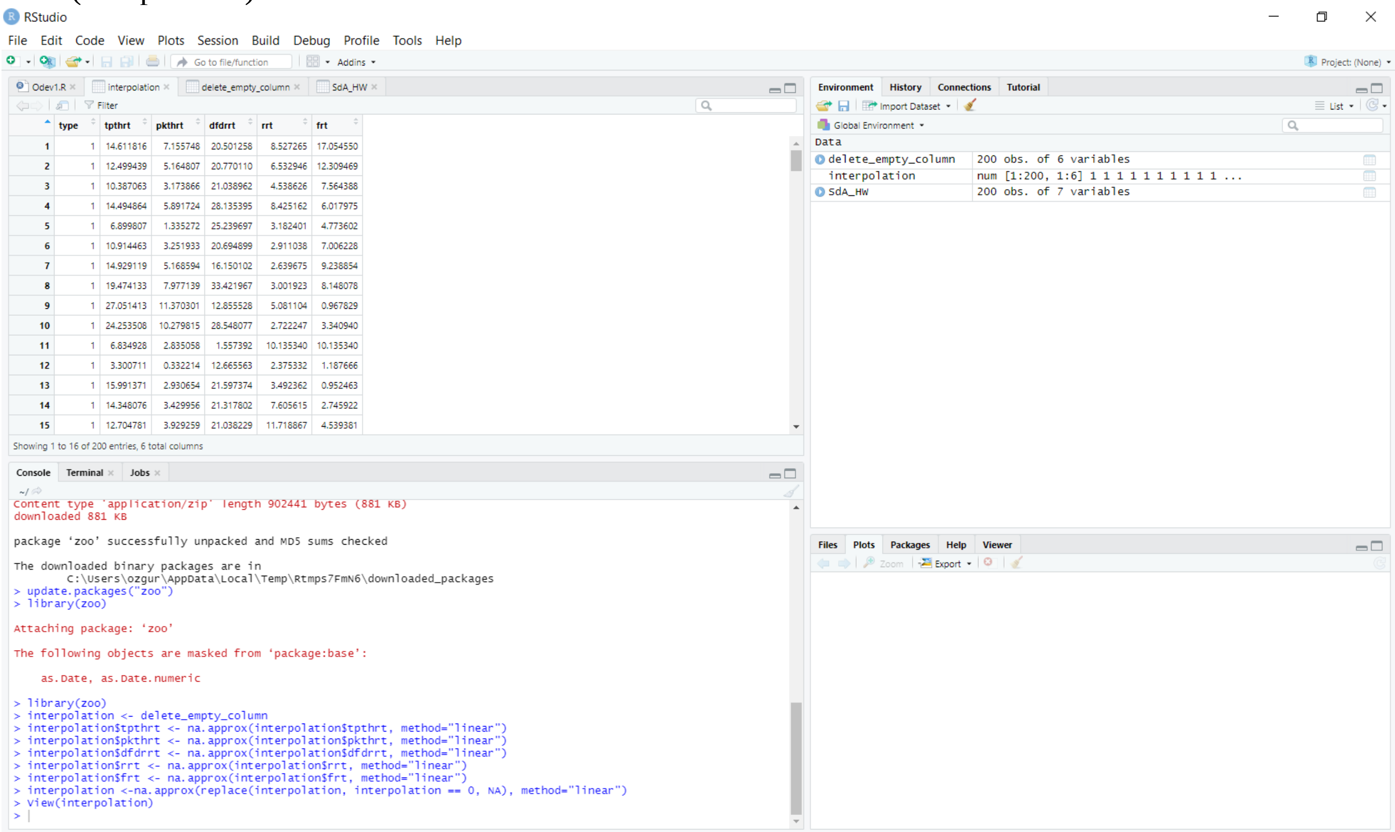
## DELETE EMPTY COLUMN

```
delete_empty_column <- SdA_HW[!sapply(SdA_HW, function (x) all(is.na(x) | x == ""))]
View(delete_empty_column)
```



# SİMPLE İNTERPOLATİON

```
install.packages("zoo")
update.packages("zoo")
library(zoo)
interpolation <- delete_empty_column
interpolation$tpthrt <- na.approx(interpolation$tpthrt, method="linear")
interpolation$pkthrt <- na.approx(interpolation$pkthrt, method="linear")
interpolation$dfdrrt <- na.approx(interpolation$dfdrrt, method="linear")
interpolation$rrt <- na.approx(interpolation$rrt, method="linear")
interpolation$frt <- na.approx(interpolation$frt, method="linear")
interpolation <-na.approx(replace(interpolation, interpolation == 0, NA), method="linear")
View(interpolation)
```



==================================================================================

**T3:** Find **Five-number data summary** of the **variables** for each **data type** in this dataset.

-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------

# TYPE 1

```
type1 <-interpolation[ interpolation[,"type"]==1, ]
View(type1)
fivenum(type1[,"tpthrt"])
summary(type1[,"tpthrt"])
fivenum(type1[,"pkthrt"])
summary(type1[,"pkthrt"])
fivenum(type1[,"dfdrrt"])
summary(type1[,"dfdrrt"])
fivenum(type1[,"rrt"])
summary(type1[,"rrt"])
fivenum(type1[,"frt"])
summary(type1[,"frt"])
```

## TPTHRT

**0.33637 11.70441 14.73410 19.47500 28.86399**

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| 0.3364 | 11.7300 | 14.7300 | 15.4800 | 19.4700 | 28.8600 |

## PKTHRT

**-8.358763 3.299621 5.949281 8.369141 19.906871**

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| -8.359 | 3.320 | 5.949 | 5.793 | 8.319 | 19.910 |

## DFDRRT

**0.26008 12.06188 17.85649 22.45371 45.41403**

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| 0.2601 | 12.2700 | 17.8600 | 17.5900 | 22.4100 | 45.4100 |

## RRT

**-59.765200 2.920039 5.654713 9.475557 20.609650**

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| -59.770 | 2.925 | 5.655 | 4.236 | 9.469 | 20.610 |

## FRT

**0.952463 4.544763 6.596013 10.113480 24.732330**

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| 0.9525 | 4.5470 | 6.5960 | 7.5670 | 10.1000 | 24.7300 |

# TYPE 2

```
type2 <-interpolation[ interpolation[,"type"]==2, ]
View(type2)
fivenum(type2[,"tpthrt"])
summary(type2[,"tpthrt"])
fivenum(type2[,"pkthrt"])
summary(type2[,"pkthrt"])
fivenum(type2[,"dfdrrt"])
summary(type2[,"dfdrrt"])
fivenum(type2[,"rrt"])
summary(type2[,"rrt"])
fivenum(type2[,"frt"])
summary(type2[,"frt"])
```

## TPTHRT

0.008013 8.021390 11.451825 14.274517 20.963047

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| 0.008013 | 8.039000 | 11.450000 | 11.090000 | 14.270000 | 20.960000 |

## PKTHRT

-9.622567 -1.020240 1.276692 4.162536 7.323946

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| -9.623 | -1.003 | 1.277 | 1.301 | 4.161 | 7.324 |

## DFDRRT

-3.475887 6.807376 13.798834 21.922938 40.545011

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| -3.476 | 7.022 | 13.800 | 14.420 | 21.880 | 40.550 |

## RRT

-68.801400 -7.294725 2.210573 4.650650 26.127030

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| -68.800 | -7.168 | 2.211 | -3.131 | 4.616 | 26.130 |

## FRT

0.057293 2.127381 3.901223 6.326019 32.282380

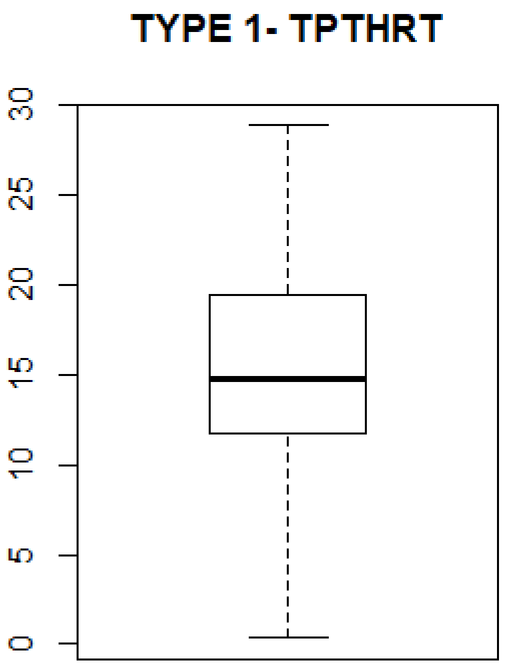
| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|---|---|---|---|---|---|
| 0.05729 | 2.16400 | 3.90100 | 4.93300 | 6.30500 | 32.28000 |

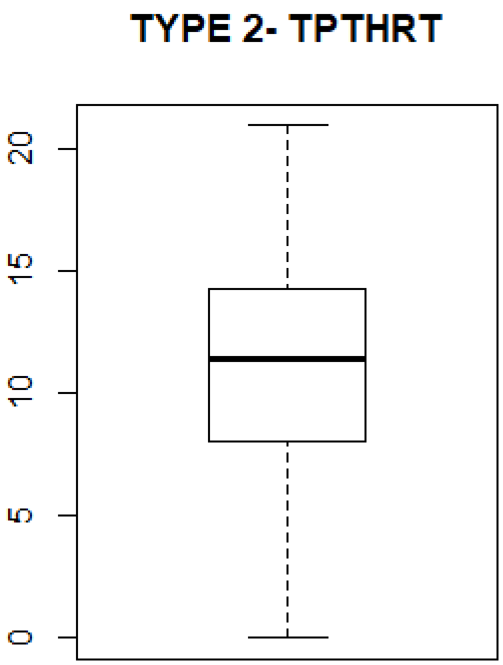
==========================================================================

**T4:** Plot **boxplots** of the **variables** for each **data type** and determine if there is any outlier in these variables.

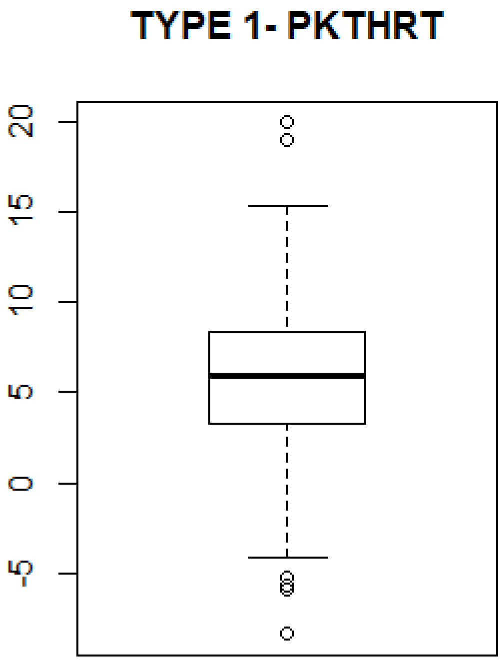
---

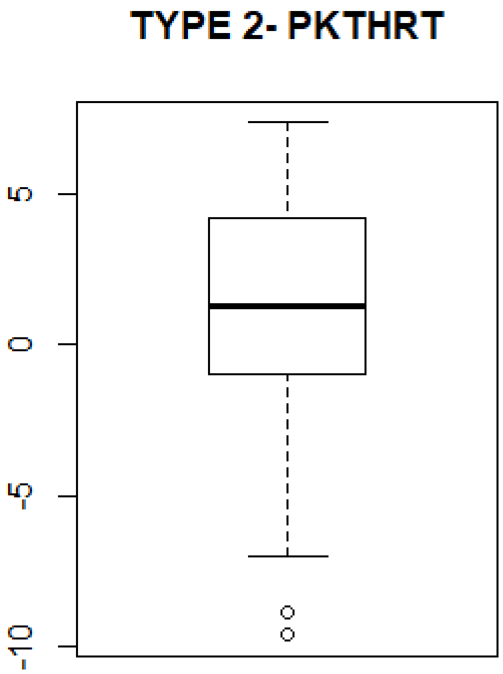
```
boxplot(type1[,"tpthrt"],main="TYPE 1- TPTHRT")
boxplot(type1[,"pkthrt"],main="TYPE 1- PKTHRT")
boxplot(type1[,"dfdrrt"],main="TYPE 1- DFDRRT")
boxplot(type1[,"rrt"],main="TYPE 1- RRT")
boxplot(type1[,"frt"],main="TYPE 1- FRT")

boxplot(type2[,"tpthrt"],main="TYPE 2- TPTHRT")
boxplot(type2[,"pkthrt"],main="TYPE 2- PKTHRT")
boxplot(type2[,"dfdrrt"],main="TYPE 2- DFDRRT")
boxplot(type2[,"rrt"],main="TYPE 2- RRT")
boxplot(type2[,"frt"],main="TYPE 2- FRT")
```



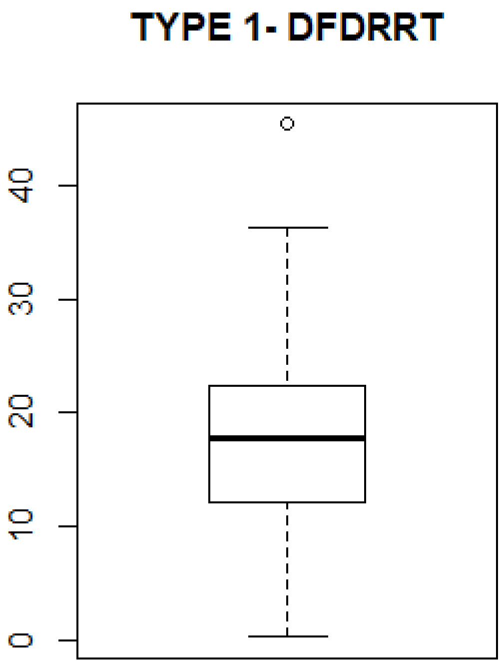



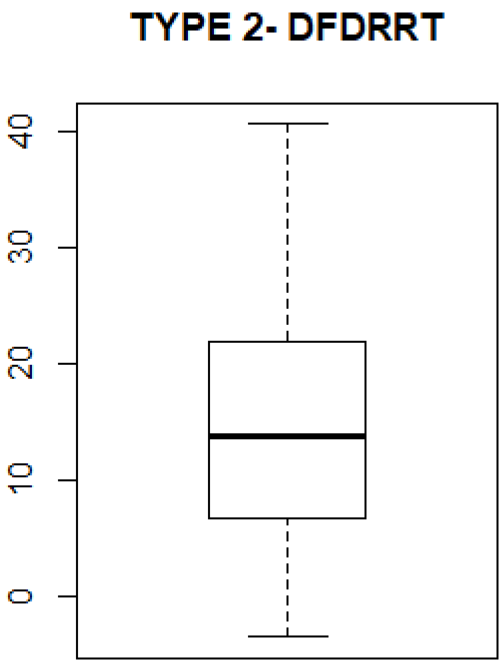

**For "TYPE1-TPTHRT", the boxplot is almost symmetric, there is no outlier, central tendency is around 15.**
**For " TYPE2-TPTHRT ", the boxplot is almost symmetric, there is no outlier, central tendency is around 10-15.**



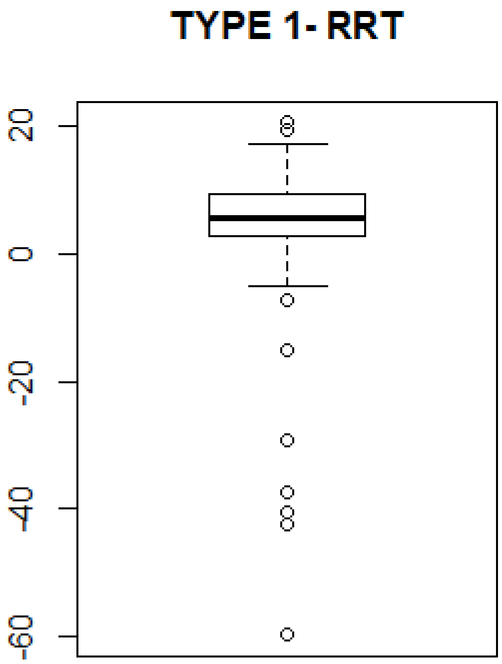



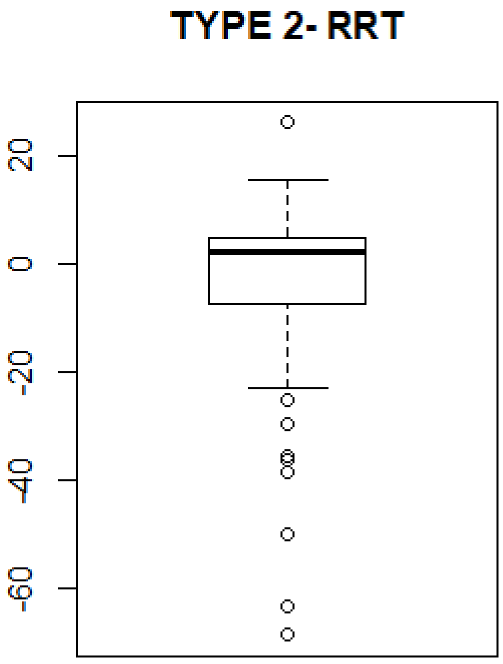

For "TYPE1-PKTHRT", the boxplot have outlier. The central tendency is around 5-10.
For " TYPE2- PKTHRT ", the boxplot have outlier. The central tendency is around 0-5.



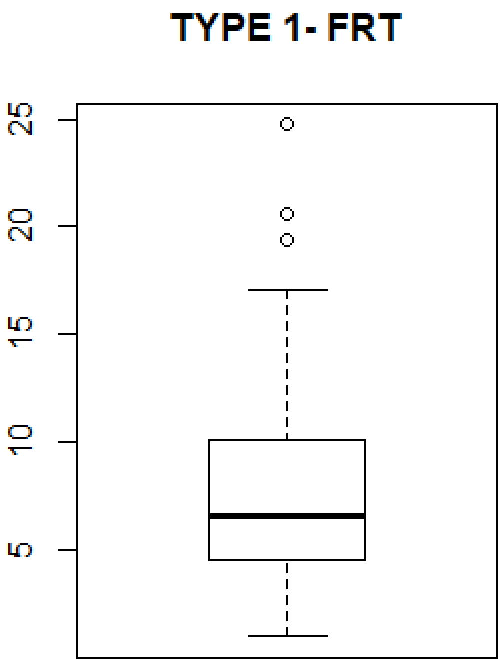



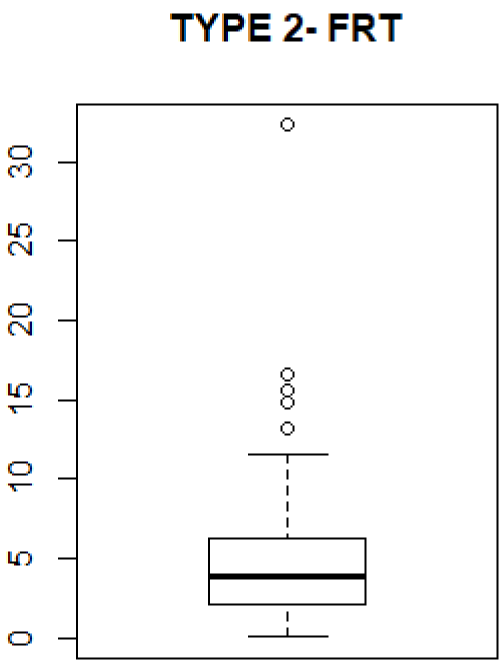

For "TYPE1-DFDRRT", the boxplot have outlier. The central tendency is around 10-20.
For " TYPE2- DFDRRT ", the boxplot is almost symmetric, there is no outlier, central tendency is around 10-20.




For "TYPE1-RRT", the boxplot have outlier. The central tendency is around 0-20.
For " TYPE2- RRT ", the boxplot have outlier. The central tendency is around 0-20.



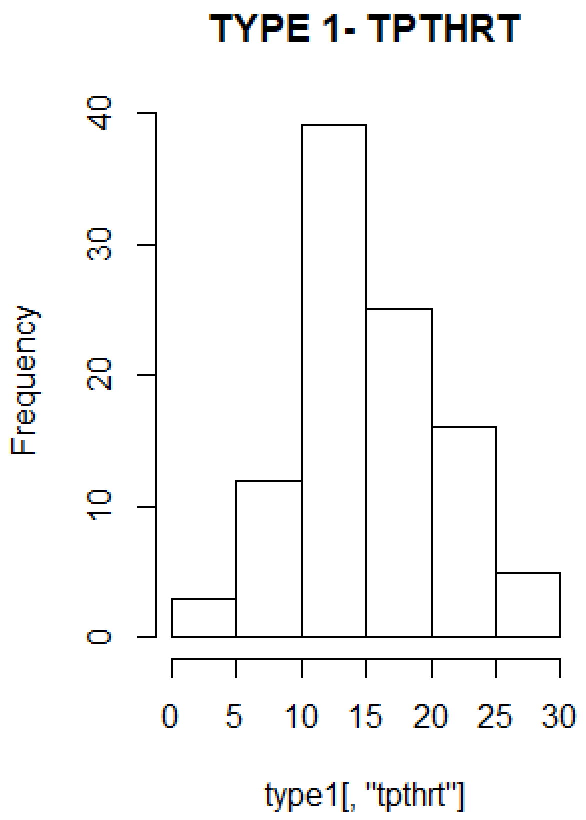

For "TYPE1-FRT", the boxplot have outlier. The central tendency is around 5-10.
For " TYPE2- FRT ", the boxplot have outlier. The central tendency is around 0-5.

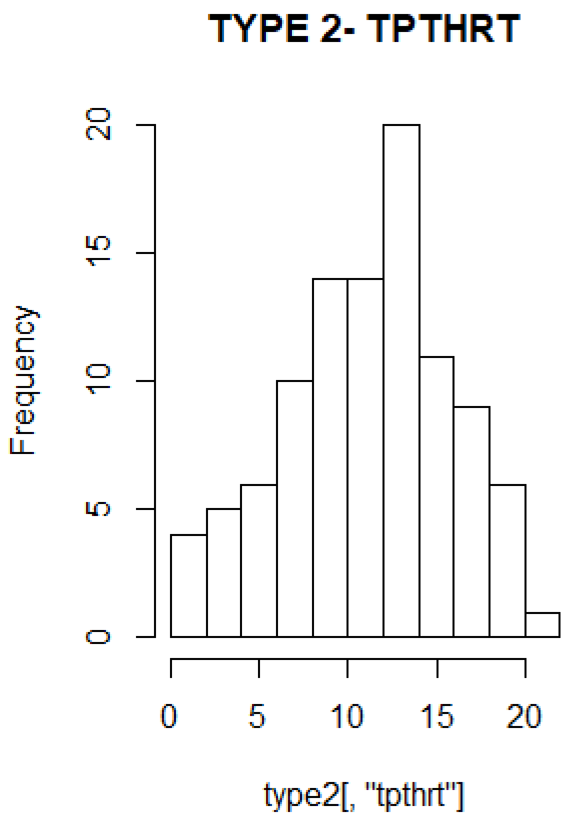
==========================================================================

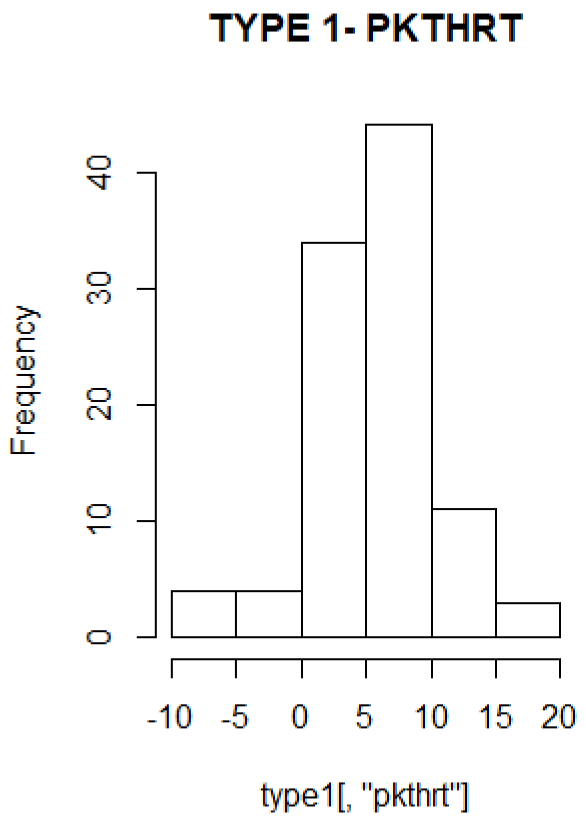
**T5:** Plot histograms of the **variables** for each **data type**, compare the histograms, and comment on the distributions.

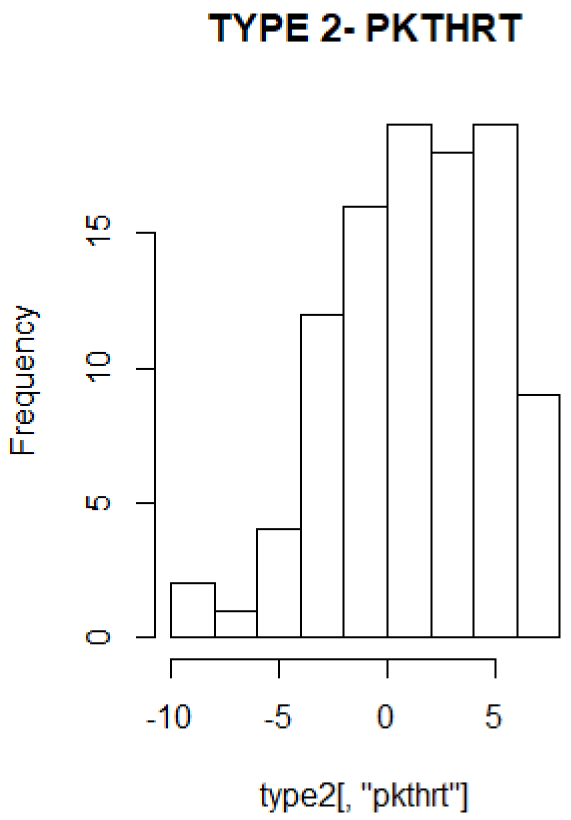
---

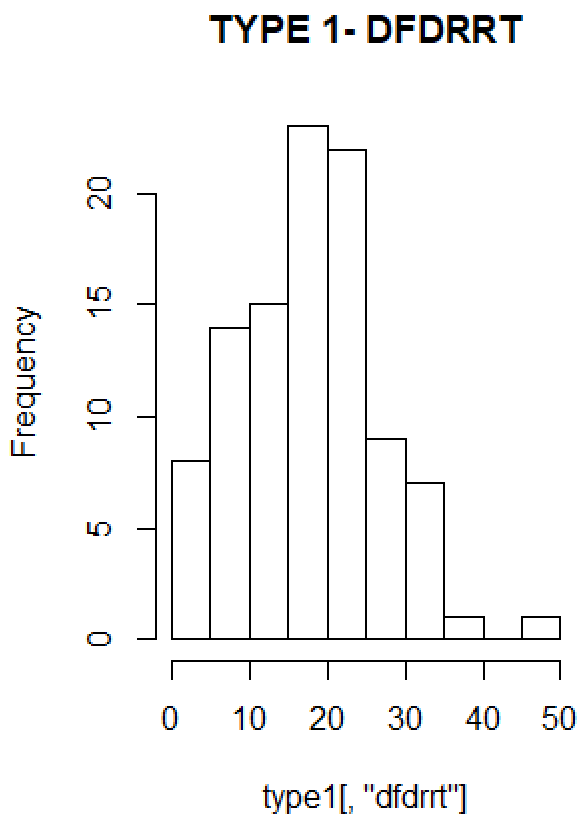
```
hist(type1[,"tpthrt"],main="TYPE 1- TPTHRT")
hist(type1[,"pkthrt"],main="TYPE 1- PKTHRT")
hist(type1[,"dfdrrt"],main="TYPE 1- DFDRRT")
hist(type1[,"rrt"],main="TYPE 1- RRT")
hist(type1[,"frt"],main="TYPE 1- FRT")


hist(type2[,"tpthrt"],main="TYPE 2- TPTHRT")
hist(type2[,"pkthrt"],main="TYPE 2- PKTHRT")
hist(type2[,"dfdrrt"],main="TYPE 2- DFDRRT")
hist(type2[,"rrt"],main="TYPE 2- RRT")
hist(type2[,"frt"],main="TYPE 2- FRT")
```

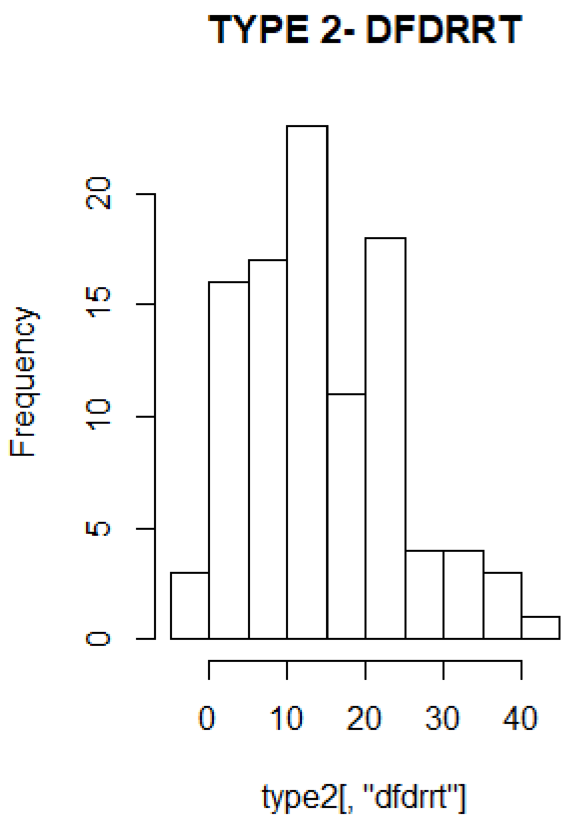


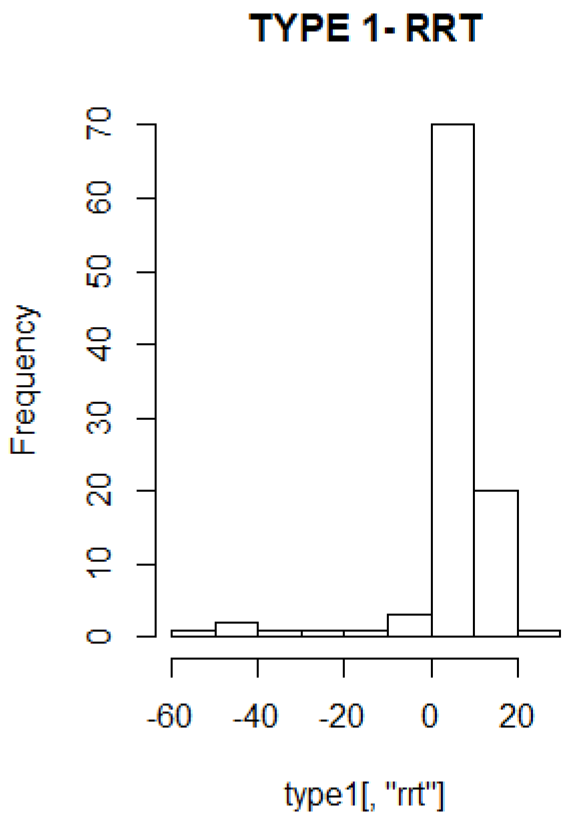



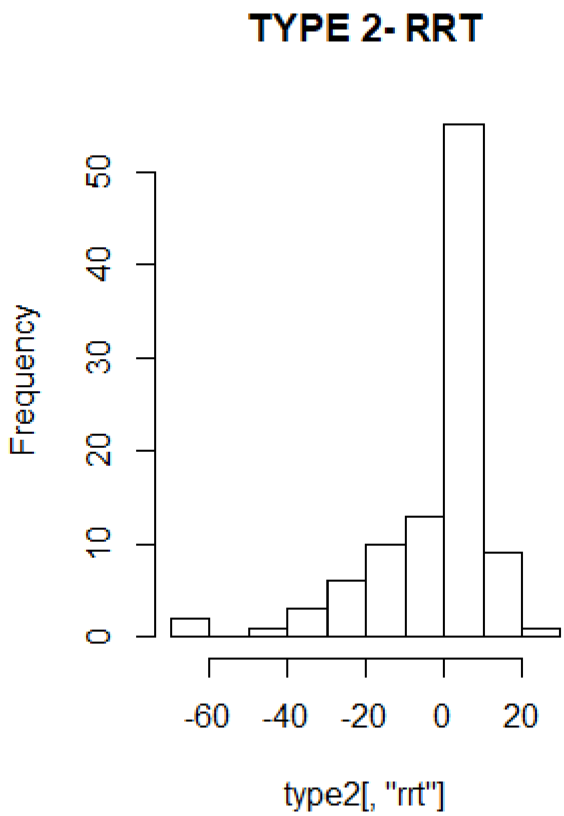

TYPE 1- PKTHRT
Frequency
0
10
20
30
40
-10
-5
0
5
10
15
20
type1[, "pkthrt"]

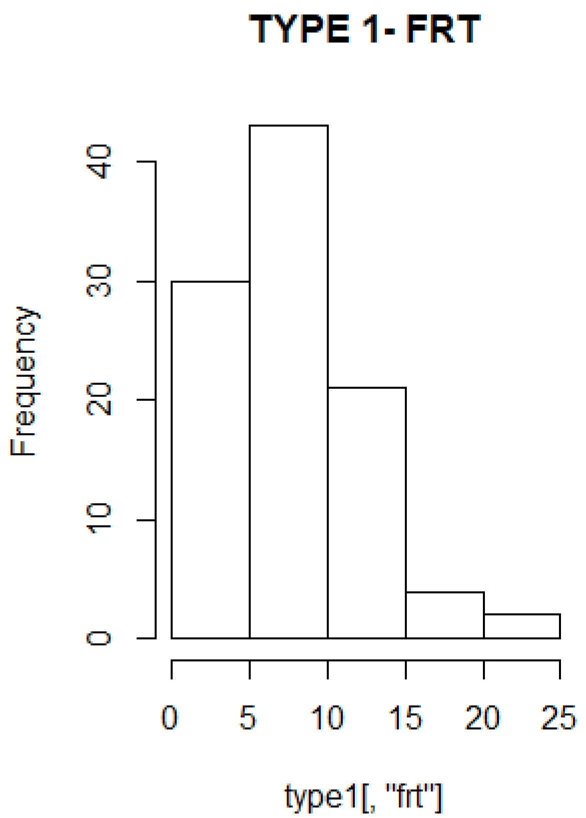

TYPE 2- PKTHRT
Frequency
0
5
10
15
-10
-5
0
5
type2[, "pkthrt"]

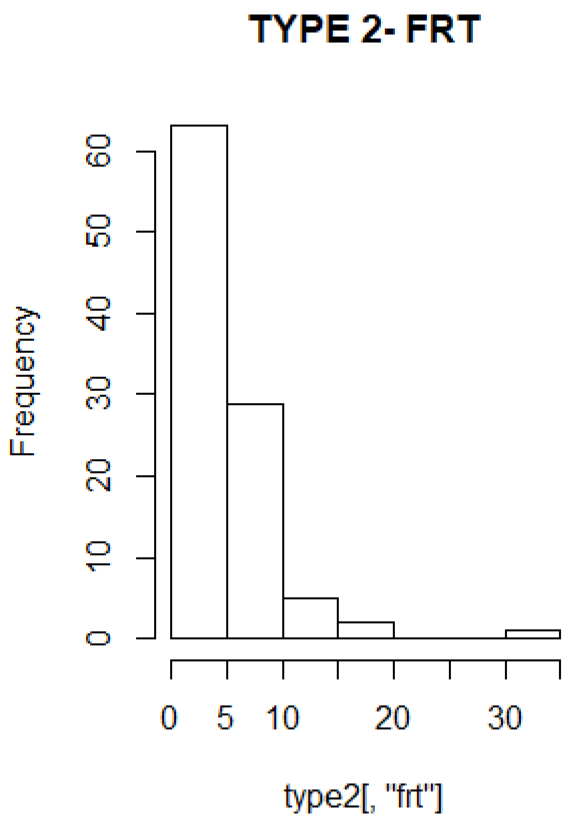

TYPE 1- DFDRRT
Frequency
0
5
10
15
20
0
10
20
30
40
50
type1[, "dfdrrt"]


TYPE 2- DFDRRT
Frequency
0
5
10
15
20
0
10
20
30
40
type2[, "dfdrrt"]


TYPE 1- RRT
Frequency
0
10
20
30
40
50
60
70
-60
-40
-20
0
20
type1[, "rrt"]


TYPE 2- RRT
Frequency
0
10
20
30
40
50
-60
-40
-20
0
20
type2[, "rrt"]


TYPE 1- FRT
Frequency
0
10
20
30
40
0
5
10
15
20
25
type1[, "frt"]

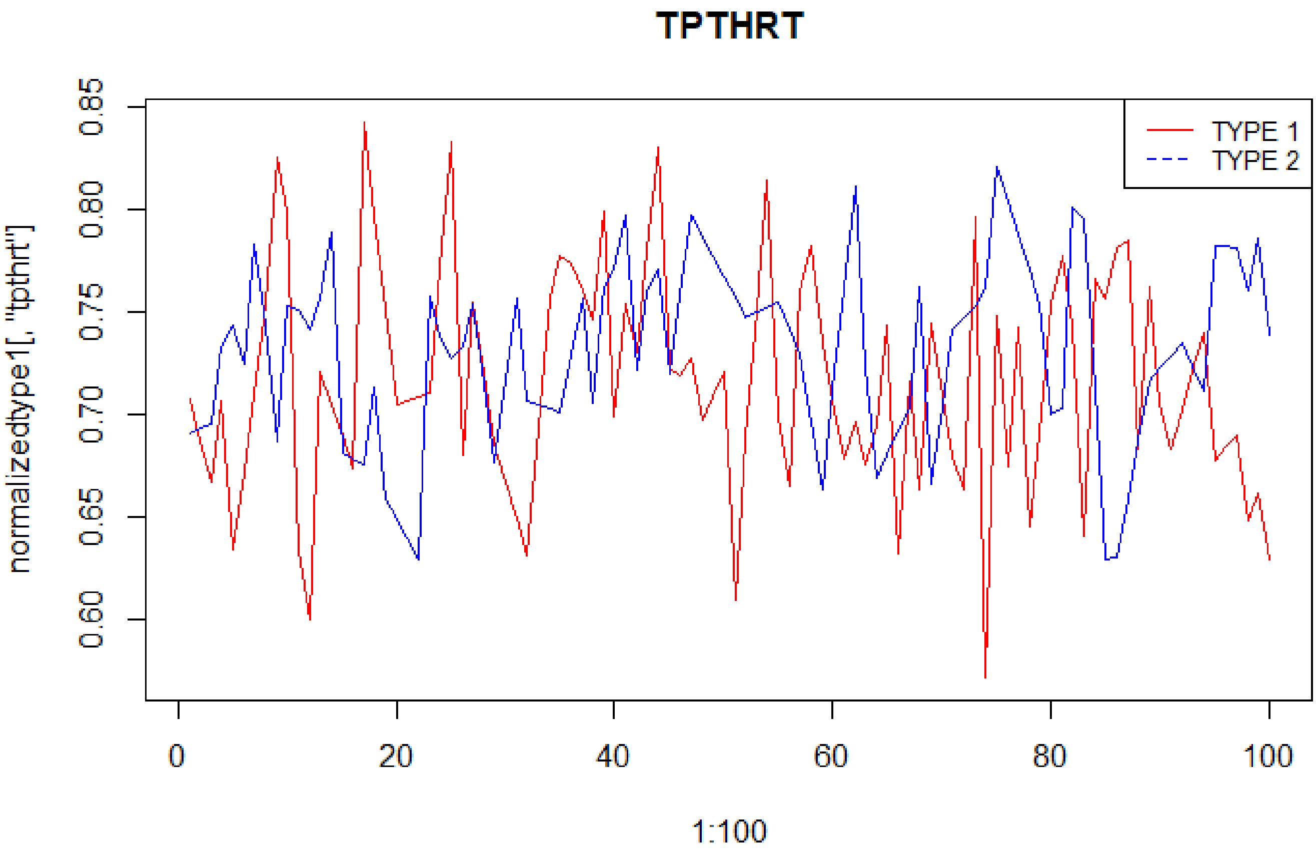

TYPE 2- FRT
Frequency
0
10
20
30
40
50
60
0
5
10
20
30
type2[, "frt"]

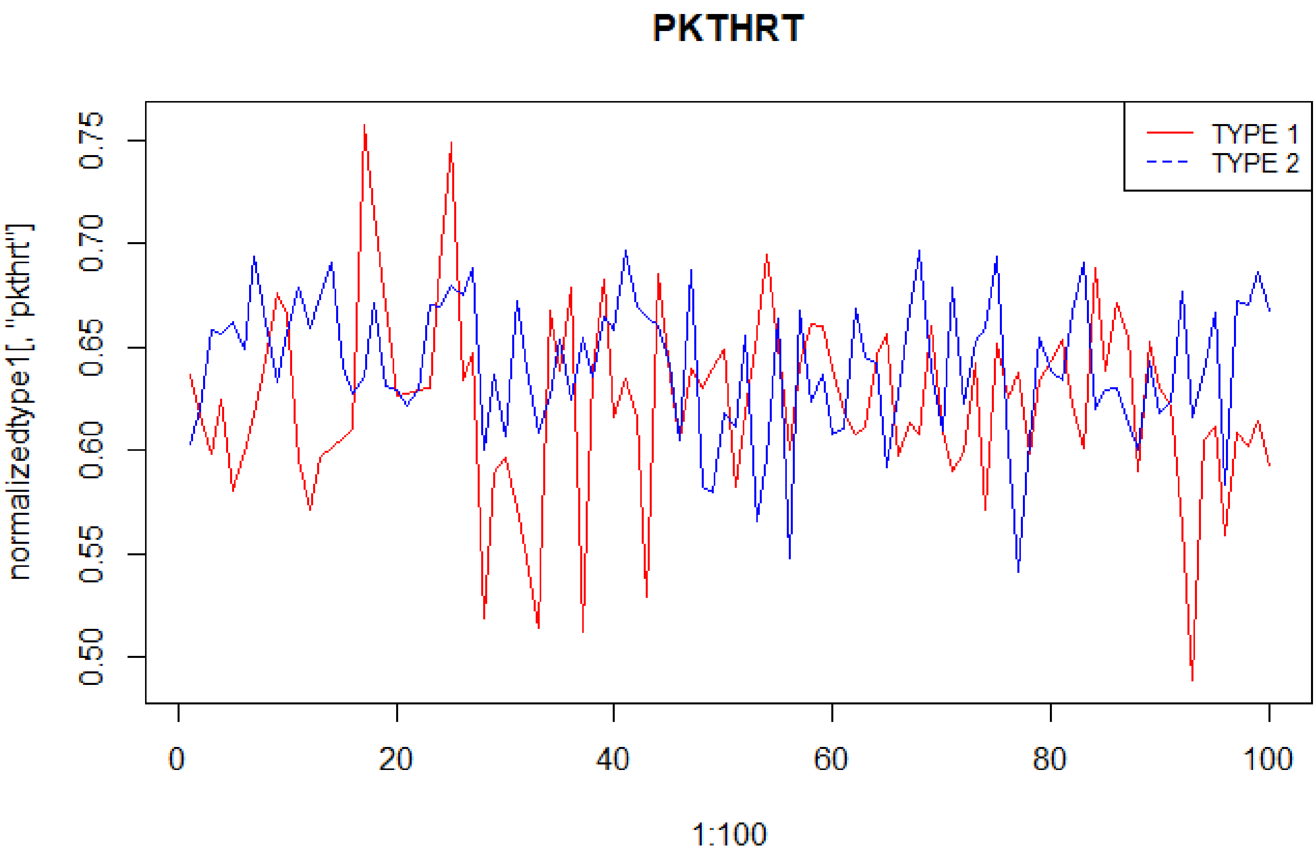
================================================================================

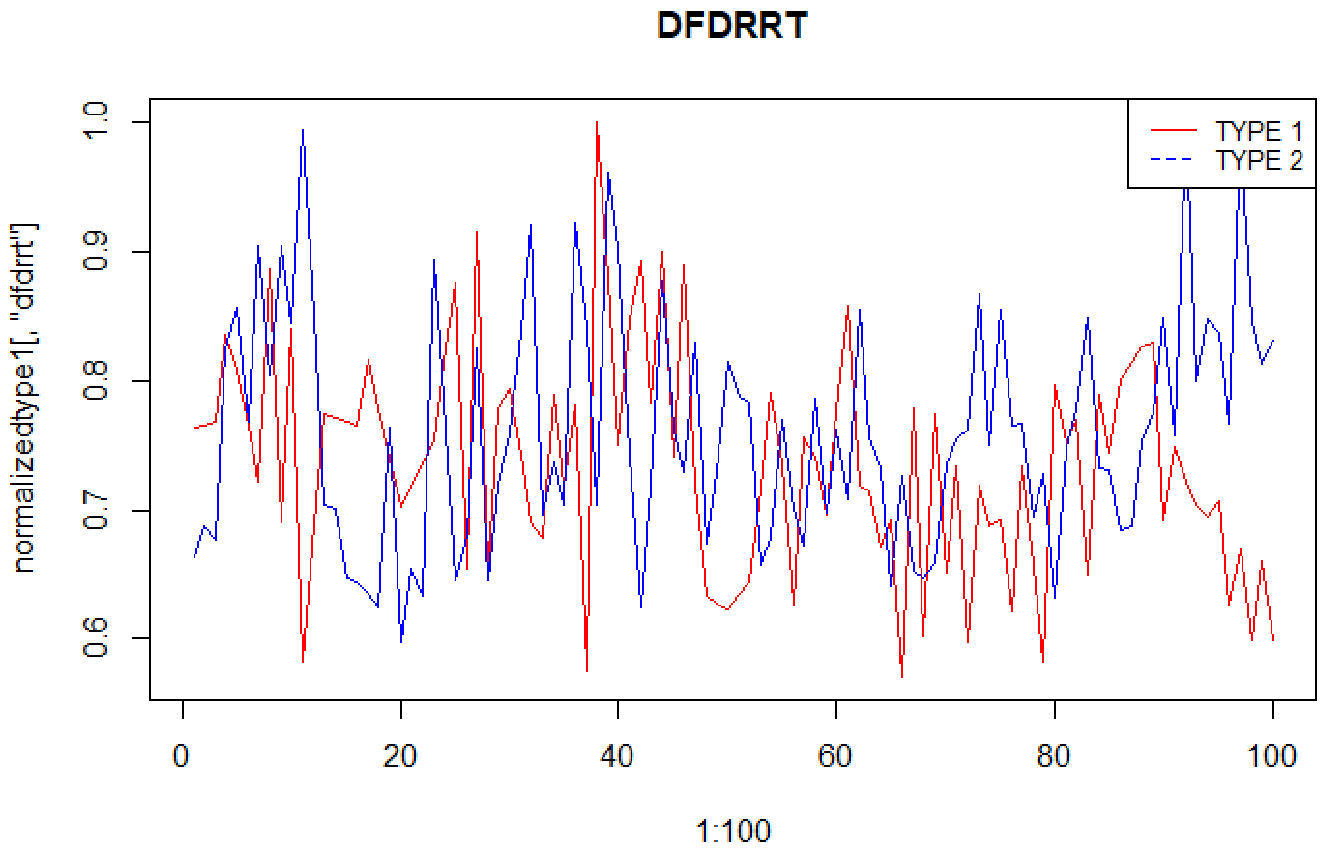
**T6:** First, normalize the **variables** for each **data type** so that the values of these variables range between **0** and **1**, and then line-plot (using different colors) each variables for both data types in one figure (total 5 figures). Comment on the similarities of the variables for each plot.

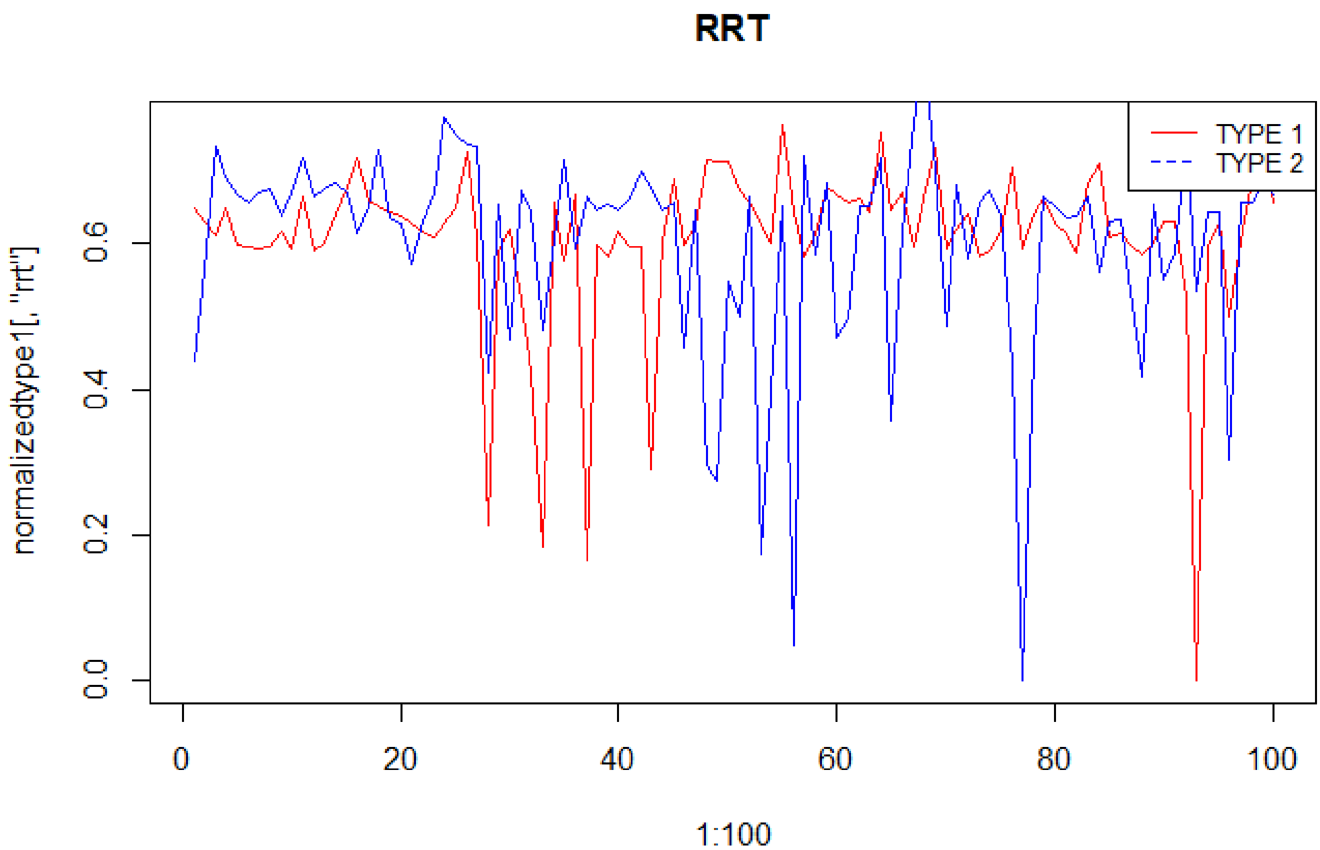
--------------------------------------------------------------------------------

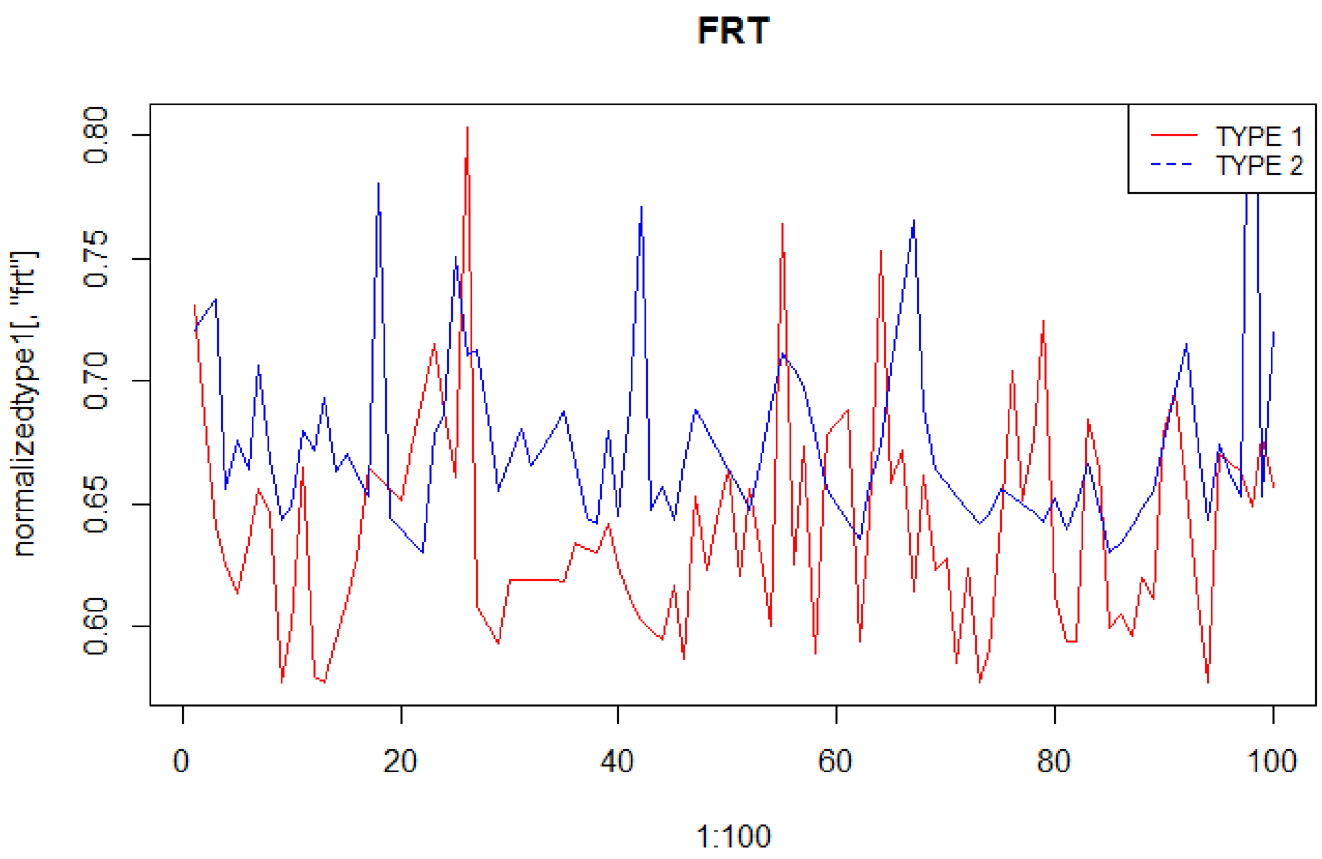
```
normalizedtype1 <-type1
normalizedtype1 <- (type1[, c(2, 3, 4, 5,6)]-min(type1[, c(2, 3, 4, 5,6)]))/(max(type1[, c(2, 3, 4, 5,6)])-min(type1[, c(2, 3, 4, 5,6)]))
View(normalizedtype1)



normalizedtype2 <-type2
normalizedtype2 <- (type2[, c(2, 3, 4, 5,6)]-min(type2[, c(2, 3, 4, 5,6)]))/(max(type2[, c(2, 3, 4, 5,6)])-min(type2[, c(2, 3, 4, 5,6)]))
View(normalizedtype2)



plot(x=1:100,y=normalizedtype1[,"tpthrt"],type = 'l',col = "red",main="TPTHRT")
lines(x=1:100, y=normalizedtype2[,"tpthrt"],type = 'l',col = "blue")
# Add a legend to the plot
legend("topright", legend=c("TYPE 1", "TYPE 2"),
      col=c("red", "blue"), lty = 1:2, cex=0.8)



plot(x=1:100,y=normalizedtype1[,"pkthrt"],type = 'l',col = "red",main="PKTHRT")
lines(x=1:100, y=normalizedtype2[,"pkthrt"],type = 'l',col = "blue")
# Add a legend to the plot
legend("topright", legend=c("TYPE 1", "TYPE 2"),
      col=c("red", "blue"), lty = 1:2, cex=0.8)


plot(x=1:100,y=normalizedtype1[,"dfdrrt"],type = 'l',col = "red",main="DFDRRT")
lines(x=1:100, y=normalizedtype2[,"dfdrrt"],type = 'l',col = "blue")
# Add a legend to the plot
legend("topright", legend=c("TYPE 1", "TYPE 2"),
      col=c("red", "blue"), lty = 1:2, cex=0.8)


plot(x=1:100,y=normalizedtype1[,"rrt"],type = 'l',col = "red",main="RRT")
lines(x=1:100, y=normalizedtype2[,"rrt"],type = 'l',col = "blue")
# Add a legend to the plot
legend("topright", legend=c("TYPE 1", "TYPE 2"),
      col=c("red", "blue"), lty = 1:2, cex=0.8)


plot(x=1:100,y=normalizedtype1[,"frt"],type = 'l',col = "red",main="FRT")
lines(x=1:100, y=normalizedtype2[,"frt"],type = 'l',col = "blue")
# Add a legend to the plot
legend("topright", legend=c("TYPE 1", "TYPE 2"),
      col=c("red", "blue"), lty = 1:2, cex=0.8)
```


TPTHRT
TYPE 1
TYPE 2
normalizedtype1[, "tpthrt"]
0.60
0.65
0.70
0.75
0.80
0.85
0
20
40
60
80
100
1:100


PKTHRT
TYPE 1
TYPE 2
normalizedtype1[, "pkthrt"]
0.50
0.55
0.60
0.65
0.70
0.75
0
20
40
60
80
100
1:100


DFDRRT
normalizedtype1[, "dfdrrt"]
1.0
0.9
0.8
0.7
0.6
0
20
40
60
80
100
1:100
TYPE 1
TYPE 2


RRT
normalizedtype1[, "rrt"]
0.6
0.4
0.2
0.0
0
20
40
60
80
100
1:100
TYPE 1
TYPE 2




- When we look at the first, second, third and fifth figures, type1 and type2 are not alike. While the values in the variable type1 decrease, the values in the type2 variable increase. Therefore, we can say that there is no similarity between the two types.

- When we look at the RRT variable in the fourth figure, it is seen that type1 and type2 behave similarly.

==========================================================================

**T7:** First, determine how similar the variables **tpthrt** and **pkthrt** are for each **data type**, and then determine how similar **tpthrt of data type 1** and **tpthrt of data type 2** by using similarity metric (correlation).

------------------------------------------------------------------------------------------------------------------------------------------------------------------------

```
cor(normalizedtype1[,"tpthrt"],normalizedtype1[,"pkthrt"],method = c("pearson"))
cor(normalizedtype2[,"tpthrt"],normalizedtype2[,"pkthrt"],method = c("pearson"))
cor(normalizedtype1[,"tpthrt"],normalizedtype2[,"tpthrt"],method = c("pearson"))
```

**Type 1(**tpthrt and pkthrt**)**= 0.6417237

**Type 2(**tpthrt and pkthrt**)**= 0.2726601

TPTHRT(Type1 and Type2)= -0.1859388

- When we examined the results, it was observed that the variables in type 1 were a little more similar to each other, but it was observed that the variables in type 2 were not alike.

- (+) correlation coefficient indicates that the two variables are in the same direction, while a negative (-) relationship indicates an inverse relationship between the two variables. Therefore, we can say that TPTHRT variable type1 and type2 also showed an inverse relationship.