Group Project Report

Students:

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Github Link:

https://github.com/st3vd/2022_DAIT_GCA_-SD-_-PC-

Introduction.

Dentist's patients pain data was collected.

A sample of 100 patients was taken from the population. Sample was split evenly into 2 groups. One received meditation, the other did not get meditation. In some groups the gender split 27-23. This was adjusted to having 23 in each sample.

The data analysis will then be concerned with whether patients who do meditation will have reduced pain from the treatments.

1. Determine whether the data provided is appropriate for the test(s) available and that any analysis is achievable.

We want a reasonable Normal Distribution to apply our standard tests. With sample size< 30 we use t score. With low sample we check data for normatity and no significant outliers. Box and Whisker charts were completed on the data sets to show there were no significant outliers.

The histograms shows a normal distribution appearance.

Only one box chart has outliers (Meditation group male) but one is either side so spread is balanced.

Hence data can be taken as independent.

We had to make some assumptions.

- **Dental Work:** We assume dentist treatment was similar.
- **Age.** Age was not recorded so we assume age isn't a factor.
- **Gender split:** Though each data is split equally, within the groups, the male and female divide is not equal in all groups. Data was adjusted to give even spread.

Adjusting Figures:

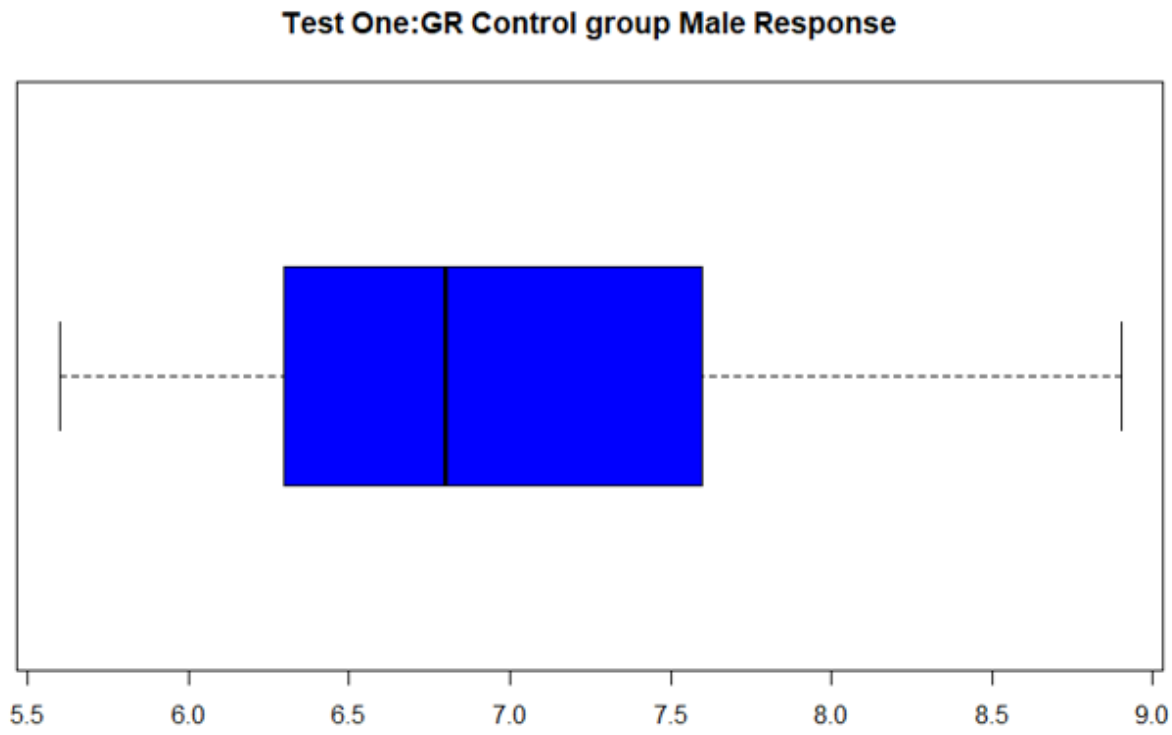
When looking at difference in gender results some adjustment was needed to make sure both genders had equal samples. I chose to adjust the Galvanic response data over the Perceived Data as the data is derived more scientifically.

Data adjustment Male data.

For Males there were 27 sampled in the control group, and 23 sampled in the Meditation group. 4 cases were removed from the control group.

Cntrol group for Galvanic Responses:

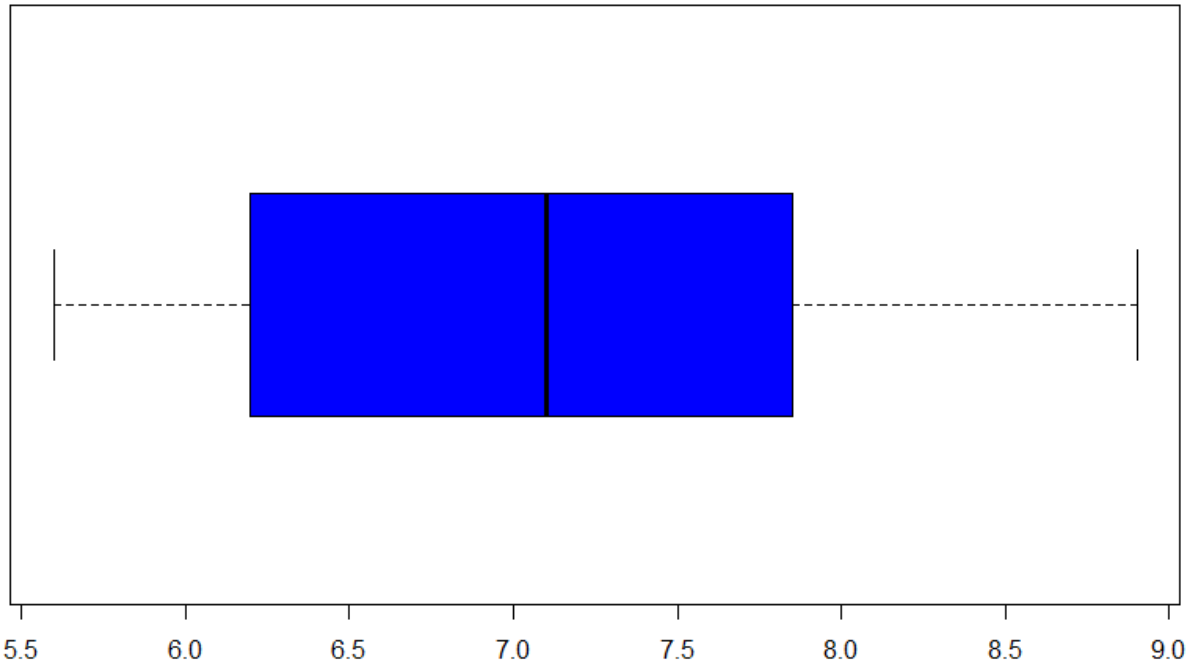
```
 Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
5.600   6.300   6.800   7.041   7.600   8.900
```



From the boxplot there doesn't look like there is any outliers. However, the median is less than the mean so there is a small bit of skewness to the right. To improve this will remove some numbers up to and including the median.

The resulting stats are:

```
 Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
5.600   6.200   7.100   7.096   7.850   8.900
```



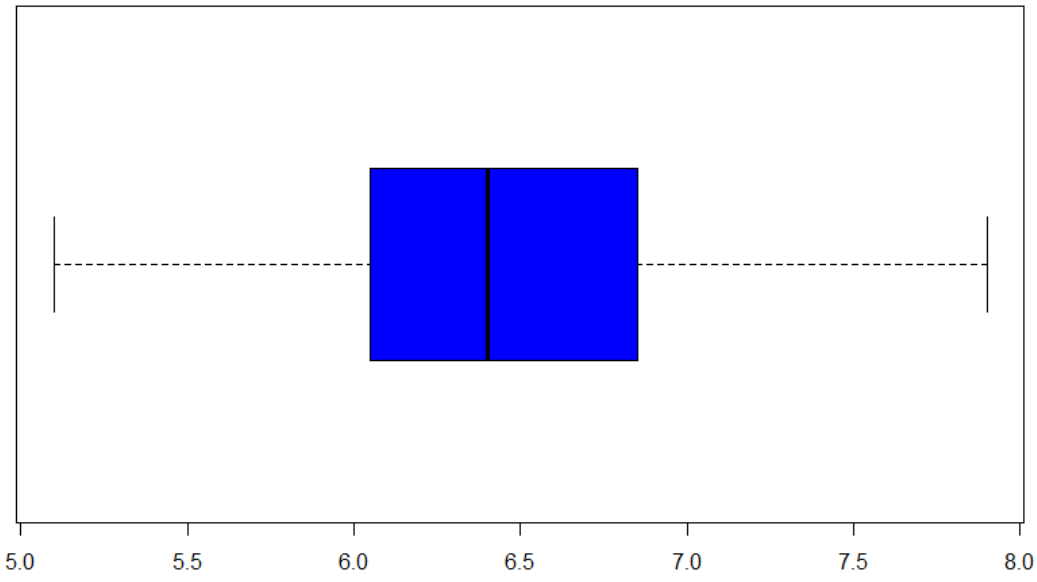
The median is now almost the same as the mean and the boxplot has a more normal appearance. The skewness to the right has reduced. We will proceed with this male data.

Data adjustment Female data.

The Female data has 27 in the meditation group V 23 in the control group.

Looking at the galvanic responses we have the following data:

```
 Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
5.100   6.050   6.400   6.507   6.850   7.900
```

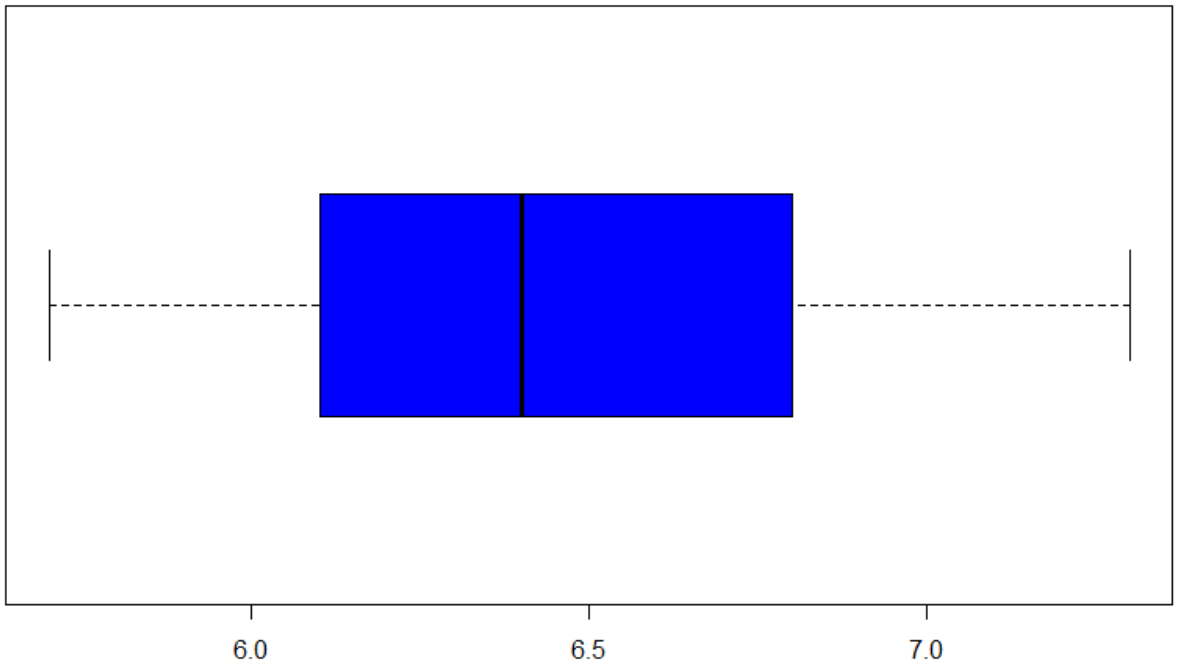


The data looks reasonably normal in spread. Mean is slightly larger than median.

No outliers. Took 2 samples from extremes. 2 largest and 2 smallest.

New data gives.

```
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 5.700   6.100   6.400   6.491   6.800   7.300
```



Here the mean is closer to the median in value(less skewness) and reasonably normal looking with more data between the first and third quartile.

We proceed with this data.

3. Formulate a hypothesis test to be used to compare the effectiveness of the two approaches (control, meditation) used during dental surgery.

T1: Meditation V Control: GR Male

- H0: µdiff = 0. There is no difference in the average Galvanic Response pain recorded for Males between the Meditation group and the control group.
- HA: µdiff 6= 0. There is a difference in the average Galvanic Response pain recorded for Males between the Meditation group and the control group.

T2: Meditation V Control: PP Male

- H0: µdiff = 0. There is no difference in the average Perceived pain recorded for Males between the Meditation group and the control group.
- HA: µdiff 6= 0. There is a difference in the average Perceived pain recorded for Males between the Meditation group and the control group.

T3: Meditation V Control: GR Female

- H0: µdiff = 0. There is no difference in the average Galvanic Response pain recorded for Females between the Meditation group and the control group.
- HA: µdiff 6= 0. There is a difference in the average Galvanic Response pain recorded for Females between the Meditation group and the control group.

T4: Meditation V Control: PP Female

- H0: µdiff = 0. There is no difference in the average Perceived pain recorded for Females between the Meditation group and the control group
- HA: µdiff 6= 0. There is a difference in the average Perceived pain recorded for Males between the Meditation group and the control group.

4. Analyse the data to provide the hypothesis testing conclusion.

G1: Male Control GR:

```
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(MGR)
 5.600   6.200   7.100   7.096   7.850   8.900  [1] 1.057647
```

68–95–99.7 rule: All data lies within 3*(1.057647) of mean – indicates normal/no outliers

G2: Male Meditation GR:

```
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(MMGR)
 5.000   6.400   6.800   6.826   7.200   8.700  [1] 0.8698053
```

All data lies within 3*(0.8698053) of mean – indicates normal

G3: Male Control PP

```
> summary(MPR)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  7.000   8.000   8.000   8.217   9.000   9.000  > sd(MPR)
                                                 [1] 0.6712622
```

All data lies within 3*(0.6712622) of mean – indicates normal

G4: Male Meditation PP:

```
> summary(MMPP)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   > sd(MMPP)
  7.000   8.000   8.000   8.043   8.000   9.000   [1] 0.5623216
```

All data lies within 3*(0.5623216) of mean – indicates normal

G5: Female Control GR:

```
> summary(FGR)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  5.800   6.650   7.000   7.039   7.550   7.900  > sd(FGR)
>                                                [1] 0.5516415
```

All data lies within 3*(0.5516415) of mean – indicates normal

G6: Female Meditation GR:

```
 summary(FMG)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max. > sd(FMG)
 5.700   6.100   6.400   6.491   6.800   7.300 [1] 0.4747373
```

All data lies within 3*(0.4747373) of mean – indicates normal

G7: Female Control PP:

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(FPP)
  6.000   7.000   8.000   7.739   8.000   9.000  [1] 0.8100163
```

All data lies within 3*(0.8100163) of mean – indicates normal

G8: Female Med PP:

```
> summary(FMP)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(FMP)
  7.000   7.000   8.000   7.565   8.000   8.000  [1] 0.5068698
```

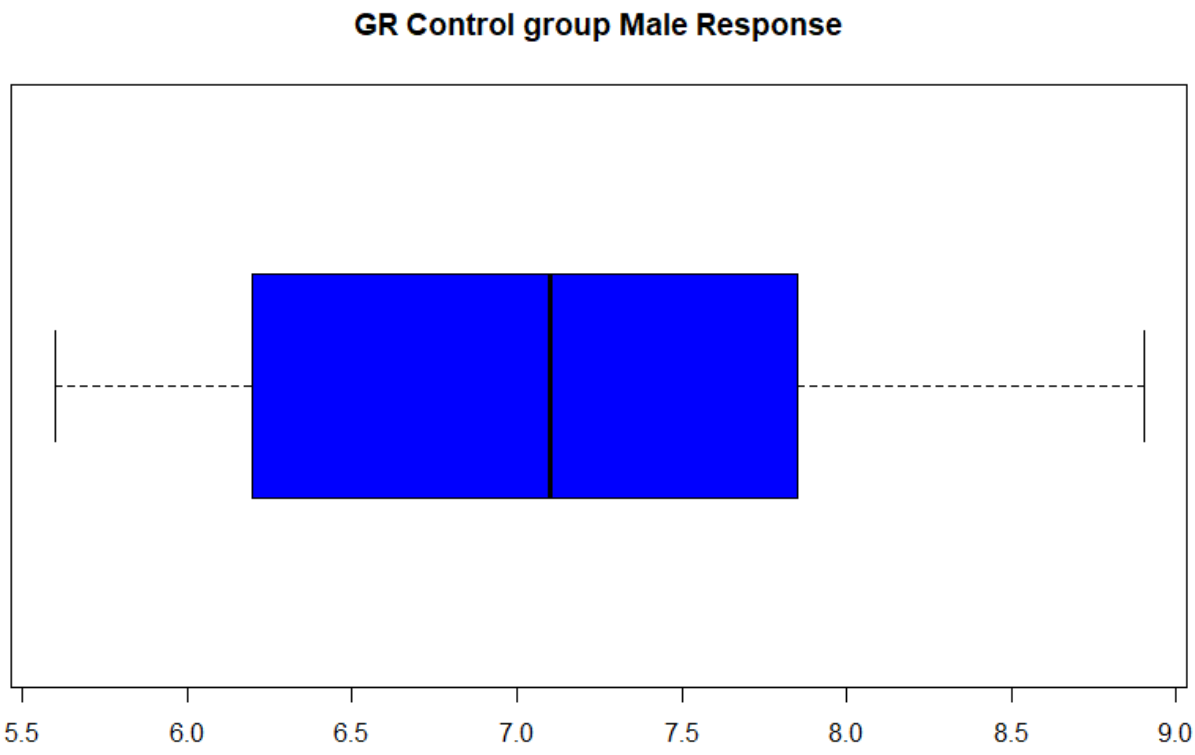
All data lies within 3*(0.5068698) of mean – indicates normal

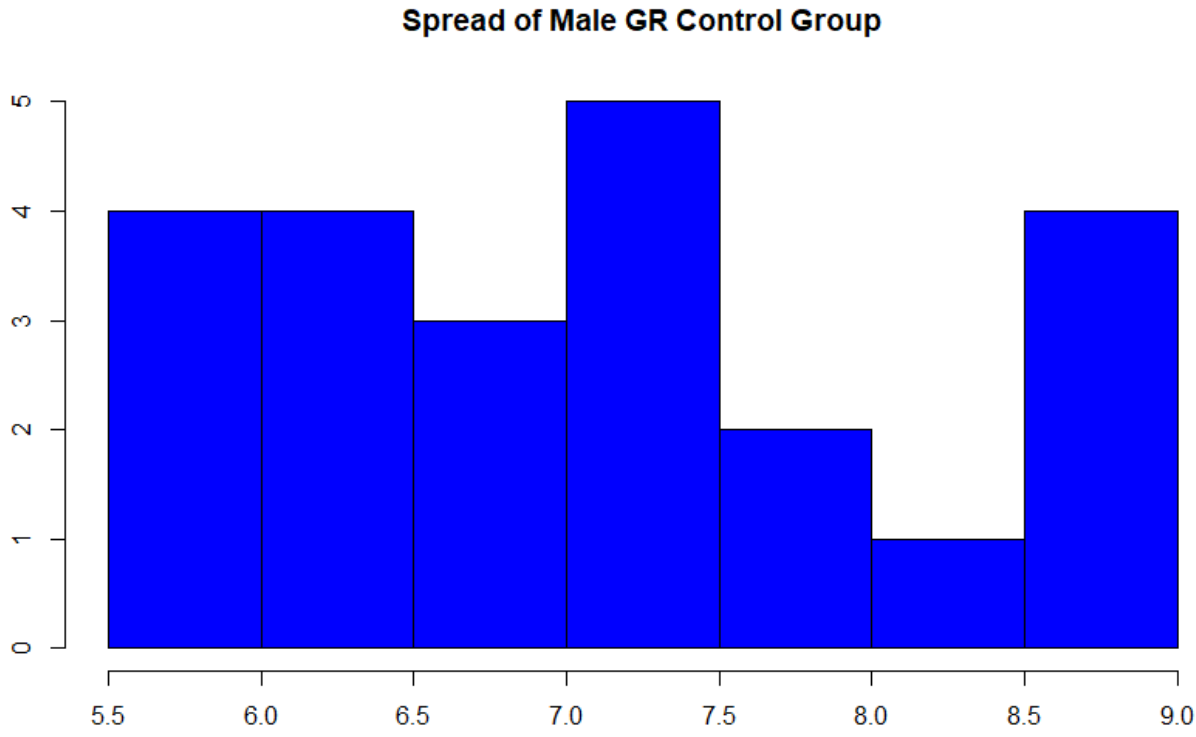
Largest difference between means is Meditation V Control group of Females Galvanic Response. This showed up in the confidence interval test that suggested a difference between the main scores and that Females in particular benefit from meditation with pain relief with the Galvanic Response test. This may be that Females 'buy' into meditation more than males. This was the only group that indicated meditation improved pain.

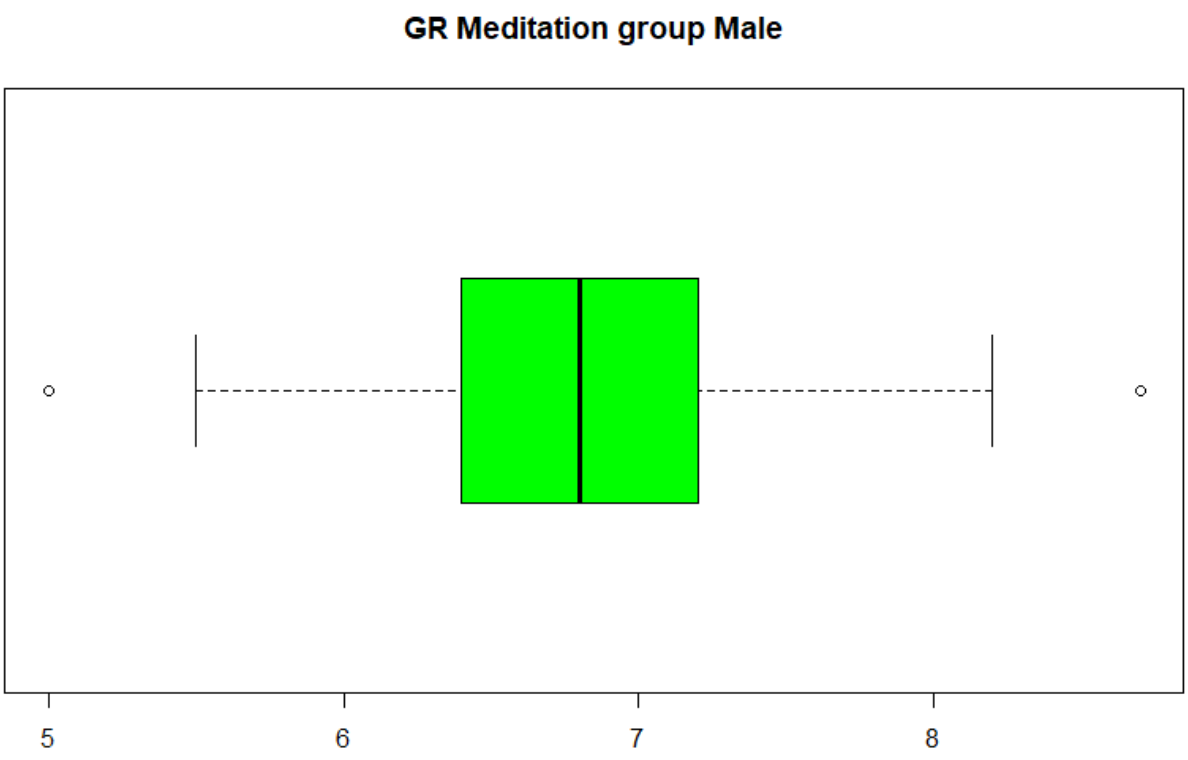
The graphs as follows were for the adjusted data.

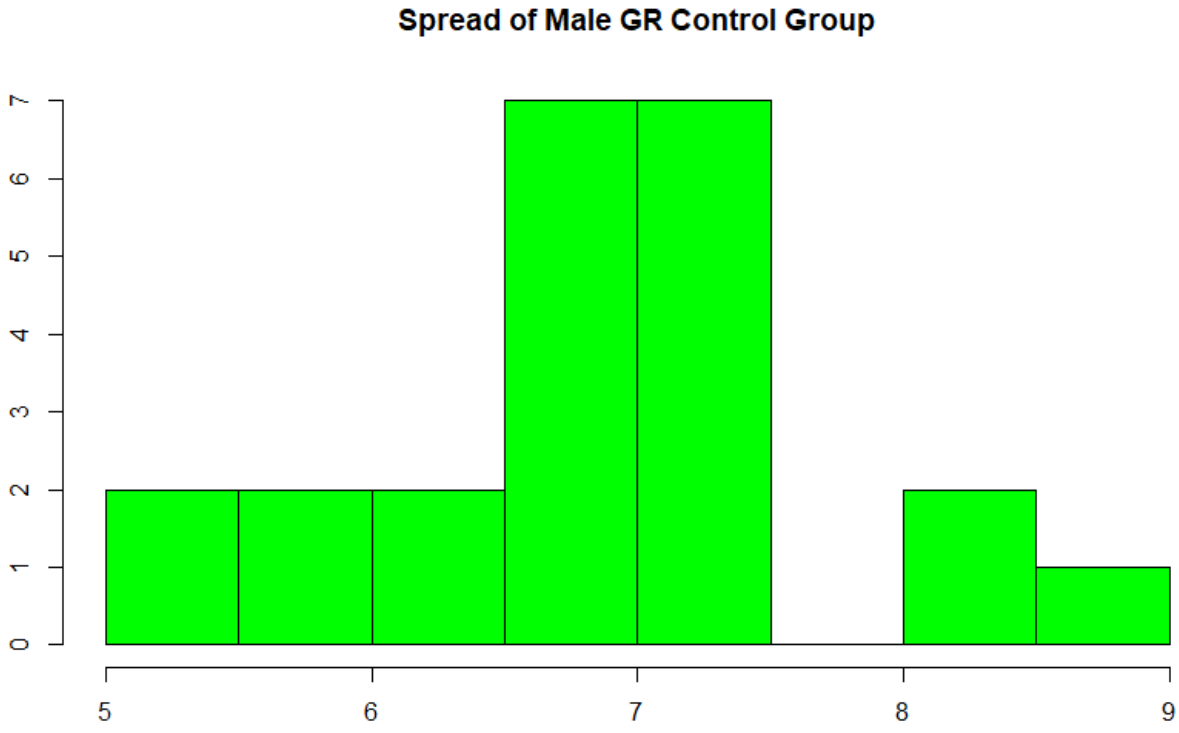
In general - boxplots look skewed for Perceived Pain data compared to Galvanic Response. Could be due to the narrower range of values (finite whole numbers for PP) but also could be that more randomness will follow as the measures are less scientific. Males have more randomness which support notion that males are less honest with pain scores.

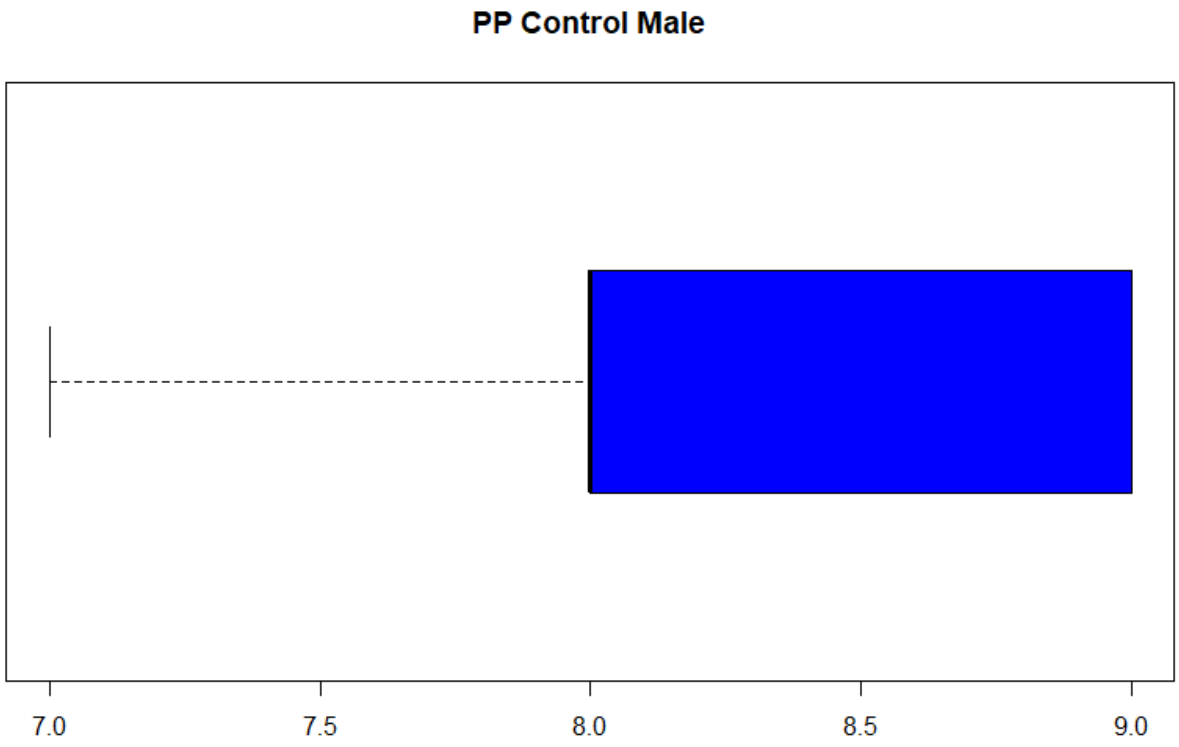
5. Descriptive Statistics:

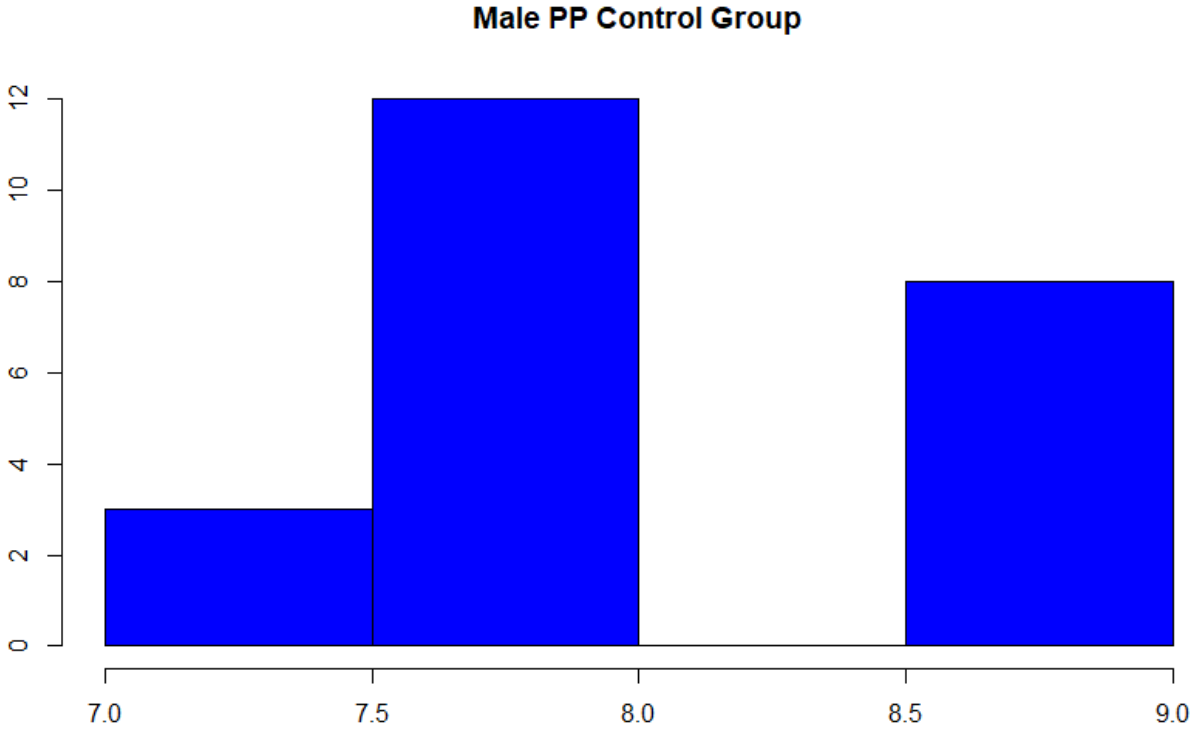


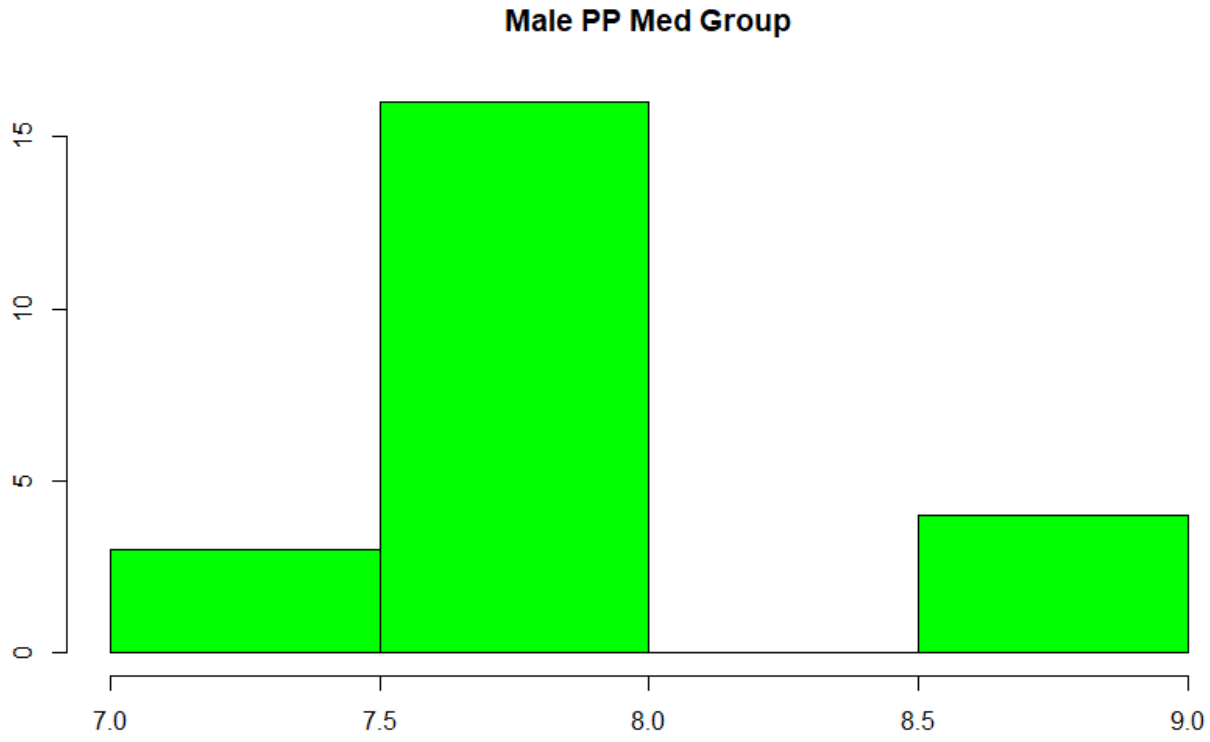


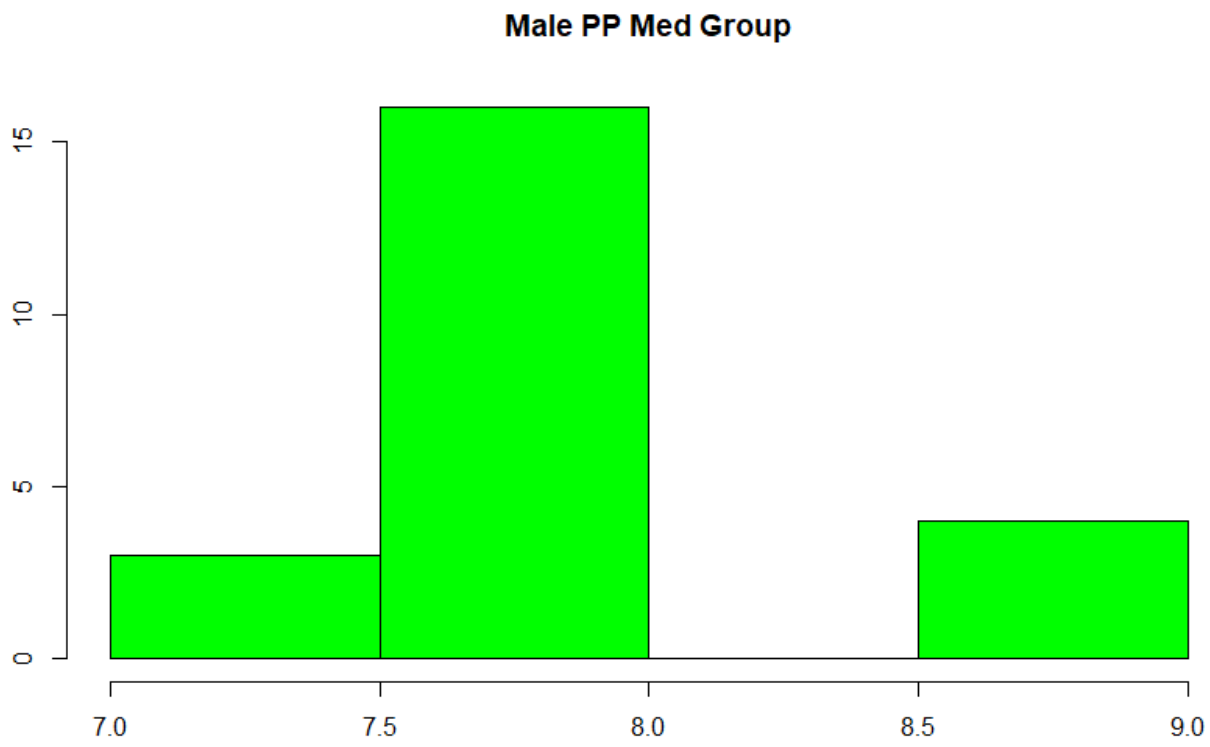

GR Meditation group Male
5
6
7
8

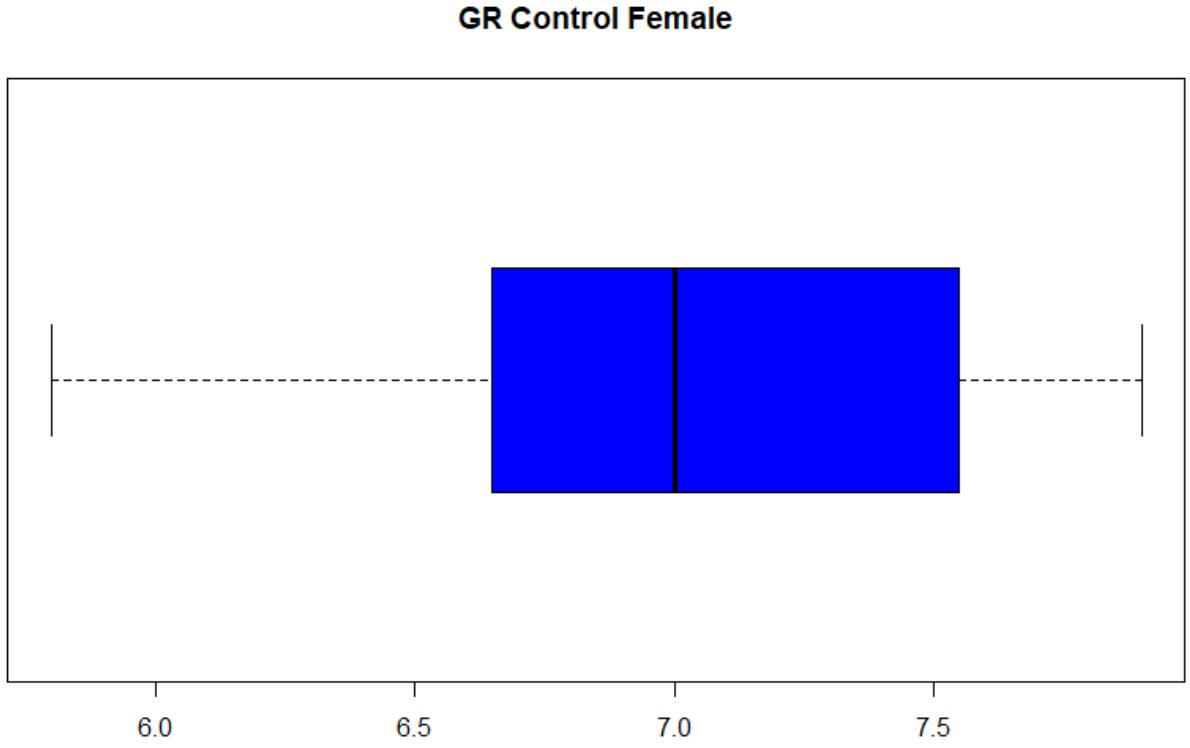

Spread of Male GR Control Group
0
1
2
3
4
5
6
7
5
6
7
8
9

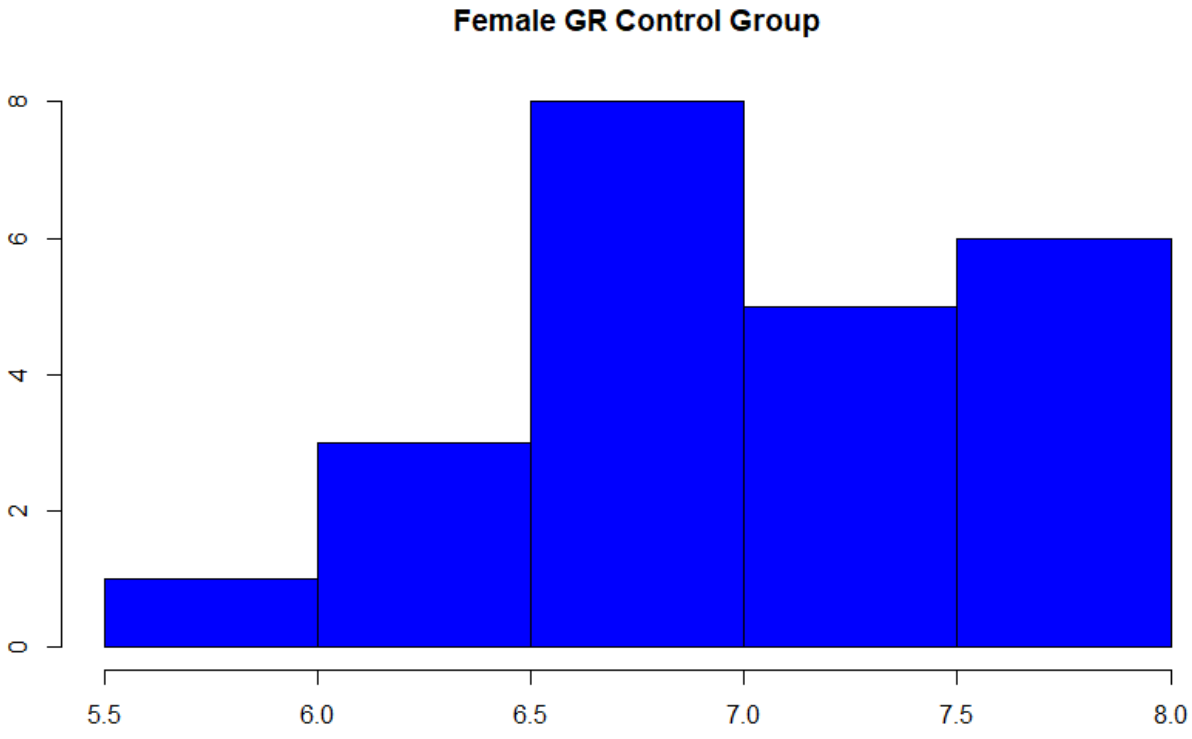

PP Control Male
7.0
7.5
8.0
8.5
9.0

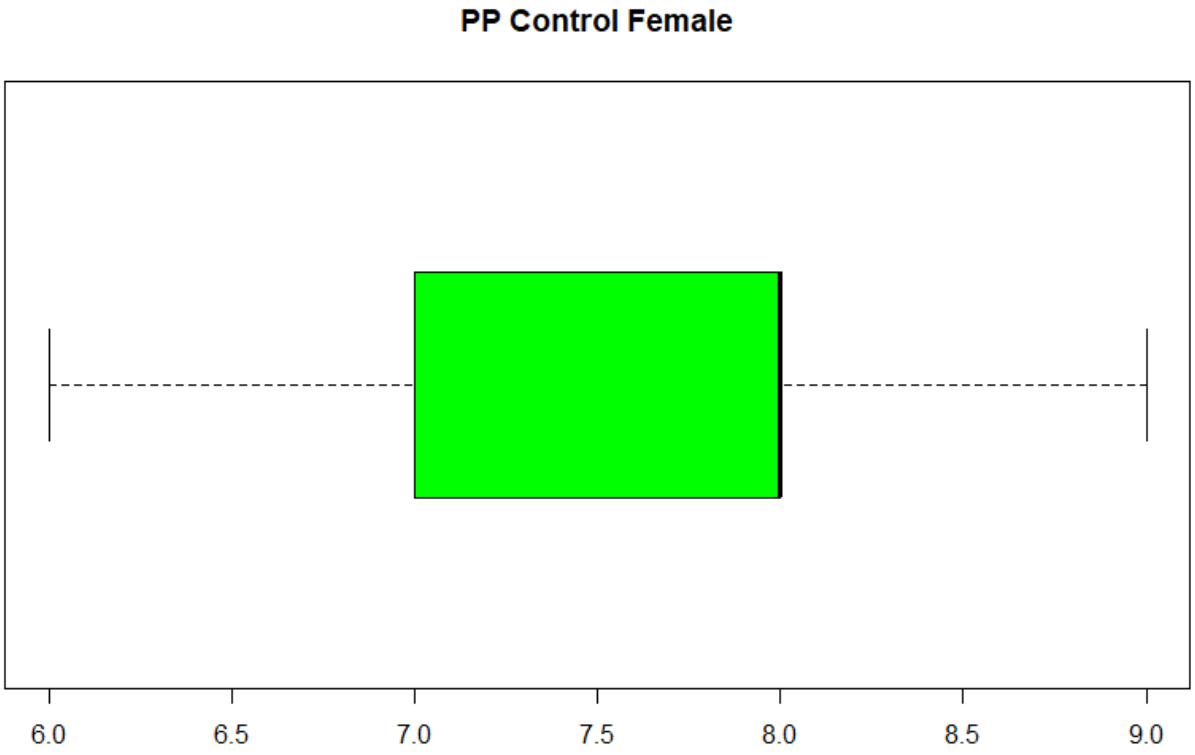

Male PP Control Group
0
2
4
6
8
10
12
7.0
7.5
8.0
8.5
9.0

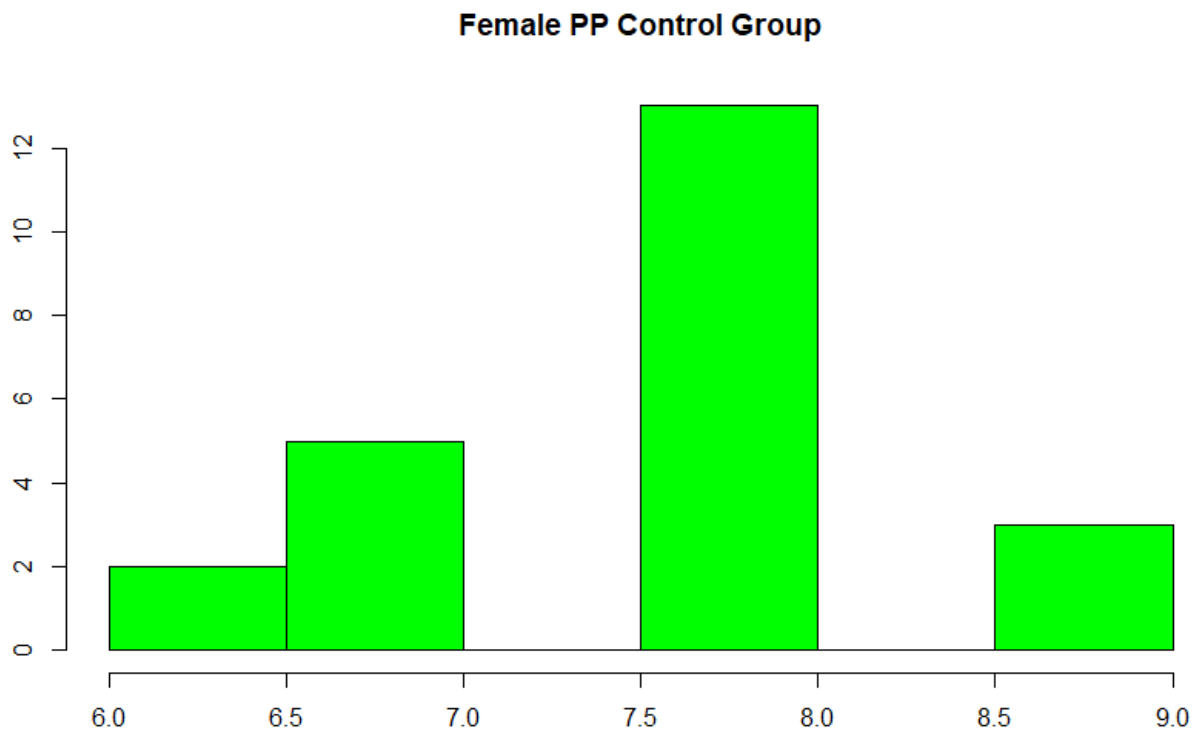

Male PP Med Group
0
5
10
15
7.0
7.5
8.0
8.5
9.0

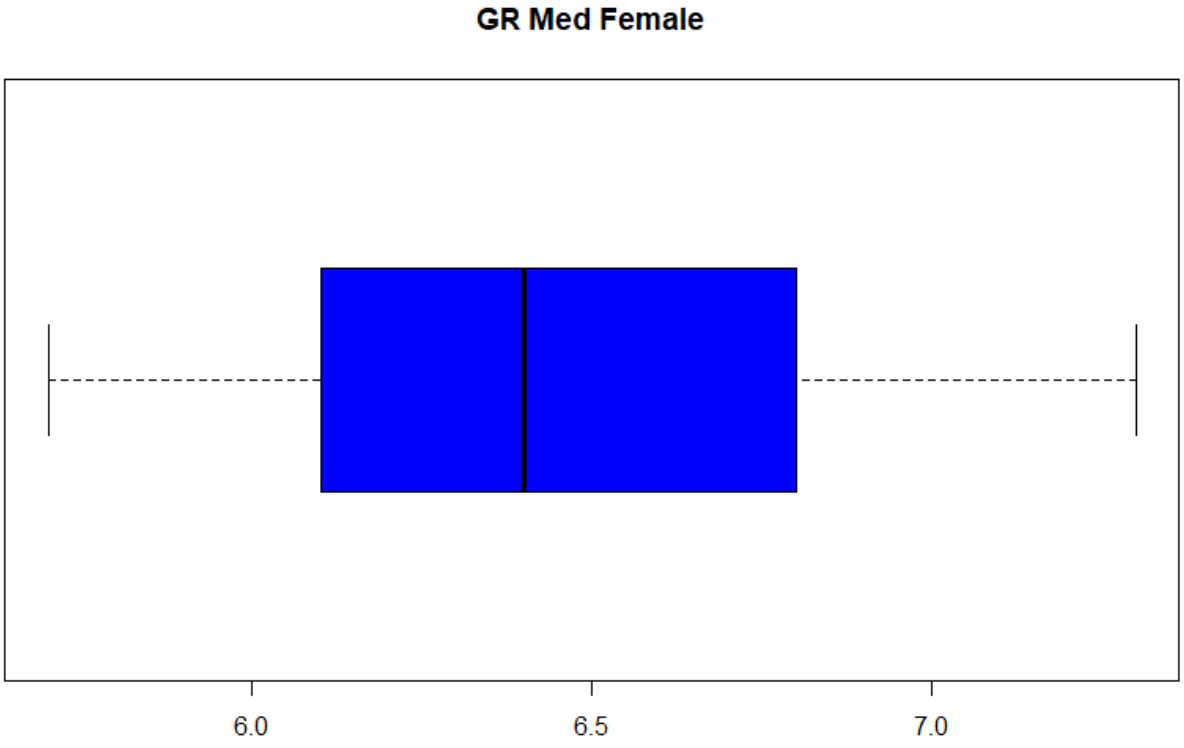

Male PP Med Group
0
5
10
15
7.0
7.5
8.0
8.5
9.0

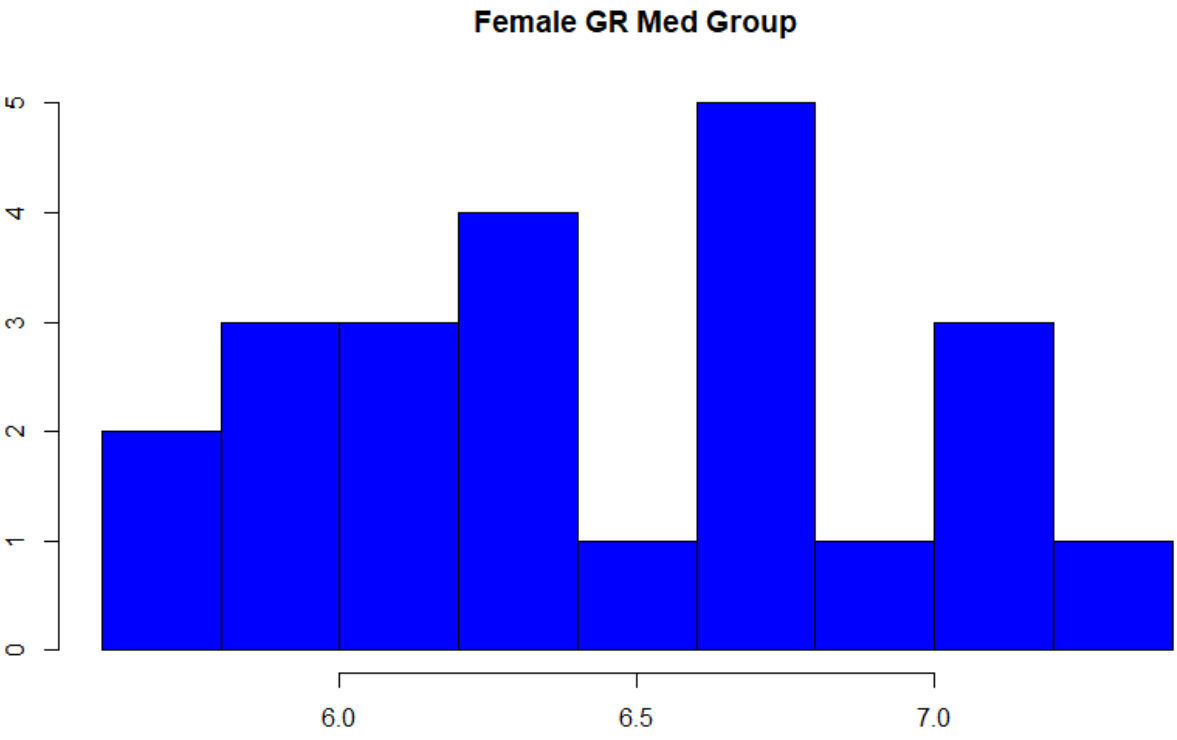

GR Control Female
6.0
6.5
7.0
7.5

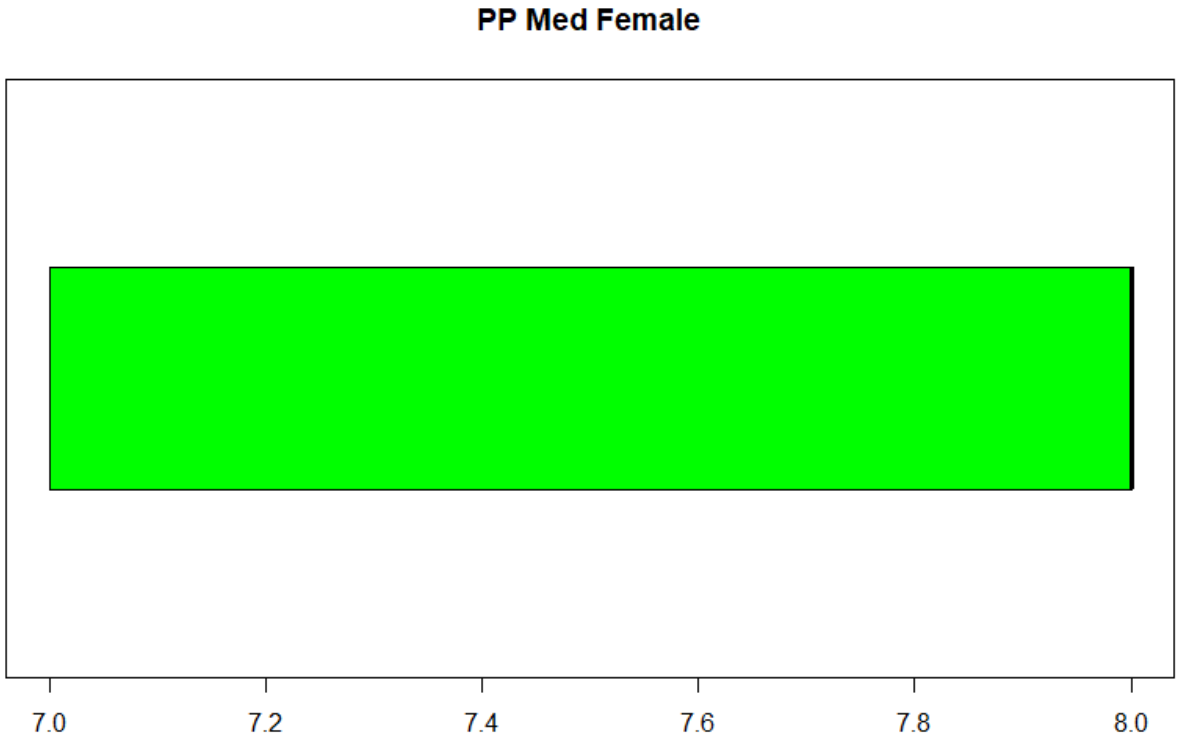

Female GR Control Group
0
2
4
6
8
5.5
6.0
6.5
7.0
7.5
8.0

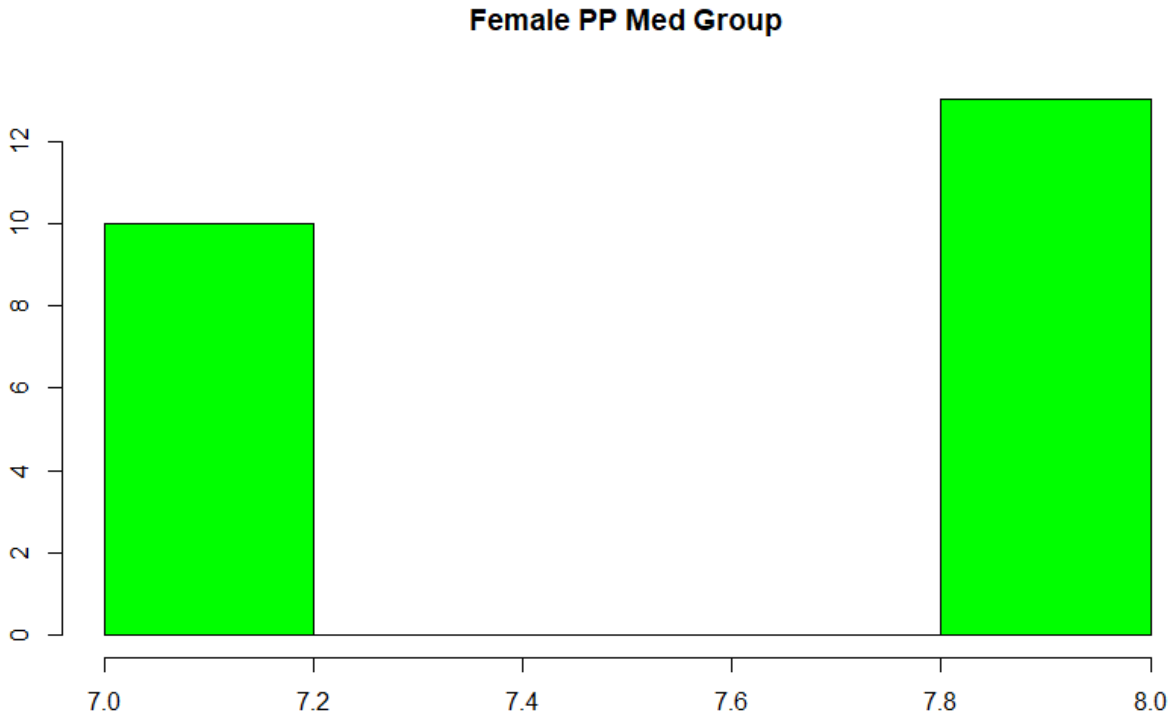

PP Control Female
6.0
6.5
7.0
7.5
8.0
8.5
9.0


Female PP Control Group
0
2
4
6
8
10
12
6.0
6.5
7.0
7.5
8.0
8.5
9.0


GR Med Female
6.0
6.5
7.0


Female GR Med Group
0
1
2
3
4
5
6.0
6.5
7.0


PP Med Female
7.0
7.2
7.4
7.6
7.8
8.0


Female PP Med Group
0
2
4
6
8
10
12
7.0
7.2
7.4
7.6
7.8
8.0

5. Determine the 95% confidence interval for the population mean of each group, and the 95% confidence interval for the difference between the means of the two groups.

Group one: Male Control GR:

```
U<=7.096
s<-1.057647
n<-23
SE<-qnorm(0.975)*s/sqrt(n)
```

SE	0.432239960532422

```
> 7.096+SE
[1] 7.52824

> 7.096-SE
[1] 6.66376
```

CI 95% is (6.66376,7.52824)

We are 95% happy the mean is correct.

Group Two: Male Med GR:

```
U2<=6.826
s2<-0.8698053
n2<-23
SE2<-qnorm(0.975)*s2/sqrt(n2)
```

SE2	0.355472675233695

```
 6.826-0.355472675233695
1] 6.470527
 6.826+0.355472675233695
1] 7.181473
```

CI for group 2 is (6.470527,7.181473)

We are 95% happy the mean (6.826) is in this range.

Group 3: Male Perceived Pain Control Group

```
U3<-8.217
S3<-0.6712622
n3<-23
SE3<-qnorm(0.975)*(0.6712622)/sqrt(23)
```

SE3	0.274331933844569

```
 8.217+0.274331933844569
1] 8.491332
 8.217-0.274331933844569
1] 7.942668
```

CI 95% is (7.942668,8.491332)

We are 95% happy the mean is in this interval.

Group 4: Male Perceived Pain Med Group

```
u4<-8.043
S4<-0.5623216
N4<-23
SE4<-qnorm(0.975)*(0.5623216)/sqrt(23)
```

SE4	0.229810008623414

```
 8.043+0.229810008623414
1] 8.27281
 8.043-0.229810008623414
1] 7.81319
```

CI 95% is (7.81319,8.27281)

We are 95% happy the mean is in this interval.

Group 5:Female GR Control Group

```
u5<-7.039
S5<-0.5516415
N4<-23
SE5<-qnorm(0.975)*(0.5516415)/sqrt(23)
```

```
 7.039-0.225445257432816
1] 6.813555
 7.039+0.225445257432816
1] 7.264445
```

CI 95% is (6.813555,7.264445)

We are 95% happy the mean is in this interval.

Group 6: Female Med Group GR

```
u6<-6.491
s6<-0.4747373
N6<-23
SE6<-qnorm(0.975)*(0.4747373)/sqrt(23)
```

SE6	0.194015991928563

```
> 6.491+0.194015991928563
[1] 6.685016
> 6.491-0.194015991928563
[1] 6.296984
```

CI 95% is (6.296984,6.685016)

We are 95% happy the mean is in this interval.

Group 7: Female Control Group PP

```
u7<-7.739
s7<-0.8100163
n7<-23
se7<-qnorm(0.975)*(0.8100163)/sqrt(23)
```

se7	0.331038062361656

```
> se7<-qnorm(0.975)*(0.8100163)/sqrt(23)
> 7.739+0.331038062361656
[1] 8.070038
> 7.739-0.331038062361656
[1] 7.407962
```

CI 95% is (7.407962,8.070038)

We are 95% happy the mean is in this interval.

Group 8: Female Med Group PP

```
u8<-7.565
s8<-0.5068698
n8<-23
se8<-qnorm(0.975)*(0.5068698)/sqrt(23)
```

se8	0.207147925864751

```
 7.565-0.207147925864751
1] 7.357852
 7.565+0.207147925864751
1] 7.772148
```

CI 95% is (7.357852,7.772148)

We are 95% happy the mean is in this interval.

Difference of Means

G1:Stats Male Control Group Galvanic Response:

```
 Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(MGR)
5.600   6.200   7.100   7.096   7.850   8.900  [1] 1.057647
```

G2:Stats Male Meditation Group Galvanic Response:

```
 Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(MMGR)
5.000   6.400   6.800   6.826   7.200   8.700  [1] 0.8698053
```

Male Control GR – Male Med GR

Mean – mean +_ t*(SE)

```
#t value, same for all as all samples have 23 each
qt(p=0.975,df=22)
```

```
> qt(p=0.975,df=22)
[1] 2.073873
```

SE=

```
> (((1.057647^2)+(0.8698053^2))/22)^0.5
[1] 0.291951
```

```
> (7.096-6.826)+(2.073873*0.291951)
[1] 0.8754693
```

```
> (7.096-6.826)-(2.073873*0.291951)
[1] -0.3354693
```

CI interval is: (-0.3354693,0.8754693). Interval contains 0 so it supports the null hypothesis that there is no difference.

G3:Stats Male Control Group Perceived Pain Response:

```
> summary(MPR)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  7.000   8.000   8.000   8.217   9.000   9.000
> sd(MPR)
[1] 0.6712622
```

G4:Stats Male Meditation Group Perceived Pain Response:

```
> summary(MMPP)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  7.000   8.000   8.000   8.043   8.000   9.000
> sd(MMPP)
[1] 0.5623216
```

Male Control PP – Male Med PP

```
> qt(p=0.975,df=22)
[1] 2.073873

> (((0.6712622^2)+(0.5623216^2))/22)^0.5
[1] 0.1866935

> (8.217-8.043)+(2.073873*0.1866935)
[1] 0.5611786
> (8.217-8.043)-(2.073873*0.1866935)
[1] -0.2131786
```

CI interval is: (-0.2131786,0.5611786). Interval contains 0 so it supports the null hypothesis that there is no difference.

Female Control GR – Female Med GR

G5:Stats Female Control Group Galvanic Response:

```
> summary(FGR)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  5.800   6.650   7.000   7.039   7.550   7.900
> sd(FGR)
[1] 0.5516415
```

G6:Stats Female Meditation Group Galvanic Response:

```
summary(FMG)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  5.700   6.100   6.400   6.491   6.800   7.300
> sd(FMG)
[1] 0.4747373

> (((0.55164152^2)+(0.4747373^2))/22)^0.5
[1] 0.1551662
> (7.039-6.491)-(2.073873*0.1551662)
[1] 0.226205
> (7.039-6.491)+(2.073873*0.1551662)
[1] 0.869795
```

CI interval is: (0.226205,0.869795). This interval doesn't have 0 so we reject the null hypothesis that there is no difference in favour of alternative hypothesis.

G7:Stats Female Control Group Perceived Pain Response:

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(FPP)
  6.000   7.000   8.000   7.739   8.000   9.000  [1] 0.8100163
```

G8:Stats Female Med Group Perceived Pain:

```
> summary(FMP)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.  > sd(FMP)
  7.000   7.000   8.000   7.565   8.000   8.000  [1] 0.5068698
```

```
> (((0.81001632^2)+(0.5068698^2))/22)^0.5
[1] 0.2037203
> (7.739-7.565)+(2.073873*0.2037203)
[1] 0.59649
> (7.739-7.565)-(2.073873*0.2037203)
[1] -0.24849
```

CI interval is: (-0.24849,0.59649). Interval contains 0 so it supports the null hypothesis that there is no difference.