Statistics Examen_NeuroBIM

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Loading the data file into R

First of all, the data was loaded into R from the textfile. A summary of the data was obtained as an indication whether the data was correctly loaded into R.

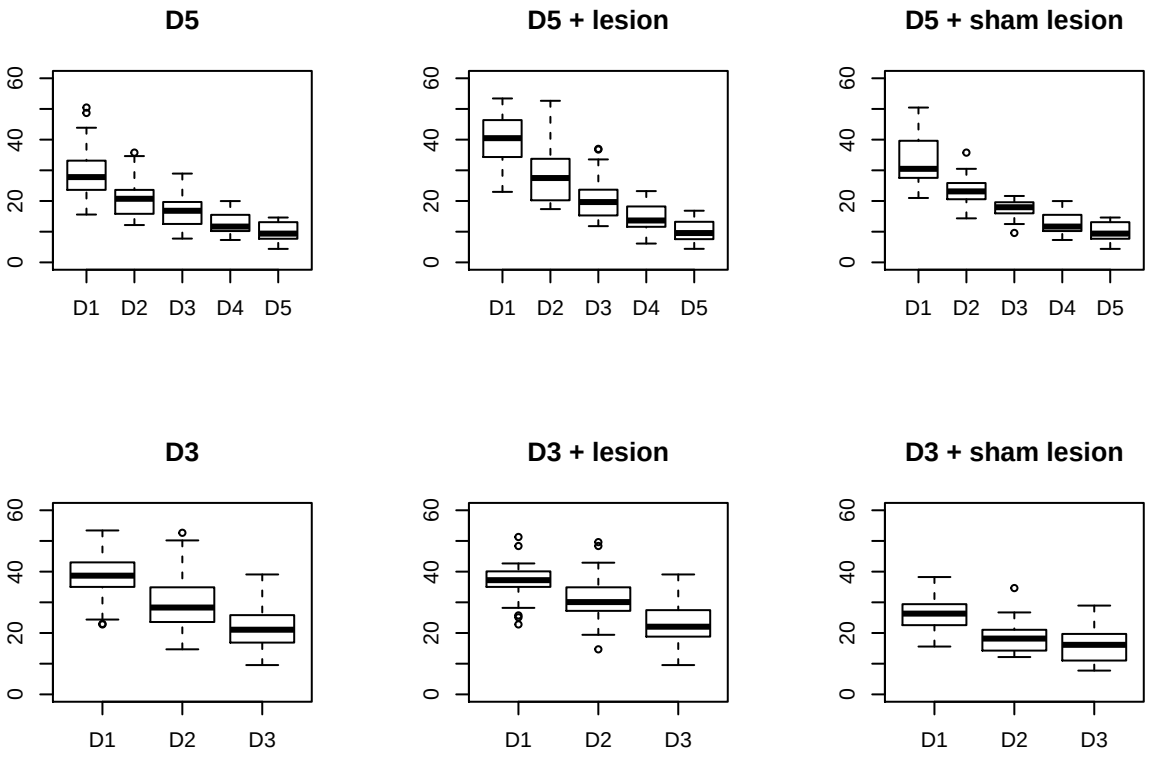
Let's add a collumn for the difference between time needed

Creating seperate files for the 4 conditions

The mice were either trained in 3 sessions (D3) or in 5 sessions (D5). Within each of these two groups, the animals were either lesioned in the dorsal hippocampus (H) or they were given a sham lesion (SH). These groups were originally stored in the datafile, but will now be sorted in order to easily be able to display them seperately.

Learning time

The mice were given a task, and the time they spent in the dark is a measure of how well they learnt it.




```
## [1] 29.5587
```

```
## [1] 22.88382
```

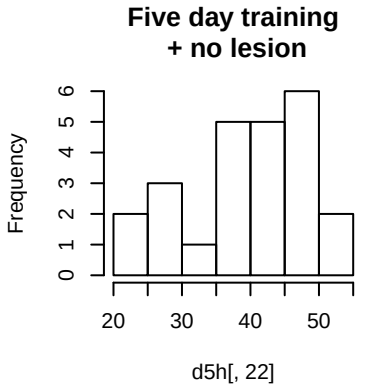
```
## [1] 13.70844
```

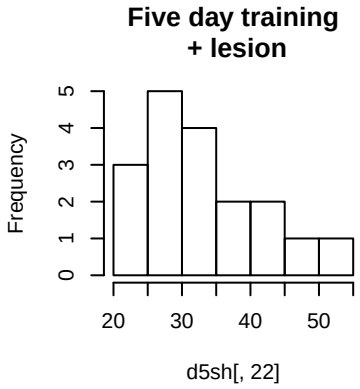
```
## [1] 10.73177
```

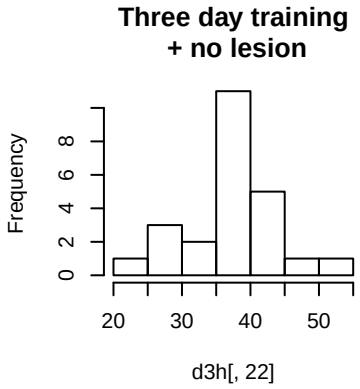
Is the data normally distributed?

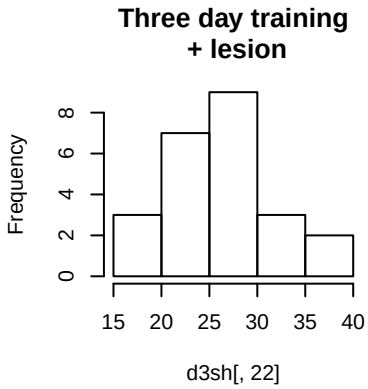
First, Let's look at histograms of each group.

Day 1

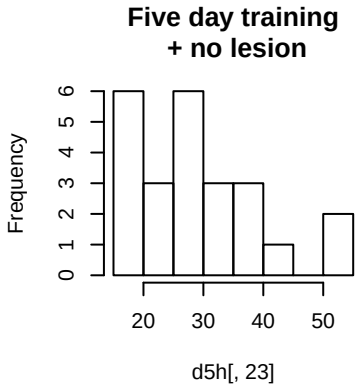

Five day training
+ no lesion
Frequency
0 1 2 3 4 5 6
20 30 40 50
d5h[, 22]

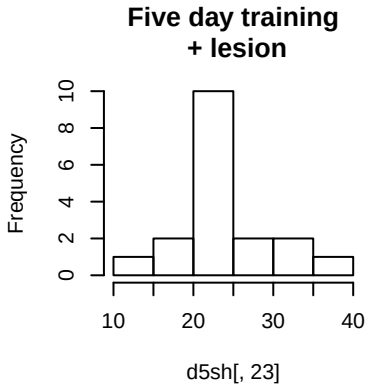

Five day training
+ lesion
Frequency
0 1 2 3 4 5
20 30 40 50
d5sh[, 22]

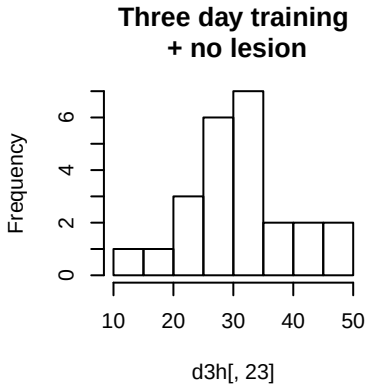

Three day training
+ no lesion
Frequency
0 2 4 6 8
20 30 40 50
d3h[, 22]

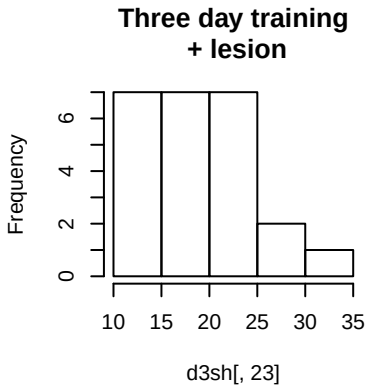

Three day training
+ lesion
Frequency
0 2 4 6 8
15 20 25 30 35 40
d3sh[, 22]

Day 2

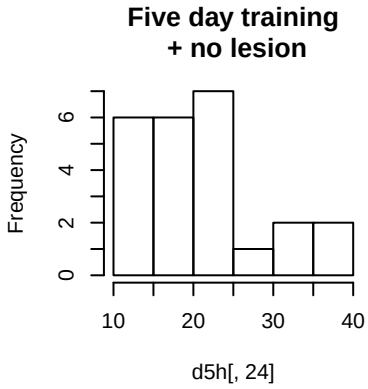

Five day training
+ no lesion
Frequency
0 1 2 3 4 5 6
20 30 40 50
d5h[, 23]

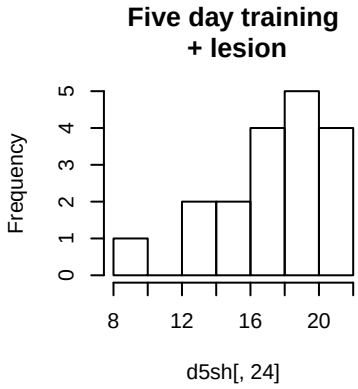

Five day training
+ lesion
Frequency
0 2 4 6 8 10
10 20 30 40
d5sh[, 23]

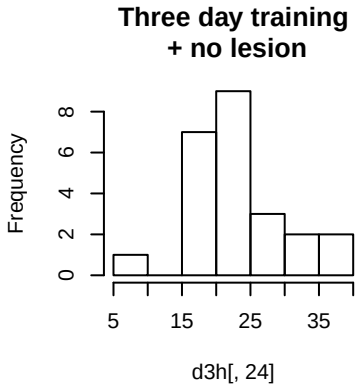

Three day training
+ no lesion
Frequency
0 2 4 6
10 20 30 40 50
d3h[, 23]

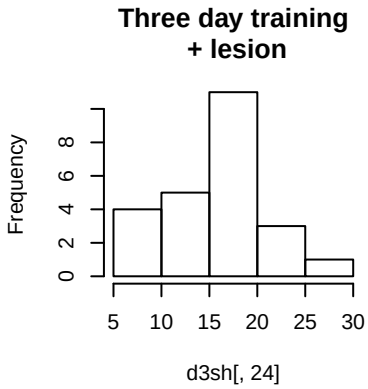

Three day training
+ lesion
Frequency
0 2 4 6
10 15 20 25 30 35
d3sh[, 23]

Day 3

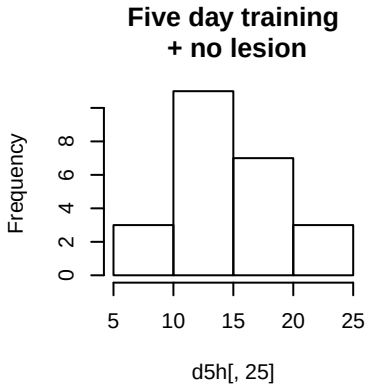

Five day training
+ no lesion
Frequency
0
2
4
6
10
20
30
40
d5h[, 24]

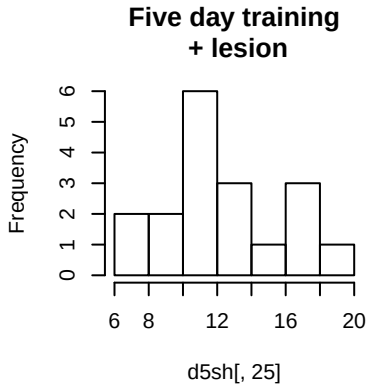

Five day training
+ lesion
Frequency
0
1
2
3
4
5
8
12
16
20
d5sh[, 24]


Three day training
+ no lesion
Frequency
0
2
4
6
8
5
15
25
35
d3h[, 24]

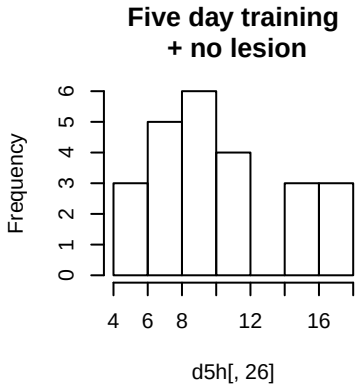

Three day training
+ lesion
Frequency
0
2
4
6
8
5
10
15
20
25
30
d3sh[, 24]

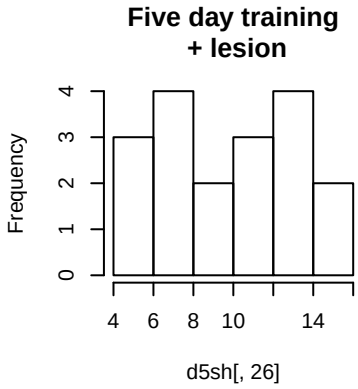
Day 4


Five day training
+ no lesion
Frequency
0 2 4 6 8
5 10 15 20 25
d5h[, 25]

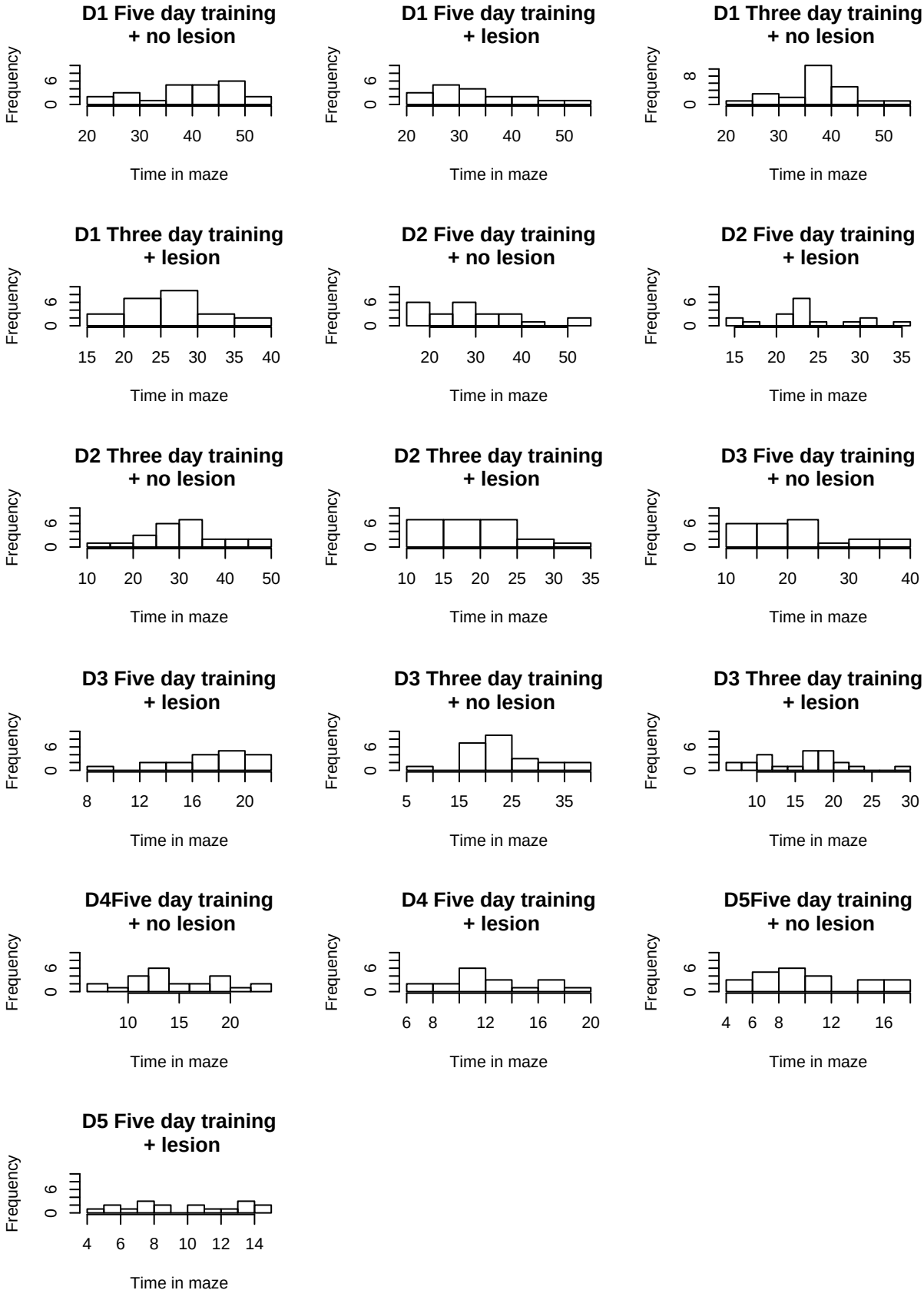

Five day training
+ lesion
Frequency
0 1 2 3 4 5 6
6 8 12 16 20
d5sh[, 25]

Day 5


Five day training
+ no lesion
Frequency
0 1 2 3 4 5 6
4 6 8 12 16
d5h[, 26]


Five day training
+ lesion
Frequency
0 1 2 3 4
4 6 8 10 14
d5sh[, 26]

Day 1


D1 Five day training + no lesion
Frequency
0 6
20 30 40 50
Time in maze
D1 Five day training + lesion
Frequency
0 6
20 30 40 50
Time in maze
D1 Three day training + no lesion
Frequency
0 8
20 30 40 50
Time in maze
D1 Three day training + lesion
Frequency
0 6
15 20 25 30 35 40
Time in maze
D2 Five day training + no lesion
Frequency
0 6
20 30 40 50
Time in maze
D2 Five day training + lesion
Frequency
0 6
15 20 25 30 35
Time in maze
D2 Three day training + no lesion
Frequency
0 6
10 20 30 40 50
Time in maze
D2 Three day training + lesion
Frequency
0 6
10 15 20 25 30 35
Time in maze
D3 Five day training + no lesion
Frequency
0 6
10 20 30 40
Time in maze
D3 Five day training + lesion
Frequency
0 6
8 12 16 20
Time in maze
D3 Three day training + no lesion
Frequency
0 6
5 15 25 35
Time in maze
D3 Three day training + lesion
Frequency
0 6
10 15 20 25 30
Time in maze
D4Five day training + no lesion
Frequency
0 6
10 15 20
Time in maze
D4 Five day training + lesion
Frequency
0 6
6 8 12 16 20
Time in maze
D5Five day training + no lesion
Frequency
0 6
4 6 8 12 16
Time in maze
D5 Five day training + lesion
Frequency
0 6
4 6 8 10 12 14
Time in maze

NORMAL DISTIBUTION?

We will carry out the shapiro-Wilk test. If p>a (bigger than 0.05 generally), the data is normal.

```
##
##  Shapiro-Wilk normality test
##
## data:  d5h[, 22]
## W = 0.93728, p-value = 0.1418
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5sh[, 22]
## W = 0.91884, p-value = 0.1233
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d3h[, 22]
## W = 0.95137, p-value = 0.29
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d3sh[, 22]
## W = 0.97685, p-value = 0.8315
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5h[, 23]
## W = 0.89922, p-value = 0.02072
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5sh[, 23]
## W = 0.95189, p-value = 0.4555
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d3h[, 23]
## W = 0.95015, p-value = 0.273
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d3sh[, 23]
## W = 0.90132, p-value = 0.02296
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5h[, 24]
## W = 0.90804, p-value = 0.03198
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5sh[, 24]
## W = 0.93531, p-value = 0.2405
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d3h[, 24]
## W = 0.97188, p-value = 0.7135
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d3sh[, 24]
## W = 0.95286, p-value = 0.3121
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5h[, 24]
## W = 0.90804, p-value = 0.03198
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5sh[, 24]
## W = 0.93531, p-value = 0.2405
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5h[, 25]
## W = 0.97568, p-value = 0.805
```

```
##
##  Shapiro-Wilk normality test
##
## data:  d5sh[, 25]
## W = 0.93916, p-value = 0.2803
```

All the values are higher than p=0.05, so the data is normally distributed.

Making a new dataframe for ANOVA

We will make a list of the factors (d5h, d5sh, d3h, d3sh), and a list with the "learned" decrease in time needed to explore the matrix.

Homogeneity of Variance

```
##
##  Bartlett test of homogeneity of variances
##
## data:  d1$values by d1$exp
## Bartlett's K-squared = 3.6572, df = 3, p-value = 0.3009
```

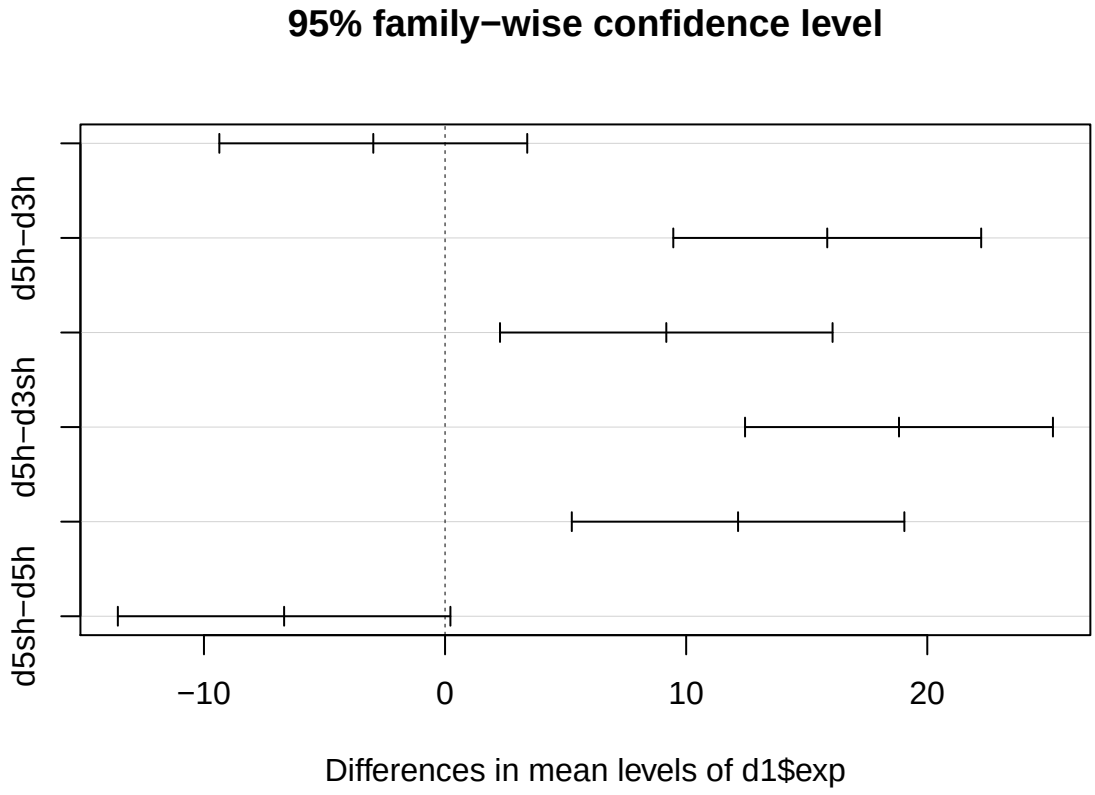
ANOVA

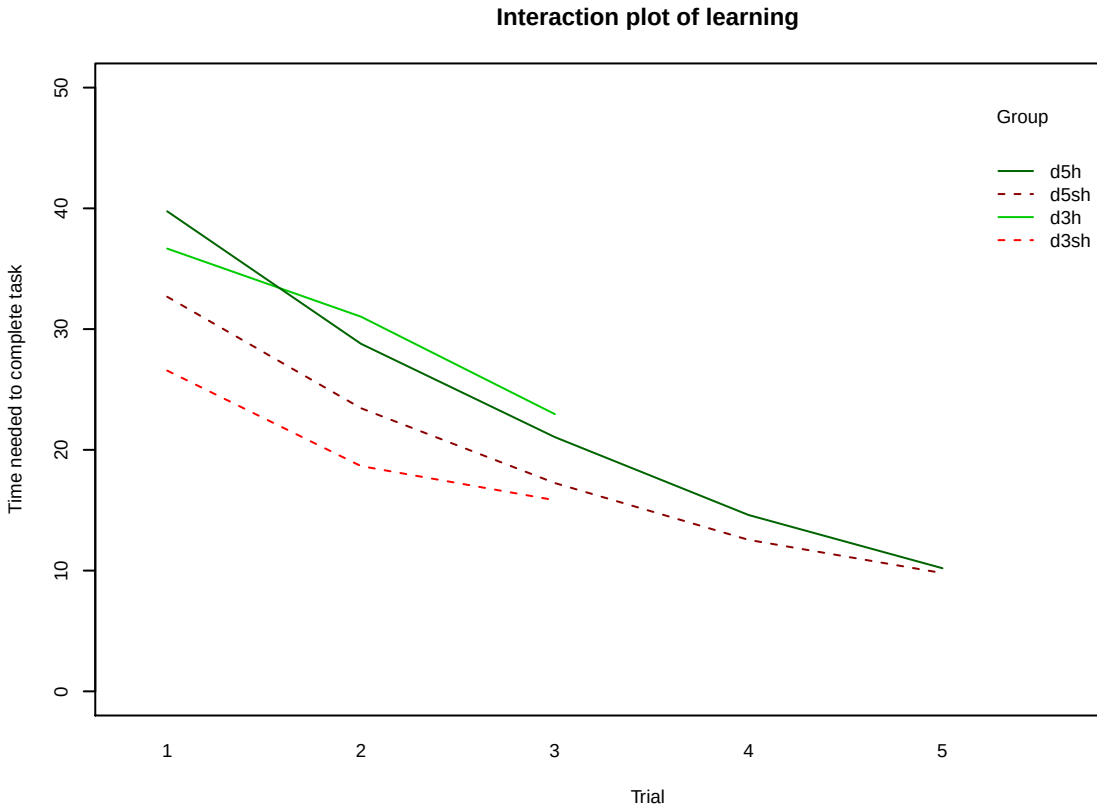
Maybe we should instead to a repeated measures anova where we follow the animal over the different learning trials.

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## d1$exp       3   5260  1753.3    24.6 1.38e-11 ***
## Residuals   86   6129    71.3
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The anova is highly significant at $p<0.05$. Let's do a post-hoc Tukey test to find where the differences are #Tukey posthoc

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = f1)
##
## $`d1$exp`
##                 diff        lwr        upr     p adj
## d3sh-d3h  -2.976667  -9.361469  3.4081355 0.6150204
## d5h-d3h   15.850260   9.465458 22.2350626 0.0000000
## d5sh-d3h   9.175382   2.279007 16.0717565 0.0042380
## d5h-d3sh  18.826927  12.442125 25.2117293 0.0000000
## d5sh-d3sh 12.152049   5.255674 19.0484232 0.0000790
## d5sh-d5h  -6.674878 -13.571253  0.2214961 0.0614873
```


95% family−wise confidence level
d5h−d3h
d5h−d3sh
d5sh−d5h
−10
0
10
20
Differences in mean levels of d1$exp



#Repeated measures ANOVA

```
##
## Error: id
##           Df Sum Sq Mean Sq F value   Pr(>F)
## group      3   5594  1864.7   27.11 1.95e-12 ***
## Residuals 86   5914    68.8
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Error: Within
##             Df Sum Sq Mean Sq F value  Pr(>F)
## time         4  22320    5580 169.998 < 2e-16 ***
## group:time   8    751      94   2.861 0.00462 **
## Residuals  252   8272      33
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Mauchly's test for sphericity was not met, so the degrees of freedom

```
## Loading required package: lme4
## Loading required package: Matrix
## Loading required package: reshape2
## Loading required package: lsmeans
## Loading required package: estimability
##
## Attaching package: 'lsmeans'
```

```
##
## The following object is masked from 'package:base':
##
##     rbind
##
## ************
## Welcome to afex. Important changes in the current version:
## - Functions for ANOVAs have been renamed to: aov_car(), aov_ez(), and aov_4().
## - ANOVA functions return an object of class 'afex_aov' as default, see: ?aov_car
## - 'afex_aov' objects can be passed to lsmeans for contrasts and follow-up tests.
## - Reset previous (faster) behavior via: afex_options(return_aov='nice')
## - Many more arguments can now be set globally via options, see: afex_options()
## ************
## Loading required package: mvtnorm
## Loading required package: survival
## Loading required package: TH.data
```

model.cs <- gls(tasktime ~ group * time , data = d2, corr = corCompSymm(, form = ~ 1 | id))

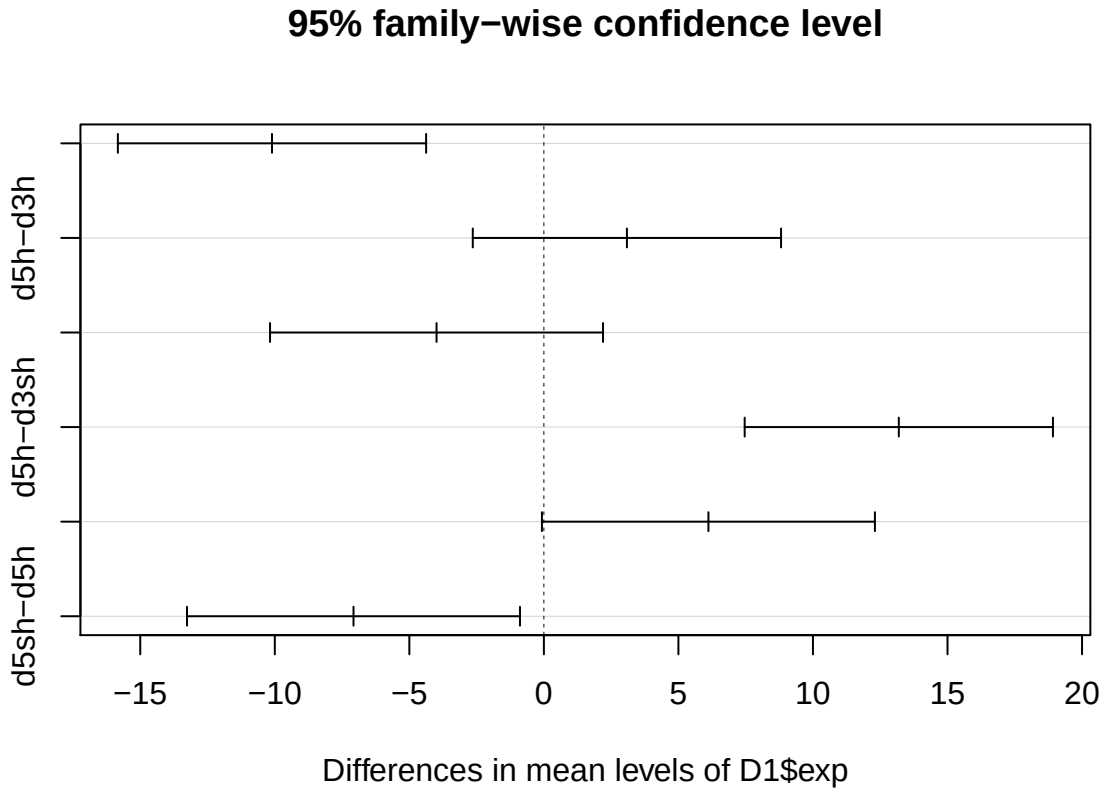
summary(model.cs)

The between group tests indicates that the variable group is significant. consequently, int he graph we see that the liens for the two groups are rather far apart. The within subject test indicates that there is a significant time effect, inother words, the groups do change other time, both groups are taking less time to complete the task over time. Morover, the interaction of time and group is significant which means that the groups are changing over time but are changing in different ways, which means that in the graph, the liens will not be parallel.

DAY 1

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## D1$exp       3   2324   774.7    13.5 2.68e-07 ***
## Residuals   86   4934    57.4
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

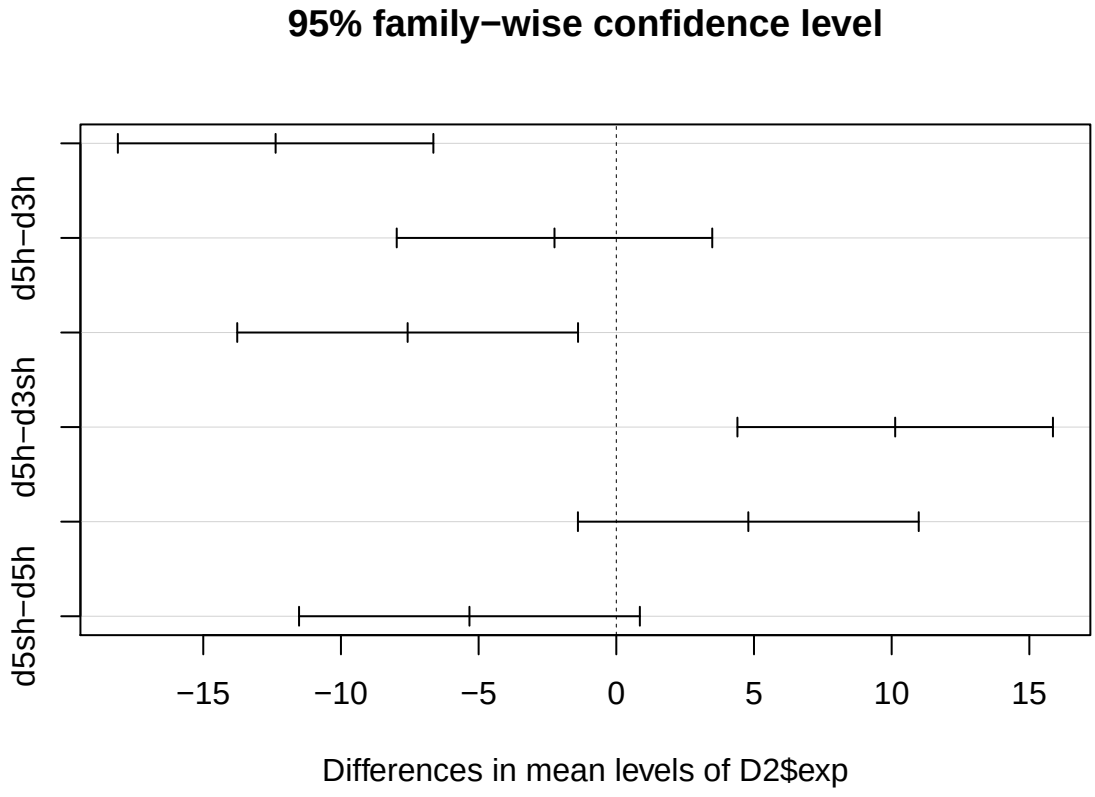
```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = fD1)
##
## $`D1$exp`
##                  diff          lwr        upr     p adj
## d3sh-d3h  -10.104688 -15.83327806 -4.3760969 0.0000775
## d5h-d3h     3.086062  -2.64252806  8.8146531 0.4957580
## d5sh-d3h   -3.989444 -10.17702945  2.1981406 0.3356221
## d5h-d3sh   13.190750   7.46215944 18.9193406 0.0000002
## d5sh-d3sh   6.115243  -0.07234195 12.3028281 0.0539491
## d5sh-d5h   -7.075507 -13.26309195 -0.8879219 0.0184144
```



DAY 2

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## D2$exp       3   2191   730.4   12.73 5.84e-07 ***
## Residuals   86   4935    57.4
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

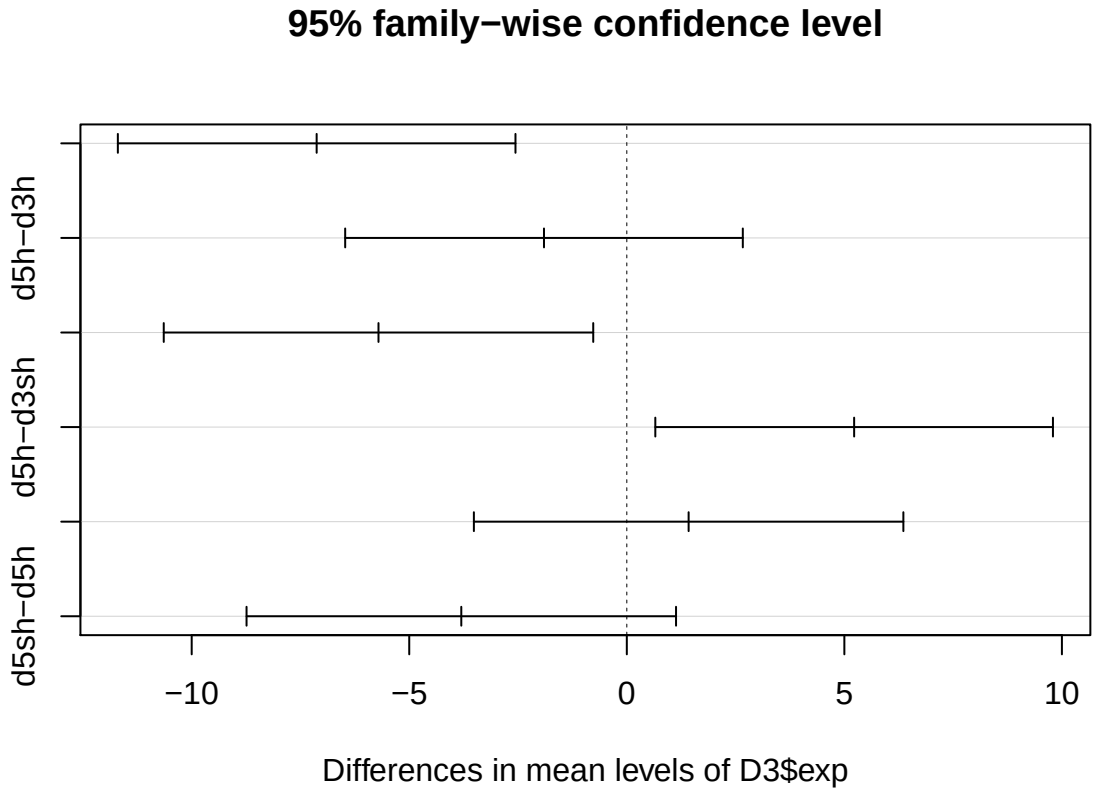
```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = fD2)
##
## $`D2$exp`
##                  diff        lwr        upr     p adj
## d3sh-d3h  -12.373333 -18.102674 -6.6439923 0.0000012
## d5h-d3h    -2.244844  -7.974185  3.4844973 0.7343947
## d5sh-d3h   -7.578073 -13.766469 -1.3896773 0.0099558
## d5h-d3sh   10.128490   4.399149 15.8578307 0.0000745
## d5sh-d3sh   4.795260  -1.393135 10.9836561 0.1850429
## d5sh-d5h   -5.333229 -11.521625  0.8551665 0.1161882
```



#DAY 3

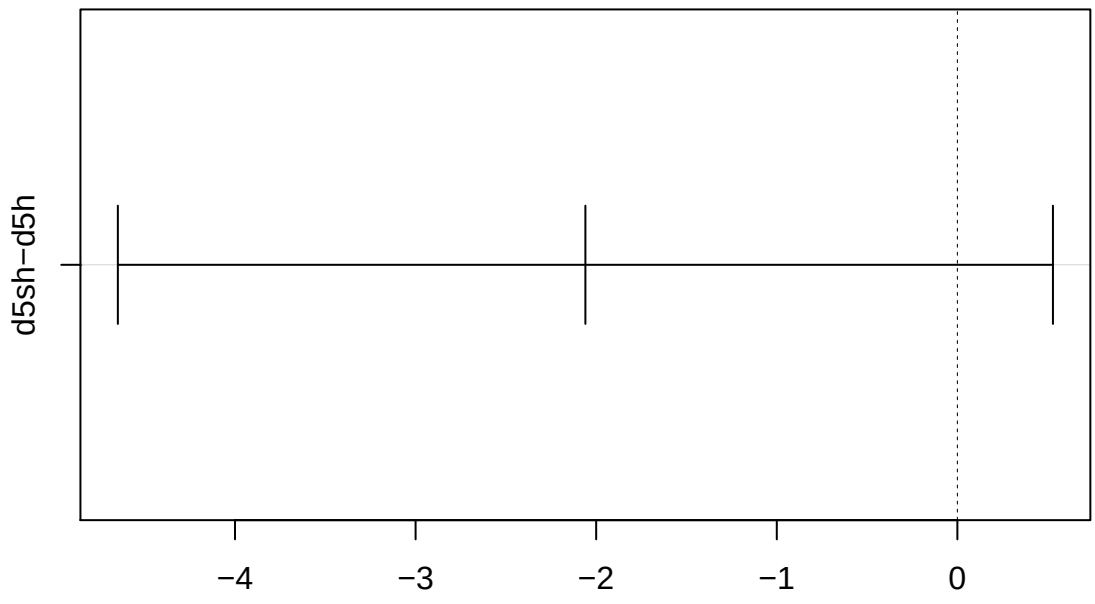
```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## D3$exp       3  758.6   252.8   6.927 0.000313 ***
## Residuals   86 3139.3    36.5
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = fD3)
##
## $`D3$exp`
##                 diff        lwr        upr     p adj
## d3sh-d3h  -7.128021 -11.697564 -2.5584780 0.0005588
## d5h-d3h   -1.903073  -6.472616  2.6664700 0.6958769
## d5sh-d3h  -5.706979 -10.642650 -0.7713088 0.0167529
## d5h-d3sh   5.224948   0.655405  9.7944908 0.0184241
## d5sh-d3sh  1.421042  -3.514629  6.3567121 0.8745762
## d5sh-d5h  -3.803906  -8.739577  1.1317642 0.1889809
```



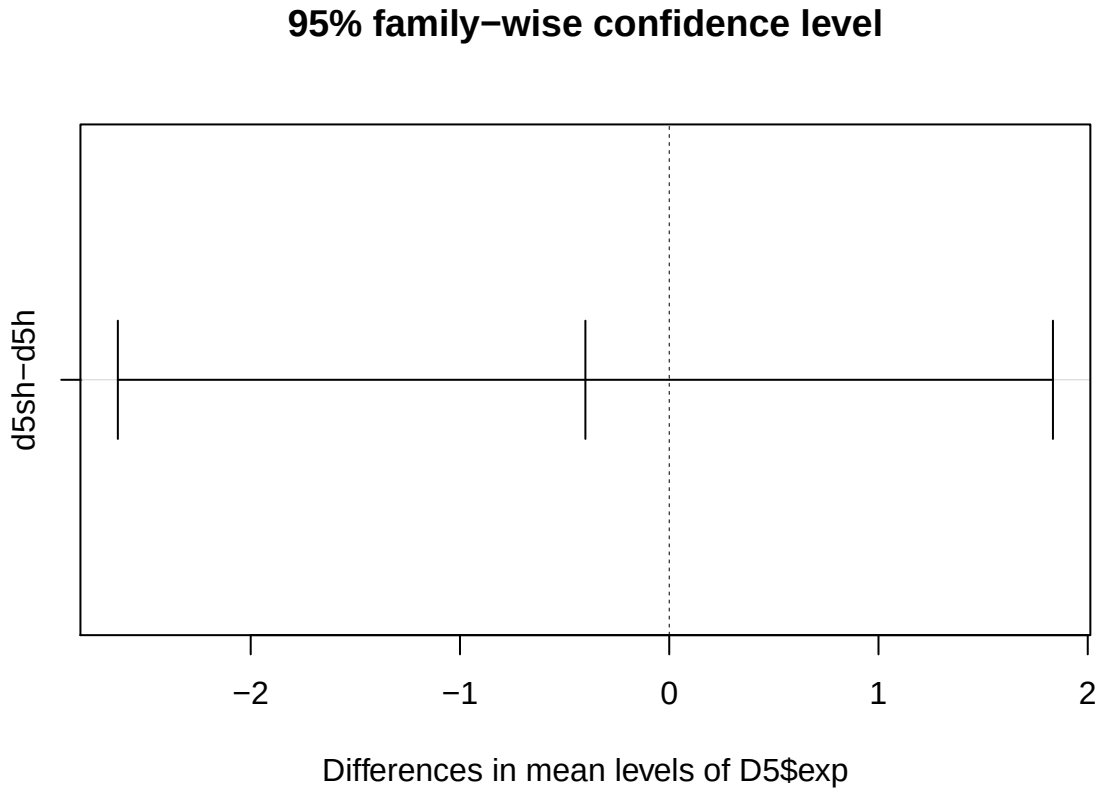
#DAY 4

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## D4$exp       1   43.6   43.64   2.586  0.116
## Residuals   40  675.1   16.88

##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = fD4)
##
## $`D4$exp`
##                diff       lwr       upr     p adj
## d5sh-d5h -2.059722 -4.648644 0.5291991 0.1157122
```



#DAY 5

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## D5$exp       1    1.7   1.651   0.131  0.719
## Residuals   40  502.8  12.571

##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = fD5)
##
## $`D5$exp`
##                diff       lwr      upr     p adj
## d5sh-d5h -0.4006285 -2.634966 1.833709 0.7189687
```



Are there structures that are differentially activated depending on the duration of the training?

I think the best option here is MANOVA. I used this video first https://www.youtube.com/watch?v=48cZ2cMBpio

```
##                   Df  Pillai approx F num Df den Df    Pr(>F)
## as.factor(TRAIN)  1 0.87467   8.0807     19     22 4.842e-06 ***
## Residuals        40
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

I don't think these results are helpful at all. So there are areas that differ.. ok..

What are the structure activities that are correlated with performance (in the last training session) ?

Ok. So we need a correlation. then we need a matrix.

```
## Loading required package: grid
## Loading required package: Formula
## Loading required package: ggplot2
##
```

```
## Attaching package: 'Hmisc'
##
## The following objects are masked from 'package:base':
##
##     format.pval, round.POSIXt, trunc.POSIXt, units
```

```
##            row column         cor          p
## 172       STLD  final -0.25688878 0.01451892
## 173       STMD  final -0.11459476 0.28215434
## 174   AMBASLAT  final  0.12201443 0.25194559
## 175      AMLAT  final  0.03474115 0.74512462
## 176     ENTORH  final -0.08409247 0.43068690
## 177     PERIRH  final -0.06621543 0.53520851
## 178        CA1  final -0.29772902 0.05549844
## 179        CA3  final -0.30402470 0.05029389
## 180         DG  final -0.15854518 0.31593655
## 181   CINGULAR  final -0.23694505 0.02454052
## 182    PRELIMB  final  0.06786582 0.52505980
## 183    SOMSENS  final  0.09701581 0.36300415
## 184  SUBICULUM  final  0.24090412 0.02218022
## 185    ACCCORE  final -0.08076198 0.44922795
## 186   ACCSHELL  final -0.06811436 0.52353991
## 187     VISUAL  final  0.05980199 0.57554592
## 188   PIRIFORM  final -0.05737391 0.59117707
## 189   PARIETAL  final  0.06761815 0.52657656
## 190 RETROSPLEN  final  0.23501243 0.02576832
```

```
##              STLD  STMD AMBASLAT AMLAT ENTORH PERIRH CINGULAR PRELIMB
## STLD         1.00  0.68     0.53  0.57   0.09   0.05     0.56   -0.10
## STMD         0.68  1.00     0.43  0.43   0.17  -0.14     0.52   -0.18
## AMBASLAT     0.53  0.43     1.00  0.38  -0.01  -0.07     0.40    0.14
## AMLAT        0.57  0.43     0.38  1.00   0.48   0.15     0.59    0.05
## ENTORH       0.09  0.17    -0.01  0.48   1.00   0.62     0.32   -0.37
## PERIRH       0.05 -0.14    -0.07  0.15   0.62   1.00     0.20   -0.30
## CINGULAR     0.56  0.52     0.40  0.59   0.32   0.20     1.00    0.00
## PRELIMB     -0.10 -0.18     0.14  0.05  -0.37  -0.30     0.00    1.00
## SOMSENS      0.14  0.30     0.21  0.12   0.24   0.20     0.02    0.23
## SUBICULUM    0.01  0.12     0.29  0.02  -0.09   0.09    -0.09    0.24
## ACCCORE      0.57  0.47     0.33  0.58   0.35   0.28     0.44    0.11
## ACCSHELL     0.25  0.35    -0.04  0.06   0.23   0.30     0.03   -0.10
## VISUAL      -0.01 -0.05     0.25  0.10   0.00  -0.17     0.13    0.14
## PIRIFORM     0.22  0.05     0.51  0.35   0.22   0.20     0.39   -0.01
## PARIETAL     0.11  0.11     0.59  0.28  -0.05   0.07     0.06    0.38
## RETROSPLEN   0.40  0.49     0.40  0.54   0.10  -0.12     0.33    0.08
## performance  0.42  0.51     0.31  0.15   0.02  -0.03     0.28   -0.27
##              SOMSENS SUBICULUM ACCCORE ACCSHELL VISUAL PIRIFORM PARIETAL
## STLD            0.14      0.01    0.57     0.25  -0.01     0.22     0.11
## STMD            0.30      0.12    0.47     0.35  -0.05     0.05     0.11
## AMBASLAT        0.21      0.29    0.33    -0.04   0.25     0.51     0.59
## AMLAT           0.12      0.02    0.58     0.06   0.10     0.35     0.28
## ENTORH          0.24     -0.09    0.35     0.23   0.00     0.22    -0.05
## PERIRH          0.20      0.09    0.28     0.30  -0.17     0.20     0.07
## CINGULAR        0.02     -0.09    0.44     0.03   0.13     0.39     0.06
## PRELIMB         0.23      0.24    0.11    -0.10   0.14    -0.01     0.38
```

```
## SOMSENS        1.00      0.36    0.49     0.60  -0.32    -0.11     0.32
## SUBICULUM      0.36      1.00   -0.11     0.01  -0.05     0.05     0.43
## ACCCORE        0.49     -0.11    1.00     0.58   0.05     0.26     0.33
## ACCSHELL       0.60      0.01    0.58     1.00  -0.44    -0.30     0.00
## VISUAL        -0.32     -0.05    0.05    -0.44   1.00     0.60     0.13
## PIRIFORM      -0.11      0.05    0.26    -0.30   0.60     1.00     0.28
## PARIETAL       0.32      0.43    0.33     0.00   0.13     0.28     1.00
## RETROSPLEN     0.31      0.21    0.33    -0.10   0.05     0.26     0.31
## performance   -0.01     -0.19    0.35     0.09   0.06     0.18     0.29
##             RETROSPLEN performance
## STLD              0.40        0.42
## STMD              0.49        0.51
## AMBASLAT          0.40        0.31
## AMLAT             0.54        0.15
## ENTORH            0.10        0.02
## PERIRH           -0.12       -0.03
## CINGULAR          0.33        0.28
## PRELIMB           0.08       -0.27
## SOMSENS           0.31       -0.01
## SUBICULUM         0.21       -0.19
## ACCCORE           0.33        0.35
## ACCSHELL         -0.10        0.09
## VISUAL            0.05        0.06
## PIRIFORM          0.26        0.18
## PARIETAL          0.31        0.29
## RETROSPLEN        1.00        0.00
## performance       0.00        1.00
##
## n= 24
##
##
## P
##             STLD   STMD   AMBASLAT AMLAT  ENTORH PERIRH CINGULAR PRELIMB
## STLD               0.0002 0.0084   0.0037 0.6734 0.8234 0.0047   0.6552
## STMD        0.0002        0.0362   0.0352 0.4311 0.5207 0.0092   0.4126
## AMBASLAT    0.0084 0.0362          0.0675 0.9739 0.7422 0.0508   0.5030
## AMLAT       0.0037 0.0352 0.0675         0.0165 0.4723 0.0025   0.8010
## ENTORH      0.6734 0.4311 0.9739   0.0165        0.0012 0.1229   0.0756
## PERIRH      0.8234 0.5207 0.7422   0.4723 0.0012        0.3559   0.1576
## CINGULAR    0.0047 0.0092 0.0508   0.0025 0.1229 0.3559          0.9908
## PRELIMB     0.6552 0.4126 0.5030   0.8010 0.0756 0.1576 0.9908
## SOMSENS     0.5081 0.1476 0.3221   0.5828 0.2527 0.3571 0.9284   0.2898
## SUBICULUM   0.9561 0.5760 0.1737   0.9427 0.6643 0.6914 0.6687   0.2568
## ACCCORE     0.0037 0.0216 0.1211   0.0031 0.0938 0.1815 0.0301   0.5996
## ACCSHELL    0.2328 0.0970 0.8566   0.7983 0.2696 0.1577 0.8963   0.6447
## VISUAL      0.9721 0.8012 0.2366   0.6481 0.9999 0.4359 0.5481   0.5171
## PIRIFORM    0.2926 0.8243 0.0116   0.0932 0.2954 0.3582 0.0626   0.9788
## PARIETAL    0.6238 0.6129 0.0025   0.1841 0.8200 0.7453 0.7684   0.0651
## RETROSPLEN  0.0539 0.0142 0.0545   0.0065 0.6361 0.5864 0.1148   0.7184
## performance 0.0405 0.0112 0.1339   0.4745 0.9167 0.8928 0.1934   0.1961
##             SOMSENS SUBICULUM ACCCORE ACCSHELL VISUAL PIRIFORM PARIETAL
## STLD        0.5081  0.9561    0.0037  0.2328   0.9721 0.2926   0.6238
## STMD        0.1476  0.5760    0.0216  0.0970   0.8012 0.8243   0.6129
## AMBASLAT    0.3221  0.1737    0.1211  0.8566   0.2366 0.0116   0.0025
```

```
## AMLAT       0.5828  0.9427    0.0031  0.7983   0.6481 0.0932   0.1841
## ENTORH      0.2527  0.6643    0.0938  0.2696   0.9999 0.2954   0.8200
## PERIRH      0.3571  0.6914    0.1815  0.1577   0.4359 0.3582   0.7453
## CINGULAR    0.9284  0.6687    0.0301  0.8963   0.5481 0.0626   0.7684
## PRELIMB     0.2898  0.2568    0.5996  0.6447   0.5171 0.9788   0.0651
## SOMSENS             0.0882    0.0157  0.0019   0.1325 0.6199   0.1262
## SUBICULUM   0.0882            0.6189  0.9688   0.8341 0.8025   0.0358
## ACCCORE     0.0157  0.6189            0.0029   0.8326 0.2180   0.1127
## ACCSHELL    0.0019  0.9688    0.0029          0.0306 0.1583   0.9856
## VISUAL      0.1325  0.8341    0.8326  0.0306         0.0020   0.5605
## PIRIFORM    0.6199  0.8025    0.2180  0.1583   0.0020         0.1864
## PARIETAL    0.1262  0.0358    0.1127  0.9856   0.5605 0.1864
## RETROSPLEN  0.1368  0.3207    0.1205  0.6513   0.7989 0.2207   0.1465
## performance 0.9783  0.3847    0.0925  0.6815   0.7729 0.4130   0.1657
##             RETROSPLEN performance
## STLD        0.0539     0.0405
## STMD        0.0142     0.0112
## AMBASLAT    0.0545     0.1339
## AMLAT       0.0065     0.4745
## ENTORH      0.6361     0.9167
## PERIRH      0.5864     0.8928
## CINGULAR    0.1148     0.1934
## PRELIMB     0.7184     0.1961
## SOMSENS     0.1368     0.9783
## SUBICULUM   0.3207     0.3847
## ACCCORE     0.1205     0.0925
## ACCSHELL    0.6513     0.6815
## VISUAL      0.7989     0.7729
## PIRIFORM    0.2207     0.4130
## PARIETAL    0.1465     0.1657
## RETROSPLEN             0.9869
## performance 0.9869
```

```
##            row      column          cor          p
## 121       STLD performance  0.420943916 0.04052046
## 122       STMD performance  0.508609712 0.01115149
## 123   AMBASLAT performance  0.314945042 0.13387549
## 124      AMLAT performance  0.153313786 0.47446618
## 125     ENTORH performance  0.022545485 0.91671974
## 126     PERIRH performance -0.029052418 0.89280380
## 127   CINGULAR performance  0.275005847 0.19340416
## 128    PRELIMB performance -0.273405820 0.19611358
## 129    SOMSENS performance -0.005872661 0.97827284
## 130  SUBICULUM performance -0.185807616 0.38469403
## 131    ACCCORE performance  0.351101816 0.09251817
## 132   ACCSHELL performance  0.088317879 0.68153189
## 133     VISUAL performance  0.062166829 0.77290674
## 134   PIRIFORM performance  0.175138682 0.41304156
## 135   PARIETAL performance  0.292301059 0.16573976
## 136 RETROSPLEN performance  0.003533508 0.98692608
```

```
##
##  Pearson's product-moment correlation
##
```

```
## data:  cordataD5H$STLD and cordataD5H$performance
## t = 2.1766, df = 22, p-value = 0.04052
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.02113631 0.70468065
## sample estimates:
##       cor
## 0.4209439

##
##  Pearson's product-moment correlation
##
## data:  cordataD5H$STMD and cordataD5H$performance
## t = 2.7707, df = 22, p-value = 0.01115
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.1323719 0.7567441
## sample estimates:
##       cor
## 0.5086097

##            row      column          cor           p
## 121       STLD performance -0.076227695 0.723325284
## 122       STMD performance -0.002770538 0.989748891
## 123   AMBASLAT performance  0.225778431 0.288775563
## 124      AMLAT performance  0.246296376 0.245979988
## 125     ENTORH performance -0.179720566 0.400729262
## 126     PERIRH performance -0.532149076 0.007435526
## 127   CINGULAR performance -0.004120424 0.984754725
## 128    PRELIMB performance -0.236160472 0.266572650
## 129    SOMSENS performance  0.205784410 0.334698112
## 130  SUBICULUM performance -0.109996065 0.608889819
## 131    ACCCORE performance  0.075546660 0.725703792
## 132   ACCSHELL performance  0.177521572 0.406612533
## 133     VISUAL performance -0.021707390 0.919805660
## 134   PIRIFORM performance  0.150478333 0.482773527
## 135   PARIETAL performance  0.236988276 0.264850721
## 136 RETROSPLEN performance -0.021632330 0.920082088

##
##  Pearson's product-moment correlation
##
## data:  cordataD3H$PERIRH and cordataD3H$performance
## t = -2.9481, df = 22, p-value = 0.007436
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.7702075 -0.1639462
## sample estimates:
##        cor
## -0.5321491

##            row      column         cor          p
## 172       STLD performance -0.32145479 0.12559258
```

```
## 173       STMD performance -0.28133541 0.18293688
## 174   AMBASLAT performance -0.25245550 0.23398786
## 175      AMLAT performance -0.21934773 0.30309215
## 176     ENTORH performance -0.44434154 0.02960353
## 177     PERIRH performance -0.30310613 0.14993311
## 178        CA1 performance -0.14480291 0.49961947
## 179        CA3 performance -0.10614695 0.62155328
## 180         DG performance  0.06378335 0.76715843
## 181   CINGULAR performance -0.45524520 0.02539334
## 182    PRELIMB performance  0.06031009 0.77952358
## 183    SOMSENS performance -0.22309427 0.29469885
## 184  SUBICULUM performance -0.36111617 0.08296873
## 185    ACCCORE performance -0.35409132 0.08958555
## 186   ACCSHELL performance -0.06335748 0.76867166
## 187     VISUAL performance  0.41607288 0.04314844
## 188   PIRIFORM performance -0.36375323 0.08058232
## 189   PARIETAL performance -0.29271892 0.16510766
## 190 RETROSPLEN performance -0.17931114 0.40182103

##
##  Pearson's product-moment correlation
##
## data:  cordataD3SH$ENTORH and cordataD3SH$performance
## t = -2.3264, df = 22, p-value = 0.0296
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.71888165 -0.04988684
## sample estimates:
##       cor
## -0.4443415

##
##  Pearson's product-moment correlation
##
## data:  cordataD3SH$CINGULAR and cordataD3SH$performance
## t = -2.3982, df = 22, p-value = 0.02539
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.72542218 -0.06351215
## sample estimates:
##       cor
## -0.4552452

##
##  Pearson's product-moment correlation
##
## data:  cordataD3SH$VISUAL and cordataD3SH$performance
## t = 2.1461, df = 22, p-value = 0.04315
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.01523293 0.70169535
## sample estimates:
##       cor
## 0.4160729
```

```
##            row      column         cor          p
## 172       STLD performance  0.35961094 0.14272193
## 173       STMD performance  0.11980815 0.63584001
## 174   AMBASLAT performance  0.08361112 0.74151822
## 175      AMLAT performance  0.20436074 0.41597587
## 176     ENTORH performance -0.01583276 0.95028112
## 177     PERIRH performance  0.12335004 0.62581283
## 178        CA1 performance -0.06897060 0.78567310
## 179        CA3 performance  0.20157377 0.42249904
## 180         DG performance  0.12214736 0.62921076
## 181   CINGULAR performance  0.26162213 0.29432116
## 182    PRELIMB performance  0.52393258 0.02562968
## 183    SOMSENS performance  0.39525074 0.10449866
## 184  SUBICULUM performance  0.35399941 0.14951909
## 185    ACCCORE performance  0.18270271 0.46806182
## 186   ACCSHELL performance  0.13056333 0.60558531
## 187     VISUAL performance  0.27053288 0.27757543
## 188   PIRIFORM performance  0.25667286 0.30388027
## 189   PARIETAL performance  0.38416871 0.11549134
## 190 RETROSPLEN performance  0.35882717 0.14365820
```

```
##
##  Pearson's product-moment correlation
##
## data:  cordataD5SH$PRELIMB and cordataD5SH$performance
## t = 2.4605, df = 16, p-value = 0.02563
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.07554028 0.79607578
## sample estimates:
##       cor
## 0.5239326
```

First took all the data to see whether they are normally distributed or not: per brain area per group 4 groups, lesion vs. non lesion depending on normality: t test or wilcox

NORMAL DISTIBUTION?

We will carry out the shapiro-Wilk test. If p>a (bigger than 0.05 generally), the data is normal.

d5h[,c(3,17,20,21)] are not normally distributed d5sh[,c(3)] is not normally distributed d3h[,c(15,21)] are not normally distributed d3sh[,c(3,8,2,14,16,18)] is not normally distributed. You have a small sample size but the population is actually normally distributed, so we will use a parametric test anyway

T tests

t.test(collumn 1, collumn 2) skip collumns 9:11 for d3h vs d5h

```
datac<-colnames(data)
for(i in c(3:8,12:21)){
  print(i)
```

```
  print(datac[i])
  print(d3h[,i])
  print(d5h[,i])
  print(t.test(d3h[,i],d5h[,i]))
}
```

```
## [1] 3
## [1] "STLD"
##  [1]   19.63168 2236.07699  582.83527 1077.53831 1489.37467 1687.12486
##  [7] 1359.73386 1527.44955 1504.49669 1844.15789 1334.24550  956.44905
## [13] 2145.38404 2038.74676 2098.16692 2168.44480 2051.68900 2080.87669
## [19]  412.75920 1979.93478 1674.53727 2608.44735 2475.18341 1345.30369
##  [1] 2162.5189 2253.7244 2476.0565 2497.7111 2159.9612 1908.7014 1397.8837
##  [8] 1471.1390 2680.2471 2605.7150  220.3700 3033.4675  447.4333 2264.8033
## [15] 1912.9299 2129.9374 1519.5065  127.0036 2575.5788 2063.8802 2078.9927
## [22] 1492.2731 1466.8414 2129.6703
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -1.3064, df = 45.032, p-value = 0.1981
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -675.4311  143.9513
## sample estimates:
## mean of x mean of y
##  1612.441  1878.181
##
## [1] 4
## [1] "STMD"
##  [1]  613.4044 1268.1460  731.9615  737.6180 1068.3961 1850.6294 1081.5922
##  [8] 1553.5219 1628.5231 1411.1270 1173.7789  666.4401 1959.8445 1468.4872
## [15] 1690.2822 1836.2487 1636.8039 1810.1890  999.8705  800.0622 1132.4764
## [22] 1642.4100 2148.1133 1235.3099
##  [1] 1381.72319  942.41211 1718.07166 1850.48905 1752.27224  902.42175
##  [7]  977.93435 1073.60159 1277.29103 1658.16531  940.05475 1979.61404
## [13] 1161.47194 1302.59044  661.15728 1464.25676  951.58813   76.97897
## [19] 1343.72393 1554.99805  873.80158  796.80967 1145.40671 1015.84092
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = 1.0996, df = 45.955, p-value = 0.2772
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -115.6838  394.2305
## sample estimates:
## mean of x mean of y
##  1339.385  1200.111
##
## [1] 5
## [1] "AMBASLAT"
##  [1]  12.73977 341.25103 229.40977 210.07327 233.19370 559.49423 242.27726
```

```
##  [8] 190.33886 481.87630 657.61089 623.26432 105.07088 904.33602 873.71290
## [15] 611.48552 684.59717 771.89945 674.19626 652.45592 613.67106 427.14157
## [22] 697.09527 550.03210 526.15830
##  [1] 733.2051 447.0207 435.1223 562.3705 439.4769 436.9660 450.6712
##  [8] 528.4098 540.3655 679.4420 433.8248 550.4839 200.0790 573.6337
## [15] 530.6642 596.9028 470.2848 337.2469 780.3969 936.9758 491.3654
## [22] 471.4619 411.0121 306.5309
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.32978, df = 38.962, p-value = 0.7433
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -139.8576  100.6467
## sample estimates:
## mean of x mean of y
##  494.7242  514.3297
##
## [1] 6
## [1] "AMLAT"
##  [1]  229.0571  729.0829  776.5962  537.3600  549.4386  964.7550  740.2038
##  [8]  951.5492  830.8318  728.7903  995.5701  370.9346 1412.5148 1747.0339
## [15] 1637.1286 1361.3641 1105.8566 1431.9131 1183.0070 1504.2344  728.3111
## [22] 1488.1785 1384.3927 1269.9198
##  [1] 1320.7379 1334.3172 1564.4870 1810.6113 1266.4851 1327.9889 1006.9825
##  [8] 1017.1517 1672.4449 1750.4069  848.8875  765.0776  388.9530  574.4337
## [15]  721.8478 1085.2089 1120.3019  532.7377 1097.9460 1220.4230 1267.1138
## [22] 1367.6256  921.9832  904.4263
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.81178, df = 45.571, p-value = 0.4211
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -323.4522  137.5726
## sample estimates:
## mean of x mean of y
##  1027.418  1120.357
##
## [1] 7
## [1] "ENTORH"
##  [1]  91.72464 415.76910 286.12744 194.47332 225.42337 382.03887 398.29572
##  [8] 103.89286 276.03488 537.51700 561.64069 216.27492 517.29182 313.07790
## [15] 159.57977 401.06620 450.91545 495.52609 145.34975 107.30789 249.29914
## [22] 512.72635 376.10235 366.16357
##  [1] 550.65938 479.10621 503.87191 601.20792 750.94900 658.14444 242.57817
##  [8] 361.57334 450.33673 190.88583 449.87827  52.68679 218.18128 114.38750
## [15] 208.99339 317.66591 240.16797 271.25312 494.90884 319.91478 172.14224
## [22] 342.24586 446.01656 407.14660
##
##  Welch Two Sample t-test
##
```

```
## data:  d3h[, i] and d5h[, i]
## t = -0.94103, df = 44.666, p-value = 0.3518
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -138.88516   50.44491
## sample estimates:
## mean of x mean of y
##  324.3175  368.5376
##
## [1] 8
## [1] "PERIRH"
##  [1] 453.8086 509.1763 709.5561 239.6807 568.3276 873.3179 780.9274
##  [8] 328.0283 594.2740 621.7334 763.9351 149.0912 739.9500 213.5823
## [15] 141.1846 235.3600 439.7055 494.0332 102.3134 234.3406 432.6095
## [22] 525.8464 574.6087 638.5184
##  [1]  438.67440  624.85969  505.00445  382.16027  928.66268  821.89627
##  [7]  248.06842  472.50871  465.06550  186.65085  271.35792  126.64439
## [13]   90.65035  135.82274  259.34925  690.26515  622.09331  648.20365
## [19]  872.22562  523.14645  414.69737  546.09091 1013.08656  960.89705
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.50866, df = 44.331, p-value = 0.6135
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -182.7754  109.0943
## sample estimates:
## mean of x mean of y
##  473.4962  510.3367
##
## [1] 12
## [1] "CINGULAR"
##  [1] 1189.0509  974.8326  890.9506 1469.8007  794.7879 1522.2636 1179.4122
##  [8] 1530.0271 1413.5438 1690.5018 1419.5049  161.7786 1932.0041 1522.1914
## [15] 1291.7541 1593.1331 1001.5932 1072.3151  746.2974 1093.6215 1179.9426
## [22] 1141.3207 1098.8717 1279.7912
##  [1] 1888.5034 1757.5289 1682.9119 1952.4770 1315.0218 1352.6516  930.1527
##  [8] 1540.9672 2121.3722 1905.8407 1328.7931 1576.5346 1341.7819 1303.0469
## [15] 1035.5243 1246.9179 1181.2109  665.0386 2041.7037 1763.9257 1568.5532
## [22] 1696.4146 2187.2375 1619.5530
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -2.9969, df = 45.89, p-value = 0.004389
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -544.3015 -106.8962
## sample estimates:
## mean of x mean of y
##  1216.220  1541.819
##
## [1] 13
```

```
## [1] "PRELIMB"
##  [1]  302.7055  510.9758  377.2699  519.5547  728.4430  583.4598  768.9257
##  [8]  393.2149  734.4360  934.1867 1221.3623 1113.9348  501.6878 1205.6599
## [15]  839.9720  258.4478 1002.6615  710.3353  616.2404  580.7256 1671.4620
## [22] 1432.4989  965.4515  793.0820
##  [1]  754.56712  460.18159  719.66811   51.35142  462.40428 1191.59963
##  [7]  701.06513 1088.87592 1212.39593 1644.27258 1356.05437  980.72552
## [13]  660.13774 1054.32716  537.41924  466.02764 1087.43581  910.48197
## [19]  787.38757  902.66389 1359.32608  990.89980  613.46461  544.82173
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.70902, df = 45.997, p-value = 0.4819
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -283.2634  135.6917
## sample estimates:
## mean of x mean of y
##  781.9456  855.7315
##
## [1] 14
## [1] "SOMSENS"
##  [1]  295.8071  763.2701 1248.5506 1093.7165  801.5070 1170.5920 1408.0629
##  [8]  468.3159 1061.0880  445.4522 1257.3004  267.2804 1657.4183  961.0371
## [15] 1000.9821 1206.0895 1090.0306 1233.6414 1137.7227  868.6023  827.8960
## [22] 1365.9371  875.9594  867.7981
##  [1]  419.7263  392.7557  526.9915  786.7337 1319.5633 1170.4086  760.6506
##  [8] 1444.4387 1032.8186  953.8275 1100.4718 1089.9629  501.7886  577.7349
## [15]  491.5200 1133.7740  602.6142  675.9579 1122.4049  910.5111  669.7422
## [22]  489.3859  580.4181  806.0902
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = 1.6793, df = 45.154, p-value = 0.1
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -31.6646 349.4785
## sample estimates:
## mean of x mean of y
##  973.9191  815.0121
##
## [1] 15
## [1] "SUBICULUM"
##  [1]  30.394446  76.244279 109.393136   3.517938 231.503140 238.453229
##  [7] 244.199397 252.213119 255.936922  60.677214 168.788433  69.717218
## [13] 927.167749 289.707362 199.189954  51.713521 153.642136 155.161329
## [19] 652.182710 459.817124 684.192707 355.905823 603.599176 140.754674
##  [1]  74.38612 262.57332 190.87357  80.14563 332.62146 158.67563  60.45477
##  [8] 378.57365 317.29749 373.96000 551.90815 213.02181  15.46664 527.59890
## [15]  54.75268 674.36858 539.28482 199.31859 198.29799 585.58759   0.00000
## [22] 390.68105  50.12850 389.05831
##
```

```
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.13494, df = 44.752, p-value = 0.8933
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -136.0261  118.9459
## sample estimates:
## mean of x mean of y
##  267.2530  275.7931
##
## [1] 16
## [1] "ACCCORE"
##  [1]    0.00000  499.21100  421.90588   60.96137  293.74147  716.92129
##  [7]  643.18992  683.50358  620.14793  619.50060  467.51054  197.23661
## [13] 1273.11067 1005.02994 1211.13824  708.76010 1063.42437  955.95737
## [19]  408.56288  561.13736  272.87447  913.40674  954.74941  335.99607
##  [1]  537.052988  760.695317  815.088740  573.388955 1252.169212
##  [6]  993.721181  682.450767  943.792789  810.526909  831.594087
## [11]  175.246336  951.092374    9.208951  152.291196  103.808676
## [16]  562.533171   94.285145   71.351955  763.310434  893.297528
## [21] 1143.967221  602.381988  700.967903  390.527684
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = 0.029937, df = 45.939, p-value = 0.9762
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -202.1064  208.2086
## sample estimates:
## mean of x mean of y
##  620.3324  617.2813
##
## [1] 17
## [1] "ACCSHELL"
##  [1]    0.00000  371.69841  393.89281  132.41395  174.79480  188.20150
##  [7]  327.22929  342.55288  448.42252  446.23261  536.74305   60.66397
## [13]  765.37616  607.62277 1000.68103  338.61933  423.53709 1148.39495
## [19]  595.08793  228.09360  262.40224  492.37821  938.71987  251.16691
##  [1]   69.03610   86.19230  201.46654  261.38804 1003.20414  796.55909
##  [7]  649.62390  465.73022  625.80322  138.86534  213.76360  792.86123
## [13]   97.08080  271.53633  141.35465  812.73889   55.10388   48.97736
## [19]  200.24141  283.85512  352.53467  104.94275  819.79693  225.55579
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = 0.85777, df = 45.962, p-value = 0.3955
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -98.57526 244.96806
## sample estimates:
## mean of x mean of y
```

```
##  436.4552  363.2588
##
## [1] 18
## [1] "VISUAL"
##  [1] 1650.0002  727.2651 1135.8754  483.8034 1289.0062  795.2425  911.1697
##  [8]  889.4256 1697.8288 2060.8394 1058.9871 2578.5550 2608.1663 2349.7761
## [15] 2525.3455 2178.3968 1143.2052 1915.0932 1679.0647 1114.4223 1689.9358
## [22] 2308.5930 2258.0596 1837.7650
##  [1] 2364.2853 2492.3274 2741.6098  852.1156 1383.9815  741.6902 1361.7415
##  [8] 1446.6161 1912.3757 1394.3112 1888.1780  921.7771 1899.2051 1771.0759
## [15] 1419.5459 1501.6714 1270.1287 1800.0286 2356.8211 2086.9184 2483.6562
## [22] 1580.2455  947.0600  706.6363
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.10222, df = 45.497, p-value = 0.919
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -377.8926  341.3776
## sample estimates:
## mean of x mean of y
##  1620.243  1638.500
##
## [1] 19
## [1] "PIRIFORM"
##  [1]  290.7614  680.2856 1075.2906  998.2483  649.2903  729.4191  461.5141
##  [8]  369.7249  390.2760  819.5842  656.7918  205.5560 2156.2403 1054.8970
## [15] 1455.1875 1084.3327 1410.1966 1396.1459  850.6449  620.7615  775.9276
## [22] 1361.3625 1104.2274 1313.0554
##  [1] 1542.6366 1327.2941 1343.6345 1095.9509  974.3028  559.3602  341.3091
##  [8] 1260.1695  924.6103  956.3898  852.3875  774.8290  346.0964  973.9658
## [15]  861.8510 1034.4663  738.2106 1285.8619 1502.4653 1216.0405 1277.7870
## [22] 1392.9566  988.2248  515.2162
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.77948, df = 42.538, p-value = 0.44
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -325.3603  144.0024
## sample estimates:
## mean of x mean of y
##  912.9051 1003.5840
##
## [1] 20
## [1] "PARIETAL"
##  [1]  699.0426 1195.5321  616.5253  971.3159  779.4885  654.3109  190.9464
##  [8]  770.6220 1390.4268 1014.4012 1388.0256 1013.7774 2107.6320 1392.1114
## [15]  930.4257 1417.6378 1609.8839  798.4997 1614.8015  131.9491  999.4903
## [22] 1371.9894 1799.5246 1227.8684
##  [1]  473.9331  317.6224  660.6428  611.6791  765.1903 1184.6210  499.5968
##  [8]  668.6452  482.1610 1182.4117  929.2897  690.5339  356.5037  517.7259
```

```
## [15]  578.8710 1198.3215  854.0712  615.1084 1191.6545 1954.1022 1215.8441
## [22] 1418.5282  311.8506  367.6126
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = 2.282, df = 45.091, p-value = 0.02726
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   34.44698 552.19530
## sample estimates:
## mean of x mean of y
##  1086.926   793.605
##
## [1] 21
## [1] "RETROSPLEN"
##  [1]   30.17491  121.22471   58.44250  293.54620  666.46009  383.16502
##  [7]  225.11236  369.36895  731.26148  490.25299  178.65174  180.70523
## [13] 1482.64510  714.21050  178.79584  585.50803  711.64190  698.16546
## [19]  219.99130   98.33257  223.12835  294.86115  491.72858  242.42248
##  [1]  142.71743  799.15269  876.34749  984.04091  298.12442  409.69847
##  [7]  182.45455  639.19874  213.66630 1462.73960  585.07282  609.23909
## [13]   71.75766  128.85968  250.21363  675.34247  187.35278  259.77474
## [19]  694.32052  661.92112  211.50702  182.07045  131.41290  270.39861
##
##  Welch Two Sample t-test
##
## data:  d3h[, i] and d5h[, i]
## t = -0.54259, df = 45.789, p-value = 0.59
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -246.8148  142.0159
## sample estimates:
## mean of x mean of y
##  402.9082  455.3077
```

```
for(i in c(3:21)){
  print(i)
  print(datac[i])
  print(d3sh[,i])
  print(d5sh[,i])
  print(t.test(d3sh[,i],d5sh[,i]))
}
```

```
## [1] 3
## [1] "STLD"
##  [1] 1626.1525 1663.3876  891.5109  948.4005  508.1688  370.4668 1108.4923
##  [8]  396.1667  880.5493 1417.2135  383.2633 1361.5692  346.1915 1075.1482
## [15]  260.0112 1093.7873  208.6283  733.9499  439.7875  353.7289  220.4576
## [22] 1760.9146  636.8605  483.5656
##  [1] 1813.83883 1773.68078 1864.78416 1458.56987 1943.39743 2311.44133
##  [7]  941.33682 1288.33436 2267.03804 2099.52053 1249.20457 1979.89009
## [13]  133.59505  773.18478   31.20738  571.27357  368.56612 1990.66420
##
```

```
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -2.8767, df = 27.78, p-value = 0.007635
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -997.2579 -167.5475
## sample estimates:
## mean of x mean of y
##  798.6822 1381.0849
##
## [1] 4
## [1] "STMD"
##  [1]  935.8401  974.7790  299.4603  128.1306  431.3401  443.3764 1360.4525
##  [8] 1397.0040 1271.7009 1298.3413  785.7446 1339.4888  840.4513 1308.8872
## [15]  679.5407 1265.1649 1239.4770 1701.5004 1560.9403 1463.2966  641.6505
## [22] 1262.1462 1334.9830  797.2842
##  [1] 1547.3892 1366.7777 1948.1798 2254.3775 1079.1844 2045.3673 1747.5611
##  [8] 1578.6136 1497.0050 1665.2593 1192.3471  821.4506  463.9963 1422.4593
## [15]  120.3235 1372.5445  881.8147 1559.8982
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -2.1563, df = 31.541, p-value = 0.0388
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -647.7289  -18.2504
## sample estimates:
## mean of x mean of y
##  1031.708  1364.697
##
## [1] 5
## [1] "AMBASLAT"
##  [1] 737.7954 625.3028 333.6549 263.1304 358.7202 324.1496 836.1927
##  [8] 388.6039 581.8528 859.9709 539.4665 686.5490 582.1046 856.5553
## [15] 600.3433 732.9304 525.3220 565.3811 587.4101 558.7472 340.2263
## [22] 872.0486 592.8541 473.0275
##  [1] 456.10122 753.58455 831.94393 752.04418 863.02796 744.74700 424.75303
##  [8] 474.14074 528.20235 715.60487 566.07274 602.07013  74.44802  96.02370
## [15] 304.95157 580.28263 544.39685 790.80918
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = 0.22244, df = 31.349, p-value = 0.8254
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -119.5437  148.8271
## sample estimates:
## mean of x mean of y
##  575.9308  561.2891
##
## [1] 6
```

```
## [1] "AMLAT"
##  [1]  980.6947  882.4832  649.7270 1007.3658  688.1688  486.5925 1600.3403
##  [8]  538.4465 1095.8304 1501.3049 1055.5192 1422.8369 1034.7604 1046.8525
## [15] 1139.0164 1351.7834  939.0851 1117.2361  932.8468 1505.7654  834.7335
## [22] 1642.9460 1388.5666 1103.8237
##  [1] 1252.1829 1677.5058 1438.5606 1692.0424 1566.8743 1777.8396 1747.6632
##  [8] 1478.8173 1716.1256 1998.8250 1278.9000 1411.8769  356.1333  585.1305
## [15]  946.8632 1365.7267 1253.6747 2149.4549
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -2.7633, df = 29.22, p-value = 0.0098
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -602.5997  -90.0839
## sample estimates:
## mean of x mean of y
##  1081.114  1427.455
##
## [1] 7
## [1] "ENTORH"
##  [1] 494.6635 436.8637 223.7204 274.8236 170.1507 292.4317 433.9332
##  [8] 370.8114 593.7646 189.0362 159.8828 556.6863 141.9746 307.8278
## [15] 266.2139 376.7678 200.5772 410.3136 274.7239 214.4160 361.5496
## [22] 350.4278 231.1092 160.6285
##  [1] 950.26504 535.36041 843.05108 784.93911 716.73772 951.56071 365.00613
##  [8] 658.92842 463.79711 867.80306  30.10925 378.41402  27.29392 225.01125
## [15] 179.10885 534.01840 376.02249 552.41527
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -2.8569, df = 21.807, p-value = 0.009218
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -366.34520  -58.08466
## sample estimates:
## mean of x mean of y
##  312.2207  524.4357
##
## [1] 8
## [1] "PERIRH"
##  [1] 496.8900 858.2422 159.9325 238.3952 186.7101 393.3066 708.1422
##  [8] 378.5004 627.4368 189.0802 254.0463 999.0494 307.3029 503.7936
## [15] 420.4762 982.0568 573.5921 709.6807 247.5401 317.8319 405.4286
## [22] 479.0642 290.7502 424.4448
##  [1] 1320.2009  639.1330 1179.2812 1142.6742  985.1793 1227.2127 1230.1495
##  [8] 1440.0468  963.3359 1591.4357  268.2388  870.4064  226.2739  568.1335
## [15]  404.8274  882.7326  374.6234  559.1706
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
```

```
## t = -3.7813, df = 25.461, p-value = 0.0008469
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -644.1981 -190.1669
## sample estimates:
## mean of x mean of y
##  464.6539  881.8364
##
## [1] 9
## [1] "CA1"
##  [1] 1415.18562 1656.90739   70.21876  372.21412 1321.05195 1318.26592
##  [7] 1104.04290 1500.27571 1200.44453 1398.36910 1141.80759 1869.64016
## [13]  652.48845 1565.69009  460.52386 1623.76592  453.59534 1271.18700
## [19] 1111.24332  813.51653  467.74155 1230.09086  726.78046  836.41025
##  [1] 2195.7873 1399.6061 1743.2090 1491.6185 1687.0435 2011.6921  894.2681
##  [8] 1767.4868 1983.9454 1532.4934 1932.4835 2003.4493 1030.8704 1620.3005
## [15] 1192.2696 2271.3864 2172.6205 1547.8993
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -4.662, df = 39.474, p-value = 3.537e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -899.4325 -355.2715
## sample estimates:
## mean of x mean of y
##  1065.894  1693.246
##
## [1] 10
## [1] "CA3"
##  [1] 243.956179 200.296953   4.266112  17.678919 229.945977 140.796551
##  [7] 281.119284 385.090722 578.157343 564.151160 250.830257 510.603135
## [13] 213.460196 236.319750 219.778133 290.839587 205.898091 310.150688
## [19] 146.169500 541.442372 268.627894 452.710958 593.443546 416.638327
##  [1] 1144.2227 1015.2941 1111.8616  752.5032  733.1973  715.0151  245.9719
##  [8]  644.4086  623.0889  981.6865  822.5886 1142.7968  417.2485  516.8162
## [15]   83.8194  551.4659  919.8737 1034.7955
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -5.5277, df = 24.487, p-value = 1.027e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -608.6800 -277.9728
## sample estimates:
## mean of x mean of y
##  304.2655  747.5919
##
## [1] 11
## [1] "DG"
##  [1] 180.74903 152.28291  87.91902  10.68911 119.65766 124.47172 127.81177
##  [8] 404.70401 325.71509 343.08009 159.75250 280.56048 168.94746 185.68273
```

```
## [15]  94.23423 599.56512 232.25835 250.20323 380.98558 523.05003 333.43087
## [22] 454.29463 287.75467 329.66401
##  [1] 417.7549 522.9694 573.2553 317.1312 342.4008 439.9362 167.3939
##  [8] 378.8975 316.4511 409.5439 312.1505 131.1042 134.9310 238.2517
## [15] 112.8586 180.6243 204.5706 351.4036
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -1.1798, df = 38.161, p-value = 0.2454
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -140.84168   37.11607
## sample estimates:
## mean of x mean of y
##  256.5610  308.4238
##
## [1] 12
## [1] "CINGULAR"
##  [1] 1336.6044 1076.5801  914.7009  732.4102 1523.1423  826.6462 1191.4209
##  [8] 1046.1510 1351.8289 1153.4496  866.1878 1709.6159  881.6696  841.0765
## [15]  764.4515  729.1370  740.8784  858.7202  765.2191 1050.4452  828.5184
## [22] 1580.3992 1226.4269  764.0019
##  [1] 1661.8590 1548.2172 2001.3952 2016.0759 1150.2572 1370.6391  990.4318
##  [8] 1039.6583  663.8386  524.4494  910.5621 1649.1674  139.2616  548.6146
## [15]  156.7780 1009.9288  918.9879 1893.9318
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -0.59702, df = 23.292, p-value = 0.5563
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -402.6953  222.2184
## sample estimates:
## mean of x mean of y
##  1031.653  1121.892
##
## [1] 13
## [1] "PRELIMB"
##  [1] 1470.4061  727.7757 1010.9571 1729.0604  257.0464 1063.8607  766.8024
##  [8] 1040.1642  117.2874  739.7734 1152.7274  617.1288 1639.7066  861.8571
## [15]  801.9405  795.3440  638.1053  551.0724 1444.8897  679.8691 1131.2161
## [22]  905.9430  885.6176 1272.5083
##  [1]  953.07488 1375.89734 1116.37621 1415.52879 1100.60861  869.63491
##  [7] 1921.23393 1061.27349 1133.10233  240.37790 1153.98405 1606.86954
## [13] 1420.54706  263.50415  821.83772   83.17162  822.68838  482.74651
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -0.44025, df = 31.991, p-value = 0.6627
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
```

```
##  -349.0704  224.9968
## sample estimates:
## mean of x mean of y
##  929.2108  991.2476
##
## [1] 14
## [1] "SOMSENS"
##  [1]  701.2169  729.2583  685.5808  696.2624 1158.7197  969.7462 1100.8677
##  [8]  953.7537  912.2914 1579.4156  693.0371 1331.2484  747.9968  728.7464
## [15]  838.4135 1588.1537  840.2725 1168.6594  959.0623  975.6435  657.4036
## [22] 1757.5624 1505.1685 1154.7732
##  [1] 1865.8377 1216.2266  735.4657 1267.4683 1479.1937 1531.7169 1727.0268
##  [8] 1625.8054  395.5875 1260.0027 1067.7496  868.8100  116.2483  602.1472
## [15]  340.4565  543.8900  453.4225 1497.6544
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -0.10443, df = 26.241, p-value = 0.9176
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -309.8448  279.8704
## sample estimates:
## mean of x mean of y
##  1018.052  1033.039
##
## [1] 15
## [1] "SUBICULUM"
##  [1]  518.09581  369.83677  265.23605   21.42566  138.89280  285.07100
##  [7]  732.47287  405.51499  691.71380  998.72937  343.84814 1168.32144
## [13]  222.62068  394.62945  386.85163  847.58389  419.76393  829.91501
## [19]  442.22833  491.58537  332.41317  796.73021  644.74898  390.42028
##  [1]  657.2161  760.0114 1021.0264 1345.2107  850.3158 1140.8269  593.0528
##  [8]  424.5421  808.1220  782.0248  781.0496  875.2900  260.5019  506.6365
## [15]  156.6424  194.9447  236.4135  753.9349
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -1.7484, df = 32.93, p-value = 0.08971
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -365.88103   27.68379
## sample estimates:
## mean of x mean of y
##  505.7771  674.8757
##
## [1] 16
## [1] "ACCCORE"
##  [1] 1055.6125  655.0419  788.6430  220.1650  166.5759  174.2133 1035.2953
##  [8]  251.7365  455.3165  711.5228  144.9620  633.6785  362.1314  902.7043
## [15]  383.6661  894.0253  330.7065  754.4627  420.6549  606.4772  263.9794
## [22] 1821.3205 1336.5930  845.2178
##  [1] 1566.08352 1289.46491 1425.75055 1462.93568  878.44194 2140.94322
```

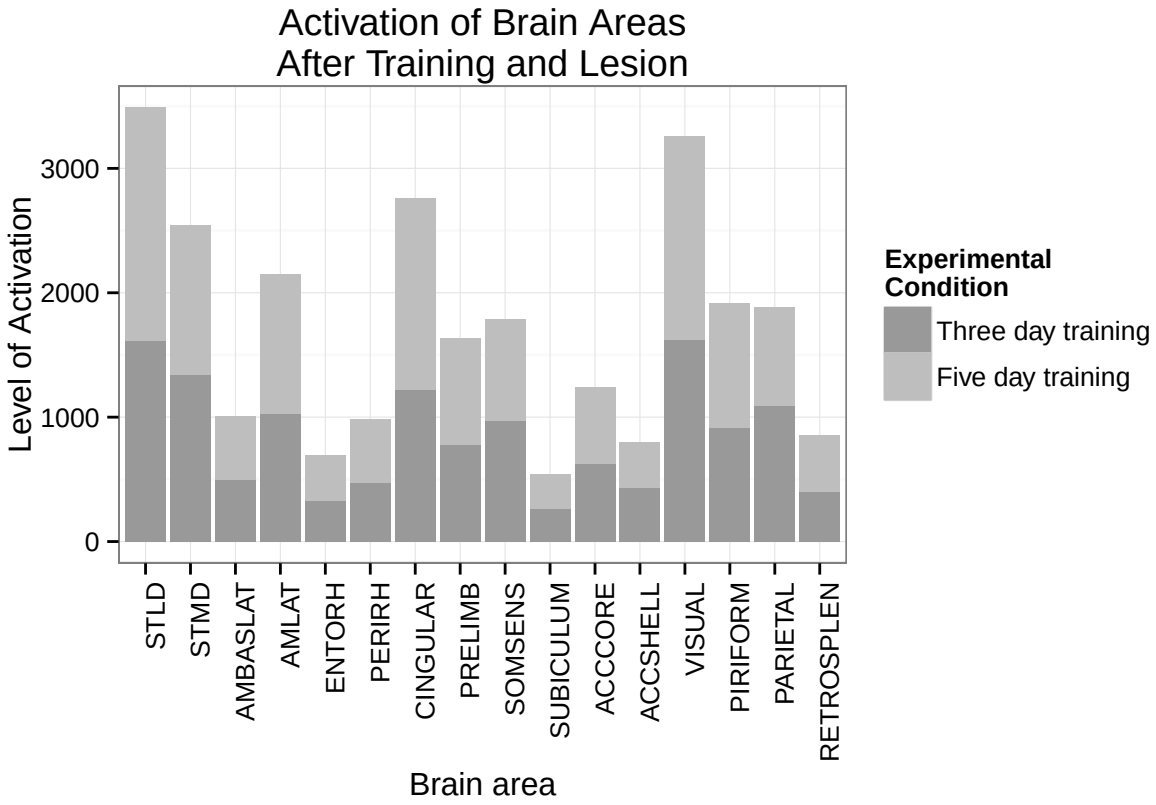
```
##  [7] 1536.95141  494.97806 1013.15658 1259.12092  711.34906  316.61854
## [13]  362.49083  621.17702   65.93949  697.66603  185.53278 1026.17511
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -1.9937, df = 29.799, p-value = 0.05541
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -634.816975    7.733769
## sample estimates:
## mean of x mean of y
##  633.9459  947.4875
##
## [1] 17
## [1] "ACCSHELL"
##  [1]  818.6418  332.2302  432.5381  212.5861  205.4181  137.9044  517.2211
##  [8]  368.0097  140.8968  481.4614  290.0950   91.2361  180.0318  901.8344
## [15]  765.4123 1132.2682  289.6264  888.9333  632.7679 1160.3095  711.3445
## [22] 1351.1269  505.2900  588.8532
##  [1] 1175.65150  836.91010  736.60812  574.51346  330.54772 1718.73139
##  [7] 1599.39794  280.37888  422.02481 1444.46532  903.04891  246.73342
## [13]   80.80288  393.80188   24.80192  478.23116  135.43868  809.05582
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -0.91218, df = 28.386, p-value = 0.3694
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -421.5918  161.6901
## sample estimates:
## mean of x mean of y
##  547.3349  677.2858
##
## [1] 18
## [1] "VISUAL"
##  [1]  973.2298 1747.3206 1561.6277 1632.5534 1513.8984 2147.8361 1673.9369
##  [8] 2127.6740 1338.5969 1100.8310 2014.6520 1106.7198 1688.3044 1826.8662
## [15] 1557.0154 1262.0692 1481.4533  995.5034 1473.8602 1276.5891 1569.5078
## [22] 1535.6845 1783.7036 2886.8027
##  [1] 2903.7705 2385.4412 3064.4036 2701.9024 2916.8375 2187.1625 3633.5384
##  [8] 2217.8620 2764.2579 2831.6342 2632.2658  135.9970 1568.8116  599.2459
## [15] 2205.7933 1284.5397 1492.1365 1497.7254
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -2.482, df = 22.529, p-value = 0.02098
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1051.34862   -94.89004
## sample estimates:
## mean of x mean of y
```

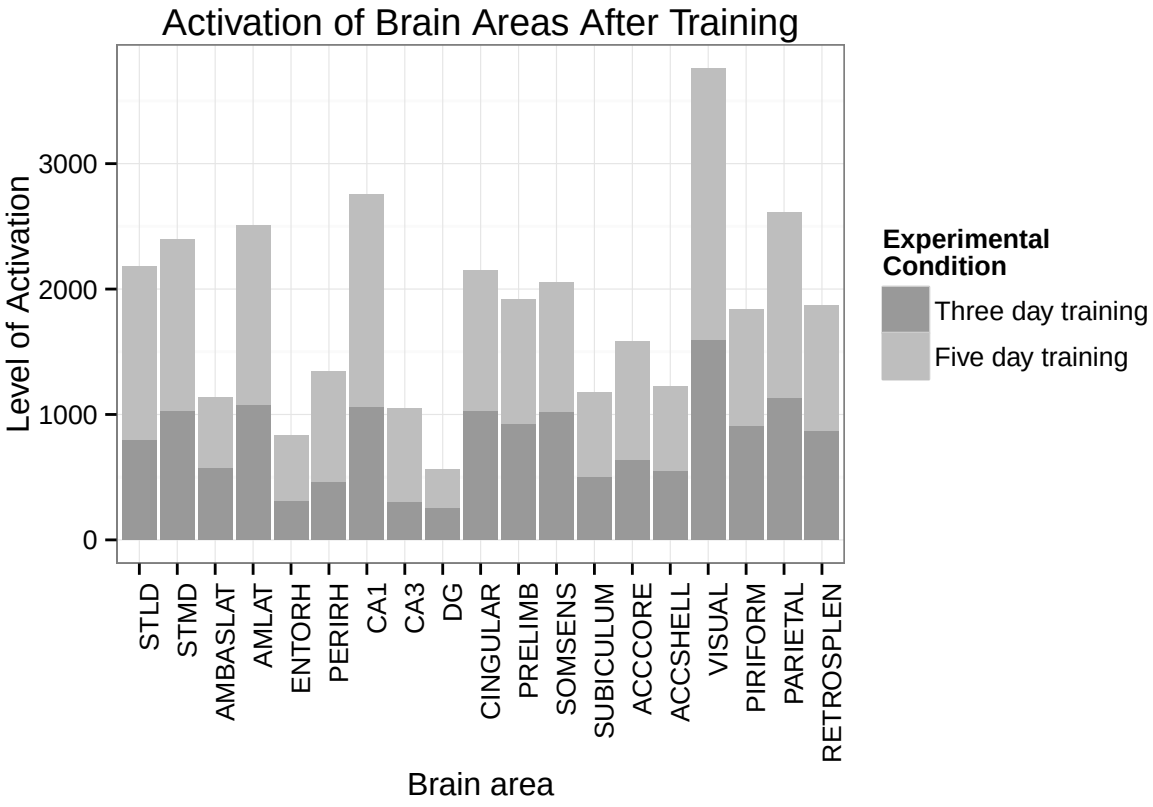
```
##  1594.843  2167.963
##
## [1] 19
## [1] "PIRIFORM"
##  [1] 1455.3918 1203.6926  682.1899  555.5770  900.5662  272.6136 1242.9914
##  [8]  673.4909 1359.8377 1150.6365  345.7962 1159.8776  784.0315 1031.4822
## [15]  660.3337 1406.4114  568.1117  801.7572  707.7875  880.0958  557.8774
## [22] 1386.7372 1346.2514  634.3290
##  [1] 1866.7763 1525.6831 1510.4866 1321.0698  736.1566 1246.4647  698.1987
##  [8]  617.9486  824.3403 1262.3892  593.0238  759.3812  190.2494  509.5698
## [15]  162.6236  833.3418  616.6629 1497.7254
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -0.1828, df = 29.808, p-value = 0.8562
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -301.8090  252.2322
## sample estimates:
## mean of x mean of y
##  906.9945  931.7829
##
## [1] 20
## [1] "PARIETAL"
##  [1] 1313.5288 1240.2981 1418.5924  821.9018  907.1708  394.9036 1269.6966
##  [8]  676.5602  525.3878 1134.3568  542.1861 1347.5796  869.3052 1584.0192
## [15] 1547.5808 1277.6701 1009.9986 1074.2213  835.4763 1342.8649 1568.5863
## [22] 1909.1969 1647.3232 1015.9406
##  [1] 2793.73306 2247.49163 2288.51692 2575.64125 1580.32940 2045.33390
##  [7] 1057.37973 1248.07038 1400.31262 1757.67997 1963.52500  924.42728
## [13]   87.72421  321.39463  487.57350 1268.91805 1181.75094 1347.39212
##
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -1.7383, df = 23.722, p-value = 0.09512
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -744.10838   63.94894
## sample estimates:
## mean of x mean of y
##  1136.431  1476.511
##
## [1] 21
## [1] "RETROSPLEN"
##  [1]  853.6977  718.0764  814.9653  456.0680  891.5274  576.1159  737.9601
##  [8]  976.9528 1098.6392 1182.9095  695.5210 1321.5875  897.7781 1113.0553
## [15]  870.8365  989.6349  772.2439 1068.8488  788.0415  839.7859  614.0912
## [22]  882.4791  811.6971  893.1766
##  [1] 1272.0796  964.7599 1396.5376 1781.0728  831.8088 1537.5966  524.3582
##  [8] 1038.9527 1580.0858 1325.8715 1070.2533 1312.4449  368.5222  296.6101
## [15]  222.1799  501.6593  524.0189 1418.0520
##
```

```
##  Welch Two Sample t-test
##
## data:  d3sh[, i] and d5sh[, i]
## t = -1.0525, df = 21.17, p-value = 0.3044
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -383.0276  125.5168
## sample estimates:
## mean of x mean of y
##  869.4037  998.1591
```

Figures for T test

```
##
## Attaching package: 'reshape'
##
## The following objects are masked from 'package:reshape2':
##
##     colsplit, melt, recast
##
## The following object is masked from 'package:Matrix':
##
##     expand
```




Activation of Brain Areas After Training
Level of Activation
3000
2000
1000
0
STLD
STMD
AMBASLAT
AMLAT
ENTORH
PERIRH
CA1
CA3
DG
CINGULAR
PRELIMB
SOMSENS
SUBICULUM
ACCCORE
ACCSHELL
VISUAL
PIRIFORM
PARIETAL
RETROSPLEN
Brain area
Experimental Condition
Three day training
Five day training