Лабораторная работа №5.1

Цель работы: Дисперсионный анализ (ANOVA)

1. ANOVA;
2. ANOVA;
3. ANOVA;
4. ANCOVA!

Загрузим данные

```
data = read.csv("https://raw.githubusercontent.com/SergeyMirvoda/MD-DA-2017/master/data/diet.csv", row.names = 1)
summary(data)
```

```
##      gender           Age            Height        pre.weight
##  Min.   :0.0000   Min.   :16.00   Min.   :141.0   Min.   : 58.00
##  1st Qu.:0.0000   1st Qu.:32.25   1st Qu.:164.2   1st Qu.: 66.00
##  Median :0.0000   Median :39.00   Median :169.5   Median : 72.00
##  Mean   :0.4342   Mean   :39.15   Mean   :170.8   Mean   : 72.53
##  3rd Qu.:1.0000   3rd Qu.:46.75   3rd Qu.:174.8   3rd Qu.: 78.00
##  Max.   :1.0000   Max.   :60.00   Max.   :201.0   Max.   :103.00
##  NA's   :2
##       Diet        weight6weeks
##  Min.   :1.000   Min.   : 53.00
##  1st Qu.:1.000   1st Qu.: 61.85
##  Median :2.000   Median : 68.95
##  Mean   :2.038   Mean   : 68.68
##  3rd Qu.:3.000   3rd Qu.: 73.83
##  Max.   :3.000   Max.   :103.00
##
```

Ознакомимся со структурой и переименуем колонки, как нам удобно

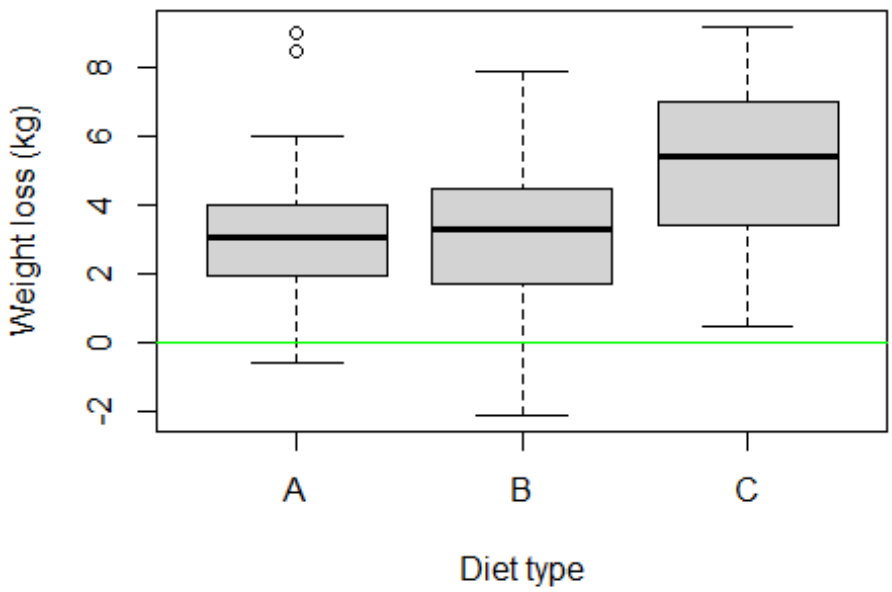
```
colnames(data) <- c("gender", "age", "height", "initial.weight",
                    "diet.type", "final.weight")
data$diet.type <- factor(c("A", "B", "C")[data$diet.type])
```

Добавим новую колонку - Похудение

```
data$weight.loss = data$initial.weight - data$final.weight
```

Проанализируем есть ли различия по типам диет

```
boxplot(weight.loss ~ diet.type, data = data, col = "light gray",
        ylab = "Weight loss (kg)", xlab = "Diet type")
abline(h = 0, col = "green")
```

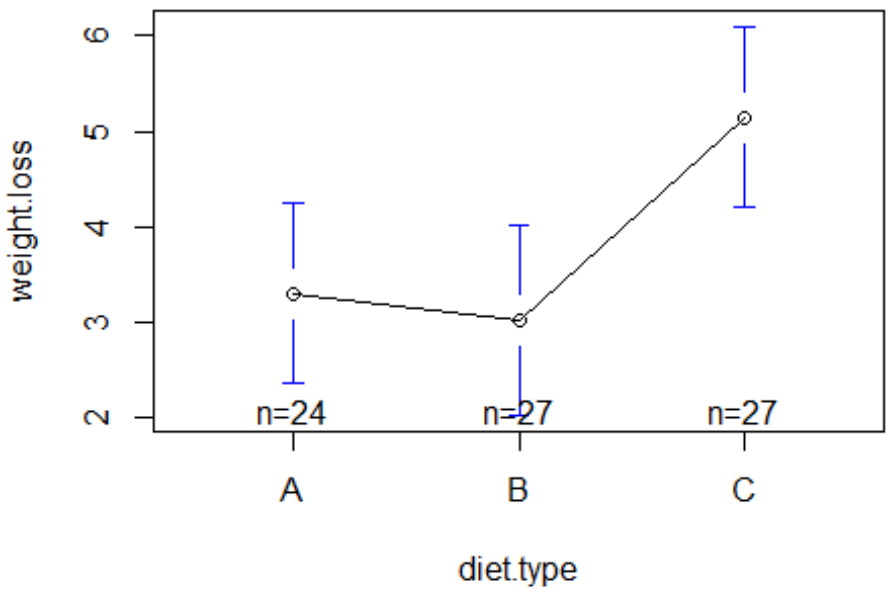


проверим сбалансированные ли данные

```
table(data$diet.type)

##
##  A  B  C
## 24 27 27

plotmeans(weight.loss ~ diet.type, data = data)
```




```
aggregate(data$weight.loss, by = list(data$diet.type), FUN = sd)
```

```
##   Group.1        x
## 1       A 2.240148
## 2       B 2.523367
## 3       C 2.395568
```

Тест на межгрупповые различия

```
fit <- aov(weight.loss ~ diet.type, data = data)
summary(fit)
```

```
##             Df Sum Sq Mean Sq F value  Pr(>F)
## diet.type    2   71.1   35.55   6.197 0.00323 **
## Residuals   75  430.2    5.74
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

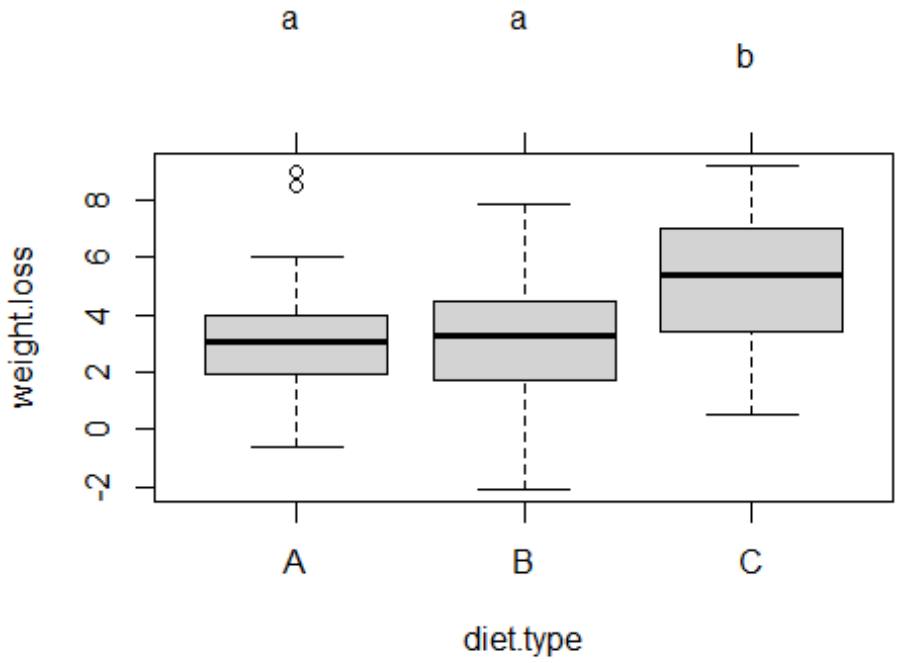
попарные различия между средними значениями для всех групп

```
TukeyHSD(fit)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = weight.loss ~ diet.type, data = data)
##
## $diet.type
##           diff        lwr      upr     p adj
## B-A -0.2740741 -1.8806155 1.332467 0.9124737
```

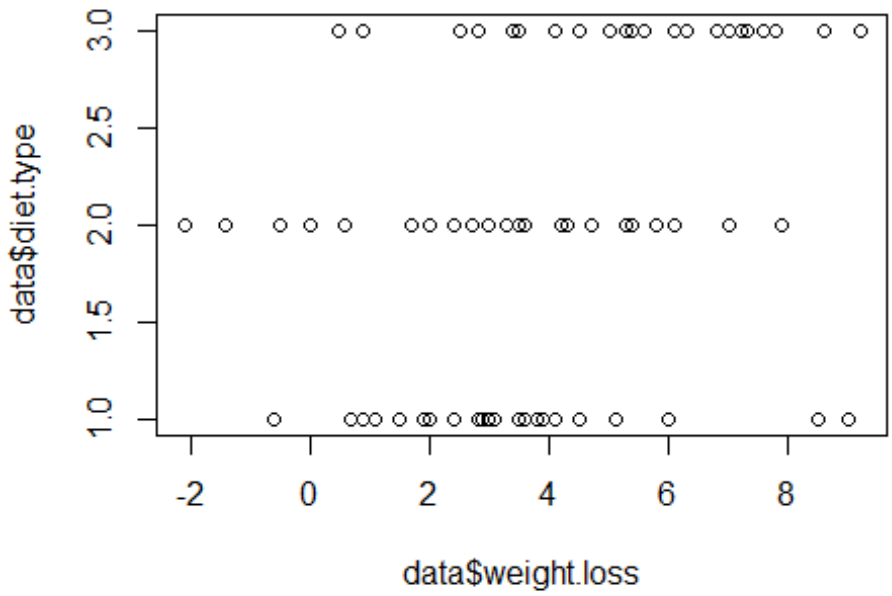
```
## C-A  1.8481481  0.2416067 3.454690 0.0201413
## C-B  2.1222222  0.5636481 3.680796 0.0047819

par(mar = c(5, 4, 6, 2))
tuk <- glht(fit, linfct = mcp(diet.type = "Tukey"))
plot(cld(tuk, level = .05), col = "lightgrey")
```

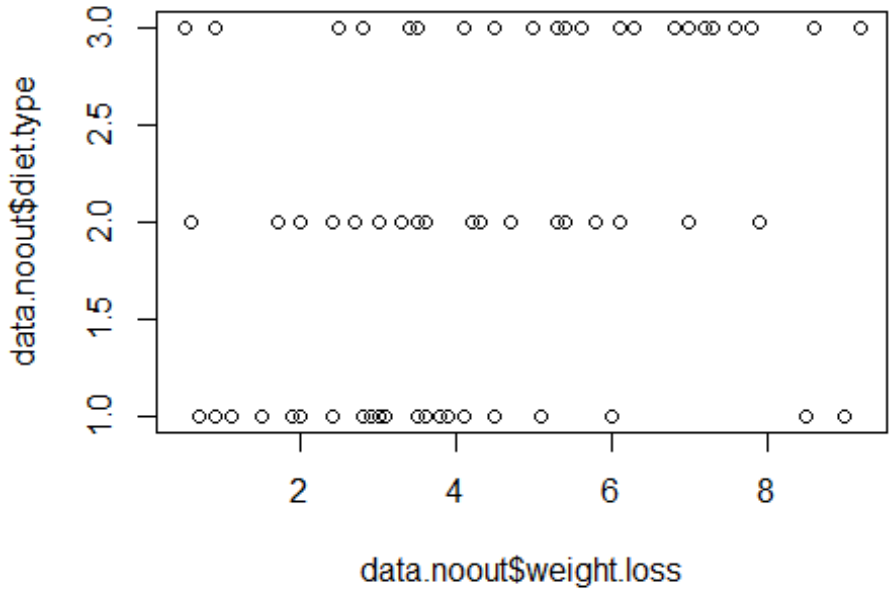


Добавить проверку на выборы и избавиться от них

```
plot(data$weight.loss, data$diet.type)
```




```
data.noout <- data[data$weight.loss > 0,]
plot(data.noout$weight.loss, data.noout$diet.type)
```

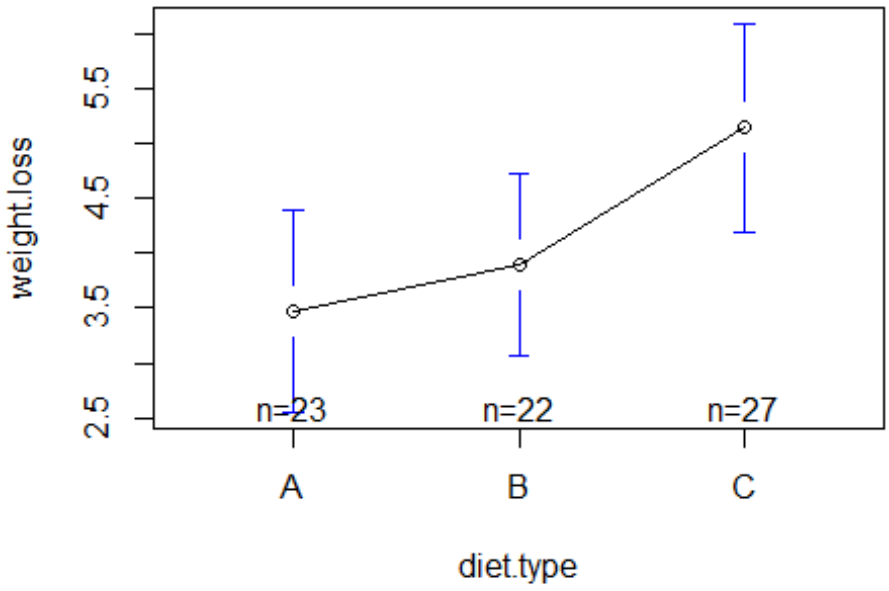


повторно проверсти все тесты и сравнить результаты с выбросами и без

```
table(data.noout$diet.type)
```

```
##
##  A  B  C
## 23 22 27

plotmeans(weight.loss ~ diet.type, data = data.noout)
```



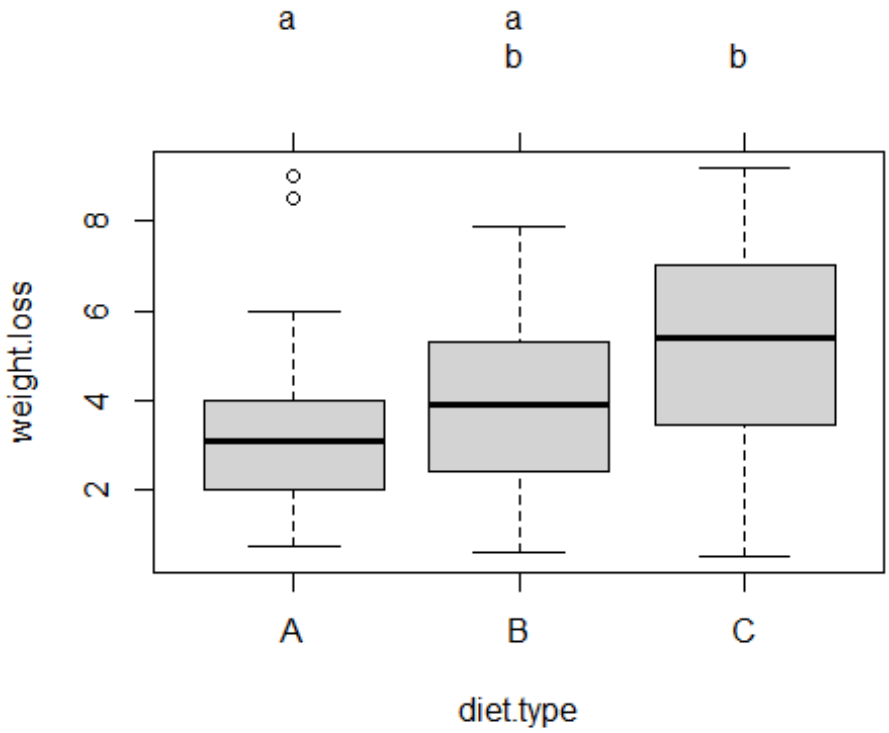

```
fit <- aov(weight.loss ~ diet.type, data = data.noout)
summary(fit)

##             Df Sum Sq Mean Sq F value Pr(>F)
## diet.type    2   38.5  19.262   4.139 0.0201 *
## Residuals   69  321.1   4.653
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

TukeyHSD(fit)

##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = weight.loss ~ diet.type, data = data.noout)
##
## $diet.type
##          diff        lwr      upr     p adj
## B-A 0.4258893 -1.1149787 1.966757 0.7861657
## C-A 1.6785829  0.2124490 3.144717 0.0209348
## C-B 1.2526936 -0.2313247 2.736712 0.1145630

tuk <- glht(fit, linfct = mcp(diet.type = "Tukey"))
plot(cld(tuk, level = .05), col = "lightgrey")
```



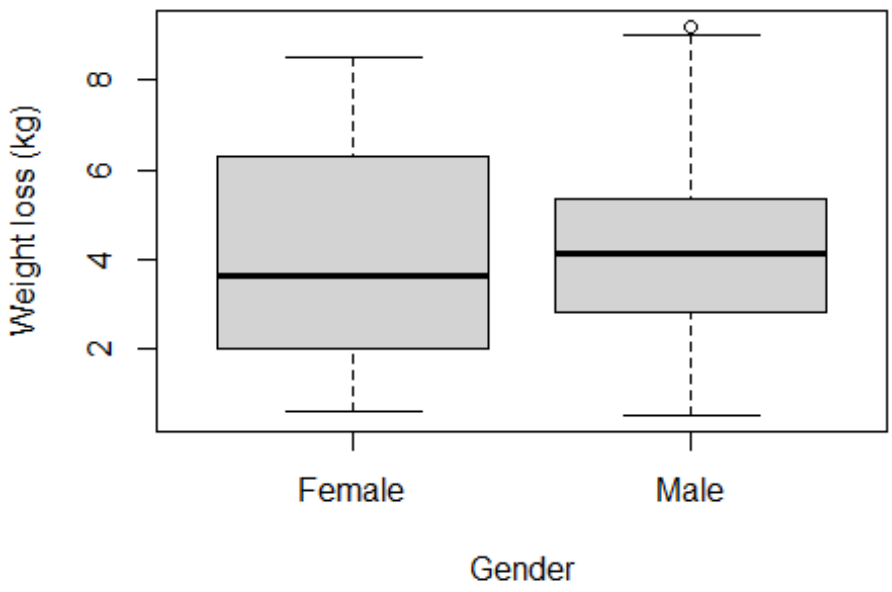
Удаление выбросов не повлияло на диету-победителя - Диета C всё так же заметно лучше двух других. Однако, по результатам сравнения на данных без выбросов, диета B заняла 2 место! Таким образом, выбросы, приводят к досадным ошибкам и могут повлиять на репутацию компании...

Задания из документа

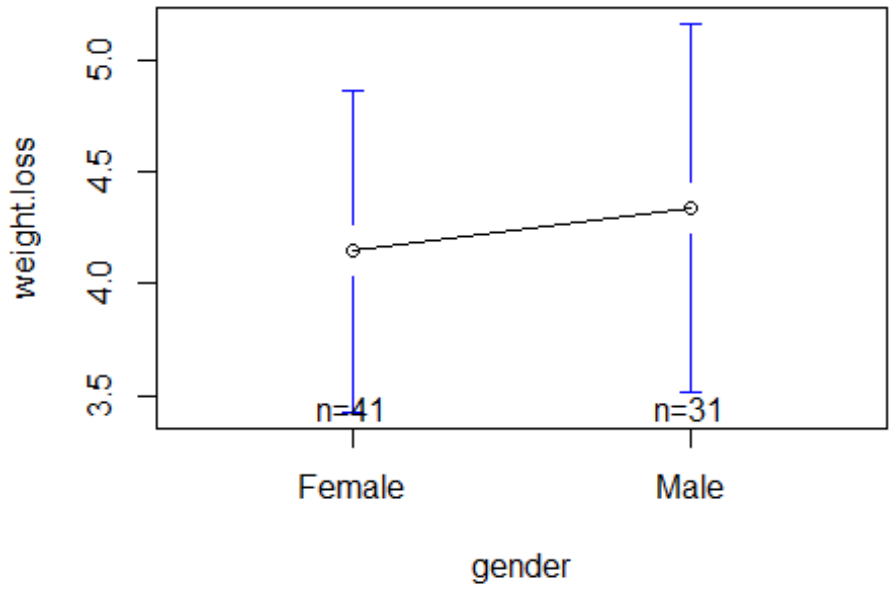
Are there gender differences for weight lost?

```
data.noout$gender <- factor(c("Female", "Male")[as.ordered(data.noout$gender)])

boxplot(weight.loss ~ gender, data = data.noout, col = "light gray",
        ylab = "Weight loss (kg)", xlab = "Gender")
```




```
plotmeans(weight.loss ~ gender, data = data.noout)
```




```
aggregate(data.noout$weight.loss, by = list(data.noout$gender), FUN = sd)
```

```
##   Group.1        x
## 1  Female 2.280362
## 2    Male 2.243015
```

Effect of diet and gender on weight lost? Means plot of weight lost by diet and gender

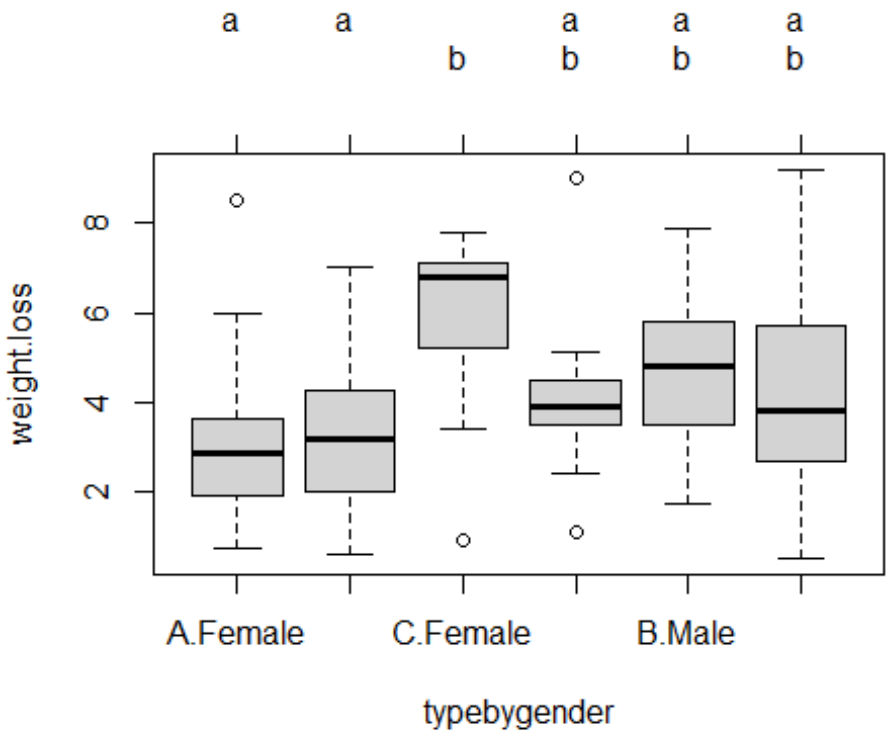
```
data.noout$typebygender <- interaction(data.noout$diet.type, data.noout$gender)
fit <- aov(weight.loss ~ typebygender, data = data.noout)
summary(fit)
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
## typebygender  5  73.61  14.723   3.398 0.0086 **
## Residuals    66 285.97   4.333
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
TukeyHSD(fit)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = weight.loss ~ typebygender, data = data.noout)
##
## $typebygender
##                           diff        lwr       upr     p adj
## B.Female-A.Female  0.2083333 -2.1951757 2.6118423 0.9998482
## C.Female-A.Female  2.8300000  0.5595964 5.1004036 0.0064413
## A.Male-A.Female    1.0722222 -1.5380895 3.6825339 0.8325890
## B.Male-A.Female    1.6100000 -0.9196202 4.1396202 0.4306447
## C.Male-A.Female    1.1833333 -1.2201757 3.5868423 0.6996318
## C.Female-B.Female  2.6216667  0.2554236 4.9879097 0.0213839
## A.Male-B.Female    0.8638889 -1.8301973 3.5579751 0.9342180
## B.Male-B.Female    1.4016667 -1.2143134 4.0176468 0.6191362
## C.Male-B.Female    0.9750000 -1.5192392 3.4692392 0.8595838
## A.Male-C.Female   -1.7577778 -4.3338169 0.8182614 0.3518914
## B.Male-C.Female   -1.2200000 -3.7142392 1.2742392 0.7053894
## C.Male-C.Female   -1.6466667 -4.0129097 0.7195764 0.3301372
## B.Male-A.Male      0.5377778 -2.2693958 3.3449513 0.9930926
## C.Male-A.Male      0.1111111 -2.5829751 2.8051973 0.9999962
## C.Male-B.Male     -0.4266667 -3.0426468 2.1893134 0.9967497
```

```
tuk <- glht(fit, linfct = mcp(typebygender = "Tukey"))
plot(cld(tuk, level = .05), col = "lightgrey")
```



Add height to either ANOVA

```
data.noout$height <- cut(data.noout$height, 3, labels = c('small', 'mid',
'tall'))

fit <- aov(weight.loss ~ typebygender * height, data = data.noout)
summary(fit)

##                      Df Sum Sq Mean Sq F value Pr(>F)
## typebygender          5  73.61  14.723   3.106 0.0152 *
## height                2   2.34   1.168   0.246 0.7825
## typebygender:height   8  18.20   2.275   0.480 0.8653
## Residuals            56 265.44   4.740
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

TukeyHSD(fit)

##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = weight.loss ~ typebygender * height, data = data.noout)
##
## $typebygender
##                           diff        lwr       upr     p adj
## B.Female-A.Female  0.2083333 -2.3188741 2.7355408 0.9998772
## C.Female-A.Female  2.8300000  0.4427483 5.2172517 0.0113572
## A.Male-A.Female    1.0722222 -1.6724311 3.8168756 0.8568778
## B.Male-A.Female    1.6100000 -1.0498091 4.2698091 0.4828188
## C.Male-A.Female    1.1833333 -1.3438741 3.7105408 0.7376689
```

```
## C.Female-B.Female  2.6216667  0.1336431 5.1096902 0.0332832
## A.Male-B.Female    0.8638889 -1.9688505 3.6966283 0.9449367
## B.Male-B.Female    1.4016667 -1.3489469 4.1522802 0.6634043
## C.Male-B.Female    0.9750000 -1.6476071 3.5976071 0.8805457
## A.Male-C.Female   -1.7577778 -4.4663947 0.9508392 0.4041350
## B.Male-C.Female   -1.2200000 -3.8426071 1.4026071 0.7429200
## C.Male-C.Female   -1.6466667 -4.1346902 0.8413569 0.3819982
## B.Male-A.Male      0.5377778 -2.4138691 3.4894247 0.9943505
## C.Male-A.Male      0.1111111 -2.7216283 2.9438505 0.9999969
## C.Male-B.Male     -0.4266667 -3.1772802 2.3239469 0.9973514
##
## $height
##                   diff       lwr      upr     p adj
## mid-small   0.2551683 -1.383685 1.894021 0.9255747
## tall-small -0.1184965 -2.265857 2.028864 0.9903180
## tall-mid   -0.3736648 -2.125836 1.378506 0.8651271
##
## $`typebygender:height`
##                                         diff         lwr         upr     p adj
## B.Female:small-A.Female:small -0.10000000  -9.8482256  9.6482256 1.0000000
## C.Female:small-A.Female:small  2.71666667  -3.7821504  9.2154837 0.9845260
## A.Male:small-A.Female:small   -0.80000000  -8.7593929  7.1593929 1.0000000
## B.Male:small-A.Female:small    1.90000000  -7.8482256 11.6482256 0.9999992
## C.Male:small-A.Female:small   -0.90000000 -10.6482256  8.8482256 1.0000000
## A.Female:mid-A.Female:small   -0.61000000  -6.7753192  5.5553192 1.0000000
## B.Female:mid-A.Female:small   -0.14545455  -6.2638885  5.9729794 1.0000000
## C.Female:mid-A.Female:small    2.32222222  -3.8999214  8.5443659 0.9952429
## A.Male:mid-A.Female:small      1.33333333  -5.1654837  7.8321504 0.9999982
## B.Male:mid-A.Female:small      2.35000000  -5.6093929 10.3093929 0.9997129
## C.Male:mid-A.Female:small      1.15000000  -5.0153192  7.3153192 0.9999996
## A.Female:tall-A.Female:small   0.60000000  -7.3593929  8.5593929 1.0000000
## B.Female:tall-A.Female:small           NA          NA         NA        NA
## C.Female:tall-A.Female:small           NA          NA         NA        NA
## A.Male:tall-A.Female:small     0.10000000  -9.6482256  9.8482256 1.0000000
## B.Male:tall-A.Female:small     0.85714286  -5.5245688  7.2388545 1.0000000
## C.Male:tall-A.Female:small    -0.60000000 -10.3482256  9.1482256 1.0000000
## C.Female:small-B.Female:small  2.81666667  -5.7804602 11.4137936 0.9989440
## A.Male:small-B.Female:small   -0.70000000 -10.4482256  9.0482256 1.0000000
## B.Male:small-B.Female:small    2.00000000  -9.2562814 13.2562814 0.9999998
## C.Male:small-B.Female:small   -0.80000000 -12.0562814 10.4562814 1.0000000
## A.Female:mid-B.Female:small   -0.51000000  -8.8578817  7.8378817 1.0000000
## B.Female:mid-B.Female:small   -0.04545455  -8.3587693  8.2678602 1.0000000
## C.Female:mid-B.Female:small    2.42222222  -5.9677146 10.8121590 0.9997853
## A.Male:mid-B.Female:small      1.43333333  -7.1637936 10.0304602 0.9999999
## B.Male:mid-B.Female:small      2.45000000  -7.2982256 12.1982256 0.9999669
## C.Male:mid-B.Female:small      1.25000000  -7.0978817  9.5978817 1.0000000
## A.Female:tall-B.Female:small   0.70000000  -9.0482256 10.4482256 1.0000000
## B.Female:tall-B.Female:small           NA          NA         NA        NA
## C.Female:tall-B.Female:small           NA          NA         NA        NA
## A.Male:tall-B.Female:small     0.20000000 -11.0562814 11.4562814 1.0000000
## B.Male:tall-B.Female:small     0.95714286  -7.5518061  9.4660918 1.0000000
## C.Male:tall-B.Female:small    -0.50000000 -11.7562814 10.7562814 1.0000000
```

```
## A.Male:small-C.Female:small   -3.51666667 -10.0154837  2.9821504 0.8667316
## B.Male:small-C.Female:small   -0.81666667  -9.4137936  7.7804602 1.0000000
## C.Male:small-C.Female:small   -3.61666667 -12.2137936  4.9804602 0.9835356
## A.Female:mid-C.Female:small   -3.32666667  -7.4368795  0.7835461 0.2551423
## B.Female:mid-C.Female:small   -2.86212121  -6.9016661  1.1774237 0.4772824
## C.Female:mid-C.Female:small   -0.39444444  -4.5894128  3.8005239 1.0000000
## A.Male:mid-C.Female:small     -1.38333333  -5.9786910  3.2120243 0.9996318
## B.Male:mid-C.Female:small     -0.36666667  -6.8654837  6.1321504 1.0000000
## C.Male:mid-C.Female:small     -1.56666667  -5.6768795  2.5435461 0.9940196
## A.Female:tall-C.Female:small  -2.11666667  -8.6154837  4.3821504 0.9990171
## B.Female:tall-C.Female:small          NA          NA         NA        NA
## C.Female:tall-C.Female:small          NA          NA         NA        NA
## A.Male:tall-C.Female:small    -2.61666667 -11.2137936  5.9804602 0.9995764
## B.Male:tall-C.Female:small    -1.85952381  -6.2877212  2.5686736 0.9838219
## C.Male:tall-C.Female:small    -3.31666667 -11.9137936  5.2804602 0.9931958
## B.Male:small-A.Male:small      2.70000000  -7.0482256 12.4482256 0.9998758
## C.Male:small-A.Male:small     -0.10000000  -9.8482256  9.6482256 1.0000000
## A.Female:mid-A.Male:small      0.19000000  -5.9753192  6.3553192 1.0000000
## B.Female:mid-A.Male:small      0.65454545  -5.4638885  6.7729794 1.0000000
## C.Female:mid-A.Male:small      3.12222222  -3.0999214  9.3443659 0.9228949
## A.Male:mid-A.Male:small        2.13333333  -4.3654837  8.6321504 0.9989190
## B.Male:mid-A.Male:small        3.15000000  -4.8093929 11.1093929 0.9911012
## C.Male:mid-A.Male:small        1.95000000  -4.2153192  8.1153192 0.9993143
## A.Female:tall-A.Male:small     1.40000000  -6.5593929  9.3593929 0.9999998
## B.Female:tall-A.Male:small            NA          NA         NA        NA
## C.Female:tall-A.Male:small            NA          NA         NA        NA
## A.Male:tall-A.Male:small       0.90000000  -8.8482256 10.6482256 1.0000000
## B.Male:tall-A.Male:small       1.65714286  -4.7245688  8.0388545 0.9999481
## C.Male:tall-A.Male:small       0.20000000  -9.5482256  9.9482256 1.0000000
## C.Male:small-B.Male:small     -2.80000000 -14.0562814  8.4562814 0.9999714
## A.Female:mid-B.Male:small     -2.51000000 -10.8578817  5.8378817 0.9996373
## B.Female:mid-B.Male:small     -2.04545455 -10.3587693  6.2678602 0.9999754
## C.Female:mid-B.Male:small      0.42222222  -7.9677146  8.8121590 1.0000000
## A.Male:mid-B.Male:small       -0.56666667  -9.1637936  8.0304602 1.0000000
## B.Male:mid-B.Male:small        0.45000000  -9.2982256 10.1982256 1.0000000
## C.Male:mid-B.Male:small       -0.75000000  -9.0978817  7.5978817 1.0000000
## A.Female:tall-B.Male:small    -1.30000000 -11.0482256  8.4482256 1.0000000
## B.Female:tall-B.Male:small            NA          NA         NA        NA
## C.Female:tall-B.Male:small            NA          NA         NA        NA
## A.Male:tall-B.Male:small      -1.80000000 -13.0562814  9.4562814 1.0000000
## B.Male:tall-B.Male:small      -1.04285714  -9.5518061  7.4660918 1.0000000
## C.Male:tall-B.Male:small      -2.50000000 -13.7562814  8.7562814 0.9999943
## A.Female:mid-C.Male:small      0.29000000  -8.0578817  8.6378817 1.0000000
## B.Female:mid-C.Male:small      0.75454545  -7.5587693  9.0678602 1.0000000
## C.Female:mid-C.Male:small      3.22222222  -5.1677146 11.6121590 0.9935143
## A.Male:mid-C.Male:small        2.23333333  -6.3637936 10.8304602 0.9999478
## B.Male:mid-C.Male:small        3.25000000  -6.4982256 12.9982256 0.9986973
## C.Male:mid-C.Male:small        2.05000000  -6.2978817 10.3978817 0.9999761
## A.Female:tall-C.Male:small     1.50000000  -8.2482256 11.2482256 1.0000000
## B.Female:tall-C.Male:small            NA          NA         NA        NA
## C.Female:tall-C.Male:small            NA          NA         NA        NA
## A.Male:tall-C.Male:small       1.00000000 -10.2562814 12.2562814 1.0000000
```

```
## B.Male:tall-C.Male:small       1.75714286  -6.7518061 10.2660918 0.9999980
## C.Male:tall-C.Male:small       0.30000000 -10.9562814 11.5562814 1.0000000
## B.Female:mid-A.Female:mid      0.46454545  -3.0131636  3.9422545 1.0000000
## C.Female:mid-A.Female:mid      2.93222222  -0.7248664  6.5893109 0.2691463
## A.Male:mid-A.Female:mid        1.94333333  -2.1668795  6.0535461 0.9523197
## B.Male:mid-A.Female:mid        2.96000000  -3.2053192  9.1253192 0.9458192
## C.Male:mid-A.Female:mid        1.76000000  -1.7995487  5.3195487 0.9312832
## A.Female:tall-A.Female:mid     1.21000000  -4.9553192  7.3753192 0.9999991
## B.Female:tall-A.Female:mid            NA          NA         NA        NA
## C.Female:tall-A.Female:mid            NA          NA         NA        NA
## A.Male:tall-A.Female:mid       0.71000000  -7.6378817  9.0578817 1.0000000
## B.Male:tall-A.Female:mid       1.46714286  -2.4552888  5.3895745 0.9951271
## C.Male:tall-A.Female:mid       0.01000000  -8.3378817  8.3578817 1.0000000
## C.Female:mid-B.Female:mid      2.46767677  -1.1098043  6.0451578 0.5248477
## A.Male:mid-B.Female:mid        1.47878788  -2.5607570  5.5183327 0.9961578
## B.Male:mid-B.Female:mid        2.49545455  -3.6229794  8.6138885 0.9878884
## C.Male:mid-B.Female:mid        1.29545455  -2.1822545  4.7731636 0.9953422
## A.Female:tall-B.Female:mid     0.74545455  -5.3729794  6.8638885 1.0000000
## B.Female:tall-B.Female:mid            NA          NA         NA        NA
## C.Female:tall-B.Female:mid            NA          NA         NA        NA
## A.Male:tall-B.Female:mid       0.24545455  -8.0678602  8.5587693 1.0000000
## B.Male:tall-B.Female:mid       1.00259740  -2.8457195  4.8509143 0.9999457
## C.Male:tall-B.Female:mid      -0.45454545  -8.7678602  7.8587693 1.0000000
## A.Male:mid-C.Female:mid       -0.98888889  -5.1838573  3.2060795 0.9999866
## B.Male:mid-C.Female:mid        0.02777778  -6.1943659  6.2499214 1.0000000
## C.Male:mid-C.Female:mid       -1.17222222  -4.8293109  2.4848664 0.9991915
## A.Female:tall-C.Female:mid    -1.72222222  -7.9443659  4.4999214 0.9998769
## B.Female:tall-C.Female:mid            NA          NA         NA        NA
## C.Female:tall-C.Female:mid            NA          NA         NA        NA
## A.Male:tall-C.Female:mid      -2.22222222 -10.6121590  6.1677146 0.9999320
## B.Male:tall-C.Female:mid      -1.46507937  -5.4762364  2.5460776 0.9962535
## C.Male:tall-C.Female:mid      -2.92222222 -11.3121590  5.4677146 0.9978188
## B.Male:mid-A.Male:mid          1.01666667  -5.4821504  7.5154837 1.0000000
## C.Male:mid-A.Male:mid         -0.18333333  -4.2935461  3.9268795 1.0000000
## A.Female:tall-A.Male:mid      -0.73333333  -7.2321504  5.7654837 1.0000000
## B.Female:tall-A.Male:mid              NA          NA         NA        NA
## C.Female:tall-A.Male:mid              NA          NA         NA        NA
## A.Male:tall-A.Male:mid        -1.23333333  -9.8304602  7.3637936 1.0000000
## B.Male:tall-A.Male:mid        -0.47619048  -4.9043879  3.9520069 1.0000000
## C.Male:tall-A.Male:mid        -1.93333333 -10.5304602  6.6637936 0.9999932
## C.Male:mid-B.Male:mid         -1.20000000  -7.3653192  4.9653192 0.9999992
## A.Female:tall-B.Male:mid      -1.75000000  -9.7093929  6.2093929 0.9999951
## B.Female:tall-B.Male:mid              NA          NA         NA        NA
## C.Female:tall-B.Male:mid              NA          NA         NA        NA
## A.Male:tall-B.Male:mid        -2.25000000 -11.9982256  7.4982256 0.9999901
## B.Male:tall-B.Male:mid        -1.49285714  -7.8745688  4.8888545 0.9999880
## C.Male:tall-B.Male:mid        -2.95000000 -12.6982256  6.7982256 0.9996062
## A.Female:tall-C.Male:mid      -0.55000000  -6.7153192  5.6153192 1.0000000
## B.Female:tall-C.Male:mid              NA          NA         NA        NA
## C.Female:tall-C.Male:mid              NA          NA         NA        NA
## A.Male:tall-C.Male:mid        -1.05000000  -9.3978817  7.2978817 1.0000000
## B.Male:tall-C.Male:mid        -0.29285714  -4.2152888  3.6295745 1.0000000
```

```
## C.Male:tall-C.Male:mid        -1.75000000 -10.0978817  6.5978817 0.9999976
## B.Female:tall-A.Female:tall           NA          NA         NA        NA
## C.Female:tall-A.Female:tall           NA          NA         NA        NA
## A.Male:tall-A.Female:tall     -0.50000000 -10.2482256  9.2482256 1.0000000
## B.Male:tall-A.Female:tall      0.25714286  -6.1245688  6.6388545 1.0000000
## C.Male:tall-A.Female:tall     -1.20000000 -10.9482256  8.5482256 1.0000000
## C.Female:tall-B.Female:tall           NA          NA         NA        NA
## A.Male:tall-B.Female:tall             NA          NA         NA        NA
## B.Male:tall-B.Female:tall             NA          NA         NA        NA
## C.Male:tall-B.Female:tall             NA          NA         NA        NA
## A.Male:tall-C.Female:tall             NA          NA         NA        NA
## B.Male:tall-C.Female:tall             NA          NA         NA        NA
## C.Male:tall-C.Female:tall             NA          NA         NA        NA
## B.Male:tall-A.Male:tall        0.75714286  -7.7518061  9.2660918 1.0000000
## C.Male:tall-A.Male:tall       -0.70000000 -11.9562814 10.5562814 1.0000000
## C.Male:tall-B.Male:tall       -1.45714286  -9.9660918  7.0518061 0.9999999
```

Заключение

В ходе выполнения данной работы я получил незабываемый опыт и приобрел навыки, которые пригодятся в дальнейшей профессиональной деятельности. Были изучены и освоены на практике основы анализа данных с помощью ANOVA

С уважением,

студент гр. РИ-440005

Кабанов Евгений