HW4

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```r
library(tidyverse)
```

```
## -- Attaching packages --------------------------- tidyverse 1.3.0 --

## v ggplot2 3.3.2     v purrr   0.3.4
## v tibble  3.0.3     v dplyr   1.0.2
## v tidyr   1.1.2     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0

## -- Conflicts ------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```r
library(mosaic)
```

```
## Registered S3 method overwritten by 'mosaic':
##   method                           from
##   fortify.SpatialPolygonsDataFrame ggplot2

##
## The 'mosaic' package masks several functions from core packages in order to add
## additional features.  The original behavior of these functions should not be affected by this.

##
## Attaching package: 'mosaic'

## The following object is masked from 'package:Matrix':
##
##     mean

## The following objects are masked from 'package:dplyr':
##
##     count, do, tally

## The following object is masked from 'package:purrr':
##
##     cross

## The following object is masked from 'package:ggplot2':
##
##     stat

## The following objects are masked from 'package:stats':
##
##     binom.test, cor, cor.test, cov, fivenum, IQR, median, prop.test,
##     quantile, sd, t.test, var

## The following objects are masked from 'package:base':
```

```
##
##     max, mean, min, prod, range, sample, sum
```

```r
vaild <- read_csv("https://s3.amazonaws.com/blackboard.learn.xythos.prod/5a306634d5d25/4188093?response-
```

```
## Parsed with column specification:
## cols(
##   `'Id'` = col_double(),
##   `'sfat_dr'` = col_double(),
##   `'sfat_ffq'` = col_double(),
##   `'tfat_dr'` = col_double(),
##   `'tfat_ffq'` = col_double(),
##   `'alco_dr'` = col_double(),
##   `'alco_ffq'` = col_double(),
##   `'cal_dr'` = col_double(),
##   `'cal_ffq'` = col_double()
## )
```

```r
print(vaild)
```

```
## # A tibble: 173 x 9
##    `'Id'` `'sfat_dr'` `'sfat_ffq'` `'tfat_dr'` `'tfat_ffq'` `'alco_dr'`
##     <dbl>       <dbl>        <dbl>       <dbl>        <dbl>       <dbl>
##  1 100396        33.2         21.2        81.2         53.8        8.26
##  2 100566        17.7         10.6        53.3         36.6        0.83
##  3 107633        38.7         23.8        83.5         47.2       20.1
##  4 107737        21.6         22.7        49.6         55.3       11.2
##  5 107744        21.4         30.4        55.2         71          7.18
##  6 107813        28.0         15.1        73.8         41.1        1.76
##  7 107825        23.2         17.8        68.3         49.1       22.7
##  8 107879        19.7         19.1        58.3         48.9        0
##  9 108618        36.3         23.4        92.6         55.4        0
## 10 109000        20.9         16          68.4         44.2        0
## # ... with 163 more rows, and 3 more variables: `'alco_ffq'` <dbl>,
## #   `'cal_dr'` <dbl>, `'cal_ffq'` <dbl>
```

```r
summary(vaild)
```

```
##       'Id'           'sfat_dr'        'sfat_ffq'       'tfat_dr'
##  Min.   :100396   Min.   :11.82   Min.   : 5.60   Min.   : 35.90
##  1st Qu.:113882   1st Qu.:20.20   1st Qu.:15.60   1st Qu.: 56.16
##  Median :132382   Median :24.16   Median :19.90   Median : 68.28
##  Mean   :125997   Mean   :24.93   Mean   :21.92   Mean   : 68.62
##  3rd Qu.:134611   3rd Qu.:28.26   3rd Qu.:25.80   3rd Qu.: 77.98
##  Max.   :184093   Max.   :46.36   Max.   :57.40   Max.   :119.83
##    'tfat_ffq'       'alco_dr'         'alco_ffq'        'cal_dr'
##  Min.   : 14.80   Min.   : 0.000   Min.   : 0.000   Min.   : 910
##  1st Qu.: 40.80   1st Qu.: 1.760   1st Qu.: 0.760   1st Qu.:1418
##  Median : 51.70   Median : 5.840   Median : 4.550   Median :1606
##  Mean   : 56.08   Mean   : 8.963   Mean   : 8.951   Mean   :1620
##  3rd Qu.: 68.00   3rd Qu.:12.970   3rd Qu.:11.860   3rd Qu.:1781
##  Max.   :133.50   Max.   :49.150   Max.   :64.750   Max.   :2518
##    'cal_ffq'
##  Min.   : 463.2
##  1st Qu.:1035.5
##  Median :1297.6
```

```
##  Mean   :1371.7
##  3rd Qu.:1589.6
##  Max.   :3077.3
```

```r
dim(vaild)
```

```
## [1] 173   9
```

- rename

```r
vaild %>%
  rename("Id" = "'Id'", "alco_dr" = "'alco_dr'", "alco_ffq" = "'alco_ffq'") -> vaild
vaild
```

```
## # A tibble: 173 x 9
##        Id `'sfat_dr'` `'sfat_ffq'` `'tfat_dr'` `'tfat_ffq'` alco_dr alco_ffq
##     <dbl>       <dbl>        <dbl>       <dbl>        <dbl>   <dbl>    <dbl>
##  1 100396        33.2         21.2        81.2         53.8    8.26     1.68
##  2 100566        17.7         10.6        53.3         36.6    0.83     0
##  3 107633        38.7         23.8        83.5         47.2   20.1     15.1
##  4 107737        21.6         22.7        49.6         55.3   11.2      7.49
##  5 107744        21.4         30.4        55.2         71      7.18    12.8
##  6 107813        28.0         15.1        73.8         41.1    1.76     0
##  7 107825        23.2         17.8        68.3         49.1   22.7     25.1
##  8 107879        19.7         19.1        58.3         48.9    0        0
##  9 108618        36.3         23.4        92.6         55.4    0        0
## 10 109000        20.9         16          68.4         44.2    0        0
## # ... with 163 more rows, and 2 more variables: `'cal_dr'` <dbl>,
## #   `'cal_ffq'` <dbl>
```

- EDA (exploratory data analysis) is always a good idea
- create a DIFF variable

```r
vaild = transform(vaild, DIFF = alco_dr - alco_ffq)
vaild %>%
  select(alco_dr, alco_ffq, DIFF) -> vaild02
favstats(~DIFF, data = vaild)
```

```
##     min   Q1 median   Q3  max      mean       sd   n missing
##  -34.94 -0.7   0.51 2.59 21.4 0.0116185 6.501457 173       0
```

```r
head(vaild)
```

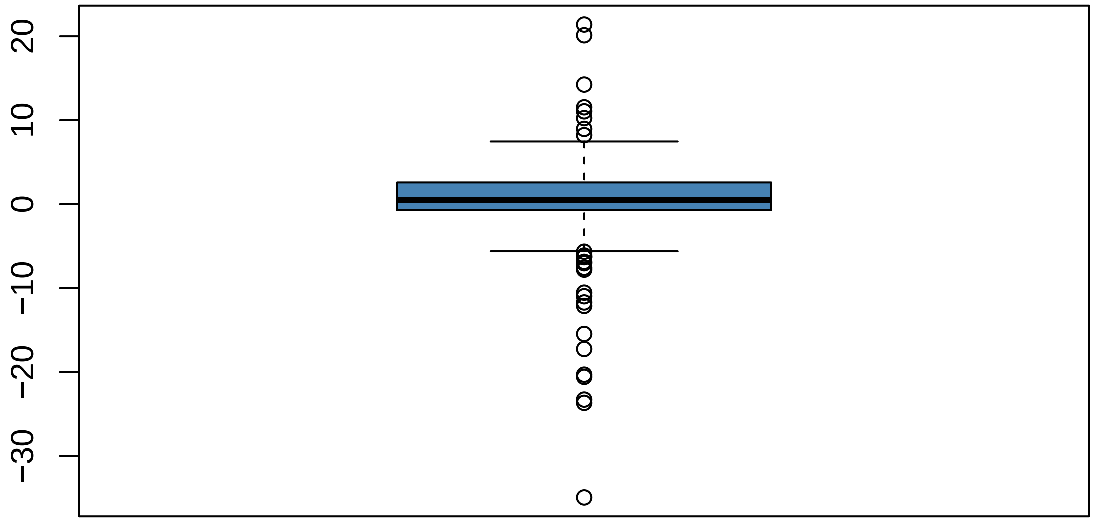
```
##       Id X.sfat_dr. X.sfat_ffq. X.tfat_dr. X.tfat_ffq. alco_dr alco_ffq
## 1 100396      33.20        21.2      81.15        53.8    8.26     1.68
## 2 100566      17.73        10.6      53.28        36.6    0.83     0.00
## 3 107633      38.73        23.8      83.48        47.2   20.13    15.10
## 4 107737      21.57        22.7      49.65        55.3   11.16     7.49
## 5 107744      21.35        30.4      55.18        71.0    7.18    12.84
## 6 107813      28.04        15.1      73.83        41.1    1.76     0.00
##   X.cal_dr. X.cal_ffq.  DIFF
## 1      1807     1242.2  6.58
## 2      1418      907.0  0.83
## 3      1889      786.0  5.03
## 4      1426     1392.5  3.67
## 5      1253     1259.8 -5.66
## 6      1699      987.1  1.76
```

- Check the assumptions (y = Diff)

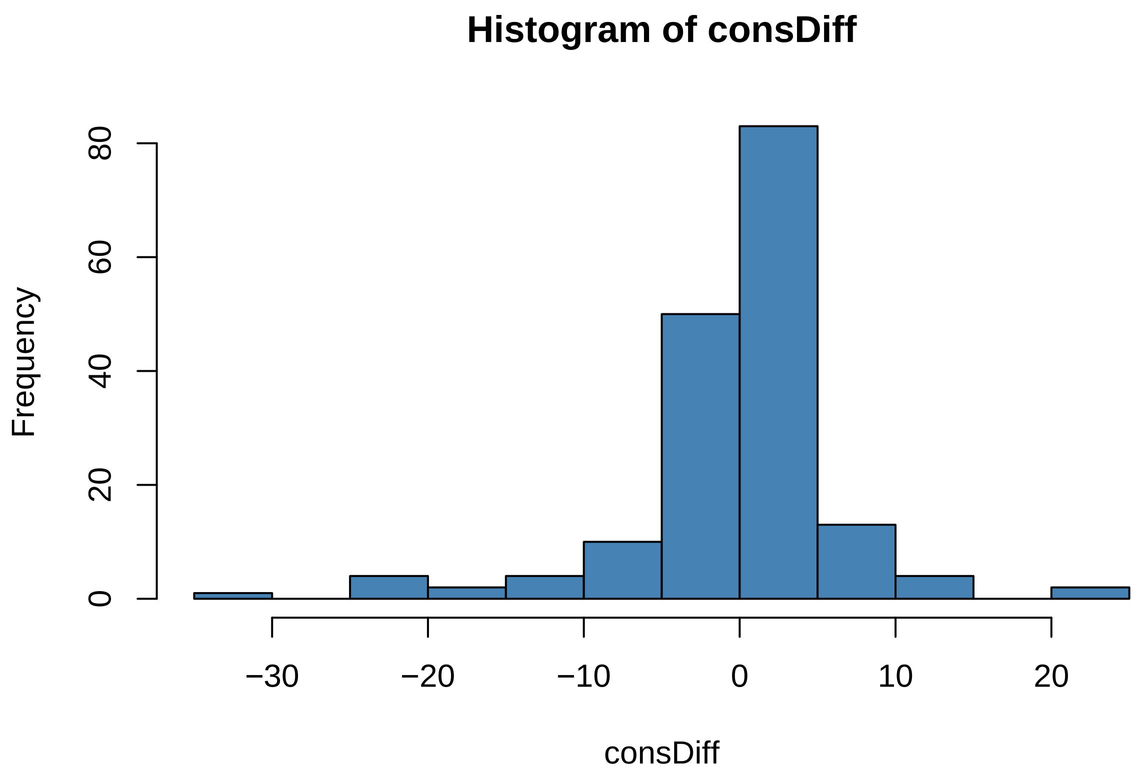
```
consDiff <- vaild$alco_dr - vaild$alco_ffq # consumption different
favstats(consDiff)
```

```
##     min   Q1 median   Q3  max      mean       sd   n missing
##  -34.94 -0.7   0.51 2.59 21.4 0.0116185 6.501457 173       0
```

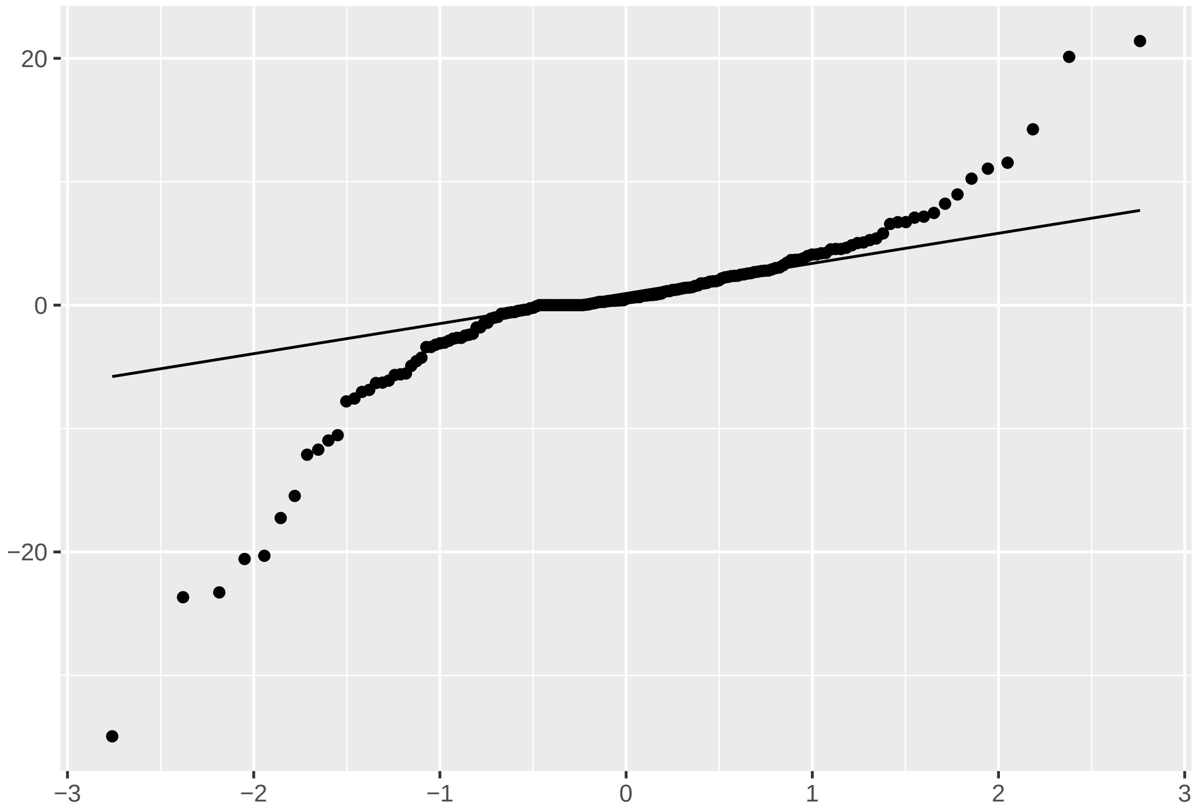
```
boxplot(consDiff, col = "steelblue")
```



```
hist(consDiff,col="steelblue")
```



```r
qplot(sample = consDiff, geom = "qq") + geom_qq_line()
```



- Consider a square root transformation of the alcohol data

```r
vaild %>%
  mutate(alco_drSqrt = sqrt(alco_dr),
         alco_ffqSqrt = sqrt(alco_ffq)) -> vaildSqrt

# Check the assumptions of two dependent samples again!
# use another way to create a DIFF variable

diffSqrt = vaildSqrt$alco_drSqrt - vaildSqrt$alco_ffqSqrt
cbind(vaildSqrt, diffSqrt)
```

```
##         Id X.sfat_dr. X.sfat_ffq. X.tfat_dr. X.tfat_ffq. alco_dr alco_ffq
## 1   100396      33.20        21.2      81.15        53.8    8.26     1.68
## 2   100566      17.73        10.6      53.28        36.6    0.83     0.00
## 3   107633      38.73        23.8      83.48        47.2   20.13    15.10
## 4   107737      21.57        22.7      49.65        55.3   11.16     7.49
## 5   107744      21.35        30.4      55.18        71.0    7.18    12.84
## 6   107813      28.04        15.1      73.83        41.1    1.76     0.00
## 7   107825      23.17        17.8      68.29        49.1   22.66    25.06
## 8   107879      19.73        19.1      58.30        48.9    0.00     0.00
## 9   108618      36.31        23.4      92.58        55.4    0.00     0.00
## 10  109000      20.87        16.0      68.44        44.2    0.00     0.00
## 11  109259      26.40        19.4      69.16        46.6    4.75     1.06
## 12  109565      28.26        27.4      79.42        59.7    4.57     1.81
## 13  109856      19.81        15.8      69.59        50.5   15.12    11.14
## 14  109885      23.48        19.9      65.86        55.6    5.37     2.57
```

```
## 15  109908       25.62          17.4       74.22          51.7    0.00      0.00
## 16  110108       23.59           9.5       63.44          23.4    1.89      0.76
## 17  110360       14.60          20.9       38.14          46.9    0.78      5.70
## 18  110406       20.71          27.7       49.77          70.1    8.09     10.56
## 19  110419       28.63          15.3       80.73          35.3   37.90     35.34
## 20  110483       18.12          20.7       53.56          55.7    2.22      0.76
## 21  110579       16.93          17.6       52.75          51.5   20.69     18.22
## 22  110714       25.10          18.9       80.15          57.5    0.00      0.00
## 23  111040       14.04          14.9       39.40          37.0    2.62      1.68
## 24  111220       21.98          32.6       54.91          73.2    9.49      6.49
## 25  111536       24.83          24.0       67.73          63.1    9.69     16.72
## 26  111538       20.72          15.6       55.24          47.6    0.95      1.51
## 27  111799       24.61          24.2       68.11          54.4    3.00      2.74
## 28  111970       32.03          38.2       71.02          98.8   37.28     45.08
## 29  112071       23.49          18.8       63.72          55.8   21.78     33.49
## 30  112087       25.69          23.5       67.99          68.0   15.41     12.91
## 31  112163       23.65          21.3       64.61          46.8    7.85      0.76
## 32  112226       23.45          13.9       60.13          31.8    0.39      0.00
## 33  112650       46.36          33.3      104.91          88.1   29.81     64.75
## 34  112738       16.04          17.6       44.23          40.6    0.00      0.00
## 35  112812       38.68          17.8       98.14          55.8    6.77      2.57
## 36  112862       24.10          15.9       64.21          41.5    5.97      2.74
## 37  112896       27.92          16.7       91.37          53.5    0.85      0.00
## 38  112982       26.26          24.1       70.44          61.9    5.23      5.70
## 39  113429       26.46          21.0       76.06          57.7    2.26      2.11
## 40  113436       22.02          19.5       61.13          63.8    7.79      1.06
## 41  113441       24.51          25.9       62.60          60.7    7.75     11.14
## 42  113525       20.06          16.1       55.50          49.9   10.86     10.75
## 43  113613       34.14          38.5       93.04          93.5   22.44     11.38
## 44  113882       24.38          18.2       67.02          48.7    4.49     12.06
## 45  114053       14.38           5.6       41.09          14.8    5.20      4.55
## 46  114129       17.74          15.2       54.07          48.4    0.38      0.76
## 47  114353       27.83          16.5       78.26          36.7    5.17      3.79
## 48  114865       29.17          24.8       84.52          71.1    0.00      0.00
## 49  115013       15.94          12.8       45.89          38.0   22.89      8.64
## 50  115223       28.33          27.2       75.96          88.4    2.93      0.76
## 51  115399       15.18          11.6       49.44          30.7    0.05      0.00
## 52  115512       22.51          31.2       68.28          78.7    4.75      5.70
## 53  115601       46.01          17.4      119.83          49.5   10.12      5.57
## 54  115724       27.15          16.9       80.54          37.7   17.90      8.93
## 55  115764       25.47          15.8       75.54          41.6    0.00      1.81
## 56  115806       27.99          17.5       69.13          40.7    3.35      0.76
## 57  115822       25.28          17.0       68.36          48.6   10.04      2.87
## 58  115875       26.58          14.8       77.83          40.1   17.27     15.86
## 59  115879       28.72          35.8       74.26          76.0    0.00      0.00
## 60  116007       24.62          34.6       66.12          66.0    8.15     13.76
## 61  116164       26.46          18.0       78.20          48.8   27.55     34.42
## 62  116263       29.57          14.4       69.80          33.5    0.60      0.00
## 63  116413       20.39          23.7       48.85          56.5   22.31     12.06
## 64  116461       14.68          13.6       52.24          40.3    4.40      2.11
## 65  116528       23.43          25.6       71.16          62.4    1.99      0.76
## 66  129518       20.74          23.7       61.82          68.8    0.00      0.00
## 67  129729       21.76          19.3       63.73          56.3    0.38      0.00
## 68  129732       21.58          13.8       64.25          40.9    0.80      1.81
```

```
## 69  129743       39.30          32.7     109.83          78.5    0.14     0.76
## 70  129765       21.95          21.0      59.74          52.9   12.03    10.75
## 71  129813       21.90          11.9      67.87          38.3   10.35     3.63
## 72  130757       28.65          13.6      78.99          41.0    5.84     0.76
## 73  130786       30.01          33.4      79.13          82.8   17.22    12.99
## 74  130793       29.35          23.9      98.96          75.6    5.97     4.64
## 75  130847       21.56           8.8      72.02          34.6    2.79     0.00
## 76  130863       18.83          40.6      54.78         100.0   20.50    37.75
## 77  131023       36.16          18.5     100.56          52.6    8.65     4.55
## 78  131100       31.20          29.3      92.12          70.5   10.41    16.72
## 79  131126       29.06          23.5      80.52          67.9    7.12     6.76
## 80  131129       21.79          14.6      68.42          45.2   12.97    16.06
## 81  132293       29.60          30.3      70.98          78.9    8.75     4.64
## 82  132303       12.71          12.1      35.90          32.3    3.45     1.51
## 83  132316       22.16          14.8      70.33          45.6    3.11     0.76
## 84  132327       22.61          13.8      65.19          34.6    2.69     0.76
## 85  132328       27.08          18.8      70.95          43.7   49.15    27.75
## 86  132361       17.92          15.2      49.72          41.9    0.57     0.00
## 87  132382       31.41          30.4      90.21          74.1   31.26    11.14
## 88  132390       33.25          25.8      87.69          73.9   11.13    11.38
## 89  132426       32.19          54.9      86.35         133.5    4.67     2.87
## 90  132621       25.17           7.5      70.20          18.4   15.69    11.14
## 91  132622       34.34          19.0      86.68          44.7   23.44    43.75
## 92  132624       25.11          24.2      69.86          63.1    4.60    16.72
## 93  132638       45.31          47.1     106.40          93.8    0.03     0.00
## 94  132662       18.59          12.5      45.37          29.5   19.38    29.92
## 95  133002       28.34          35.5      71.45          80.0    0.77     0.00
## 96  133079       18.75          11.8      60.54          36.4    8.49     7.25
## 97  133094       24.37          39.0      67.73         109.3    0.79     0.00
## 98  133317       18.33          19.1      64.53          56.1   11.15     6.63
## 99  133372       17.26          20.0      42.53          41.4   13.11    12.84
## 100 133443       16.73          57.4      54.07         119.0    0.00     0.00
## 101 133497       24.78          11.8      73.18          28.0    0.00     0.00
## 102 133507       16.74           5.7      54.84          16.5    4.17     2.57
## 103 133533       15.30          17.1      51.96          41.4    6.68     3.63
## 104 133606       27.74          26.6      82.71          70.9    0.40     0.76
## 105 133615       26.40          14.8      80.64          40.8    1.58     0.76
## 106 133637       26.76          20.4      70.67          47.0    3.44     0.00
## 107 133676       17.73          19.4      52.62          55.1    3.70     3.79
## 108 133692       25.97          24.3      65.65          52.0    4.88     1.98
## 109 133833       18.57          14.0      53.18          37.4    7.31     4.64
## 110 133925       26.48          17.3      72.45          37.9   25.74    28.06
## 111 133987       26.98          23.2      64.35          60.9   32.64    28.85
## 112 134013       33.26          27.6      80.79          62.3    1.14     2.57
## 113 134021       19.03          11.2      47.56          29.0    0.90     0.00
## 114 134047       16.00          13.6      49.35          37.7    2.25     0.00
## 115 134103       27.59          17.0      72.49          34.8   16.61    10.80
## 116 134119       22.32          13.2      64.53          31.0    1.27     1.85
## 117 134129       26.83          19.9      77.98          49.5    2.20     1.06
## 118 134144       36.44          36.8      94.53          89.3   16.51    11.86
## 119 134223       26.25          43.4      73.74          89.8    6.92    10.32
## 120 134350       30.92          20.2      82.98          51.8   17.76    15.86
## 121 134385       27.50           9.8      74.55          25.5    1.84     0.76
## 122 134431       34.25          18.8      77.12          41.9   40.11    46.39
```

```
## 123 134486      23.79        28.7      62.49        67.8   32.72    56.39
## 124 134495      23.56        36.9      72.11       105.0    1.89     2.57
## 125 134519      20.46         7.5      58.42        21.1   27.86    43.32
## 126 134550      24.16        21.8      69.11        60.4   13.62    19.74
## 127 134553      23.42        31.5      72.08        90.4    9.92     7.55
## 128 134566      26.40        14.5      72.99        36.1    5.04     4.64
## 129 134598      24.09        14.9      61.17        35.2   12.95     9.30
## 130 134611      25.25        20.5      56.16        42.6    9.43    12.08
## 131 134622      23.34        41.1      66.51       113.2    0.00     0.00
## 132 134835      16.61        21.6      49.65        56.8   27.26    27.00
## 133 134838      39.36        22.7      99.10        45.8   18.69    39.26
## 134 134839      23.66        18.3      55.86        41.0   28.28    25.90
## 135 134845      40.59        48.4     108.72       107.5    6.99     6.63
## 136 135002      34.04        37.4      82.11        91.1    0.00     0.00
## 137 135009      18.94        37.0      56.34        90.7   12.48    12.91
## 138 135026      21.41        23.4      52.20        60.2    4.21     4.42
## 139 135126      18.00        24.1      46.44        61.2   12.18    11.86
## 140 135130      21.04        24.8      58.92        67.0    0.00     0.00
## 141 135146      11.82        11.5      38.59        28.9    2.18     0.76
## 142 135172      27.39        20.8      79.63        58.1    1.76     0.00
## 143 135182      34.61        34.3      98.94       104.6    2.17     2.87
## 144 135201      19.79        22.6      57.70        62.1    1.43     4.64
## 145 135258      21.34        16.7      57.30        33.9   14.23     6.76
## 146 135262      18.79        25.7      57.33        76.6    1.39     2.87
## 147 135313      18.63         6.6      61.11        20.7    2.98     5.70
## 148 135324      20.39        16.9      62.54        48.0    3.77     1.06
## 149 135330      18.64        14.9      53.56        44.2    8.10    11.14
## 150 135351      15.39        12.1      50.40        33.7   13.79     5.57
## 151 135372      31.35        24.9      91.65        72.8   28.29    39.26
## 152 135391      23.62        23.3      62.62        59.3   15.60    10.75
## 153 135465      27.51        42.8      81.29       112.3    6.97     6.63
## 154 135472      41.01        18.3     114.85        41.7    0.00     0.00
## 155 135488      15.99        20.6      48.25        50.2    8.18     6.63
## 156 135530      17.48        18.8      50.43        46.5    0.51     0.00
## 157 135547      31.35        35.3      76.92        75.1    7.82    12.08
## 158 135559      17.64        17.8      45.39        38.5    6.60    11.14
## 159 135588      39.43        26.4      98.34        77.9   28.79    52.07
## 160 135596      30.98        28.8      73.80        70.3    3.82     1.81
## 161 135619      32.86        41.2      84.85        92.5    0.00     0.00
## 162 135769      26.24        26.4      72.73        60.7    8.31     2.91
## 163 135829      20.07        25.9      65.41        87.6    8.22    13.76
## 164 135834      14.42        11.3      40.64        29.6    0.96     0.76
## 165 135848      29.59        29.9      71.41        67.6    0.63     0.00
## 166 135869      28.02        15.5      77.82        40.5   15.72    16.81
## 167 136104      25.85        23.7      70.89        75.0   23.97    12.43
## 168 136377      20.20        20.3      51.99        52.0    7.28     6.63
## 169 136378      36.19        18.1      95.43        47.1    4.60     7.25
## 170 136407      22.42        10.9      62.15        32.0    2.56     1.81
## 171 136421      16.98        20.4      42.85        47.5   13.91     8.64
## 172 137461      23.98        18.5      67.43        45.9    5.39     7.19
## 173 184093      21.39        19.0      56.70        40.4    0.60     3.49
##     X.cal_dr. X.cal_ffq.   DIFF alco_drSqrt alco_ffqSqrt    diffSqrt
## 1        1807     1242.2   6.58   2.8740216    1.2961481  1.57787343
## 2        1418      907.0   0.83   0.9110434    0.0000000  0.91104336
```

```
## 3          1889      786.0   5.03   4.4866469    3.8858718  0.60077501
## 4          1426     1392.5   3.67   3.3406586    2.7367864  0.60387218
## 5          1253     1259.8  -5.66   2.6795522    3.5832946 -0.90374237
## 6          1699      987.1   1.76   1.3266499    0.0000000  1.32664992
## 7          1700     1189.9  -2.40   4.7602521    5.0059964 -0.24574431
## 8          1369     1364.1   0.00   0.0000000    0.0000000  0.00000000
## 9          2163     1311.4   0.00   0.0000000    0.0000000  0.00000000
## 10         1609     1200.6   0.00   0.0000000    0.0000000  0.00000000
## 11         1704     1227.4   3.69   2.1794495    1.0295630  1.14988646
## 12         1884     1448.1   2.76   2.1377558    1.3453624  0.79239343
## 13         1518     1367.7   3.98   3.8884444    3.3376639  0.55078057
## 14         1450     1154.4   2.80   2.3173260    1.6031220  0.71420409
## 15         1702     1217.7   0.00   0.0000000    0.0000000  0.00000000
## 16         1400      483.4   1.13   1.3747727    0.8717798  0.50299292
## 17          910     1056.5  -4.92   0.8831761    2.3874673 -1.50429119
## 18         1332     1265.3  -2.47   2.8442925    3.2496154 -0.40532283
## 19         1947      890.1   2.56   6.1562976    5.9447456  0.21155201
## 20         1428     1378.5   1.46   1.4899664    0.8717798  0.61818665
## 21         1557     1317.5   2.47   4.5486262    4.2684892  0.28013697
## 22         1788     1257.5   0.00   0.0000000    0.0000000  0.00000000
## 23         1098     1087.8   0.94   1.6186414    1.2961481  0.32249327
## 24         1362     1589.6   3.00   3.0805844    2.5475478  0.53303652
## 25         1562     1422.7  -7.03   3.1128765    4.0890097 -0.97613318
## 26         1286     1569.6  -0.56   0.9746794    1.2288206 -0.25414114
## 27         1529     1386.0   0.26   1.7320508    1.6552945  0.07675627
## 28         1810     2220.0  -7.80   6.1057350    6.7141641 -0.60842912
## 29         1606     1291.4 -11.71   4.6669048    5.7870545 -1.12014976
## 30         1363     1102.0   2.50   3.9255573    3.5930488  0.33250844
## 31         1457      943.2   7.09   2.8017851    0.8717798  1.93000536
## 32         1233      731.4   0.39   0.6244998    0.0000000  0.62449980
## 33         2285     1878.9 -34.94   5.4598535    8.0467385 -2.58688499
## 34         1183     1326.6   0.00   0.0000000    0.0000000  0.00000000
## 35         2176     1635.4   4.20   2.6019224    1.6031220  0.99880041
## 36         1587     1035.5   3.23   2.4433583    1.6552945  0.78806381
## 37         2029     1548.3   0.85   0.9219544    0.0000000  0.92195445
## 38         1484     1376.3  -0.47   2.2869193    2.3874673 -0.10054795
## 39         1685     1460.5   0.15   1.5033296    1.4525839  0.05074573
## 40         1440     1970.2   6.73   2.7910571    1.0295630  1.76149413
## 41         1293     1350.3  -3.39   2.7838822    3.3376639 -0.55378167
## 42         1433     1326.3   0.11   3.2954514    3.2787193  0.01673215
## 43         2333     2253.5  11.06   4.7370877    3.3734256  1.36366215
## 44         1402     1139.9  -7.57   2.1189620    3.4727511 -1.35378906
## 45          923      463.2   0.65   2.2803509    2.1330729  0.14727795
## 46         1330     1498.4  -0.38   0.6164414    0.8717798 -0.25533839
## 47         1731      946.7   1.38   2.2737634    1.9467922  0.32697117
## 48         1636     1396.7   0.00   0.0000000    0.0000000  0.00000000
## 49         1311     1078.4  14.25   4.7843495    2.9393877  1.84496179
## 50         1769     1996.8   2.17   1.7117243    0.8717798  0.83994449
## 51         1481     1051.9   0.05   0.2236068    0.0000000  0.22360680
## 52         1649     2100.3  -0.95   2.1794495    2.3874673 -0.20801781
## 53         2334      988.7   4.55   3.1811947    2.3600847  0.82111000
## 54         1823     1025.7   8.97   4.2308392    2.9883106  1.24252860
## 55         1548     1259.6  -1.81   0.0000000    1.3453624 -1.34536240
## 56         1456      825.1   2.59   1.8303005    0.8717798  0.95852073
```

```
## 57        1535     1047.0   7.17   3.1685959    1.6941074  1.47448847
## 58        1718      726.9   1.41   4.1557190    3.9824616  0.17325740
## 59        1641     1961.6   0.00   0.0000000    0.0000000  0.00000000
## 60        1402     1434.4  -5.61   2.8548205    3.7094474 -0.85462691
## 61        2143     1464.4  -6.87   5.2488094    5.8668561 -0.61804667
## 62        1490      768.7   0.60   0.7745967    0.0000000  0.77459667
## 63        1221     1698.5  10.25   4.7233463    3.4727511  1.25059520
## 64        1255      758.3   2.29   2.0976177    1.4525839  0.64503379
## 65        1555     1462.0   1.23   1.4106736    0.8717798  0.53889381
## 66        1374     1592.4   0.00   0.0000000    0.0000000  0.00000000
## 67        1593     1661.5   0.38   0.6164414    0.0000000  0.61644140
## 68        1491     1249.3  -1.01   0.8944272    1.3453624 -0.45093521
## 69        2505     2282.1  -0.62   0.3741657    0.8717798 -0.49761405
## 70        1560     1152.1   1.28   3.4684290    3.2787193  0.18970978
## 71        1661      979.9   6.72   3.2171416    1.9052559  1.31188570
## 72        1742     1253.0   5.08   2.4166092    0.8717798  1.54482941
## 73        1680     1799.2   4.23   4.1496988    3.6041643  0.54553453
## 74        2096     1873.2   1.33   2.4433583    2.1540659  0.28929242
## 75        1438      811.8   2.79   1.6703293    0.0000000  1.67032931
## 76        1325     1940.4 -17.25   4.5276926    6.1441029 -1.61641029
## 77        2051     1219.8   4.10   2.9410882    2.1330729  0.80801533
## 78        2050     1644.5  -6.31   3.2264532    4.0890097 -0.86255650
## 79        1707     1933.5   0.36   2.6683328    2.6000000  0.06833281
## 80        1502     1120.8  -3.09   3.6013886    4.0074930 -0.40610436
## 81        1691     1470.5   4.11   2.9580399    2.1540659  0.80397397
## 82         940      842.3   1.94   1.8574176    1.2288206  0.62859699
## 83        1591     1156.4   2.35   1.7635192    0.8717798  0.89173942
## 84        1769     1539.8   1.93   1.6401219    0.8717798  0.76834216
## 85        2054     1330.9  21.40   7.0107061    5.2678269  1.74287922
## 86        1514     1509.9   0.57   0.7549834    0.0000000  0.75498344
## 87        1989     1506.5  20.12   5.5910643    3.3376639  2.25340045
## 88        1968     1795.5  -0.25   3.3361655    3.3734256 -0.03726010
## 89        1781     2263.5   1.80   2.1610183    1.6941074  0.46691084
## 90        1761      513.6   4.55   3.9610605    3.3376639  0.62339661
## 91        1639     1124.7 -20.31   4.8414874    6.6143783 -1.77289090
## 92        1445     1340.3 -12.12   2.1447611    4.0890097 -1.94424860
## 93        2260     2047.8   0.03   0.1732051    0.0000000  0.17320508
## 94        1107      811.1 -10.54   4.4022721    5.4699177 -1.06764559
## 95        1878     2136.0   0.77   0.8774964    0.0000000  0.87749644
## 96        1612     1251.2   1.24   2.9137605    2.6925824  0.22117805
## 97        1669     3077.3   0.79   0.8888194    0.0000000  0.88881944
## 98        1533     1415.3   4.52   3.3391616    2.5748786  0.76428293
## 99        1149     1055.8   0.27   3.6207734    3.5832946  0.03747882
## 100       1555     2691.0   0.00   0.0000000    0.0000000  0.00000000
## 101       1470      662.4   0.00   0.0000000    0.0000000  0.00000000
## 102       1620      932.5   1.60   2.0420578    1.6031220  0.43893583
## 103       1122     1100.2   3.05   2.5845696    1.9052559  0.67931371
## 104       1994     1530.5  -0.36   0.6324555    0.8717798 -0.23932426
## 105       1940      902.4   0.82   1.2569805    0.8717798  0.38520072
## 106       1472      954.2   3.44   1.8547237    0.0000000  1.85472370
## 107       1388     1504.7  -0.09   1.9235384    1.9467922 -0.02325383
## 108       1683     1333.6   2.90   2.2090722    1.4071247  0.80194748
## 109       1226      798.2   2.67   2.7037012    2.1540659  0.54963524
## 110       1679      912.3  -2.32   5.0734604    5.2971691 -0.22370870
```

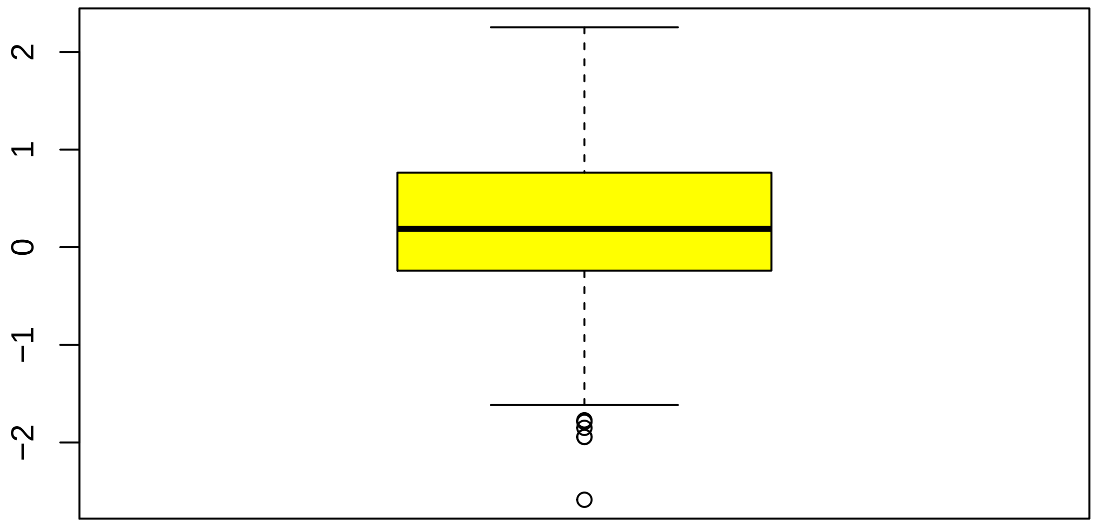
```
## 111       1583      1210.5   3.79   5.7131427    5.3712196  0.34192314
## 112       2229      1637.1  -1.43   1.0677078    1.6031220 -0.53541413
## 113       1321      1254.6   0.90   0.9486833    0.0000000  0.94868330
## 114       1162      1046.1   2.25   1.5000000    0.0000000  1.50000000
## 115       1761      1009.6   5.81   4.0755368    3.2863353  0.78920143
## 116       1376       730.6  -0.58   1.1269428    1.3601471 -0.23320428
## 117       1689      1130.7   1.14   1.4832397    1.0295630  0.45367668
## 118       2010      1870.1   4.65   4.0632499    3.4438351  0.61941486
## 119       1815      2425.4  -3.40   2.6305893    3.2124757 -0.58188639
## 120       1779      1187.8   1.90   4.2142615    3.9824616  0.23179995
## 121       2038       782.3   1.08   1.3564660    0.8717798  0.48468621
## 122       1973      1187.9  -6.28   6.3332456    6.8110205 -0.47777487
## 123       1870      2166.6 -23.67   5.7201399    7.5093275 -1.78918767
## 124       1936      2497.0  -0.68   1.3747727    1.6031220 -0.22834925
## 125       1619       757.5 -15.46   5.2782573    6.5817931 -1.30353578
## 126       1757      1297.6  -6.12   3.6905284    4.4429720 -0.75244356
## 127       1582      1837.6   2.37   3.1496031    2.7477263  0.40187682
## 128       1670       956.9   0.40   2.2449944    2.1540659  0.09092851
## 129       1454       878.4   3.65   3.5986108    3.0495901  0.54902071
## 130       1616      1144.2  -2.65   3.0708305    3.4756294 -0.40479893
## 131       1371      2921.6   0.00   0.0000000    0.0000000  0.00000000
## 132       1388      1227.6   0.26   5.2211110    5.1961524  0.02495857
## 133       2425       891.8 -20.57   4.3231933    6.2657801 -1.94258681
## 134       1280       842.6   2.38   5.3178943    5.0892043  0.22869006
## 135       2376      2539.5   0.36   2.6438608    2.5748786  0.06898218
## 136       1885      2389.5   0.00   0.0000000    0.0000000  0.00000000
## 137       1302      1713.9  -0.43   3.5327043    3.5930488 -0.06034450
## 138       1016       936.6  -0.21   2.0518285    2.1023796 -0.05055115
## 139        963      1307.6   0.32   3.4899857    3.4438351  0.04615060
## 140       1501      1466.6   0.00   0.0000000    0.0000000  0.00000000
## 141       1026       991.7   1.42   1.4764823    0.8717798  0.60470252
## 142       1820      1532.9   1.76   1.3266499    0.0000000  1.32664992
## 143       2087      2279.8  -0.70   1.4730920    1.6941074 -0.22101545
## 144       1299      1228.1  -3.21   1.1958261    2.1540659 -0.95823985
## 145       1524       854.3   7.47   3.7722672    2.6000000  1.17226722
## 146       1450      1975.8  -1.48   1.1789826    1.6941074 -0.51512482
## 147       1340       601.1  -2.72   1.7262677    2.3874673 -0.66119963
## 148       1634      1140.4   2.71   1.9416488    1.0295630  0.91208577
## 149       1608      1520.6  -3.04   2.8460499    3.3376639 -0.49161396
## 150       1649       922.9   8.22   3.7134889    2.3600847  1.35340418
## 151       2013      1394.8 -10.97   5.3188345    6.2657801 -0.94694562
## 152       1626      1706.9   4.85   3.9496835    3.2787193  0.67096427
## 153       1732      2447.5   0.34   2.6400758    2.5748786  0.06519712
## 154       2518      1323.7   0.00   0.0000000    0.0000000  0.00000000
## 155       1561      1399.8   1.55   2.8600699    2.5748786  0.28519129
## 156       1485      1739.3   0.51   0.7141428    0.0000000  0.71414284
## 157       1767      1627.5  -4.26   2.7964263    3.4756294 -0.67920315
## 158       1006       922.5  -4.54   2.5690465    3.3376639 -0.76861734
## 159       2085      1602.7 -23.28   5.3656314    7.2159545 -1.85032318
## 160       1588      1570.3   2.01   1.9544820    1.3453624  0.60911962
## 161       1682      2074.9   0.00   0.0000000    0.0000000  0.00000000
## 162       2121      2039.1   5.40   2.8827071    1.7058722  1.17683485
## 163       1568      1958.8  -5.54   2.8670542    3.7094474 -0.84239316
## 164       1216      1043.6   0.20   0.9797959    0.8717798  0.10801611
```

```
## 165       1612      1327.6    0.63    0.7937254    0.0000000  0.79372539
## 166       1827      1026.9   -1.09    3.9648455    4.1000000 -0.13515448
## 167       1721      1584.6   11.54    4.8959167    3.5256205  1.37029615
## 168       1467      1342.4    0.65    2.6981475    2.5748786  0.12326887
## 169       1976      1204.3   -2.65    2.1447611    2.6925824 -0.54782134
## 170       1731       981.6    0.75    1.6000000    1.3453624  0.25463760
## 171       1033      1128.3    5.27    3.7296112    2.9393877  0.79022355
## 172       1585      1247.5   -1.80    2.3216374    2.6814175 -0.35978018
## 173       1320       994.0   -2.89    0.7745967    1.8681542 -1.09355750
```

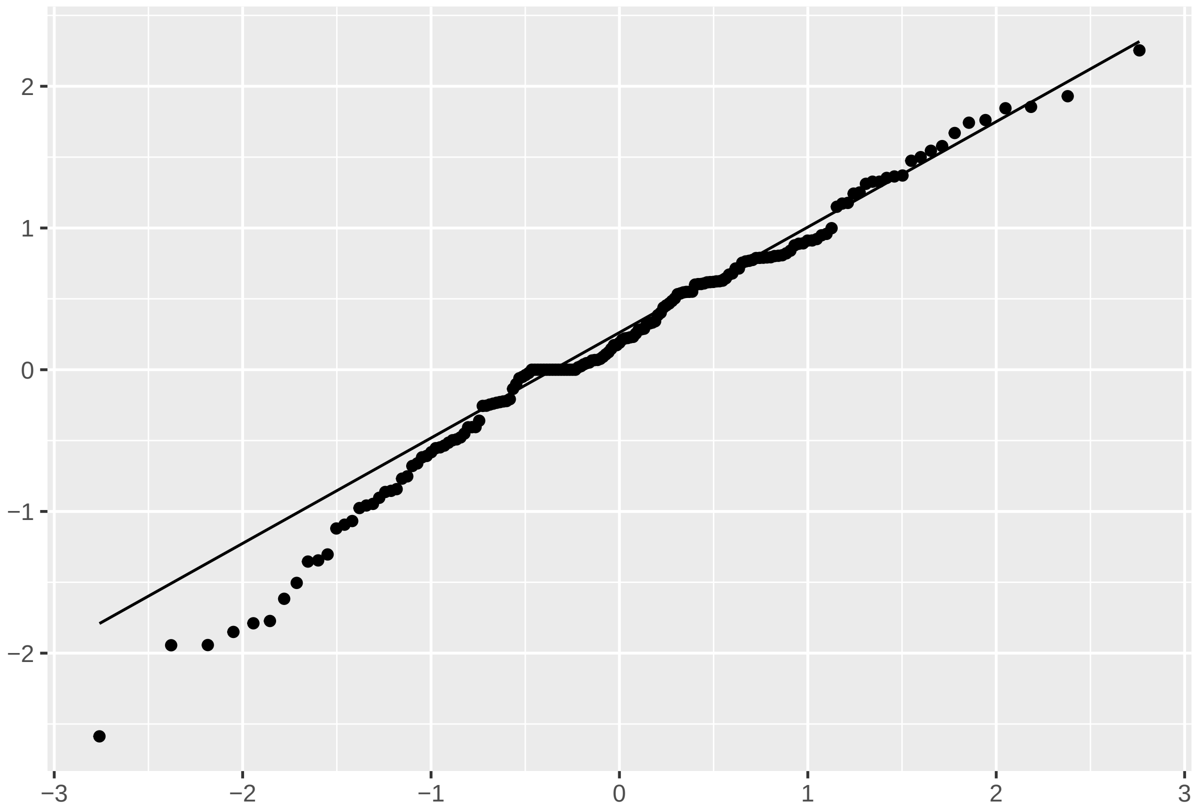
```r
favstats(diffSqrt)
```

```
##         min         Q1    median        Q3    max      mean        sd   n
##   -2.586885 -0.2393243 0.1897098 0.7642829 2.2534 0.1856477 0.8451669 173
##   missing
##         0
```

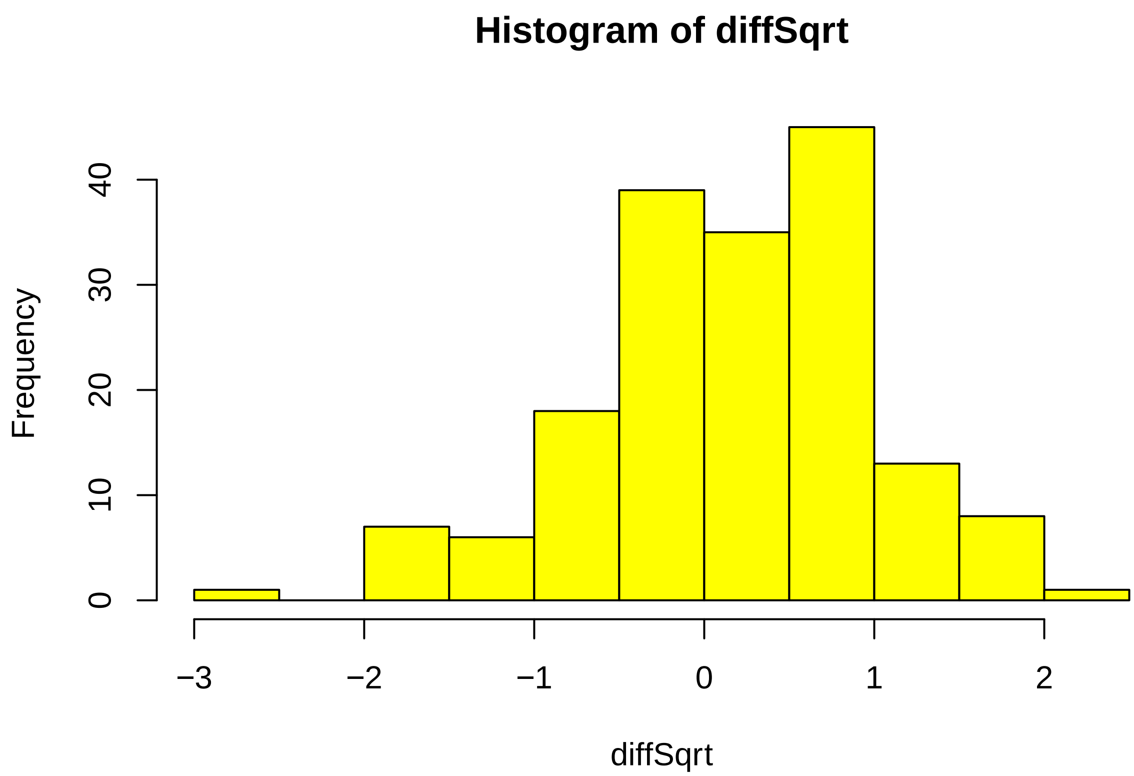
```r
boxplot(diffSqrt, col = "yellow")
```




```r
qplot(sample = diffSqrt, geom = "qq") + geom_qq_line()
```




```r
hist(diffSqrt ,col = "yellow")
```



- Conduct the appropriate test on the square root transformed data

```r
# Ha: DR > FFQ, but check CI with two sided
toutCI <- t.test(vaildSqrt$alco_drSqrt, vaildSqrt$alco_ffqSqrt,
                  con.level = 0.95, alternative = "two.sided")
print(toutCI)
```

```
##
##  Welch Two Sample t-test
##
## data:  vaildSqrt$alco_drSqrt and vaildSqrt$alco_ffqSqrt
## t = 0.97571, df = 337.18, p-value = 0.3299
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1886159  0.5599113
## sample estimates:
## mean of x mean of y
##  2.508425  2.322777
```

```r
# Ha: DR > FFQ for research question
toutRQ <- t.test(vaildSqrt$alco_drSqrt, vaildSqrt$alco_ffqSqrt,
                  con.level = 0.95, alternative = "greater")
print(toutRQ)
```

```
##
##  Welch Two Sample t-test
##
## data:  vaildSqrt$alco_drSqrt and vaildSqrt$alco_ffqSqrt
## t = 0.97571, df = 337.18, p-value = 0.165
## alternative hypothesis: true difference in means is greater than 0
## 95 percent confidence interval:
##  -0.1281791        Inf
## sample estimates:
## mean of x mean of y
##  2.508425  2.322777
```

```r
favstats(vaildSqrt$alco_drSqrt)
```

```
##  min      Q1   median       Q3      max     mean       sd   n missing
##    0 1.32665 2.416609 3.601389 7.010706 2.508425 1.638988 173       0
```

```r
favstats(vaildSqrt$alco_ffqSqrt)
```

```
##  min        Q1   median       Q3      max     mean       sd   n missing
##    0 0.8717798 2.133073 3.443835 8.046738 2.322777 1.891219 173       0
```

- standard error

```r
toutRQ$stderr
```

```
## [1] 0.1902689
```

- the original data: check CI

```r
WoutCI <- wilcox.test(vaild$alco_dr, vaild$alco_ffq,
                  paired = T,exact = F,conf.int = T, alternative = "two.sided")
print(WoutCI)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
```

```
## data:  vaild$alco_dr and vaild$alco_ffq
## V = 7472.5, p-value = 0.02597
## alternative hypothesis: true location shift is not equal to 0
## 95 percent confidence interval:
##  0.100001 1.324965
## sample estimates:
## (pseudo)median
##      0.7349569
```

```
WoutCIQ <- wilcox.test(vaildSqrt$alco_drSqrt, vaildSqrt$alco_ffqSqrt,
                  paired = T,exact = F,conf.int = T, alternative = "two.sided")
print(WoutCIQ)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  vaildSqrt$alco_drSqrt and vaildSqrt$alco_ffqSqrt
## V = 8072, p-value = 0.001048
## alternative hypothesis: true location shift is not equal to 0
## 95 percent confidence interval:
##  0.1034030 0.3865579
## sample estimates:
## (pseudo)median
##      0.2466939
```

- the original data: check research question

```
WoutRQ <- wilcox.test(vaild$alco_dr, vaild$alco_ffq,
                  paired = T,exact = F,conf.int = T, alternative = "greater")
print(WoutRQ)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  vaild$alco_dr and vaild$alco_ffq
## V = 7472.5, p-value = 0.01299
## alternative hypothesis: true location shift is greater than 0
## 95 percent confidence interval:
##  0.2150307       Inf
## sample estimates:
## (pseudo)median
##      0.7349569
```