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
```

```
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()
## )
```

```
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>
```

```
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")
```
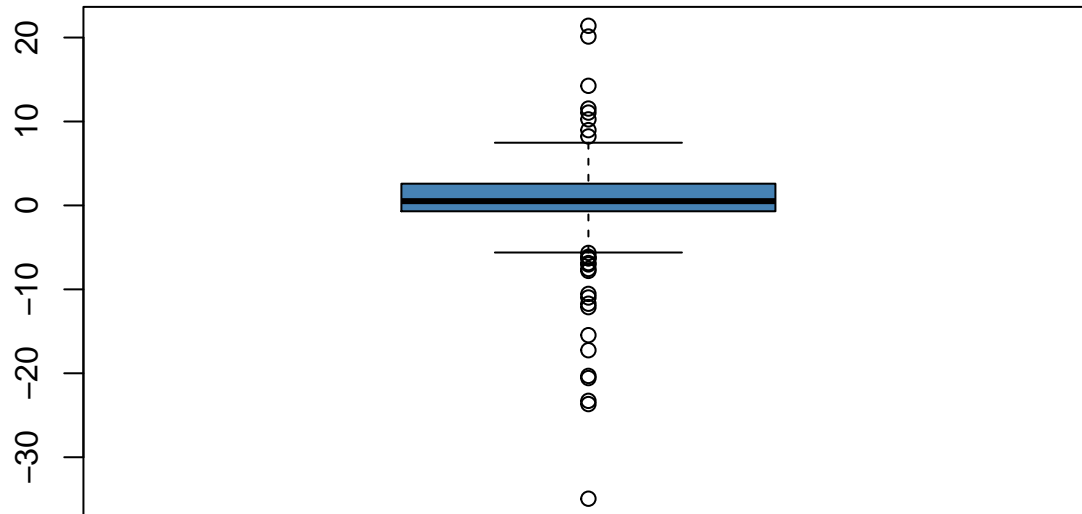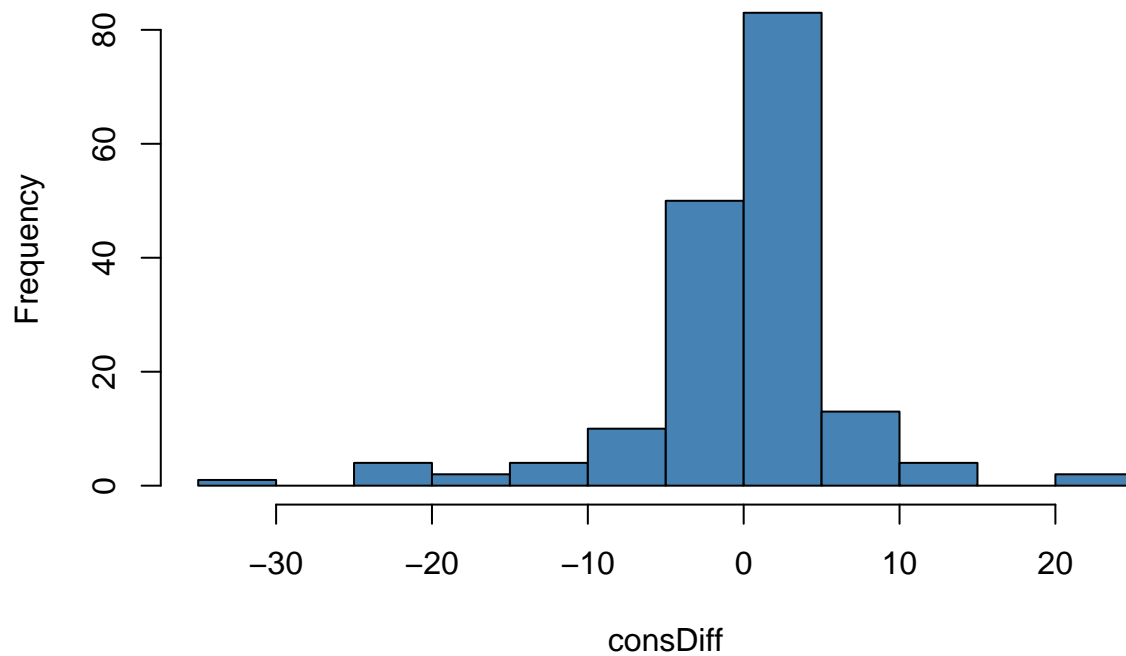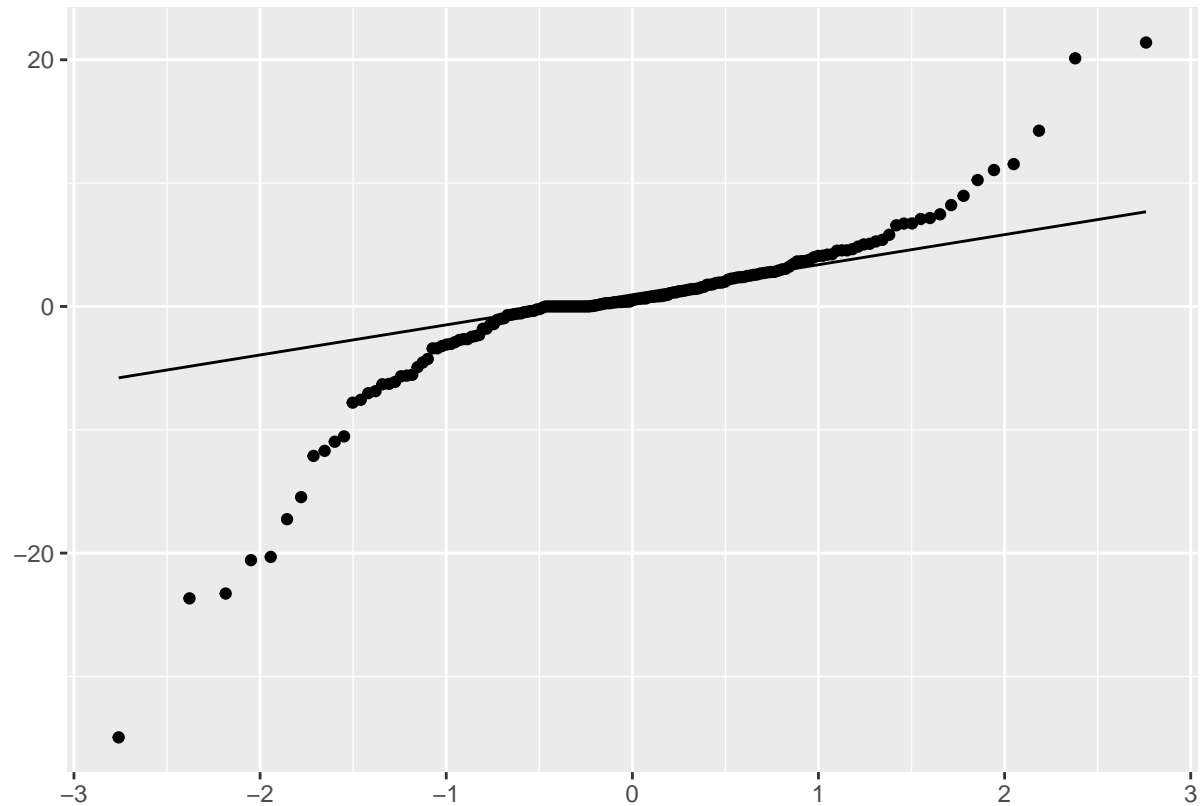


```
hist(consDiff,col="steelblue")
```

Histogram of consDiff

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


- Consider a square root transformation of the alcohol data

```
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
```

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```
## 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
```

8

```
## 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
```

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
```

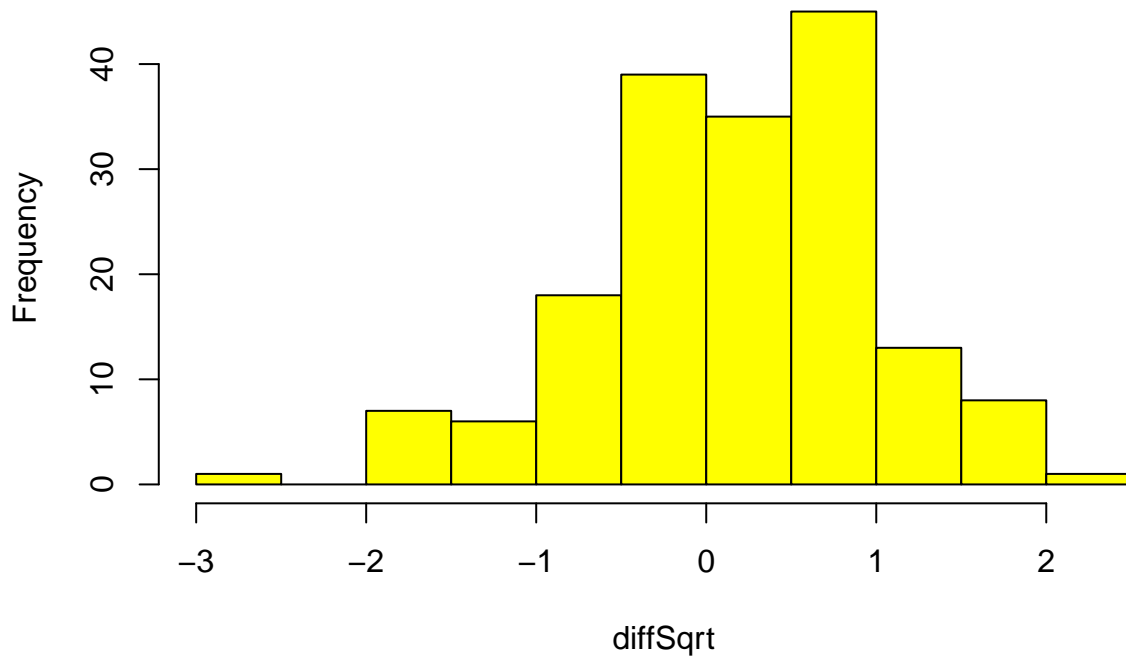**boxplot**(diffSqrt, col = "yellow")
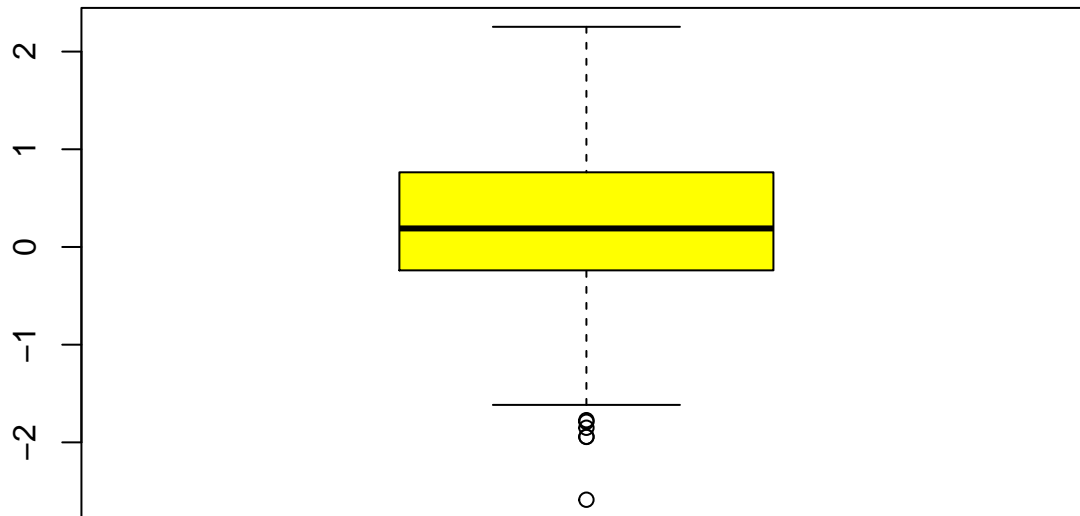
qplot(sample = diffSqrt, geom = "qq") **+** **geom_qq_line**()
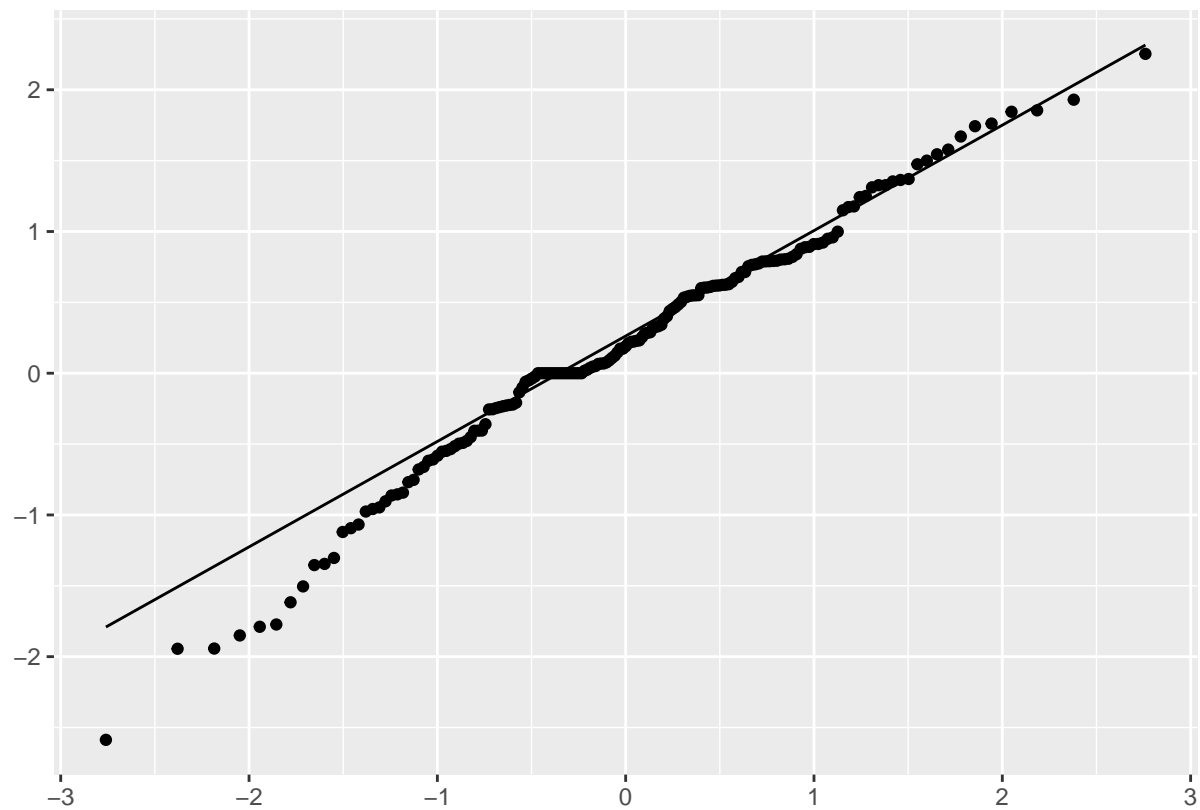
```
hist(diffSqrt ,col = "yellow")
```

Histogram of diffSqrt

- 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
```

- 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
```

```r
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

```r
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
```