BAHEDA

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4/27/2021

This document includes exploratory data analysis for the HRV and Oura_Ring_Sleep tables.

HRV TABLE

```
##   mean_hrv mean_hrv_sdd_1_4 mean_hrv_sdd_2_4 mean_hrv_sdd_3_4 mean_hrv_sdd_4_4
## 1   18.934            7.358            7.552            7.518            7.372
##   mean_hrv_sdd_5_4 mean_hrv_sdd_6_4 mean_hrv_sdd_7_4 mean_hrv_slp
## 1            7.574            7.916            8.374        1.916
```

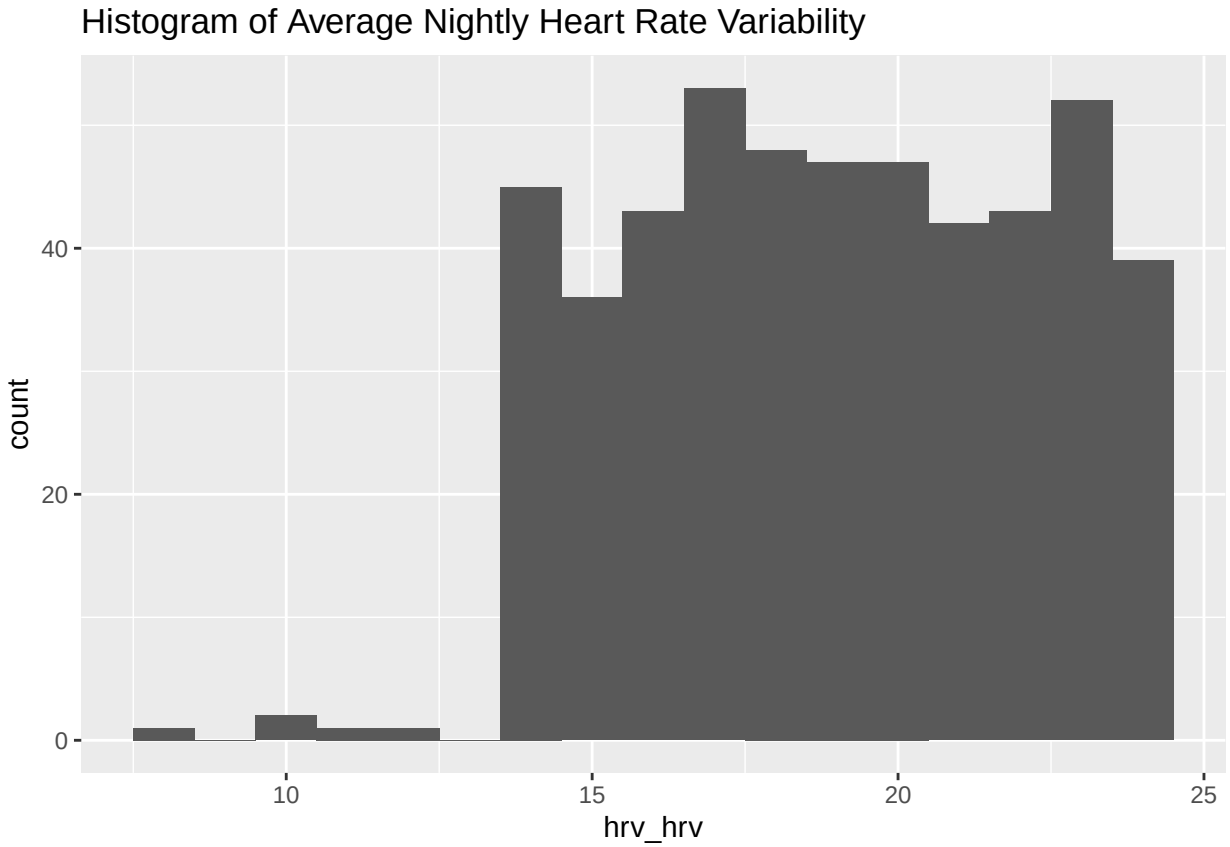
```
##     sd_hrv sd_hrv_sdd_1_4 sd_hrv_sdd_2_4 sd_hrv_sdd_3_4 sd_hrv_sdd_4_4
## 1 3.212832       1.871053       1.868228       1.930059       1.847279
##   sd_hrv_sdd_5_4 sd_hrv_sdd_6_4 sd_hrv_sdd_7_4 sd_hrv_slp
## 1       1.870701       1.591858       1.400731  0.7862445
```

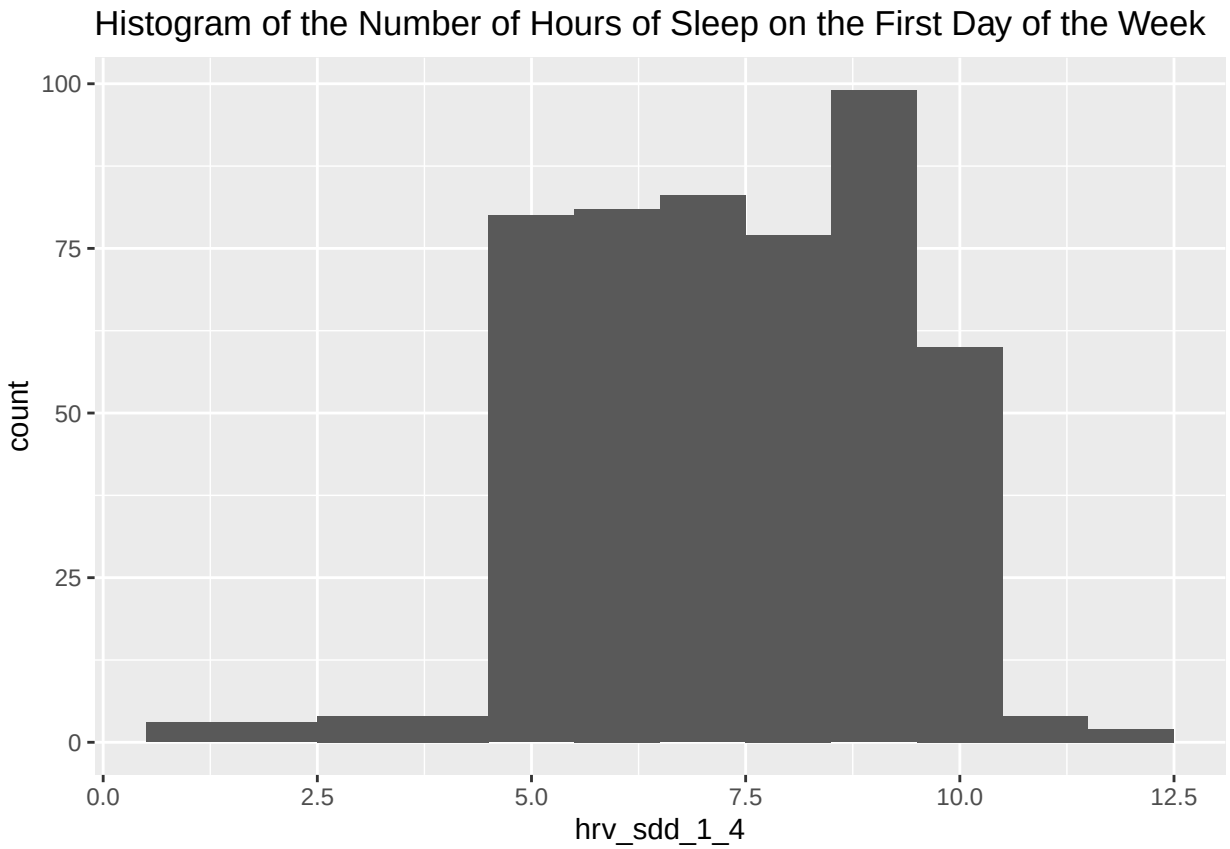
```
##   min_hrv min_hrv_sdd_1_4 min_hrv_sdd_2_4 min_hrv_sdd_3_4 min_hrv_sdd_4_4
## 1       8               1               2               1               1
##   min_hrv_sdd_5_4 min_hrv_sdd_6_4 min_hrv_sdd_7_4 min_hrv_slp
## 1               1               2               1           1
```

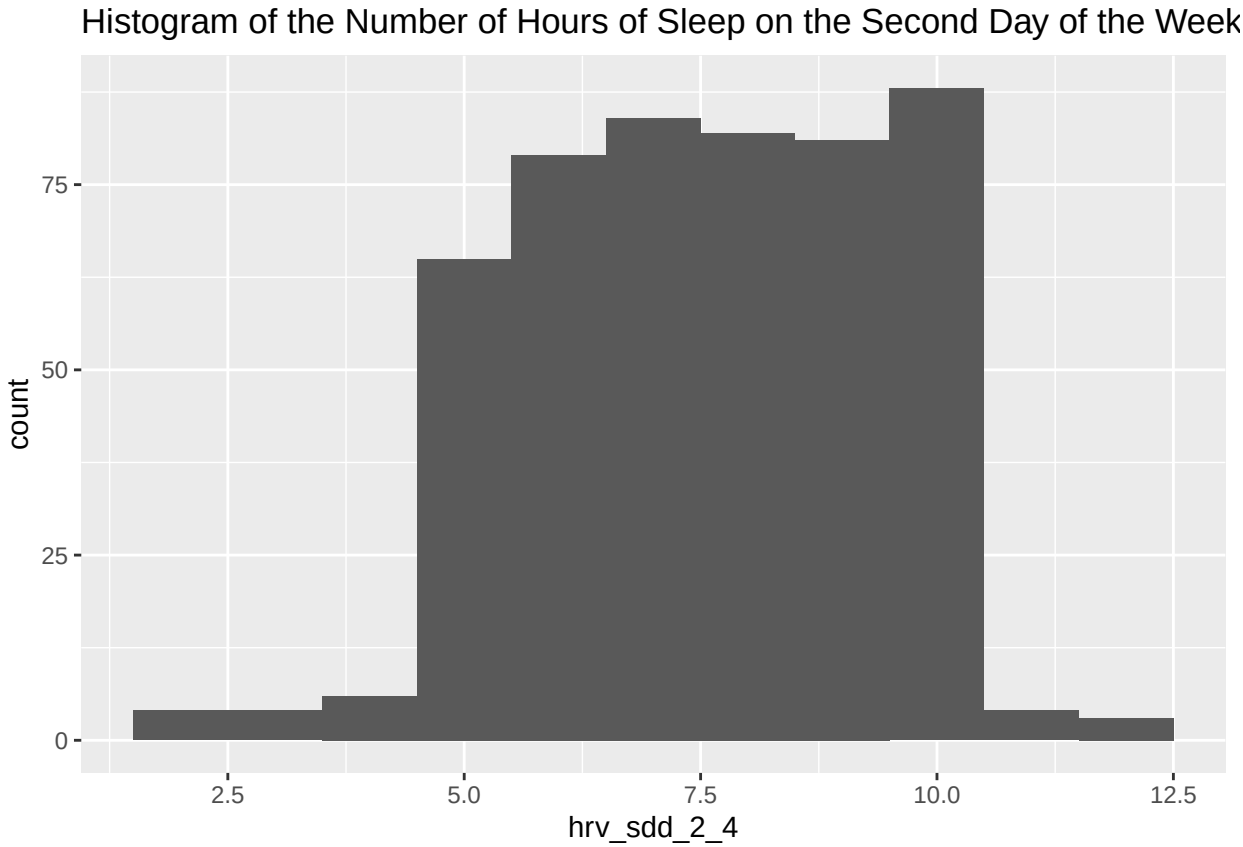
```
##   max_hrv max_hrv_sdd_1_4 max_hrv_sdd_2_4 max_hrv_sdd_3_4 max_hrv_sdd_4_4
## 1      24              12              12              12              11
##   max_hrv_sdd_5_4 max_hrv_sdd_6_4 max_hrv_sdd_7_4 max_hrv_slp
## 1              13              13              13           3
```

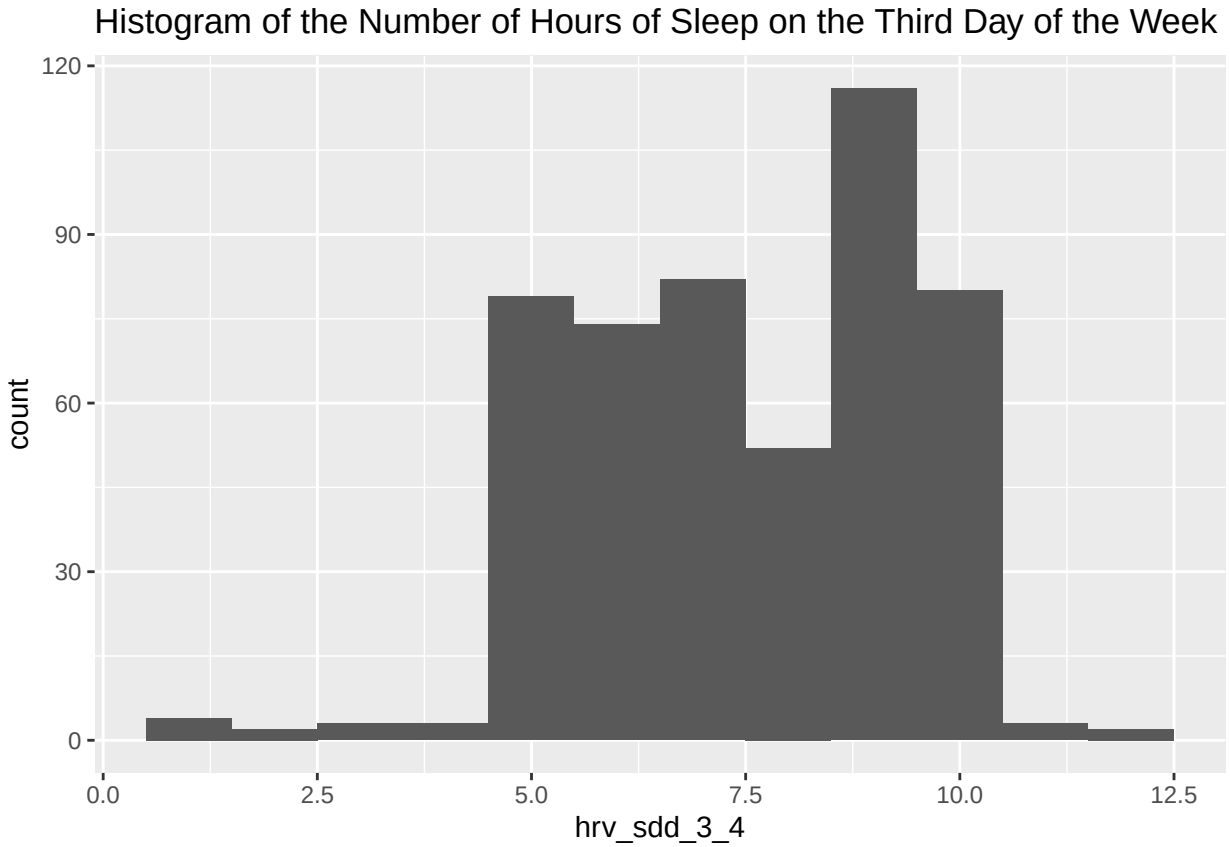
```
##   skewness_hrv skewness_hrv_sdd_1_4 skewness_hrv_sdd_2_4 skewness_hrv_sdd_3_4
## 1   -0.1470878           -0.3090359           -0.2295076           -0.4086757
##   skewness_hrv_sdd_4_4 skewness_hrv_sdd_5_4 skewness_hrv_sdd_6_4
## 1           -0.3179302          -0.09917351           -0.1988487
##   skewness_hrv_sdd_7_4 skewness_hrv_slp
## 1            -1.070963        0.1482645
```

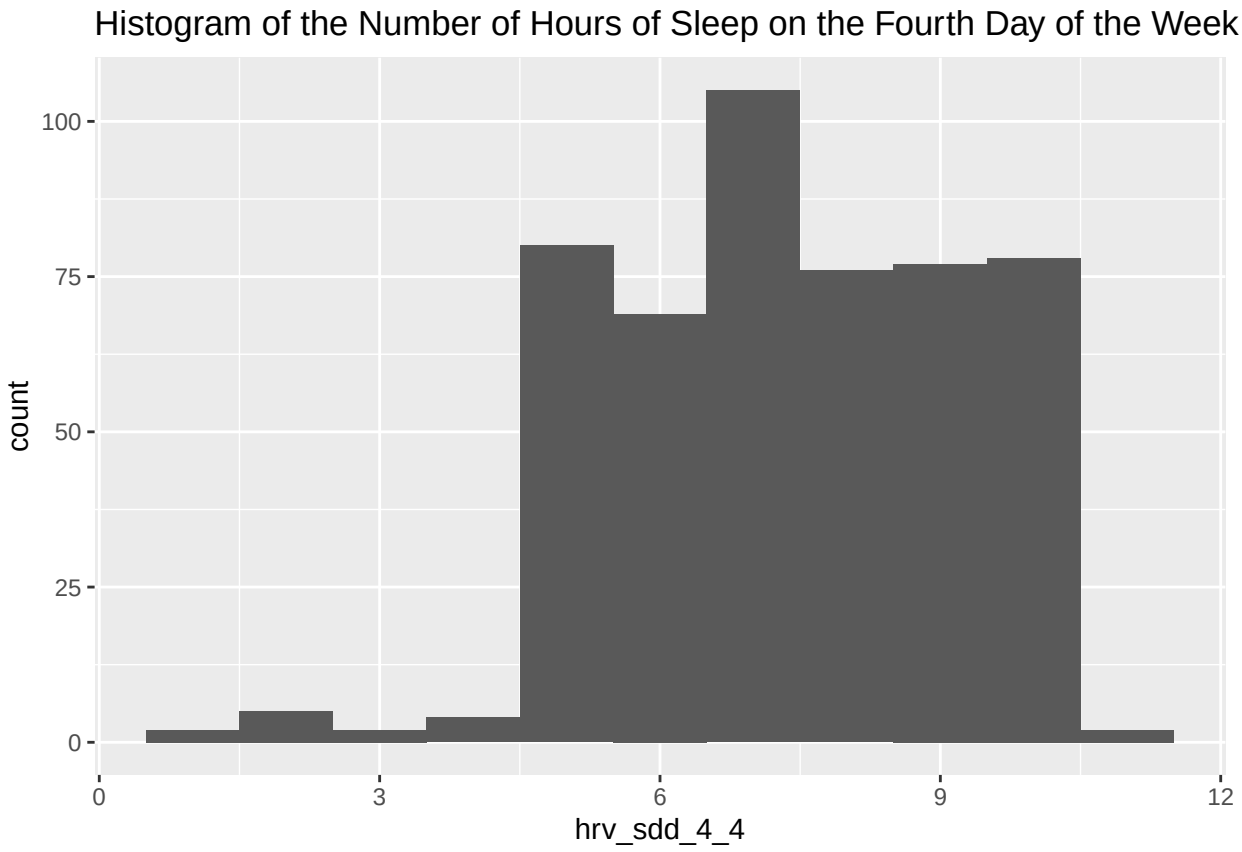
The users saw nightly overall averages of around 7-8 hours of sleep, with an average sleep quality of 1.916 and an average hrv of 18.394. All of the variables are skewed to the left except for hrv_sleep, which is skewed to the right, and the standard deviations are small, so the data is not too spread out.

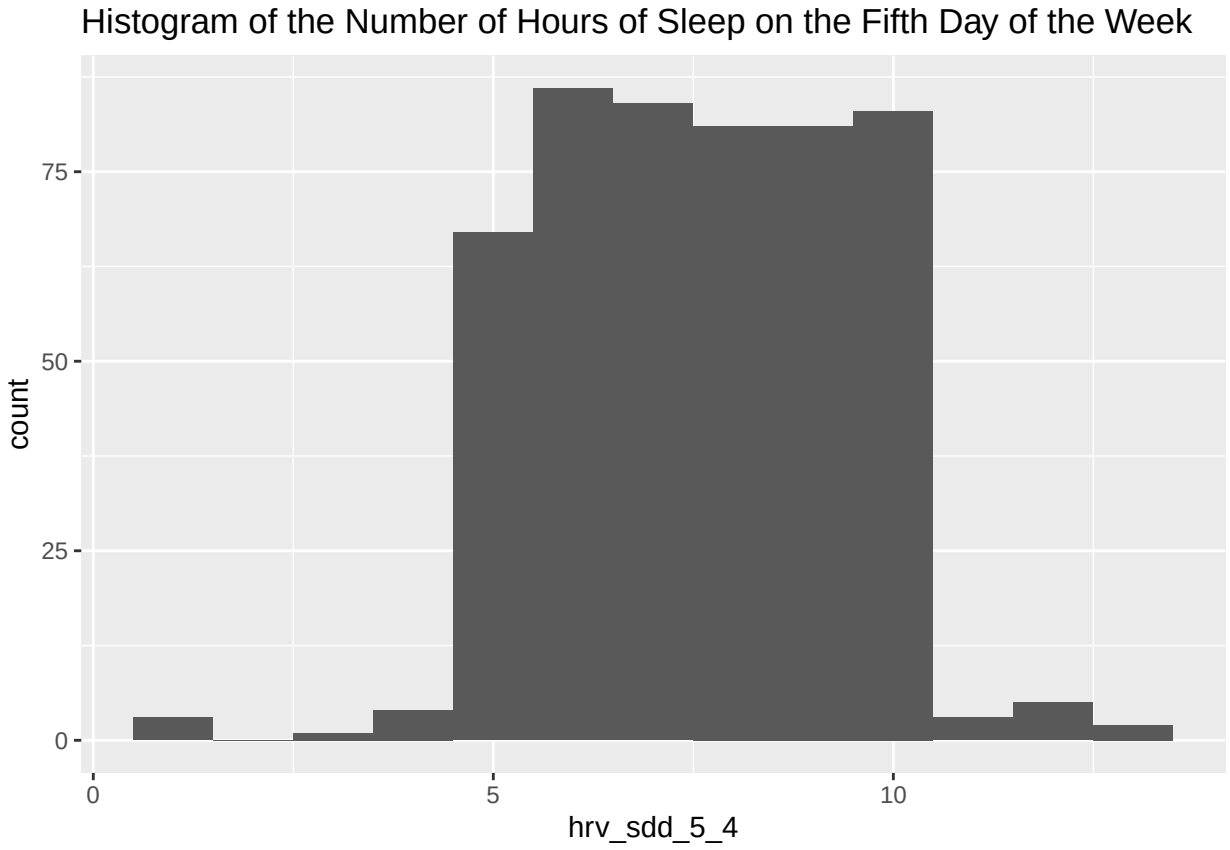

Histogram of Average Nightly Heart Rate Variability
count
40
20
0
10
15
20
25
hrv_hrv

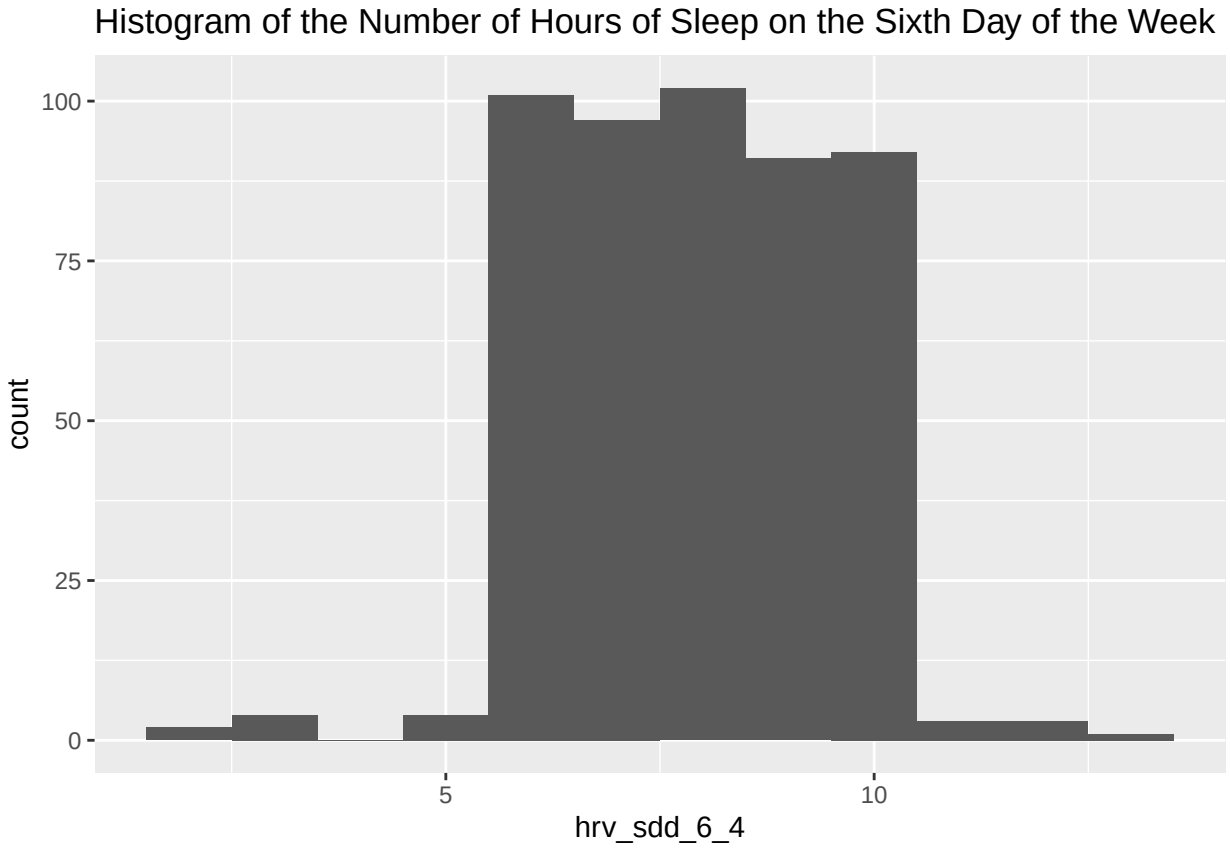

Histogram of the Number of Hours of Sleep on the First Day of the Week
count
100
75
50
25
0
0.0
2.5
5.0
7.5
10.0
12.5
hrv_sdd_1_4

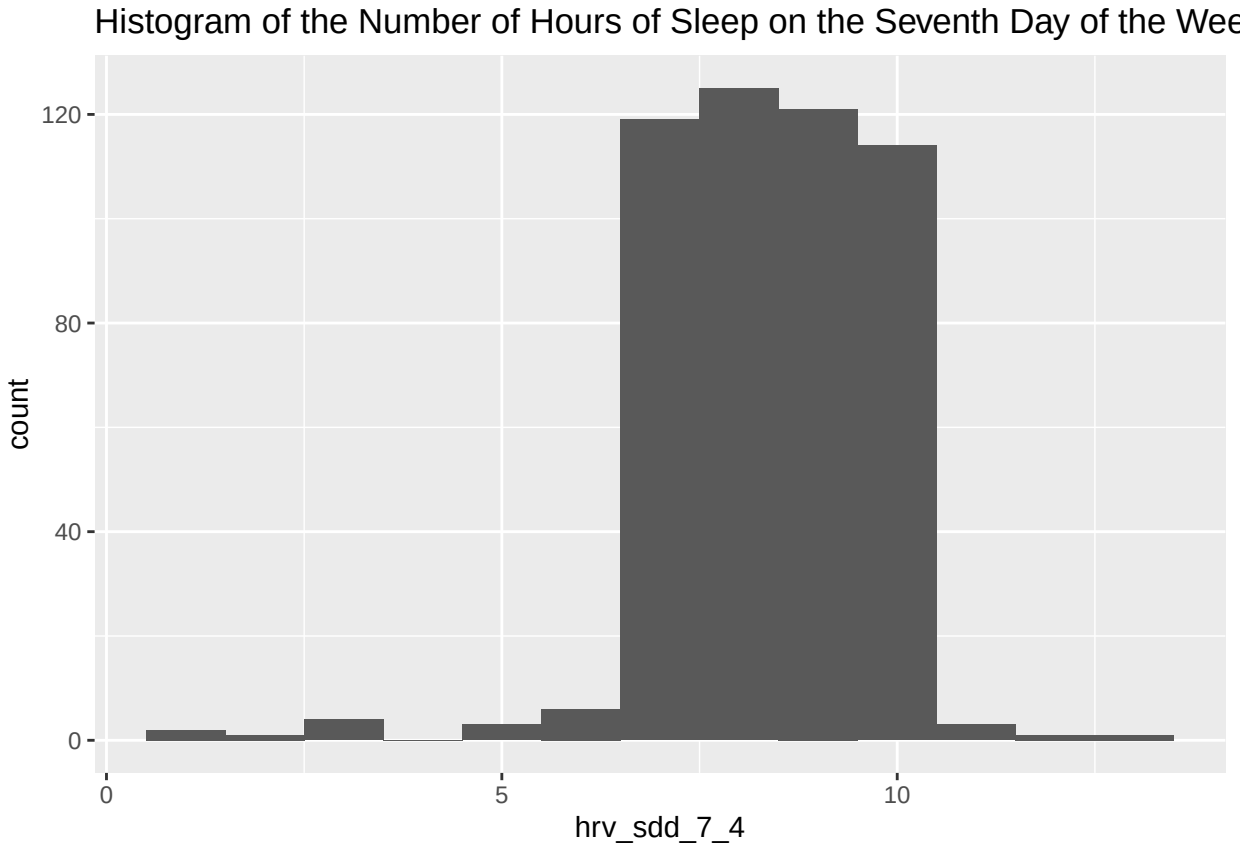

Histogram of the Number of Hours of Sleep on the Second Day of the Week
count
75
50
25
0
2.5
5.0
7.5
10.0
12.5
hrv_sdd_2_4

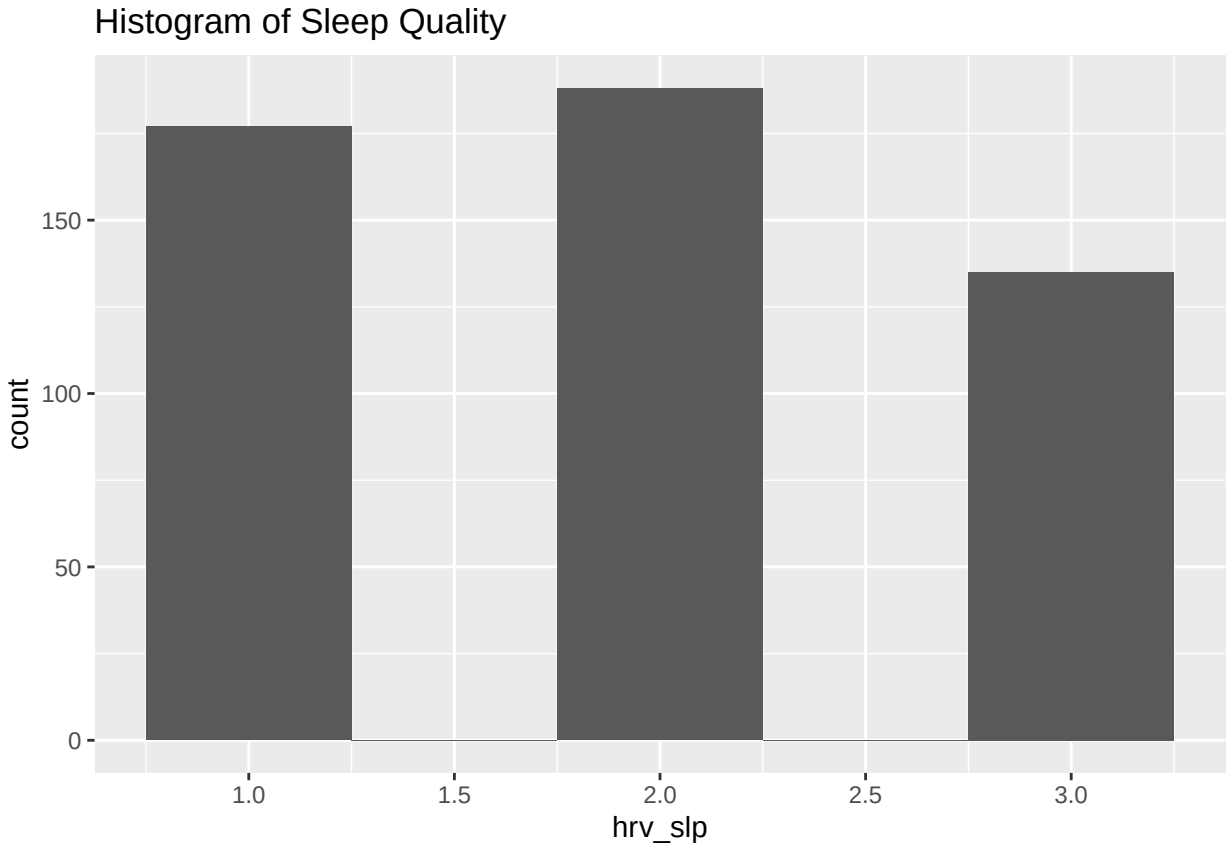

Histogram of the Number of Hours of Sleep on the Third Day of the Week
count
120
90
60
30
0
0.0
2.5
5.0
7.5
10.0
12.5
hrv_sdd_3_4


Histogram of the Number of Hours of Sleep on the Fourth Day of the Week
count
100
75
50
25
0
0
3
6
9
12
hrv_sdd_4_4

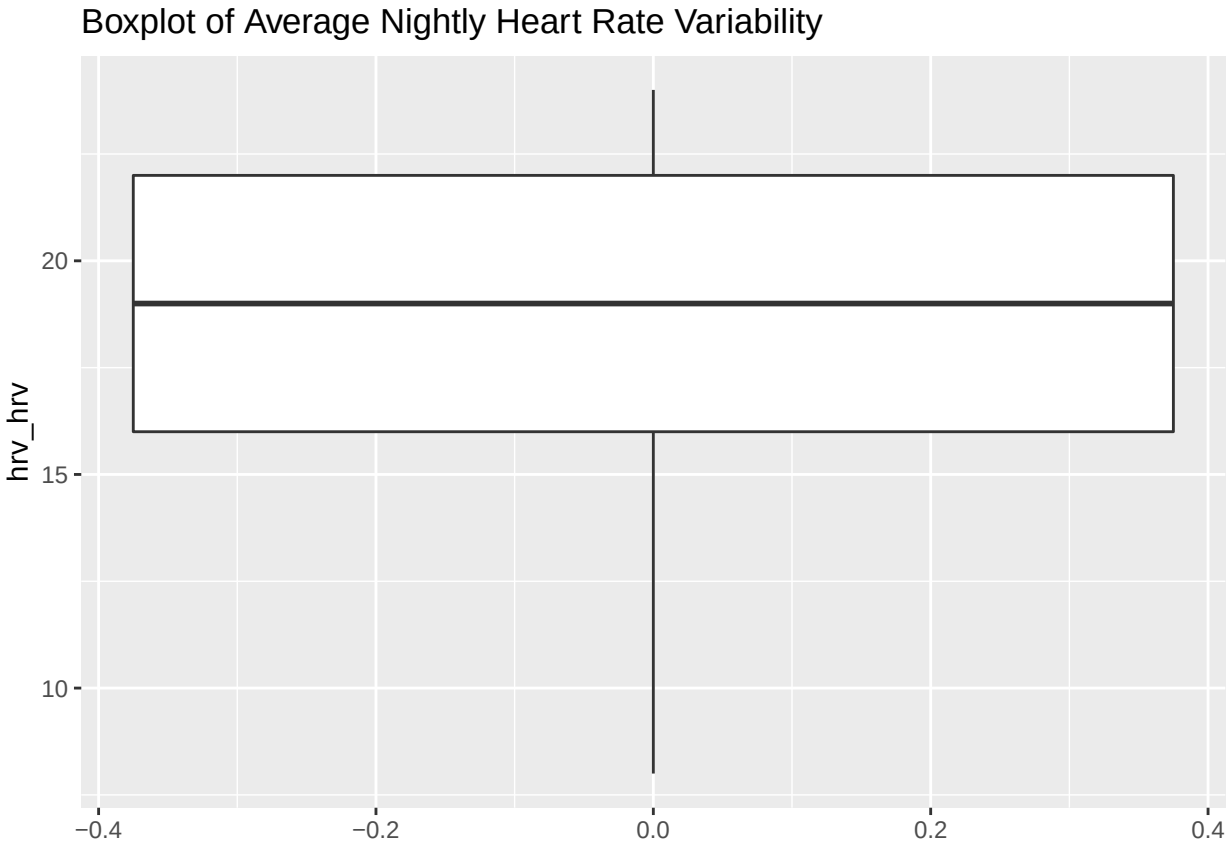

Histogram of the Number of Hours of Sleep on the Fifth Day of the Week
count
75
50
25
0
0
5
10
hrv_sdd_5_4

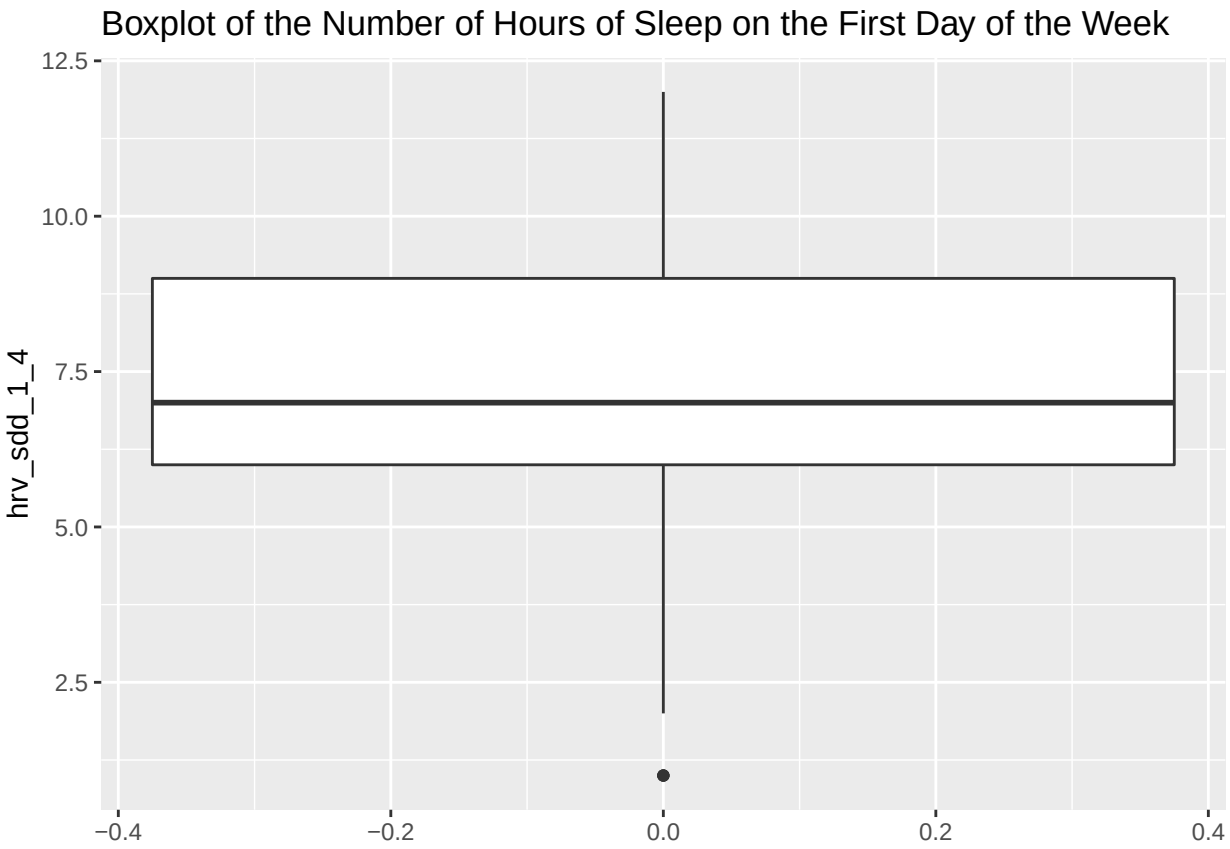

Histogram of the Number of Hours of Sleep on the Sixth Day of the Week
count
100
75
50
25
0
5
10
hrv_sdd_6_4

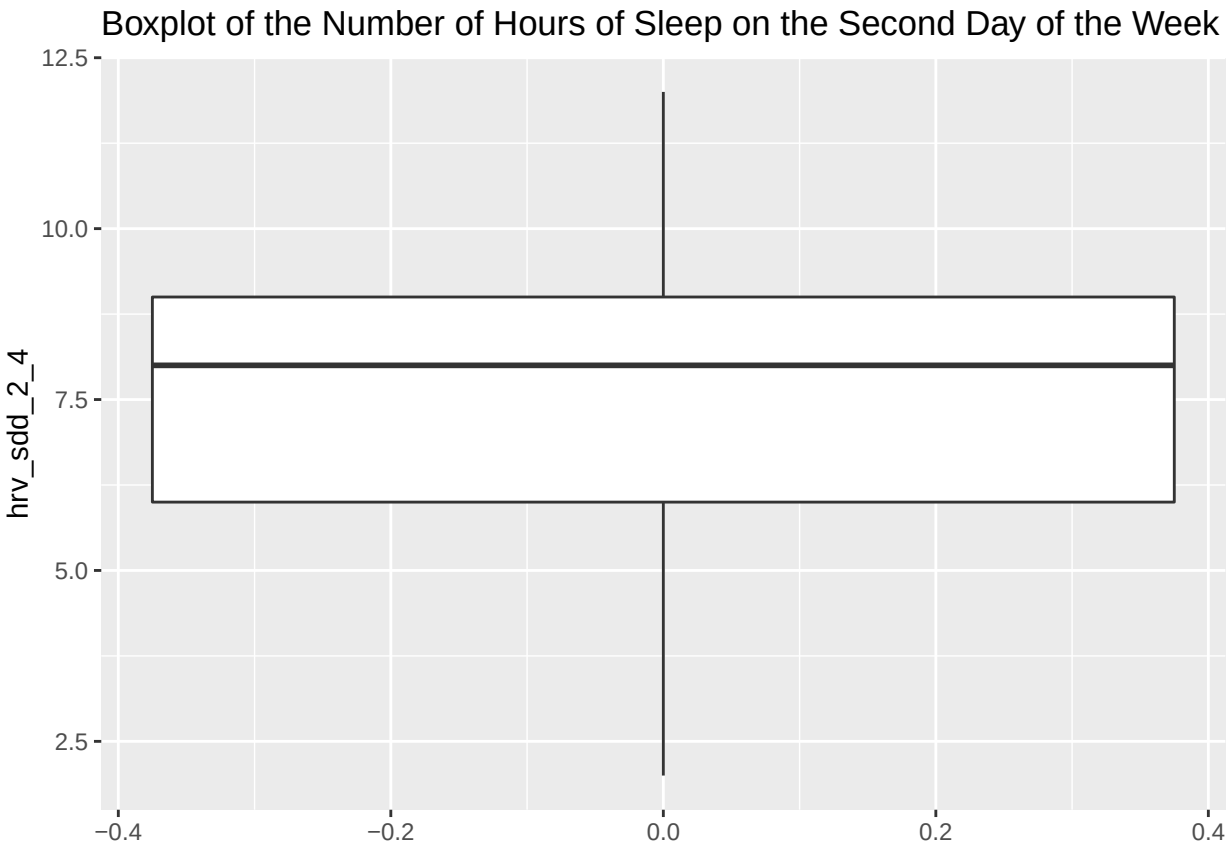

Histogram of the Number of Hours of Sleep on the Seventh Day of the Wee
120
80
40
0
count
0
5
10
hrv_sdd_7_4

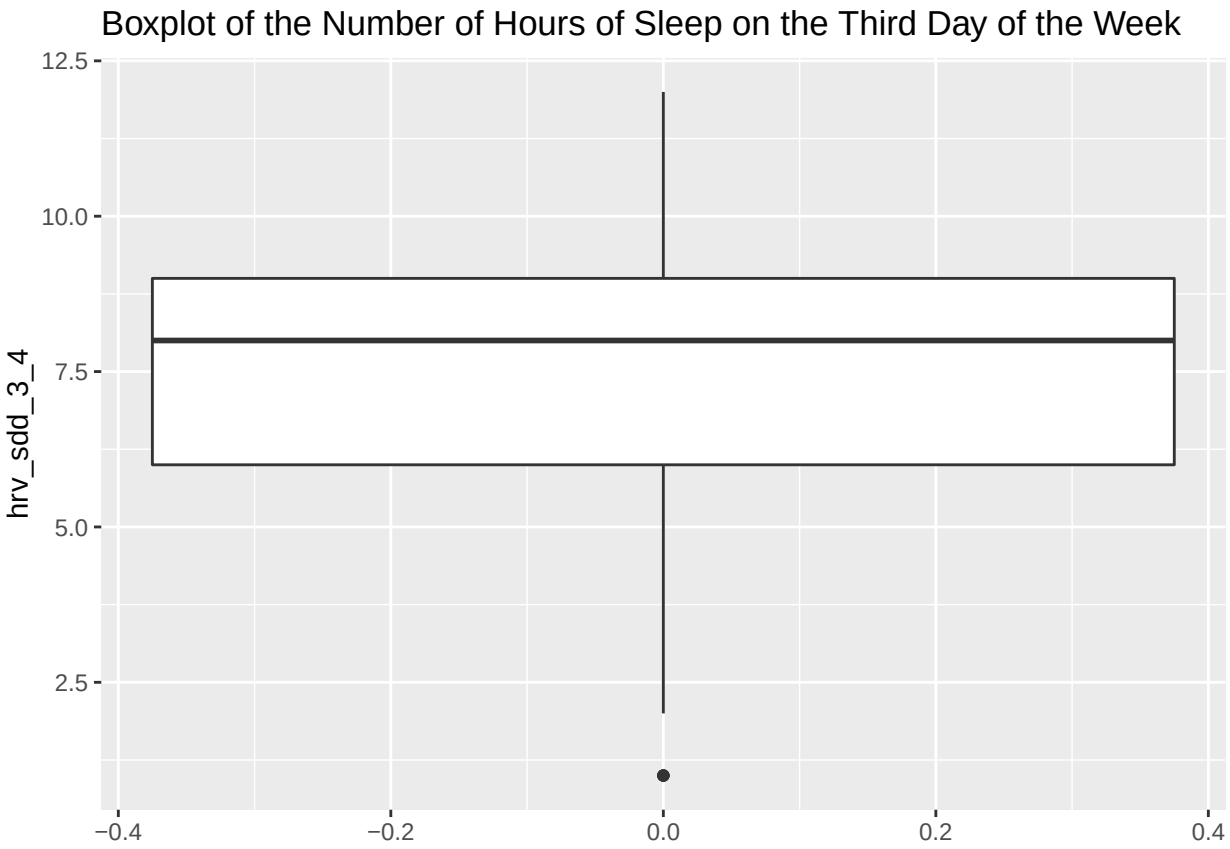


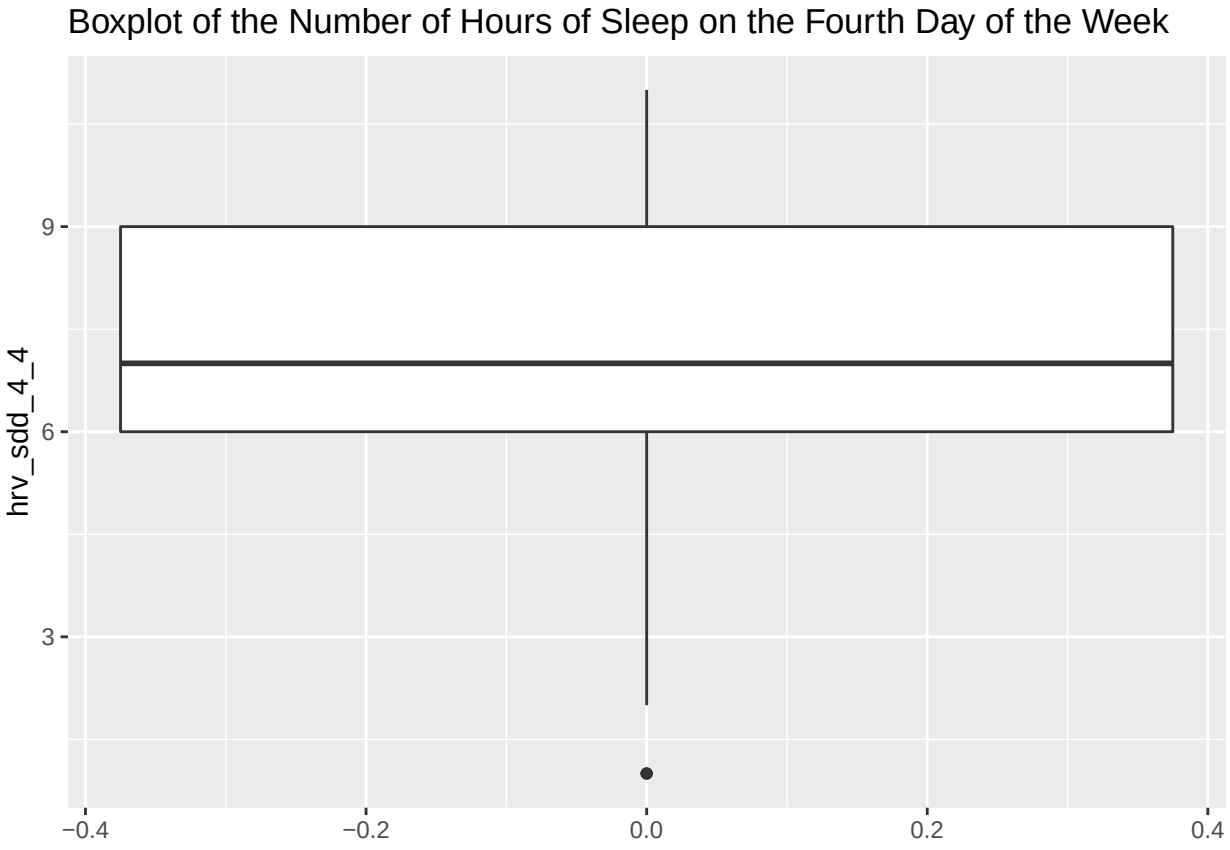
We can see the frequency of the values these variables take on from the histograms. The tails on these histograms are due to personal user stories setting different ranges for the variables for some users.

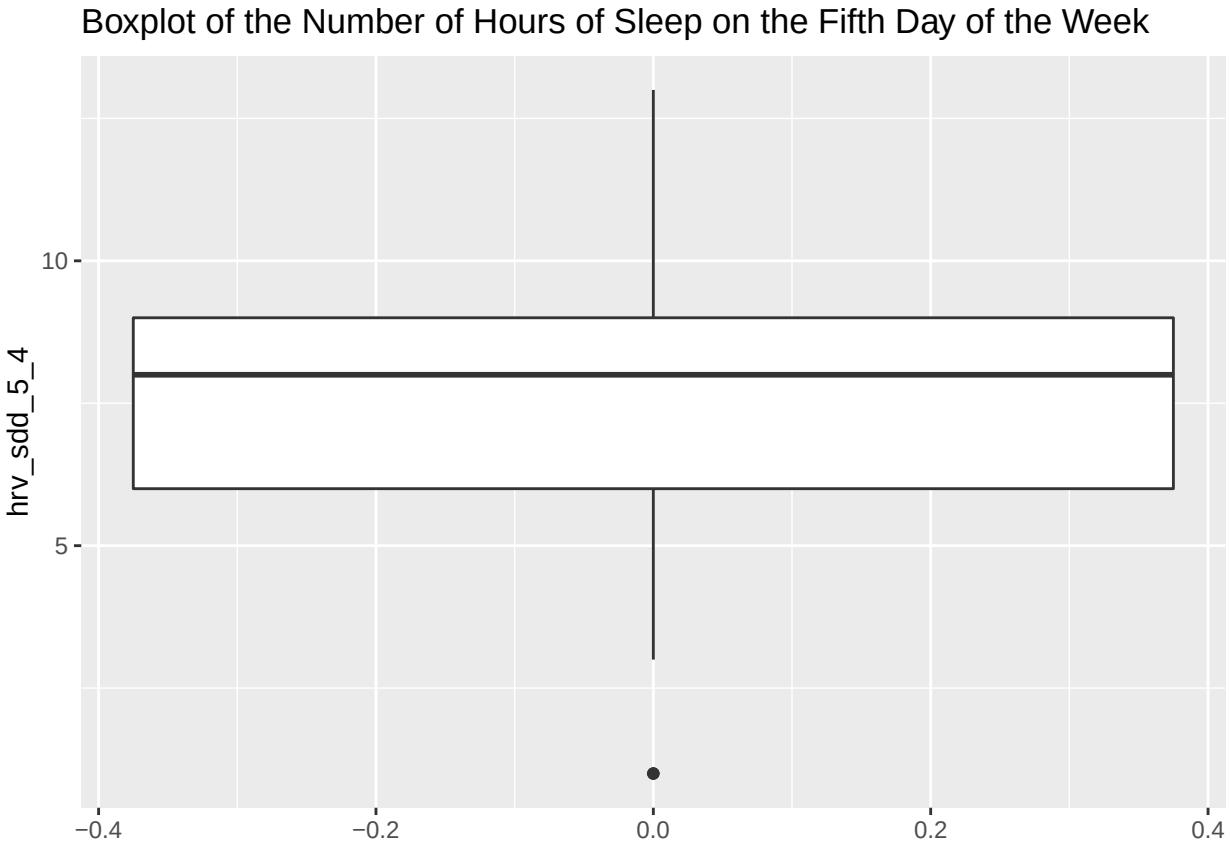

Boxplot of Average Nightly Heart Rate Variability
hrv_hrv
20
15
10
−0.4
−0.2
0.0
0.2
0.4

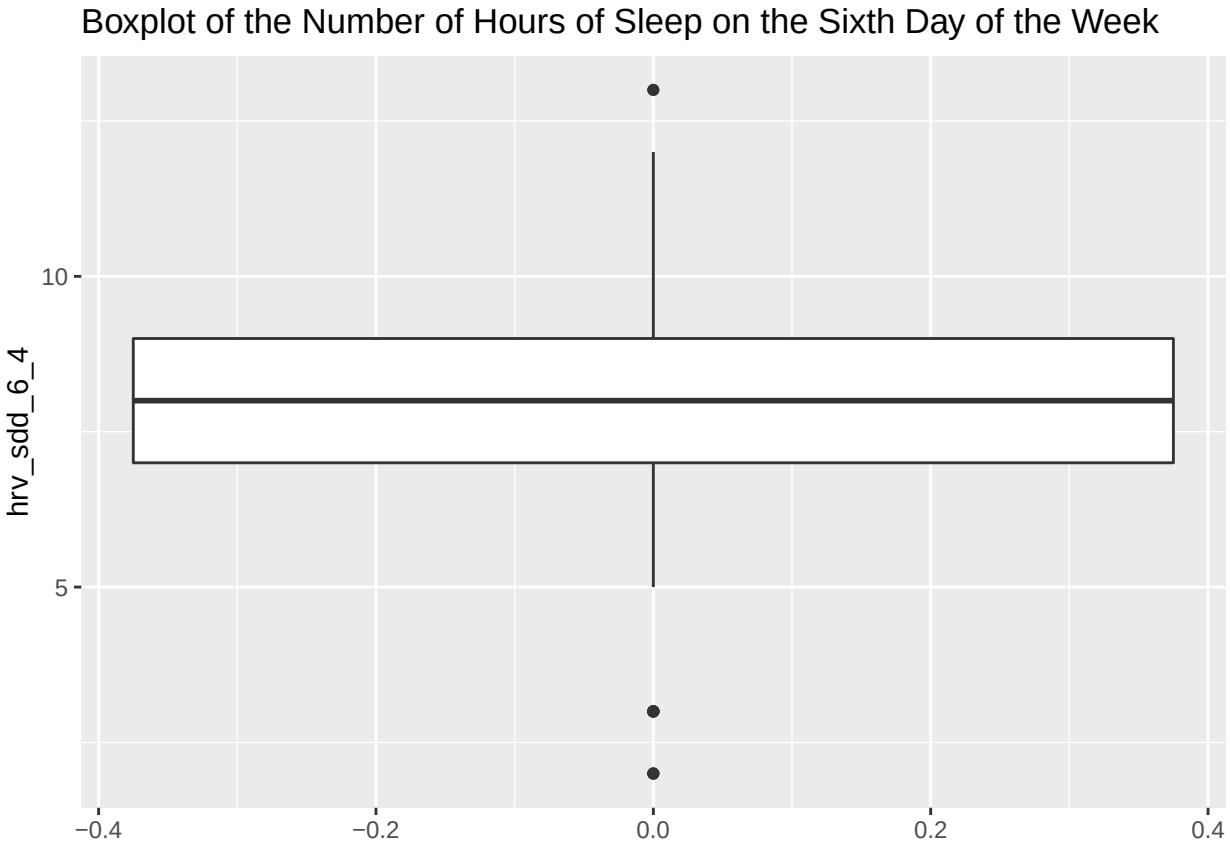

Boxplot of the Number of Hours of Sleep on the First Day of the Week
hrv_sdd_1_4
12.5
10.0
7.5
5.0
2.5
−0.4
−0.2
0.0
0.2
0.4

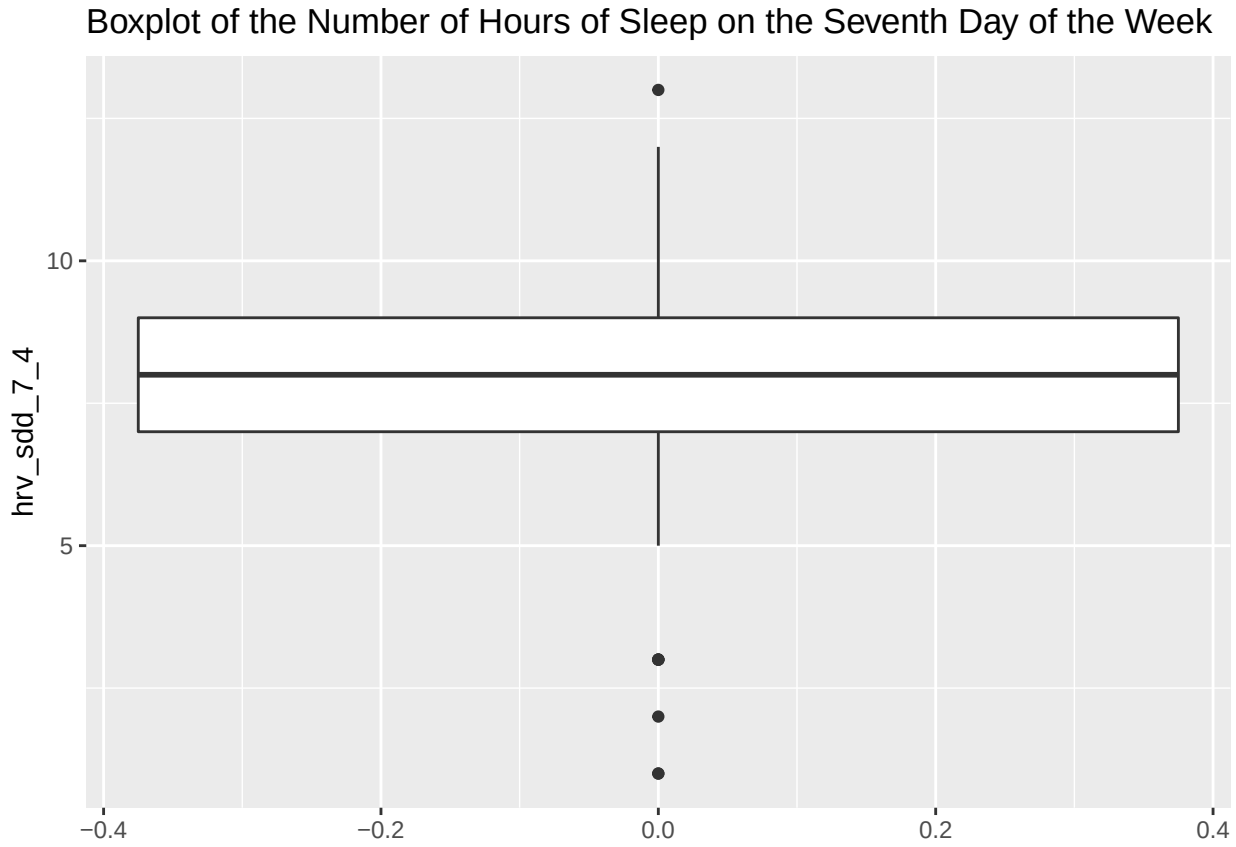

Boxplot of the Number of Hours of Sleep on the Second Day of the Week
hrv_sdd_2_4
12.5
10.0
7.5
5.0
2.5
−0.4
−0.2
0.0
0.2
0.4


Boxplot of the Number of Hours of Sleep on the Third Day of the Week
hrv_sdd_3_4
12.5
10.0
7.5
5.0
2.5
−0.4
−0.2
0.0
0.2
0.4


Boxplot of the Number of Hours of Sleep on the Fourth Day of the Week
hrv_sdd_4_4
9
6
3
−0.4
−0.2
0.0
0.2
0.4


Boxplot of the Number of Hours of Sleep on the Fifth Day of the Week
hrv_sdd_5_4
10
5
−0.4
−0.2
0.0
0.2
0.4


Boxplot of the Number of Hours of Sleep on the Sixth Day of the Week
hrv_sdd_6_4
10
5
−0.4
−0.2
0.0
0.2
0.4



The boxplots show a lot of overlap among the variables for how much each person sleeps on each night of the week. There is greater spread for the first five days versus the last two days because the variables hrv_sdd_6_4 and hrv_sdd_7_4 have more restricted ranges. The outliers in the boxplots are can be attributed to personal user stories that gave some users different ranges for these variables. The variables hrv_sdd_1_4 through hrv_sdd_5_4 seemed to be skewed, which can be explained by a combination of random variation and personal user stories fixing certain values.

```
##                hrv_week       hrv_hrv hrv_sdd_1_4  hrv_sdd_2_4  hrv_sdd_3_4
## hrv_week     1.0000000000  0.0003254176 -0.03818349 -0.007461701 -0.010292292
## hrv_hrv      0.0003254176  1.0000000000 -0.04406674 -0.012281191  0.027500456
## hrv_sdd_1_4 -0.0381834907 -0.0440667407  1.00000000  0.096998132  0.090608855
## hrv_sdd_2_4 -0.0074617007 -0.0122811911  0.09699813  1.000000000  0.115618992
## hrv_sdd_3_4 -0.0102922923  0.0275004561  0.09060885  0.115618992  1.000000000
## hrv_sdd_4_4 -0.0158472706 -0.0046340381  0.13765233  0.089034523  0.154375776
## hrv_sdd_5_4 -0.0486232332  0.0393256143  0.04194115 -0.044395680  0.032932762
## hrv_sdd_6_4 -0.0604244215  0.0138036872 -0.08811728 -0.001897570  0.085287669
## hrv_sdd_7_4  0.0136840805 -0.0069725706 -0.04889585 -0.026208700 -0.018432323
## hrv_slp     -0.0691472243 -0.0101324102  0.02593173 -0.006570500  0.006280774
##              hrv_sdd_4_4 hrv_sdd_5_4  hrv_sdd_6_4  hrv_sdd_7_4      hrv_slp
## hrv_week    -0.015847271 -0.04862323 -0.060424422  0.013684080 -0.069147224
## hrv_hrv     -0.004634038  0.03932561  0.013803687 -0.006972571 -0.010132410
## hrv_sdd_1_4  0.137652330  0.04194115 -0.088117276 -0.048895853  0.025931734
## hrv_sdd_2_4  0.089034523 -0.04439568 -0.001897570 -0.026208700 -0.006570500
## hrv_sdd_3_4  0.154375776  0.03293276  0.085287669 -0.018432323  0.006280774
## hrv_sdd_4_4  1.000000000  0.06508706  0.016099633  0.018925274  0.014658764
## hrv_sdd_5_4  0.065087057  1.00000000  0.059293356 -0.072913213  0.032847219
```

```
## hrv_sdd_6_4  0.016099633  0.05929336  1.000000000  0.002433823 -0.016857121
## hrv_sdd_7_4  0.018925274 -0.07291321  0.002433823  1.000000000  0.004927603
## hrv_slp      0.014658764  0.03284722 -0.016857121  0.004927603  1.000000000
```

There is no strong correlation among the variables in the HRV table.

OURA_RING_SLEEP TABLE

```
##   mean_awake mean_breath_average mean_deep mean_duration mean_efficiency
## 1    6351.89            16.00969  6550.946      39703.53        83.12258
##   mean_hr_avg mean_hr_lowest mean_light mean_midpoint_time mean_onset_latency
## 1    79.85097           74.8   18858.61           16674.95            1852.88
##   mean_rem mean_restless mean_score mean_score_alignment mean_score_deep
## 1 7940.348         50.38    49.5028             50.29333        50.19806
##   mean_score_disturbances mean_score_efficiency mean_score_latency
## 1                49.52086              49.99677           50.34473
##   mean_score_rem mean_score_total mean_temperature_delta mean_timezone
## 1       50.86731         49.70559            0.002090323          22.8
##   mean_total
## 1   33349.91
```

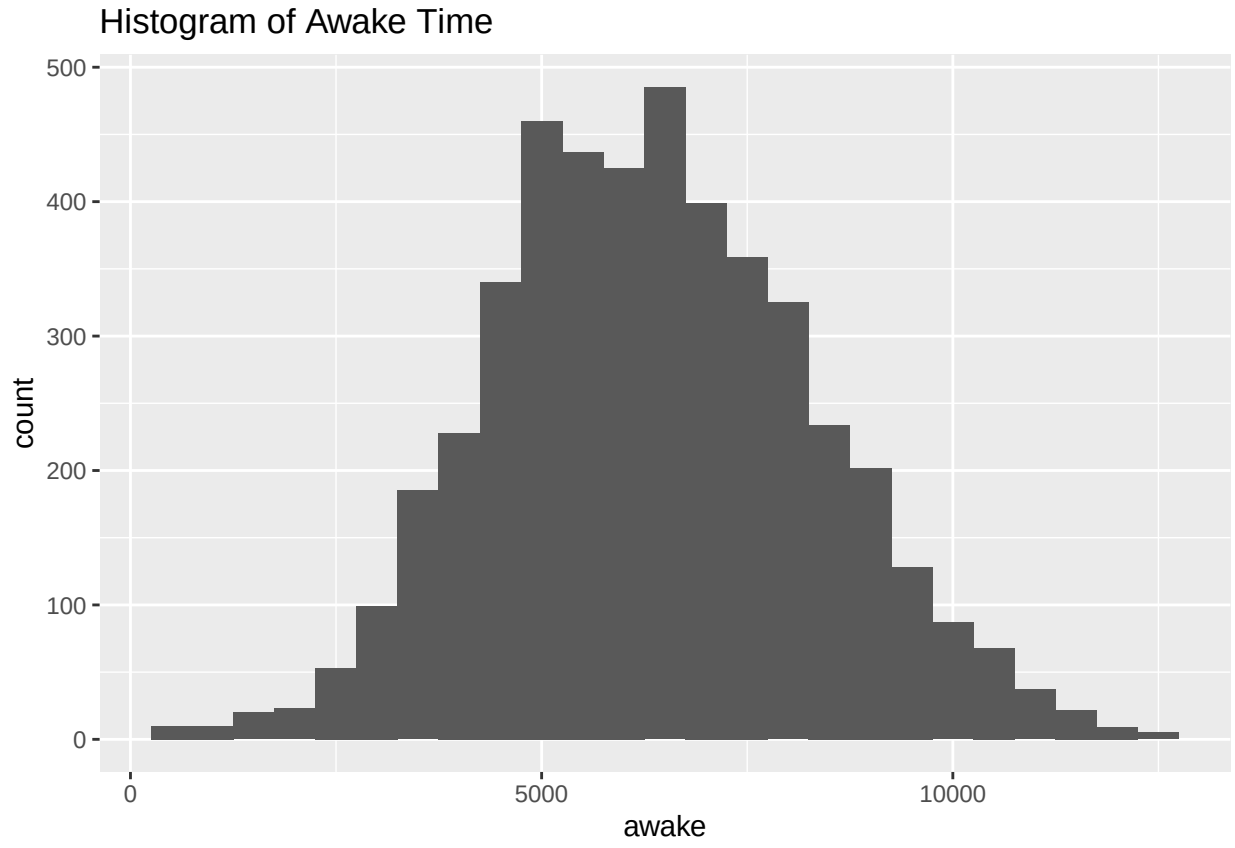
```
##   sd_awake sd_breath_average  sd_deep sd_duration sd_efficiency sd_hr_avg
## 1  1966.59          2.323931 1857.965     9737.05      2.917306   1.04571
##   sd_hr_lowest sd_light sd_midpoint_time sd_onset_latency   sd_rem sd_restless
## 1    0.9799013 4669.146         4124.591         1018.758 1947.341    28.89518
##   sd_score sd_score_alignment sd_score_deep sd_score_disturbances
## 1 13.34033           29.10169      28.91648              28.85283
##   sd_score_efficiency sd_score_latency sd_score_rem sd_score_total
## 1            28.97653         29.27779     28.89902       28.81754
##   sd_temperature_delta sd_timezone sd_total
## 1            0.5858575    350.0779 8249.182
```

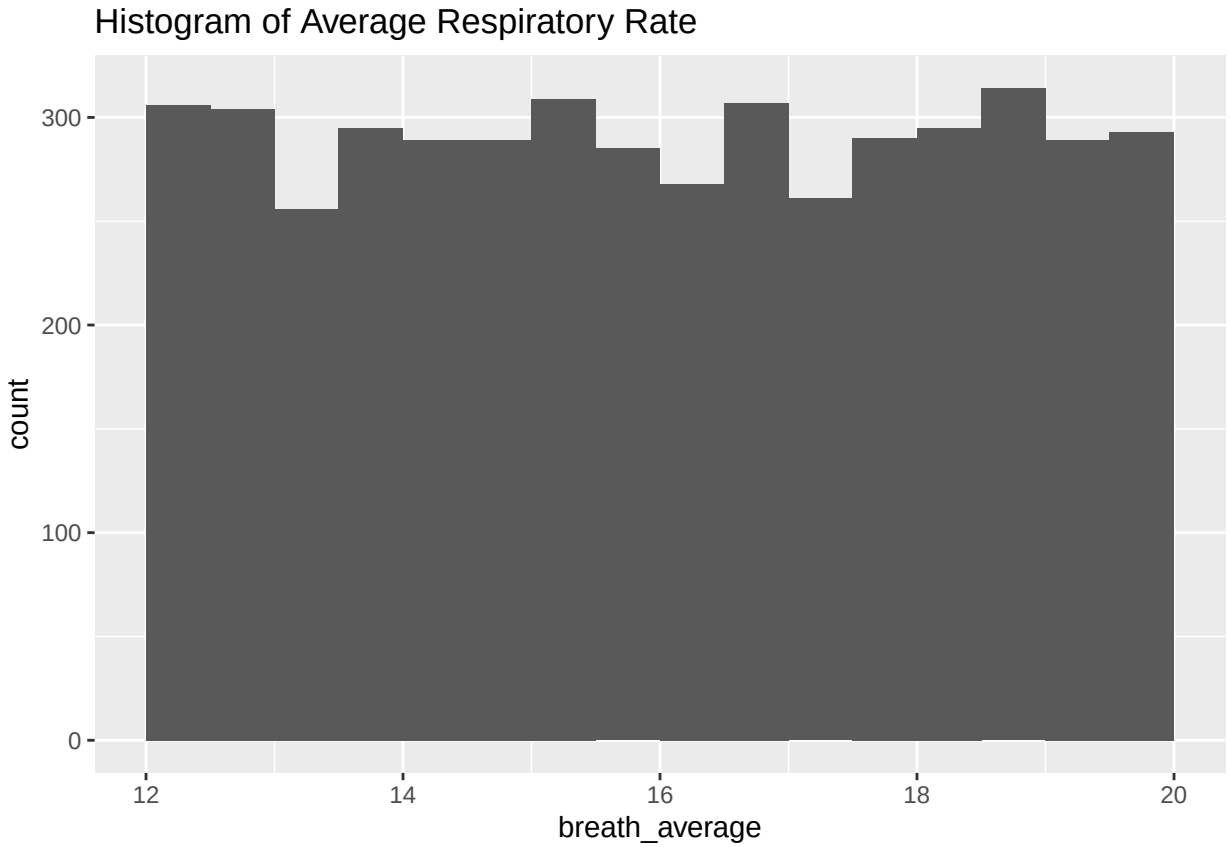
```
##   min_awake min_breath_average min_deep min_duration min_efficiency min_hr_avg
## 1       503                 12      468         3600             77         72
##   min_hr_lowest min_light min_midpoint_time min_onset_latency min_rem
## 1            70      1656              1476               120     720
##   min_restless min_score min_score_alignment min_score_deep
## 1            0         9                   0              0
##   min_score_disturbances min_score_efficiency min_score_latency min_score_rem
## 1                      0                    0                 0             0
##   min_score_total min_temperature_delta min_timezone min_total
## 1               0                    -1         -600      2952
```

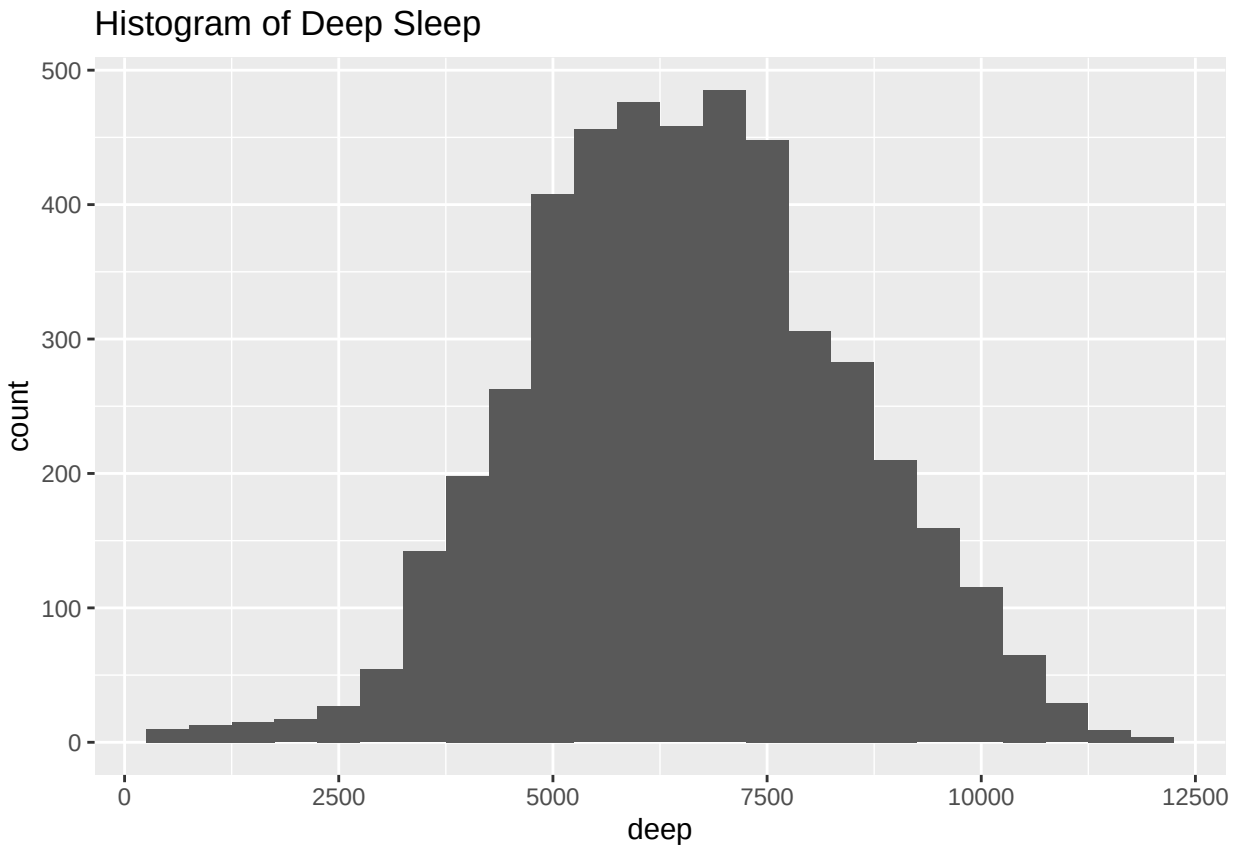
```
##   max_awake max_breath_average max_deep max_duration max_efficiency max_hr_avg
## 1     12479                 20    12092        64668             90         80
##   max_hr_lowest max_light max_midpoint_time max_onset_latency max_rem
## 1            75     30393             26547              3598   12933
##   max_restless max_score max_score_alignment max_score_deep
## 1          100        87                 100            100
##   max_score_disturbances max_score_efficiency max_score_latency max_score_rem
## 1                    100                  100               100           100
##   max_score_total max_temperature_delta max_timezone max_total
## 1             100                     1          600     53094
```

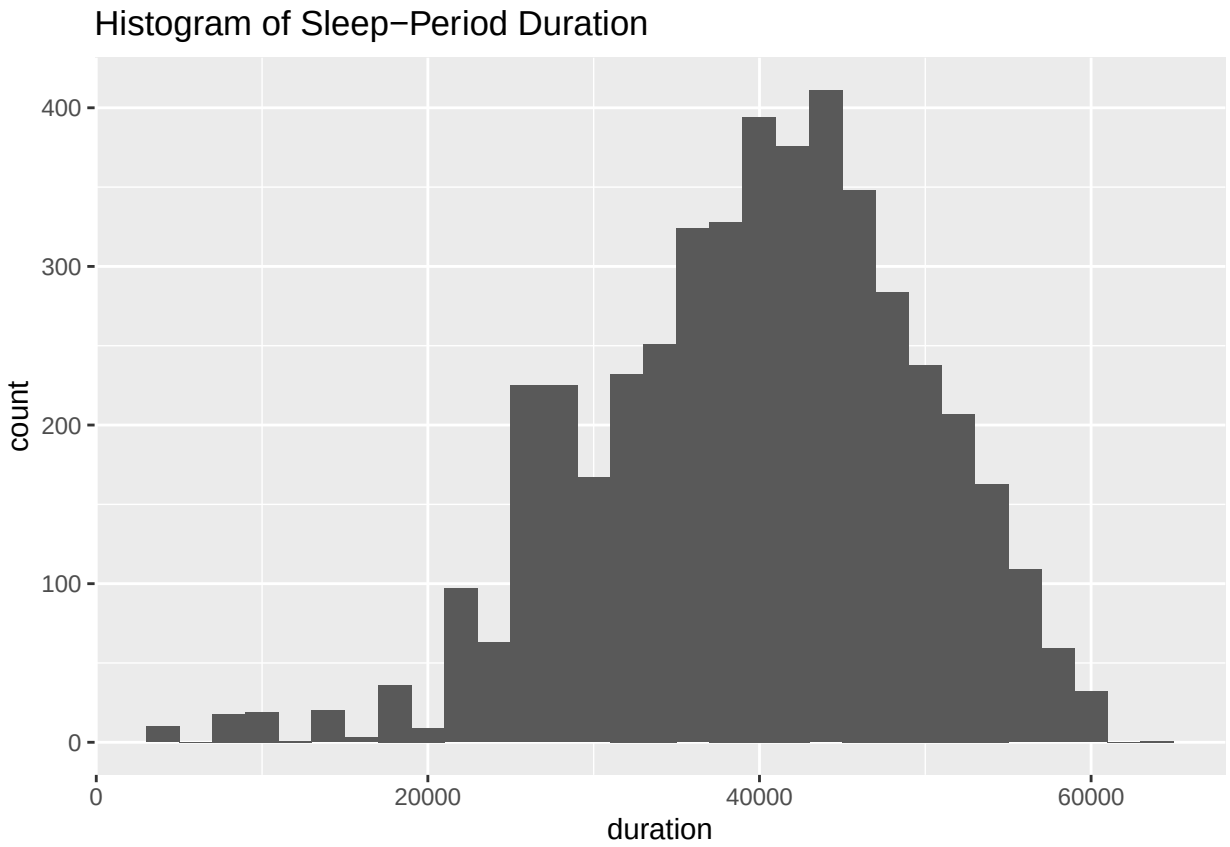
```
##   skewness_awake skewness_breath_average skewness_deep skewness_duration
## 1      0.1562061            -0.007585055   -0.01209597        -0.4565157
##   skewness_efficiency skewness_hr_avg skewness_hr_lowest skewness_light
## 1          0.02788456       -6.903714          -4.693341     -0.4165982
##   skewness_midpoint_time skewness_onset_latency skewness_rem skewness_restless
## 1             -0.4215566             0.01444844   -0.4564366       -0.02758679
##   skewness_score skewness_score_alignment skewness_score_deep
## 1    -0.03506191              -0.01622749         -0.01371907
##   skewness_score_disturbances skewness_score_efficiency skewness_score_latency
## 1                  0.01510132               0.008615333            -0.01751554
##   skewness_score_rem skewness_score_total skewness_temperature_delta
## 1        -0.05104949           0.01358179                0.001856272
##   skewness_timezone skewness_total
## 1       -0.05233634     -0.4215566
```

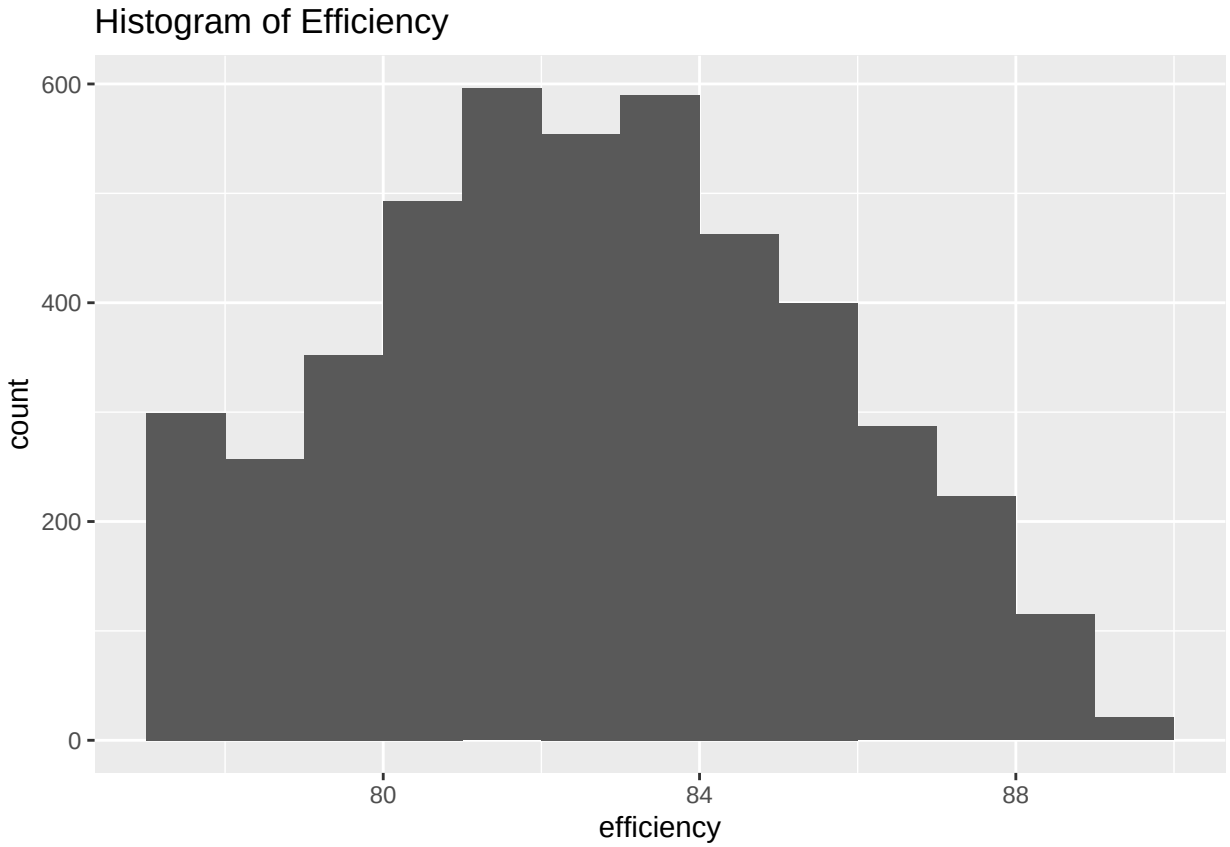
Many variables have high standard deviations, which indicates the data are very spread out. Given the nature of the random draws, this is unsurprising.

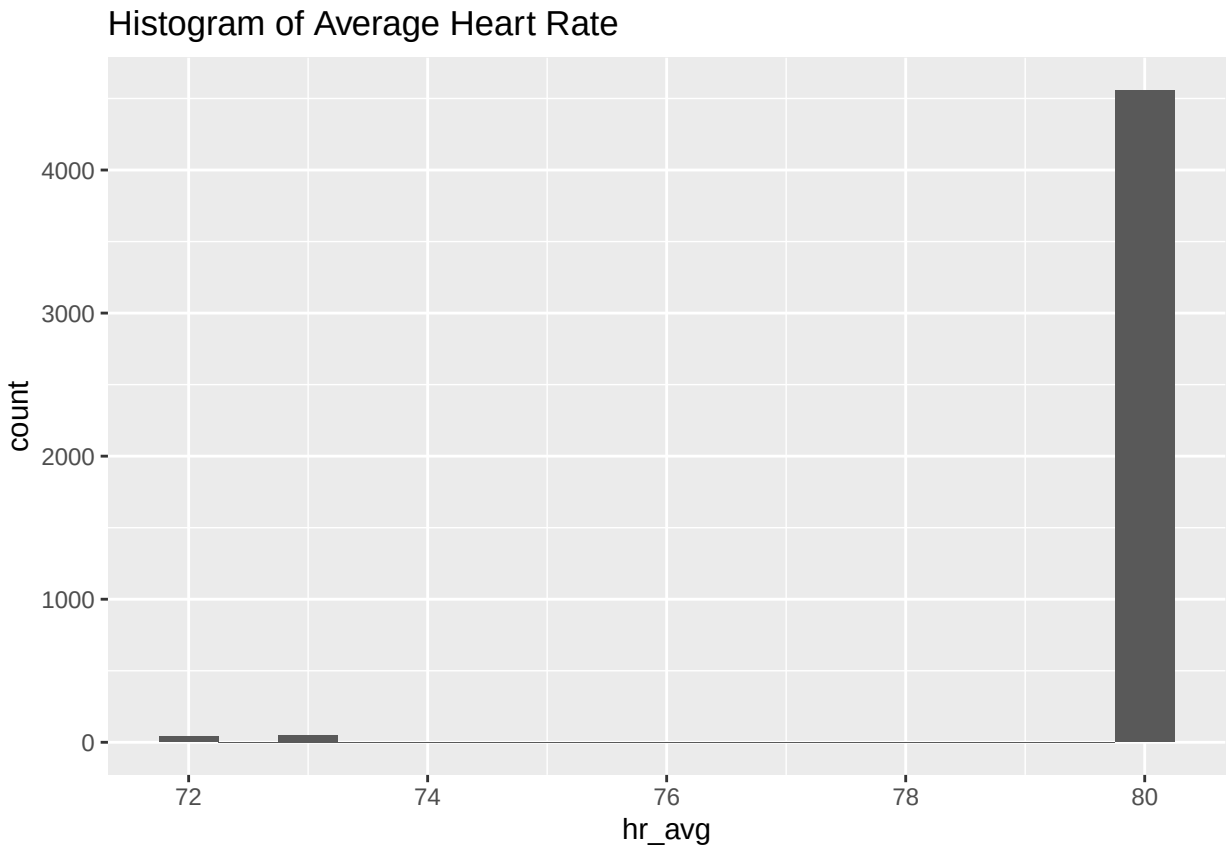


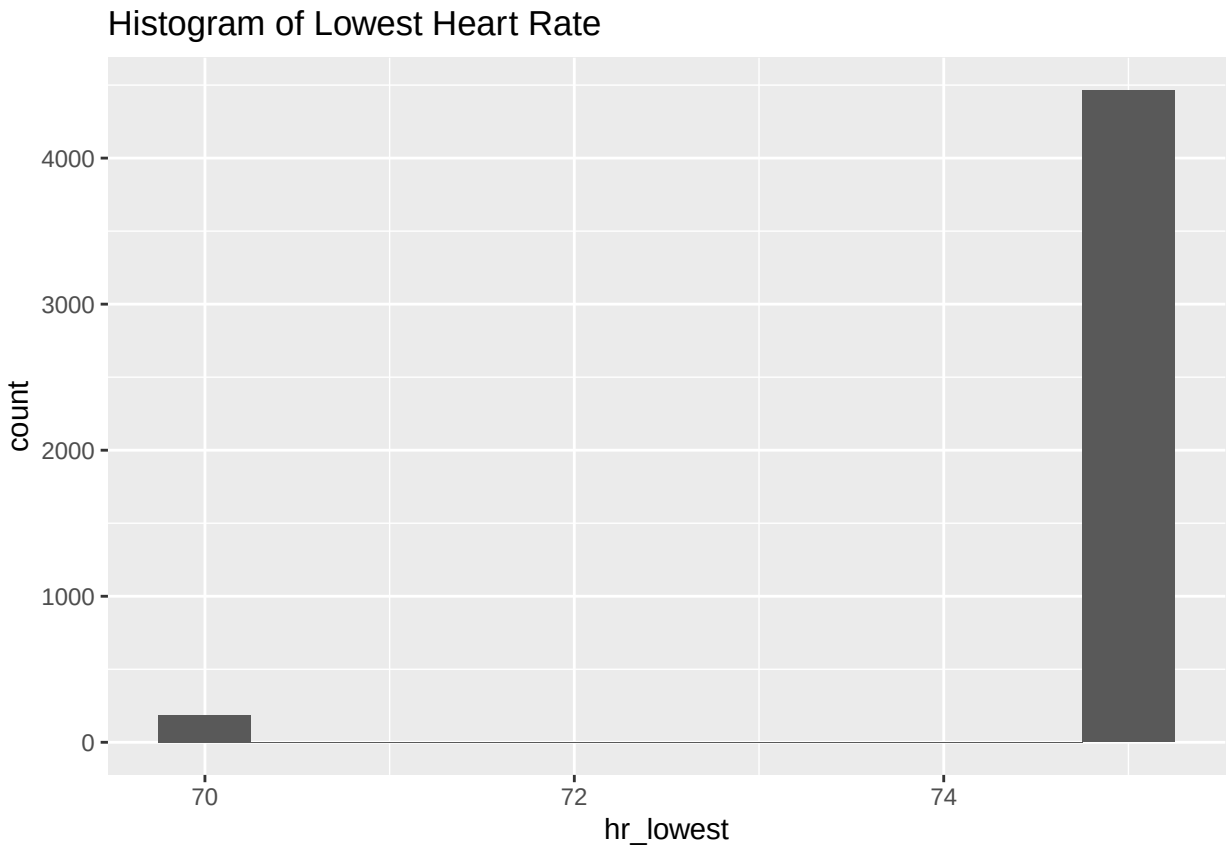

Histogram of Average Respiratory Rate
count
300
200
100
0
12
14
16
18
20
breath_average

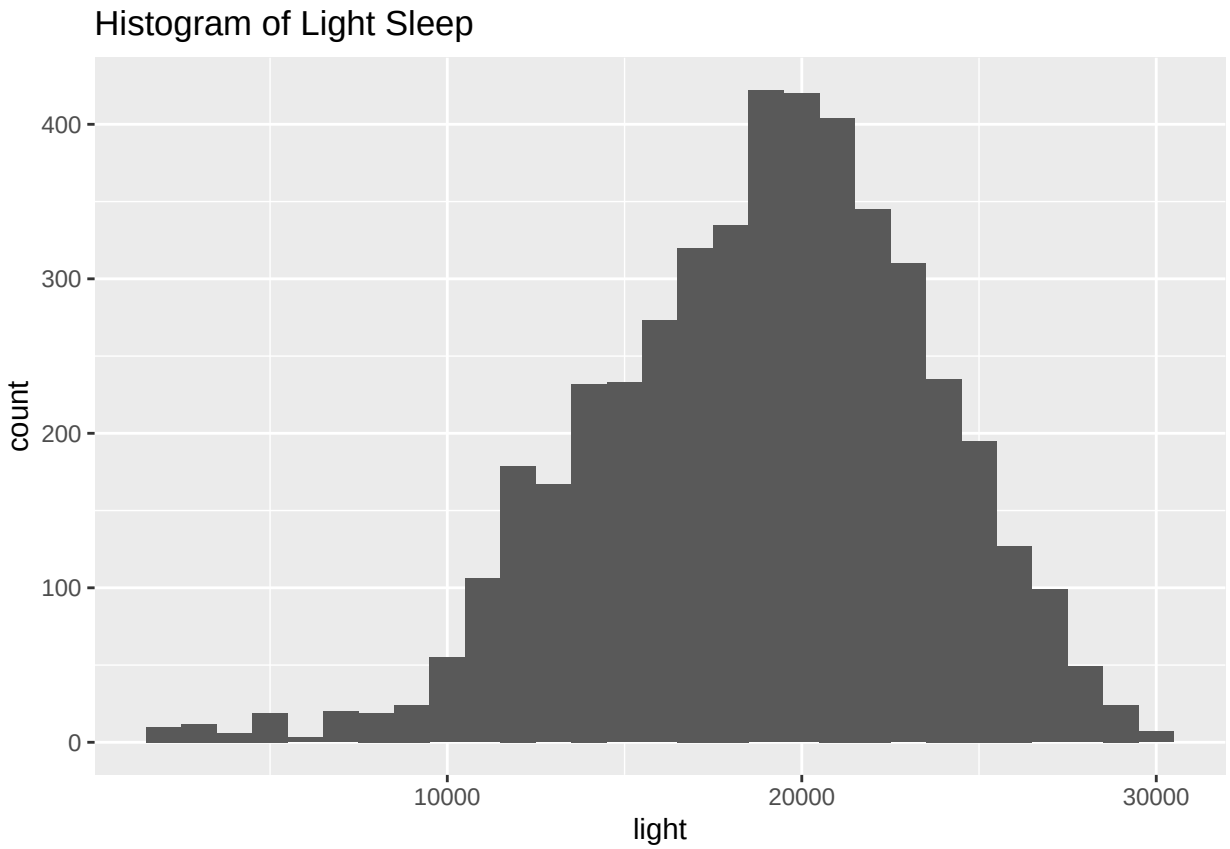

Histogram of Deep Sleep
count
500
400
300
200
100
0
0
2500
5000
7500
10000
12500
deep

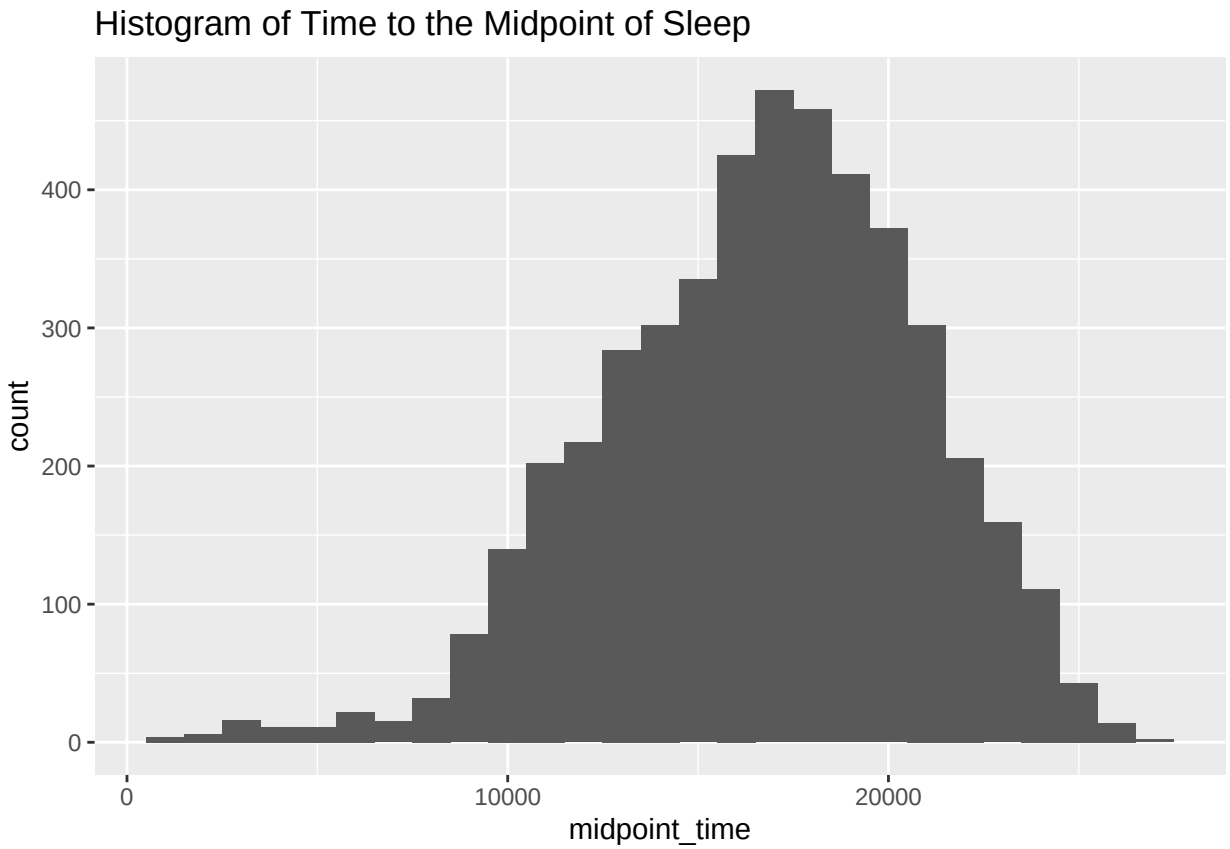

Histogram of Sleep−Period Duration
count
400
300
200
100
0
0
20000
40000
60000
duration

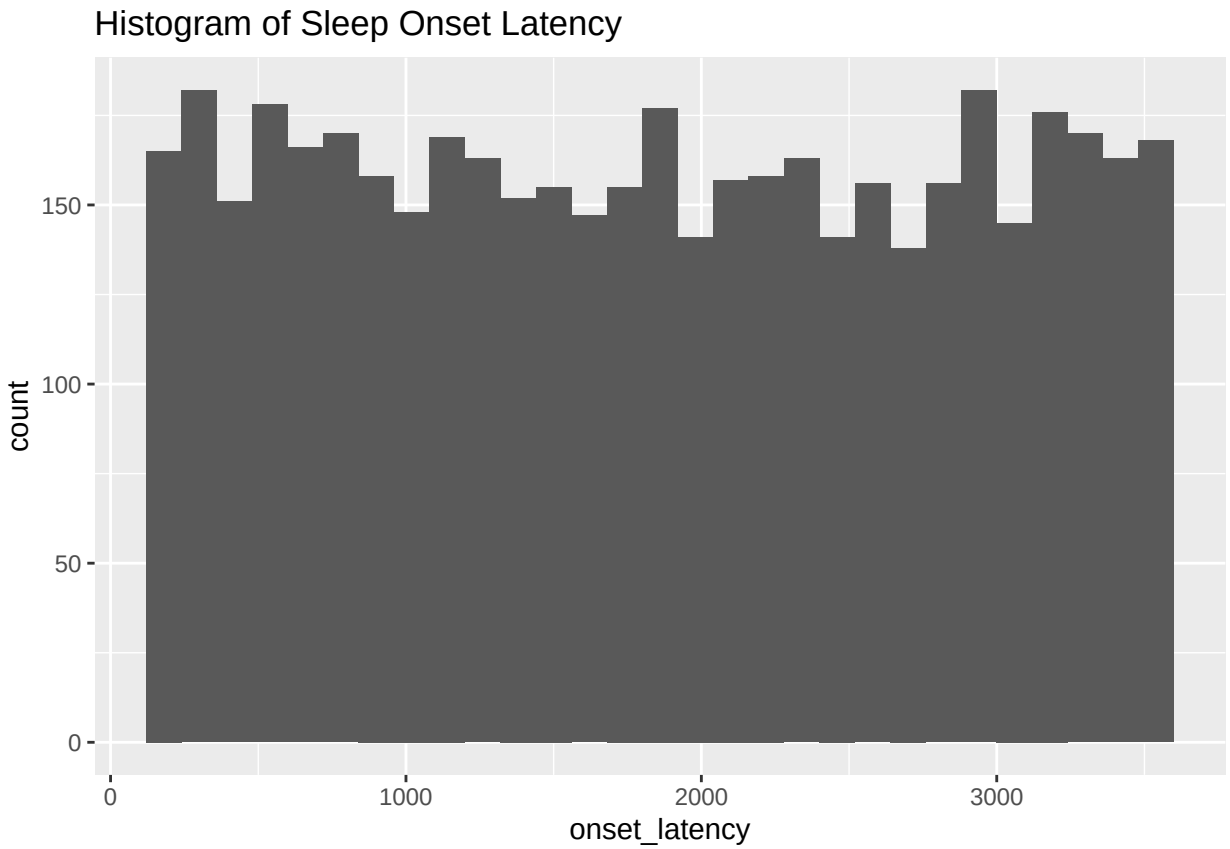

Histogram of Efficiency
600
400
200
0
count
80
84
88
efficiency

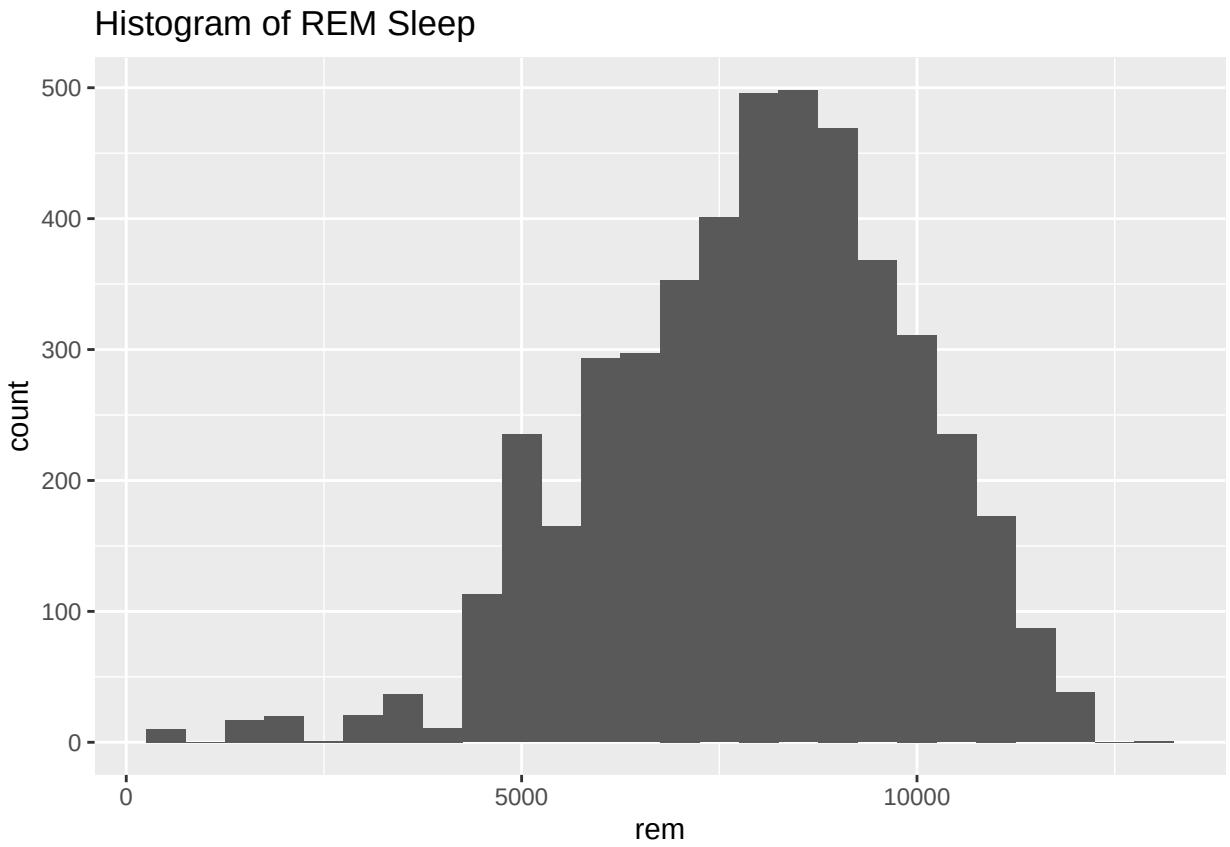

Histogram of Average Heart Rate
count
4000
3000
2000
1000
0
72
74
76
78
80
hr_avg

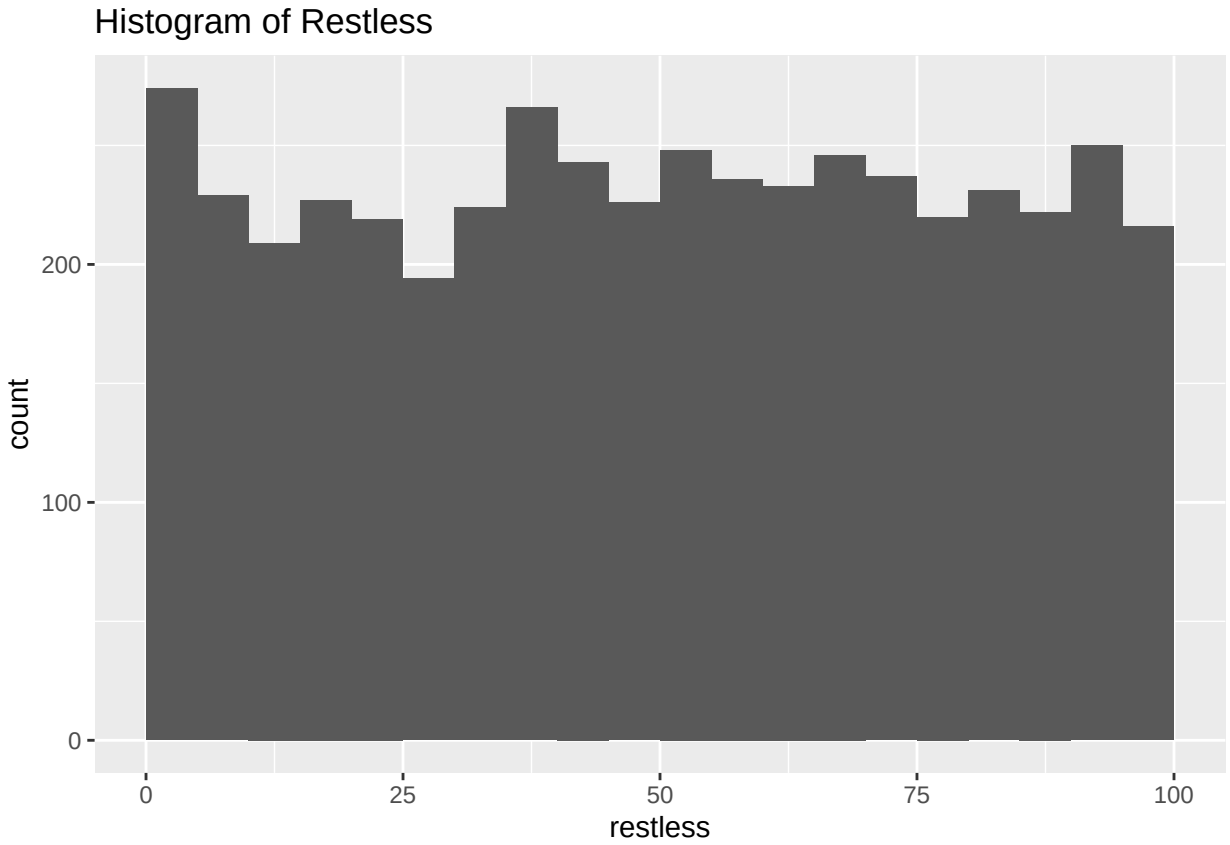

Histogram of Lowest Heart Rate
count
4000
3000
2000
1000
0
70
72
74
hr_lowest

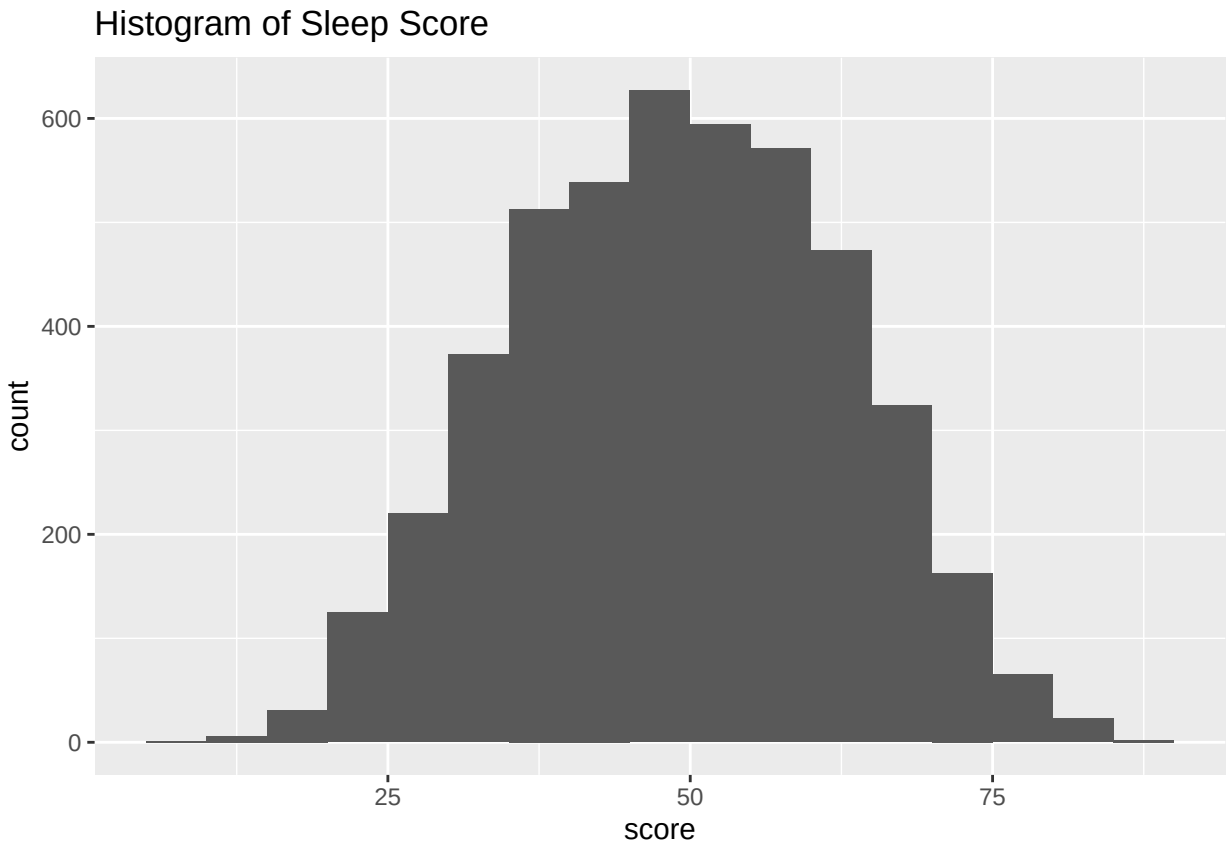

Histogram of Light Sleep
count
400
300
200
100
0
10000
20000
30000
light

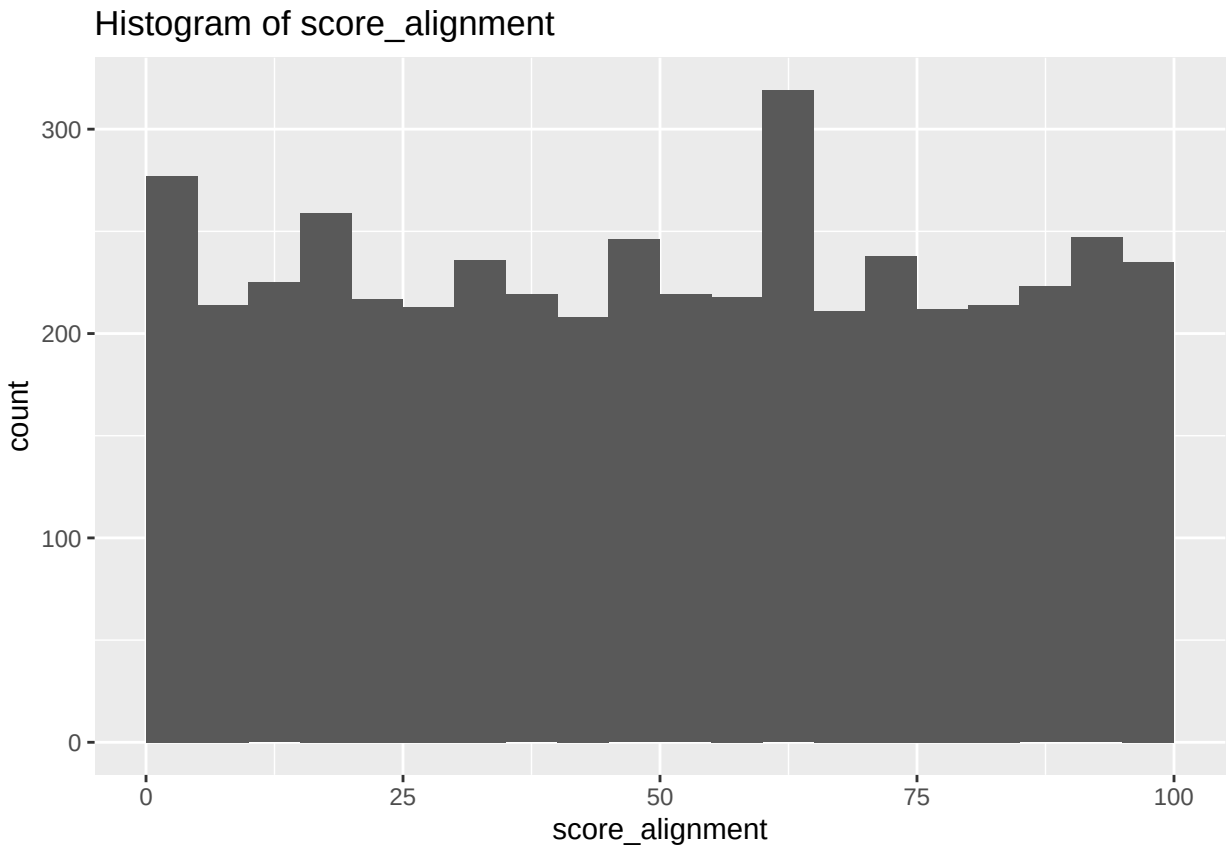

Histogram of Time to the Midpoint of Sleep
count
400
300
200
100
0
0
10000
20000
midpoint_time

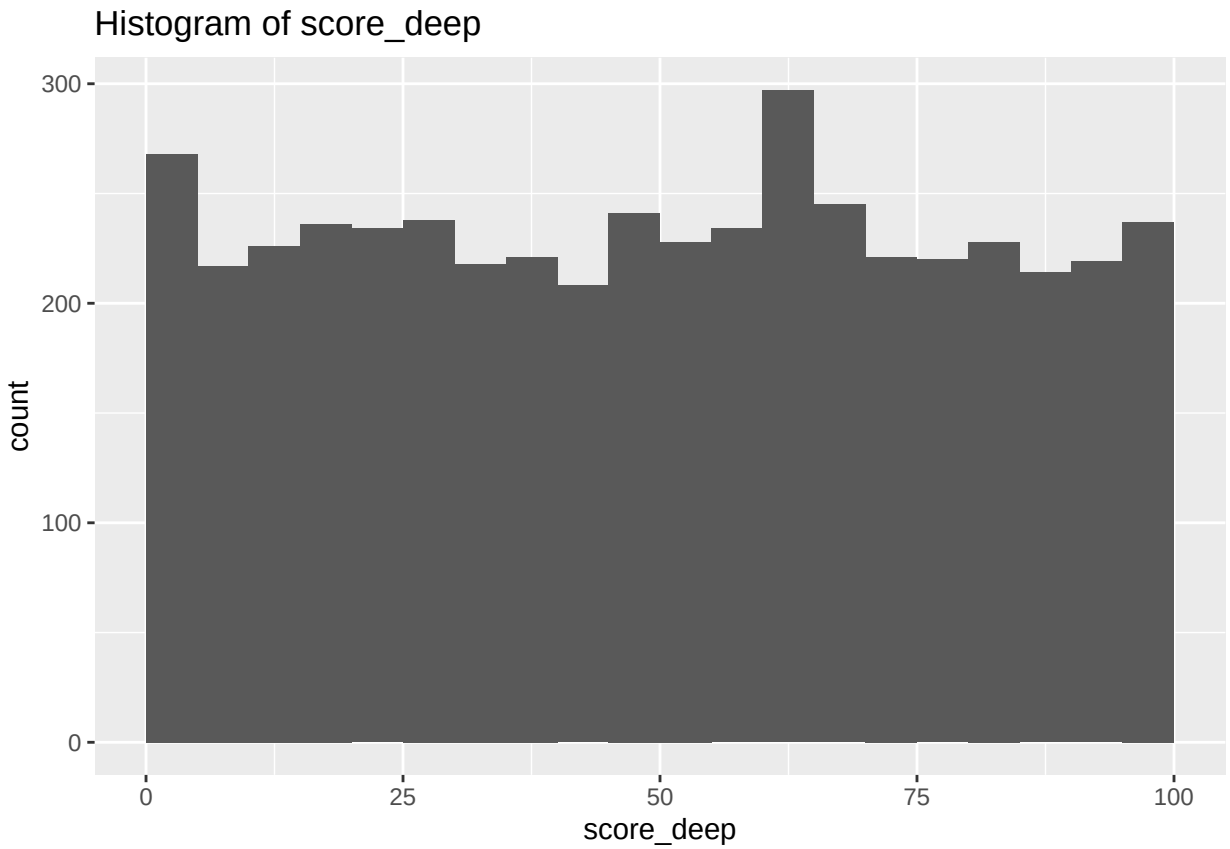

Histogram of Sleep Onset Latency
count
150
100
50
0
0
1000
2000
3000
onset_latency

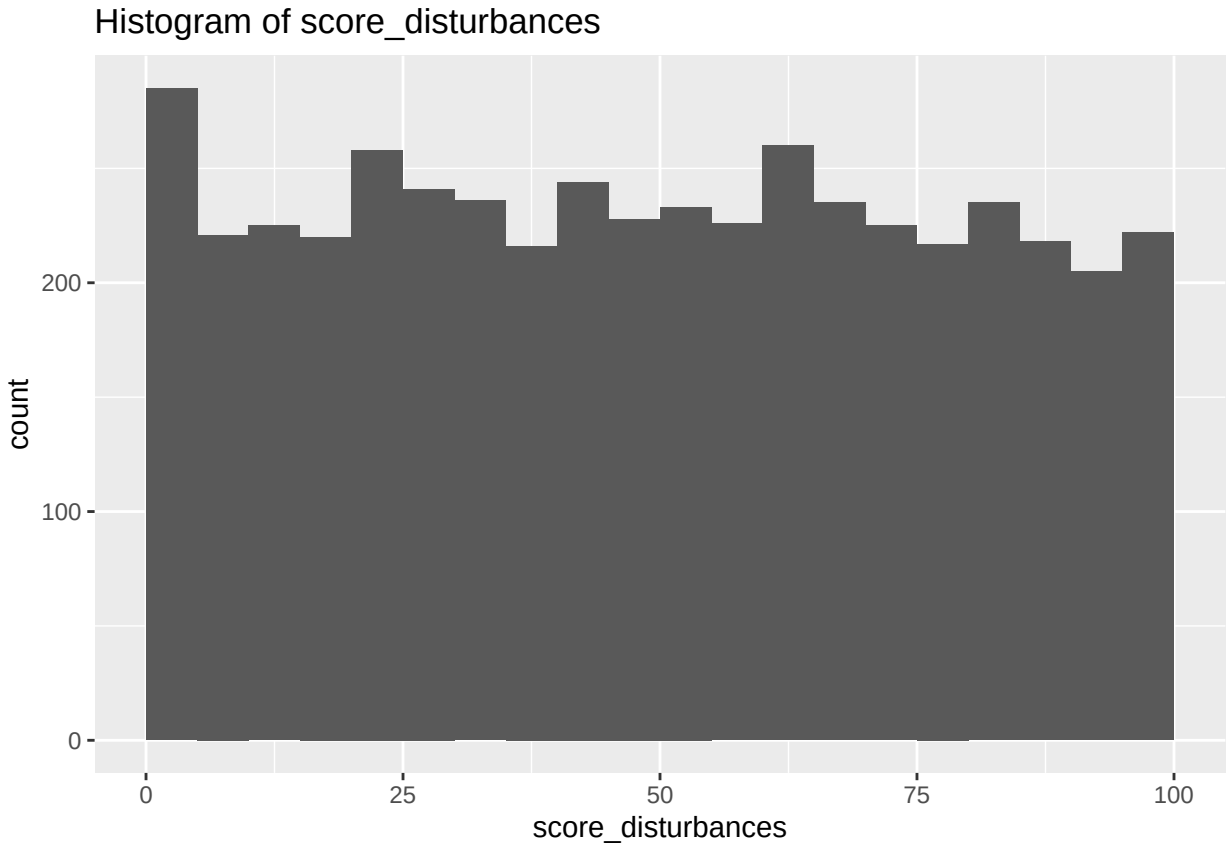

Histogram of REM Sleep
count
500
400
300
200
100
0
0
5000
10000
rem

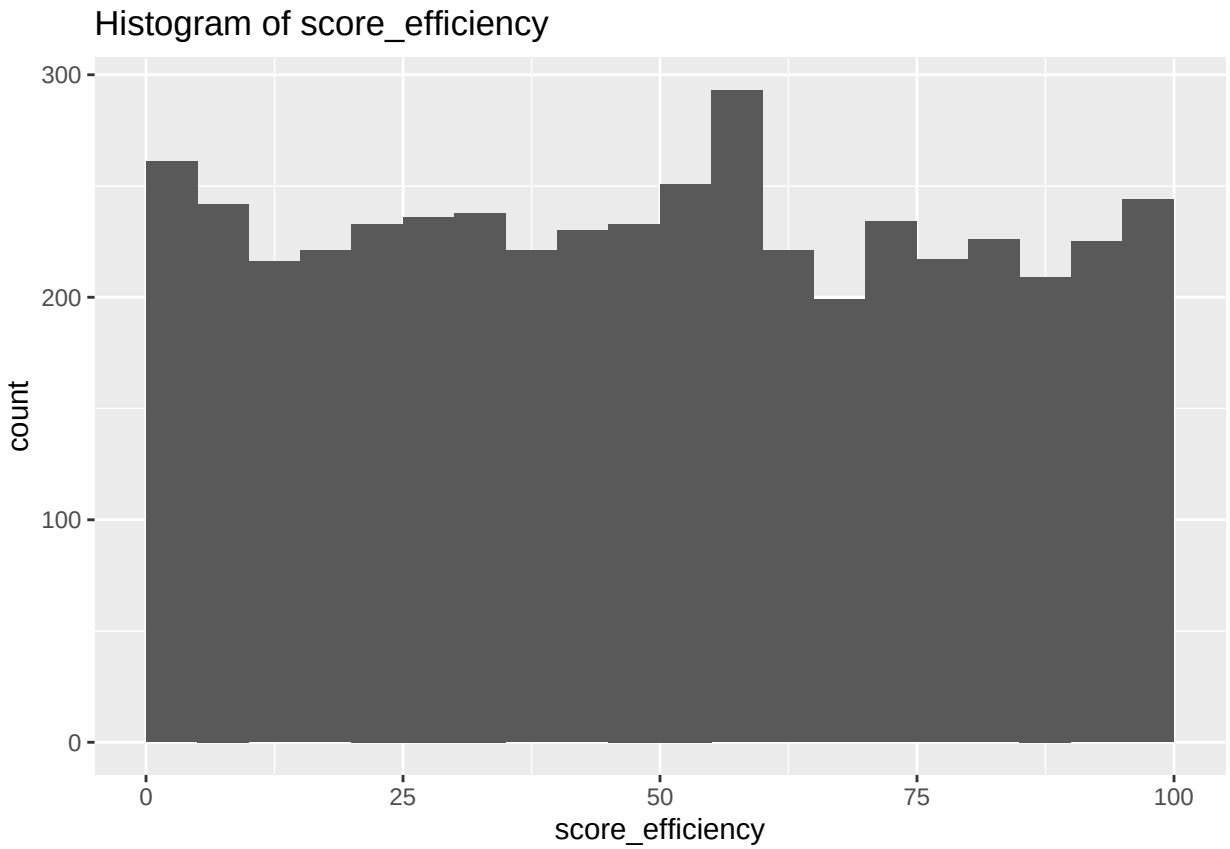

Histogram of Restless
count
200
100
0
0
25
50
75
100
restless

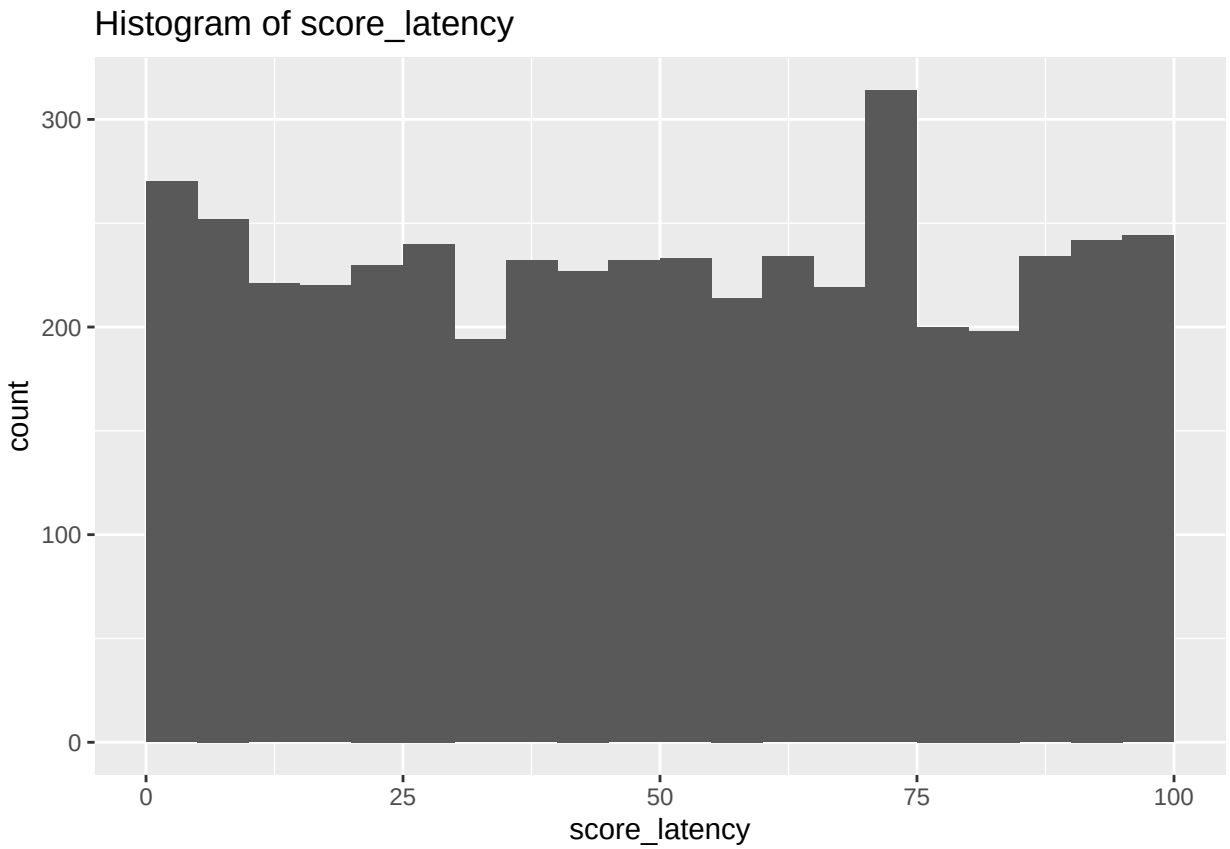

Histogram of Sleep Score
600
400
200
0
count
25
50
75
score

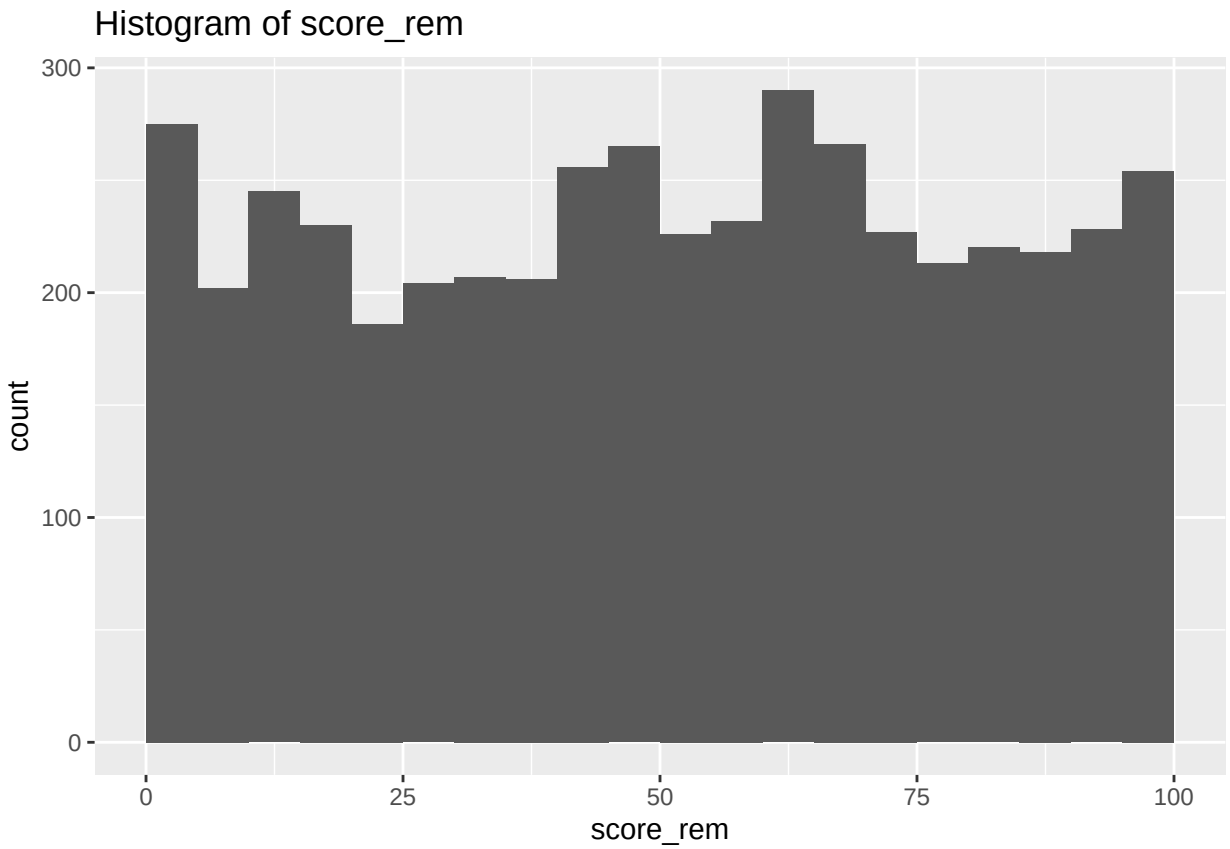

Histogram of score_alignment
count
300
200
100
0
0
25
50
75
100
score_alignment

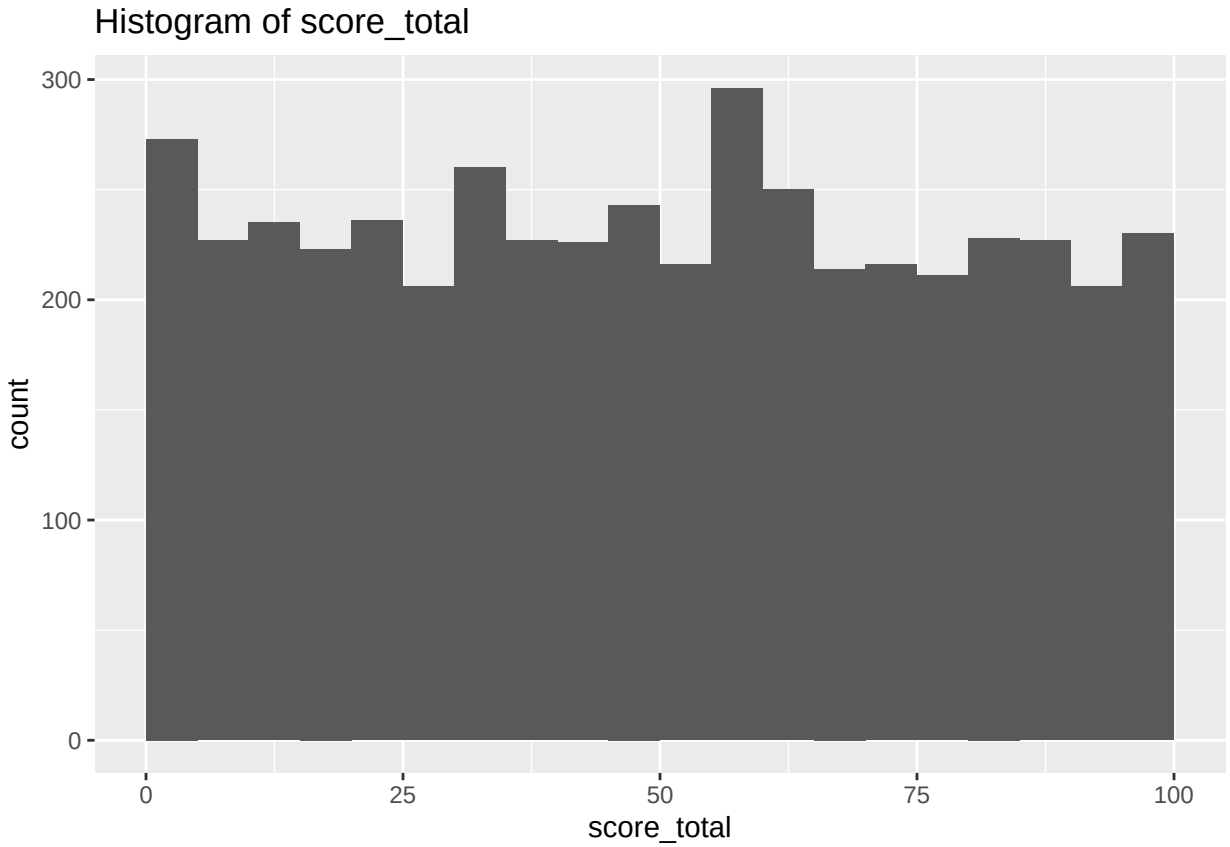

Histogram of score_deep
300
200
100
0
count
0
25
50
75
100
score_deep

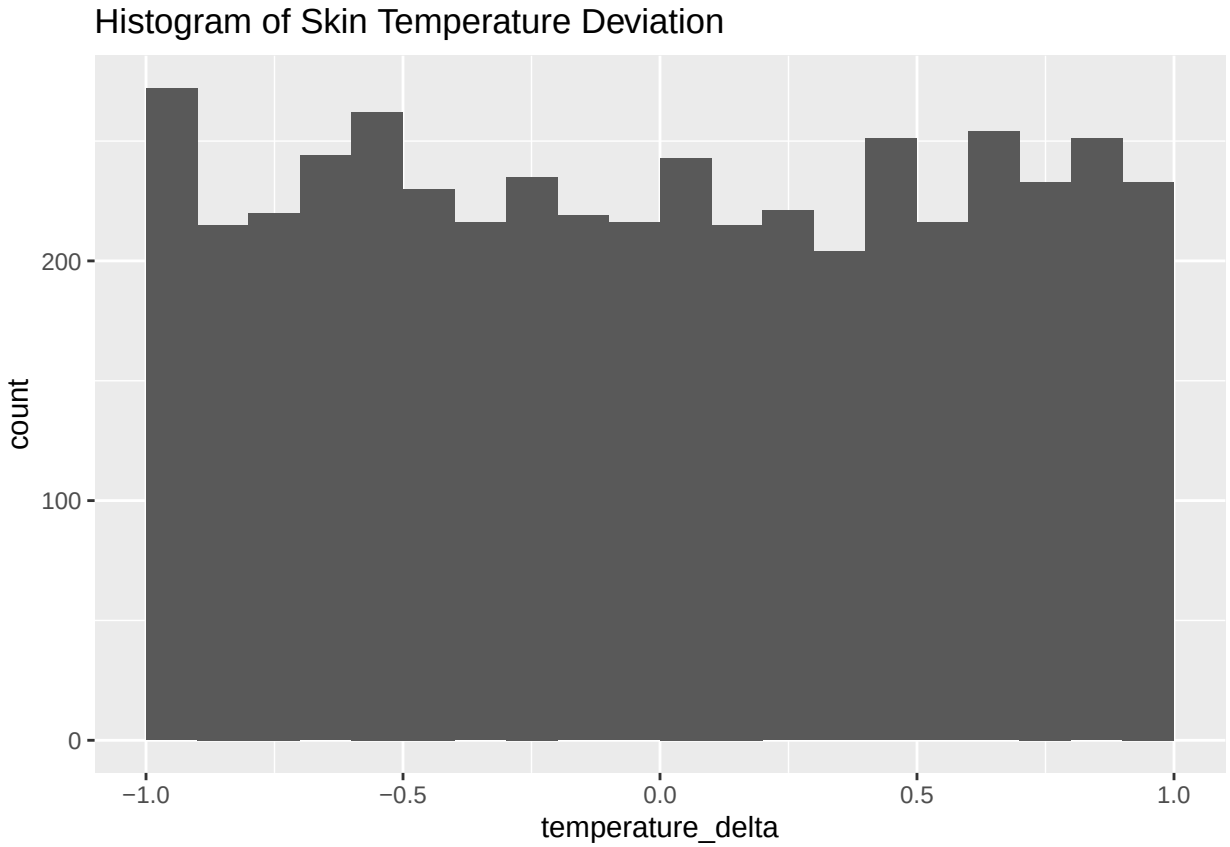

Histogram of score_disturbances
count
200
100
0
0
25
50
75
100
score_disturbances

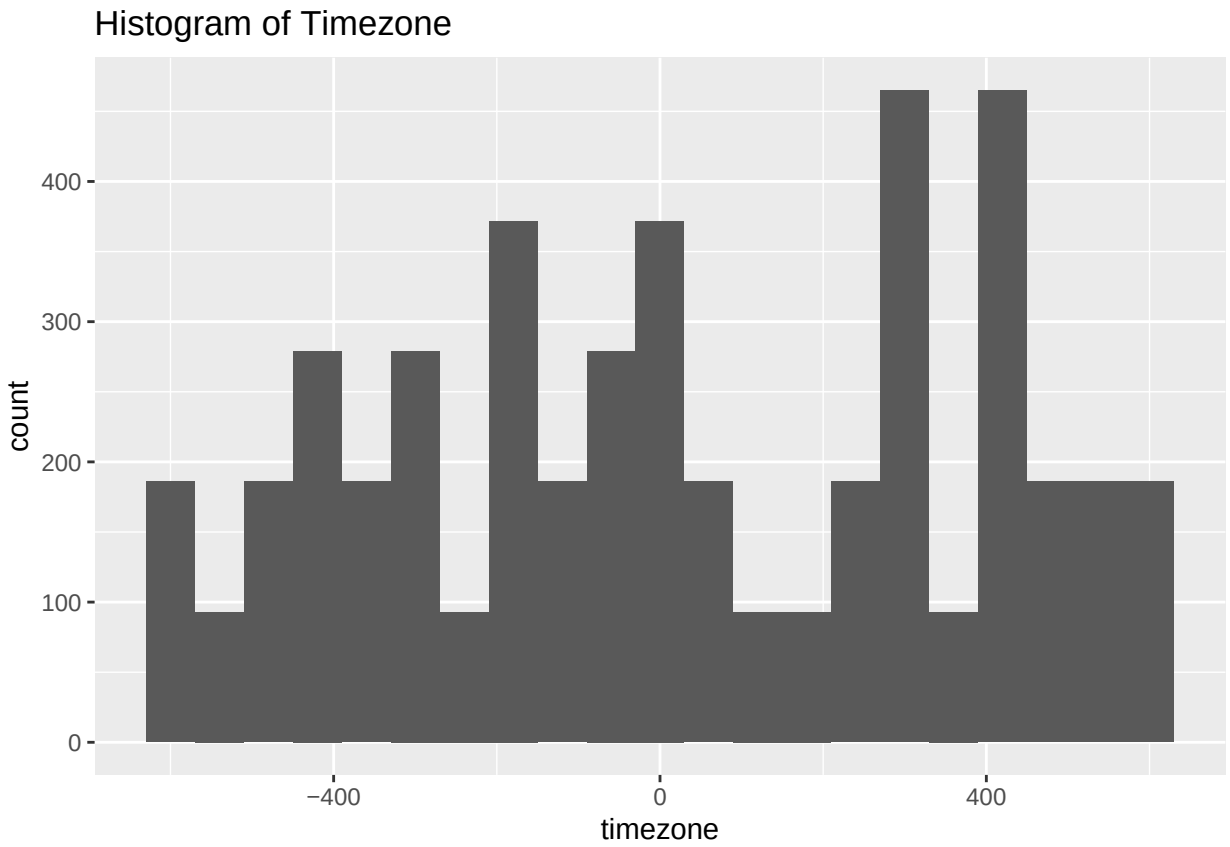

Histogram of score_efficiency
300
200
100
0
count
0
25
50
75
100
score_efficiency

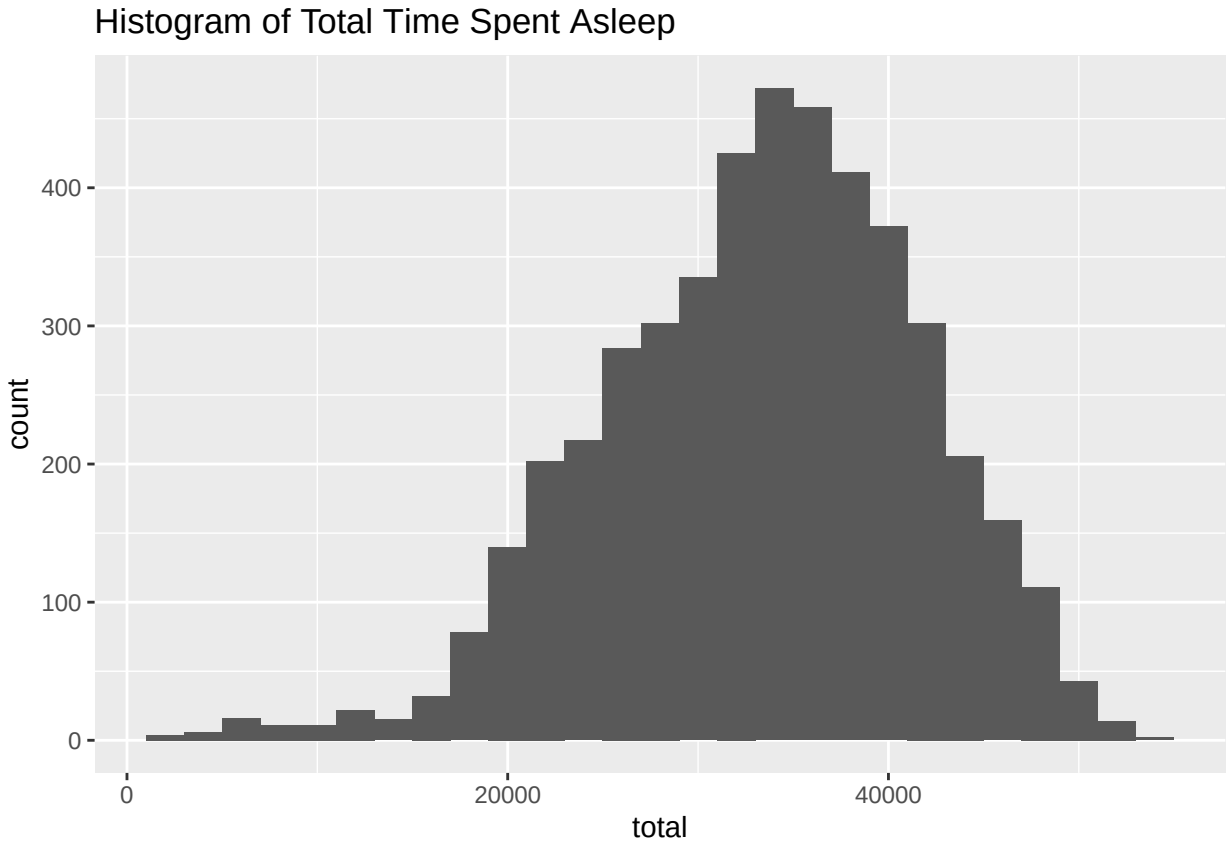

Histogram of score_latency
count
300
200
100
0
0
25
50
75
100
score_latency


Histogram of score_rem
300
200
100
0
count
0
25
50
75
100
score_rem


Histogram of score_total
300
200
100
0
count
0
25
50
75
100
score_total


Histogram of Skin Temperature Deviation
count
200
100
0
−1.0
−0.5
0.0
0.5
1.0
temperature_delta


Histogram of Timezone
count
400
300
200
100
0
−400
0
400
timezone



The histograms show that hr_lowest and hr_avg take on only two and three unique values, respectively. The variables awake, deep, duration, efficiency, light, midpoint_time, rem, score, and total follow bell curves. Breath_average, onset_latency, restless, score-alignment, score_deep, score_disturbances, score_efficiency, score_latency, score_rem, score_total, and temperature_delta are somewhat uniformly distributed.

```
##                          awake breath_average         deep     duration
## awake                1.0000000000   0.0167506077  0.443425218  0.799684797
## breath_average       0.0167506077   1.0000000000  0.003860241  0.004849407
## deep                 0.4434252182   0.0038602407  1.000000000  0.861469498
## duration             0.7996847966   0.0048494073  0.861469498  1.000000000
## efficiency          -0.6282283028  -0.0203199208  0.342833752 -0.060972482
## hr_avg               0.1457800007   0.0264231934  0.151208749  0.183277378
## hr_lowest            0.0853666448   0.0189868361  0.092947516  0.111179584
## light                0.7364666240  -0.0004994712  0.852503987  0.988683030
## midpoint_time        0.7054999353   0.0017319064  0.911121122  0.989701248
## onset_latency        0.0036876934   0.0114609142  0.019954158  0.015673136
## rem                  0.7996849095   0.0048510898  0.861469159  0.999999989
## restless            -0.0034155669   0.0084277402 -0.012873007 -0.009994967
## score                0.0243223076  -0.0225265313  0.037904916  0.034281771
## score_alignment      0.0191001828   0.0144989552  0.025893655  0.025056974
## score_deep          -0.0129620186   0.0069642811  0.002182346 -0.008465209
## score_disturbances  -0.0041928562  -0.0267129163  0.010723117  0.007776488
## score_efficiency     0.0155290089   0.0022890909  0.010821032  0.019074924
## score_latency       -0.0074386339  -0.0172650488  0.009513108  0.001183955
## score_rem            0.0065030485   0.0206142479  0.002082175  0.002846185
## score_total          0.0246224960  -0.0280089711  0.028056425  0.027456603
## temperature_delta    0.0008390346  -0.0047206260 -0.007374153 -0.004801738
```

```
## timezone           -0.0546176165   0.0133705571 -0.076292582 -0.080526075
## total               0.7054999353   0.0017319064  0.911121122  0.989701248
##                       efficiency       hr_avg     hr_lowest         light
## awake              -0.6282283028  0.145780001  8.536664e-02  0.7364666240
## breath_average     -0.0203199208  0.026423193  1.898684e-02 -0.0004994712
## deep                0.3428337517  0.151208749  9.294752e-02  0.8525039875
## duration           -0.0609724824  0.183277378  1.111796e-01  0.9886830298
## efficiency          1.0000000000 -0.044424598 -2.151999e-02  0.0264830550
## hr_avg             -0.0444245981  1.000000000  6.982670e-01  0.1841789212
## hr_lowest          -0.0215199946  0.698267036  1.000000e+00  0.1125300449
## light               0.0264830550  0.184178921  1.125300e-01  1.0000000000
## midpoint_time       0.0778142025  0.181565137  1.108708e-01  0.9914159809
## onset_latency       0.0115991267  0.002099371 -1.524883e-03  0.0166533493
## rem                -0.0609665783  0.183257673  1.111676e-01  0.9886831023
## restless           -0.0078046899 -0.004147812 -2.967779e-02 -0.0101146917
## score               0.0022683291 -0.001427244  4.156473e-03  0.0318660909
## score_alignment    -0.0001398554  0.001012737  1.691728e-02  0.0234548329
## score_deep          0.0137796021 -0.003362850  6.028963e-03 -0.0095323638
## score_disturbances  0.0122154056 -0.022186392  7.151507e-05  0.0104742941
## score_efficiency   -0.0011632727 -0.007036551  6.567965e-03  0.0209754984
## score_latency       0.0087828351 -0.006576789 -1.101691e-02  0.0013210727
## score_rem          -0.0091476380  0.017930091  1.254526e-02  0.0011801615
## score_total        -0.0048080792  0.005617375 -6.046616e-03  0.0242723381
## temperature_delta  -0.0114453344  0.009395084  2.313454e-02 -0.0054301827
## timezone           -0.0010438187 -0.161736188 -2.316251e-01 -0.0809770514
## total               0.0778142025  0.181565137  1.108708e-01  0.9914159809
##                    midpoint_time onset_latency          rem     restless
## awake               0.705499935   0.003687693  0.799684910 -0.003415567
## breath_average      0.001731906   0.011460914  0.004851090  0.008427740
## deep                0.911121122   0.019954158  0.861469159 -0.012873007
## duration            0.989701248   0.015673136  0.999999989 -0.009994967
## efficiency          0.077814202   0.011599127 -0.060966578 -0.007804690
## hr_avg              0.181565137   0.002099371  0.183257673 -0.004147812
## hr_lowest           0.110870828  -0.001524883  0.111167634 -0.029677793
## light               0.991415981   0.016653349  0.988683102 -0.010114692
## midpoint_time       1.000000000   0.017619051  0.989701215 -0.010983676
## onset_latency       0.017619051   1.000000000  0.015668404  0.009228261
## rem                 0.989701215   0.015668404  1.000000000 -0.009994031
## restless           -0.010983676   0.009228261 -0.009994031  1.000000000
## score               0.034666593   0.020336280  0.034281426 -0.001039276
## score_alignment     0.025021779   0.028770581  0.025052465  0.015598209
## score_deep         -0.006902107   0.010983827 -0.008464601  0.013658796
## score_disturbances  0.010179372  -0.003992029  0.007775892  0.009617525
## score_efficiency    0.018812438   0.015841473  0.019074461 -0.004770246
## score_latency       0.003169198   0.003726288  0.001181092 -0.005348377
## score_rem           0.001809053   0.003122075  0.002847092 -0.026066612
## score_total         0.026539441   0.009639147  0.027457830 -0.002293825
## temperature_delta  -0.005868183  -0.010688187 -0.004802692  0.002982277
## timezone           -0.082025358   0.033340075 -0.080519825  0.033289041
## total               1.000000000   0.017619051  0.989701215 -0.010983676
##                           score score_alignment   score_deep score_disturbances
## awake               0.024322308    0.0191001828 -0.012962019      -4.192856e-03
## breath_average     -0.022526531    0.0144989552  0.006964281      -2.671292e-02
## deep                0.037904916    0.0258936554  0.002182346       1.072312e-02
```

```
## duration            0.034281771    0.0250569741 -0.008465209       7.776488e-03
## efficiency          0.002268329   -0.0001398554  0.013779602       1.221541e-02
## hr_avg             -0.001427244    0.0010127371 -0.003362850      -2.218639e-02
## hr_lowest           0.004156473    0.0169172754  0.006028963       7.151507e-05
## light               0.031866091    0.0234548329 -0.009532364       1.047429e-02
## midpoint_time       0.034666593    0.0250217795 -0.006902107       1.017937e-02
## onset_latency       0.020336280    0.0287705814  0.010983827      -3.992029e-03
## rem                 0.034281426    0.0250524645 -0.008464601       7.775892e-03
## restless           -0.001039276    0.0155982089  0.013658796       9.617525e-03
## score               1.000000000    0.2477008275  0.267816538       3.472813e-01
## score_alignment     0.247700828    1.0000000000  0.016601277       1.736049e-02
## score_deep          0.267816538    0.0166012771  1.000000000       1.668941e-02
## score_disturbances  0.347281259    0.0173604888  0.016689411       1.000000e+00
## score_efficiency    0.220701314   -0.0092256190  0.005866666       3.397846e-03
## score_latency       0.098326075    0.0026363330 -0.006965255      -1.090320e-03
## score_rem           0.242763849   -0.0050244825  0.019876376       3.215173e-03
## score_total         0.808164017    0.0115543730  0.030250274       2.194819e-03
## temperature_delta   0.003751893   -0.0039362843 -0.014566383      -1.726031e-02
## timezone           -0.021769356   -0.0125620153 -0.023211099      -5.510026e-03
## total               0.034666593    0.0250217795 -0.006902107       1.017937e-02
##                   score_efficiency score_latency    score_rem  score_total
## awake                 0.015529009  -0.007438634  0.006503048  0.024622496
## breath_average        0.002289091  -0.017265049  0.020614248 -0.028008971
## deep                  0.010821032   0.009513108  0.002082175  0.028056425
## duration              0.019074924   0.001183955  0.002846185  0.027456603
## efficiency           -0.001163273   0.008782835 -0.009147638 -0.004808079
## hr_avg               -0.007036551  -0.006576789  0.017930091  0.005617375
## hr_lowest             0.006567965  -0.011016911  0.012545265 -0.006046616
## light                 0.020975498   0.001321073  0.001180161  0.024272338
## midpoint_time         0.018812438   0.003169198  0.001809053  0.026539441
## onset_latency         0.015841473   0.003726288  0.003122075  0.009639147
## rem                   0.019074461   0.001181092  0.002847092  0.027457830
## restless             -0.004770246  -0.005348377 -0.026066612 -0.002293825
## score                 0.220701314   0.098326075  0.242763849  0.808164017
## score_alignment      -0.009225619   0.002636333 -0.005024483  0.011554373
## score_deep            0.005866666  -0.006965255  0.019876376  0.030250274
## score_disturbances    0.003397846  -0.001090320  0.003215173  0.002194819
## score_efficiency      1.000000000  -0.042088748  0.004615930 -0.006343896
## score_latency        -0.042088748   1.000000000 -0.025251268 -0.002947937
## score_rem             0.004615930  -0.025251268  1.000000000  0.013384199
## score_total          -0.006343896  -0.002947937  0.013384199  1.000000000
## temperature_delta     0.007288735  -0.026891440  0.013963633  0.014751146
## timezone             -0.010627687   0.019704772 -0.014378948 -0.008423866
## total                 0.018812438   0.003169198  0.001809053  0.026539441
##                   temperature_delta     timezone        total
## awake                 0.0008390346 -0.054617616  0.705499935
## breath_average       -0.0047206260  0.013370557  0.001731906
## deep                 -0.0073741533 -0.076292582  0.911121122
## duration             -0.0048017380 -0.080526075  0.989701248
## efficiency           -0.0114453344 -0.001043819  0.077814202
## hr_avg                0.0093950842 -0.161736188  0.181565137
## hr_lowest             0.0231345416 -0.231625123  0.110870828
## light                -0.0054301827 -0.080977051  0.991415981
## midpoint_time        -0.0058681829 -0.082025358  1.000000000
```

```
## onset_latency          -0.0106881873  0.033340075  0.017619051
## rem                    -0.0048026923 -0.080519825  0.989701215
## restless                0.0029822765  0.033289041 -0.010983676
## score                   0.0037518933 -0.021769356  0.034666593
## score_alignment        -0.0039362843 -0.012562015  0.025021779
## score_deep             -0.0145663830 -0.023211099 -0.006902107
## score_disturbances     -0.0172603146 -0.005510026  0.010179372
## score_efficiency        0.0072887355 -0.010627687  0.018812438
## score_latency          -0.0268914398  0.019704772  0.003169198
## score_rem               0.0139636330 -0.014378948  0.001809053
## score_total             0.0147511463 -0.008423866  0.026539441
## temperature_delta       1.0000000000  0.011285680 -0.005868183
## timezone                0.0112856795  1.000000000 -0.082025358
## total                  -0.0058681829 -0.082025358  1.000000000
```

Many of the variables are not highly correlated. However, there are high amounts of positive correlation among the variables awake, deep, duration, light, midpoint_time, rem, and total. This is unsurprising since duration was used to calculate deep, light, and rem; deep, light, and rem, were used to calculate awake; total was calculated by awake, deep, light, and rem; and midpoint_time was calculated from total. Score and score_total are also positively correlated. Score_total contributed to the calculation for score with the highest weight, which is likely why score_total is highly correlated with score, but the other sleep score variables are not.