case2

GustavoAquino

2024-01-11

Padronized Data

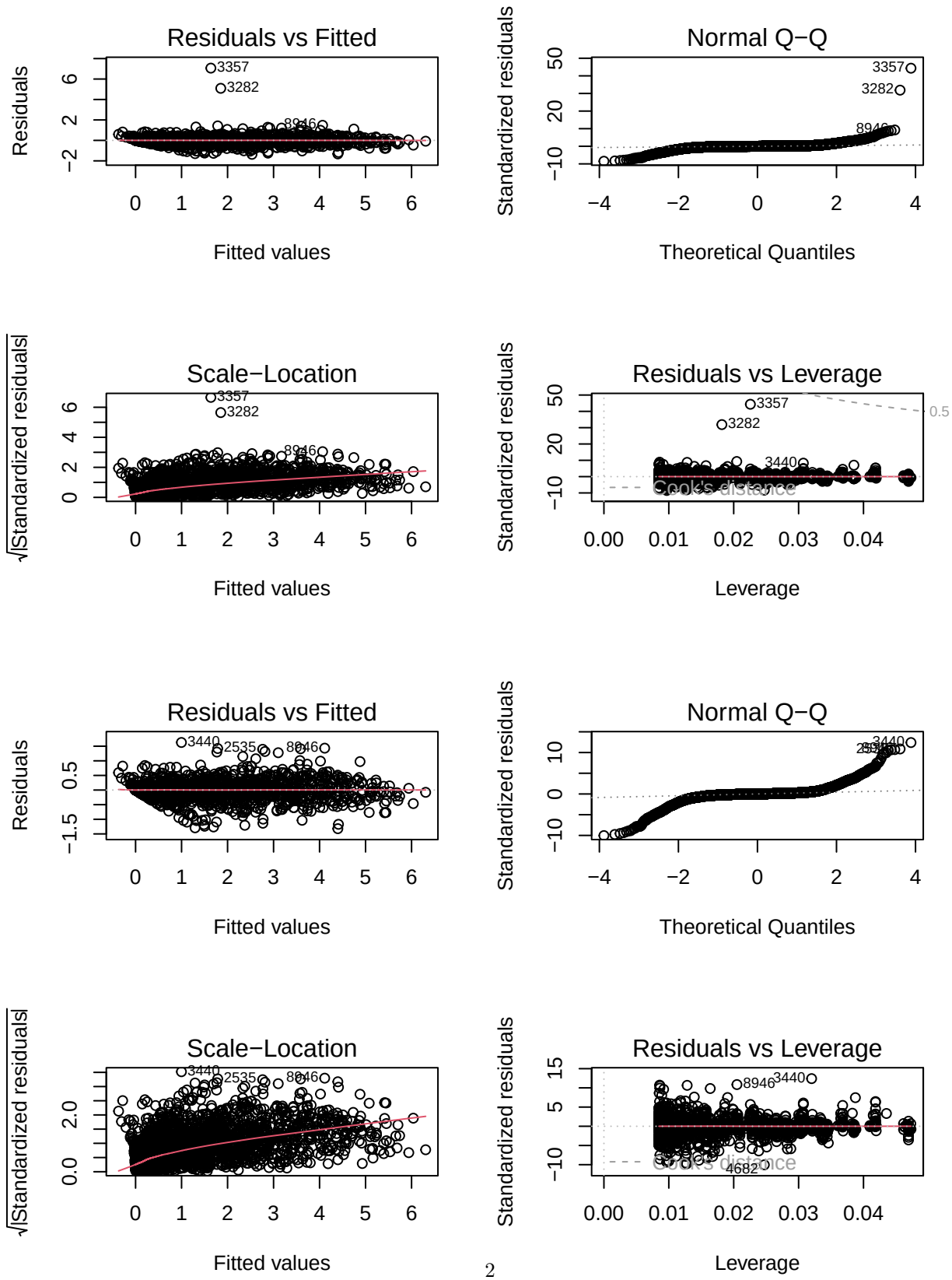
Statistics

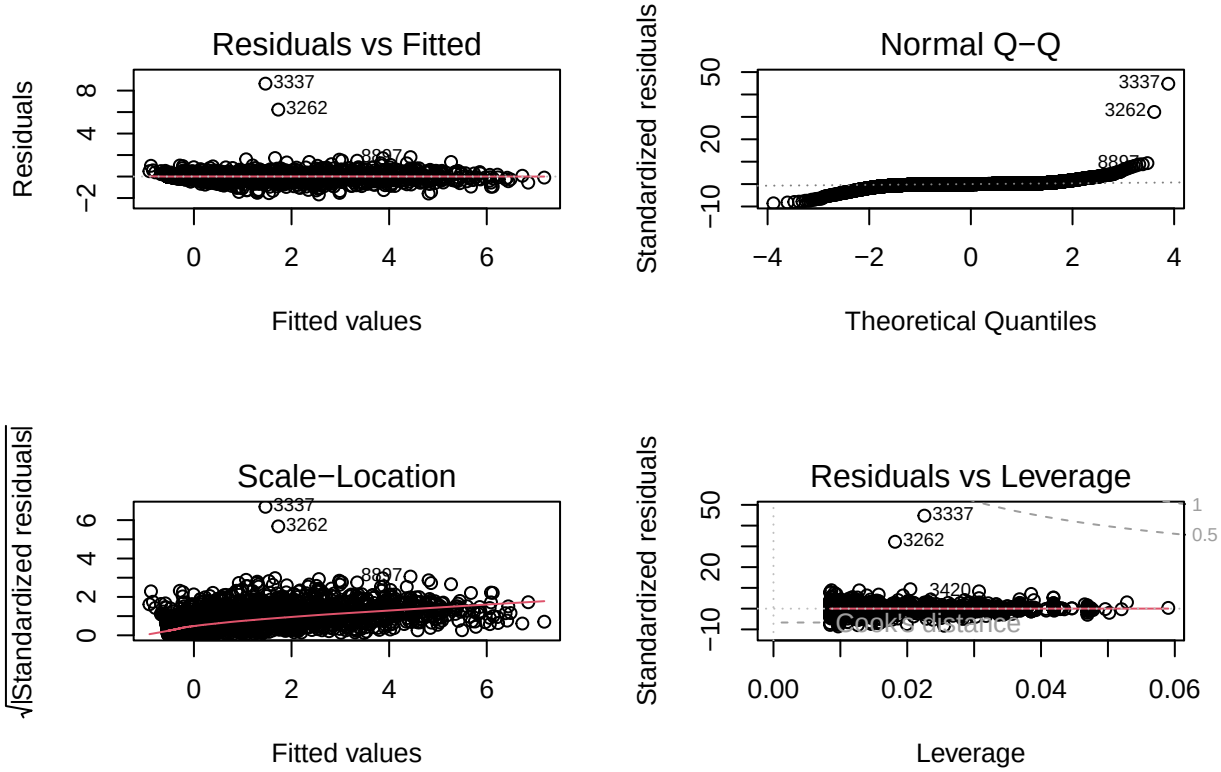
Only on a basic level to have an understandig of the data and how it may behave in the model

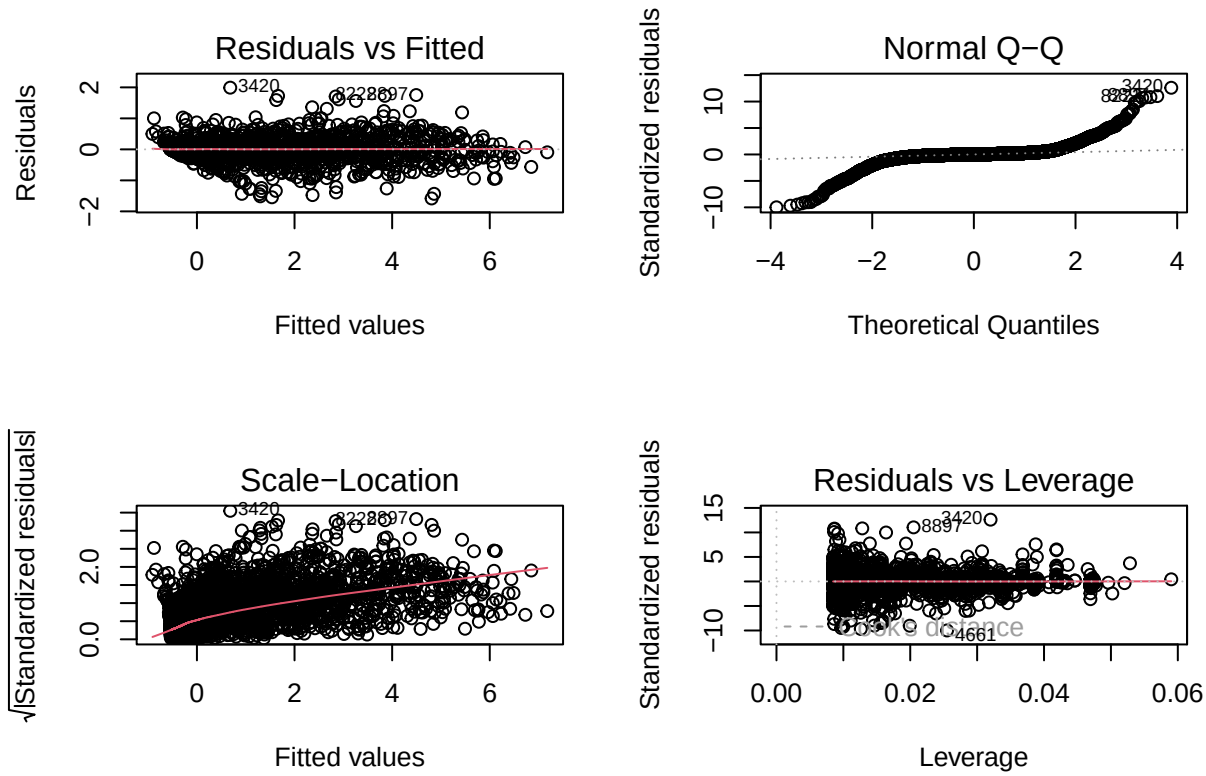
```
##          date            ID        consumption           temp
##  2018-09-30:  89   4529799: 118   Min.   :0.00000   Min.   :-1.900
##  2018-11-20:  86   4529800: 118   1st Qu.:0.07465   1st Qu.: 4.556
##  2018-10-30:  85   4839509: 118   Median :0.15160   Median : 8.833
##  2018-11-06:  85   4866195: 118   Mean   :0.43617   Mean   : 8.724
##  2018-11-13:  85   4887707: 118   3rd Qu.:0.33618   3rd Qu.:12.857
##  2018-09-03:  84   4962433: 118   Max.   :8.70266   Max.   :18.615
##  (Other)   :9280   (Other):9086
##      dew_pt            hum           wind_spd          dir
##  Min.   :-3.650   Min.   :49.00   Min.   : 3.84   West   :1239
##  1st Qu.: 2.333   1st Qu.:72.68   1st Qu.:11.24   SW     :1079
##  Median : 6.600   Median :82.07   Median :15.44   SE     :1076
##  Mean   : 6.309   Mean   :81.02   Mean   :16.37   East   : 828
##  3rd Qu.:10.000   3rd Qu.:89.81   3rd Qu.:20.72   South  : 748
##  Max.   :15.125   Max.   :98.61   Max.   :42.27   ESE    : 745
##                                                   (Other):4079
##       vis            pressure                     cond      fog      rain
##  Min.   : 1.965   Min.   : 986.5   Scattered Clouds:3066   0:9547   0:9461
##  1st Qu.:11.706   1st Qu.:1011.2   Mist            :2325   1: 247   1: 333
##  Median :18.878   Median :1017.4   Clear           :1990
##  Mean   :20.541   Mean   :1016.5   Mostly Cloudy   : 998
##  3rd Qu.:29.815   3rd Qu.:1022.5   Fog             : 580
##  Max.   :50.000   Max.   :1040.4   Light Rain      : 252
##                                    (Other)         : 583
##       diff          mapped_id
##  Min.   : 2.385   1      : 118
##  1st Qu.: 8.143   2      : 118
##  Median :12.167   3      : 118
##  Mean   :12.276   4      : 118
##  3rd Qu.:16.444   5      : 118
##  Max.   :22.900   6      : 118
##                   (Other):9086
```

Modelling

Basic and first iterations




Residuals vs Fitted
Residuals
Fitted values
3337
3262
8897
Normal Q−Q
Standardized residuals
Theoretical Quantiles
3337
3262
8897
Scale−Location
√|Standardized residuals|
Fitted values
3337
3262
8897
Residuals vs Leverage
Standardized residuals
Leverage
3337
3262
3420
Cook's distance
1
0.5




```
## Anova Table (Type II tests)
##
## Response: consumption
##                Sum Sq   Df F value    Pr(>F)
## diff            592.0    1 22979.1 < 2.2e-16 ***
## mapped_id      7104.6   82  3363.3 < 2.2e-16 ***
## diff:mapped_id 1610.7   82   762.5 < 2.2e-16 ***
## Residuals       246.6 9574
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Call:
## lm(formula = consumption ~ diff + mapped_id + diff:mapped_id,
##     data = htk_no_zero[-c(3337, 3262), ])
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.58304 -0.02264  0.00090  0.02376  1.99017
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)      -4.449e-01  1.478e-02 -30.110  < 2e-16 ***
## diff              3.321e-02  1.477e-02   2.248 0.024608 *
## mapped_id2       -1.499e-03  2.090e-02  -0.072 0.942796
## mapped_id3        5.104e-01  2.090e-02  24.427  < 2e-16 ***
## mapped_id4        4.522e-01  2.094e-02  21.595  < 2e-16 ***
```

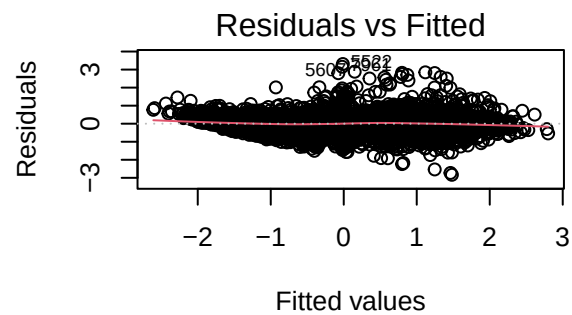
```
## mapped_id5        3.283e-01  2.090e-02  15.709  < 2e-16 ***
## mapped_id6        6.280e-01  2.094e-02  29.990  < 2e-16 ***
## mapped_id7        4.791e-02  2.090e-02   2.293 0.021885 *
## mapped_id8        5.290e-03  2.090e-02   0.253 0.800138
## mapped_id9        8.825e-02  2.090e-02   4.224 2.43e-05 ***
## mapped_id10       3.857e-01  2.099e-02  18.378  < 2e-16 ***
## mapped_id11       5.792e-02  2.090e-02   2.772 0.005588 **
## mapped_id12      -2.893e-02  2.090e-02  -1.384 0.166240
## mapped_id13       1.168e-01  2.090e-02   5.590 2.33e-08 ***
## mapped_id14       5.000e-03  2.144e-02   0.233 0.815585
## mapped_id15       6.001e-02  2.090e-02   2.872 0.004087 **
## mapped_id16       2.024e-01  2.094e-02   9.663  < 2e-16 ***
## mapped_id17      -2.901e-03  2.090e-02  -0.139 0.889570
## mapped_id18       4.229e-02  2.090e-02   2.024 0.043025 *
## mapped_id19       2.205e+00  2.090e-02 105.540  < 2e-16 ***
## mapped_id20       5.556e-01  2.090e-02  26.588  < 2e-16 ***
## mapped_id21      -1.691e-02  2.090e-02  -0.809 0.418456
## mapped_id22       1.072e-02  2.090e-02   0.513 0.608055
## mapped_id23       8.708e-02  2.090e-02   4.167 3.11e-05 ***
## mapped_id24       6.923e-03  2.090e-02   0.331 0.740398
## mapped_id25       3.522e-02  2.094e-02   1.682 0.092627 .
## mapped_id26       7.007e-02  2.090e-02   3.353 0.000802 ***
## mapped_id27      -4.525e-02  2.090e-02  -2.166 0.030362 *
## mapped_id28       8.274e-02  2.094e-02   3.951 7.83e-05 ***
## mapped_id29       4.283e-02  2.094e-02   2.045 0.040864 *
## mapped_id30       1.006e-01  2.090e-02   4.813 1.51e-06 ***
## mapped_id31       1.511e-01  2.090e-02   7.231 5.18e-13 ***
## mapped_id32       4.238e-02  2.090e-02   2.028 0.042567 *
## mapped_id33       5.846e-02  2.090e-02   2.798 0.005156 **
## mapped_id34       3.010e+00  2.090e-02 144.032  < 2e-16 ***
## mapped_id35       6.127e-01  2.090e-02  29.323  < 2e-16 ***
## mapped_id36       1.529e-01  2.090e-02   7.315 2.77e-13 ***
## mapped_id37       3.111e-02  2.090e-02   1.489 0.136529
## mapped_id38       1.664e-01  2.090e-02   7.961 1.90e-15 ***
## mapped_id39       1.655e-01  2.094e-02   7.903 3.01e-15 ***
## mapped_id40       7.988e-02  2.090e-02   3.823 0.000133 ***
## mapped_id41       9.235e-01  2.090e-02  44.194  < 2e-16 ***
## mapped_id42       9.490e-02  2.090e-02   4.541 5.66e-06 ***
## mapped_id43       4.835e-02  2.103e-02   2.299 0.021525 *
## mapped_id44       5.558e-02  2.090e-02   2.660 0.007826 **
## mapped_id45       8.331e-02  2.090e-02   3.987 6.75e-05 ***
## mapped_id46       1.849e-01  2.090e-02   8.850  < 2e-16 ***
## mapped_id47       5.611e-02  2.090e-02   2.685 0.007257 **
## mapped_id48       1.157e-01  2.090e-02   5.539 3.13e-08 ***
## mapped_id49      -5.134e-03  2.090e-02  -0.246 0.805938
## mapped_id50       9.175e-03  2.099e-02   0.437 0.661985
## mapped_id51       2.818e-02  2.139e-02   1.317 0.187710
## mapped_id52       6.047e-02  2.122e-02   2.849 0.004394 **
## mapped_id53      -4.966e-03  2.090e-02  -0.238 0.812145
## mapped_id54      -1.288e-02  2.090e-02  -0.616 0.537583
## mapped_id55       2.115e-01  2.090e-02  10.124  < 2e-16 ***
## mapped_id56       9.241e-02  2.090e-02   4.423 9.86e-06 ***
## mapped_id57      -2.658e-02  2.090e-02  -1.272 0.203329
## mapped_id58       1.195e-01  2.090e-02   5.721 1.09e-08 ***
```

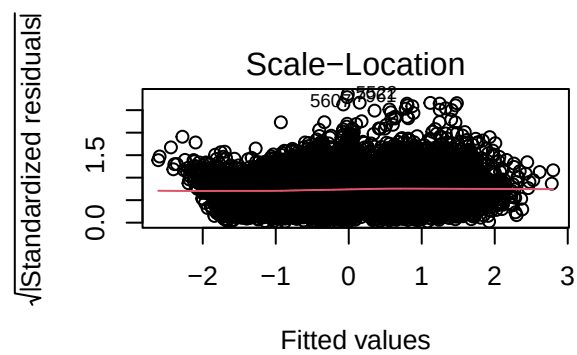
```
## mapped_id59       1.923e-01  2.090e-02   9.202  < 2e-16 ***
## mapped_id60       2.415e-01  2.090e-02  11.559  < 2e-16 ***
## mapped_id61       8.052e-01  2.090e-02  38.532  < 2e-16 ***
## mapped_id62       2.118e-01  2.090e-02  10.136  < 2e-16 ***
## mapped_id63       3.292e+00  2.090e-02 157.555  < 2e-16 ***
## mapped_id64       1.030e+00  2.090e-02  49.279  < 2e-16 ***
## mapped_id65       1.841e+00  2.090e-02  88.122  < 2e-16 ***
## mapped_id66       3.731e-01  2.090e-02  17.858  < 2e-16 ***
## mapped_id67       9.892e-01  2.090e-02  47.342  < 2e-16 ***
## mapped_id68       2.226e+00  2.094e-02 106.296  < 2e-16 ***
## mapped_id69       2.932e+00  2.134e-02 137.388  < 2e-16 ***
## mapped_id70       2.989e-01  2.090e-02  14.306  < 2e-16 ***
## mapped_id71       5.049e-02  2.090e-02   2.416 0.015699 *
## mapped_id72      -5.420e-02  2.090e-02  -2.594 0.009510 **
## mapped_id73       1.371e-01  2.090e-02   6.564 5.53e-11 ***
## mapped_id74       7.731e-02  2.090e-02   3.700 0.000217 ***
## mapped_id75       3.989e-02  2.090e-02   1.909 0.056296 .
## mapped_id76       1.526e-02  2.090e-02   0.730 0.465240
## mapped_id77       2.556e-01  2.094e-02  12.206  < 2e-16 ***
## mapped_id78       1.762e+00  2.094e-02  84.131  < 2e-16 ***
## mapped_id79       2.983e-01  2.090e-02  14.275  < 2e-16 ***
## mapped_id80       3.757e+00  2.090e-02 179.787  < 2e-16 ***
## mapped_id81       3.324e+00  2.099e-02 158.398  < 2e-16 ***
## mapped_id82      -1.979e-03  2.090e-02  -0.095 0.924554
## mapped_id83       6.593e-02  2.090e-02   3.155 0.001610 **
## diff:mapped_id2   4.497e-03  2.089e-02   0.215 0.829586
## diff:mapped_id3   9.852e-02  2.089e-02   4.716 2.44e-06 ***
## diff:mapped_id4   1.603e-01  2.089e-02   7.673 1.84e-14 ***
## diff:mapped_id5   1.656e-01  2.089e-02   7.929 2.46e-15 ***
## diff:mapped_id6   3.287e-01  2.090e-02  15.728  < 2e-16 ***
## diff:mapped_id7   2.435e-02  2.089e-02   1.165 0.243864
## diff:mapped_id8   2.349e-02  2.089e-02   1.124 0.260840
## diff:mapped_id9   5.277e-02  2.089e-02   2.526 0.011562 *
## diff:mapped_id10  1.348e-01  2.092e-02   6.442 1.24e-10 ***
## diff:mapped_id11  6.122e-02  2.089e-02   2.930 0.003396 **
## diff:mapped_id12  2.213e-03  2.089e-02   0.106 0.915656
## diff:mapped_id13  7.059e-02  2.089e-02   3.379 0.000731 ***
## diff:mapped_id14  7.864e-03  2.180e-02   0.361 0.718271
## diff:mapped_id15  4.141e-02  2.089e-02   1.982 0.047475 *
## diff:mapped_id16  1.000e-01  2.089e-02   4.789 1.70e-06 ***
## diff:mapped_id17  1.120e-02  2.089e-02   0.536 0.591824
## diff:mapped_id18  5.159e-05  2.089e-02   0.002 0.998030
## diff:mapped_id19  1.193e+00  2.089e-02  57.088  < 2e-16 ***
## diff:mapped_id20  3.622e-01  2.089e-02  17.335  < 2e-16 ***
## diff:mapped_id21  3.987e-04  2.089e-02   0.019 0.984775
## diff:mapped_id22  2.691e-03  2.089e-02   0.129 0.897522
## diff:mapped_id23  4.156e-02  2.089e-02   1.989 0.046701 *
## diff:mapped_id24  1.587e-02  2.089e-02   0.759 0.447590
## diff:mapped_id25  3.090e-02  2.101e-02   1.471 0.141282
## diff:mapped_id26  4.985e-02  2.089e-02   2.386 0.017050 *
## diff:mapped_id27 -1.910e-03  2.089e-02  -0.091 0.927146
## diff:mapped_id28  8.354e-04  2.093e-02   0.040 0.968156
## diff:mapped_id29  2.254e-02  2.089e-02   1.079 0.280649
## diff:mapped_id30  5.100e-02  2.089e-02   2.441 0.014664 *
```

```
## diff:mapped_id31  8.702e-02  2.089e-02   4.165 3.14e-05 ***
## diff:mapped_id32  1.297e-02  2.089e-02   0.621 0.534607
## diff:mapped_id33  3.647e-02  2.089e-02   1.746 0.080902 .
## diff:mapped_id34  1.270e+00  2.089e-02  60.773  < 2e-16 ***
## diff:mapped_id35  3.689e-01  2.089e-02  17.655  < 2e-16 ***
## diff:mapped_id36  6.366e-02  2.089e-02   3.047 0.002318 **
## diff:mapped_id37  2.425e-02  2.089e-02   1.161 0.245825
## diff:mapped_id38  1.149e-01  2.089e-02   5.500 3.89e-08 ***
## diff:mapped_id39  1.100e-01  2.092e-02   5.258 1.49e-07 ***
## diff:mapped_id40  5.903e-02  2.089e-02   2.826 0.004730 **
## diff:mapped_id41  4.726e-01  2.089e-02  22.622  < 2e-16 ***
## diff:mapped_id42  4.515e-02  2.089e-02   2.161 0.030728 *
## diff:mapped_id43  3.709e-02  2.095e-02   1.771 0.076622 .
## diff:mapped_id44  3.101e-02  2.089e-02   1.484 0.137768
## diff:mapped_id45  4.063e-02  2.089e-02   1.945 0.051838 .
## diff:mapped_id46  1.146e-01  2.089e-02   5.484 4.25e-08 ***
## diff:mapped_id47  4.134e-02  2.089e-02   1.979 0.047855 *
## diff:mapped_id48  6.434e-02  2.089e-02   3.080 0.002078 **
## diff:mapped_id49  4.855e-03  2.089e-02   0.232 0.816258
## diff:mapped_id50  6.594e-03  2.099e-02   0.314 0.753465
## diff:mapped_id51  2.147e-02  2.120e-02   1.013 0.311187
## diff:mapped_id52  3.351e-02  2.121e-02   1.580 0.114139
## diff:mapped_id53  1.072e-02  2.089e-02   0.513 0.607922
## diff:mapped_id54  1.326e-02  2.089e-02   0.634 0.525792
## diff:mapped_id55  9.424e-02  2.089e-02   4.511 6.53e-06 ***
## diff:mapped_id56  5.979e-02  2.089e-02   2.862 0.004220 **
## diff:mapped_id57 -7.626e-03  2.089e-02  -0.365 0.715116
## diff:mapped_id58  7.084e-02  2.089e-02   3.391 0.000700 ***
## diff:mapped_id59  9.347e-02  2.089e-02   4.474 7.77e-06 ***
## diff:mapped_id60  1.033e-01  2.089e-02   4.943 7.81e-07 ***
## diff:mapped_id61  3.522e-01  2.089e-02  16.858  < 2e-16 ***
## diff:mapped_id62  1.123e-01  2.089e-02   5.374 7.87e-08 ***
## diff:mapped_id63  1.845e+00  2.089e-02  88.308  < 2e-16 ***
## diff:mapped_id64  7.205e-01  2.089e-02  34.487  < 2e-16 ***
## diff:mapped_id65  4.962e-01  2.089e-02  23.752  < 2e-16 ***
## diff:mapped_id66  2.209e-01  2.089e-02  10.575  < 2e-16 ***
## diff:mapped_id67  4.342e-01  2.089e-02  20.784  < 2e-16 ***
## diff:mapped_id68  9.630e-01  2.089e-02  46.095  < 2e-16 ***
## diff:mapped_id69  1.643e+00  2.182e-02  75.288  < 2e-16 ***
## diff:mapped_id70  1.661e-01  2.089e-02   7.953 2.03e-15 ***
## diff:mapped_id71  2.822e-02  2.089e-02   1.351 0.176789
## diff:mapped_id72 -1.815e-02  2.089e-02  -0.869 0.385053
## diff:mapped_id73  6.349e-02  2.089e-02   3.039 0.002382 **
## diff:mapped_id74  3.509e-02  2.089e-02   1.680 0.093057 .
## diff:mapped_id75  3.867e-02  2.089e-02   1.851 0.064220 .
## diff:mapped_id76  2.564e-02  2.089e-02   1.227 0.219761
## diff:mapped_id77 -2.019e-02  2.095e-02  -0.964 0.335273
## diff:mapped_id78  9.240e-01  2.089e-02  44.227  < 2e-16 ***
## diff:mapped_id79  1.472e-01  2.089e-02   7.047 1.95e-12 ***
## diff:mapped_id80  1.781e+00  2.089e-02  85.250  < 2e-16 ***
## diff:mapped_id81  1.322e+00  2.102e-02  62.912  < 2e-16 ***
## diff:mapped_id82  2.915e-03  2.089e-02   0.140 0.889034
## diff:mapped_id83  5.321e-02  2.089e-02   2.547 0.010879 *
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1605 on 9574 degrees of freedom
## Multiple R-squared:  0.9742, Adjusted R-squared:  0.9738
## F-statistic:  2195 on 165 and 9574 DF,  p-value: < 2.2e-16
```

Bad assumptions overall so new method





Using observation/mean(building) Change the unit to have better comparison

```
## Anova Table (Type II tests)
##
## Response: avg_con
##                Sum Sq   Df    F value Pr(>F)
## mapped_id         2.8   82     0.2079      1
## diff           7769.2    1 46797.5270 <2e-16 ***
## mapped_id:diff  359.5   82    26.4085 <2e-16 ***
## Residuals      1589.5 9574
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Call:
## lm(formula = avg_con ~ mapped_id + diff + diff:mapped_id, data = htk_avg[-c(3337,
##     3262), ])
##
## Residuals:
##     Min      1Q  Median      3Q     Max
```

```
## -2.8323 -0.2197  0.0096  0.2179  3.3083
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)      -3.131e-04  3.751e-02  -0.008 0.993339
## mapped_id2       -4.832e-05  5.305e-02  -0.001 0.999273
## mapped_id3        1.243e-04  5.305e-02   0.002 0.998130
## mapped_id4       -9.910e-05  5.316e-02  -0.002 0.998513
## mapped_id5       -9.560e-05  5.305e-02  -0.002 0.998562
## mapped_id6        3.486e-03  5.316e-02   0.066 0.947723
## mapped_id7       -4.308e-05  5.305e-02  -0.001 0.999352
## mapped_id8       -1.923e-04  5.305e-02  -0.004 0.997108
## mapped_id9       -9.953e-05  5.305e-02  -0.002 0.998503
## mapped_id10       4.876e-03  5.327e-02   0.092 0.927074
## mapped_id11      -2.321e-04  5.305e-02  -0.004 0.996509
## mapped_id12      -1.753e-04  5.305e-02  -0.003 0.997364
## mapped_id13      -1.168e-04  5.305e-02  -0.002 0.998243
## mapped_id14       8.900e-02  5.442e-02   1.635 0.102010
## mapped_id15      -1.118e-04  5.305e-02  -0.002 0.998319
## mapped_id16      -2.120e-04  5.316e-02  -0.004 0.996818
## mapped_id17      -1.193e-04  5.305e-02  -0.002 0.998205
## mapped_id18       9.864e-05  5.305e-02   0.002 0.998516
## mapped_id19      -1.474e-04  5.305e-02  -0.003 0.997784
## mapped_id20      -2.140e-04  5.305e-02  -0.004 0.996781
## mapped_id21      -7.558e-05  5.305e-02  -0.001 0.998863
## mapped_id22       1.012e-05  5.305e-02   0.000 0.999848
## mapped_id23      -4.810e-05  5.305e-02  -0.001 0.999276
## mapped_id24      -1.170e-04  5.305e-02  -0.002 0.998239
## mapped_id25      -1.328e-02  5.316e-02  -0.250 0.802794
## mapped_id26      -1.304e-04  5.305e-02  -0.002 0.998039
## mapped_id27      -2.707e-04  5.305e-02  -0.005 0.995929
## mapped_id28       2.931e-03  5.316e-02   0.055 0.956032
## mapped_id29      -1.012e-03  5.316e-02  -0.019 0.984811
## mapped_id30      -6.512e-05  5.305e-02  -0.001 0.999021
## mapped_id31      -1.145e-04  5.305e-02  -0.002 0.998278
## mapped_id32       1.551e-05  5.305e-02   0.000 0.999767
## mapped_id33      -8.775e-05  5.305e-02  -0.002 0.998680
## mapped_id34      -4.936e-05  5.305e-02  -0.001 0.999258
## mapped_id35      -1.794e-04  5.305e-02  -0.003 0.997301
## mapped_id36      -2.889e-05  5.305e-02  -0.001 0.999566
## mapped_id37      -9.116e-05  5.305e-02  -0.002 0.998629
## mapped_id38      -1.825e-04  5.305e-02  -0.003 0.997256
## mapped_id39       7.279e-03  5.316e-02   0.137 0.891098
## mapped_id40      -1.512e-04  5.305e-02  -0.003 0.997726
## mapped_id41      -1.168e-04  5.305e-02  -0.002 0.998242
## mapped_id42      -4.955e-05  5.305e-02  -0.001 0.999255
## mapped_id43      -8.641e-03  5.339e-02  -0.162 0.871433
## mapped_id44      -6.357e-05  5.305e-02  -0.001 0.999044
## mapped_id45      -5.130e-05  5.305e-02  -0.001 0.999228
## mapped_id46      -1.481e-04  5.305e-02  -0.003 0.997772
## mapped_id47      -1.226e-04  5.305e-02  -0.002 0.998156
## mapped_id48      -9.299e-05  5.305e-02  -0.002 0.998601
## mapped_id49      -6.710e-05  5.305e-02  -0.001 0.998991
## mapped_id50      -9.858e-03  5.328e-02  -0.185 0.853207
```

```
## mapped_id51       4.719e-02  5.430e-02   0.869 0.384789
## mapped_id52      -4.801e-03  5.388e-02  -0.089 0.928991
## mapped_id53      -1.248e-04  5.305e-02  -0.002 0.998123
## mapped_id54      -1.967e-04  5.305e-02  -0.004 0.997041
## mapped_id55      -4.974e-05  5.305e-02  -0.001 0.999252
## mapped_id56      -1.231e-04  5.305e-02  -0.002 0.998148
## mapped_id57      -2.687e-05  5.305e-02  -0.001 0.999596
## mapped_id58      -1.122e-04  5.305e-02  -0.002 0.998312
## mapped_id59      -7.199e-05  5.305e-02  -0.001 0.998917
## mapped_id60      -4.046e-05  5.305e-02  -0.001 0.999391
## mapped_id61      -5.771e-05  5.305e-02  -0.001 0.999132
## mapped_id62      -1.007e-04  5.305e-02  -0.002 0.998485
## mapped_id63      -1.657e-04  5.305e-02  -0.003 0.997507
## mapped_id64      -2.668e-04  5.305e-02  -0.005 0.995987
## mapped_id65       7.679e-05  5.305e-02   0.001 0.998845
## mapped_id66      -1.588e-04  5.305e-02  -0.003 0.997612
## mapped_id67      -6.003e-05  5.305e-02  -0.001 0.999097
## mapped_id68      -1.847e-04  5.316e-02  -0.003 0.997227
## mapped_id69      -1.069e-01  5.417e-02  -1.973 0.048473 *
## mapped_id70      -1.274e-04  5.305e-02  -0.002 0.998084
## mapped_id71      -6.014e-05  5.305e-02  -0.001 0.999096
## mapped_id72      -3.517e-05  5.305e-02  -0.001 0.999471
## mapped_id73      -5.173e-05  5.305e-02  -0.001 0.999222
## mapped_id74      -3.595e-05  5.305e-02  -0.001 0.999459
## mapped_id75      -1.588e-04  5.305e-02  -0.003 0.997611
## mapped_id76      -1.624e-04  5.305e-02  -0.003 0.997557
## mapped_id77       9.771e-04  5.316e-02   0.018 0.985335
## mapped_id78      -2.850e-04  5.316e-02  -0.005 0.995722
## mapped_id79      -8.627e-05  5.305e-02  -0.002 0.998702
## mapped_id80      -9.363e-05  5.305e-02  -0.002 0.998592
## mapped_id81      -7.196e-02  5.328e-02  -1.351 0.176849
## mapped_id82      -3.501e-05  5.305e-02  -0.001 0.999473
## mapped_id83      -1.605e-04  5.305e-02  -0.003 0.997586
## diff              7.049e-01  3.750e-02  18.795  < 2e-16 ***
## mapped_id2:diff   1.088e-01  5.304e-02   2.051 0.040324 *
## mapped_id3:diff  -2.798e-01  5.304e-02  -5.275 1.35e-07 ***
## mapped_id4:diff  -1.360e-02  5.304e-02  -0.256 0.797697
## mapped_id5:diff   2.152e-01  5.304e-02   4.057 5.00e-05 ***
## mapped_id6:diff   2.739e-01  5.306e-02   5.162 2.49e-07 ***
## mapped_id7:diff   9.697e-02  5.304e-02   1.828 0.067515 .
## mapped_id8:diff   4.328e-01  5.304e-02   8.160 3.78e-16 ***
## mapped_id9:diff   2.240e-01  5.304e-02   4.224 2.42e-05 ***
## mapped_id10:diff -1.937e-02  5.312e-02  -0.365 0.715404
## mapped_id11:diff  5.224e-01  5.304e-02   9.850  < 2e-16 ***
## mapped_id12:diff  3.945e-01  5.304e-02   7.438 1.11e-13 ***
## mapped_id13:diff  2.629e-01  5.304e-02   4.956 7.31e-07 ***
## mapped_id14:diff  1.596e-01  5.534e-02   2.885 0.003925 **
## mapped_id15:diff  2.516e-01  5.304e-02   4.744 2.12e-06 ***
## mapped_id16:diff  1.758e-01  5.304e-02   3.314 0.000923 ***
## mapped_id17:diff  2.686e-01  5.304e-02   5.064 4.17e-07 ***
## mapped_id18:diff -2.220e-01  5.304e-02  -4.186 2.86e-05 ***
## mapped_id19:diff  3.317e-01  5.304e-02   6.254 4.17e-10 ***
## mapped_id20:diff  4.817e-01  5.304e-02   9.083  < 2e-16 ***
## mapped_id21:diff  1.701e-01  5.304e-02   3.207 0.001344 **
```

```
## mapped_id22:diff -2.277e-02  5.304e-02  -0.429 0.667719
## mapped_id23:diff  1.083e-01  5.304e-02   2.041 0.041229 *
## mapped_id24:diff  2.635e-01  5.304e-02   4.968 6.90e-07 ***
## mapped_id25:diff  2.710e-01  5.332e-02   5.082 3.80e-07 ***
## mapped_id26:diff  2.935e-01  5.304e-02   5.533 3.22e-08 ***
## mapped_id27:diff  6.093e-01  5.304e-02  11.488  < 2e-16 ***
## mapped_id28:diff -3.248e-01  5.312e-02  -6.115 1.00e-09 ***
## mapped_id29:diff  1.008e-01  5.304e-02   1.900 0.057446 .
## mapped_id30:diff  1.466e-01  5.304e-02   2.764 0.005728 **
## mapped_id31:diff  2.577e-01  5.304e-02   4.858 1.20e-06 ***
## mapped_id32:diff -3.491e-02  5.304e-02  -0.658 0.510462
## mapped_id33:diff  1.975e-01  5.304e-02   3.724 0.000197 ***
## mapped_id34:diff  1.111e-01  5.304e-02   2.095 0.036223 *
## mapped_id35:diff  4.039e-01  5.304e-02   7.615 2.88e-14 ***
## mapped_id36:diff  6.502e-02  5.304e-02   1.226 0.220267
## mapped_id37:diff  2.052e-01  5.304e-02   3.869 0.000110 ***
## mapped_id38:diff  4.107e-01  5.304e-02   7.743 1.07e-14 ***
## mapped_id39:diff  3.814e-01  5.311e-02   7.182 7.38e-13 ***
## mapped_id40:diff  3.404e-01  5.304e-02   6.417 1.45e-10 ***
## mapped_id41:diff  2.630e-01  5.304e-02   4.959 7.20e-07 ***
## mapped_id42:diff  1.115e-01  5.304e-02   2.103 0.035495 *
## mapped_id43:diff  2.671e-01  5.317e-02   5.023 5.19e-07 ***
## mapped_id44:diff  1.431e-01  5.304e-02   2.698 0.006993 **
## mapped_id45:diff  1.155e-01  5.304e-02   2.177 0.029485 *
## mapped_id46:diff  3.334e-01  5.304e-02   6.287 3.38e-10 ***
## mapped_id47:diff  2.760e-01  5.304e-02   5.203 2.00e-07 ***
## mapped_id48:diff  2.093e-01  5.304e-02   3.946 7.99e-05 ***
## mapped_id49:diff  1.510e-01  5.304e-02   2.848 0.004412 **
## mapped_id50:diff  5.907e-02  5.330e-02   1.108 0.267720
## mapped_id51:diff  2.041e-01  5.383e-02   3.792 0.000151 ***
## mapped_id52:diff  1.457e-01  5.384e-02   2.706 0.006813 **
## mapped_id53:diff  2.810e-01  5.304e-02   5.298 1.20e-07 ***
## mapped_id54:diff  4.428e-01  5.304e-02   8.350  < 2e-16 ***
## mapped_id55:diff  1.120e-01  5.304e-02   2.111 0.034815 *
## mapped_id56:diff  2.772e-01  5.304e-02   5.226 1.77e-07 ***
## mapped_id57:diff  6.048e-02  5.304e-02   1.140 0.254143
## mapped_id58:diff  2.526e-01  5.304e-02   4.763 1.93e-06 ***
## mapped_id59:diff  1.620e-01  5.304e-02   3.055 0.002255 **
## mapped_id60:diff  9.106e-02  5.304e-02   1.717 0.086016 .
## mapped_id61:diff  1.299e-01  5.304e-02   2.449 0.014328 *
## mapped_id62:diff  2.267e-01  5.304e-02   4.275 1.93e-05 ***
## mapped_id63:diff  3.731e-01  5.304e-02   7.034 2.14e-12 ***
## mapped_id64:diff  6.006e-01  5.304e-02  11.323  < 2e-16 ***
## mapped_id65:diff -1.729e-01  5.304e-02  -3.259 0.001122 **
## mapped_id66:diff  3.573e-01  5.304e-02   6.737 1.71e-11 ***
## mapped_id67:diff  1.351e-01  5.304e-02   2.548 0.010857 *
## mapped_id68:diff  1.300e-01  5.304e-02   2.451 0.014252 *
## mapped_id69:diff  3.128e-01  5.540e-02   5.645 1.70e-08 ***
## mapped_id70:diff  2.867e-01  5.304e-02   5.406 6.59e-08 ***
## mapped_id71:diff  1.354e-01  5.304e-02   2.552 0.010722 *
## mapped_id72:diff  7.916e-02  5.304e-02   1.493 0.135588
## mapped_id73:diff  1.164e-01  5.304e-02   2.196 0.028150 *
## mapped_id74:diff  8.093e-02  5.304e-02   1.526 0.127068
## mapped_id75:diff  3.575e-01  5.304e-02   6.741 1.66e-11 ***
```

```
## mapped_id76:diff  3.656e-01  5.304e-02   6.893 5.79e-12 ***
## mapped_id77:diff -6.320e-01  5.318e-02 -11.884  < 2e-16 ***
## mapped_id78:diff  2.981e-01  5.304e-02   5.621 1.95e-08 ***
## mapped_id79:diff  1.942e-01  5.304e-02   3.661 0.000252 ***
## mapped_id80:diff  2.107e-01  5.304e-02   3.974 7.13e-05 ***
## mapped_id81:diff  3.739e-02  5.336e-02   0.701 0.483576
## mapped_id82:diff  7.881e-02  5.304e-02   1.486 0.137324
## mapped_id83:diff  3.612e-01  5.304e-02   6.811 1.03e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4075 on 9574 degrees of freedom
## Multiple R-squared:  0.8365, Adjusted R-squared:  0.8336
## F-statistic: 296.8 on 165 and 9574 DF,  p-value: < 2.2e-16
```

Improving the model

Creating maximal model and scoping it down all parameters + all interactions of diff and parameters

```
## Note: model has aliased coefficients
##       sums of squares computed by model comparison
```

```
## Anova Table (Type II tests)
##
## Response: avg_con
##               Sum Sq   Df    F value    Pr(>F)
## ID               3.1   82     0.2617  1.000000
## hum             24.7    1   171.1142 < 2.2e-16 ***
## wind_spd        71.1    1   493.0220 < 2.2e-16 ***
## pressure         2.3    1    15.7424 7.311e-05 ***
## cond            53.8    9    41.4751 < 2.2e-16 ***
## fog              8.1    1    55.8491 8.513e-14 ***
## rain             4.0    1    27.5856 1.535e-07 ***
## diff          5208.8    1 36108.6124 < 2.2e-16 ***
## ID:diff        359.8   82    30.4195 < 2.2e-16 ***
## wind_spd:diff    9.1    1    62.9800 2.323e-15 ***
## hum:diff        21.8    1   150.7999 < 2.2e-16 ***
## pressure:diff    1.1    1     7.2801  0.006985 **
## cond:diff       33.0    8    28.6041 < 2.2e-16 ***
## fog:diff         0.1    1     0.3722  0.541823
## rain:diff        0.0    1     0.0678  0.794503
## Residuals     1377.2 9547
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Model :
## avg_con ~ ((ID + dew_pt + hum + wind_spd + dir + vis + pressure +
##     cond + fog + rain + diff) - vis - dew_pt - dir) + diff:(ID +
##     wind_spd + hum + pressure + cond + fog + rain)
##
## Complete :
##                         (Intercept) ID4529800  ID4839509  ID4866195  ID4887707
## condPatches of Fog:diff          0           0          0          0          0
##                         ID4962433  ID5037175  ID5093913  ID5093998  ID5140250
## condPatches of Fog:diff          0          0          0          0          0
```

```
##                          ID5325295  ID6392057  ID6392146  ID6392172  ID6393013
## condPatches of Fog:diff          0          0          0          0          0
##                          ID6393014  ID6540708  ID6567326  ID6618578  ID6618580
## condPatches of Fog:diff          0          0          0          0          0
##                          ID6627217  ID6627258  ID6627261  ID6627320  ID6681763
## condPatches of Fog:diff          0          0          0          0          0
##                          ID6681892  ID6681894  ID6790785  ID6790798  ID6842413
## condPatches of Fog:diff          0          0          0          0          0
##                          ID6842421  ID6842603  ID6842762  ID6921678  ID6940321
## condPatches of Fog:diff          0          0          0          0          0
##                          ID6940322  ID7072161  ID7072231  ID7072241  ID7072337
## condPatches of Fog:diff          0          0          0          0          0
##                          ID7183151  ID65005112 ID65012411 ID65014229 ID65014274
## condPatches of Fog:diff          0          0          0          0          0
##                          ID65052581 ID65063195 ID65063211 ID65063303 ID65067046
## condPatches of Fog:diff          0          0          0          0          0
##                          ID65118755 ID65118764 ID65118805 ID65118812 ID65118826
## condPatches of Fog:diff          0          0          0          0          0
##                          ID65118829 ID65118840 ID65118848 ID69001263 ID69001269
## condPatches of Fog:diff          0          0          0          0          0
##                          ID69089222 ID69250492 ID69429582 ID69469107 ID69478883
## condPatches of Fog:diff          0          0          0          0          0
##                          ID69518080 ID69518092 ID69580701 ID69585544 ID69585545
## condPatches of Fog:diff          0          0          0          0          0
##                          ID69611360 ID69652588 ID69652603 ID69688095 ID69749518
## condPatches of Fog:diff          0          0          0          0          0
##                          ID69861509 ID69999051 ID69999094 ID78082613 ID78138095
## condPatches of Fog:diff          0          0          0          0          0
##                          ID78185925 ID78443775 ID78673711 hum        wind_spd
## condPatches of Fog:diff          0          0          0          0          0
##                          pressure   condFog    condLight Rain condLight Snow
## condPatches of Fog:diff          0          0          0               0
##                          condMist   condMostly Cloudy condOvercast
## condPatches of Fog:diff          0          0                 0
##                          condPartly Cloudy condPatches of Fog
## condPatches of Fog:diff          0        3740/42629
##                          condScattered Clouds fog1       rain1      diff
## condPatches of Fog:diff          0                     0          0          0
##                          ID4529800:diff ID4839509:diff ID4866195:diff
## condPatches of Fog:diff          0              0              0
##                          ID4887707:diff ID4962433:diff ID5037175:diff
## condPatches of Fog:diff          0              0              0
##                          ID5093913:diff ID5093998:diff ID5140250:diff
## condPatches of Fog:diff          0              0              0
##                          ID5325295:diff ID6392057:diff ID6392146:diff
## condPatches of Fog:diff          0              0              0
##                          ID6392172:diff ID6393013:diff ID6393014:diff
## condPatches of Fog:diff          0              0              0
##                          ID6540708:diff ID6567326:diff ID6618578:diff
## condPatches of Fog:diff          0              0              0
##                          ID6618580:diff ID6627217:diff ID6627258:diff
## condPatches of Fog:diff          0              0              0
##                          ID6627261:diff ID6627320:diff ID6681763:diff
## condPatches of Fog:diff          0              0              0
```

```
##                          ID6681892:diff ID6681894:diff ID6790785:diff
## condPatches of Fog:diff          0              0              0
##                          ID6790798:diff ID6842413:diff ID6842421:diff
## condPatches of Fog:diff          0              0              0
##                          ID6842603:diff ID6842762:diff ID6921678:diff
## condPatches of Fog:diff          0              0              0
##                          ID6940321:diff ID6940322:diff ID7072161:diff
## condPatches of Fog:diff          0              0              0
##                          ID7072231:diff ID7072241:diff ID7072337:diff
## condPatches of Fog:diff          0              0              0
##                          ID7183151:diff ID65005112:diff ID65012411:diff
## condPatches of Fog:diff          0              0               0
##                          ID65014229:diff ID65014274:diff ID65052581:diff
## condPatches of Fog:diff          0               0               0
##                          ID65063195:diff ID65063211:diff ID65063303:diff
## condPatches of Fog:diff          0               0               0
##                          ID65067046:diff ID65118755:diff ID65118764:diff
## condPatches of Fog:diff          0               0               0
##                          ID65118805:diff ID65118812:diff ID65118826:diff
## condPatches of Fog:diff          0               0               0
##                          ID65118829:diff ID65118840:diff ID65118848:diff
## condPatches of Fog:diff          0               0               0
##                          ID69001263:diff ID69001269:diff ID69089222:diff
## condPatches of Fog:diff          0               0               0
##                          ID69250492:diff ID69429582:diff ID69469107:diff
## condPatches of Fog:diff          0               0               0
##                          ID69478883:diff ID69518080:diff ID69518092:diff
## condPatches of Fog:diff          0               0               0
##                          ID69580701:diff ID69585544:diff ID69585545:diff
## condPatches of Fog:diff          0               0               0
##                          ID69611360:diff ID69652588:diff ID69652603:diff
## condPatches of Fog:diff          0               0               0
##                          ID69688095:diff ID69749518:diff ID69861509:diff
## condPatches of Fog:diff          0               0               0
##                          ID69999051:diff ID69999094:diff ID78082613:diff
## condPatches of Fog:diff          0               0               0
##                          ID78138095:diff ID78185925:diff ID78443775:diff
## condPatches of Fog:diff          0               0               0
##                          ID78673711:diff wind_spd:diff hum:diff   pressure:diff
## condPatches of Fog:diff          0               0             0          0
##                          condFog:diff condLight Rain:diff condLight Snow:diff
## condPatches of Fog:diff          0            0                  0
##                          condMist:diff condMostly Cloudy:diff condOvercast:diff
## condPatches of Fog:diff          0             0                      0
##                          condPartly Cloudy:diff condScattered Clouds:diff
## condPatches of Fog:diff          0                      0
##                          fog1:diff  rain1:diff
## condPatches of Fog:diff          0          0
```

```
## Anova Table (Type II tests)
##
## Response: avg_con
##               Sum Sq   Df    F value    Pr(>F)
## ID               3.0   82     0.2454  1.000000
```

```
## hum             20.4    1   138.0054 < 2.2e-16 ***
## wind_spd        59.2    1   401.3590 < 2.2e-16 ***
## pressure         1.5    1     9.9933  0.001576 **
## cond            53.8    9    40.5382 < 2.2e-16 ***
## fog              8.5    1    57.4168 3.854e-14 ***
## rain            11.8    1    79.7011 < 2.2e-16 ***
## diff          5208.8    1 35292.9308 < 2.2e-16 ***
## ID:diff        359.6   82    29.7106 < 2.2e-16 ***
## wind_spd:diff   18.0    1   121.6765 < 2.2e-16 ***
## hum:diff        11.8    1    79.8296 < 2.2e-16 ***
## pressure:diff    0.0    1     0.0561  0.812747
## fog:diff         0.3    1     1.8789  0.170490
## rain:diff        0.3    1     2.3545  0.124951
## Residuals     1410.2 9555
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Anova Table (Type II tests)
##
## Response: avg_con
##               Sum Sq   Df    F value    Pr(>F)
## ID               3.0   82     0.2454  1.000000
## hum             20.1    1   136.4964 < 2.2e-16 ***
## wind_spd        56.8    1   385.1392 < 2.2e-16 ***
## pressure         1.5    1     9.9943  0.001575 **
## cond            55.5    9    41.7575 < 2.2e-16 ***
## fog              8.5    1    57.5326 3.635e-14 ***
## rain            11.9    1    80.7483 < 2.2e-16 ***
## diff          5208.8    1 35296.4171 < 2.2e-16 ***
## ID:diff        359.6   82    29.7132 < 2.2e-16 ***
## wind_spd:diff   21.5    1   145.6169 < 2.2e-16 ***
## hum:diff        12.0    1    81.3048 < 2.2e-16 ***
## fog:diff         0.3    1     1.8791  0.170470
## rain:diff        0.3    1     2.3051  0.128980
## Residuals     1410.2 9556
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Anova Table (Type II tests)
##
## Response: avg_con
##               Sum Sq   Df    F value    Pr(>F)
## ID               3.0   82     0.2447  1.000000
## hum             20.8    1   140.9221 < 2.2e-16 ***
## wind_spd        56.9    1   385.6073 < 2.2e-16 ***
## pressure         1.4    1     9.7674  0.001782 **
## cond            55.6    9    41.8303 < 2.2e-16 ***
## fog              8.5    1    57.5273 3.644e-14 ***
## rain            11.8    1    80.1582 < 2.2e-16 ***
## diff          5208.8    1 35293.1707 < 2.2e-16 ***
## ID:diff        359.5   82    29.7092 < 2.2e-16 ***
## wind_spd:diff   21.3    1   144.1411 < 2.2e-16 ***
## hum:diff        12.0    1    81.0339 < 2.2e-16 ***
## rain:diff        0.3    1     2.2967  0.129683
## Residuals     1410.5 9557
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## Anova Table (Type II tests)
##
## Response: avg_con
##               Sum Sq   Df    F value    Pr(>F)
## ID               3.0   82     0.2451  1.000000
## hum             21.0    1   142.4016 < 2.2e-16 ***
## wind_spd        57.4    1   389.0674 < 2.2e-16 ***
## pressure         1.5    1    10.1773  0.001426 **
## cond            55.3    9    41.6573 < 2.2e-16 ***
## fog              8.5    1    57.3922 3.902e-14 ***
## rain            11.8    1    80.1474 < 2.2e-16 ***
## diff          5208.8    1 35288.3833 < 2.2e-16 ***
## ID:diff        359.6   82    29.7069 < 2.2e-16 ***
## wind_spd:diff   21.0    1   142.5424 < 2.2e-16 ***
## hum:diff        11.6    1    78.7354 < 2.2e-16 ***
## Residuals     1410.8 9558
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```