Metro Interstate Traffic Volumen

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GOAL

We will be analyzing how changes in the climate can affect the traffic volume for westbound interstate I-94 from 2012-2018. Then we carry out a multilinear regression model to predict how temperature, raining and snow could impact the traffic volume.

Data set information

We selected the metro interstate traffic volume data set from the UCI Machine Learning Repository (2022). The data was captured from hourly Interstate 94 Westbound traffic volume for MN DoT ATR station 301, roughly midway between Minneapolis and St Paul, MN. Hourly weather features and holidays included for impacts on traffic volume.The data set belong to Traffic data from Minnesota Department of Transportation - USA.

#STEP 1: READ AND PROCESS THE DATA ##1.1 Read the data

```
df <- read.csv("Metro_Interstate_Traffic_Volume.csv", header=TRUE, sep=",")
head(df, 3)
```

```
##   holiday   temp rain_1h snow_1h clouds_all weather_main weather_description
## 1    None 288.28       0       0         40       Clouds    scattered clouds
## 2    None 289.36       0       0         75       Clouds       broken clouds
## 3    None 289.58       0       0         90       Clouds     overcast clouds
##             date_time traffic_volume
## 1 2012-10-02 09:00:00           5545
## 2 2012-10-02 10:00:00           4516
## 3 2012-10-02 11:00:00           4767
```

##1.2 Process the data ###1.2.1 check unique value

```
unique(df$holiday)
```

```
##  [1] "None"                      "Columbus Day"
##  [3] "Veterans Day"              "Thanksgiving Day"
##  [5] "Christmas Day"             "New Years Day"
##  [7] "Washingtons Birthday"      "Memorial Day"
##  [9] "Independence Day"          "State Fair"
## [11] "Labor Day"                 "Martin Luther King Jr Day"
```

```
unique(df$weather_main)
```

```
##  [1] "Clouds"       "Clear"        "Rain"         "Drizzle"      "Mist"
##  [6] "Haze"         "Fog"          "Thunderstorm" "Snow"         "Squall"
## [11] "Smoke"
```

###1.2.2 check null and blank value, drop row that contain null or blank value

```
sum(is.na(df))
```

```
## [1] 0
```

```
sum(df=="")
```

```
## [1] 0
```

###1.2.3 split date and time column variable

```
df$time <- as.integer(format(as.POSIXct(df$date_time), format = "%H"))
head(df)
```

```
##   holiday   temp rain_1h snow_1h clouds_all weather_main weather_description
## 1    None 288.28       0       0         40       Clouds    scattered clouds
## 2    None 289.36       0       0         75       Clouds       broken clouds
## 3    None 289.58       0       0         90       Clouds     overcast clouds
## 4    None 290.13       0       0         90       Clouds     overcast clouds
## 5    None 291.14       0       0         75       Clouds       broken clouds
## 6    None 291.72       0       0          1        Clear        sky is clear
##             date_time traffic_volume time
## 1 2012-10-02 09:00:00           5545    9
## 2 2012-10-02 10:00:00           4516   10
## 3 2012-10-02 11:00:00           4767   11
## 4 2012-10-02 12:00:00           5026   12
## 5 2012-10-02 13:00:00           4918   13
## 6 2012-10-02 14:00:00           5181   14
```

###1.2.3 drop unneeded columns and rows

```
df <- df[,-c(7,8)]
head(df)
```

```
##   holiday   temp rain_1h snow_1h clouds_all weather_main traffic_volume time
## 1    None 288.28       0       0         40       Clouds           5545    9
## 2    None 289.36       0       0         75       Clouds           4516   10
## 3    None 289.58       0       0         90       Clouds           4767   11
## 4    None 290.13       0       0         90       Clouds           5026   12
## 5    None 291.14       0       0         75       Clouds           4918   13
## 6    None 291.72       0       0          1        Clear           5181   14
```

```r
#There were deleted temperature values as 0 because is outside kelvin range
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
df <- df %>% filter(temp >= 243)
```

#STEP 2: TRANSFORMING DATA SET ##2.1 check categories variable frequency ##load & required package

```r
#install.packages("dplyr")
library(dplyr)
#install.packages("funModeling")
library(funModeling)
```

```
## Loading required package: Hmisc

## Loading required package: lattice

## Loading required package: survival

## Loading required package: Formula

## Loading required package: ggplot2

##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:dplyr':
##
##     src, summarize

## The following objects are masked from 'package:base':
##
##     format.pval, units

## funModeling v.1.9.4 :)
## Examples and tutorials at livebook.datascienceheroes.com
##  / Now in Spanish: librovivodecienciadedatos.ai
```

2.2 First approaching of exploation data analytics (EDA)

```r
basic_eda <- function(df)
{
  glimpse(df)
  print(status(df))
  freq(df, path_out = ".")
  print(profiling_num(df))
  plot_num(df)
  describe(df)
}
basic_eda(df)
```

```
## Rows: 48,194
## Columns: 8
## $ holiday        <chr> "None", "None", "None", "None", "None", "None", "None",~
## $ temp           <dbl> 288.28, 289.36, 289.58, 290.13, 291.14, 291.72, 293.17,~
## $ rain_1h        <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0~
## $ snow_1h        <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0~
## $ clouds_all     <int> 40, 75, 90, 90, 75, 1, 1, 1, 20, 20, 20, 1, 1, 1, 1, 1,~
## $ weather_main   <chr> "Clouds", "Clouds", "Clouds", "Clouds", "Clouds", "Clea~
## $ traffic_volume <int> 5545, 4516, 4767, 5026, 4918, 5181, 5584, 6015, 5791, 4~
## $ time           <int> 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, ~
##                      variable q_zeros      p_zeros q_na p_na q_inf p_inf
## holiday               holiday       0 0.000000e+00    0    0     0     0
## temp                     temp       0 0.000000e+00    0    0     0     0
## rain_1h               rain_1h   44727 9.280616e-01    0    0     0     0
## snow_1h               snow_1h   48131 9.986928e-01    0    0     0     0
## clouds_all         clouds_all    1978 4.104245e-02    0    0     0     0
## weather_main     weather_main       0 0.000000e+00    0    0     0     0
## traffic_volume traffic_volume       2 4.149894e-05    0    0     0     0
## time                     time    2037 4.226667e-02    0    0     0     0
##                      type unique
## holiday         character     12
## temp              numeric   5842
## rain_1h           numeric    372
## snow_1h           numeric     12
## clouds_all        integer     60
## weather_main    character     11
## traffic_volume    integer   6704
## time              integer     24
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

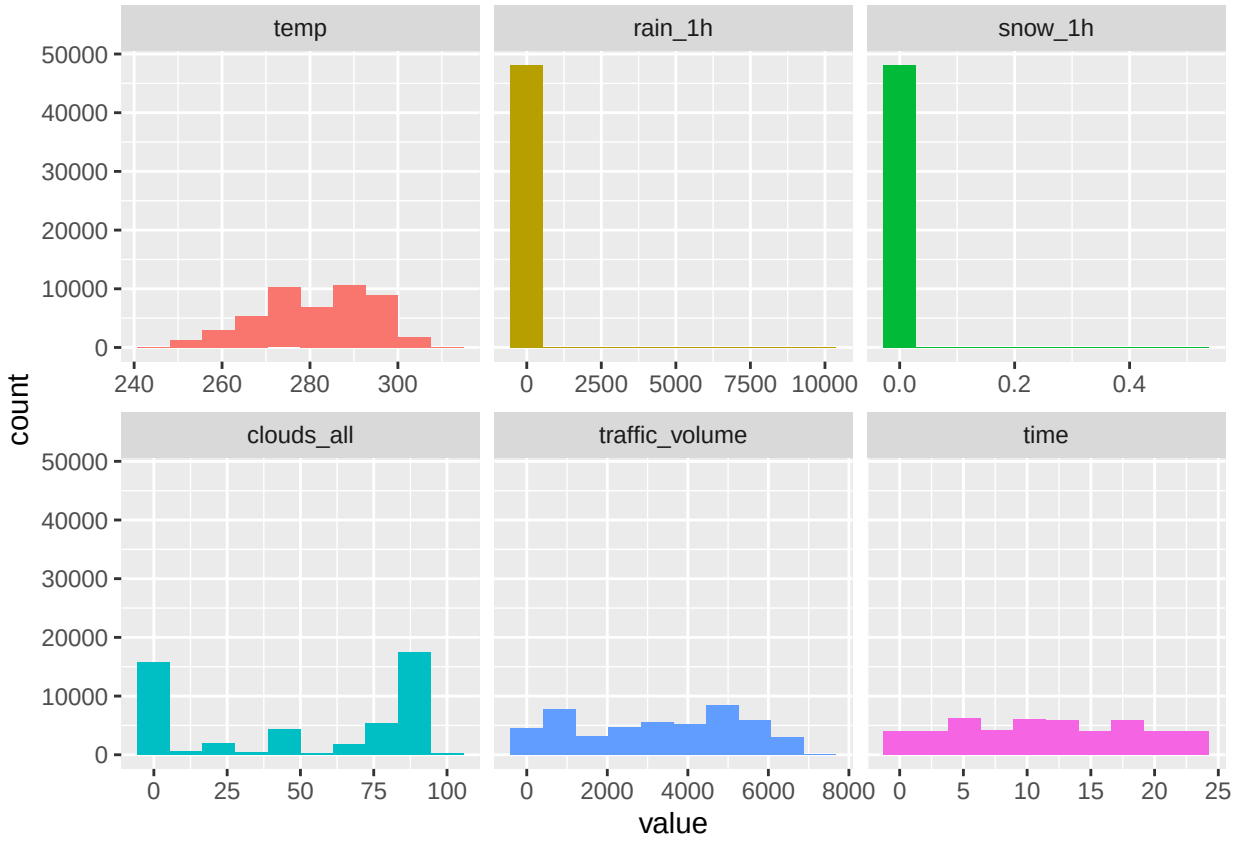
```
##                      holiday frequency percentage cumulative_perc
## 1                       None     48133      99.87           99.87
## 2                  Labor Day         7       0.01           99.88
## 3               Christmas Day         6       0.01           99.89
## 4  Martin Luther King Jr Day         6       0.01           99.90
## 5                New Years Day         6       0.01           99.91
## 6            Thanksgiving Day         6       0.01           99.92
## 7                Columbus Day         5       0.01           99.93
## 8            Independence Day         5       0.01           99.94
```

```
## 9               Memorial Day         5       0.01           99.95
## 10                State Fair         5       0.01           99.96
## 11              Veterans Day         5       0.01           99.97
## 12      Washingtons Birthday         5       0.01          100.00
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

```
##    weather_main frequency percentage cumulative_perc
## 1        Clouds     15164      31.46           31.46
## 2         Clear     13381      27.76           59.22
## 3          Mist      5950      12.35           71.57
## 4          Rain      5672      11.77           83.34
## 5          Snow      2876       5.97           89.31
## 6       Drizzle      1821       3.78           93.09
## 7          Haze      1360       2.82           95.91
## 8  Thunderstorm      1034       2.15           98.06
## 9           Fog       912       1.89           99.95
## 10        Smoke        20       0.04           99.99
## 11       Squall         4       0.01          100.00
##
##         variable         mean      std_dev variation_coef     p_01   p_05
## 1           temp 2.812642e+02 1.270959e+01     0.04518736 250.8393 258.36
## 2        rain_1h 3.343333e-01 4.479378e+01   133.97940551   0.0000   0.00
## 3        snow_1h 2.224343e-04 8.168458e-03    36.72300942   0.0000   0.00
## 4     clouds_all 4.937247e+01 3.901332e+01     0.79018357   0.0000   1.00
## 5 traffic_volume 3.260221e+03 1.986760e+03     0.60939436 257.0000 339.00
## 6           time 1.139947e+01 6.940327e+00     0.60882902   0.0000   1.00
##        p_25    p_50    p_75    p_95      p_99     skewness     kurtosis
## 1  272.1825  282.46  291.81  299.29  302.8214  -0.36418301     2.341424
## 2    0.0000    0.00    0.00    0.30    3.2707 219.35945119 48143.642048
## 3    0.0000    0.00    0.00    0.00    0.0000  48.36095631  2622.649431
## 4    1.0000   64.00   90.00   90.00   92.0000  -0.19769572     1.258041
## 5 1194.0000 3380.50 4933.00 6197.00 6702.0000  -0.08964507     1.691130
## 6    5.0000   11.00   17.00   22.00   23.0000   0.02896515     1.789914
##         iqr            range_98      range_80
## 1   19.6275 [250.8393, 302.8214] [264, 296.69]
## 2    0.0000          [0, 3.2707]        [0, 0]
## 3    0.0000               [0, 0]        [0, 0]
## 4   89.0000              [0, 92]       [1, 90]
## 5 3739.0000          [257, 6702]   [425, 5820]
## 6   12.0000              [0, 23]       [2, 21]
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```




```
## df
##
##  8  Variables      48194  Observations
## ---------------------------------------------------------------------------
## holiday
##        n  missing distinct
##    48194        0       12
##
## lowest : Christmas Day             Columbus Day              Independence Day          Labor Day
## highest: None                      State Fair                Thanksgiving Day          Veterans Day
## ---------------------------------------------------------------------------
## temp
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    48194        0     5842        1    281.3    14.49    258.4    264.0
##      .25      .50      .75      .90      .95
##    272.2    282.5    291.8    296.7    299.3
##
## lowest : 243.39 243.62 244.22 244.82 244.89, highest: 308.87 308.95 309.08 309.29 310.07
## ---------------------------------------------------------------------------
## rain_1h
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    48194        0      372    0.201   0.3343    0.662      0.0      0.0
##      .25      .50      .75      .90      .95
##      0.0      0.0      0.0      0.0      0.3
##
## lowest :    0.00    0.25    0.26    0.27    0.28
```

```
## highest:   28.70   31.75   44.45   55.63 9831.30
##
## Value          0   100  9800
## Frequency  48192     1     1
## Proportion     1     0     0
##
## For the frequency table, variable is rounded to the nearest 100
## ------------------------------------------------------------------------------
## snow_1h
##         n   missing  distinct      Info      Mean       Gmd       .05       .10
##     48194         0        12     0.004 0.0002224 0.0004446         0         0
##       .25       .50       .75       .90       .95
##         0         0         0         0         0
##
## lowest : 0.00 0.05 0.06 0.08 0.10, highest: 0.21 0.25 0.32 0.44 0.51
##
## Value       0.00  0.05  0.06  0.08  0.10  0.13  0.17  0.21  0.25  0.32  0.44
## Frequency  48131    14    12     2     6     6     3     1     6     5     2
## Proportion 0.999 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
##
## Value       0.51
## Frequency      6
## Proportion 0.000
## ------------------------------------------------------------------------------
## clouds_all
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    48194        0       60     0.94    49.37    42.52        1        1
##      .25      .50      .75      .90      .95
##        1       64       90       90       90
##
## lowest :   0   1   2   3   4, highest:  96  97  98  99 100
## ------------------------------------------------------------------------------
## weather_main
##        n  missing distinct
##    48194        0       11
##
## lowest : Clear        Clouds       Drizzle      Fog          Haze
## highest: Rain         Smoke        Snow         Squall       Thunderstorm
##
## Clear (13381, 0.278), Clouds (15164, 0.315), Drizzle (1821, 0.038), Fog (912,
## 0.019), Haze (1360, 0.028), Mist (5950, 0.123), Rain (5672, 0.118), Smoke (20,
## 0.000), Snow (2876, 0.060), Squall (4, 0.000), Thunderstorm (1034, 0.021)
## ------------------------------------------------------------------------------
## traffic_volume
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    48194        0     6704        1     3260     2282      339      425
##      .25      .50      .75      .90      .95
##     1194     3380     4933     5820     6197
##
## lowest :    0    1    2    3    5, highest: 7213 7217 7241 7260 7280
## ------------------------------------------------------------------------------
## time
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    48194        0       24    0.998     11.4    8.007        1        2
```

```
##      .25      .50      .75      .90      .95
##        5       11       17       21       22
##
## lowest :  0  1  2  3  4, highest: 19 20 21 22 23
## ------------------------------------------------------------------------------
```

```
## check frequency

count(df, weather_main)
```

```
##    weather_main     n
## 1         Clear 13381
## 2        Clouds 15164
## 3       Drizzle  1821
## 4           Fog   912
## 5          Haze  1360
## 6          Mist  5950
## 7          Rain  5672
## 8         Smoke    20
## 9          Snow  2876
## 10       Squall     4
## 11 Thunderstorm  1034
```

```
count(df, holiday)
```

```
##                     holiday     n
## 1              Christmas Day     6
## 2               Columbus Day     5
## 3           Independence Day     5
## 4                 Labor Day     7
## 5  Martin Luther King Jr Day     6
## 6               Memorial Day     5
## 7              New Years Day     6
## 8                       None 48133
## 9                 State Fair     5
## 10          Thanksgiving Day     6
## 11              Veterans Day     5
## 12      Washingtons Birthday     5
```

```
count(df, time)
```

```
##    time    n
## 1     0 2037
## 2     1 2049
## 3     2 2019
## 4     3 2023
## 5     4 2089
## 6     5 2061
## 7     6 2085
## 8     7 2078
## 9     8 2079
## 10    9 2018
```

```
## 11   10 2078
## 12   11 1952
## 13   12 1955
## 14   13 1905
## 15   14 1969
## 16   15 1934
## 17   16 1988
## 18   17 1933
## 19   18 1986
## 20   19 1961
## 21   20 1979
## 22   21 1982
## 23   22 1994
## 24   23 2040
```

```
count(df, temp)
```

```
##         temp   n
## 1    243.390   1
## 2    243.620   1
## 3    244.220   1
## 4    244.820   3
## 5    244.890   1
## 6    245.620   1
## 7    245.700   3
## 8    246.040   1
## 9    246.150   2
## 10   246.260   1
## 11   246.360   1
## 12   246.380   1
## 13   246.390   3
## 14   246.470   3
## 15   246.520   2
## 16   246.600   1
## 17   246.640   1
## 18   246.650   1
## 19   246.680   1
## 20   246.740   1
## 21   247.000   1
## 22   247.020   1
## 23   247.080   1
## 24   247.130   1
## 25   247.150  23
## 26   247.160   2
## 27   247.210   1
## 28   247.260   1
## 29   247.270   1
## 30   247.290   2
## 31   247.350   1
## 32   247.370   1
## 33   247.380   1
## 34   247.400   2
## 35   247.430   1
## 36   247.440   1
```

```
## 37   247.450   1
## 38   247.470   1
## 39   247.480   1
## 40   247.490   1
## 41   247.530   1
## 42   247.620   3
## 43   247.640   2
## 44   247.650   1
## 45   247.660   1
## 46   247.680   1
## 47   247.760   1
## 48   247.770   1
## 49   247.790   1
## 50   247.800   3
## 51   247.810   2
## 52   247.820   2
## 53   247.840   2
## 54   247.900   1
## 55   248.000   1
## 56   248.020   1
## 57   248.070   1
## 58   248.080   3
## 59   248.120   1
## 60   248.130   6
## 61   248.140   8
## 62   248.150   9
## 63   248.160   1
## 64   248.170   1
## 65   248.220   4
## 66   248.230   1
## 67   248.250   1
## 68   248.260   1
## 69   248.270   2
## 70   248.280   3
## 71   248.310   1
## 72   248.380   3
## 73   248.390   2
## 74   248.410   1
## 75   248.420   2
## 76   248.430   1
## 77   248.440   1
## 78   248.470   2
## 79   248.480   6
## 80   248.510   3
## 81   248.570   2
## 82   248.610   2
## 83   248.620   2
## 84   248.630   4
## 85   248.640   1
## 86   248.660   2
## 87   248.680   2
## 88   248.700   1
## 89   248.720   2
## 90   248.730   1
```

```
## 91   248.750   2
## 92   248.770   2
## 93   248.780   1
## 94   248.790   4
## 95   248.800   2
## 96   248.830   1
## 97   248.840   3
## 98   248.850   1
## 99   248.860   3
## 100  248.880   5
## 101  248.890   1
## 102  248.900   1
## 103  248.910   1
## 104  249.000   3
## 105  249.010   1
## 106  249.020   1
## 107  249.070   1
## 108  249.080   2
## 109  249.130   2
## 110  249.140   4
## 111  249.150  19
## 112  249.160   1
## 113  249.170   1
## 114  249.220   1
## 115  249.230   1
## 116  249.270   2
## 117  249.290   3
## 118  249.300   2
## 119  249.330   1
## 120  249.340   1
## 121  249.350   4
## 122  249.360   2
## 123  249.380   4
## 124  249.390   3
## 125  249.430   1
## 126  249.440   2
## 127  249.450   3
## 128  249.460   3
## 129  249.470   1
## 130  249.480   3
## 131  249.490   1
## 132  249.500   3
## 133  249.510   3
## 134  249.520   1
## 135  249.530   1
## 136  249.540   1
## 137  249.570   1
## 138  249.590   1
## 139  249.610   1
## 140  249.620   2
## 141  249.630   2
## 142  249.640   3
## 143  249.650   4
## 144  249.660   2
```

```
## 145  249.670   1
## 146  249.690   3
## 147  249.710   1
## 148  249.730   1
## 149  249.750   2
## 150  249.760   1
## 151  249.770   2
## 152  249.790   2
## 153  249.800   4
## 154  249.830   1
## 155  249.840   3
## 156  249.860   1
## 157  249.870   1
## 158  249.880   4
## 159  249.890   2
## 160  249.900   1
## 161  249.910   4
## 162  249.930   2
## 163  249.940   1
## 164  249.950   1
## 165  249.960   1
## 166  249.990   1
## 167  250.000   1
## 168  250.010   1
## 169  250.020   4
## 170  250.030   2
## 171  250.080   4
## 172  250.100   1
## 173  250.110   1
## 174  250.120   2
## 175  250.140   9
## 176  250.150   9
## 177  250.160   2
## 178  250.210   1
## 179  250.220   4
## 180  250.240   3
## 181  250.280   1
## 182  250.290   2
## 183  250.300   1
## 184  250.320   1
## 185  250.330   2
## 186  250.350   3
## 187  250.360   6
## 188  250.380   3
## 189  250.390   5
## 190  250.400   3
## 191  250.410   4
## 192  250.420   1
## 193  250.430   3
## 194  250.440   2
## 195  250.460   3
## 196  250.470   1
## 197  250.480   2
## 198  250.490   1
```

```
## 199  250.540   1
## 200  250.550   1
## 201  250.560   2
## 202  250.570   1
## 203  250.610   3
## 204  250.630   7
## 205  250.640   3
## 206  250.650   3
## 207  250.660   1
## 208  250.680   2
## 209  250.690   2
## 210  250.700   1
## 211  250.720   3
## 212  250.730   1
## 213  250.750   3
## 214  250.770   3
## 215  250.780   1
## 216  250.790   2
## 217  250.800   5
## 218  250.810   1
## 219  250.830   1
## 220  250.840   2
## 221  250.860   4
## 222  250.870   1
## 223  250.880   3
## 224  250.890   2
## 225  250.900   6
## 226  250.910   3
## 227  250.920   1
## 228  250.930   1
## 229  250.990   3
## 230  251.000   2
## 231  251.010   1
## 232  251.020   1
## 233  251.070   5
## 234  251.080   3
## 235  251.090   2
## 236  251.100   1
## 237  251.110   2
## 238  251.130   1
## 239  251.140   6
## 240  251.150  21
## 241  251.160   1
## 242  251.210   2
## 243  251.220   1
## 244  251.230   3
## 245  251.270   3
## 246  251.290   8
## 247  251.310   1
## 248  251.320   1
## 249  251.330   1
## 250  251.350   3
## 251  251.360   2
## 252  251.380   3
```

```
## 253  251.390   3
## 254  251.400   2
## 255  251.430   4
## 256  251.450   3
## 257  251.460   3
## 258  251.480   1
## 259  251.500   2
## 260  251.510   3
## 261  251.520   4
## 262  251.530   1
## 263  251.540   2
## 264  251.560   4
## 265  251.580   1
## 266  251.610   1
## 267  251.620   1
## 268  251.630   1
## 269  251.640   4
## 270  251.650   2
## 271  251.670   1
## 272  251.680   2
## 273  251.690   2
## 274  251.720   5
## 275  251.730   1
## 276  251.740   2
## 277  251.750   1
## 278  251.760   2
## 279  251.770   7
## 280  251.790   1
## 281  251.800   3
## 282  251.820   1
## 283  251.830   2
## 284  251.840   3
## 285  251.860   1
## 286  251.870   1
## 287  251.880   3
## 288  251.890   1
## 289  251.900   2
## 290  251.930   3
## 291  251.940   1
## 292  251.950   3
## 293  251.960   1
## 294  251.990   2
## 295  252.000   4
## 296  252.010   3
## 297  252.020   7
## 298  252.070   1
## 299  252.080   4
## 300  252.090   2
## 301  252.130   5
## 302  252.140   9
## 303  252.150   9
## 304  252.180   1
## 305  252.210   2
## 306  252.220   6
```

```
## 307  252.230   1
## 308  252.270   1
## 309  252.290   4
## 310  252.350   1
## 311  252.360   2
## 312  252.370   2
## 313  252.380   2
## 314  252.390   1
## 315  252.400   1
## 316  252.420   1
## 317  252.430   3
## 318  252.440   3
## 319  252.450   1
## 320  252.460   3
## 321  252.470   1
## 322  252.480   2
## 323  252.490   1
## 324  252.500   1
## 325  252.510   1
## 326  252.530   1
## 327  252.550   2
## 328  252.560   1
## 329  252.570   1
## 330  252.580   2
## 331  252.620   2
## 332  252.630   3
## 333  252.640   1
## 334  252.650   1
## 335  252.660   1
## 336  252.720   7
## 337  252.730   2
## 338  252.740   1
## 339  252.750   1
## 340  252.760   1
## 341  252.770  11
## 342  252.800   3
## 343  252.810   1
## 344  252.820   1
## 345  252.830   2
## 346  252.840   1
## 347  252.850   1
## 348  252.870   1
## 349  252.880   2
## 350  252.890   1
## 351  252.910   3
## 352  252.930   1
## 353  252.940   2
## 354  252.950   2
## 355  252.970   2
## 356  252.980   1
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## 358  253.010   3
## 359  253.020   2
## 360  253.030   1
```

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## 362  253.080   3
## 363  253.090   1
## 364  253.130   1
## 365  253.140   6
## 366  253.150   3
## 367  253.160   2
## 368  253.180   1
## 369  253.210   3
## 370  253.220   5
## 371  253.230   1
## 372  253.270   4
## 373  253.280   1
## 374  253.290   4
## 375  253.310   1
## 376  253.330   3
## 377  253.340   3
## 378  253.360   2
## 379  253.380   1
## 380  253.390   6
## 381  253.400   4
## 382  253.410   1
## 383  253.420   1
## 384  253.430   1
## 385  253.440   3
## 386  253.460   5
## 387  253.480   2
## 388  253.490   1
## 389  253.500   2
## 390  253.510   3
## 391  253.520   3
## 392  253.530   2
## 393  253.550   3
## 394  253.570   2
## 395  253.580   2
## 396  253.600   1
## 397  253.620   2
## 398  253.640   1
## 399  253.650   4
## 400  253.660   1
## 401  253.680   2
## 402  253.690   2
## 403  253.720   3
## 404  253.730   1
## 405  253.750   1
## 406  253.760   2
## 407  253.770   6
## 408  253.780   1
## 409  253.810   1
## 410  253.820   2
## 411  253.840   4
## 412  253.850   2
## 413  253.860   8
## 414  253.870   2
```

```
## 415  253.880   5
## 416  253.890   4
## 417  253.900   4
## 418  253.920   2
## 419  253.930   1
## 420  253.950   2
## 421  253.970   1
## 422  253.980   1
## 423  253.990   1
## 424  254.010   1
## 425  254.020   1
## 426  254.030   3
## 427  254.070   1
## 428  254.080   3
## 429  254.090   2
## 430  254.110   3
## 431  254.120   2
## 432  254.140   6
## 433  254.150  12
## 434  254.160   2
## 435  254.190   3
## 436  254.200   2
## 437  254.220   5
## 438  254.230   1
## 439  254.250   2
## 440  254.270   2
## 441  254.280   3
## 442  254.290   5
## 443  254.300   1
## 444  254.310   2
## 445  254.320   2
## 446  254.330   1
## 447  254.340   3
## 448  254.350   4
## 449  254.360   1
## 450  254.380   2
## 451  254.390   4
## 452  254.400   3
## 453  254.410   4
## 454  254.420   4
## 455  254.430   1
## 456  254.440   4
## 457  254.450   1
## 458  254.460   4
## 459  254.470   2
## 460  254.480   4
## 461  254.490   4
## 462  254.500   4
## 463  254.510   2
## 464  254.520   3
## 465  254.530   4
## 466  254.540   1
## 467  254.550   4
## 468  254.560   1
```

```
## 469  254.570   2
## 470  254.580   3
## 471  254.590   3
## 472  254.610   3
## 473  254.620   1
## 474  254.630   3
## 475  254.640   2
## 476  254.650   6
## 477  254.670   5
## 478  254.680   1
## 479  254.690   6
## 480  254.700   2
## 481  254.710   1
## 482  254.720   2
## 483  254.730   1
## 484  254.750   3
## 485  254.760   4
## 486  254.770   2
## 487  254.780   1
## 488  254.790   3
## 489  254.800   4
## 490  254.810   1
## 491  254.820   6
## 492  254.830   2
## 493  254.840   6
## 494  254.850   2
## 495  254.860   1
## 496  254.870   1
## 497  254.880   1
## 498  254.890   8
## 499  254.900   4
## 500  254.910   2
## 501  254.917   3
## 502  254.920   1
## 503  254.930   3
## 504  254.940   1
## 505  254.950   3
## 506  254.960   6
## 507  254.980   2
## 508  254.990   1
## 509  255.000   2
## 510  255.010   6
## 511  255.020   2
## 512  255.030   3
## 513  255.040   2
## 514  255.070   4
## 515  255.080   7
## 516  255.090   2
## 517  255.100   1
## 518  255.110   1
## 519  255.130   3
## 520  255.140   2
## 521  255.150  11
## 522  255.160   1
```

```
## 523  255.180   3
## 524  255.190   1
## 525  255.200   3
## 526  255.210   2
## 527  255.220  11
## 528  255.230   2
## 529  255.250   1
## 530  255.260   2
## 531  255.280   6
## 532  255.290   3
## 533  255.300   3
## 534  255.310   2
## 535  255.320   1
## 536  255.330   2
## 537  255.340   3
## 538  255.350   5
## 539  255.360   3
## 540  255.370   6
## 541  255.380   8
## 542  255.390   3
## 543  255.400   3
## 544  255.410   5
## 545  255.420   5
## 546  255.430   7
## 547  255.440   1
## 548  255.450   1
## 549  255.460   4
## 550  255.480   7
## 551  255.490   1
## 552  255.500   7
## 553  255.510   4
## 554  255.520   3
## 555  255.530   2
## 556  255.540   1
## 557  255.550   5
## 558  255.560   2
## 559  255.570   7
## 560  255.580   7
## 561  255.590   3
## 562  255.610   6
## 563  255.620   6
## 564  255.630   3
## 565  255.640   1
## 566  255.650   2
## 567  255.660   2
## 568  255.680   4
## 569  255.690   3
## 570  255.700   3
## 571  255.710   3
## 572  255.720   6
## 573  255.730   2
## 574  255.740   1
## 575  255.750   4
## 576  255.760   3
```

```
## 577  255.770   1
## 578  255.780   9
## 579  255.790   5
## 580  255.800   3
## 581  255.810   8
## 582  255.820   6
## 583  255.830   2
## 584  255.840   6
## 585  255.850   3
## 586  255.860   4
## 587  255.870   3
## 588  255.880   1
## 589  255.890   3
## 590  255.900   2
## 591  255.910   5
## 592  255.920   3
## 593  255.930  15
## 594  255.940   7
## 595  255.950  12
## 596  255.980   6
## 597  255.990   4
## 598  256.000   2
## 599  256.010   8
## 600  256.020   3
## 601  256.030   1
## 602  256.040   1
## 603  256.050   3
## 604  256.060   2
## 605  256.070   1
## 606  256.080   4
## 607  256.090   8
## 608  256.100   3
## 609  256.120   2
## 610  256.130   2
## 611  256.140   4
## 612  256.150  23
## 613  256.160   4
## 614  256.170   1
## 615  256.180   1
## 616  256.190   3
## 617  256.200   2
## 618  256.210   8
## 619  256.220   8
## 620  256.230   2
## 621  256.240   1
## 622  256.250   2
## 623  256.270   4
## 624  256.280   6
## 625  256.290   6
## 626  256.300   3
## 627  256.320   5
## 628  256.330   4
## 629  256.340   5
## 630  256.350   6
```

```
## 631  256.360   6
## 632  256.370   1
## 633  256.380   2
## 634  256.390   3
## 635  256.400   4
## 636  256.410   1
## 637  256.420   4
## 638  256.430   3
## 639  256.440   5
## 640  256.450   3
## 641  256.460   3
## 642  256.470   3
## 643  256.480   3
## 644  256.490   5
## 645  256.500   1
## 646  256.510   5
## 647  256.530   6
## 648  256.540   5
## 649  256.550   2
## 650  256.560   5
## 651  256.570   1
## 652  256.580  10
## 653  256.590   4
## 654  256.610   6
## 655  256.620   1
## 656  256.630   1
## 657  256.640   1
## 658  256.650   6
## 659  256.660   4
## 660  256.670   3
## 661  256.680   4
## 662  256.690   1
## 663  256.700   3
## 664  256.710   1
## 665  256.720   4
## 666  256.730   1
## 667  256.740   2
## 668  256.750   1
## 669  256.760   6
## 670  256.770   1
## 671  256.780   2
## 672  256.790   3
## 673  256.800   4
## 674  256.810   1
## 675  256.820   5
## 676  256.830   2
## 677  256.840   3
## 678  256.850   1
## 679  256.860   3
## 680  256.870   3
## 681  256.880   7
## 682  256.890   3
## 683  256.900   7
## 684  256.910   1
```

```
## 685  256.920   6
## 686  256.930   1
## 687  256.940   7
## 688  256.950   6
## 689  256.960   2
## 690  256.970   3
## 691  256.980   1
## 692  257.000   5
## 693  257.010   9
## 694  257.020   7
## 695  257.030   1
## 696  257.040   3
## 697  257.050   1
## 698  257.060   1
## 699  257.070   3
## 700  257.080   7
## 701  257.110   3
## 702  257.120   2
## 703  257.130   1
## 704  257.140   9
## 705  257.150   9
## 706  257.160   5
## 707  257.170   1
## 708  257.180   3
## 709  257.190   1
## 710  257.200   1
## 711  257.210   3
## 712  257.220   7
## 713  257.230   1
## 714  257.260   1
## 715  257.270   1
## 716  257.280   6
## 717  257.290  14
## 718  257.300   6
## 719  257.310   3
## 720  257.320   2
## 721  257.330   7
## 722  257.340   7
## 723  257.350   7
## 724  257.360   3
## 725  257.370   2
## 726  257.380   2
## 727  257.390   5
## 728  257.400   2
## 729  257.410   3
## 730  257.420   5
## 731  257.430   7
## 732  257.440   8
## 733  257.450   1
## 734  257.460   3
## 735  257.470   2
## 736  257.480   6
## 737  257.490   4
## 738  257.510   4
```

```
## 739  257.520   2
## 740  257.530   1
## 741  257.540   2
## 742  257.550   4
## 743  257.560   1
## 744  257.570   7
## 745  257.590   3
## 746  257.600   1
## 747  257.610   3
## 748  257.620   2
## 749  257.630   2
## 750  257.640   3
## 751  257.650   3
## 752  257.660   3
## 753  257.670   1
## 754  257.680  11
## 755  257.690   3
## 756  257.700   1
## 757  257.710   3
## 758  257.720   7
## 759  257.730   2
## 760  257.740   2
## 761  257.750   9
## 762  257.760   3
## 763  257.770   7
## 764  257.780   5
## 765  257.790   4
## 766  257.810   3
## 767  257.820   6
## 768  257.830   3
## 769  257.840   2
## 770  257.850   1
## 771  257.860   7
## 772  257.880   9
## 773  257.890   5
## 774  257.910   2
## 775  257.920   5
## 776  257.930   7
## 777  257.940   5
## 778  257.950  11
## 779  257.960   4
## 780  257.970   2
## 781  257.990   2
## 782  258.000   1
## 783  258.010   5
## 784  258.020   4
## 785  258.030   3
## 786  258.050   5
## 787  258.060   2
## 788  258.070   2
## 789  258.080   7
## 790  258.090   5
## 791  258.100   6
## 792  258.120   2
```

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## 793  258.130   2
## 794  258.140   4
## 795  258.150  11
## 796  258.170   4
## 797  258.180   2
## 798  258.190   1
## 799  258.200   3
## 800  258.205   1
## 801  258.210   2
## 802  258.220  13
## 803  258.230   2
## 804  258.240   2
## 805  258.250   1
## 806  258.270   3
## 807  258.280   5
## 808  258.290   9
## 809  258.300   7
## 810  258.320   2
## 811  258.330   4
## 812  258.340   6
## 813  258.350   2
## 814  258.360   7
## 815  258.370   1
## 816  258.380  11
## 817  258.390   3
## 818  258.400   3
## 819  258.410   2
## 820  258.420   6
## 821  258.430   2
## 822  258.440   3
## 823  258.450   2
## 824  258.460  10
## 825  258.470   2
## 826  258.480   2
## 827  258.490   2
## 828  258.500   2
## 829  258.510   6
## 830  258.520   5
## 831  258.530   3
## 832  258.540   2
## 833  258.550   5
## 834  258.590  10
## 835  258.610   2
## 836  258.620   1
## 837  258.630   1
## 838  258.640   1
## 839  258.650   3
## 840  258.670   5
## 841  258.680  11
## 842  258.690   7
## 843  258.700   3
## 844  258.710   6
## 845  258.720   2
## 846  258.740   4
```

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## 847  258.750   7
## 848  258.760   4
## 849  258.780   6
## 850  258.790   7
## 851  258.800   3
## 852  258.810   5
## 853  258.820   2
## 854  258.830   3
## 855  258.840   6
## 856  258.850   1
## 857  258.870   2
## 858  258.880   2
## 859  258.890   5
## 860  258.900   6
## 861  258.910   2
## 862  258.920   5
## 863  258.930   4
## 864  258.940   5
## 865  258.950   2
## 866  258.960   6
## 867  258.970   2
## 868  258.990   3
## 869  259.000   2
## 870  259.010   3
## 871  259.020   6
## 872  259.030   2
## 873  259.040   5
## 874  259.050   1
## 875  259.060   3
## 876  259.070   4
## 877  259.080  11
## 878  259.090   4
## 879  259.100   5
## 880  259.110   1
## 881  259.120   4
## 882  259.140   6
## 883  259.150  13
## 884  259.160   6
## 885  259.170   5
## 886  259.180   2
## 887  259.190   1
## 888  259.210   5
## 889  259.220  14
## 890  259.230   3
## 891  259.240   5
## 892  259.250   2
## 893  259.260   5
## 894  259.270   3
## 895  259.280   8
## 896  259.290   9
## 897  259.300   9
## 898  259.310   1
## 899  259.330   2
## 900  259.340   6
```

```
## 901  259.350   6
## 902  259.360  10
## 903  259.370   7
## 904  259.380   1
## 905  259.390   3
## 906  259.400   7
## 907  259.410   4
## 908  259.420   4
## 909  259.430   4
## 910  259.440   3
## 911  259.450   5
## 912  259.460   3
## 913  259.470   2
## 914  259.480   1
## 915  259.490   3
## 916  259.500   3
## 917  259.520   1
## 918  259.530   5
## 919  259.540   1
## 920  259.550   2
## 921  259.560   2
## 922  259.570   4
## 923  259.580  11
## 924  259.590   4
## 925  259.600   4
## 926  259.610   2
## 927  259.620   5
## 928  259.630   1
## 929  259.640   2
## 930  259.650   9
## 931  259.660   2
## 932  259.680   6
## 933  259.690   4
## 934  259.700   1
## 935  259.710   1
## 936  259.720   6
## 937  259.730   2
## 938  259.740   2
## 939  259.750   4
## 940  259.760   5
## 941  259.770  11
## 942  259.780   3
## 943  259.790   7
## 944  259.800   5
## 945  259.810   4
## 946  259.820   4
## 947  259.830   1
## 948  259.840   2
## 949  259.850   1
## 950  259.860   6
## 951  259.870   2
## 952  259.880   4
## 953  259.890   2
## 954  259.900  11
```

```
## 955  259.910   4
## 956  259.920   7
## 957  259.930   4
## 958  259.940   4
## 959  259.950   6
## 960  259.960   2
## 961  259.970   5
## 962  259.980   7
## 963  259.990   1
## 964  260.000   9
## 965  260.010   8
## 966  260.020   6
## 967  260.030   2
## 968  260.040   2
## 969  260.060   3
## 970  260.070   7
## 971  260.080  14
## 972  260.090   6
## 973  260.100   3
## 974  260.110   2
## 975  260.120   2
## 976  260.130   2
## 977  260.140   5
## 978  260.150  13
## 979  260.170   5
## 980  260.180   1
## 981  260.190   4
## 982  260.200   1
## 983  260.210   8
## 984  260.220   9
## 985  260.230   2
## 986  260.240   4
## 987  260.250   3
## 988  260.260   1
## 989  260.270   2
## 990  260.280   3
## 991  260.290  12
## 992  260.300   1
## 993  260.320   3
## 994  260.330   1
## 995  260.340   6
## 996  260.350   7
## 997  260.360   3
## 998  260.370   3
## 999  260.380   1
## 1000 260.390   7
## 1001 260.400   1
## 1002 260.410   5
## 1003 260.420   9
## 1004 260.430   3
## 1005 260.440   6
## 1006 260.450   4
## 1007 260.460   4
## 1008 260.470   2
```

```
## 1009 260.480  13
## 1010 260.490   3
## 1011 260.500  12
## 1012 260.510   5
## 1013 260.520   3
## 1014 260.530   4
## 1015 260.540   4
## 1016 260.550  10
## 1017 260.570   7
## 1018 260.580   7
## 1019 260.590   9
## 1020 260.600   1
## 1021 260.610   5
## 1022 260.620   6
## 1023 260.630   4
## 1024 260.640   8
## 1025 260.650   9
## 1026 260.660   5
## 1027 260.670   1
## 1028 260.680   6
## 1029 260.690   7
## 1030 260.710   4
## 1031 260.720   8
## 1032 260.740   6
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## 1095 261.410   3
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## 1097 261.430   4
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## 1108 261.550   2
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## 1116 261.630   1
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## 1142 261.900   4
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## 1144 261.920   1
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## 1169 262.210  10
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## 1186 262.380   3
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## 1188 262.400   2
## 1189 262.410   2
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## 1191 262.430  10
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## 1217 262.700   1
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## 1220 262.730   4
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## 1222 262.750  11
## 1223 262.760   3
## 1224 262.770   6
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## 1277 263.340   6
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## 1330 263.860   5
## 1331 263.870   7
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## 1363 264.190   2
## 1364 264.200   2
## 1365 264.210   7
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## 1367 264.230   1
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## 1373 264.290  11
## 1374 264.300   5
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## 1382 264.390   3
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## 1384 264.410  11
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## 1416 264.730   5
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## 1422 264.790   9
## 1423 264.800   3
## 1424 264.810   5
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## 1428 264.850   5
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## 1430 264.870   6
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## 1440 264.960   7
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## 1492 265.480  15
## 1493 265.490   7
## 1494 265.500   3
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## 1515 265.730   5
## 1516 265.740   3
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## 1518 265.760   6
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## 1522 265.800   1
## 1523 265.810   9
## 1524 265.820  10
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## 1541 265.990   4
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## 1595 266.560   3
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## 1601 266.620   7
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## 1612 266.730   8
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## 1616 266.770   7
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## 1668 267.290  11
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## 1675 267.360   6
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## 1709 267.710   6
## 1710 267.720  13
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## 1776 268.350  25
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## 1779 268.380   3
## 1780 268.381   3
## 1781 268.390  10
## 1782 268.400   8
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## 1796 268.540   3
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## 1798 268.560   5
## 1799 268.570   1
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## 1817 268.750   7
## 1818 268.760   4
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## 1827 268.840   4
## 1828 268.850   6
## 1829 268.860  13
## 1830 268.870   9
## 1831 268.880  10
## 1832 268.890   5
## 1833 268.900  15
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## 1835 268.920   4
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## 1837 268.940  19
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## 1847 269.040   3
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## 1852 269.090   9
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## 1863 269.210  16
## 1864 269.220  23
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## 1872 269.300   6
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## 1911 269.690  19
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## 2033 270.810   9
## 2034 270.820  16
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## 2141 271.820  13
## 2142 271.830   6
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## 2294 273.240   4
## 2295 273.250   4
## 2296 273.260   8
## 2297 273.270   9
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## 2314 273.440  15
## 2315 273.450  10
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## 2317 273.470  12
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## 2345 273.730   8
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## 2349 273.770  10
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## 2463 274.800  15
## 2464 274.810   7
## 2465 274.820  43
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## 2482 274.970   7
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## 2529 275.390   8
## 2530 275.400  13
## 2531 275.410   8
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## 2539 275.490  17
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## 2615 276.190   4
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## 2628 276.290  38
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## 2674 276.680  13
## 2675 276.690  19
## 2676 276.700   7
## 2677 276.710   8
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## 2680 276.740   3
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## 2682 276.760   8
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## 2719 277.090  12
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## 2728 277.180   4
## 2729 277.190   4
## 2730 277.196   1
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## 2732 277.210  15
## 2733 277.220  33
## 2734 277.230   6
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## 2736 277.250   1
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## 2917 278.820  13
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## 3103 280.390   7
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## 3151 280.820  11
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## 3168 280.980   2
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## 3243 281.610   6
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## 3349 282.510   7
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## 5077 297.770  11
## 5078 297.780   5
## 5079 297.790  11
## 5080 297.800  15
## 5081 297.810   9
## 5082 297.811   1
## 5083 297.820  16
## 5084 297.830   7
## 5085 297.840   9
## 5086 297.850   7
## 5087 297.851   3
## 5088 297.860  10
## 5089 297.870   5
## 5090 297.880  11
## 5091 297.888  43
## 5092 297.890   6
## 5093 297.900  11
## 5094 297.910   7
## 5095 297.920  10
## 5096 297.930  10
## 5097 297.940   4
## 5098 297.950   8
## 5099 297.960   9
## 5100 297.970   5
## 5101 297.980   4
## 5102 297.981   1
## 5103 297.990   4
## 5104 298.000   8
## 5105 298.010  17
## 5106 298.020  13
## 5107 298.030   5
## 5108 298.034   3
## 5109 298.040   6
## 5110 298.050   4
## 5111 298.060  10
## 5112 298.070  10
```

```
## 5113 298.080  27
## 5114 298.090  17
## 5115 298.100   4
## 5116 298.110   4
## 5117 298.120   2
## 5118 298.130   6
## 5119 298.140   9
## 5120 298.150  34
## 5121 298.160   5
## 5122 298.167   3
## 5123 298.170   6
## 5124 298.180   7
## 5125 298.190   7
## 5126 298.200   3
## 5127 298.210  15
## 5128 298.220  10
## 5129 298.230   3
## 5130 298.240   9
## 5131 298.250  11
## 5132 298.260   5
## 5133 298.270  11
## 5134 298.271   1
## 5135 298.280  10
## 5136 298.290  18
## 5137 298.300  12
## 5138 298.310   7
## 5139 298.320   9
## 5140 298.330   5
## 5141 298.340   7
## 5142 298.350  14
## 5143 298.356   3
## 5144 298.360  10
## 5145 298.370   9
## 5146 298.380   5
## 5147 298.390   5
## 5148 298.400   9
## 5149 298.410   4
## 5150 298.420  11
## 5151 298.430  12
## 5152 298.440  17
## 5153 298.450   8
## 5154 298.460   8
## 5155 298.470   3
## 5156 298.480  13
## 5157 298.490   5
## 5158 298.500   9
## 5159 298.510  11
## 5160 298.520   5
## 5161 298.530   7
## 5162 298.540   6
## 5163 298.550  11
## 5164 298.560   4
## 5165 298.570   6
## 5166 298.580  12
```

```
## 5167 298.590  12
## 5168 298.600   5
## 5169 298.610  12
## 5170 298.620  16
## 5171 298.630   6
## 5172 298.640  11
## 5173 298.650  13
## 5174 298.660   8
## 5175 298.670   5
## 5176 298.680  12
## 5177 298.690   6
## 5178 298.700   2
## 5179 298.710   2
## 5180 298.720   4
## 5181 298.730   6
## 5182 298.740   4
## 5183 298.750  11
## 5184 298.760   9
## 5185 298.770   7
## 5186 298.780   7
## 5187 298.790   9
## 5188 298.800   2
## 5189 298.810   8
## 5190 298.820   9
## 5191 298.830   5
## 5192 298.840   5
## 5193 298.850   7
## 5194 298.860  11
## 5195 298.870   6
## 5196 298.880  13
## 5197 298.890   6
## 5198 298.900   9
## 5199 298.910   2
## 5200 298.920   7
## 5201 298.930   7
## 5202 298.940   6
## 5203 298.950   9
## 5204 298.960   7
## 5205 298.970   7
## 5206 298.980   7
## 5207 298.990   2
## 5208 299.000  10
## 5209 299.001   3
## 5210 299.007   1
## 5211 299.010  18
## 5212 299.020  14
## 5213 299.030   4
## 5214 299.040   7
## 5215 299.050   5
## 5216 299.060   6
## 5217 299.070   9
## 5218 299.080  22
## 5219 299.090   2
## 5220 299.100   4
```

```
## 5221 299.110   7
## 5222 299.120   7
## 5223 299.130   7
## 5224 299.140   7
## 5225 299.150  32
## 5226 299.160   4
## 5227 299.170   7
## 5228 299.180  13
## 5229 299.190   5
## 5230 299.200   7
## 5231 299.210   9
## 5232 299.220  12
## 5233 299.230   4
## 5234 299.240   2
## 5235 299.250   6
## 5236 299.260   4
## 5237 299.270   5
## 5238 299.280  13
## 5239 299.290  21
## 5240 299.300   7
## 5241 299.310   3
## 5242 299.320   2
## 5243 299.330   4
## 5244 299.340   9
## 5245 299.350  12
## 5246 299.360  13
## 5247 299.370   4
## 5248 299.380   7
## 5249 299.390  10
## 5250 299.400   4
## 5251 299.410   5
## 5252 299.420   6
## 5253 299.430   4
## 5254 299.440  10
## 5255 299.450   6
## 5256 299.460   4
## 5257 299.470  11
## 5258 299.480  13
## 5259 299.487   2
## 5260 299.490  11
## 5261 299.500   8
## 5262 299.510  12
## 5263 299.520   9
## 5264 299.530   7
## 5265 299.540   6
## 5266 299.550   4
## 5267 299.560   6
## 5268 299.570   8
## 5269 299.580  13
## 5270 299.589   1
## 5271 299.590  11
## 5272 299.600   7
## 5273 299.610  12
## 5274 299.620  11
```

```
## 5275 299.630   5
## 5276 299.640   3
## 5277 299.650  19
## 5278 299.660   4
## 5279 299.670   6
## 5280 299.680  12
## 5281 299.690   9
## 5282 299.700   3
## 5283 299.710  10
## 5284 299.720   9
## 5285 299.730   9
## 5286 299.740   3
## 5287 299.750  13
## 5288 299.760   4
## 5289 299.770   5
## 5290 299.780   5
## 5291 299.781   3
## 5292 299.790  10
## 5293 299.800  11
## 5294 299.810   5
## 5295 299.820  15
## 5296 299.830   9
## 5297 299.840   6
## 5298 299.850   5
## 5299 299.860   6
## 5300 299.870   2
## 5301 299.880  15
## 5302 299.882   2
## 5303 299.890   3
## 5304 299.900  12
## 5305 299.910   1
## 5306 299.920   6
## 5307 299.930   6
## 5308 299.940  11
## 5309 299.950  11
## 5310 299.960   2
## 5311 299.970   6
## 5312 299.980   7
## 5313 300.000   7
## 5314 300.010  12
## 5315 300.020  15
## 5316 300.030   2
## 5317 300.040   4
## 5318 300.050   4
## 5319 300.060   3
## 5320 300.070   5
## 5321 300.080  10
## 5322 300.090   5
## 5323 300.100  10
## 5324 300.110   9
## 5325 300.120   3
## 5326 300.130   2
## 5327 300.140   6
## 5328 300.150  29
```

```
## 5329 300.160   5
## 5330 300.170   6
## 5331 300.180   6
## 5332 300.190   3
## 5333 300.200   3
## 5334 300.210   4
## 5335 300.220  19
## 5336 300.230   6
## 5337 300.240   4
## 5338 300.250   6
## 5339 300.260   4
## 5340 300.270   6
## 5341 300.280  18
## 5342 300.290  10
## 5343 300.300   4
## 5344 300.310   4
## 5345 300.320   2
## 5346 300.330   3
## 5347 300.340   4
## 5348 300.350   8
## 5349 300.360  11
## 5350 300.370   8
## 5351 300.380   5
## 5352 300.390   5
## 5353 300.400   6
## 5354 300.410   8
## 5355 300.420   8
## 5356 300.430   4
## 5357 300.440   9
## 5358 300.450   8
## 5359 300.460   4
## 5360 300.470   4
## 5361 300.480  13
## 5362 300.490   7
## 5363 300.500   5
## 5364 300.510   8
## 5365 300.520   4
## 5366 300.530   5
## 5367 300.540   3
## 5368 300.550   8
## 5369 300.560   5
## 5370 300.570   4
## 5371 300.580   9
## 5372 300.590   6
## 5373 300.600   4
## 5374 300.610   8
## 5375 300.620   5
## 5376 300.630   6
## 5377 300.640   2
## 5378 300.650   7
## 5379 300.660   2
## 5380 300.670   6
## 5381 300.680   6
## 5382 300.690   5
```

```
## 5383 300.700   4
## 5384 300.710   4
## 5385 300.720   9
## 5386 300.730   7
## 5387 300.740   4
## 5388 300.750   6
## 5389 300.760   5
## 5390 300.770   2
## 5391 300.780   9
## 5392 300.790  12
## 5393 300.800   6
## 5394 300.810   5
## 5395 300.820  15
## 5396 300.830   5
## 5397 300.840   7
## 5398 300.850   1
## 5399 300.860   3
## 5400 300.870   5
## 5401 300.880   9
## 5402 300.890   6
## 5403 300.900   7
## 5404 300.910   4
## 5405 300.920   3
## 5406 300.930   2
## 5407 300.940   7
## 5408 300.950   5
## 5409 300.960   7
## 5410 300.970   4
## 5411 300.980   4
## 5412 300.987   1
## 5413 300.990   5
## 5414 301.000   3
## 5415 301.010  11
## 5416 301.020  11
## 5417 301.030   1
## 5418 301.040   2
## 5419 301.050   2
## 5420 301.060   6
## 5421 301.070   8
## 5422 301.080  14
## 5423 301.090   3
## 5424 301.100   2
## 5425 301.110   2
## 5426 301.120   4
## 5427 301.130   9
## 5428 301.140   3
## 5429 301.150  21
## 5430 301.160   3
## 5431 301.170   4
## 5432 301.180   3
## 5433 301.190   3
## 5434 301.200   4
## 5435 301.210   4
## 5436 301.220   9
```

```
## 5437 301.221   3
## 5438 301.230   4
## 5439 301.240   3
## 5440 301.250   2
## 5441 301.260   5
## 5442 301.270   3
## 5443 301.280  10
## 5444 301.290   8
## 5445 301.300   4
## 5446 301.310   2
## 5447 301.320   5
## 5448 301.330   4
## 5449 301.340   2
## 5450 301.350   6
## 5451 301.360  10
## 5452 301.370   4
## 5453 301.380   2
## 5454 301.400   4
## 5455 301.410   7
## 5456 301.420   8
## 5457 301.430   6
## 5458 301.440  12
## 5459 301.450   1
## 5460 301.460   2
## 5461 301.470   2
## 5462 301.480  10
## 5463 301.490   6
## 5464 301.500   5
## 5465 301.510   8
## 5466 301.520   2
## 5467 301.530   3
## 5468 301.540   3
## 5469 301.550   6
## 5470 301.560   1
## 5471 301.570   5
## 5472 301.580   5
## 5473 301.590   2
## 5474 301.600   2
## 5475 301.610   5
## 5476 301.620  14
## 5477 301.630   1
## 5478 301.640   3
## 5479 301.650  10
## 5480 301.660   6
## 5481 301.670   2
## 5482 301.680   7
## 5483 301.690   4
## 5484 301.700   2
## 5485 301.710   3
## 5486 301.720  12
## 5487 301.730   4
## 5488 301.740   3
## 5489 301.750  10
## 5490 301.760   2
```

```
## 5491 301.770   4
## 5492 301.780   3
## 5493 301.790   5
## 5494 301.800   6
## 5495 301.810   4
## 5496 301.820   7
## 5497 301.830   4
## 5498 301.840   5
## 5499 301.850   4
## 5500 301.860   7
## 5501 301.870   1
## 5502 301.880   5
## 5503 301.887   1
## 5504 301.890   3
## 5505 301.900   6
## 5506 301.910   4
## 5507 301.920   6
## 5508 301.930   6
## 5509 301.940   5
## 5510 301.950   6
## 5511 301.960   2
## 5512 301.970   5
## 5513 301.980   2
## 5514 302.000   5
## 5515 302.010   5
## 5516 302.012   1
## 5517 302.020   7
## 5518 302.030   2
## 5519 302.040   3
## 5520 302.050   2
## 5521 302.060   2
## 5522 302.070   4
## 5523 302.080   3
## 5524 302.090   4
## 5525 302.100   5
## 5526 302.110   3
## 5527 302.120   2
## 5528 302.140   1
## 5529 302.150  13
## 5530 302.160   1
## 5531 302.170   3
## 5532 302.180   3
## 5533 302.200   2
## 5534 302.210   3
## 5535 302.220   4
## 5536 302.230   6
## 5537 302.240   1
## 5538 302.250   4
## 5539 302.260   4
## 5540 302.270   4
## 5541 302.274   2
## 5542 302.280   4
## 5543 302.290   6
## 5544 302.299   2
```

```
## 5545 302.300   4
## 5546 302.310   1
## 5547 302.330   1
## 5548 302.340   2
## 5549 302.350   4
## 5550 302.360   9
## 5551 302.370   3
## 5552 302.380   1
## 5553 302.390   2
## 5554 302.400   2
## 5555 302.410   2
## 5556 302.420   5
## 5557 302.430   1
## 5558 302.440   1
## 5559 302.450   2
## 5560 302.460   3
## 5561 302.470   3
## 5562 302.480   1
## 5563 302.490   2
## 5564 302.500   1
## 5565 302.510   2
## 5566 302.520   3
## 5567 302.530   3
## 5568 302.540   4
## 5569 302.550   3
## 5570 302.560   3
## 5571 302.570   4
## 5572 302.580   6
## 5573 302.588   3
## 5574 302.590   2
## 5575 302.600   3
## 5576 302.610   6
## 5577 302.620   1
## 5578 302.630   1
## 5579 302.640   2
## 5580 302.650   3
## 5581 302.660   3
## 5582 302.670   1
## 5583 302.680   2
## 5584 302.690   7
## 5585 302.700   3
## 5586 302.710   1
## 5587 302.720   2
## 5588 302.730   1
## 5589 302.740   3
## 5590 302.750   5
## 5591 302.760   5
## 5592 302.770   2
## 5593 302.780   3
## 5594 302.790   5
## 5595 302.810   1
## 5596 302.820   4
## 5597 302.840   1
## 5598 302.860   1
```

```
## 5599 302.870   3
## 5600 302.880   3
## 5601 302.890   1
## 5602 302.900   3
## 5603 302.910   1
## 5604 302.920   2
## 5605 302.930   4
## 5606 302.940   2
## 5607 302.950   4
## 5608 302.960   5
## 5609 302.970   2
## 5610 302.980   2
## 5611 302.990   4
## 5612 303.010   3
## 5613 303.020   5
## 5614 303.030   2
## 5615 303.040   4
## 5616 303.060   2
## 5617 303.070   5
## 5618 303.080   5
## 5619 303.100   2
## 5620 303.150  14
## 5621 303.160   3
## 5622 303.180   3
## 5623 303.190   1
## 5624 303.210   1
## 5625 303.220   5
## 5626 303.230   1
## 5627 303.240   2
## 5628 303.250   2
## 5629 303.260   1
## 5630 303.280   1
## 5631 303.290   4
## 5632 303.300   3
## 5633 303.320   1
## 5634 303.340   1
## 5635 303.350   4
## 5636 303.360   1
## 5637 303.370   3
## 5638 303.380   2
## 5639 303.410   1
## 5640 303.420   3
## 5641 303.430   2
## 5642 303.440   3
## 5643 303.450   2
## 5644 303.470   1
## 5645 303.480   1
## 5646 303.490   1
## 5647 303.500   3
## 5648 303.510   2
## 5649 303.550   3
## 5650 303.560   2
## 5651 303.570   1
## 5652 303.580   2
```

```
## 5653 303.590   3
## 5654 303.600   2
## 5655 303.608   3
## 5656 303.610   2
## 5657 303.620   2
## 5658 303.630   2
## 5659 303.640   1
## 5660 303.650   1
## 5661 303.660   1
## 5662 303.670   3
## 5663 303.680   2
## 5664 303.690   2
## 5665 303.720   1
## 5666 303.730   1
## 5667 303.750   1
## 5668 303.760   2
## 5669 303.770   1
## 5670 303.780   1
## 5671 303.790   2
## 5672 303.800   1
## 5673 303.810   2
## 5674 303.820   6
## 5675 303.830   2
## 5676 303.840   6
## 5677 303.860   1
## 5678 303.870   2
## 5679 303.880   4
## 5680 303.890   4
## 5681 303.900   2
## 5682 303.920   1
## 5683 303.930   3
## 5684 303.940   4
## 5685 303.950   2
## 5686 303.960   1
## 5687 303.980   1
## 5688 304.010   6
## 5689 304.020   5
## 5690 304.070   1
## 5691 304.080   6
## 5692 304.090   2
## 5693 304.130   2
## 5694 304.150  15
## 5695 304.180   3
## 5696 304.200   1
## 5697 304.210   1
## 5698 304.220   2
## 5699 304.230   1
## 5700 304.240   2
## 5701 304.270   1
## 5702 304.280   4
## 5703 304.290   2
## 5704 304.300   1
## 5705 304.340   1
## 5706 304.360   3
```

```
## 5707 304.370   3
## 5708 304.399   3
## 5709 304.410   1
## 5710 304.430   2
## 5711 304.440   1
## 5712 304.450   1
## 5713 304.460   1
## 5714 304.470   2
## 5715 304.480   1
## 5716 304.490   3
## 5717 304.500   2
## 5718 304.510   2
## 5719 304.530   2
## 5720 304.550   2
## 5721 304.560   1
## 5722 304.600   1
## 5723 304.610   2
## 5724 304.620   3
## 5725 304.630   1
## 5726 304.650   2
## 5727 304.660   1
## 5728 304.680   2
## 5729 304.690   1
## 5730 304.698   2
## 5731 304.720   2
## 5732 304.750   1
## 5733 304.760   1
## 5734 304.775   3
## 5735 304.790   2
## 5736 304.800   1
## 5737 304.820   4
## 5738 304.830   1
## 5739 304.840   1
## 5740 304.850   1
## 5741 304.860   1
## 5742 304.890   1
## 5743 304.900   1
## 5744 304.910   1
## 5745 304.940   2
## 5746 304.950   2
## 5747 304.970   1
## 5748 305.000   3
## 5749 305.010   3
## 5750 305.020   2
## 5751 305.060   1
## 5752 305.070   1
## 5753 305.080   3
## 5754 305.090   2
## 5755 305.100   1
## 5756 305.120   1
## 5757 305.130   1
## 5758 305.150   4
## 5759 305.160   1
## 5760 305.170   3
```

```
## 5761 305.210   1
## 5762 305.220   2
## 5763 305.230   1
## 5764 305.240   1
## 5765 305.250   1
## 5766 305.260   2
## 5767 305.290   1
## 5768 305.310   2
## 5769 305.330   1
## 5770 305.340   1
## 5771 305.350   2
## 5772 305.370   2
## 5773 305.430   2
## 5774 305.440   2
## 5775 305.450   1
## 5776 305.460   1
## 5777 305.461   3
## 5778 305.470   1
## 5779 305.480   1
## 5780 305.490   2
## 5781 305.500   1
## 5782 305.510   1
## 5783 305.520   1
## 5784 305.550   1
## 5785 305.560   2
## 5786 305.600   2
## 5787 305.610   1
## 5788 305.620   4
## 5789 305.680   1
## 5790 305.690   1
## 5791 305.710   2
## 5792 305.770   1
## 5793 305.870   1
## 5794 305.880   2
## 5795 305.930   1
## 5796 305.950   1
## 5797 306.020   2
## 5798 306.070   2
## 5799 306.080   1
## 5800 306.090   1
## 5801 306.150   2
## 5802 306.200   1
## 5803 306.220   2
## 5804 306.240   1
## 5805 306.250   1
## 5806 306.280   2
## 5807 306.290   2
## 5808 306.310   1
## 5809 306.330   1
## 5810 306.340   1
## 5811 306.370   3
## 5812 306.390   1
## 5813 306.510   1
## 5814 306.580   2
```

```
## 5815 306.610   1
## 5816 306.650   1
## 5817 306.660   1
## 5818 306.670   1
## 5819 306.680   1
## 5820 306.750   1
## 5821 306.760   1
## 5822 306.790   1
## 5823 306.860   1
## 5824 307.000   1
## 5825 307.020   1
## 5826 307.030   1
## 5827 307.090   1
## 5828 307.200   1
## 5829 307.290   1
## 5830 307.320   1
## 5831 307.330   1
## 5832 307.660   1
## 5833 307.680   1
## 5834 307.690   1
## 5835 307.870   1
## 5836 308.240   1
## 5837 308.430   1
## 5838 308.870   1
## 5839 308.950   1
## 5840 309.080   1
## 5841 309.290   1
## 5842 310.070   1
```

##2.2 combine various holiday into holiday value

```
df <- df %>% mutate(holiday = case_when(holiday == "None"   ~ "No",
                                        TRUE  ~  "Yes"))

head(df)
```

```
##   holiday   temp rain_1h snow_1h clouds_all weather_main traffic_volume time
## 1      No 288.28       0       0         40       Clouds           5545    9
## 2      No 289.36       0       0         75       Clouds           4516   10
## 3      No 289.58       0       0         90       Clouds           4767   11
## 4      No 290.13       0       0         90       Clouds           5026   12
## 5      No 291.14       0       0         75       Clouds           4918   13
## 6      No 291.72       0       0          1        Clear           5181   14
```

###2.3 group various weather value ##==========
good weather - Clear ## moderately good weather - Clouds ## moderately bad weather - Fog, Haze, Smoke, Mist, Drizzle ## bad weather - Thunderstorm, Squall, Rain, snow

```
df <- df %>% mutate(weather_main = case_when(weather_main == "Thunderstorm"  | weather_main == "Squall"
                                             "bad weather", weather_main == "Fog" |
                                             weather_main == "Haze" |
                                             weather_main == "Smoke" |
                                             weather_main == "Mist" |
```

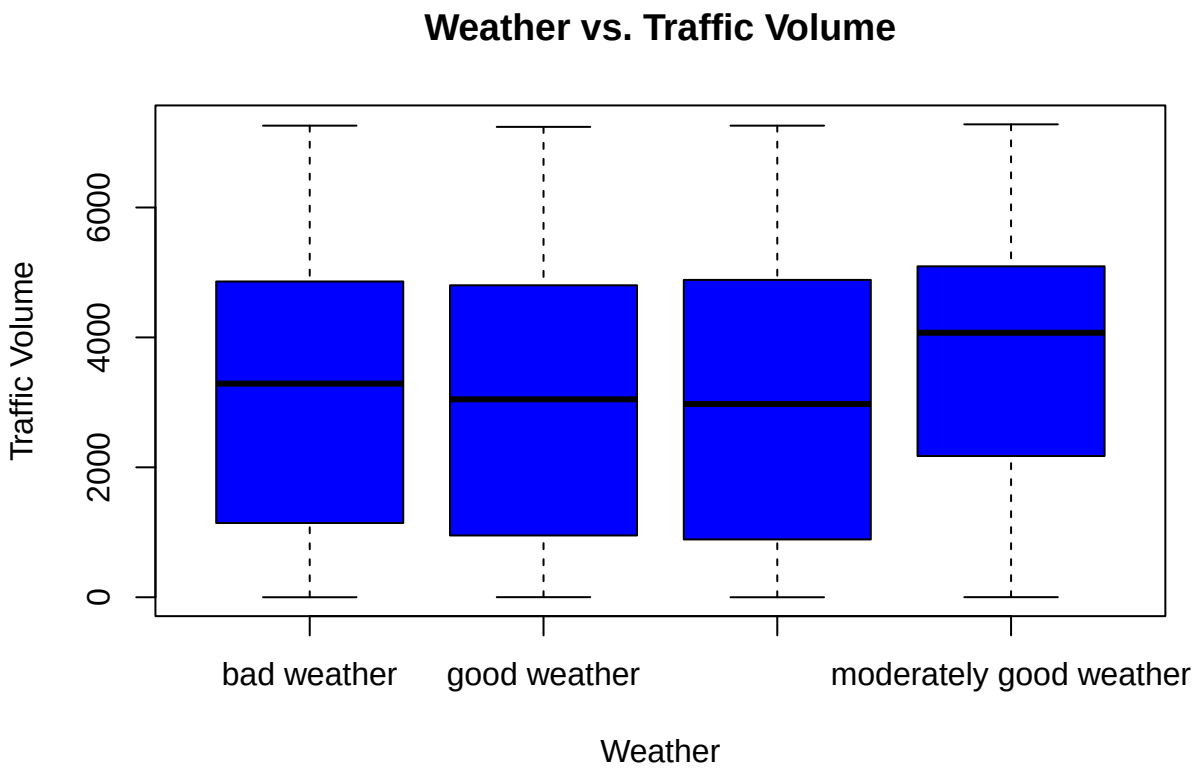
```
                                                  weather_main == "Drizzle" ~ "moderately bad weather",
                                                weather_main == "Clouds"  ~ "moderately good weather",
                                                weather_main == "Clear"  ~ "good weather"
                                                )
                    )
head(df)
```

```
##   holiday   temp rain_1h snow_1h clouds_all           weather_main
## 1      No 288.28       0       0         40 moderately good weather
## 2      No 289.36       0       0         75 moderately good weather
## 3      No 289.58       0       0         90 moderately good weather
## 4      No 290.13       0       0         90 moderately good weather
## 5      No 291.14       0       0         75 moderately good weather
## 6      No 291.72       0       0          1            good weather
##   traffic_volume time
## 1           5545    9
## 2           4516   10
## 3           4767   11
## 4           5026   12
## 5           4918   13
## 6           5181   14
```

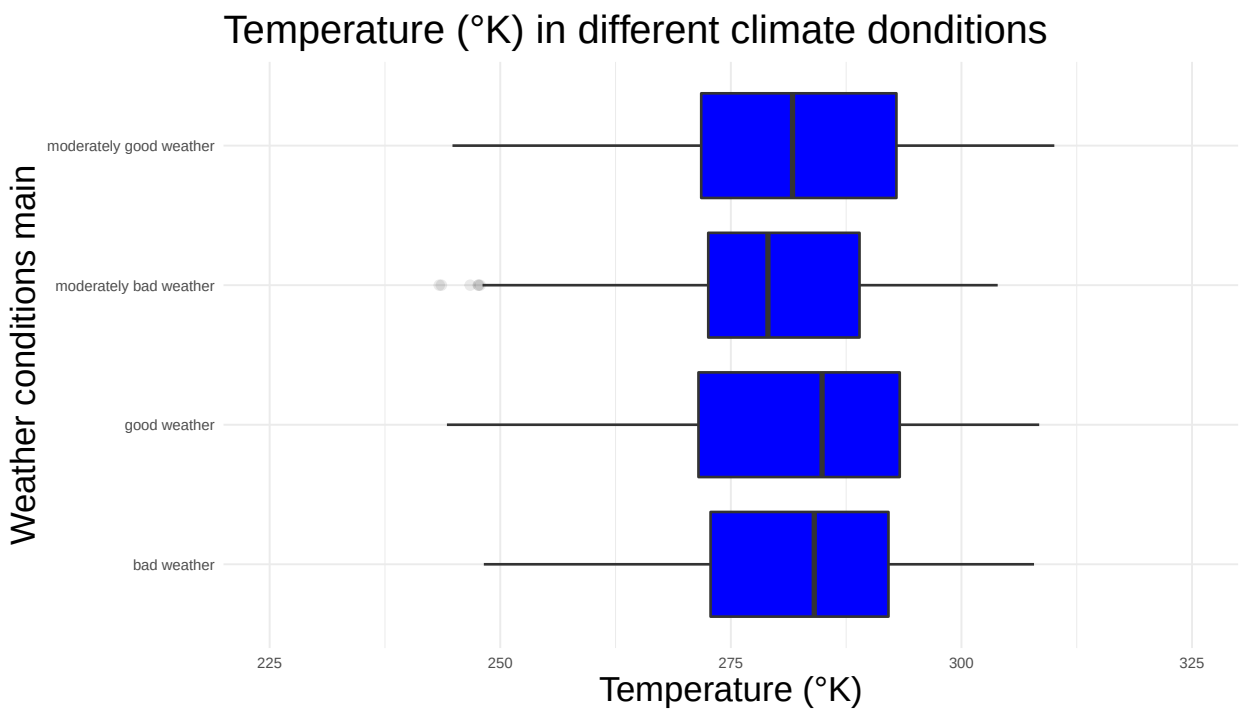
#STEP 3: EXPLORE THE DATA ##PLOTS ## weather vs. traffic volume ## holiday vs. traffic volume ## time vs. traffic volume

```
#weather vs. traffic volume
df$weather_main <- factor(df$weather)

plot(df$weather_main, df$traffic_volume, main="Weather vs. Traffic Volume", xlab = "Weather", ylab="Tra
```

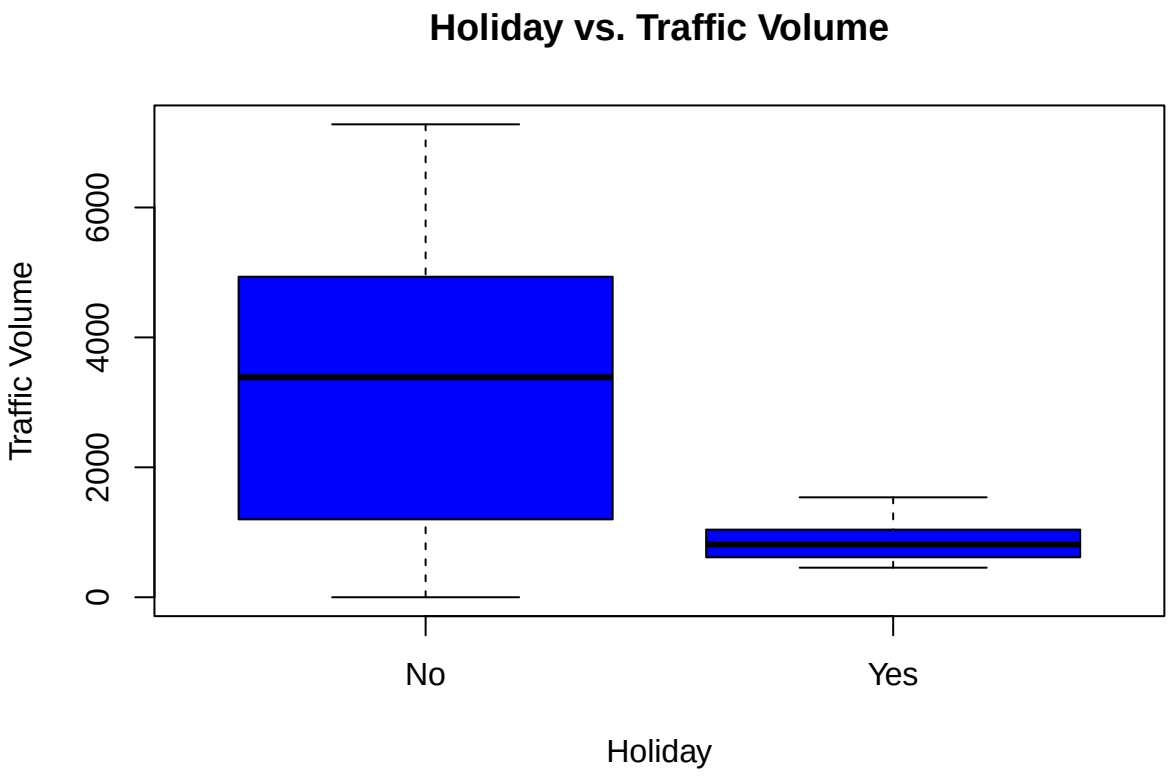



```
# Weather conditions vs temperature
p <- ggplot(df, aes(x=temp, y=weather_main)) +
  geom_boxplot(outlier.alpha = 0.1, fill='blue') +
  theme_minimal(base_size = 8) + xlim(225, 325) +
  labs(title = "Temperature (°K) in different climate donditions",
       x = "Temperature (°K)", y = "Weather conditions main") +
  theme(plot.title = element_text(size=16),
        axis.title.x = element_text(size=14),
        axis.title.y = element_text(size=14))
p
```

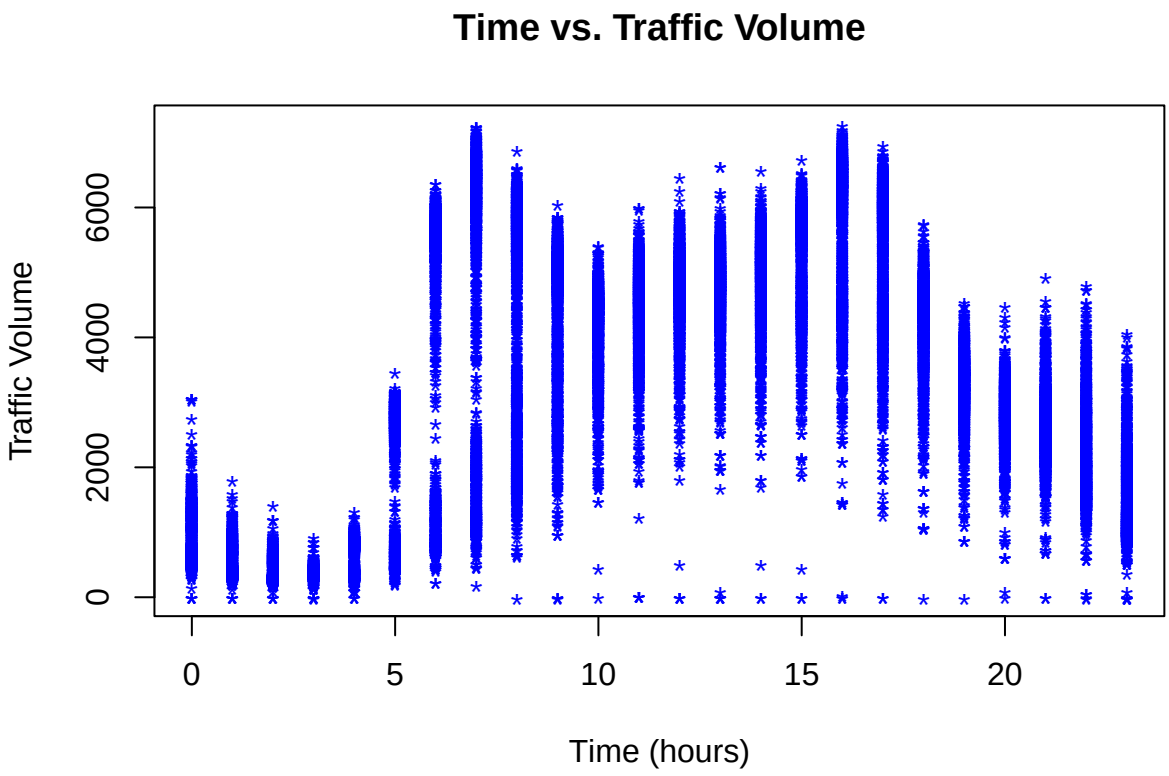



```
#holiday vs. traffic volume
df$holiday <- factor(df$holiday)

plot(df$holiday, df$traffic_volume, main="Holiday vs. Traffic Volume", xlab = "Holiday", ylab="Traffic
```




```
## time vs. traffic volume
plot(df$time, df$traffic_volume, main="Time vs. Traffic Volume", xlab = "Time (hours)", ylab="Traffic V
```



#STEP 4: CONVERTING CATEGORICAL VARIABLES TO DUMMY VARIABLES

##4.1 subset for holiday and weather

```
cat_data <- subset(df, select=c(holiday, weather_main))
head(cat_data)
```

```
##   holiday            weather_main
## 1      No moderately good weather
## 2      No moderately good weather
## 3      No moderately good weather
## 4      No moderately good weather
## 5      No moderately good weather
## 6      No            good weather
```

##4.2 get dummy variables in R, use the model.matrix() function

```
holiday_Dumm <- model.matrix(~holiday, data=cat_data)
weather_main_Dumm <- model.matrix(~weather_main, data=cat_data)
head(holiday_Dumm)
```

```
##   (Intercept) holidayYes
## 1           1          0
## 2           1          0
## 3           1          0
```

```
## 4           1          0
## 5           1          0
## 6           1          0
```

```
head(weather_main_Dumm)
```

```
##   (Intercept) weather_maingood weather weather_mainmoderately bad weather
## 1           1                         0                                  0
## 2           1                         0                                  0
## 3           1                         0                                  0
## 4           1                         0                                  0
## 5           1                         0                                  0
## 6           1                         1                                  0
##   weather_mainmoderately good weather
## 1                                   1
## 2                                   1
## 3                                   1
## 4                                   1
## 5                                   1
## 6                                   0
```

##4.3 bind the dummies to the original data

```
holiday <- holiday_Dumm[,c(2)]
good_weather <- weather_main_Dumm[,c(2)]
moderately_bad_weather <- weather_main_Dumm[,c(3)]
moderately_good_weather <- weather_main_Dumm[,c(4)]
df1 <- df[,-c(1,6)]

df2 <- cbind(df1,holiday,moderately_bad_weather,moderately_good_weather,good_weather)

head(df2)
```

```
##     temp rain_1h snow_1h clouds_all traffic_volume time holiday
## 1 288.28       0       0         40           5545    9       0
## 2 289.36       0       0         75           4516   10       0
## 3 289.58       0       0         90           4767   11       0
## 4 290.13       0       0         90           5026   12       0
## 5 291.14       0       0         75           4918   13       0
## 6 291.72       0       0          1           5181   14       0
##   moderately_bad_weather moderately_good_weather good_weather
## 1                      0                       1            0
## 2                      0                       1            0
## 3                      0                       1            0
## 4                      0                       1            0
## 5                      0                       1            0
## 6                      0                       0            1
```

#SAVING CLEANED DATA SET

```
write.csv(df2, "final_df.csv")
```

GOAL: We will be analysing how traffic volume is affected by weather conditions

STEP 3 MULTILINEAR REGRESSION MODEL

3.1 Reading data set cleaned

```
metro_df <- read.csv("final_df.csv", header = TRUE, sep = ",")
str(metro_df)
```

```
## 'data.frame':    48194 obs. of  11 variables:
##  $ X                     : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ temp                  : num  288 289 290 290 291 ...
##  $ rain_1h               : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ snow_1h               : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ clouds_all            : int  40 75 90 90 75 1 1 1 20 20 ...
##  $ traffic_volume        : int  5545 4516 4767 5026 4918 5181 5584 6015 5791 4770 ...
##  $ time                  : int  9 10 11 12 13 14 15 16 17 18 ...
##  $ holiday               : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ moderately_bad_weather : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ moderately_good_weather: int  1 1 1 1 1 0 0 0 1 1 ...
##  $ good_weather          : int  0 0 0 0 0 1 1 1 0 0 ...
```

STEP 4: FORMATTING AND REMOVING COLUMNS

```
#Removing unnecessary column
metro_df <- metro_df[,-c(1)]
str(metro_df)
```

```
## 'data.frame':    48194 obs. of  10 variables:
##  $ temp                  : num  288 289 290 290 291 ...
##  $ rain_1h               : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ snow_1h               : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ clouds_all            : int  40 75 90 90 75 1 1 1 20 20 ...
##  $ traffic_volume        : int  5545 4516 4767 5026 4918 5181 5584 6015 5791 4770 ...
##  $ time                  : int  9 10 11 12 13 14 15 16 17 18 ...
##  $ holiday               : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ moderately_bad_weather : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ moderately_good_weather: int  1 1 1 1 1 0 0 0 1 1 ...
##  $ good_weather          : int  0 0 0 0 0 1 1 1 0 0 ...
```

STEP 5: SELECTING NUMERIC VARIABLE TO LOG TRANSFORMATION

```r
metro_df <- metro_df %>% dplyr::select(where(is.numeric))
str(metro_df)
```

```
## 'data.frame':    48194 obs. of  10 variables:
##  $ temp                   : num  288 289 290 290 291 ...
##  $ rain_1h                : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ snow_1h                : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ clouds_all             : int  40 75 90 90 75 1 1 1 20 20 ...
##  $ traffic_volume         : int  5545 4516 4767 5026 4918 5181 5584 6015 5791 4770 ...
##  $ time                   : int  9 10 11 12 13 14 15 16 17 18 ...
##  $ holiday                : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ moderately_bad_weather : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ moderately_good_weather: int  1 1 1 1 1 0 0 0 1 1 ...
##  $ good_weather           : int  0 0 0 0 0 1 1 1 0 0 ...
```

STEP 6: ASSESSING THE EXPLANATORY MODEL

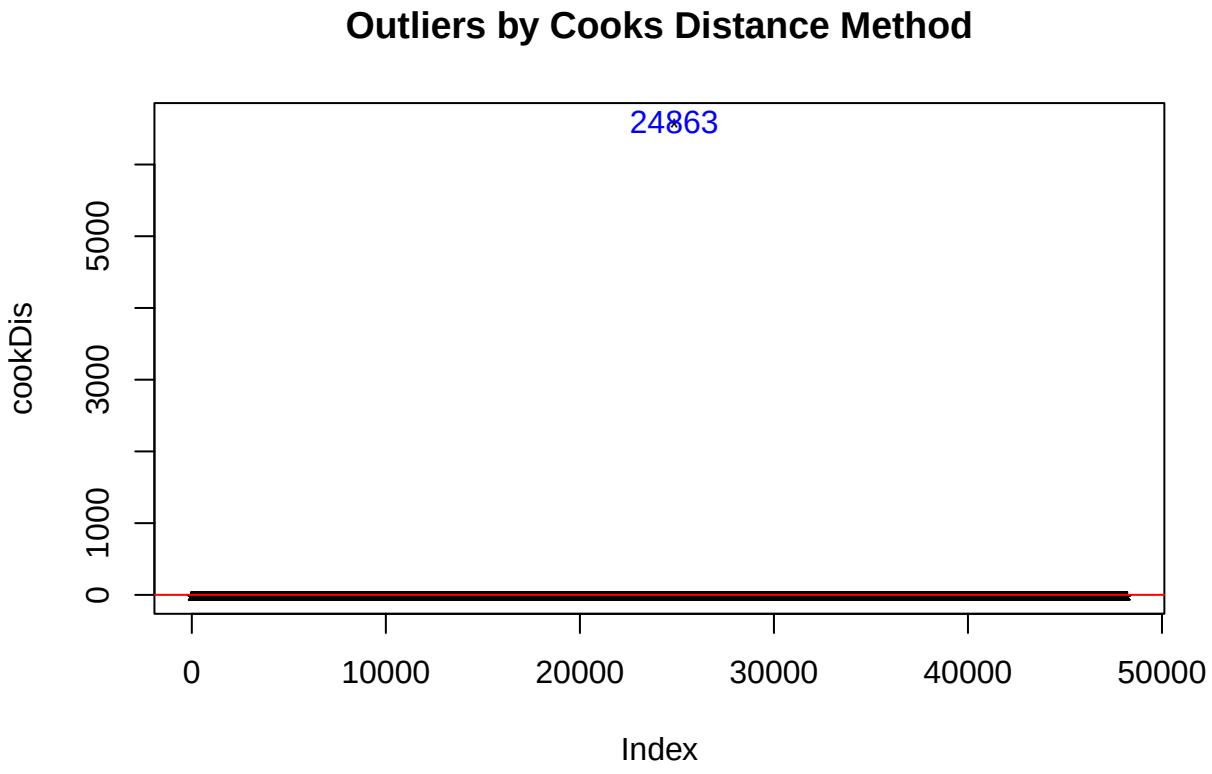
6.1. We modelling the relationship between Traffic volume and weather conditions throug out different day and time moments

```r
full_model_1 <- lm(traffic_volume~., data = metro_df)
options(scipen = 999)
summary(full_model_1)
```

```
##
## Call:
## lm(formula = traffic_volume ~ ., data = metro_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4771.6 -1660.1   -67.1  1549.9  4796.5
##
## Coefficients:
##                            Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -2438.2239   195.3208 -12.483 < 0.0000000000000002 ***
## temp                       15.5269     0.6739  23.039 < 0.0000000000000002 ***
## rain_1h                     0.1295     0.1872   0.692               0.4890
## snow_1h                   -38.4453  1027.2239  -0.037               0.9701
## clouds_all                  2.3650     0.3399   6.959     0.00000000000348 ***
## time                       94.3772     1.2323  76.586 < 0.0000000000000002 ***
## holiday                 -1256.1646   236.1741  -5.319     0.00000010491480 ***
## moderately_bad_weather     50.3790    26.5067   1.901               0.0574 .
## moderately_good_weather   359.6995    24.3598  14.766 < 0.0000000000000002 ***
## good_weather               59.5062    35.0218   1.699               0.0893 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1840 on 48184 degrees of freedom
## Multiple R-squared:  0.1422, Adjusted R-squared:  0.1421
## F-statistic: 887.8 on 9 and 48184 DF,  p-value: < 0.00000000000000022
```

6.2. Finding outliers, selecting and deleting outliers

```
cookDis <- cooks.distance(full_model_1)
plot(cookDis, pch='*', cex=0.8, main='Outliers by Cooks Distance Method')
abline(h=4*mean(cookDis, na.rm=TRUE), col='red')
text(x=1:length(cookDis)+1, y=cookDis, labels = ifelse(cookDis>4*mean(cookDis, na.rm = TRUE), names(cook
```



6.3. Selecting and Deleting outliers

```
outliers_rows <- cookDis>4*mean(cookDis)

df_outliers <- cbind(metro_df, outliers_rows)
nrow(df_outliers)
```

```
## [1] 48194
```

```
nrow(df_outliers[(df_outliers$outliers_rows=='FALSE'),])
```

```
## [1] 48193
```

```
nrow(df_outliers[(df_outliers$outliers_rows=='TRUE'),])
```

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

```
#deleting outliers
df_outliers <- df_outliers[(df_outliers$outliers_rows=='FALSE'), ]
df_outliers <- subset(df_outliers, select = -c(outliers_rows))
```

STEP 7: TESTING THE EXPLANATORY MODEL FROM ORIGINAL DATA SET WITHOUT OUTLIERS

```
#Model 1 Original data set

model_1_full <- lm(traffic_volume~., data = df_outliers)
options(scipen = 999)
summary(model_1_full)
```

```
##
## Call:
## lm(formula = traffic_volume ~ ., data = df_outliers)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4776.5 -1659.1   -66.5  1551.2  4807.0
##
## Coefficients:
##                            Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -2520.1526   195.7988 -12.871 < 0.0000000000000002 ***
## temp                       15.8888     0.6768  23.478 < 0.0000000000000002 ***
## rain_1h                   -47.9225     8.5280  -5.619     0.00000001926495 ***
## snow_1h                   -52.4373  1026.8992  -0.051                0.959
## clouds_all                  2.4101     0.3399   7.091     0.00000000000135 ***
## time                       94.2640     1.2321  76.508 < 0.0000000000000002 ***
## holiday                 -1258.9192   236.0993  -5.332     0.00000009748738 ***
## moderately_bad_weather     38.0739    26.5880   1.432                0.152
## moderately_good_weather   338.2981    24.6463  13.726 < 0.0000000000000002 ***
## good_weather               40.6967    35.1693   1.157                0.247
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1840 on 48183 degrees of freedom
## Multiple R-squared:  0.1428, Adjusted R-squared:  0.1426
## F-statistic: 891.7 on 9 and 48183 DF,  p-value: < 0.00000000000000022
```

STEP 8: IMPROVING THE EXPLANATORY MODEL WITH STEPWISE REGRESSION MODEL

```
library(MASS)
```

```
##
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':
##
##     select
```

```
#Model 2 Reducing the original model with Stepwise regression model

model_2_step <- stepAIC(full_model_1, direction = "backward", trace = FALSE)
summary(model_2_step)
```

```
##
## Call:
## lm(formula = traffic_volume ~ temp + clouds_all + time + holiday +
##     moderately_bad_weather + moderately_good_weather + good_weather,
##     data = metro_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4771.7 -1660.1   -67.1  1550.0  4796.7
##
## Coefficients:
##                            Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -2439.4047   195.2785 -12.492 < 0.0000000000000002 ***
## temp                       15.5316     0.6738  23.052 < 0.0000000000000002 ***
## clouds_all                  2.3652     0.3398   6.960      0.00000000000345 ***
## time                       94.3787     1.2322  76.595 < 0.0000000000000002 ***
## holiday                 -1256.1544   236.1704  -5.319      0.00000010489119 ***
## moderately_bad_weather     50.2281    26.5052   1.895                0.0581 .
## moderately_good_weather   359.5321    24.3508  14.765 < 0.0000000000000002 ***
## good_weather               59.3480    35.0197   1.695                0.0901 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1840 on 48186 degrees of freedom
## Multiple R-squared:  0.1422, Adjusted R-squared:  0.1421
## F-statistic:  1141 on 7 and 48186 DF,  p-value: < 0.00000000000000022
```

STEP 9: EVALUATION OF MODELS BASED ON Akaike Information Criteria (AIC) ANALYSIS AND R-SQUARED SCORE

```
# Evaluations model from original data set without outliers

full_model_AIC <- AIC(model_1_full)
step_model_AIC <- AIC(model_2_step)

print(paste0("Full model     AIC score: ", full_model_AIC))
```

```
## [1] "Full model     AIC score: 861342.145002938"
```

```
print(paste0("Full mode      R-squared: ", summary(model_1_full)$r.squared))
```

```
## [1] "Full mode      R-squared: 0.142782046683378"
```

```
print(paste0(""))
```

```
## [1] ""
```

```
print(paste0("Stepwise model AIC score: ", step_model_AIC))
```

```
## [1] "Stepwise model AIC score: 861387.258464806"
```

```
print(paste0("Stepwise model R-squared: ", summary(model_2_step)$r.squared))
```

```
## [1] "Stepwise model R-squared: 0.142231721337549"
```

STEP 10: LOG TRANSFORMATION OF ORIGINAL DATA SET

```
# Log transformation of numeric variables from original data set without outliers

metro_Log <- df_outliers

metro_Log[c("temp", "rain_1h", "snow_1h", "clouds_all", "traffic_volume", "time")] <- log1p(metro_Log[c
```

STEP 11: RUNNING MODELS LOG TRANSFORMATED

10.1 Full model Log transformated

```
# Model 3 Log transformation

model_3_full_log <- lm(traffic_volume~., data = metro_Log)
summary(model_3_full_log)
```

```
##
## Call:
## lm(formula = traffic_volume ~ ., data = metro_Log)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.5333 -0.5170  0.1879  0.5220  2.0013
##
## Coefficients:
##                          Estimate Std. Error t value             Pr(>|t|)
```

```
## (Intercept)             -1.458158   0.432113  -3.374             0.000740 ***
## temp                     1.305214   0.076339  17.098 < 0.0000000000000002 ***
## rain_1h                 -0.089149   0.013757  -6.480    0.000000000092364 ***
## snow_1h                 -0.199387   0.488536  -0.408             0.683178
## clouds_all               0.027149   0.003755   7.230    0.000000000000488 ***
## time                     0.758618   0.004245 178.719 < 0.0000000000000002 ***
## holiday                  0.697618   0.095462   7.308    0.000000000000276 ***
## moderately_bad_weather   0.026928   0.010804   2.492             0.012694 *
## moderately_good_weather  0.086437   0.010033   8.616 < 0.0000000000000002 ***
## good_weather             0.060365   0.016136   3.741             0.000183 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7414 on 48183 degrees of freedom
## Multiple R-squared:  0.4231, Adjusted R-squared:  0.423
## F-statistic:  3927 on 9 and 48183 DF,  p-value: < 0.00000000000000022
```

11.2 Stepwise model of Full model Log transformated

```
# Model 4 reducing model 3 Stepwise model (Log) with stepwise regression

model_4_step_log <- stepAIC(model_3_full_log, direction = "backward", trace = FALSE)
options(scipen = 999)
summary(model_4_step_log)
```

```
##
## Call:
## lm(formula = traffic_volume ~ temp + rain_1h + clouds_all + time +
##     holiday + moderately_bad_weather + moderately_good_weather +
##     good_weather, data = metro_Log)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.5332 -0.5170  0.1879  0.5220  2.0014
##
## Coefficients:
##                          Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -1.461482   0.432032  -3.383             0.000718 ***
## temp                     1.305807   0.076325  17.109 < 0.0000000000000002 ***
## rain_1h                 -0.089150   0.013757  -6.480    0.000000000092308 ***
## clouds_all               0.027126   0.003754   7.225    0.000000000000508 ***
## time                     0.758602   0.004245 178.724 < 0.0000000000000002 ***
## holiday                  0.697621   0.095461   7.308    0.000000000000276 ***
## moderately_bad_weather   0.026942   0.010804   2.494             0.012644 *
## moderately_good_weather  0.086547   0.010029   8.630 < 0.0000000000000002 ***
## good_weather             0.060394   0.016136   3.743             0.000182 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7414 on 48184 degrees of freedom
## Multiple R-squared:  0.4231, Adjusted R-squared:  0.423
## F-statistic:  4417 on 8 and 48184 DF,  p-value: < 0.00000000000000022
```

11.3 Comparation of model accuracy assessment based on R-squared scores

```
print(paste0("*************** Original data set ***************"))
```

```
## [1] "*************** Original data set ***************"
```

```
print(paste0(""))
```

```
## [1] ""
```

```
print(paste0("Full mode            R-squared: ", summary(model_1_full)$r.squared))
```

```
## [1] "Full mode            R-squared: 0.142782046683378"
```

```
print(paste0("Stepwise model       R-squared: ", summary(model_2_step)$r.squared))
```

```
## [1] "Stepwise model       R-squared: 0.142231721337549"
```

```
print(paste0(""))
```

```
## [1] ""
```

```
print(paste0("********** Log transformated data set ***********"))
```

```
## [1] "********** Log transformated data set ***********"
```

```
print(paste0(""))
```

```
## [1] ""
```

```
print(paste0("Full model (Log)     R-squared: ", summary(model_3_full_log)$r.squared))
```

```
## [1] "Full model (Log)     R-squared: 0.423111554243861"
```

```
print(paste0("Stepwise model (Log) R-squared: ", summary(model_4_step_log)$r.squared))
```

```
## [1] "Stepwise model (Log) R-squared: 0.423109559894008"
```

STEP 12 CANDIDATE MODELS FROM ORIGINAL AND LOG TRANSFORMATED DATA SET

```
library(AICcmodavg)
# Candidate model
candidate_models <- list('Full model'= model_1_full, 'Stepwise model'= model_2_step, 'Full model (Log)'=

selectionTable <- aictab(cand.set = candidate_models)
selectionTable
```

```
##
## Model selection based on AICc:
##
##                        K     AICc Delta_AICc AICcWt Cum.Wt         LL
## Stepwise model (Log) 10 107934.6       0.00   0.71   0.71  -53957.32
## Full model (Log)     11 107936.5       1.83   0.29   1.00  -53957.23
## Full model           11 861342.2  753407.51   0.00   1.00 -430660.07
## Stepwise model        9 861387.3  753452.62   0.00   1.00 -430684.63
```

The best model fitted with the best predictors was Stepwise model (Log)

```
# The best model
summary(model_4_step_log)
```

```
##
## Call:
## lm(formula = traffic_volume ~ temp + rain_1h + clouds_all + time +
##     holiday + moderately_bad_weather + moderately_good_weather +
##     good_weather, data = metro_Log)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.5332 -0.5170  0.1879  0.5220  2.0014
##
## Coefficients:
##                           Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -1.461482   0.432032  -3.383             0.000718 ***
## temp                     1.305807   0.076325  17.109 < 0.0000000000000002 ***
## rain_1h                 -0.089150   0.013757  -6.480    0.000000000092308 ***
## clouds_all               0.027126   0.003754   7.225    0.000000000000508 ***
## time                     0.758602   0.004245 178.724 < 0.0000000000000002 ***
## holiday                  0.697621   0.095461   7.308    0.000000000000276 ***
## moderately_bad_weather   0.026942   0.010804   2.494             0.012644 *
## moderately_good_weather  0.086547   0.010029   8.630 < 0.0000000000000002 ***
## good_weather             0.060394   0.016136   3.743             0.000182 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7414 on 48184 degrees of freedom
## Multiple R-squared:  0.4231, Adjusted R-squared:  0.423
## F-statistic:  4417 on 8 and 48184 DF,  p-value: < 0.00000000000000022
```

12.1 Analysing candidate models

According to the candidate models, it was found that the step wise regression model with Log transformation (Step wise model (Log)) got an AICc = 107934.6 being the lowest score compared with other models. The Step wise model (Log) was fitted with next variables: Temperature, Raining (1h), Clouds, daytime, holiday, and categorical weather. Then, we can use most of independent variables to explain traffic volume changes with a R-squared statistic of 0.42 that means the model explained around to 42% of the variation in the traffic volume. We can see that the rain has a negative effect over traffic volume while temperature has a positive effect. For example, a 1 unit increase in raining (1h) traffic volume decrease around to 8% while the temperature can increase the traffic volume near to 1.3 times.

STEP 13: splitting the dataset into 90% trining set and set 10% testing set for prediction models

```
library(caTools)

set.seed(145)
#Create a copy
metro_log_split_df <- metro_Log
train_part <- sample.split(metro_log_split_df$traffic_volume, SplitRatio = 0.75)
metro_log_split_Train <- subset(metro_log_split_df, train_part==TRUE)
metro_log_split_Test <- subset(metro_log_split_df, train_part==FALSE)

print(paste0("Full data set:           ",nrow(metro_log_split_df)))
```

```
## [1] "Full data set:           48193"
```

```
print(paste0("Training data set (90%): ",nrow(metro_log_split_Train)))
```

```
## [1] "Training data set (90%): 36251"
```

```
print(paste0("Testing data set (10%):  ",nrow(metro_log_split_Test)))
```

```
## [1] "Testing data set (10%):  11942"
```

STEP 14: Modelling training dataset

```
# training model
model_train_1 <- lm(traffic_volume~., data = metro_log_split_Train)
#step wise training model
model_train_2_step <- stepAIC(model_train_1, direction = "backward", trace = FALSE)
options(scipen = 999)

# Candidate model list
candidate_Train_models <- list("Training model" = model_train_1, "Stepwise training model" = model_trai
```

```
# Best candidate model table
selection_Training_models <- aictab(cand.set = candidate_Train_models)
selection_Training_models
```

```
##
## Model selection based on AICc:
##
##                          K     AICc Delta_AICc AICcWt Cum.Wt        LL
## Stepwise training model 10 81472.01       0.00   0.61   0.61 -40726.00
## Training model          11 81472.92       0.91   0.39   1.00 -40725.45
```

14.1 Candidate models comparation

```
candidate_models <- list("Full model"= model_1_full, "Stepwise model"= model_2_step, "Full model (Log)"=

selectionTable <- aictab(cand.set = candidate_models)
print(paste0("***********            Full Models              ***********"))
```

```
## [1] "***********            Full Models              ***********"
```

```
selectionTable
```

```
##
## Model selection based on AICc:
##
##                        K     AICc Delta_AICc AICcWt Cum.Wt         LL
## Stepwise model (Log)  10 107934.6       0.00   0.71   0.71  -53957.32
## Full model (Log)      11 107936.5       1.83   0.29   1.00  -53957.23
## Full model            11 861342.2  753407.51   0.00   1.00 -430660.07
## Stepwise model         9 861387.3  753452.62   0.00   1.00 -430684.63
```

```
print(paste0("-------------------------------------------------------------"))
```

```
## [1] "-------------------------------------------------------------"
```

```
print(paste0("***********           Training Models           ***********"))
```

```
## [1] "***********           Training Models           ***********"
```

```
selection_Training_models
```

```
##
## Model selection based on AICc:
##
##                          K     AICc Delta_AICc AICcWt Cum.Wt        LL
## Stepwise training model 10 81472.01       0.00   0.61   0.61 -40726.00
## Training model          11 81472.92       0.91   0.39   1.00 -40725.45
```

14.2 Selecting the best fitting model

The best fitting model was "Stepwise training model" which has the next formula:

formula = traffic_volume ~ temp + rain_1h + clouds_all + time + holiday + moderately_bad_weather + moderately_good_weather + good_weather

```
#The best model from Full data set
summary(model_4_step_log)
```

```
##
## Call:
## lm(formula = traffic_volume ~ temp + rain_1h + clouds_all + time +
##     holiday + moderately_bad_weather + moderately_good_weather +
##     good_weather, data = metro_Log)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.5332 -0.5170  0.1879  0.5220  2.0014
##
## Coefficients:
##                           Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -1.461482   0.432032  -3.383             0.000718 ***
## temp                     1.305807   0.076325  17.109 < 0.0000000000000002 ***
## rain_1h                 -0.089150   0.013757  -6.480    0.000000000092308 ***
## clouds_all               0.027126   0.003754   7.225    0.000000000000508 ***
## time                     0.758602   0.004245 178.724 < 0.0000000000000002 ***
## holiday                  0.697621   0.095461   7.308    0.000000000000276 ***
## moderately_bad_weather   0.026942   0.010804   2.494             0.012644 *
## moderately_good_weather  0.086547   0.010029   8.630 < 0.0000000000000002 ***
## good_weather             0.060394   0.016136   3.743             0.000182 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7414 on 48184 degrees of freedom
## Multiple R-squared:  0.4231, Adjusted R-squared:  0.423
## F-statistic:  4417 on 8 and 48184 DF,  p-value: < 0.00000000000000022
```

```
best_model_full_dataset <- model_4_step_log
print("*************************************************************************")
```

```
## [1] "*************************************************************************"
```

```
#The best model from Training data set
summary(model_train_2_step)
```

```
##
## Call:
## lm(formula = traffic_volume ~ temp + rain_1h + clouds_all + time +
##     holiday + moderately_bad_weather + moderately_good_weather +
##     good_weather, data = metro_log_split_Train)
##
```

```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.5306 -0.5174  0.1878  0.5231  2.0012
##
## Coefficients:
##                           Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -1.164475   0.500284  -2.328              0.01994 *
## temp                     1.253830   0.088390  14.185 < 0.0000000000000002 ***
## rain_1h                 -0.082779   0.016023  -5.166  0.00000024008222638 ***
## clouds_all               0.026346   0.004327   6.089  0.00000000114926297 ***
## time                     0.757564   0.004918 154.048 < 0.0000000000000002 ***
## holiday                  0.744272   0.116823   6.371  0.00000000019011716 ***
## moderately_bad_weather   0.030072   0.012484   2.409              0.01601 *
## moderately_good_weather  0.091104   0.011623   7.838  0.00000000000000469 ***
## good_weather             0.055307   0.018602   2.973              0.00295 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7443 on 36242 degrees of freedom
## Multiple R-squared:  0.4201, Adjusted R-squared:   0.42
## F-statistic:  3282 on 8 and 36242 DF,  p-value: < 0.00000000000000022
```

```
best_model_training_dataset <- model_train_2_step
```

14.3 Creating a new data frame with the variables of the best fitting model

```
myvars <- c("traffic_volume", "temp", "rain_1h", "clouds_all", "time", "holiday", "moderately_bad_weathe

df_best_model <- metro_log_split_df[myvars]
names(df_best_model)
```

```
## [1] "traffic_volume"          "temp"
## [3] "rain_1h"                 "clouds_all"
## [5] "time"                    "holiday"
## [7] "moderately_bad_weather"  "moderately_good_weather"
## [9] "good_weather"
```

14.4 Full model with the new data set

```
set.seed(145)
#backup
df_split_best_model <- df_best_model
train_part1 <-  sample.split(df_split_best_model$traffic_volume, SplitRatio = 0.75)
df_split_train1 <-  subset(df_split_best_model, train_part==TRUE)
df_split_test1 <-  subset(df_split_best_model, train_part==FALSE)

print(paste0("Split the new data set from best model:          ",nrow(df_split_best_model)))
```

```
## [1] "Split the new data set from best model:          48193"
```

```
print(paste0("Training the new data set from best model (90%): ",nrow(df_split_train1)))
```

```
## [1] "Training the new data set from best model (90%): 36251"
```

```
print(paste0("Testing the new data set from best model(10%):   ",nrow(df_split_test1)))
```

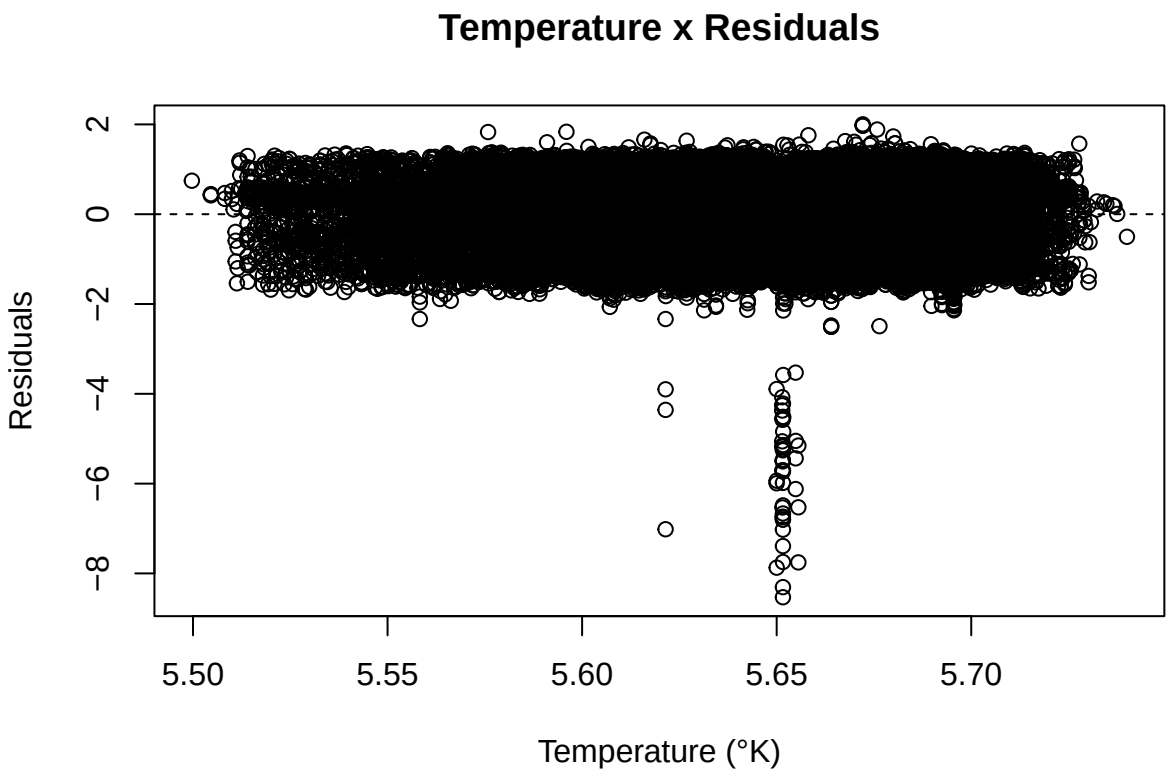
```
## [1] "Testing the new data set from best model(10%):   11942"
```

14.5 Training the best model

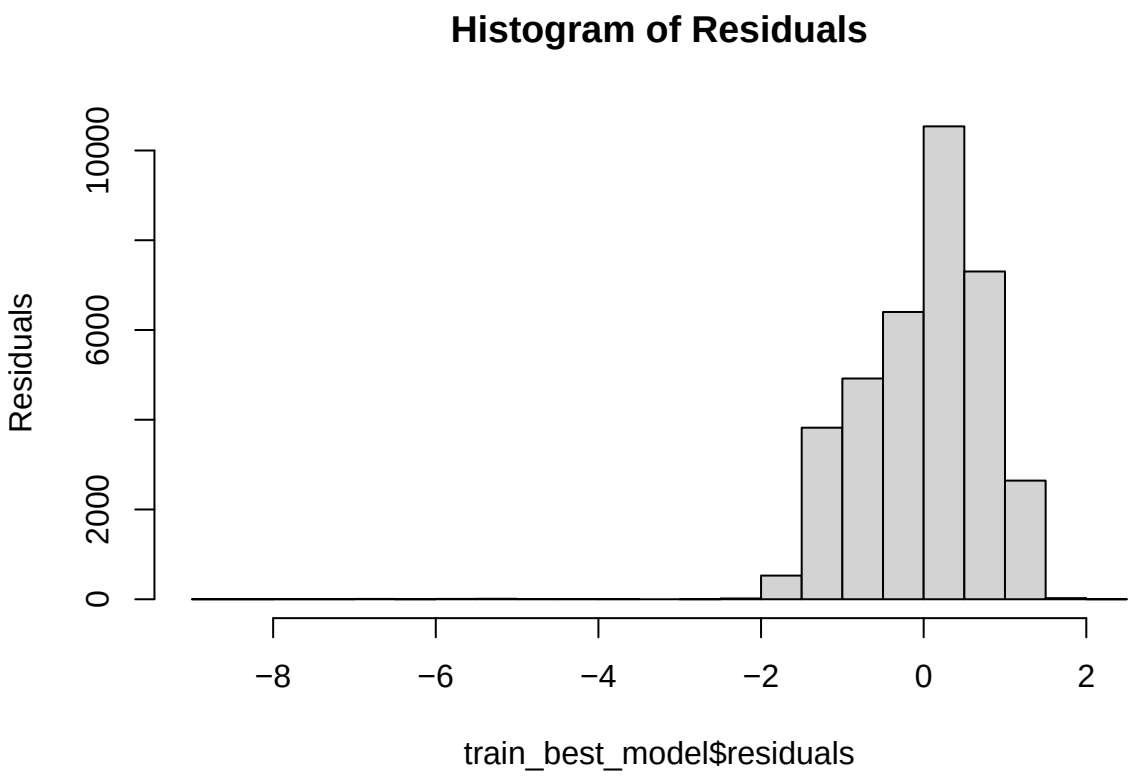
```
train_best_model <- lm(traffic_volume ~., data = df_split_train1)
options(scipen = 999)
summary(train_best_model)
```

```
##
## Call:
## lm(formula = traffic_volume ~ ., data = df_split_train1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.5306 -0.5174  0.1878  0.5231  2.0012
##
## Coefficients:
##                           Estimate Std. Error t value             Pr(>|t|)
## (Intercept)             -1.164475   0.500284  -2.328              0.01994 *
## temp                     1.253830   0.088390  14.185 < 0.0000000000000002 ***
## rain_1h                 -0.082779   0.016023  -5.166  0.00000024008222638 ***
## clouds_all               0.026346   0.004327   6.089  0.00000000114926297 ***
## time                     0.757564   0.004918 154.048 < 0.0000000000000002 ***
## holiday                  0.744272   0.116823   6.371  0.00000000019011716 ***
## moderately_bad_weather   0.030072   0.012484   2.409              0.01601 *
## moderately_good_weather  0.091104   0.011623   7.838  0.00000000000000469 ***
## good_weather             0.055307   0.018602   2.973              0.00295 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7443 on 36242 degrees of freedom
## Multiple R-squared:  0.4201, Adjusted R-squared:   0.42
## F-statistic:  3282 on 8 and 36242 DF,  p-value: < 0.00000000000000022
```

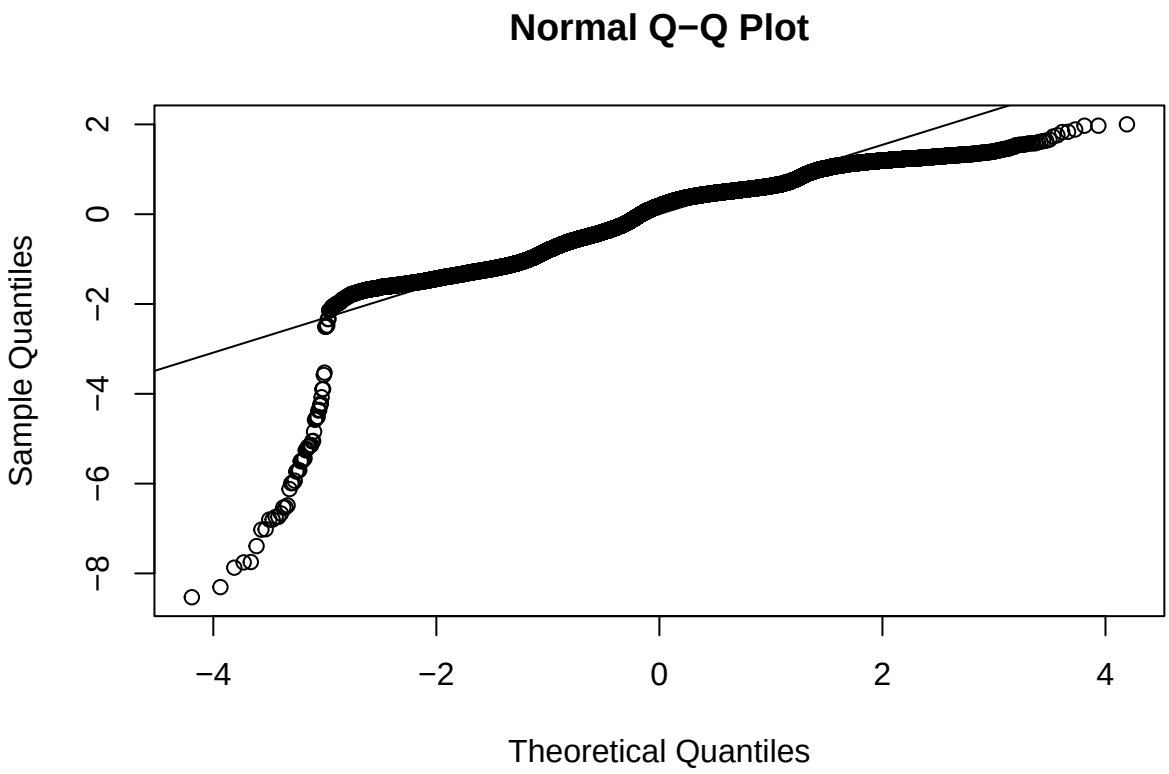
```
#Temperature x Residuals Plot
plot(train_best_model$residuals~df_split_train1$temp[order(df_split_train1$temp)],
 main="Temperature x Residuals",
 xlab="Temperature (°K)", ylab="Residuals")
abline(h=0,lty=2)
```




```
#Histogram of Residuals
hist(train_best_model$residuals, main="Histogram of Residuals",
 ylab="Residuals")
```




```
#Q-Q Plot
qqnorm(train_best_model$residuals)
qqline(train_best_model$residuals)
```



STEP 15 DISPLAYING PREDICTED, ACTUAL, AND RESIDUALS VALUES.

```
library(forecast)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
#Prediction of the best model
best_model_training_dataset_pred <- predict(train_best_model, df_split_train1)

#Training Model

print("-------------Validation Model----------------------")
```

```
## [1] "-------------Validation Model----------------------"
```

```
print("-------------  Best Model    ----------------------")
```

```
## [1] "-------------  Best Model    ----------------------"
```

```
accuracy(best_model_training_dataset_pred, df_split_train1$traffic_volume)
```

```
##                              ME      RMSE       MAE  MPE MAPE
## Test set -0.000000000000926192 0.7441642 0.6132536 -Inf  Inf
```

15.1 Display the dataframe of predicted values

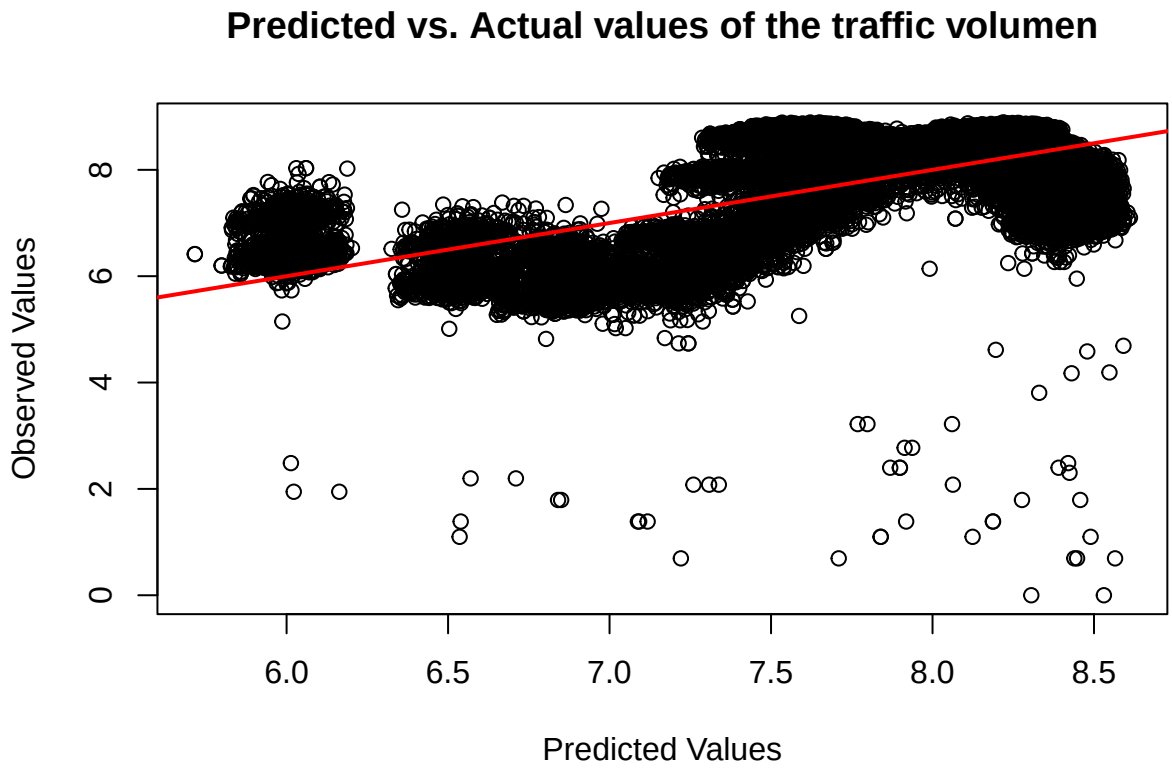
```
pred_values <- data.frame("Predicted" = best_model_training_dataset_pred[1:50],
                          "Actual" = df_split_train1$traffic_volume[1:50],
                          "Residual" = best_model_training_dataset_pred[1:50] - df_split_train1$traffic_
pred_values
```

```
##    Predicted   Actual    Residual
## 1   7.874774 8.620832 -0.74605823
## 2   7.967909 8.415603 -0.44769387
## 3   8.039521 8.469682 -0.43016082
## 4   8.102530 8.522579 -0.42004880
## 5   8.158268 8.500861 -0.34259234
## 6   8.081390 8.552946 -0.47155649
## 8   8.185342 8.702178 -0.51683576
## 9   8.327579 8.664233 -0.33665396
## 10  8.364112 8.470311 -0.10619882
## 12  8.326226 7.932003  0.39422274
## 13  8.358139 7.767264  0.59087462
## 14  8.385520 7.333023  1.05249731
## 15  8.410299 6.871091  1.53920803
## 16  5.999124 6.228511 -0.22938673
## 17  6.519126 5.774552  0.74457398
## 18  6.816157 5.613128  1.20302913
## 21  7.329834 7.908019 -0.57818548
## 22  7.444863 8.643650 -1.19878657
## 23  7.634756 8.781402 -1.14664602
## 24  7.734007 8.607399 -0.87339209
## 25  7.974052 8.536604 -0.56255144
## 26  8.035575 8.494539 -0.45896391
## 27  8.092435 8.582606 -0.49017131
## 30  8.366498 8.439015 -0.07251785
## 31  8.392482 8.186464  0.20601715
## 32  8.418823 7.972121  0.44670153
## 33  8.351584 7.877776  0.47380782
## 36  5.998773 6.395262 -0.39648855
## 37  6.519126 5.913503  0.60562252
## 38  6.824969 5.746203  1.07876532
## 39  7.037910 5.908083  1.12982750
## 41  7.341883 7.910957 -0.56907456
## 43  7.556485 8.852379 -1.29589365
## 44  7.651445 8.697179 -1.04573396
## 45  7.745016 8.577347 -0.83233074
## 46  7.835500 8.434681 -0.59918051
## 47  7.911616 8.493925 -0.58230871
```

```
## 49  8.048927 8.552367 -0.50344062
## 50  8.105150 8.612867 -0.50771672
## 51  8.157610 8.650675 -0.49306482
## 52  8.300821 8.747193 -0.44637185
## 53  8.342486 8.709135 -0.36664865
## 54  8.395561 8.498622 -0.10306103
## 57  8.503377 7.945555  0.55782161
## 58  8.535295 7.597396  0.93789868
## 59  8.566507 7.062192  1.50431532
## 60  6.156821 6.442540 -0.28571881
## 62  7.051232 5.910797  1.14043490
## 63  7.481880 7.820038 -0.33815763
## 64  7.599118 8.619389 -1.02027033
```

15.2 Visualilization of predicted and actual values

```
plot(predict(train_best_model),
     df_split_train1$traffic_volume,
     xlab = "Predicted Values",
     ylab = "Observed Values", main = "Predicted vs. Actual values of the traffic volumen")
abline(a = 0,
       b = 1,
       col = "red",
       lwd = 2)
```



STEP 16 Visualization of predicted values from the best model

```
#install.packages("jtools", "sjPlot", "sjmisc")
library(jtools)
```

```
## Warning: package 'jtools' was built under R version 4.2.2
```

```
##
## Attaching package: 'jtools'
```

```
## The following object is masked from 'package:Hmisc':
##
##     %nin%
```

```
library(sjPlot)
```

```
## Registered S3 methods overwritten by 'broom':
##   method            from
##   tidy.glht         jtools
##   tidy.summary.glht jtools
```

```
library(sjmisc)
```

```
##
## Attaching package: 'sjmisc'
```

```
## The following objects are masked from 'package:jtools':
##
##     %nin%, center
```

```
## The following object is masked from 'package:Hmisc':
##
##     %nin%
```

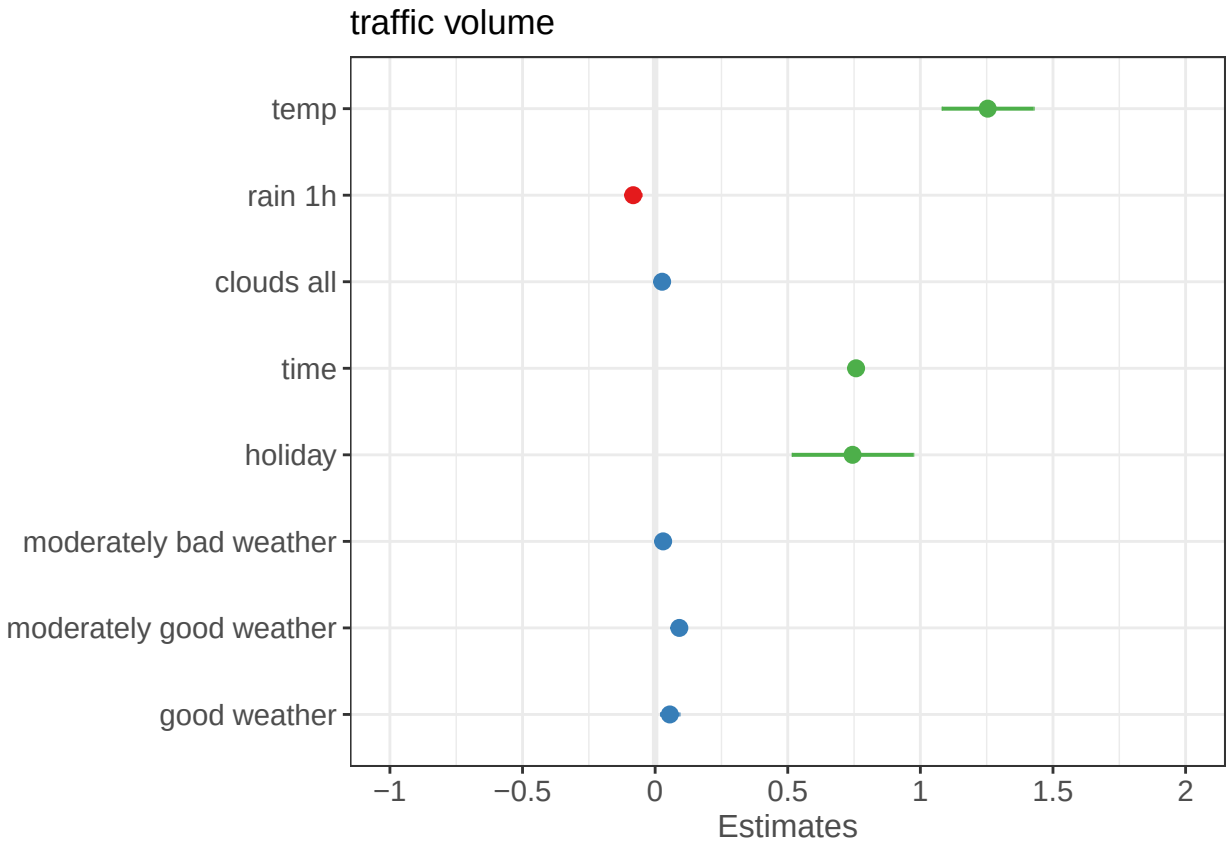
```
# Plotting the best model
set_theme(base = theme_bw())

best_model_full_dataset
```

```
##
## Call:
## lm(formula = traffic_volume ~ temp + rain_1h + clouds_all + time +
##     holiday + moderately_bad_weather + moderately_good_weather +
##     good_weather, data = metro_Log)
##
## Coefficients:
##             (Intercept)                     temp                  rain_1h
##                -1.46148                  1.30581                 -0.08915
##              clouds_all                     time                  holiday
##                 0.02713                  0.75860                  0.69762
##  moderately_bad_weather  moderately_good_weather             good_weather
##                 0.02694                  0.08655                  0.06039
```

```
best_model_training_dataset
```

```
##
## Call:
## lm(formula = traffic_volume ~ temp + rain_1h + clouds_all + time +
##     holiday + moderately_bad_weather + moderately_good_weather +
##     good_weather, data = metro_log_split_Train)
##
## Coefficients:
##              (Intercept)                      temp                   rain_1h
##                  -1.16447                   1.25383                  -0.08278
##               clouds_all                      time                   holiday
##                   0.02635                   0.75756                   0.74427
##  moderately_bad_weather  moderately_good_weather              good_weather
##                   0.03007                   0.09110                   0.05531
```

```
plot_model(best_model_training_dataset, group.terms = c(4,1,2,4,4,2,2,2))
```



16.1 Getting predicted values from independent variables

16.1.1 Getting predicted values from log transfomated data set

```r
# We got predicted values based on different scenarios
y <- get_model_data(
  train_best_model,
  type = c("pred"),
  colors = "Set1",
  case = "parsed",
  digits = 2
)
y
```

```
## $temp
## # Predicted values of traffic_volume
##
## temp | Predicted | group_col |       95% CI
## ------------------------------------------
## 5.40 |      7.40 |      temp | [7.36, 7.45]
## 5.50 |      7.53 |      temp | [7.50, 7.56]
## 5.60 |      7.65 |      temp | [7.63, 7.68]
## 5.70 |      7.78 |      temp | [7.76, 7.80]
##
## Adjusted for:
## *                rain_1h = 0.05
## *             clouds_all = 3.05
## *                   time = 2.27
## *                holiday = 0.00
## *  moderately_bad_weather = 0.00
## * moderately_good_weather = 0.00
## *            good_weather = 0.00
##
## $rain_1h
## # Predicted values of traffic_volume
##
## rain_1h | Predicted | group_col |       95% CI
## -------------------------------------------
##       0 |      7.71 |   rain_1h | [7.69, 7.73]
##       1 |      7.63 |   rain_1h | [7.60, 7.66]
##       2 |      7.55 |   rain_1h | [7.48, 7.61]
##       3 |      7.46 |   rain_1h | [7.37, 7.55]
##       4 |      7.38 |   rain_1h | [7.26, 7.50]
##       5 |      7.30 |   rain_1h | [7.14, 7.45]
##
## Adjusted for:
## *                   temp = 5.64
## *             clouds_all = 3.05
## *                   time = 2.27
## *                holiday = 0.00
## *  moderately_bad_weather = 0.00
## * moderately_good_weather = 0.00
## *            good_weather = 0.00
##
## $clouds_all
## # Predicted values of traffic_volume
##
```

```
## clouds_all | Predicted |  group_col |       95% CI
## -------------------------------------------------
##       0.00 |      7.63 | clouds_all | [7.59, 7.66]
##       0.50 |      7.64 | clouds_all | [7.60, 7.67]
##       1.50 |      7.67 | clouds_all | [7.64, 7.69]
##       2.00 |      7.68 | clouds_all | [7.65, 7.70]
##       2.50 |      7.69 | clouds_all | [7.67, 7.71]
##       3.00 |      7.71 | clouds_all | [7.69, 7.72]
##       3.50 |      7.72 | clouds_all | [7.70, 7.74]
##       5.00 |      7.76 | clouds_all | [7.74, 7.78]
##
## Adjusted for:
## *                    temp = 5.64
## *                rain_1h = 0.05
## *                    time = 2.27
## *                 holiday = 0.00
## *  moderately_bad_weather = 0.00
## * moderately_good_weather = 0.00
## *            good_weather = 0.00
##
## $time
## # Predicted values of traffic_volume
##
## time | Predicted | group_col |       95% CI
## -----------------------------------------
## 0.00 |      5.99 |      time | [5.96, 6.01]
## 0.40 |      6.29 |      time | [6.26, 6.31]
## 0.80 |      6.59 |      time | [6.57, 6.62]
## 1.20 |      6.89 |      time | [6.87, 6.92]
## 1.60 |      7.20 |      time | [7.18, 7.22]
## 2.00 |      7.50 |      time | [7.48, 7.52]
## 2.40 |      7.80 |      time | [7.78, 7.82]
## 3.20 |      8.41 |      time | [8.39, 8.43]
##
## Adjusted for:
## *                    temp = 5.64
## *                rain_1h = 0.05
## *              clouds_all = 3.05
## *                 holiday = 0.00
## *  moderately_bad_weather = 0.00
## * moderately_good_weather = 0.00
## *            good_weather = 0.00
##
## $holiday
## # Predicted values of traffic_volume
##
## holiday | Predicted | group_col |       95% CI
## -----------------------------------------
##       0 |      7.71 |   holiday | [7.69, 7.73]
##       1 |      8.45 |   holiday | [8.22, 8.68]
##
## Adjusted for:
## *                    temp = 5.64
## *                rain_1h = 0.05
```

```
## *              clouds_all = 3.05
## *                    time = 2.27
## *  moderately_bad_weather = 0.00
## * moderately_good_weather = 0.00
## *            good_weather = 0.00
##
## $moderately_bad_weather
## # Predicted values of traffic_volume
##
## moderately_bad_weather | Predicted |              group_col |       95% CI
## ------------------------------------------------------------------------
##                      0 |      7.71 | moderately_bad_weather | [7.69, 7.73]
##                      1 |      7.74 | moderately_bad_weather | [7.72, 7.75]
##
## Adjusted for:
## *                    temp = 5.64
## *                rain_1h = 0.05
## *              clouds_all = 3.05
## *                    time = 2.27
## *                 holiday = 0.00
## * moderately_good_weather = 0.00
## *            good_weather = 0.00
##
## $moderately_good_weather
## # Predicted values of traffic_volume
##
## moderately_good_weather | Predicted |               group_col |       95% CI
## ------------------------------------------------------------------------
##                       0 |      7.71 | moderately_good_weather | [7.69, 7.73]
##                       1 |      7.80 | moderately_good_weather | [7.78, 7.81]
##
## Adjusted for:
## *                    temp = 5.64
## *                rain_1h = 0.05
## *              clouds_all = 3.05
## *                    time = 2.27
## *                 holiday = 0.00
## * moderately_bad_weather = 0.00
## *            good_weather = 0.00
##
## $good_weather
## # Predicted values of traffic_volume
##
## good_weather | Predicted |    group_col |       95% CI
## ------------------------------------------------------
##            0 |      7.71 | good_weather | [7.69, 7.73]
##            1 |      7.76 | good_weather | [7.74, 7.79]
##
## Adjusted for:
## *                    temp = 5.64
## *                rain_1h = 0.05
## *              clouds_all = 3.05
## *                    time = 2.27
## *                 holiday = 0.00
```

```
## *  moderately_bad_weather = 0.00
## * moderately_good_weather = 0.00
```

16.1.2 reversing Log transformated values to real values in order to analysis and make understandeable interpretation of predictions

```
c <- do.call(rbind.data.frame, y) |> as.data.frame()
real_predicted_values <- exp(c[,1:5])
print(real_predicted_values)
```

```
##                                x predicted std.error  conf.low conf.high
## temp.1                 221.406416 1641.3190  1.024417 1565.5214 1720.7864
## temp.2                 244.691932 1860.5706  1.016628 1801.3951 1921.6900
## temp.3                 270.426407 2109.1104  1.010932 2064.6396 2154.5391
## temp.4                 298.867401 2390.8508  1.011049 2339.9099 2442.9007
## rain_1h.1                1.000000 2232.4329  1.010261 2188.2075 2277.5521
## rain_1h.2                2.718282 2055.0756  1.016662 1989.5813 2122.7258
## rain_1h.3                7.389056 1891.8085  1.031392 1780.6020 2009.9604
## rain_1h.4               20.085537 1741.5124  1.047474 1590.1821 1907.2440
## rain_1h.5               54.598150 1603.1566  1.064104 1419.3463 1810.7711
## rain_1h.6              148.413159 1475.7926  1.081117 1266.5890 1719.5507
## clouds_all.1             1.000000 2050.8070  1.019893 1973.1399 2131.5312
## clouds_all.2             1.648721 2078.0006  1.017964 2006.7383 2151.7935
## clouds_all.3             2.718282 2105.5549  1.016107 2040.6343 2172.5408
## clouds_all.4             4.481689 2133.4745  1.014351 2074.7165 2193.8966
## clouds_all.5             7.389056 2161.7643  1.012733 2108.8136 2216.0445
## clouds_all.6            12.182494 2190.4292  1.011312 2142.6677 2239.2554
## clouds_all.7            20.085537 2219.4743  1.010166 2175.9080 2263.9128
## clouds_all.8            33.115452 2248.9045  1.009395 2208.0602 2290.5043
## clouds_all.9            54.598150 2278.7249  1.009094 2238.6479 2319.5194
## clouds_all.10           90.017131 2308.9407  1.009308 2267.3933 2351.2494
## clouds_all.11          148.413159 2339.5572  1.010003 2294.3609 2385.6439
## time.1                   1.000000  397.5911  1.014735  386.3544  409.1545
## time.2                   1.221403  462.6343  1.014023  450.1779  475.4353
## time.3                   1.491825  538.3182  1.013348  524.5078  552.4922
## time.4                   1.822119  626.3834  1.012716  611.0607  642.0904
## time.5                   2.225541  728.8556  1.012133  711.8293  746.2890
## time.6                   2.718282  848.0914  1.011606  829.1257  867.4910
## time.7                   3.320117  986.8335  1.011143  965.6312 1008.5014
## time.8                   4.055200 1148.2729  1.010752 1124.4539 1172.5964
## time.9                   4.953032 1336.1226  1.010441 1309.1963 1363.6028
## time.10                  6.049647 1554.7034  1.010218 1524.0334 1585.9905
## time.11                  7.389056 1809.0424  1.010087 1773.8054 1844.9794
## time.12                  9.025013 2104.9896  1.010052 2064.1258 2146.6624
## time.13                 11.023176 2449.3518  1.010115 2401.5092 2498.1476
## time.14                 13.463738 2850.0494  1.010274 2793.5196 2907.7231
## time.15                 16.444647 3316.2984  1.010524 3248.9440 3385.0491
## time.16                 20.085537 3858.8226  1.010859 3777.9921 3941.3825
## time.17                 24.532530 4490.1002  1.011273 4392.5280 4589.8398
## holiday.1                1.000000 2222.6054  1.010064 2179.4100 2266.6571
## holiday.2                2.718282 4678.3804  1.124325 3718.3422 5886.2907
## moderately_bad_weather.1 1.000000 2222.6054  1.010064 2179.4100 2266.6571
```

```
## moderately_bad_weather.2    2.718282 2290.4589  1.009023 2250.4866 2331.1412
## moderately_good_weather.1   1.000000 2222.6054  1.010064 2179.4100 2266.6571
## moderately_good_weather.2   2.718282 2434.6032  1.008306 2395.4508 2474.3954
## good_weather.1              1.000000 2222.6054  1.010064 2179.4100 2266.6571
## good_weather.2              2.718282 2348.9930  1.012585 2292.1161 2407.2812
```

Loading table library to reports

```
#install.packages("flextable")
library(flextable)
```

16.1.3 Predicted values to temperature and traffic volume

$temp Adjusted for: rain_1h = 1.051271 clouds_all = 21.115344 time = 9.679401 holiday = 0.00 moderately_bad_weather = 0.00 moderately_good_weather = 0.00 good_weather = 0.00

```
values <- c(0.05,3.05,2.27)
values <- exp(values)
values
```

```
## [1]  1.051271 21.115344  9.679401
```

```
temp_df <- real_predicted_values[1:4,]
names(temp_df)[1] <- "Temperature (°K)"

temp_tb <- flextable(head(temp_df))
temp_tb <- temp_tb %>% color(j = "Temperature (°K)", color = "blue", part = "all") %>%
  bold(j = c("Temperature (°K)", "predicted"), bold = TRUE)
temp_tb <- theme_vanilla(temp_tb)
temp_tb
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

Temperature (°K)	predicted	std.error	conf.low	conf.high
221.4064	**1,641.319**	1.024417	1,565.521	1,720.786
244.6919	**1,860.571**	1.016628	1,801.395	1,921.690
270.4264	**2,109.110**	1.010932	2,064.640	2,154.539
298.8674	**2,390.851**	1.011049	2,339.910	2,442.901

16.1.4 Predicted values to raining 1 hour and traffic volume

$rain_1h Adjusted for: temp = 281.46 clouds_all = 1.051 time = 21.11 holiday = 0.00 moderately_bad_weather = 0.00 moderately_good_weather = 0.00 good_weather = 0.00

```
values <- c(5.64,3.05,2.27)
values <- exp(values)
#values

rain_1h_df <- real_predicted_values[5:10,]
names(rain_1h_df)[1] <- "rain_1h"

rain_tb <- flextable(head(rain_1h_df))
rain_tb <- rain_tb %>% color(j = "rain_1h", color = "blue", part = "all") %>%
  bold(j = c("rain_1h", "predicted"), bold = TRUE)
rain_tb <- theme_vanilla(rain_tb)
rain_tb
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

rain_1h	predicted	std.error	conf.low	conf.high
1.000000	**2,232.433**	1.010261	2,188.207	2,277.552
2.718282	**2,055.076**	1.016662	1,989.581	2,122.726
7.389056	**1,891.809**	1.031392	1,780.602	2,009.960
20.085537	**1,741.512**	1.047474	1,590.182	1,907.244
54.598150	**1,603.157**	1.064104	1,419.346	1,810.771
148.413159	**1,475.793**	1.081117	1,266.589	1,719.551

16.1.5 Predicted values to the clouds (%) and traffic volume

$Clouds_all Adjusted for: temp = 281.46 rain_1h = 1.051271 time = 9.679 holiday = 0.00 moderately_bad_weather = 0.00 moderately_good_weather = 0.00 good_weather = 0.00

```
values <- c(5.64,0.05,2.27)
values <- exp(values)
#values

clouds_df <- real_predicted_values[11:21,]
names(clouds_df)[1] <- "Clouds"

clouds_tb <- flextable(head(clouds_df))
clouds_tb <- clouds_tb %>% color(j = "Clouds", color = "blue", part = "all") %>%
  bold(j = c("Clouds", "predicted"), bold = TRUE)
clouds_tb <- theme_vanilla(clouds_tb)
clouds_tb
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

Clouds	predicted	std.error	conf.low	conf.high
1.000000	**2,050.807**	1.019893	1,973.140	2,131.531
1.648721	**2,078.001**	1.017964	2,006.738	2,151.794
2.718282	**2,105.555**	1.016107	2,040.634	2,172.541
4.481689	**2,133.474**	1.014351	2,074.716	2,193.897
7.389056	**2,161.764**	1.012733	2,108.814	2,216.045
12.182494	**2,190.429**	1.011312	2,142.668	2,239.255

16.1.6 Predicted values to the daytime and traffic volume

$time Adjusted for: temp = 281.46 rain_1h = 1.051 clouds_all = 21.115 holiday = 0.00 moderately_bad_weather = 0.00 moderately_good_weather = 0.00 good_weather = 0.00

```
values <- c(5.64,0.05,3.05)
values <- exp(values)
#values

time_df <- real_predicted_values[22:38,]
names(time_df)[1] <- "Daytime"

daytime_tb <- flextable(head(time_df))
daytime_tb <- daytime_tb %>% color(j = "Daytime", color = "blue", part = "all") %>%
  bold(j = c("Daytime", "predicted"), bold = TRUE)
daytime_tb <- theme_vanilla(daytime_tb)
daytime_tb
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

Daytime	predicted	std.error	conf.low	conf.high
1.000000	**397.5911**	1.014735	386.3544	409.1545
1.221403	**462.6343**	1.014023	450.1779	475.4353
1.491825	**538.3182**	1.013348	524.5078	552.4922
1.822119	**626.3834**	1.012716	611.0607	642.0904

Daytime	predicted	std.error	conf.low	conf.high
2.225541	**728.8556**	1.012133	711.8293	746.2890
2.718282	**848.0914**	1.011606	829.1257	867.4910

16.1.7 Predicted values to the holiday and traffic volume

$holiday Adjusted for: temp = 281.46 rain_1h = 1.051 clouds_all = 3.05 time = 9.679 moderately_bad_weather = 0.00 moderately_good_weather = 0.00 good_weather = 0.00

```
holiday_df <- real_predicted_values[39:40,]
names(holiday_df)[1] <- "Holiday"


holiday_tb <- flextable(head(holiday_df))
holiday_tb <- holiday_tb %>% color(j = "Holiday", color = "blue", part = "all") %>%
  bold(j = c("Holiday", "predicted"), bold = TRUE)
holiday_tb <- theme_vanilla(holiday_tb)
holiday_tb
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

Holiday	predicted	std.error	conf.low	conf.high
1.000000	**2,222.605**	1.010064	2,179.410	2,266.657
2.718282	**4,678.380**	1.124325	3,718.342	5,886.291

16.1.7 Predicted values to the Moderately_bad_weather conditions and traffic volume

$moderately_bad_weather Adjusted for: temp = 281.46 rain_1h = 1.051 clouds_all = 3.05 time = 9.679 holiday = 0.00 moderately_good_weather = 0.00 good_weather = 0.00

```
weather_df1 <- real_predicted_values[41:42,]
names(weather_df1)[1] <- "Moderately_bad_weather"

wc_tb1 <- flextable(head(weather_df1))
wc_tb1 <- wc_tb1 %>% color(j = "Moderately_bad_weather", color = "blue", part = "all") %>%
  bold(j = c("Moderately_bad_weather", "predicted"), bold = TRUE)
wc_tb1 <- theme_vanilla(wc_tb1)
wc_tb1
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

Moderately_good_weather	predicted	std.error	conf.low	conf.high
1.000000	**2,222.605**	1.010064	2,179.410	2,266.657
2.718282	**2,290.459**	1.009023	2,250.487	2,331.141

16.1.8 Predicted values to the Moderately_good_weather conditions and traffic volume

$moderately_good_weather Adjusted for: temp = 281.46 rain_1h = 1.051 clouds_all = 3.05 time = 9.679 holiday = 0.00 moderately_bad_weather = 0.00 good_weather = 0.00

```
weather_df2 <- real_predicted_values[43:44,]
names(weather_df2)[1] <- "Moderately_good_weather"

wc_tb2 <- flextable(head(weather_df2))
wc_tb2 <- wc_tb2 %>% color(j = "Moderately_good_weather", color = "blue", part = "body") %>%
  bold(j = c("Moderately_good_weather", "predicted"), bold = TRUE)
wc_tb2 <- theme_vanilla(wc_tb2)
wc_tb2
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

Moderately_good_weather	predicted	std.error	conf.low	conf.high
1.000000	**2,222.605**	1.010064	2,179.410	2,266.657
2.718282	**2,434.603**	1.008306	2,395.451	2,474.395

16.1.8 Predicted values to the good_weather conditions and traffic volume

$good_weather Adjusted for: temp = 281.46 rain_1h = 1.051 clouds_all = 3.05 time = 9.679 holiday = 0.00 moderately_bad_weather = 0.00 moderately_good_weather = 0.00

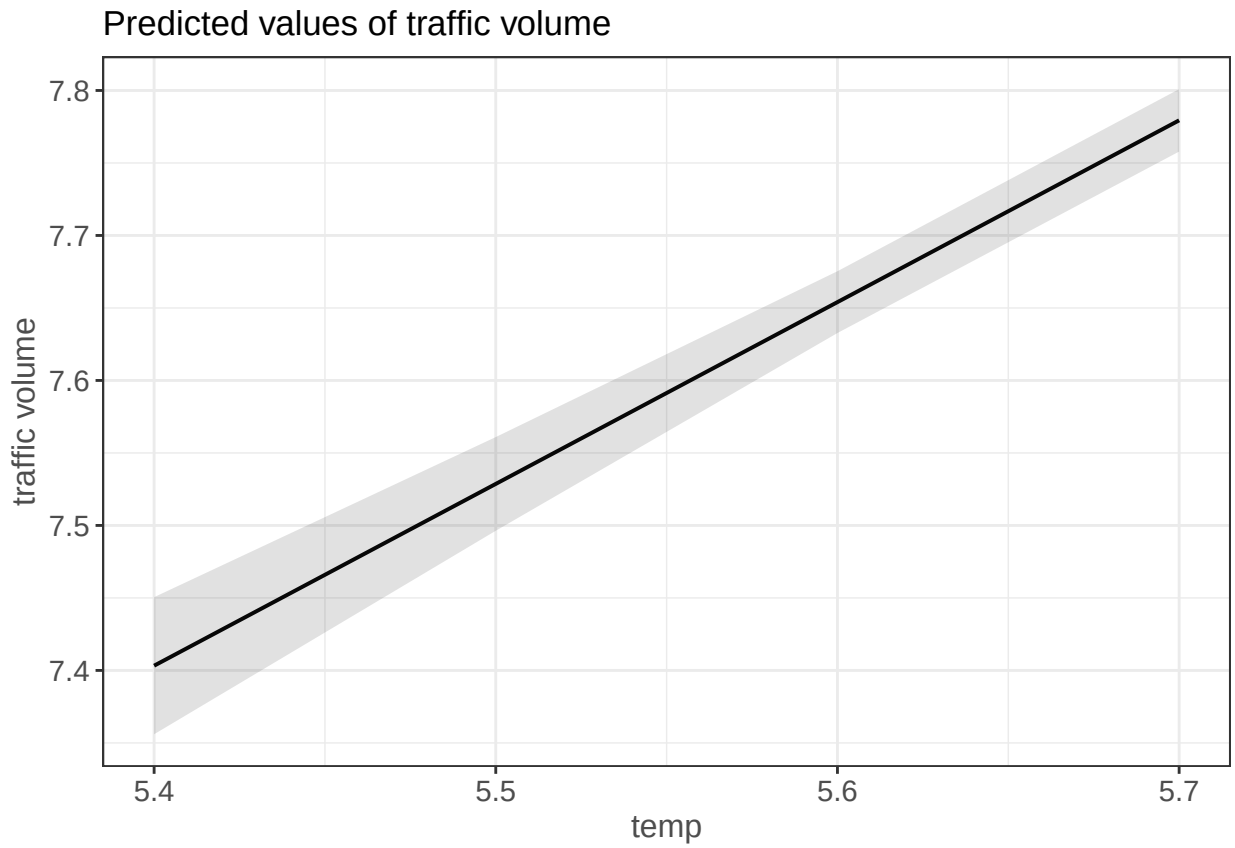
```
weather_df3 <- real_predicted_values[45:46,]
names(weather_df3)[1] <- "Good_weather"

wc_tb3 <- flextable(head(weather_df3))
wc_tb3 <- wc_tb3 %>% color(j = "Good_weather", color = "blue", part = "all") %>%
  bold(j = c("Good_weather", "predicted"), bold = TRUE)
wc_tb3 <- theme_vanilla(wc_tb3)
wc_tb3
```

```
## Warning: Warning: fonts used in ‘flextable‘ are ignored because the ‘pdflatex‘
## engine is used and not ‘xelatex‘ or ‘lualatex‘. You can avoid this warning
## by using the ‘set_flextable_defaults(fonts_ignore=TRUE)‘ command or use a
## compatible engine by defining ‘latex_engine: xelatex‘ in the YAML header of the
## R Markdown document.
```

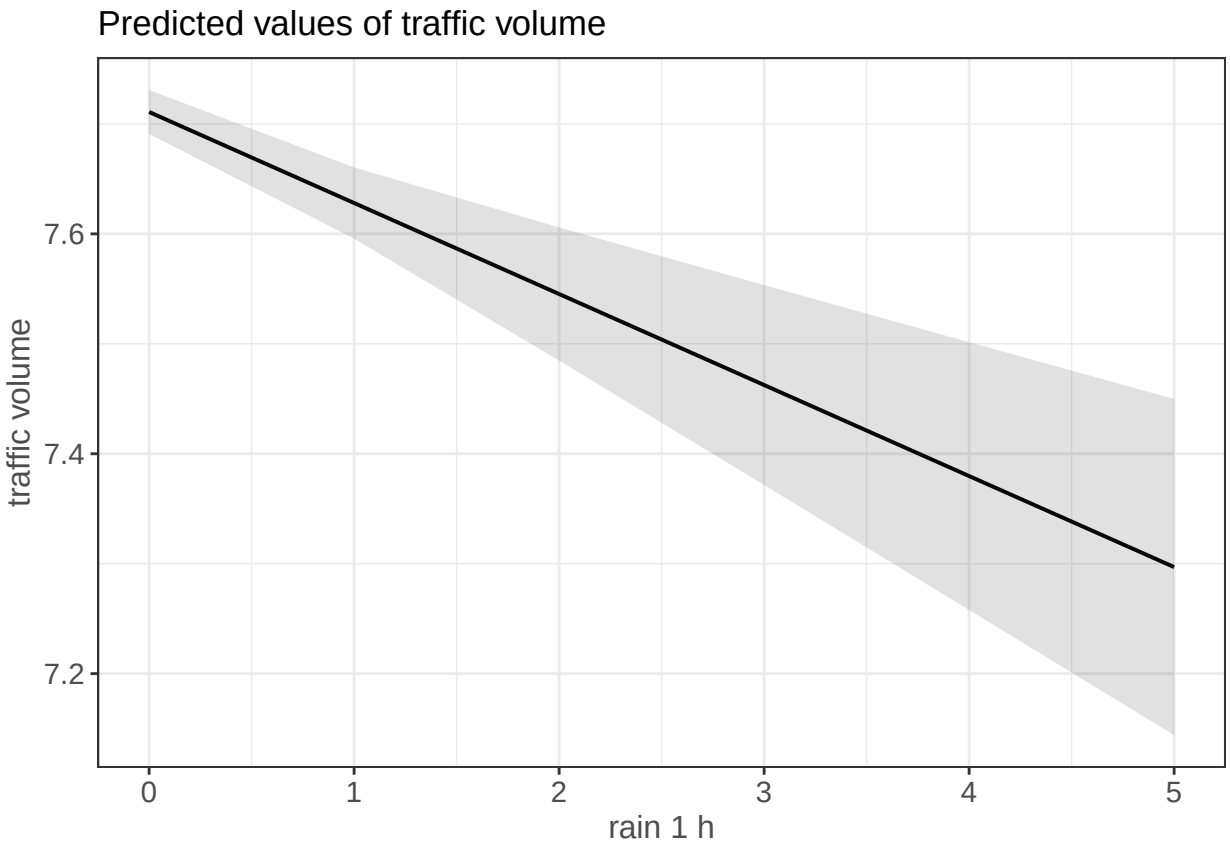
Good_weather	predicted	std.error	conf.low	conf.high
1.000000	**2,222.605**	1.010064	2,179.410	2,266.657
2.718282	**2,348.993**	1.012585	2,292.116	2,407.281

Visualization of the best model by independent variables

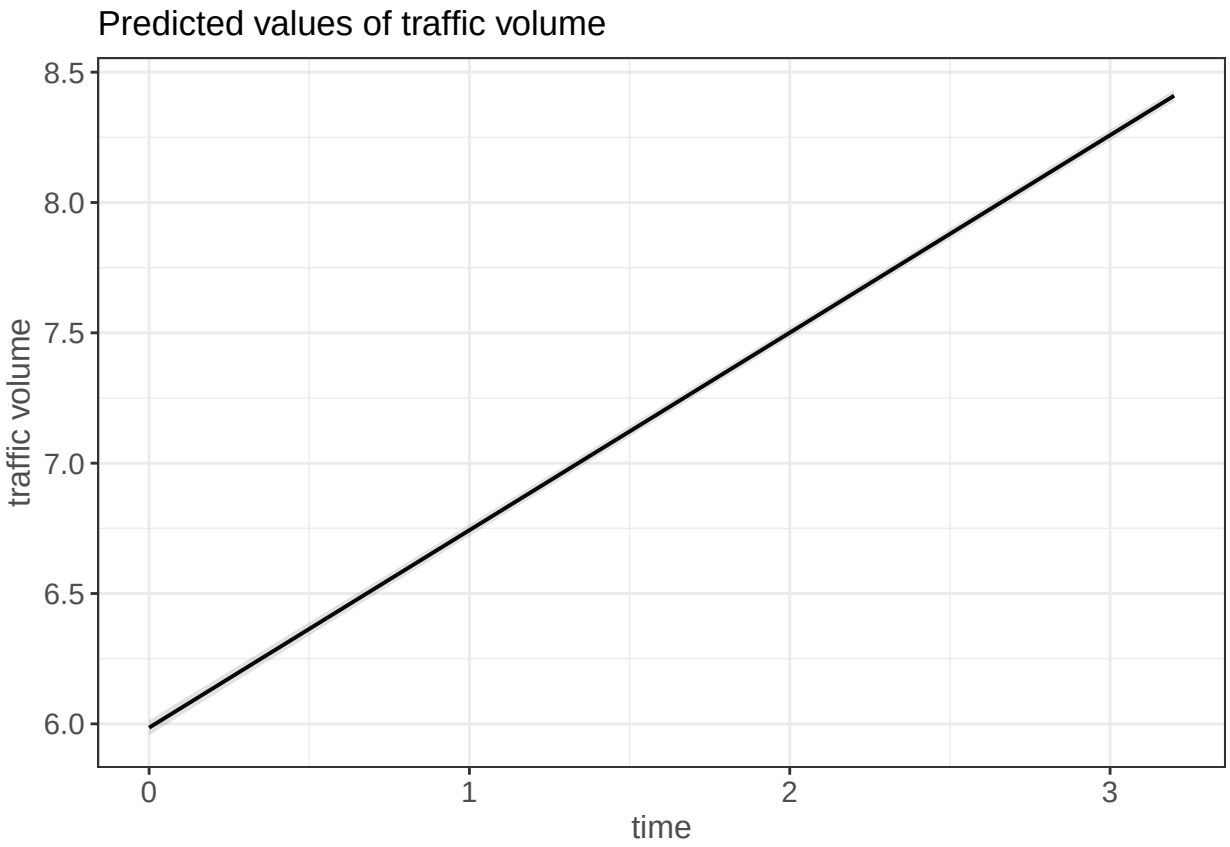
```
set_theme(base = theme_bw())

# Temperature vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("temp"), colors = "blue")
```



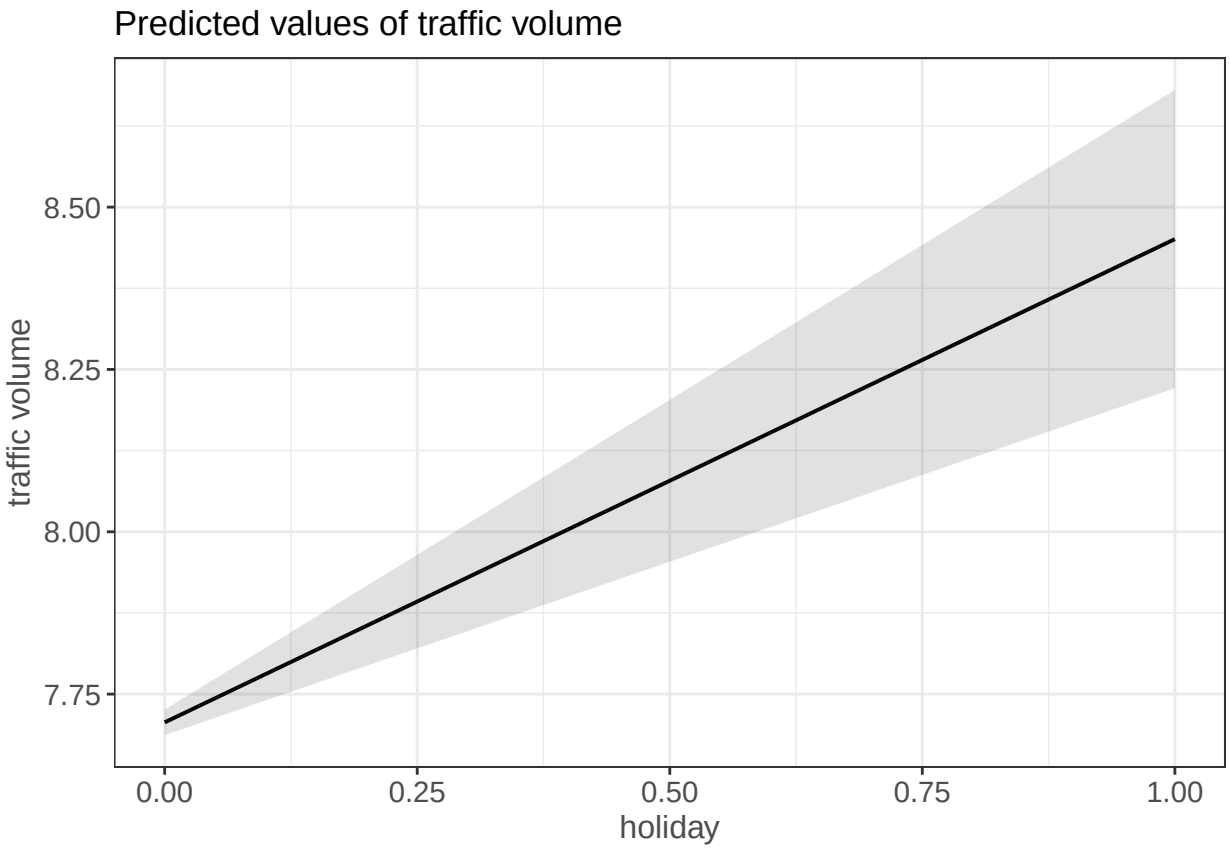

```
# Raining (1 hour) vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("rain_1h"))
```



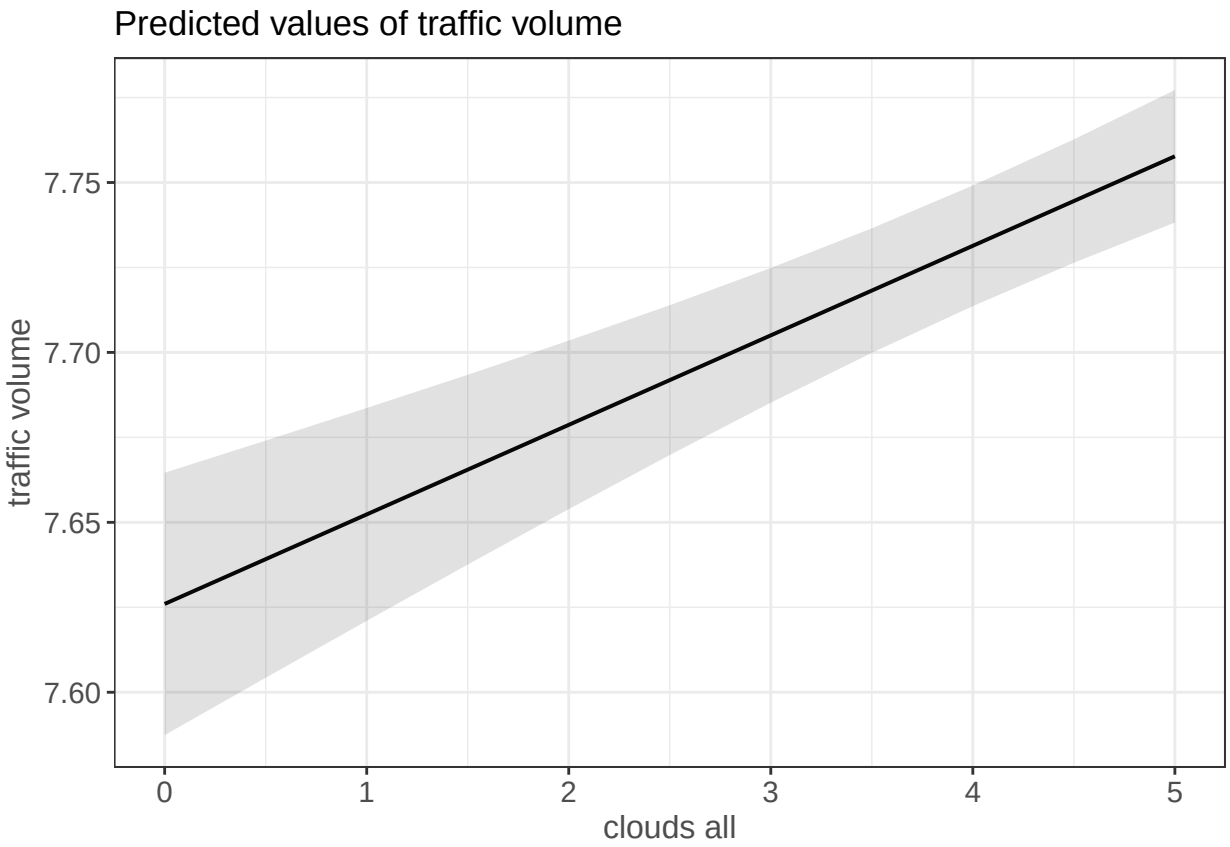

```
# Daytime vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("time"))
```



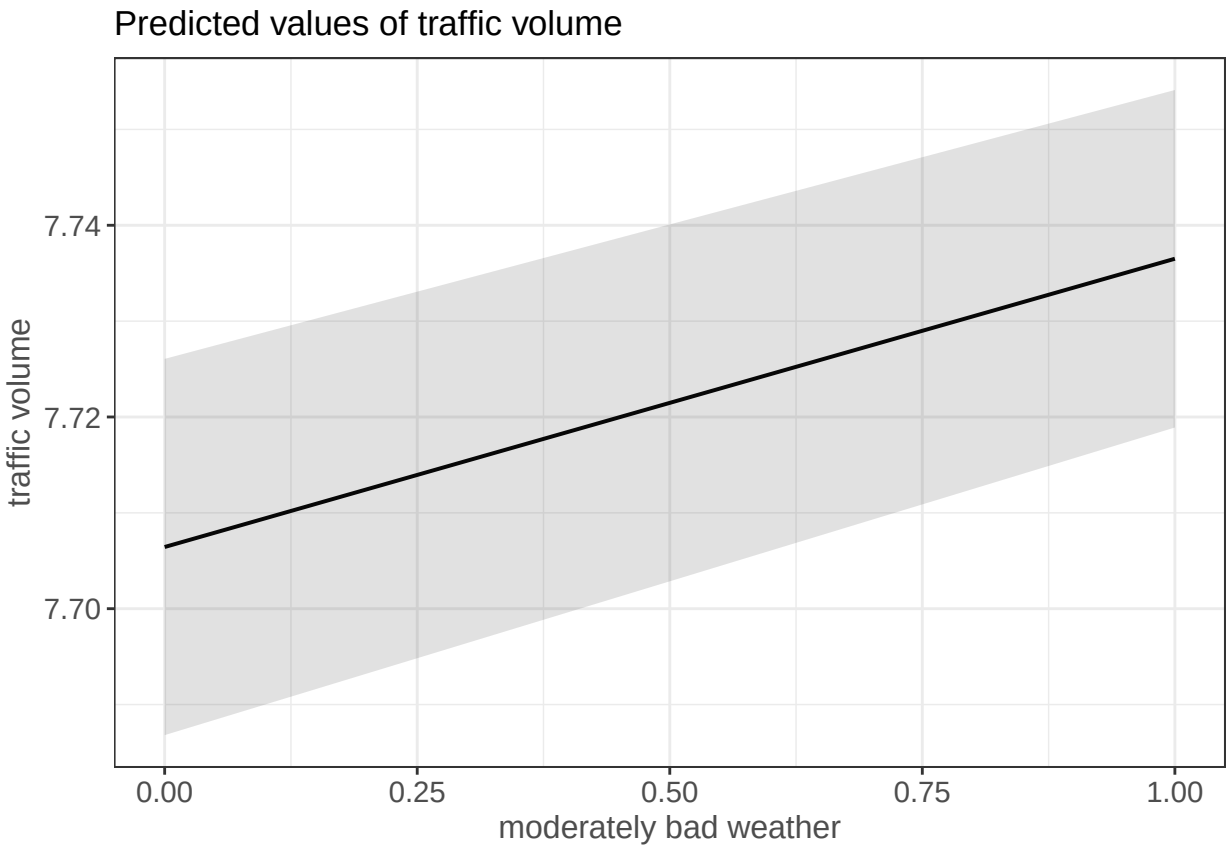

```
# Holiday vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("holiday"))
```



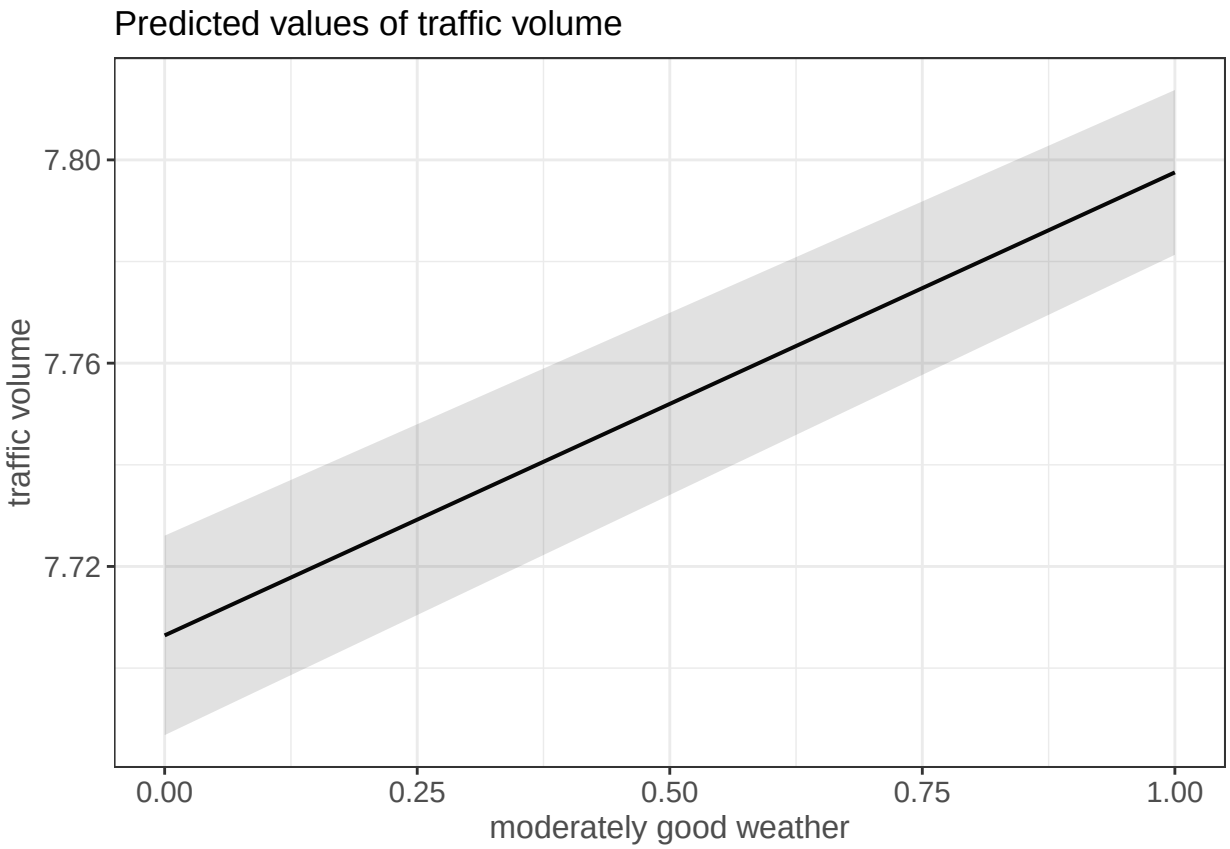

```
# Clouds (%) vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("clouds_all"))
```



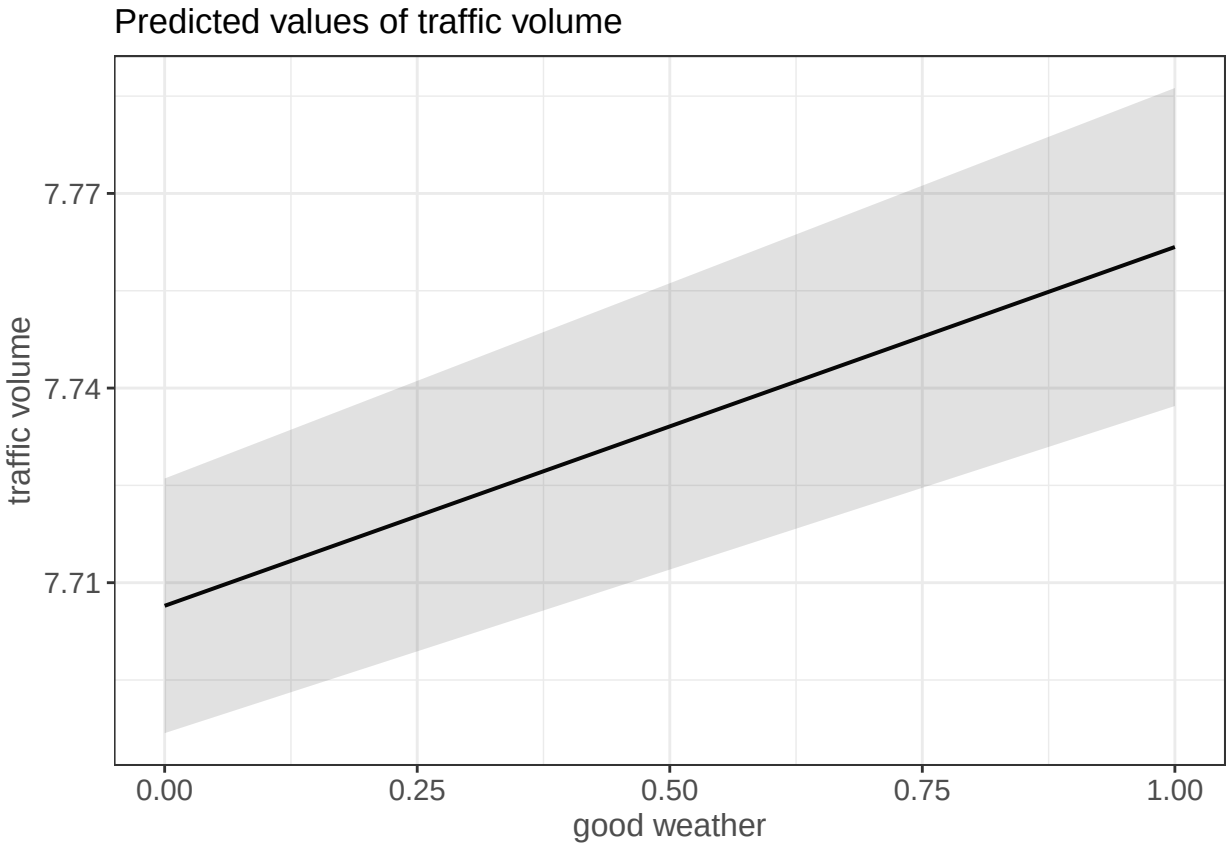

```
# moderately_bad_weather vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("moderately_bad_weather"))
```




```
# moderately_good_weather vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("moderately_good_weather"))
```




```
# good_weather vs. traffic volume
plot_model(train_best_model, type = "pred", terms = c("good_weather"))
```




```
names(df_split_train1)
```

```
## [1] "traffic_volume"          "temp"
## [3] "rain_1h"                 "clouds_all"
## [5] "time"                    "holiday"
## [7] "moderately_bad_weather"  "moderately_good_weather"
## [9] "good_weather"
```