FlipTheFleet Black Box Data Tests

Exploration of test data

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Contents

1 Citation

If you wish to use any of the material from this report please cite as:

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2 About

2.1 Circulation

Report circulation:

- Restricted to: NZ GREEN Grid project partners and contractors.

2.2 Purpose

This report is intended to:

- load and test preliminary 'black box' EV monitoring data provided for assessment purposes by FlipTheFleet.

2.3 Requirements:

- test dataset stored at /Volumes/hum-csafe/Research Projects/GREEN Grid/_RAW DATA/flipTheFleet/

2.4 History

Generally tracked via our git.soton repo:

- history
- issues

Specific history of this code:

- https://git.soton.ac.uk/ba1e12/nzGREENGrid/tree/master/analysis/ev

2.5 Support

This work was supported by:

- The University of Otago;
- The University of Southampton;
- The New Zealand Ministry of Business, Innovation and Employment (MBIE) through the NZ GREEN Grid project;
- SPATIALEC - a Marie Skłodowska-Curie Global Fellowship based at the University of Otago's Centre for Sustainability (2017-2019) & the University of Southampton's Sustainable Energy Research Group (2019-202).

We do not 'support' the code but if you have a problem check the issues on our repo and if it doesn't already exist, open one. We might be able to fix it :-)

3 Load data files

3.1 EV test data

In this section we load and describe the data files from /Volumes/hum-csafe/Research Projects/GREEN Grid/_RAW DATA/flipTheFleet/EVBlackBox export 2018-06-10-233146.csv. Note that we remove the following variables before we do so as they are potentially disclosive:

- Reg No
- Latitude
- Longitude
- Course (deg)

```
## Parsed with column specification:
## cols(
##   .default = col_integer(),
##   `Reg No` = col_character(),
##   `Date (GPS)` = col_character(),
##   `Time (GPS)` = col_time(format = ""),
##   Latitude = col_double(),
##   Longitude = col_double(),
##   Altitude = col_double(),
##   `Speed (GPS)` = col_double(),
##   `Speed (Speedometer)` = col_double(),
##   `Course (deg)` = col_double(),
##   SOC = col_double(),
##   AHr = col_double(),
##   `Pack volts` = col_double(),
##   `Pack amps` = col_double(),
##   `Pack 1 temp (C)` = col_double(),
##   `Pack 2 temp (C)` = col_double(),
##   `Pack 3 temp (C)` = col_double(),
##   `Pack 4 temp (C)` = col_double(),
##   `12V battery (amps)` = col_double(),
##   Hx = col_double(),
##   VIN = col_character()
##   # ... with 16 more columns
## )
```

```
## See spec(...) for full column specifications.
```

```
## ftfSafeDT
##
##  140  Variables      12487  Observations
## --------------------------------------------------------------------------
## Time after power on (s)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0     5845        1     3778     3908    145.0    292.6
##      .25      .50      .75      .90      .95
##    784.0   2486.0   6028.5   9269.8  11088.5
##
## lowest :    30    31    32    33    34, highest: 16530 16547 16575 16592 16636
## --------------------------------------------------------------------------
## Date (GPS)
##        n  missing distinct
##    11327     1160       39
##
## lowest : 01-05-2018 01-06-2018 02-05-2018 02-06-2018 03-05-2018
## highest: 25-05-2018 28-05-2018 29-05-2018 30-05-2018 31-05-2018
## --------------------------------------------------------------------------
## Time (GPS) [secs]
##        n  missing distinct
##    11327     1160     8903
```

```
##
## lowest : 00:00:36 00:00:37 00:00:38 00:01:04 00:01:16
## highest: 23:58:54 23:59:07 23:59:35 23:59:40 23:59:51
## ---------------------------------------------------------------------------
## Altitude
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12475       12      988    0.999    42.41     22.6     0.00    24.50
##      .25      .50      .75      .90      .95
##    36.00    39.80    44.20    74.36    89.00
##
## lowest : -293.5   -4.3    0.0   10.7   10.8, highest:  161.9  163.8  169.6  361.6  395.1
## ---------------------------------------------------------------------------
## Speed (GPS)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12475       12       57    0.436    10.35    17.97     0.00     0.00
##      .25      .50      .75      .90      .95
##     0.00     0.00     0.00    53.71    79.64
##
## lowest :   0.000   1.852   3.704   5.556   7.408
## highest:  96.304  98.156 100.008 101.860 103.712
## ---------------------------------------------------------------------------
## Speed (Speedometer)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0     2094    0.475    10.43    17.85     0.00     0.00
##      .25      .50      .75      .90      .95
##     0.00     0.00     0.00    52.62    72.86
##
## lowest :   0.00   2.88   2.96   2.97   3.03, highest: 100.80 101.25 101.38 101.45 102.08
## ---------------------------------------------------------------------------
## GIDs
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      186        1    119.4    51.14       45       55
##      .25      .50      .75      .90      .95
##       86      124      156      168      187
##
## lowest :   0  18  19  20  21, highest: 198 199 200 201 202
## ---------------------------------------------------------------------------
## SOC
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0    10582        1    57.55    23.85    22.29    28.61
##      .25      .50      .75      .90      .95
##    42.41    60.00    74.56    80.14    88.81
##
## lowest :  0.0000 12.9227 13.2509 13.2620 13.2688
## highest: 95.4935 95.5220 95.5221 95.5255 95.5286
## ---------------------------------------------------------------------------
## AHr
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       54    0.997    46.92    2.517    47.34    47.36
##      .25      .50      .75      .90      .95
##    47.38    47.44    47.48    47.50    47.53
##
## Value        0.0  47.2  47.4  47.6  47.8 132.0 132.2 132.4 132.6 132.8
## Frequency    232     8 10299  1600   295     7     8    23     9     6
```

```
## Proportion 0.019 0.001 0.825 0.128 0.024 0.001 0.001 0.002 0.001 0.000
## ---------------------------------------------------------------------------
## Pack volts
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      745        1    421.7    108.7    360.7    365.8
##      .25      .50      .75      .90      .95
##    373.6    382.8    387.2    390.0    393.3
##
## lowest :    0.000  269.856  342.144  342.816  343.200
## highest: 5612.448 5698.464 5735.904 5759.712 5783.520
## ---------------------------------------------------------------------------
## Pack amps
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0     5914        1   -5.439    8.455  -16.609   -9.750
##      .25      .50      .75      .90      .95
##   -8.906   -8.150   -0.877    2.721   13.639
##
## lowest : -32.754 -32.753 -32.717 -32.679 -32.662
## highest:  32.642  32.722  32.725  32.745  32.747
## ---------------------------------------------------------------------------
## max_cp (mV)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      623        1     4904     1942     3783     3825
##      .25      .50      .75      .90      .95
##     3906     3997     4042     4072     4106
##
## lowest :  3589  3597  3599  3609  3612, highest: 65038 65039 65040 65294 65295
## ---------------------------------------------------------------------------
## min_cp (mV)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      505        1     3917    167.2     3740     3799
##      .25      .50      .75      .90      .95
##     3874     3975     4024     4047     4075
##
## lowest :    0   14   15   16  271, highest: 4099 4100 4101 4102 4103
## ---------------------------------------------------------------------------
## avg_cp (mV)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      744        1     4441     1059     3772     3815
##      .25      .50      .75      .90      .95
##     3896     3988     4033     4064     4098
##
## lowest :  2811  3564  3571  3575  3578, highest: 58463 59359 59749 59997 60245
## ---------------------------------------------------------------------------
## cp_diff (mV)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      289    0.993    987.9     1907       13       14
##      .25      .50      .75      .90      .95
##       16       18       23       31       39
##
## lowest :     8     9    10    11    12, highest: 65024 65025 65280 65281 65295
## ---------------------------------------------------------------------------
## Pack 1 temp (C)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
```

```
##    12348      139      189        1     19.9    3.776     13.3     15.5
##      .25      .50      .75      .90      .95
##     17.6     20.2     21.8     24.5     25.4
##
## lowest :  8.7  8.9  9.1  9.2  9.5, highest: 28.0 28.1 28.2 28.3 28.4
## ------------------------------------------------------------------------
## Pack 2 temp (C)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12319      168      195        1    19.03    3.803     12.5     14.6
##      .25      .50      .75      .90      .95
##     16.8     19.4     21.1     23.6     24.5
##
## lowest :  7.6  7.8  8.0  8.2  8.3, highest: 27.2 27.3 27.4 27.6 27.7
## ------------------------------------------------------------------------
## Pack 3 temp (C)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12296      191      181        1    18.61    3.635     12.3     14.5
##      .25      .50      .75      .90      .95
##     16.4     19.0     20.7     22.8     23.7
##
## lowest :  7.7  8.0  8.1  8.3  8.5, highest: 25.8 25.9 26.0 26.1 26.2
## ------------------------------------------------------------------------
## Pack 4 temp (C)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12296      191      171        1     17.8    3.568    11.38    13.80
##      .25      .50      .75      .90      .95
##    15.50    18.20    20.00    21.90    22.60
##
## lowest :  7.6  7.7  7.8  7.9  8.1, highest: 24.7 24.8 24.9 25.0 25.1
## ------------------------------------------------------------------------
## cp_1
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      732        1     3175     1505    -4008     3633
##      .25      .50      .75      .90      .95
##     3848     3973     4032     4055     4078
##
## Value      -4100 -4000 -3900 -3800 -3700 -3600  3500  3600  3700  3800
## Frequency    275   580   211   124    28     3     1    25   366  1515
## Proportion 0.022 0.047 0.017 0.010 0.002 0.000 0.000 0.002 0.030 0.123
##
## Value       3900  4000  4100  4300
## Frequency   2340  5317  1563     1
## Proportion 0.189 0.431 0.127 0.000
## ------------------------------------------------------------------------
## cp_2
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      638        1     3585    822.4     3652     3777
##      .25      .50      .75      .90      .95
##     3877     3984     4034     4061     4083
##
## Value      -4000 -3500  3500  4000 25000
## Frequency    564    24   432 11328     1
## Proportion 0.046 0.002 0.035 0.917 0.000
## ------------------------------------------------------------------------
```

```
## cp_3
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      745        1     3387     2370    -4010    -3830
##      .25      .50      .75      .90      .95
##     3841     3971     4034     4061     4089
##
## Value      -51000  -4000      0   4000  51000
## Frequency       1   1411      2  10846     89
## Proportion  0.000  0.114  0.000  0.878  0.007
## ------------------------------------------------------------------------
## cp_4
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      698        1     3211     1445    -3993     3645
##      .25      .50      .75      .90      .95
##     3846     3974     4032     4057     4080
##
## Value      -4100 -4000 -3900 -3800 -3700 -3600  -500     0   500  3600
## Frequency    179   624   195   112    12     1     1     2    89    24
## Proportion 0.014 0.051 0.016 0.009 0.001 0.000 0.000 0.000 0.007 0.002
##
## Value       3700  3800  3900  4000  4100
## Frequency    376  1548  2342  5221  1623
## Proportion 0.030 0.125 0.190 0.423 0.131
## ------------------------------------------------------------------------
## cp_5
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      821        1     3226     2282    -4016    -3855
##      .25      .50      .75      .90      .95
##     3834     3965     4028     4051     4075
##
## lowest : -65295 -63247 -57615 -57102 -55055, highest:  60430  60686  60943  62991  65294
## ------------------------------------------------------------------------
## cp_6
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      748        1     3657     1636    -3882     3749
##      .25      .50      .75      .90      .95
##     3864     3978     4029     4052     4079
##
## lowest : -65295 -63503 -57615 -57358 -54031, highest:  61199  63503  64527  64783  65295
## ------------------------------------------------------------------------
## cp_7
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      895        1     2403     3355    -4037    -4005
##      .25      .50      .75      .90      .95
##     3743     3931     4023     4050     4073
##
## lowest : -65039 -57871 -57614 -55567 -49423, highest:  60942  61198  61455  63503  64783
## ------------------------------------------------------------------------
## cp_8
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      794        1     3472     2000    -3967     3664
##      .25      .50      .75      .90      .95
##     3846     3974     4030     4053     4085
##
```

```
## lowest : -41487  -4108  -4104  -4103  -4099, highest:  61198  61455  63759  64782  65039
## ---------------------------------------------------------------------------
## cp_9
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      775        1     3612     1667    -3901     3745
##      .25      .50      .75      .90      .95
##     3862     3978     4030     4053     4084
##
## lowest : -65039 -63246 -61455 -56591 -55567, highest:  59918  60175  62223  63246  63503
## ---------------------------------------------------------------------------
## cp_10
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      676        1     3980     1149     3718     3792
##      .25      .50      .75      .90      .95
##     3884     3987     4034     4061     4093
##
## lowest : -64784 -56591 -51983 -24847  -4112, highest:  60175  61199  63502  63759  64526
## ---------------------------------------------------------------------------
## cp_11
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      800        1     3659     1737    -3900     3744
##      .25      .50      .75      .90      .95
##     3863     3982     4034     4057     4088
##
## lowest : -64014 -60943 -57359 -56335 -56078, highest:  60943  61967  64014  64271  65294
## ---------------------------------------------------------------------------
## cp_12
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12349      138      683        1     4026     1187     3726     3797
##      .25      .50      .75      .90      .95
##     3887     3983     4030     4057     4090
##
## lowest : -65039 -56847  -4108  -4107  -4104, highest:  60175  62735  63502  63759  64782
## ---------------------------------------------------------------------------
## cp_13
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      794        1     3632     1776    -3912     3736
##      .25      .50      .75      .90      .95
##     3859     3974     4029     4052     4083
##
## lowest : -63503 -61455 -60431 -55823 -55310, highest:  62479  63502  63759  64526  65040
## ---------------------------------------------------------------------------
## cp_14
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      761        1     3619     1750    -3915     3737
##      .25      .50      .75      .90      .95
##     3859     3976     4030     4056     4083
##
## lowest : -64783 -61199 -58895 -58638 -55311, highest:  59662  63503  64526  64527  64783
## ---------------------------------------------------------------------------
## cp_15
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      835        1     3229     2366    -4016    -3859
##      .25      .50      .75      .90      .95
```

```
##     3833     3965     4025     4048     4075
##
## lowest : -64527 -62479 -61455 -56334 -55567, highest:  59918  60942  62223  64526  64783
## ---------------------------------------------------------------------------
## cp_16
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      760        1     3572     1920    -3983     3706
##      .25      .50      .75      .90      .95
##     3848     3970     4025     4052     4080
##
## lowest : -64782 -61455 -44047  -4107  -4104, highest:  61454  62479  63758  63759  64783
## ---------------------------------------------------------------------------
## cp_17
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      728        1     3872     1364     3679     3782
##      .25      .50      .75      .90      .95
##     3878     3983     4033     4057     4089
##
## lowest : -63246 -54031 -50703 -47375 -43791, highest:  62223  63246  63503  64526  65039
## ---------------------------------------------------------------------------
## cp_18
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      710        1     3948     1270     3708     3786
##      .25      .50      .75      .90      .95
##     3882     3982     4032     4056     4089
##
## lowest : -50703 -47119 -43791 -11791  -4112, highest:  62223  63246  63503  64526  64783
## ---------------------------------------------------------------------------
## cp_19
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      730        1     3866     1371     3673     3782
##      .25      .50      .75      .90      .95
##     3878     3986     4036     4061     4092
##
## lowest : -64526 -54287 -50959 -49679 -46351, highest:  61199  63502  63759  64526  65039
## ---------------------------------------------------------------------------
## cp_20
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      704        1     3947     1277     3701     3785
##      .25      .50      .75      .90      .95
##     3881     3985     4034     4061     4093
##
## lowest : -46095 -42767 -24079 -13327  -4112, highest:  62478  62479  63758  63759  64783
## ---------------------------------------------------------------------------
## cp_21
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      660        1     4124      985     3750     3809
##      .25      .50      .75      .90      .95
##     3891     3989     4035     4061     4094
##
## lowest : -49423  -4108  -4103  -4099  -4098, highest:  62479  63246  64526  64783  65039
## ---------------------------------------------------------------------------
## cp_22
##        n  missing distinct     Info     Mean      Gmd      .05      .10
```

```
##    12348      139      639        1     4119     1010     3750     3809
##      .25      .50      .75      .90      .95
##     3891     3988     4036     4061     4093
##
## lowest : -49423  -4103  -4102  -4099  -4098, highest:  62223  63246  63503  64526  64784
## ------------------------------------------------------------------------
## cp_23
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      664        1     4117     1014     3743     3805
##      .25      .50      .75      .90      .95
##     3887     3989     4039     4065     4097
##
## lowest : -51471  -4107  -4103  -4098  -4097, highest:  63247  63503  64014  64271  65294
## ------------------------------------------------------------------------
## cp_24
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      652        1     4070     1064     3738     3802
##      .25      .50      .75      .90      .95
##     3886     3988     4036     4062     4095
##
## lowest : -64527 -55567 -51983 -26127  -4112, highest:  60942  61199  63759  64526  64783
## ------------------------------------------------------------------------
## cp_25
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      693        1     4082     1082     3735     3799
##      .25      .50      .75      .90      .95
##     3887     3985     4034     4058     4091
##
## lowest : -4108 -4103 -4098 -4095 -4094, highest: 61455 63759 64015 64526 64783
## ------------------------------------------------------------------------
## cp_26
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      683        1     4025     1166     3723     3794
##      .25      .50      .75      .90      .95
##     3883     3984     4031     4057     4090
##
## lowest : -56591 -27151  -4108  -4104  -4103, highest:  63759  64526  64527  64783  64784
## ------------------------------------------------------------------------
## cp_27
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      712        1     4019     1119     3708     3787
##      .25      .50      .75      .90      .95
##     3874     3980     4030     4057     4088
##
## lowest : -56591 -45071 -29711 -27407  -4103, highest:  60942  62479  63503  64526  65039
## ------------------------------------------------------------------------
## cp_28
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      686        1     4074     1086     3714     3792
##      .25      .50      .75      .90      .95
##     3875     3981     4029     4057     4089
##
## lowest : -4103 -4099 -4098 -4094 -4093, highest: 61198 61455 63759 64782 65039
## ------------------------------------------------------------------------
```

```
## cp_29
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      775        1     3785     1601    -3847     3761
##      .25      .50      .75      .90      .95
##     3869     3980     4030     4057     4089
##
## lowest : -64526 -48398  -4104  -4099  -4095, highest:  63502  64015  64526  64783  65039
## ------------------------------------------------------------------------
## cp_30
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      678        1     4034     1141     3728     3796
##      .25      .50      .75      .90      .95
##     3883     3981     4030     4057     4089
##
## lowest : -64782 -47630  -4103  -4099  -4098, highest:  60175  62735  63502  63759  65039
## ------------------------------------------------------------------------
## cp_31
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      716        1     4056     1201     3719     3794
##      .25      .50      .75      .90      .95
##     3882     3984     4031     4058     4090
##
## lowest : -46094  -4107  -4103  -4099  -4092, highest:  62222  62735  63502  63759  65039
## ------------------------------------------------------------------------
## cp_32
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      691        1     4042     1178     3722     3793
##      .25      .50      .75      .90      .95
##     3882     3983     4030     4057     4089
##
## lowest : -49679 -46350  -4107  -4104  -4103, highest:  60175  62478  62479  63758  63759
## ------------------------------------------------------------------------
## cp_33
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      685        1     4105     1118     3739     3798
##      .25      .50      .75      .90      .95
##     3883     3980     4029     4053     4089
##
## lowest : -63502 -50959 -49679 -21775  -8719, highest:  62735  62991  63502  63759  65295
## ------------------------------------------------------------------------
## cp_34
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      677        1     4083     1101     3731     3797
##      .25      .50      .75      .90      .95
##     3881     3982     4029     4056     4088
##
## lowest : -63502 -59918 -50959 -43791 -21519, highest:  61455  62735  63502  63759  65039
## ------------------------------------------------------------------------
## cp_35
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      706        1     4287     1512     3734     3795
##      .25      .50      .75      .90      .95
##     3882     3979     4025     4053     4090
##
```

```
## lowest : -64526 -60942 -51983 -45071 -21519, highest:  62735  63502  63759  64526  65039
## ---------------------------------------------------------------------------
## cp_36
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      759        1     4049     1970    -3808     3768
##      .25      .50      .75      .90      .95
##     3869     3979     4030     4057     4094
##
## lowest : -62478 -49679 -22799 -12303  -4104, highest:  62990  63758  63759  64782  64783
## ---------------------------------------------------------------------------
## cp_37
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      873        1     3566     2670    -4002    -3743
##      .25      .50      .75      .90      .95
##     3841     3969     4030     4056     4084
##
## lowest : -63502 -62479 -59151 -58127 -56847, highest:  63502  64014  64015  64526  65039
## ---------------------------------------------------------------------------
## cp_38
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      691        1     4265     1576     3729     3795
##      .25      .50      .75      .90      .95
##     3883     3979     4025     4053     4088
##
## lowest : -50703 -36367 -23567 -12047  -5903, highest:  61966  63246  63503  64526  64783
## ---------------------------------------------------------------------------
## cp_39
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      731        1     4238     1566     3727     3792
##      .25      .50      .75      .90      .95
##     3883     3983     4029     4057     4094
##
## lowest : -63502 -49679 -38927 -35599 -24079, highest:  62222  62479  63502  64015  65039
## ---------------------------------------------------------------------------
## cp_40
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      699        1     4268     1570     3730     3794
##      .25      .50      .75      .90      .95
##     3884     3980     4026     4053     4090
##
## lowest : -51983 -50959 -48655 -13583  -7439, highest:  62990  63502  63759  64782  65039
## ---------------------------------------------------------------------------
## cp_41
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      786        1     3977     2037    -3843     3760
##      .25      .50      .75      .90      .95
##     3869     3980     4030     4057     4094
##
## lowest : -64526 -61454 -54287 -53007 -50959, highest:  62223  62479  63502  64526  65039
## ---------------------------------------------------------------------------
## cp_42
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      769        1     3963     2075    -3861     3755
##      .25      .50      .75      .90      .95
```

```
##     3867     3980     4030     4057     4094
##
## lowest : -64014 -63502 -52239 -50959 -47375, highest:  61454  62734  63502  63503  64783
## ---------------------------------------------------------------------------
## cp_43
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      743        1     4228     1638     3717     3793
##      .25      .50      .75      .90      .95
##     3883     3987     4034     4062     4094
##
## lowest : -64782 -64270 -55823 -53519 -50703, highest:  62735  63758  64015  64782  65039
## ---------------------------------------------------------------------------
## cp_44
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      778        1     3972     2061    -3851     3758
##      .25      .50      .75      .90      .95
##     3866     3984     4034     4062     4095
##
## lowest : -64526 -62734 -52239 -51215 -47631, highest:  61711  62734  62735  64014  64016
## ---------------------------------------------------------------------------
## cp_45
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      781        1     3988     1944    -3705     3773
##      .25      .50      .75      .90      .95
##     3873     3983     4034     4058     4093
##
## lowest : -62991 -55823 -55822 -53519 -52239, highest:  62734  62990  63502  64015  64782
## ---------------------------------------------------------------------------
## cp_46
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      715        1     4138     1851     3678     3779
##      .25      .50      .75      .90      .95
##     3878     3984     4030     4057     4095
##
## lowest : -43791 -32015  -4109  -4108  -4104, highest:  63502  63759  64782  64783  65039
## ---------------------------------------------------------------------------
## cp_47
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      656        1     4385     1396     3750     3809
##      .25      .50      .75      .90      .95
##     3889     3988     4034     4061     4094
##
## lowest : -43791 -32015  -4108  -4103  -4099, highest:  62478  62479  63502  64526  65039
## ---------------------------------------------------------------------------
## cp_48
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      634        1     4392     1402     3750     3809
##      .25      .50      .75      .90      .95
##     3890     3989     4036     4061     4094
##
## lowest : -45071 -33295  -4107  -4103  -4102, highest:  63502  63759  64782  64783  65039
## ---------------------------------------------------------------------------
## cp_49
##        n  missing distinct     Info     Mean      Gmd      .05      .10
```

```
##    12348      139      730        1     4034     1863     3683     3783
##      .25      .50      .75      .90      .95
##     3886     3982     4033     4056     4089
##
## lowest : -65040 -61455 -55823 -55310 -53263, highest:  63758  64014  64015  64526  65039
## ------------------------------------------------------------------------
## cp_50
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      710        1     4033     1845     3684     3779
##      .25      .50      .75      .90      .95
##     3883     3980     4025     4052     4087
##
## lowest : -63759 -56847 -56846 -54543 -53263, highest:  63759  64014  64782  64783  65039
## ------------------------------------------------------------------------
## cp_51
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      726        1     4046     1834     3693     3780
##      .25      .50      .75      .90      .95
##     3883     3979     4026     4053     4089
##
## lowest : -62735 -56847 -56590 -54543 -53263, highest:  64014  64015  64526  64527  65039
## ------------------------------------------------------------------------
## cp_52
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      714        1     4038     1839     3686     3779
##      .25      .50      .75      .90      .95
##     3883     3979     4026     4053     4088
##
## lowest : -63759 -57871 -57614 -54287 -53007, highest:  63502  63759  64015  64526  64783
## ------------------------------------------------------------------------
## cp_53
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      740        1     3937     2017    -3822     3773
##      .25      .50      .75      .90      .95
##     3882     3983     4034     4057     4093
##
## lowest : -61199 -56591 -56078 -54031 -53007, highest:  62223  63246  63503  64526  64783
## ------------------------------------------------------------------------
## cp_54
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      742        1     3922     1998    -3823     3772
##      .25      .50      .75      .90      .95
##     3878     3981     4030     4057     4094
##
## lowest : -64783 -61455 -55567 -55566 -53263, highest:  62478  62479  63758  63759  64782
## ------------------------------------------------------------------------
## cp_55
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      738        1     3929     1985    -3813     3773
##      .25      .50      .75      .90      .95
##     3881     3979     4030     4057     4093
##
## lowest : -65039 -61455 -55567 -55566 -53263, highest:  62478  62735  63502  63759  64782
## ------------------------------------------------------------------------
```

```
## cp_56
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      742        1     3924     2031    -3833     3770
##      .25      .50      .75      .90      .95
##     3879     3980     4029     4057     4090
##
## lowest : -64784 -61199 -55566 -55311 -54543, highest:  61454  62479  62734  63503  64783
## ------------------------------------------------------------------------
## cp_57
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      770        1     3891     2072    -3865     3765
##      .25      .50      .75      .90      .95
##     3878     3978     4029     4055     4089
##
## lowest : -63759 -57871 -56334 -55567 -54287, highest:  62479  63502  63759  64526  64783
## ------------------------------------------------------------------------
## cp_58
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12348      139      734        1     3909     2047    -3850     3769
##      .25      .50      .75      .90      .95
##     3878     3978     4029     4057     4089
##
## lowest : -63759 -56847 -56846 -54543 -53263, highest:  62735  63502  63759  64782  65039
## ------------------------------------------------------------------------
## cp_59
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      741        1     3908     2088    -3862     3766
##      .25      .50      .75      .90      .95
##     3877     3982     4033     4056     4093
##
## lowest : -63759 -57871 -56591 -56334 -54287, highest:  62479  63502  63759  64526  64783
## ------------------------------------------------------------------------
## cp_60
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      799        1     3674     2503    -3969     3703
##      .25      .50      .75      .90      .95
##     3856     3974     4030     4057     4089
##
## lowest : -62479 -57871 -56591 -55566 -54287, highest:  62479  63758  63759  64782  64783
## ------------------------------------------------------------------------
## cp_61
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      754        1     3895     2129    -3886     3766
##      .25      .50      .75      .90      .95
##     3877     3982     4033     4057     4092
##
## lowest : -62479 -56591 -56334 -54287 -53007, highest:  63502  63759  64526  64782  64783
## ------------------------------------------------------------------------
## cp_62
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      745        1     3870     2108    -3882     3764
##      .25      .50      .75      .90      .95
##     3874     3976     4025     4052     4089
##
```

```
## lowest : -62479 -56591 -56334 -54287 -53007, highest:  63502  63759  64526  64527  64783
## ---------------------------------------------------------------------------
## cp_63
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      749        1     3948     2261    -3883     3763
##      .25      .50      .75      .90      .95
##     3874     3975     4025     4053     4089
##
## lowest : -65039 -62223 -57615 -57358 -55311, highest:  62223  63502  63503  64526  64783
## ---------------------------------------------------------------------------
## cp_64
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      743        1     3916     2261    -3883     3761
##      .25      .50      .75      .90      .95
##     3874     3975     4025     4053     4088
##
## lowest : -64015 -62735 -56847 -56846 -54543, highest:  63502  63758  63759  64783  65039
## ---------------------------------------------------------------------------
## cp_65
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      636        1     4408     1537     3761     3810
##      .25      .50      .75      .90      .95
##     3897     3988     4032     4062     4098
##
## lowest : -62223 -51983 -51726 -45839 -41231, highest:  63246  63502  64526  64783  65039
## ---------------------------------------------------------------------------
## cp_66
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      738        1     4022     2138    -3772     3776
##      .25      .50      .75      .90      .95
##     3883     3984     4031     4057     4095
##
## lowest : -65039 -64783 -61455 -55567 -55566, highest:  62479  63758  63759  64782  65038
## ---------------------------------------------------------------------------
## cp_67
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      637        1     4434     1588     3760     3809
##      .25      .50      .75      .90      .95
##     3897     3988     4034     4061     4099
##
## lowest : -61455 -49935 -49934 -42767 -14863, highest:  63759  64015  64782  65038  65039
## ---------------------------------------------------------------------------
## cp_68
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      638        1     4446     1587     3760     3810
##      .25      .50      .75      .90      .95
##     3897     3985     4034     4061     4098
##
## lowest : -61199 -51214 -45071 -15119  -4108, highest:  63504  63758  63760  64782  64783
## ---------------------------------------------------------------------------
## cp_69
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      660        1     4427     1628     3753     3808
##      .25      .50      .75      .90      .95
```

```
##     3892     3984     4033     4061     4094
##
## lowest : -57871 -51215 -47375 -46095 -28687, highest:  63502  63758  63759  64782  65040
## ---------------------------------------------------------------------------
## cp_70
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      754        1     4031     2182    -3800     3774
##      .25      .50      .75      .90      .95
##     3882     3978     4028     4056     4093
##
## lowest : -65040 -64016 -62736 -55567 -55566, highest:  63502  63758  64782  64783  65039
## ---------------------------------------------------------------------------
## cp_71
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      749        1     4032     2172    -3808     3772
##      .25      .50      .75      .90      .95
##     3879     3978     4028     4056     4090
##
## lowest : -57871 -57614 -55567 -54287 -50959, highest:  62479  63502  63758  64526  64783
## ---------------------------------------------------------------------------
## cp_72
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      754        1     4024     2183    -3806     3771
##      .25      .50      .75      .90      .95
##     3878     3979     4027     4053     4090
##
## lowest : -65040 -62479 -57871 -56591 -56590, highest:  62479  63758  64014  64782  64783
## ---------------------------------------------------------------------------
## cp_73
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      778        1     3986     2209    -3833     3763
##      .25      .50      .75      .90      .95
##     3872     3975     4026     4049     4087
##
## lowest : -64783 -57615 -57358 -55311 -53007, highest:  63246  63503  64526  64527  64783
## ---------------------------------------------------------------------------
## cp_74
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      757        1     3983     2213    -3829     3764
##      .25      .50      .75      .90      .95
##     3871     3975     4027     4050     4086
##
## lowest : -64784 -63759 -61199 -56591 -55311, highest:  63246  63503  64526  64782  64783
## ---------------------------------------------------------------------------
## cp_75
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      759        1     3997     2206    -3829     3763
##      .25      .50      .75      .90      .95
##     3872     3977     4027     4055     4088
##
## lowest : -65039 -62223 -56591 -56078 -53007, highest:  62223  63246  63502  64526  64783
## ---------------------------------------------------------------------------
## cp_76
##        n  missing distinct     Info     Mean      Gmd      .05      .10
```

```
##    12347      140      762        1     3979     2226    -3833     3764
##      .25      .50      .75      .90      .95
##     3871     3976     4031     4054     4087
##
## lowest : -65039 -64015 -62735 -55567 -55566, highest:  61455  63502  63758  63759  64782
## ------------------------------------------------------------------------
## cp_77
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      703        1     4345     1739     3738     3800
##      .25      .50      .75      .90      .95
##     3890     3983     4033     4064     4094
##
## lowest : -64015 -50190 -48655 -42767  -4111, highest:  62223  62478  63758  64015  65038
## ------------------------------------------------------------------------
## cp_78
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      687        1     4362     1733     3739     3801
##      .25      .50      .75      .90      .95
##     3892     3986     4036     4064     4097
##
## lowest : -50190 -47887 -41999  -4115  -4110, highest:  62734  62991  63247  64271  65294
## ------------------------------------------------------------------------
## cp_79
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      777        1     3932     2287    -3875     3761
##      .25      .50      .75      .90      .95
##     3875     3982     4036     4063     4096
##
## lowest : -64272 -63503 -61967 -55055 -54542, highest:  62734  63247  64014  64271  65294
## ------------------------------------------------------------------------
## cp_80
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      777        1     3975     2276    -3862     3764
##      .25      .50      .75      .90      .95
##     3875     3981     4033     4059     4096
##
## lowest : -62224 -60687 -54799 -54542 -52495, highest:  64014  64015  64271  64527  65295
## ------------------------------------------------------------------------
## cp_81
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      730        1     4110     2069     3662     3780
##      .25      .50      .75      .90      .95
##     3882     3983     4031     4057     4094
##
## lowest : -63247 -58639 -57359 -56846 -55055, highest:  62734  63247  64014  64272  65294
## ------------------------------------------------------------------------
## cp_82
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      731        1     4118     2072     3660     3782
##      .25      .50      .75      .90      .95
##     3883     3984     4034     4061     4097
##
## lowest : -64271 -58639 -57870 -56079 -55055, highest:  63246  63247  64014  64272  65294
## ------------------------------------------------------------------------
```

```
## cp_83
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      735        1     4108     2094     3655     3779
##      .25      .50      .75      .90      .95
##     3882     3983     4030     4057     4093
##
## lowest : -64527 -63247 -57103 -56590 -54799, highest:  62478  63247  63502  64782  64783
## ------------------------------------------------------------------------
## cp_84
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      723        1     4121     2041     3677     3784
##      .25      .50      .75      .90      .95
##     3884     3984     4034     4062     4095
##
## lowest : -64527 -62991 -57359 -56846 -54799, highest:  62991  64014  64271  65294  65295
## ------------------------------------------------------------------------
## cp_85
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      727        1     4090     2096     3580     3778
##      .25      .50      .75      .90      .95
##     3880     3977     4028     4054     4087
##
## lowest : -65039 -63759 -57871 -56591 -56334, highest:  63502  63758  63759  64527  64784
## ------------------------------------------------------------------------
## cp_86
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      770        1     3954     2522    -3921     3728
##      .25      .50      .75      .90      .95
##     3864     3976     4033     4060     4089
##
## lowest : -7183 -4106 -4102 -4101 -4097, highest: 63502 63503 64526 64783 65039
## ------------------------------------------------------------------------
## cp_87
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      619        1     4502     1551     3761     3810
##      .25      .50      .75      .90      .95
##     3894     3982     4032     4059     4091
##
## lowest : -8463 -4105 -4102 -4097 -4092, highest: 63758 63759 64526 64783 65039
## ------------------------------------------------------------------------
## cp_88
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      791        1     3882     2485    -3912     3741
##      .25      .50      .75      .90      .95
##     3866     3977     4031     4059     4091
##
## lowest : -65295 -63759 -56847 -56846 -55567, highest:  62735  63502  63758  64782  65039
## ------------------------------------------------------------------------
## cp_89
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      761        1     4040     2161    -3794     3776
##      .25      .50      .75      .90      .95
##     3884     3981     4032     4059     4092
##
```

```
## lowest : -64272 -62223 -60687 -59406 -54542, highest:  62991  64014  64271  65294  65295
## ---------------------------------------------------------------------------
## cp_90
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      734        1     4061     2184    -3799     3777
##      .25      .50      .75      .90      .95
##     3882     3982     4033     4056     4093
##
## lowest : -63503 -63247 -60430 -58639 -58126, highest:  62223  62734  64014  64527  65038
## ---------------------------------------------------------------------------
## cp_91
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      749        1     4050     2164    -3782     3776
##      .25      .50      .75      .90      .95
##     3883     3981     4032     4059     4093
##
## lowest : -63503 -61967 -59150 -57359 -56846, highest:  63246  63247  64014  64271  65294
## ---------------------------------------------------------------------------
## cp_92
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      635        1     4474     1648     3761     3810
##      .25      .50      .75      .90      .95
##     3896     3985     4032     4062     4098
##
## lowest : -60430 -51471 -32527 -12559  -4104, highest:  62734  64271  64272  65294  65295
## ---------------------------------------------------------------------------
## cp_93
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      734        1     4190     1991     3709     3787
##      .25      .50      .75      .90      .95
##     3886     3980     4028     4056     4093
##
## lowest : -63247 -62991 -57359 -56846 -54799, highest:  62991  64270  64271  65038  65039
## ---------------------------------------------------------------------------
## cp_94
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      718        1     4207     2019     3709     3787
##      .25      .50      .75      .90      .95
##     3886     3982     4030     4056     4094
##
## lowest : -65039 -62223 -57615 -56591 -56078, highest:  62223  63503  64526  64782  64783
## ---------------------------------------------------------------------------
## cp_95
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      722        1     4219     2023     3708     3786
##      .25      .50      .75      .90      .95
##     3886     3984     4032     4059     4094
##
## lowest : -63248 -61967 -56079 -55822 -53775, highest:  64014  64270  64271  65294  65295
## ---------------------------------------------------------------------------
## cp_96
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12347      140      764        1     4156     2319    -3788     3762
##      .25      .50      .75      .90      .95
```

```
##     3869     3979     4034     4064     4087
##
## lowest : -4066 -4061 -4059 -4055 -4053, highest: 62735 63502 63759 64782 65038
## ---------------------------------------------------------------------------
## 12V battery (amps)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      125    0.984    1.622    1.963   -1.586   -1.586
##      .25      .50      .75      .90      .95
##    1.113    1.359    2.094    3.078    3.812
##
## lowest : -10.910156  -7.718750  -7.226562  -6.984375  -6.492188
## highest:  29.085938  29.574219  29.820312  39.882812  40.617188
## ---------------------------------------------------------------------------
## Hx
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       94    0.996    50.78    4.455    50.33    50.37
##      .25      .50      .75      .90      .95
##    50.39    50.49    50.53    50.60    50.62
##
## lowest :   0.00000  10.49805  12.99805  20.49805  22.99805
## highest: 605.49805 610.49805 615.49805 620.49805 625.49805
## ---------------------------------------------------------------------------
## VIN
##        n  missing distinct
##    12324      163        2
##
## Value            ZE0-003619 ZE0-003619003619
## Frequency             12323                1
## Proportion                1                0
## ---------------------------------------------------------------------------
## 12V battery (volts)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       37    0.468    12.83   0.5522    12.08    12.24
##      .25      .50      .75      .90      .95
##    12.96    12.96    12.96    12.96    14.32
##
## lowest :  0.00 11.68 11.76 11.84 11.92, highest: 14.32 14.40 14.48 14.64 14.72
## ---------------------------------------------------------------------------
## 12V battery (dashboard)
##        n  missing distinct     Info     Mean      Gmd
##    12487        0        1        0        0        0
##
## Value          0
## Frequency  12487
## Proportion     1
## ---------------------------------------------------------------------------
## ACC (V)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      258    0.992    12.74    1.122    11.86    12.04
##      .25      .50      .75      .90      .95
##    12.82    12.85    12.87    12.91    14.16
##
## Value        0.0  11.5  12.0  12.5  13.0  13.5  14.0  14.5  16.0  31.5
## Frequency    232   182  1245    38 10021    25   424   280     1     1
```

```
## Proportion 0.019 0.015 0.100 0.003 0.803 0.002 0.034 0.022 0.000 0.000
##
## Value       34.0  35.0  60.0  63.0  64.0
## Frequency      1     1     1     1    34
## Proportion 0.000 0.000 0.000 0.000 0.003
## ---------------------------------------------------------------------------
## ODO
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0     1684    0.594    14018    20805        0        0
##      .25      .50      .75      .90      .95
##        0        0    53114    54291    54577
##
## Value          0 53000 53500 54000 54500 55000
## Frequency   9247   346   772   833  1045   244
## Proportion 0.741 0.028 0.062 0.067 0.084 0.020
## ---------------------------------------------------------------------------
## SOH
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       39    0.996     71.5    1.722    72.17    72.20
##      .25      .50      .75      .90      .95
##    72.22    72.31    72.38    72.41    72.45
##
## Value        0.0  72.0  72.2  72.4  72.6  72.8
## Frequency    141     8  5376  6612    55   295
## Proportion 0.011 0.001 0.431 0.530 0.004 0.024
## ---------------------------------------------------------------------------
## SOH (version 2)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       61    0.997    68.94    6.562    57.92    72.17
##      .25      .50      .75      .90      .95
##    72.22    72.31    72.38    72.44    72.53
##
## Value        0.0  51.6  51.8  72.0  72.2  72.4  72.6  72.8
## Frequency    568    22    35     6  4966  6217   378   295
## Proportion 0.045 0.002 0.003 0.000 0.398 0.498 0.030 0.024
## ---------------------------------------------------------------------------
## ambient_temp_1
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       20     0.99    13.03    4.273        6        7
##      .25      .50      .75      .90      .95
##       11       14       16       17       18
##
## Value          0     4     5     6     7     8     9    10    11    12
## Frequency    104   278    24   239   730   414   806   265   985  1057
## Proportion 0.008 0.022 0.002 0.019 0.058 0.033 0.065 0.021 0.079 0.085
##
## Value         13    14    15    16    17    18    19    20    21    22
## Frequency    687  2145  1011  1231  1516   462   433    53    44     3
## Proportion 0.055 0.172 0.081 0.099 0.121 0.037 0.035 0.004 0.004 0.000
## ---------------------------------------------------------------------------
## cabin_temp_1
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       37    0.567    178.6    54.27       66       70
##      .25      .50      .75      .90      .95
```

```
##      214      214      214      214      214
##
## lowest :   0  51  52  53  54, highest:  82  83  84  85 214
## ---------------------------------------------------------------------------
## cabin_temp_2
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       37    0.567    178.6    54.27       66       70
##      .25      .50      .75      .90      .95
##      214      214      214      214      214
##
## lowest :   0  51  52  53  54, highest:  82  83  84  85 214
## ---------------------------------------------------------------------------
## QC count
##        n  missing distinct     Info     Mean      Gmd
##    12487        0        9    0.911    169.5    5.754
##
## Value          0   168   169   170   171   172   173   174   175
## Frequency    104  2055  5046     1   370   859   416   357  3279
## Proportion 0.008 0.165 0.404 0.000 0.030 0.069 0.033 0.029 0.263
## ---------------------------------------------------------------------------
## L1/L2 count
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       89    0.999     1937    64.95     1913     1916
##      .25      .50      .75      .90      .95
##     1924     1950     1979     1994     1999
##
## Value          0  1910  1915  1920  1925  1930  1935  1940  1945  1950
## Frequency    104   429  1174  1060   855   465   712   633   369   614
## Proportion 0.008 0.034 0.094 0.085 0.068 0.037 0.057 0.051 0.030 0.049
##
## Value       1955  1960  1965  1970  1975  1980  1985  1990  1995  2000
## Frequency    320   560   586   631   773   581   741   337   792   751
## Proportion 0.026 0.045 0.047 0.051 0.062 0.047 0.059 0.027 0.063 0.060
## ---------------------------------------------------------------------------
## Charger (amps)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       15    0.863    11.77     6.06     0.00     0.00
##      .25      .50      .75      .90      .95
##     0.00    15.62    15.62    15.62    15.69
##
## Value       0.0000 15.5000 15.5625 15.6250 15.6875 15.7500 15.8125 15.8750
## Frequency     3138      19    2128    6089     835      30      33      98
## Proportion   0.251   0.002   0.170   0.488   0.067   0.002   0.003   0.008
##
## Value      15.9375 16.0000 16.0625 16.1250 16.1875 33.3750 33.4375
## Frequency       35       6       2      17       2       8      47
## Proportion   0.003   0.000   0.000   0.001   0.000   0.001   0.004
## ---------------------------------------------------------------------------
## Charger (V)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      144    0.986      153    111.9    1.055    1.055
##      .25      .50      .75      .90      .95
##    1.055  238.742  241.164  242.539  243.242
##
```

```
## lowest :   0.000000   1.054688   1.562500   2.250000   3.976562
## highest: 248.406250 248.585938 249.093750 249.273438 249.445312
## ---------------------------------------------------------------------------
## h_volt_1
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0     3444        1    373.6    25.54    359.5    365.1
##      .25      .50      .75      .90      .95
##    373.3    382.4    387.0    389.4    392.2
##
## Value          0     5    60    80   170   245   335   340   345   350
## Frequency    232     1     1     1     1     1     1     1    10    48
## Proportion 0.019 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.004
##
## Value        355   360   365   370   375   380   385   390   395   655
## Frequency    191   398   864  1185  1458  1902  3605  1996   555    36
## Proportion 0.015 0.032 0.069 0.095 0.117 0.152 0.289 0.160 0.044 0.003
## ---------------------------------------------------------------------------
## Motor temp
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       76    0.999    53.65    24.56       19       22
##      .25      .50      .75      .90      .95
##       30       64       71       77       80
##
## lowest :  0 10 11 12 13, highest: 88 89 90 91 92
## ---------------------------------------------------------------------------
## inverter_2 temp
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       67    0.999    48.67    23.41       15       18
##      .25      .50      .75      .90      .95
##       25       61       66       70       72
##
## lowest :  0  8  9 10 11, highest: 81 82 83 84 86
## ---------------------------------------------------------------------------
## inverter_4 temp
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0       65    0.999    49.87    24.15       15       19
##      .25      .50      .75      .90      .95
##       26       61       67       72       76
##
## lowest :  0  6  7  8  9, highest: 78 79 80 81 82
## ---------------------------------------------------------------------------
## motor_amp (1)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      551    0.491    284.2    526.4        0        0
##      .25      .50      .75      .90      .95
##        0        0        0      149     4015
##
## lowest :    0    1    2    3    4, highest: 4091 4092 4093 4094 4095
## ---------------------------------------------------------------------------
## motor_amp (2)
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      410    0.488    284.1    526.3        0        0
##      .25      .50      .75      .90      .95
##        0        0        0      149     4045
```

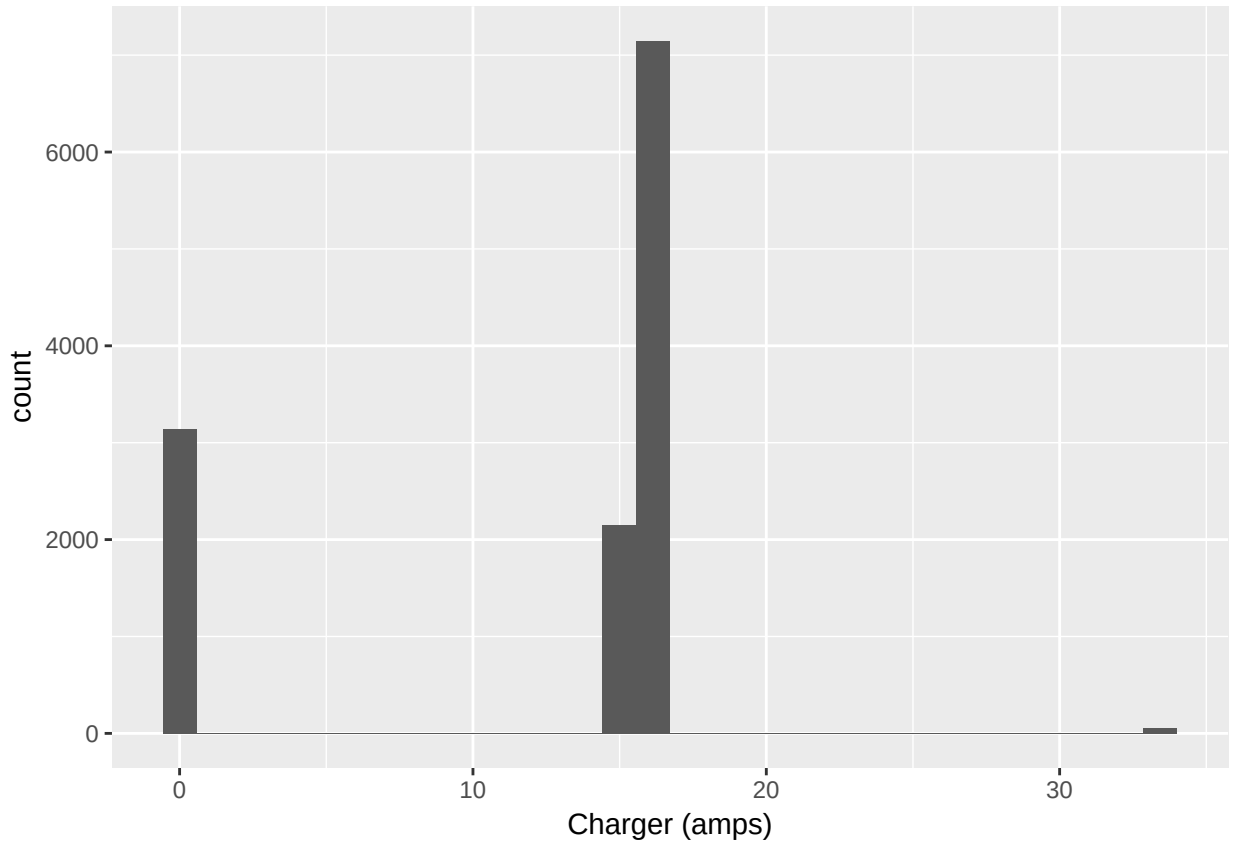
```
##
## Value          0    50   100   150   200   250   300   350   400   450
## Frequency  10176   478   433   249   139    73    49    16    14    11
## Proportion 0.815 0.038 0.035 0.020 0.011 0.006 0.004 0.001 0.001 0.001
##
## Value        500   550   600  4000  4050  4100
## Frequency     11     6     5     5   646   176
## Proportion 0.001 0.000 0.000 0.000 0.052 0.014
## ------------------------------------------------------------------------------
## throttle
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      101    0.365    4.664    8.433        0        0
##      .25      .50      .75      .90      .95
##        0        0        0       21       38
##
## lowest :   0   1   2   3   4, highest: 127 128 133 146 199
## ------------------------------------------------------------------------------
## target_regen_braking_1
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      175    0.086    12.11    23.86        0        0
##      .25      .50      .75      .90      .95
##        0        0        0        0        0
##
## lowest :    0    2    6   10   14, highest: 1234 1242 1246 1250 1258
## ------------------------------------------------------------------------------
## target_regen_braking_2
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##    12487        0      354    0.163    53.24    103.3        0        0
##      .25      .50      .75      .90      .95
##        0        0        0        0      112
##
## lowest :    0    4    8   12   16, highest: 3516 3632 3792 4088 4092
## ------------------------------------------------------------------------------
```

Create some useful derived variables.

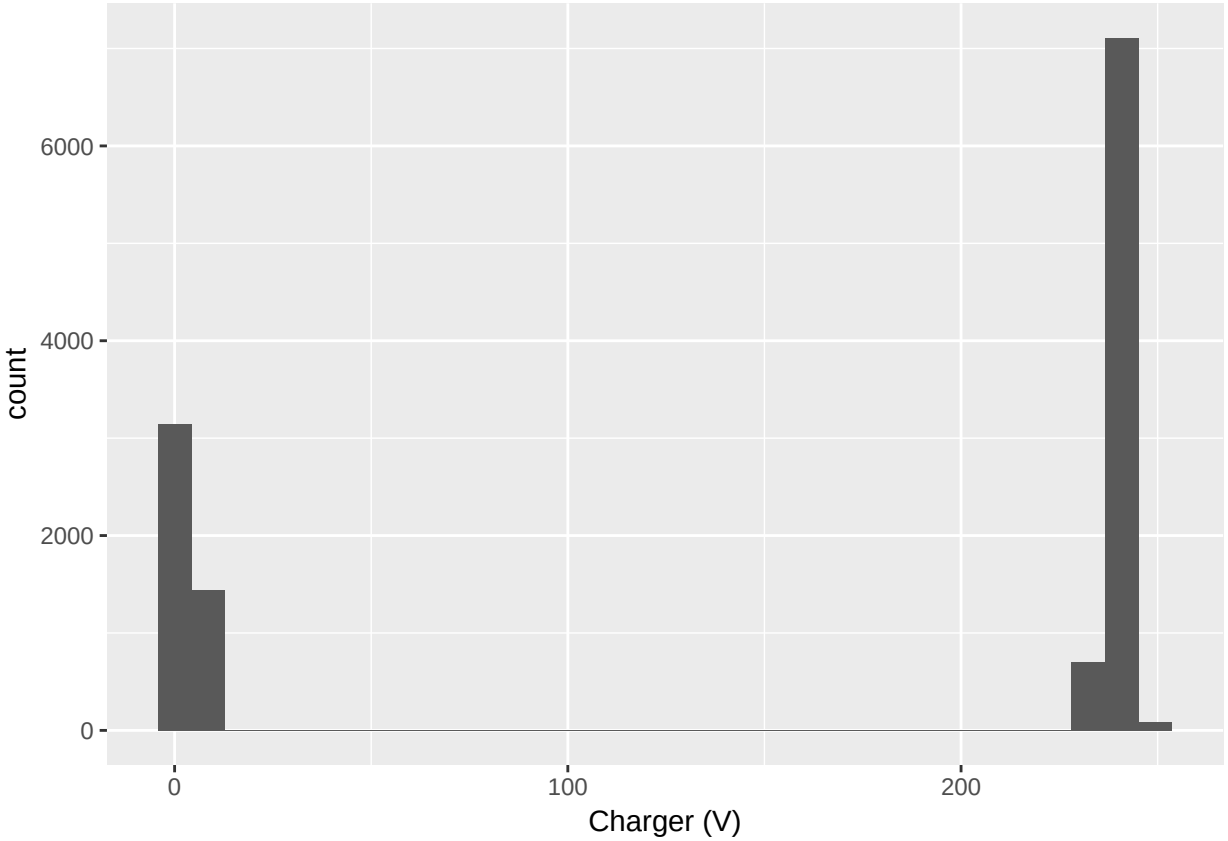
```
# create dateTime var
ftfSafeDT <- ftfSafeDT[, rDate := lubridate::dmy(`Date (GPS)`)]
ftfSafeDT <- ftfSafeDT[, rTime := hms::parse_hms(`Time (GPS)`)]
#ftfSafeDT <- ftfSafeDT[, dateTime := lubridate::dmy_hms(rDate, rTime)]
```

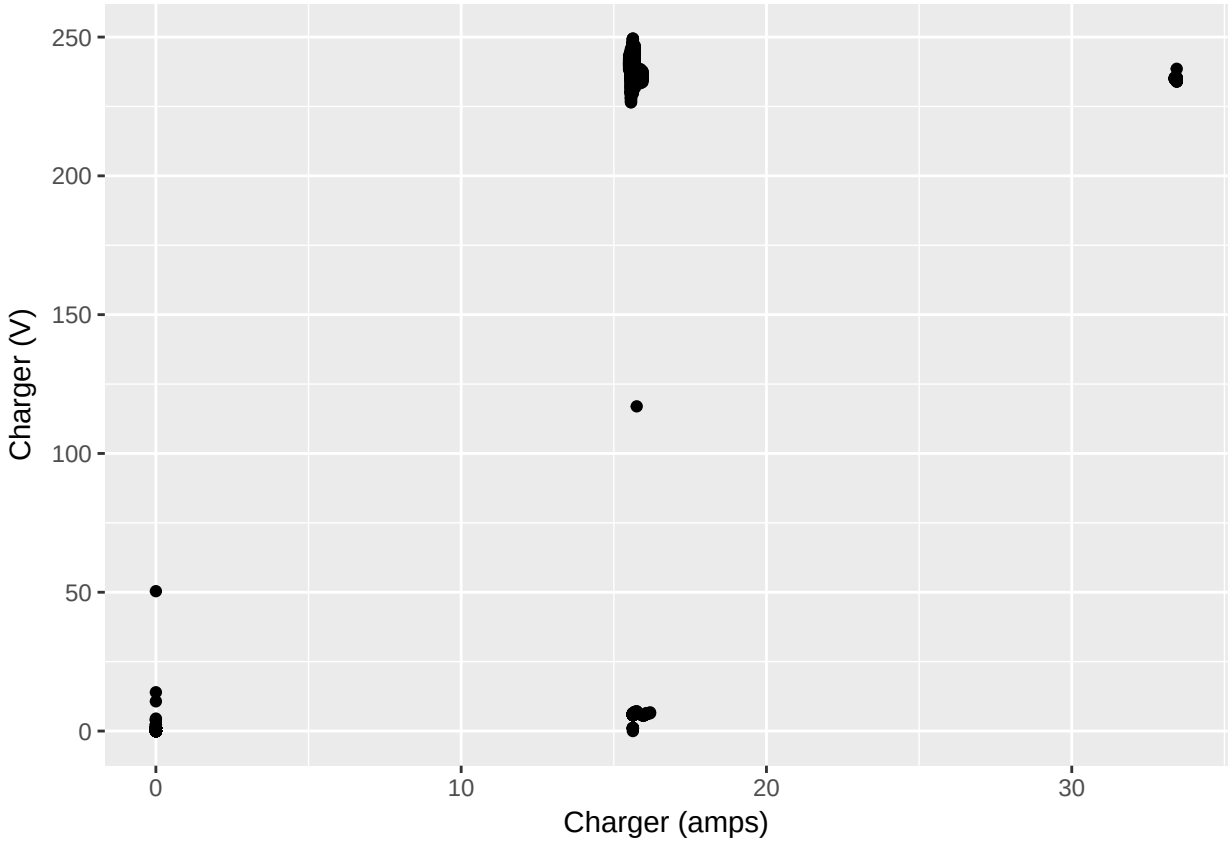
Check charger related variables.

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

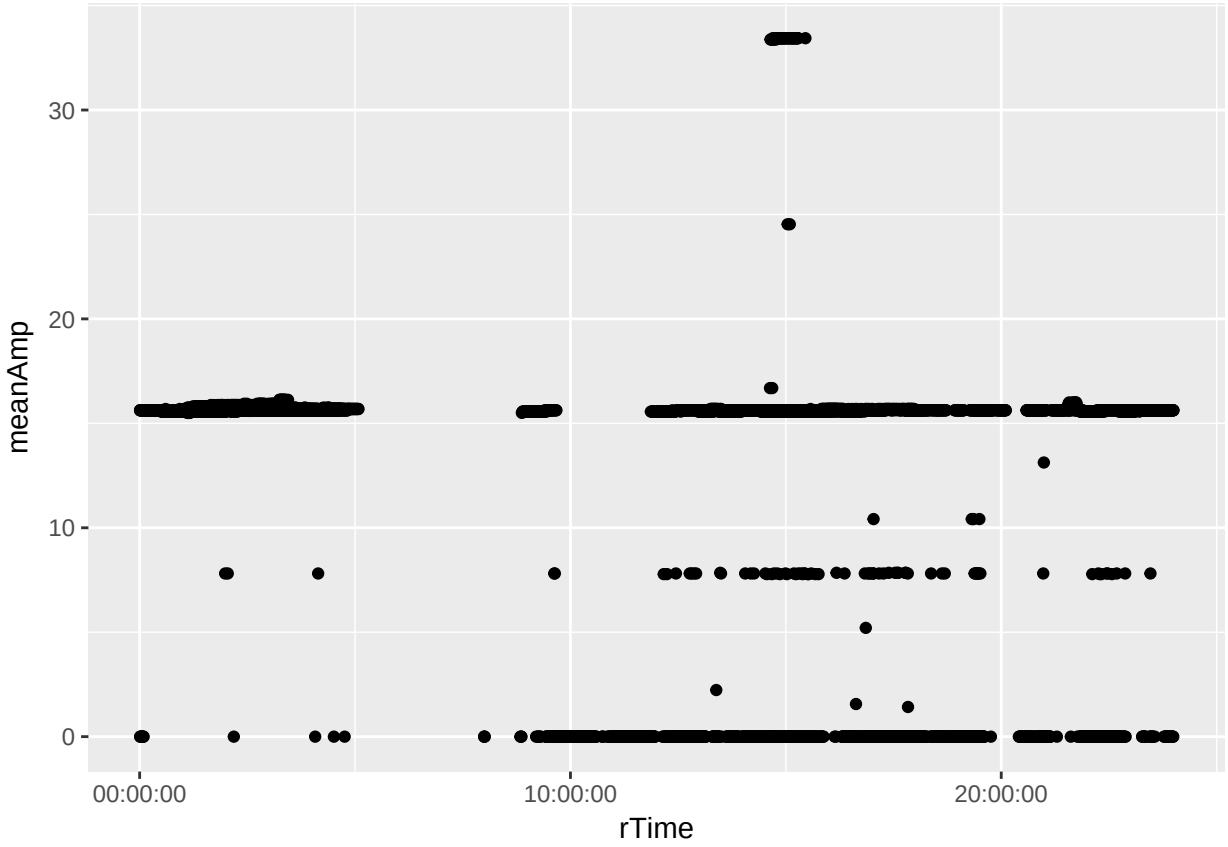

6000
4000
2000
0
count
0
100
200
Charger (V)


250
200
150
100
50
0
Charger (V)
0
10
20
30
Charger (amps)

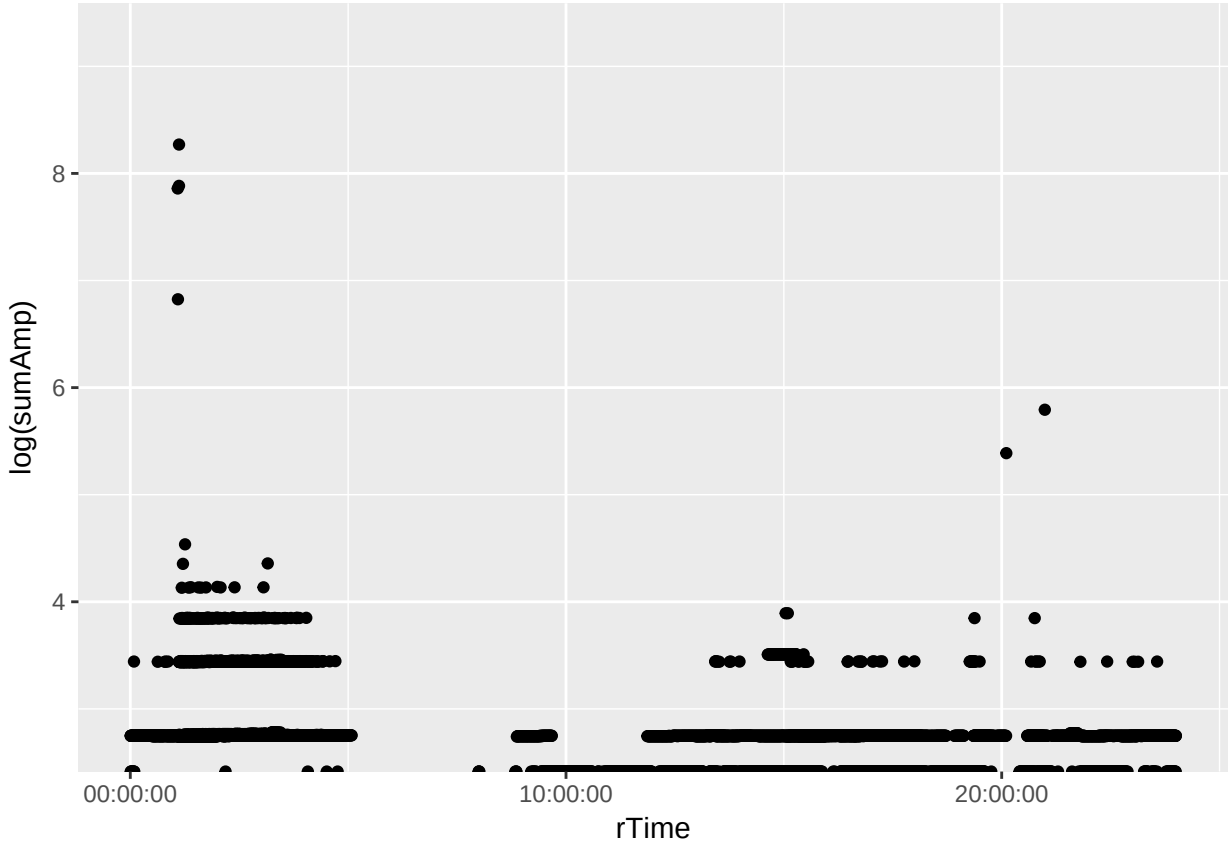
4 Timing of charging

We assume `Charger (amps)` is a good indicator of charging?

```
## Warning: Removed 1 rows containing missing values (geom_point).
```




```
## Warning: Removed 1 rows containing missing values (geom_point).
```



So this car appears to be on an overnight charging timer, although we do still see charging in the evening. We need a way to infer when the car is 'at home' without being disclosive. Perhaps we could use the modal overnight `Latitude` <-> `Longtidude` as 'home'? # Runtime

Analysis completed in 18.05 seconds (0.3 minutes) using knitr in RStudio with R version 3.5.0 (2018-04-23) running on x86_64-apple-darwin15.6.0.

5 R environment

R packages used:

- base R - for the basics (R Core Team 2016)
- data.table - for fast (big) data handling (Dowle et al. 2015)
- lubridate - date manipulation (Grolemund and Wickham 2011)
- ggplot2 - for slick graphics (Wickham 2009)
- readr - for csv reading/writing (Wickham, Hester, and Francois 2016)
- dplyr - for select and contains (Wickham and Francois 2016)
- progress - for progress bars (Csárdi and FitzJohn 2016)
- knitr - to create this document & neat tables (Xie 2016)
- nzGREENGrid - for local NZ GREEN Grid project utilities

Session info:

```
## R version 3.5.0 (2018-04-23)
## Platform: x86_64-apple-darwin15.6.0 (64-bit)
## Running under: macOS High Sierra 10.13.5
##
```

```
## Matrix products: default
## BLAS: /Library/Frameworks/R.framework/Versions/3.5/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/3.5/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_GB.UTF-8/en_GB.UTF-8/en_GB.UTF-8/C/en_GB.UTF-8/en_GB.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
## [1] knitr_1.20        readr_1.1.1       lubridate_1.7.4   ggplot2_2.2.1
## [5] dplyr_0.7.5       data.table_1.11.4 nzGREENGrid_0.1.0
##
## loaded via a namespace (and not attached):
##  [1] progress_1.2.0      tidyselect_0.2.4    xfun_0.1
##  [4] reshape2_1.4.3      purrr_0.2.5         splines_3.5.0
##  [7] lattice_0.20-35     colorspace_1.3-2    htmltools_0.3.6
## [10] yaml_2.1.19         base64enc_0.1-3     survival_2.42-3
## [13] rlang_0.2.1         pillar_1.2.3        foreign_0.8-70
## [16] glue_1.2.0          RColorBrewer_1.1-2  bindrcpp_0.2.2
## [19] bindr_0.1.1         plyr_1.8.4          stringr_1.3.1
## [22] munsell_0.5.0       gtable_0.2.0        htmlwidgets_1.2
## [25] evaluate_0.10.1     labeling_0.3        latticeExtra_0.6-28
## [28] htmlTable_1.12      Rcpp_0.12.17        acepack_1.4.1
## [31] checkmate_1.8.5     backports_1.1.2     scales_0.5.0
## [34] Hmisc_4.1-1         gridExtra_2.3       hms_0.4.2
## [37] digest_0.6.15       stringi_1.2.3       bookdown_0.7
## [40] grid_3.5.0          rprojroot_1.3-2     tools_3.5.0
## [43] magrittr_1.5        lazyeval_0.2.1      tibble_1.4.2
## [46] Formula_1.2-3       cluster_2.0.7-1     crayon_1.3.4
## [49] pkgconfig_2.0.1     Matrix_1.2-14       prettyunits_1.0.2
## [52] assertthat_0.2.0    rmarkdown_1.10      rstudioapi_0.7
## [55] R6_2.2.2            rpart_4.1-13        nnet_7.3-12
## [58] compiler_3.5.0
```

References

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