FlipTheFleet Test Black Box Data: Codebook

EVBlackBox export 2018-06-10-233146.csv.gz

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Last run at: 2018-11-12 12:58:06

1 About

1.1 License

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1.2 Citation

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

- Anderson, B. (2018) FlipTheFleet Test Black Box Data: Codebook: (File: EVBlackBox export 2018-06-10-233146.csv.gz), Centre for Sustainability, University of Otago: Dunedin, New Zealand.

This work is (c) 2018 the University of Southampton.

1.3 Purpose

This report is intended to:

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

1.4 Requirements

- test dataset: EVBlackBox export 2018-06-10-233146.csv.gz

1.5 History

Specific history of this report:

- https://github.com/CfSOtago/evAnalysis/commits/master/ftf/dataProcessing/

ftFBlackBoxTestDataCodebook.Rmd

1.6 Acknowledgements

Data provided by FlipTheFleet.

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2 Load data files

In this section we load, merge and describe /Volumes/hum-csafe/Research Projects/GREEN Grid/externalData/flipTheFleet/raw/testData/EVBlackBox export 2018-06-10-233146.csv.gz.

```
## 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.
```

Original data:

```
## Skim summary statistics
##  n obs: 12487
##  n variables: 144
##
## ── Variable type:character
```

```
##    variable missing complete     n min max empty n_unique
##  Date (GPS)    1160    11327 12487  10  10     0       39
##      Reg No       0    12487 12487   6   6     0        1
##         VIN     163    12324 12487  10  16     0        2
```

```
##
## ── Variable type:difftime
```

```
──────────────────
##    variable missing complete     n     min        max   median n_unique
##  Time (GPS)    1160    11327 12487 36 secs 86391 secs 03:46:32     8903
##
## ── Variable type:integer
```

```
──────────────────────
##                  variable missing complete     n     mean       sd     p0
##              avg_cp (mV)     138    12349 12487  4441.28  4078.58   2811
##                     cp_1     138    12349 12487  3174.82  2372.61  -4110
##                    cp_10     138    12349 12487  3980.26  3862.48 -64784
##                    cp_11     138    12349 12487  3658.69  4343.36 -64014
##                    cp_12     138    12349 12487  4026.2   4036.14 -65039
##                    cp_13     139    12348 12487  3632.37  4378.55 -63503
##                    cp_14     139    12348 12487  3618.7   4323.64 -64783
##                    cp_15     139    12348 12487  3228.86  4615.84 -64527
##                    cp_16     139    12348 12487  3572.19  4383.25 -64782
##                    cp_17     139    12348 12487  3872.05  4087.45 -63246
##                    cp_18     139    12348 12487  3947.86  4035.15 -50703
##                    cp_19     139    12348 12487  3865.68  4100.5  -64526
##                     cp_2     138    12349 12487  3584.68  1702.91  -4112
##                    cp_20     139    12348 12487  3946.56  3997.24 -46095
##                    cp_21     139    12348 12487  4124.23  3864.29 -49423
##                    cp_22     139    12348 12487  4118.77  3898.07 -49423
##                    cp_23     139    12348 12487  4116.85  3925.22 -51471
##                    cp_24     139    12348 12487  4070.32  3975.32 -64527
##                    cp_25     139    12348 12487  4081.52  3934.05  -4108
##                    cp_26     139    12348 12487  4025.31  4006.23 -56591
##                    cp_27     139    12348 12487  4018.76  3940.31 -56591
##                    cp_28     139    12348 12487  4074.24  3940.73  -4103
##                    cp_29     139    12348 12487  3784.94  4249.21 -64526
##                     cp_3     138    12349 12487  3387.44  4785.94 -50785
##                    cp_30     139    12348 12487  4033.57  3980.33 -64782
##                    cp_31     139    12348 12487  4056.02  4060.01 -46094
##                    cp_32     139    12348 12487  4041.84  4011.13 -49679
##                    cp_33     139    12348 12487  4105.48  4113.93 -63502
##                    cp_34     139    12348 12487  4082.74  4037.74 -63502
##                    cp_35     139    12348 12487  4287.43  5046.15 -64526
##                    cp_36     139    12348 12487  4048.54  5229.61 -62478
##                    cp_37     139    12348 12487  3566.08  5519.64 -63502
##                    cp_38     139    12348 12487  4264.92  5025.16 -50703
##                    cp_39     139    12348 12487  4238.34  4953.39 -63502
##                     cp_4     138    12349 12487  3211.25  2295.9   -4109
##                    cp_40     139    12348 12487  4268.42  5037.83 -51983
##                    cp_41     139    12348 12487  3976.58  5305.78 -64526
##                    cp_42     139    12348 12487  3963.11  5247.63 -64014
##                    cp_43     139    12348 12487  4228.08  5140.57 -64782
##                    cp_44     139    12348 12487  3971.76  5244.99 -64526
##                    cp_45     139    12348 12487  3988.31  5263.35 -62991
##                    cp_46     139    12348 12487  4138.27  5173.52 -43791
##                    cp_47     139    12348 12487  4385.31  4995.07 -43791
##                    cp_48     139    12348 12487  4391.83  5021.27 -45071
##                    cp_49     139    12348 12487  4034.36  5280.67 -65040
##                     cp_5     138    12349 12487  3226.04  4428.53 -65295
##                    cp_50     139    12348 12487  4032.65  5235.32 -63759
##                    cp_51     139    12348 12487  4046.48  5243.5  -62735
##                    cp_52     139    12348 12487  4037.92  5260.97 -63759
##                    cp_53     139    12348 12487  3937.21  5293.86 -61199
##                    cp_54     139    12348 12487  3921.96  5216.25 -64783
##                    cp_55     139    12348 12487  3929.48  5217.77 -65039
##                    cp_56     139    12348 12487  3923.66  5288.48 -64784
##                    cp_57     139    12348 12487  3890.84  5311.05 -63759
##                    cp_58     139    12348 12487  3908.59  5297.14 -63759
##                    cp_59     140    12347 12487  3908.29  5365.19 -63759
##                     cp_6     138    12349 12487  3656.82  4189.17 -65295
##                    cp_60     140    12347 12487  3673.9   5537.41 -62479
```

```
##                  cp_61     140    12347 12487  3895.22  5322.92 -62479
##                  cp_62     140    12347 12487  3869.71  5331.51 -62479
##                  cp_63     140    12347 12487  3948.15  5627.87 -65039
##                  cp_64     140    12347 12487  3916.22  5645.97 -64015
##                  cp_65     140    12347 12487  4407.79  5263.57 -62223
##                  cp_66     140    12347 12487  4022.25  5626.02 -65039
##                  cp_67     140    12347 12487  4433.93  5302.1  -61455
##                  cp_68     140    12347 12487  4446.36  5313.94 -61199
##                  cp_69     140    12347 12487  4426.85  5372.98 -57871
##                   cp_7     138    12349 12487  2403.5   4919.04 -65039
##                  cp_70     140    12347 12487  4031.41  5702.94 -65040
##                  cp_71     140    12347 12487  4031.9   5654.14 -57871
##                  cp_72     140    12347 12487  4024.1   5705.7  -65040
##                  cp_73     140    12347 12487  3986.43  5623.12 -64783
##                  cp_74     140    12347 12487  3982.79  5642.67 -64784
##                  cp_75     140    12347 12487  3997.03  5605.08 -65039
##                  cp_76     140    12347 12487  3978.52  5656.1  -65039
##                  cp_77     140    12347 12487  4345.47  5329.77 -64015
##                  cp_78     140    12347 12487  4362.01  5324.46 -50190
##                  cp_79     140    12347 12487  3932.43  5722.44 -64272
##                   cp_8     138    12349 12487  3471.66  4264.9  -41487
##                  cp_80     140    12347 12487  3975.42  5712.44 -62224
##                  cp_81     140    12347 12487  4109.77  5611.97 -63247
##                  cp_82     140    12347 12487  4117.74  5640.26 -64271
##                  cp_83     140    12347 12487  4108.14  5701.29 -64527
##      p25    p50      p75  p100     hist
##  3896    3988    4033    60245 ▇▁▁▁▁▁▁▁
##  3848    3973    4032     4294 ▁▁▁▁▁▁▁▇
##  3884    3987    4034    64526 ▁▁▁▁▇▁▁▁
##  3863    3982    4034    65294 ▁▁▁▁▇▁▁▁
##  3887    3983    4030    64782 ▁▁▁▁▇▁▁▁
##  3859    3974    4029    65040 ▁▁▁▁▇▁▁▁
##  3859    3975.5  4030    64783 ▁▁▁▁▇▁▁▁
##  3833    3965    4025    64783 ▁▁▁▁▇▁▁▁
##  3848    3970    4025    64783 ▁▁▁▁▇▁▁▁
##  3878    3983    4033    65039 ▁▁▁▁▇▁▁▁
##  3882    3982    4032    64783 ▁▁▁▇▁▁▁▁
##  3878    3986    4036    65039 ▁▁▁▁▇▁▁▁
##  3877    3984    4034    24834 ▁▁▇▁▁▁▁▁
##  3881    3985    4034    64783 ▁▁▁▇▁▁▁▁
##  3891    3989    4035    65039 ▁▁▁▇▁▁▁▁
##  3891    3988    4036    64784 ▁▁▁▇▁▁▁▁
##  3887    3989    4039    65294 ▁▁▁▇▁▁▁▁
##  3886    3988    4036    64783 ▁▁▁▁▇▁▁▁
##  3887    3985    4034    64783 ▇▁▁▁▁▁▁▁
##  3883    3984    4031    64784 ▁▁▁▇▁▁▁▁
##  3874    3980    4030    65039 ▁▁▁▇▁▁▁▁
##  3875    3981    4029    65039 ▇▁▁▁▁▁▁▁
##  3868.75 3980    4030    65039 ▁▁▁▁▇▁▁▁
##  3841    3971    4034    50785 ▁▁▁▁▇▁▁▁
##  3883    3981    4030    65039 ▁▁▁▁▇▁▁▁
##  3882    3984    4031    65039 ▁▁▁▇▁▁▁▁
##  3882    3983    4030    63759 ▁▁▁▇▁▁▁▁
##  3883    3980    4029    65295 ▁▁▁▁▇▁▁▁
##  3881    3982    4029    65039 ▁▁▁▁▇▁▁▁
##  3882    3979    4025    65039 ▁▁▁▁▇▁▁▁
##  3869    3979    4030    64783 ▁▁▁▁▇▁▁▁
##  3841    3969    4030    65039 ▁▁▁▁▇▁▁▁
##  3883    3979    4025    64783 ▁▁▁▇▁▁▁▁
##  3883    3983    4029    65039 ▁▁▁▁▇▁▁▁
##  3846    3974    4032     4117 ▁▁▁▁▁▁▁▇
##  3884    3980    4026    65039 ▁▁▁▇▁▁▁▁
##  3869    3980    4030    65039 ▁▁▁▁▇▁▁▁
##  3866.75 3980    4030    64783 ▁▁▁▁▇▁▁▁
##  3883    3987    4034    65039 ▁▁▁▁▇▁▁▁
##  3866    3984    4034    64016 ▁▁▁▁▇▁▁▁
##  3873    3983    4034    64782 ▁▁▁▁▇▁▁▁
##  3878    3984    4030    65039 ▁▁▁▇▁▁▁▁
##  3889    3988    4034    65039 ▁▁▁▇▁▁▁▁
```

```
##  3890    3989    4036    65039 ▁▁▁▁▁▇▁▁▁▁
##  3886    3982    4033    65039 ▁▁▁▁▁▇▁▁▁▁
##  3834    3965    4028    65294 ▁▁▁▁▁▇▁▁▁▁
##  3883    3980    4025    65039 ▁▁▁▁▁▇▁▁▁▁
##  3883    3979    4026    65039 ▁▁▁▁▁▇▁▁▁▁
##  3883    3979    4026.25 64783 ▁▁▁▁▁▇▁▁▁▁
##  3882    3983    4034    64783 ▁▁▁▁▁▇▁▁▁▁
##  3878    3981    4030    64782 ▁▁▁▁▁▇▁▁▁▁
##  3881    3979    4030    64782 ▁▁▁▁▁▇▁▁▁▁
##  3879    3980    4029    64783 ▁▁▁▁▁▇▁▁▁▁
##  3878    3978    4029    64783 ▁▁▁▁▁▇▁▁▁▁
##  3878    3978    4029    65039 ▁▁▁▁▁▇▁▁▁▁
##  3877    3982    4033    64783 ▁▁▁▁▁▇▁▁▁▁
##  3864    3978    4029    65295 ▁▁▁▁▁▇▁▁▁▁
##  3856    3974    4030    64783 ▁▁▁▁▁▇▁▁▁▁
##  3877    3982    4033    64783 ▁▁▁▁▁▇▁▁▁▁
##  3874    3976    4025    64783 ▁▁▁▁▁▇▁▁▁▁
##  3874    3975    4025    64783 ▁▁▁▁▁▇▁▁▁▁
##  3874    3975    4025    65039 ▁▁▁▁▁▇▁▁▁▁
##  3897    3988    4032    65039 ▁▁▁▁▁▇▁▁▁▁
##  3883    3984    4031    65038 ▁▁▁▁▁▇▁▁▁▁
##  3897    3988    4034    65039 ▁▁▁▁▁▇▁▁▁▁
##  3897    3985    4034    64783 ▁▁▁▁▁▇▁▁▁▁
##  3892    3984    4033    65040 ▁▁▁▁▁▇▁▁▁▁
##  3743    3931    4023    64783 ▁▁▁▁▂▇▁▁▁▁
##  3882    3978    4028    65039 ▁▁▁▁▁▇▁▁▁▁
##  3879    3978    4028    64783 ▁▁▁▁▁▇▁▁▁▁
##  3878    3979    4027    64783 ▁▁▁▁▁▇▁▁▁▁
##  3872    3975    4026    64783 ▁▁▁▁▁▇▁▁▁▁
##  3871    3975    4027    64783 ▁▁▁▁▁▇▁▁▁▁
##  3872    3977    4027    64783 ▁▁▁▁▁▇▁▁▁▁
##  3871    3976    4031    64782 ▁▁▁▁▁▇▁▁▁▁
##  3890    3983    4033    65038 ▁▁▁▁▁▇▁▁▁▁
##  3892    3986    4036    65294 ▁▁▁▁▇▁▁▁▁▁
##  3875    3982    4036    65294 ▁▁▁▁▁▇▁▁▁▁
##  3846    3974    4030    65039 ▁▁▁▁▇▁▁▁▁▁
##  3875    3981    4033    65295 ▁▁▁▁▁▇▁▁▁▁
##  3882.5  3983    4031    65294 ▁▁▁▁▁▇▁▁▁▁
##  3883    3984    4034    65294 ▁▁▁▁▁▇▁▁▁▁
##  3882    3983    4030    64783 ▁▁▁▁▁▇▁▁▁▁
##  [ reached getOption("max.print") -- omitted 25 rows ]
##
## ── Variable type:numeric
```

```
##                  variable missing complete     n   mean      sd      p0
##       12V battery (amps)       0    12487 12487   1.62    2.48  -10.91
##  12V battery (dashboard)       0    12487 12487   0       0       0
##      12V battery (volts)       0    12487 12487  12.83    1.27    0
##                  ACC (V)       0    12487 12487  12.74    3.29    0
##                      AHr       0    12487 12487  46.92    8.5     0
##                 Altitude      12    12475 12487  42.41   25.14 -293.5
##           ambient_temp_1       0    12487 12487  13.03    3.84    0
##             cabin_temp_1       0    12487 12487 178.58   62.88    0
##             cabin_temp_2       0    12487 12487 178.58   62.88    0
##           Charger (amps)       0    12487 12487  11.77    6.92    0
##              Charger (V)       0    12487 12487 153.03  114.59    0
##             Course (deg)      12    12475 12487  36.51   91.2     0
##                 h_volt_1       0    12487 12487 373.58   54.57    0
##                       Hx       0    12487 12487  50.78   23.82    0
##                 Latitude      12    12475 12487 -33.27   10.59  -36.87
##                Longitude      12    12475 12487 158.65   50.51    0
##            motor_amp (1)       0    12487 12487 284.21 1002.6     0
##            motor_amp (2)       0    12487 12487 284.14 1006.32    0
##          Pack 1 temp (C)     139    12348 12487  19.9     3.37    8.7
##          Pack 2 temp (C)     168    12319 12487  19.03    3.38    7.6
##          Pack 3 temp (C)     191    12296 12487  18.61    3.23    7.7
##          Pack 4 temp (C)     191    12296 12487  17.8     3.17    7.6
##                Pack amps       0    12487 12487  -5.44    9.21  -32.75
```

```
##               Pack volts       0    12487 12487 421.65  391.92    0
##                      SOC       0    12487 12487  57.55   21.03    0
##                      SOH       0    12487 12487  71.5     7.64    0
##          SOH (version 2)       0    12487 12487  68.94   15.11    0
##              Speed (GPS)      12    12475 12487  10.35   24.91    0
##      Speed (Speedometer)       0    12487 12487  10.43   23.75    0
##   target_regen_braking_1       0    12487 12487  12.11   93.64    0
##   target_regen_braking_2       0    12487 12487  53.24  304.3     0
##                 throttle       0    12487 12487   4.66   13.7     0
##     p25    p50    p75    p100     hist
##    1.11   1.36   2.09   40.62 ▇▂▁▁▁▁▁▁
##    0      0      0       0    ▁▁▁▇▁▁▁▁
##   12.96  12.96  12.96   14.72 ▁▁▁▁▁▁▁▇
##   12.82  12.85  12.87   64    ▁▇▁▁▁▁▁▁
##   47.38  47.44  47.48  132.74 ▁▁▇▁▁▁▁▁
##   36     39.8   44.2   395.1  ▁▁▁▇▂▁▁▁
##   11     14     16      22    ▁▁▂▃▇▃▁▁
##  214    214    214     214    ▁▁▂▁▁▁▁▇
##  214    214    214     214    ▁▁▂▁▁▁▁▇
##    0     15.62  15.62   33.44 ▂▁▂▇▁▁▁▁
##    1.05 238.74 241.16  249.45 ▇▁▁▁▁▁▁▇
##    0      0      0     359.7  ▇▁▁▁▁▁▁▁
##  373.33 382.42 386.98  655.35 ▁▁▁▁▁▇▁▁
##   50.39  50.49  50.53  625.5  ▇▁▁▁▁▁▁▁
##  -36.63 -36.63 -36.63    0    ▇▁▁▁▁▁▁▁
##  174.74 174.74 174.74  174.82 ▁▁▁▁▁▁▁▇
##    0      0      0    4095    ▇▁▁▁▁▁▁▁
##    0      0      0    4095    ▇▁▁▁▁▁▁▁
##   17.6   20.2   21.8    28.4  ▁▂▃▅▆▅▂▁
##   16.8   19.4   21.1    27.7  ▁▂▃▅▆▅▂▁
##   16.4   19     20.7    26.2  ▁▂▃▅▅▅▂▁
##   15.5   18.2   20      25.1  ▁▂▃▅▅▅▃▁
##   -8.91  -8.15  -0.88   32.75 ▂▅▅▃▁▁▁▁
##  373.63 382.75 387.17 5783.52 ▇▁▁▁▁▁▁▁
##   42.41  60     74.56   95.53 ▁▂▃▅▅▆▇▆
##   72.22  72.31  72.38   72.86 ▁▁▁▁▁▁▁▇
##   72.22  72.31  72.38   72.86 ▁▁▁▁▁▁▁▇
##    0      0      0     103.71 ▇▁▁▁▁▁▁▁
##    0      0      0     102.08 ▇▁▁▁▁▁▁▁
##    0      0      0    1258    ▇▁▁▁▁▁▁▁
##    0      0      0    4092    ▇▁▁▁▁▁▁▁
##    0      0      0     199    ▇▁▁▁▁▁▁▁
```

3 Location inference

The raw data has latitude and longitude. This is very disclosive, although there are likely to be errors. For example 0 values in the table below (off the coast of West Africa) may indicate GPS signal issues.

Table 3.1: Summary of test geo data

Longitude	Latitude	Altitude	ambient_temp_1
Min. : 0.0	Min. :-36.87	Min. :-293.50	Min. : 0.00
1st Qu.:174.7	1st Qu.:-36.63	1st Qu.: 36.00	1st Qu.:11.00
Median :174.7	Median :-36.63	Median : 39.80	Median :14.00
Mean :158.7	Mean :-33.27	Mean : 42.41	Mean :13.03
3rd Qu.:174.7	3rd Qu.:-36.63	3rd Qu.: 44.20	3rd Qu.:16.00

Longitude	Latitude	Altitude	ambient_temp_1
Max. :174.8	Max. : 0.00	Max. : 395.10	Max. :22.00
NA’s :12	NA’s :12	NA’s :12	NA

Figure 3.1: Map of sample of observations

Figure 3.1 maps the location of a random sample of 50 of the observations in the dataset. If we selected just one vehicle and zoomed our map to the location at 01:00 - 04:00 when speed is 0 then we would probably determine their home. We could also determine other places visited at other times… This indicates how disclosive GPS Lat/Long can be even if address data is not provided.

4 Derived variables

Create some useful derived variables.

```
# create derived
ftfDT <- evAnalysis::ftfCreateDerived(ftfDT)

## Warning: 1160 failed to parse.
```

If there is a ‘failed to parse’ message it suggests some dates and times could not be correctly parsed by `evAnalysis::ftfCreateDerived()`. We can check this using by comparing the original and parsed variables:

```
## Date (GPS)

##    Length     Class      Mode
##     12487 character character

## Time (GPS)

##   Length   Class1   Class2     Mode
##    12487      hms difftime  numeric

## rDateTime

##                   Min.                1st Qu.                 Median
## "2018-05-01 12:42:27" "2018-05-08 03:57:40" "2018-05-18 02:16:05"
##                   Mean                3rd Qu.                   Max.
## "2018-05-20 04:32:05" "2018-06-02 03:58:09" "2018-06-11 09:40:28"
##                   NA's
##                 "1160"
```

It looks like the dates don’t always parse. Check a few…

Table 4.1: Example rows where date failed to parse

Date (GPS)	rDateTime	Time (GPS)
NA	NA	NA

Date (GPS)	rDateTime	Time (GPS)
NA	NA	NA
NA	NA	NA
NA	NA	NA
NA	NA	NA
NA	NA	NA

Doesn’t look like we can do much about these…

5 Preventing geo-disclosure

To avoid any risk of location disclosure we next infer a very coarse geo-location at each time point so that we can remove the potentially disclosive GPS data before moving on to the analysis.

Note that this does not necessarily render this dataset *completely safe* (anonymised) as there may well be other variables that provide sufficient information either on their own or together which would enable identification of the car and it’s owner.

```
plotDT <- ftfDT[, .(nObs = .N),
                keyby = .(derivedLocation, obsHour = lubridate::hour(rDateTime), rDow
= lubridate::wday(rDateTime))]

ggplot(plotDT, aes(x = obsHour, y = nObs)) +
  geom_col() +
  facet_grid(rDow ~ derivedLocation)

## Warning: Removed 2 rows containing missing values (position_stack).
```

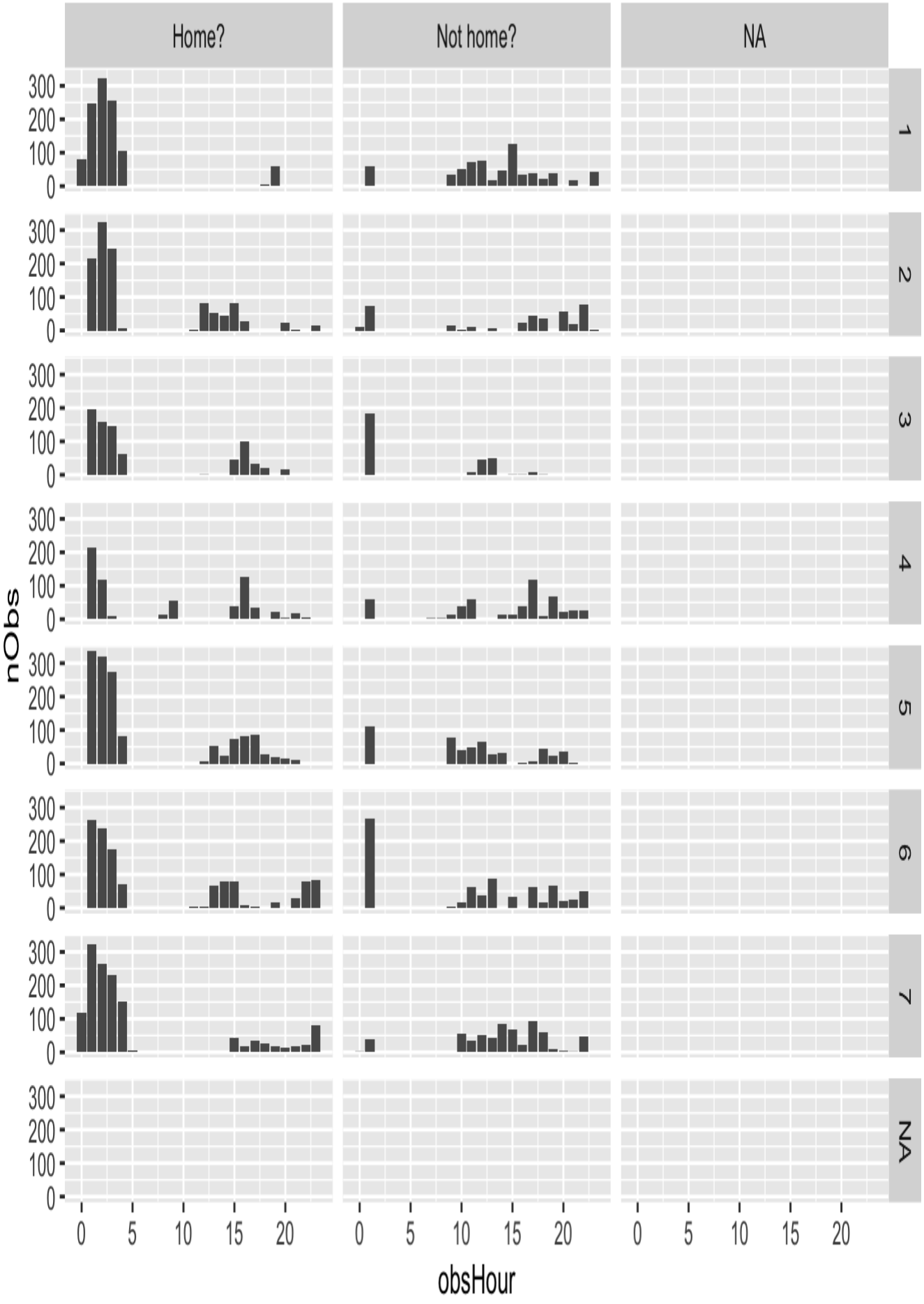

Figure 5.1: Check inferred location

Figure 5.1 shows the results of this inference. Does it look like a reasonable guestimate of location?

6 Make safe version

We now create a unique EV ID by hashing the `Reg No` and then removing the following variables before we do anything else as they are potentially disclosive:

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

That gives us a data file with:

- 12,487 rows of data
- 147 columns (variables)
- 1 EVs

7 Codebook

Describe data to create codebook:

```
## ftfSafeDT
##
##  147  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
## ---------------------------------------------------------------------------
## rDateTime
##                  n            missing           distinct
##              11327               1160              10129
##               Info               Mean                Gmd
```

```
##                   1 2018-05-20 04:32:05 1970-01-15 13:45:49
##                 .05                 .10                 .25
## 2018-05-03 01:07:04 2018-05-04 23:15:22 2018-05-08 03:57:40
##                 .50                 .75                 .90
## 2018-05-18 02:16:05 2018-06-02 03:58:09 2018-06-08 01:36:18
##                 .95
## 2018-06-09 02:40:57
##
## lowest : 2018-05-01 12:42:27 2018-05-01 12:43:08 2018-05-01 12:44:16 2018-05-01
12:44:30 2018-05-01 12:45:53
## highest: 2018-06-11 09:37:30 2018-06-11 09:38:13 2018-06-11 09:38:56 2018-06-11
09:39:45 2018-06-11 09:40:28
## ---------------------------------------------------------------------------
## homeMinLat
##        n  missing distinct     Info     Mean      Gmd
##    12487        0        1        0   -36.63        0
##
## Value      -36.62702
## Frequency      12487
## Proportion         1
## ---------------------------------------------------------------------------
## homeMaxLat
##        n  missing distinct     Info     Mean      Gmd
##    12487        0        1        0   -36.63        0
##
## Value      -36.62688
## Frequency      12487
## Proportion         1
## ---------------------------------------------------------------------------
## homeMinLon
##        n  missing distinct     Info     Mean      Gmd
##    12487        0        1        0    174.7        0
##
## Value      174.7382
## Frequency     12487
## Proportion        1
## ---------------------------------------------------------------------------
## homeMaxLon
##        n  missing distinct     Info     Mean      Gmd
##    12487        0        1        0    174.7        0
##
## Value      174.7384
## Frequency     12487
## Proportion        1
## ---------------------------------------------------------------------------
## derivedLocation
##        n  missing distinct
##    12475       12        2
##
## Value          Home? Not home?
## Frequency       7588      4887
## Proportion     0.608     0.392
## ---------------------------------------------------------------------------
## evID
##                                n                          missing
##                            12487                                0
##                         distinct                            value
##                                1 b4ed70fa9b8d2419411908df6d78ee2a
##
## Value      b4ed70fa9b8d2419411908df6d78ee2a
## Frequency                             12487
## Proportion                                1
## ---------------------------------------------------------------------------
```

8 Save safe data out

Save the safe data for future use and gzip it.

```
## Gziping /Volumes/hum-csafe/Research Projects/GREEN Grid/externalData/flipTheFleet/
safe/EVBlackBox export 2018-06-10-233146.csv.gz_safe.csv

## Gzipped /Volumes/hum-csafe/Research Projects/GREEN Grid/externalData/flipTheFleet/
safe/EVBlackBox export 2018-06-10-233146.csv.gz_safe.csv
```

Gzipped the file to reduce it from 10.53 MB to 1.55 MB.

9 Runtime

Analysis completed in 7.21 seconds (0.12 minutes) using knitr in RStudio with R version 3.5.1 (2018-07-02) running on x86_64-apple-darwin15.6.0.

10 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)
- Hmisc - for describe (Harrell Jr, Charles Dupont, and others. 2016)
- knitr - to create this document & neat tables (Xie 2016)
- evAnalysis - for local EV data utilities

Session info:

```
## R version 3.5.1 (2018-07-02)
## Platform: x86_64-apple-darwin15.6.0 (64-bit)
## Running under: macOS High Sierra 10.13.6
##
## Matrix products: default
## BLAS: /System/Library/Frameworks/Accelerate.framework/Versions/A/Frameworks/
vecLib.framework/Versions/A/libBLAS.dylib
## LAPACK:
/Library/Frameworks/R.framework/Versions/3.5/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_NZ.UTF-8/en_NZ.UTF-8/en_NZ.UTF-8/C/en_NZ.UTF-8/en_NZ.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] bindrcpp_0.2.2     knitr_1.20         skimr_1.0.3
##  [4] leaflet_2.0.2      codebook_0.6.3     Hmisc_4.1-1
##  [7] Formula_1.2-3      survival_2.42-6    lattice_0.20-35
## [10] lubridate_1.7.4    ggplot2_3.1.0      dplyr_0.7.7
## [13] evAnalysis_0.1     bookdown_0.7       rmarkdown_1.10
## [16] data.table_1.11.8  readr_1.1.1        dkUtils_0.0.0.9000
##
```

```
## loaded via a namespace (and not attached):
##  [1] tidyr_0.8.1         jsonlite_1.5        splines_3.5.1
##  [4] shiny_1.1.0         assertthat_0.2.0    highr_0.7
##  [7] latticeExtra_0.6-28 yaml_2.2.0          pillar_1.3.0
## [10] backports_1.1.2     glue_1.3.0          digest_0.6.18
## [13] RColorBrewer_1.1-2  promises_1.0.1      checkmate_1.8.5
## [16] colorspace_1.3-2    htmltools_0.3.6     httpuv_1.4.5
## [19] Matrix_1.2-14       plyr_1.8.4          pkgconfig_2.0.2
## [22] labelled_1.1.0      haven_1.1.2         purrr_0.2.5
## [25] xtable_1.8-3        scales_1.0.0        webshot_0.5.1
## [28] later_0.7.5         htmlTable_1.12      tibble_1.4.2
## [31] openssl_1.0.2       withr_2.1.2         nnet_7.3-12
## [34] lazyeval_0.2.1      cli_1.0.1           magrittr_1.5
## [37] crayon_1.3.4        mime_0.6            evaluate_0.12
## [40] forcats_0.3.0       foreign_0.8-71      tools_3.5.1
## [43] hms_0.4.2           stringr_1.3.1       munsell_0.5.0
## [46] cluster_2.0.7-1     compiler_3.5.1      rlang_0.3.0.1
## [49] grid_3.5.1          rstudioapi_0.8      htmlwidgets_1.3
## [52] crosstalk_1.0.0     miniUI_0.1.1.1      base64enc_0.1-3
## [55] labeling_0.3        gtable_0.2.0        reshape2_1.4.3
## [58] R6_2.3.0            gridExtra_2.3       bindr_0.1.1
## [61] rprojroot_1.3-2     stringi_1.2.4       Rcpp_0.12.19
## [64] rpart_4.1-13        acepack_1.4.1       tidyselect_0.2.5
## [67] xfun_0.4
```

References

Dowle, M, A Srinivasan, T Short, S Lianoglou with contributions from R Saporta, and E Antonyan. 2015. *Data.table: Extension of Data.frame*. https://CRAN.R-project.org/package=data.table.

Grolemund, Garrett, and Hadley Wickham. 2011. “Dates and Times Made Easy with lubridate.” *Journal of Statistical Software* 40 (3): 1–25. http://www.jstatsoft.org/v40/i03/.

Harrell Jr, Frank E, with contributions from Charles Dupont, and many others. 2016. *Hmisc: Harrell Miscellaneous*. https://CRAN.R-project.org/package=Hmisc.

R Core Team. 2016. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Wickham, Hadley. 2009. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. http://ggplot2.org.

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Xie, Yihui. 2016. *Knitr: A General-Purpose Package for Dynamic Report Generation in R*. https://CRAN.R-project.org/package=knitr.