HW 4

Team 2

April 12, 2019

Contents


```
require(broom)
require(ggplot2)
require(dplyr)
require(tidyr)
require(corrplot)
require(randomForest)
require(olsrr)
require(caret)
require(fastDummies)
require(car)
require(pROC)
require(pscl)
```

Logistic models

```
## 'data.frame':    8161 obs. of  26 variables:
##  $ INDEX      : int  1 2 4 5 6 7 8 11 12 13 ...
##  $ TARGET_FLAG: int  0 0 0 0 0 1 0 1 1 0 ...
##  $ TARGET_AMT : num  0 0 0 0 0 ...
##  $ KIDSDRIV   : int  0 0 0 0 0 0 0 0 1 0 0 ...
##  $ AGE        : int  60 43 35 51 50 34 54 37 34 50 ...
##  $ HOMEKIDS   : int  0 0 1 0 0 1 0 2 0 0 ...
##  $ YOJ        : int  11 11 10 14 NA 12 NA NA 10 7 ...
##  $ INCOME     : Factor w/ 6613 levels "","$0 ","$1,007 ",..: 5033 6292 1250 1 509 746 1488 315 4765 1
##  $ PARENT1    : Factor w/ 2 levels "No","Yes": 1 1 1 1 1 2 1 1 1 1 ...
##  $ HOME_VAL   : Factor w/ 5107 levels "","$0 ","$100,093 ",..: 2 3259 348 3917 3034 2 1 4167 2 2 ...
##  $ MSTATUS    : Factor w/ 2 levels "Yes","z_No": 2 2 1 1 1 2 1 1 2 2 ...
##  $ SEX        : Factor w/ 2 levels "M","z_F": 1 1 2 1 2 2 2 1 2 1 ...
##  $ EDUCATION  : Factor w/ 5 levels "<High School",..: 4 5 5 1 4 2 1 2 2 2 ...
##  $ JOB        : Factor w/ 9 levels "","Clerical",..: 7 9 2 9 3 9 9 9 2 7 ...
##  $ TRAVTIME   : int  14 22 5 32 36 46 33 44 34 48 ...
##  $ CAR_USE    : Factor w/ 2 levels "Commercial","Private": 2 1 2 2 2 1 2 1 2 1 ...
##  $ BLUEBOOK   : Factor w/ 2789 levels "$1,500 ","$1,520 ",..: 434 503 2212 553 802 746 2672 701 135 8
```

```
##  $ TIF        : int  11 1 4 7 1 1 1 1 1 7 ...
##  $ CAR_TYPE   : Factor w/ 6 levels "Minivan","Panel Truck",..: 1 1 6 1 6 4 6 5 6 5 ...
##  $ RED_CAR    : Factor w/ 2 levels "no","yes": 2 2 1 2 1 1 1 2 1 1 ...
##  $ OLDCLAIM   : Factor w/ 2857 levels "$0 ","$1,000 ",..: 1449 1 1311 1 432 1 1 510 1 1 ...
##  $ CLM_FREQ   : int  2 0 2 0 2 0 0 1 0 0 ...
##  $ REVOKED    : Factor w/ 2 levels "No","Yes": 1 1 1 1 2 1 1 2 1 1 ...
##  $ MVR_PTS    : int  3 0 3 0 3 0 0 10 0 1 ...
##  $ CAR_AGE    : int  18 1 10 6 17 7 1 7 1 17 ...
##  $ URBANICITY : Factor w/ 2 levels "Highly Urban/ Urban",..: 1 1 1 1 1 1 1 1 1 2 ...
```

```
##      INDEX        TARGET_FLAG       TARGET_AMT        KIDSDRIV
##  Min.   :    1   Min.   :0.0000   Min.   :     0   Min.   :0.0000
##  1st Qu.: 2559   1st Qu.:0.0000   1st Qu.:     0   1st Qu.:0.0000
##  Median : 5133   Median :0.0000   Median :     0   Median :0.0000
##  Mean   : 5152   Mean   :0.2638   Mean   :  1504   Mean   :0.1711
##  3rd Qu.: 7745   3rd Qu.:1.0000   3rd Qu.:  1036   3rd Qu.:0.0000
##  Max.   :10302   Max.   :1.0000   Max.   :107586   Max.   :4.0000
##
##       AGE           HOMEKIDS           YOJ             INCOME
##  Min.   :16.00   Min.   :0.0000   Min.   : 0.0   $0       : 615
##  1st Qu.:39.00   1st Qu.:0.0000   1st Qu.: 9.0            : 445
##  Median :45.00   Median :0.0000   Median :11.0   $26,840  :   4
##  Mean   :44.79   Mean   :0.7212   Mean   :10.5   $48,509  :   4
##  3rd Qu.:51.00   3rd Qu.:1.0000   3rd Qu.:13.0   $61,790  :   4
##  Max.   :81.00   Max.   :5.0000   Max.   :23.0   $107,375 :   3
##  NA's   :6                        NA's   :454    (Other)  :7086
##  PARENT1         HOME_VAL    MSTATUS      SEX              EDUCATION
##  No :7084   $0       :2294   Yes :4894   M  :3786   <High School :1203
##  Yes:1077            : 464   z_No:3267   z_F:4375   Bachelors    :2242
##             $111,129 :   3                          Masters      :1658
##             $115,249 :   3                          PhD          : 728
##             $123,109 :   3                          z_High School:2330
##             $153,061 :   3
##             (Other)  :5391
##             JOB          TRAVTIME           CAR_USE        BLUEBOOK
##  z_Blue Collar:1825   Min.   :  5.00   Commercial:3029   $1,500 : 157
##  Clerical     :1271   1st Qu.: 22.00   Private   :5132   $6,000 :  34
##  Professional :1117   Median : 33.00                     $5,800 :  33
##  Manager      : 988   Mean   : 33.49                     $6,200 :  33
##  Lawyer       : 835   3rd Qu.: 44.00                     $6,400 :  31
##  Student      : 712   Max.   :142.00                     $5,900 :  30
##  (Other)      :1413                                      (Other):7843
##       TIF               CAR_TYPE    RED_CAR       OLDCLAIM
##  Min.   : 1.000   Minivan    :2145   no :5783   $0     :5009
##  1st Qu.: 1.000   Panel Truck: 676   yes:2378   $1,310 :   4
##  Median : 4.000   Pickup     :1389              $1,391 :   4
##  Mean   : 5.351   Sports Car : 907              $4,263 :   4
##  3rd Qu.: 7.000   Van        : 750              $1,105 :   3
##  Max.   :25.000   z_SUV      :2294              $1,332 :   3
##                                                 (Other):3134
##     CLM_FREQ      REVOKED       MVR_PTS          CAR_AGE
##  Min.   :0.0000   No :7161   Min.   : 0.000   Min.   :-3.000
##  1st Qu.:0.0000   Yes:1000   1st Qu.: 0.000   1st Qu.: 1.000
##  Median :0.0000              Median : 1.000   Median : 8.000
```

```
##  Mean   :0.7986             Mean   : 1.696   Mean   : 8.328
##  3rd Qu.:2.0000             3rd Qu.: 3.000   3rd Qu.:12.000
##  Max.   :5.0000             Max.   :13.000   Max.   :28.000
##                                              NA's   :510
##                  URBANICITY
##  Highly Urban/ Urban  :6492
##  z_Highly Rural/ Rural:1669
##
##
##
##
##
```

```
##       INDEX TARGET_FLAG  TARGET_AMT    KIDSDRIV         AGE    HOMEKIDS
##   0.0000000   0.0000000   0.0000000   0.0000000   0.0735204   0.0000000
##         YOJ      INCOME     PARENT1    HOME_VAL     MSTATUS         SEX
##   5.5630437   0.0000000   0.0000000   0.0000000   0.0000000   0.0000000
##   EDUCATION         JOB    TRAVTIME     CAR_USE    BLUEBOOK         TIF
##   0.0000000   0.0000000   0.0000000   0.0000000   0.0000000   0.0000000
##    CAR_TYPE     RED_CAR    OLDCLAIM    CLM_FREQ     REVOKED     MVR_PTS
##   0.0000000   0.0000000   0.0000000   0.0000000   0.0000000   0.0000000
##     CAR_AGE  URBANICITY
##   6.2492342   0.0000000
```

Data Cleaning

1. Removing $ sign and commas
2. Cleaning data set from "_z" characters
3. Removing rows with NAs

Transforming TARGET_FLAG, KIDSDRIV and HOMEKIDS to factors.

Model Building

MODEl 1

1. Building logistic regression model using variables without any transformations.

```
## Start:  AIC=5968.06
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + TRAVTIME + CAR_USE +
##     BLUEBOOK + TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ +
##     REVOKED + MVR_PTS + CAR_AGE + URBANICITY
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##             Df Deviance    AIC
## - TRAVTIME   95   5554.6 5918.6
## - CAR_AGE    29   5447.3 5943.3
## - YOJ        19   5439.8 5955.8
## - HOMEKIDS    5   5419.9 5963.9
## - SEX         1   5415.3 5967.3
## - INCOME      1   5415.5 5967.5
## <none>            5414.1 5968.1
## - RED_CAR     1   5416.4 5968.4
```

```
## - PARENT1     1   5417.1 5969.1
## - HOME_VAL    1   5426.4 5978.4
## - OLDCLAIM    1   5426.9 5978.9
## - EDUCATION   3   5432.6 5980.6
## - AGE        57   5540.7 5980.7
## - BLUEBOOK    1   5432.6 5984.6
## - MVR_PTS    12   5454.8 5984.8
## - KIDSDRIV    4   5443.9 5989.9
## - MSTATUS     1   5440.4 5992.4
## - TIF        22   5488.2 5998.2
## - CLM_FREQ    5   5465.0 6009.0
## - JOB         8   5478.4 6016.4
## - CAR_USE     1   5478.9 6030.9
## - CAR_TYPE    5   5488.9 6032.9
## - REVOKED     1   5483.0 6035.0
## - URBANICITY  1   5856.9 6408.9
##
## Step:  AIC=5918.56
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + CAR_AGE + URBANICITY
##
##              Df Deviance    AIC
## - CAR_AGE    29   5587.4 5893.4
## - YOJ        19   5584.1 5910.1
## - HOMEKIDS    5   5560.6 5914.6
## - INCOME      1   5556.4 5918.4
## <none>            5554.6 5918.6
## - SEX         1   5556.9 5918.9
## - RED_CAR     1   5557.4 5919.4
## - PARENT1     1   5557.4 5919.4
## - EDUCATION   3   5570.3 5928.3
## - HOME_VAL    1   5567.2 5929.2
## - AGE        57   5680.7 5930.7
## - OLDCLAIM    1   5569.3 5931.3
## - BLUEBOOK    1   5569.8 5931.8
## - MVR_PTS    12   5596.1 5936.1
## - KIDSDRIV    4   5582.5 5938.5
## - MSTATUS     1   5580.6 5942.6
## - TIF        22   5629.9 5949.9
## - CLM_FREQ    5   5610.8 5964.8
## - JOB         8   5621.7 5969.7
## - CAR_USE     1   5617.3 5979.3
## - CAR_TYPE    5   5629.8 5983.8
## - REVOKED     1   5624.0 5986.0
## - URBANICITY  1   5974.8 6336.8
##
## Step:  AIC=5893.41
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + URBANICITY
##
```

```
##              Df Deviance    AIC
## - YOJ        19   5616.6 5884.6
## - HOMEKIDS    5   5594.1 5890.1
## - INCOME      1   5589.2 5893.2
## <none>            5587.4 5893.4
## - SEX         1   5589.5 5893.5
## - PARENT1     1   5589.7 5893.7
## - RED_CAR     1   5590.2 5894.2
## - HOME_VAL    1   5598.5 5902.5
## - AGE        57   5712.2 5904.2
## - OLDCLAIM    1   5602.3 5906.3
## - BLUEBOOK    1   5602.4 5906.4
## - MVR_PTS    12   5628.2 5910.2
## - EDUCATION   3   5612.4 5912.4
## - KIDSDRIV    4   5616.7 5914.7
## - MSTATUS     1   5616.3 5920.3
## - TIF        22   5663.0 5925.0
## - CLM_FREQ    5   5645.1 5941.1
## - JOB         8   5655.2 5945.2
## - CAR_USE     1   5652.8 5956.8
## - CAR_TYPE    5   5662.2 5958.2
## - REVOKED     1   5658.2 5962.2
## - URBANICITY  1   6007.4 6311.4
##
## Step:  AIC=5884.61
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - HOMEKIDS    5   5622.3 5880.3
## <none>            5616.6 5884.6
## - PARENT1     1   5618.6 5884.6
## - SEX         1   5618.7 5884.7
## - RED_CAR     1   5619.0 5885.0
## - INCOME      1   5619.9 5885.9
## - HOME_VAL    1   5627.4 5893.4
## - AGE        58   5744.5 5896.5
## - BLUEBOOK    1   5631.1 5897.1
## - OLDCLAIM    1   5631.2 5897.2
## - EDUCATION   3   5641.4 5903.4
## - MVR_PTS    12   5660.0 5904.0
## - KIDSDRIV    4   5645.5 5905.5
## - MSTATUS     1   5645.3 5911.3
## - TIF        22   5694.4 5918.4
## - JOB         8   5677.9 5929.9
## - CLM_FREQ    5   5673.1 5931.1
## - CAR_USE     1   5684.0 5950.0
## - CAR_TYPE    5   5692.2 5950.2
## - REVOKED     1   5689.0 5955.0
## - URBANICITY  1   6036.6 6302.6
##
## Step:  AIC=5880.32
```

```
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF +
##     CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
##     URBANICITY
##
##              Df Deviance    AIC
## - SEX         1   5624.2 5880.2
## <none>            5622.3 5880.3
## - RED_CAR     1   5624.7 5880.7
## - INCOME      1   5625.5 5881.5
## - PARENT1     1   5628.4 5884.4
## - HOME_VAL    1   5633.4 5889.4
## - OLDCLAIM    1   5636.1 5892.1
## - BLUEBOOK    1   5637.3 5893.3
## - AGE        58   5755.3 5897.3
## - EDUCATION   3   5646.7 5898.7
## - MVR_PTS    12   5666.5 5900.5
## - MSTATUS     1   5650.6 5906.6
## - KIDSDRIV    4   5660.8 5910.8
## - TIF        22   5699.7 5913.7
## - JOB         8   5683.8 5925.8
## - CLM_FREQ    5   5678.1 5926.1
## - CAR_TYPE    5   5697.4 5945.4
## - CAR_USE     1   5689.6 5945.6
## - REVOKED     1   5693.7 5949.7
## - URBANICITY  1   6042.2 6298.2
##
## Step:  AIC=5880.19
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - RED_CAR     1   5625.3 5879.3
## <none>            5624.2 5880.2
## - INCOME      1   5627.4 5881.4
## - PARENT1     1   5630.2 5884.2
## - HOME_VAL    1   5635.1 5889.1
## - OLDCLAIM    1   5638.1 5892.1
## - AGE        58   5758.0 5898.0
## - EDUCATION   3   5648.6 5898.6
## - MVR_PTS    12   5668.1 5900.1
## - BLUEBOOK    1   5646.8 5900.8
## - MSTATUS     1   5652.8 5906.8
## - KIDSDRIV    4   5662.2 5910.2
## - TIF        22   5701.1 5913.1
## - JOB         8   5685.2 5925.2
## - CLM_FREQ    5   5680.2 5926.2
## - CAR_USE     1   5691.2 5945.2
## - CAR_TYPE    5   5700.0 5946.0
## - REVOKED     1   5695.7 5949.7
## - URBANICITY  1   6043.9 6297.9
##
## Step:  AIC=5879.31
```

```
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## <none>            5625.3 5879.3
## - INCOME      1   5628.6 5880.6
## - PARENT1     1   5631.5 5883.5
## - HOME_VAL    1   5636.0 5888.0
## - OLDCLAIM    1   5639.3 5891.3
## - AGE        58   5758.2 5896.2
## - EDUCATION   3   5649.9 5897.9
## - BLUEBOOK    1   5646.8 5898.8
## - MVR_PTS    12   5669.4 5899.4
## - MSTATUS     1   5653.8 5905.8
## - KIDSDRIV    4   5663.4 5909.4
## - TIF        22   5702.3 5912.3
## - JOB         8   5686.8 5924.8
## - CLM_FREQ    5   5681.3 5925.3
## - CAR_USE     1   5692.4 5944.4
## - REVOKED     1   5696.7 5948.7
## - CAR_TYPE    5   5712.8 5956.8
## - URBANICITY  1   6044.9 6296.9
```

```
summary(model_1)
```

```
##
## Call:
## glm(formula = TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
##     URBANICITY, family = "binomial", data = training %>% select(-INDEX,
##     -TARGET_AMT))
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.5621  -0.6928  -0.3840   0.5741   3.0962
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 -1.575e+00  1.310e+00  -1.202 0.229283
## KIDSDRIV1                    5.495e-01  1.283e-01   4.284 1.84e-05 ***
## KIDSDRIV2                    8.263e-01  1.771e-01   4.667 3.06e-06 ***
## KIDSDRIV3                    8.989e-01  3.376e-01   2.662 0.007762 **
## KIDSDRIV4                   -1.095e+01  5.218e+02  -0.021 0.983255
## AGE18                       -1.326e+00  1.913e+00  -0.693 0.488268
## AGE19                       -3.497e-02  1.760e+00  -0.020 0.984149
## AGE20                       -1.922e+00  1.857e+00  -1.035 0.300674
## AGE21                       -3.968e-01  1.492e+00  -0.266 0.790206
## AGE22                       -4.770e-01  1.432e+00  -0.333 0.739075
## AGE23                       -9.352e-02  1.505e+00  -0.062 0.950467
## AGE24                        7.723e-01  1.457e+00   0.530 0.596145
## AGE25                        5.064e-01  1.396e+00   0.363 0.716726
## AGE26                        1.441e-01  1.353e+00   0.107 0.915167
## AGE27                       -6.181e-01  1.329e+00  -0.465 0.641794
```

```
## AGE28                    -7.625e-01  1.321e+00  -0.577 0.563919
## AGE29                    -1.527e+00  1.320e+00  -1.157 0.247371
## AGE30                    -9.278e-01  1.318e+00  -0.704 0.481391
## AGE31                    -9.272e-01  1.305e+00  -0.710 0.477453
## AGE32                    -1.009e+00  1.302e+00  -0.775 0.438217
## AGE33                    -1.302e+00  1.298e+00  -1.003 0.315818
## AGE34                    -1.424e+00  1.298e+00  -1.097 0.272726
## AGE35                    -1.123e+00  1.293e+00  -0.868 0.385255
## AGE36                    -1.041e+00  1.292e+00  -0.805 0.420750
## AGE37                    -1.161e+00  1.292e+00  -0.899 0.368676
## AGE38                    -9.992e-01  1.291e+00  -0.774 0.438954
## AGE39                    -1.048e+00  1.290e+00  -0.812 0.416795
## AGE40                    -1.526e+00  1.290e+00  -1.183 0.236611
## AGE41                    -1.411e+00  1.290e+00  -1.094 0.274149
## AGE42                    -1.201e+00  1.289e+00  -0.931 0.351611
## AGE43                    -1.452e+00  1.290e+00  -1.125 0.260479
## AGE44                    -1.732e+00  1.291e+00  -1.341 0.179824
## AGE45                    -1.412e+00  1.289e+00  -1.096 0.273237
## AGE46                    -1.481e+00  1.290e+00  -1.148 0.250949
## AGE47                    -1.549e+00  1.291e+00  -1.200 0.230318
## AGE48                    -1.655e+00  1.291e+00  -1.282 0.199819
## AGE49                    -1.599e+00  1.292e+00  -1.238 0.215854
## AGE50                    -1.387e+00  1.292e+00  -1.074 0.283013
## AGE51                    -1.622e+00  1.295e+00  -1.252 0.210449
## AGE52                    -1.295e+00  1.295e+00  -1.000 0.317166
## AGE53                    -1.316e+00  1.294e+00  -1.016 0.309501
## AGE54                    -1.198e+00  1.297e+00  -0.923 0.355873
## AGE55                    -1.469e+00  1.300e+00  -1.130 0.258422
## AGE56                    -1.212e+00  1.305e+00  -0.929 0.353020
## AGE57                    -5.848e-01  1.299e+00  -0.450 0.652507
## AGE58                    -5.293e-01  1.308e+00  -0.405 0.685708
## AGE59                    -4.454e-01  1.322e+00  -0.337 0.736223
## AGE60                    -4.377e-01  1.316e+00  -0.333 0.739441
## AGE61                    -7.757e-01  1.325e+00  -0.585 0.558314
## AGE62                    -9.034e-01  1.337e+00  -0.676 0.499242
## AGE63                    -8.643e-01  1.347e+00  -0.642 0.521192
## AGE64                    -2.867e-01  1.376e+00  -0.208 0.834932
## AGE65                    -1.387e+00  1.466e+00  -0.946 0.344266
## AGE66                    -1.290e+00  1.446e+00  -0.892 0.372443
## AGE67                    -2.105e-01  1.529e+00  -0.138 0.890475
## AGE68                    -4.814e-01  1.790e+00  -0.269 0.787987
## AGE69                    -6.551e-01  1.759e+00  -0.373 0.709480
## AGE70                    -1.400e+01  4.001e+02  -0.035 0.972092
## AGE72                     3.295e-01  1.902e+00   0.173 0.862476
## AGE73                    -8.550e-01  1.962e+00  -0.436 0.663046
## AGE76                     1.745e+01  8.827e+02   0.020 0.984232
## AGE80                    -1.279e+01  8.827e+02  -0.014 0.988441
## AGE81                    -1.380e+01  8.827e+02  -0.016 0.987524
## INCOME                   -2.303e-06  1.284e-06  -1.793 0.072943 .
## PARENT1Yes                2.895e-01  1.167e-01   2.481 0.013103 *
## HOME_VAL                 -1.294e-06  3.959e-07  -3.268 0.001083 **
## MSTATUSYes               -5.153e-01  9.588e-02  -5.374 7.70e-08 ***
## EDUCATIONHigh School      4.523e-01  9.430e-02   4.797 1.61e-06 ***
## EDUCATIONMasters          5.554e-02  1.576e-01   0.352 0.724531
```

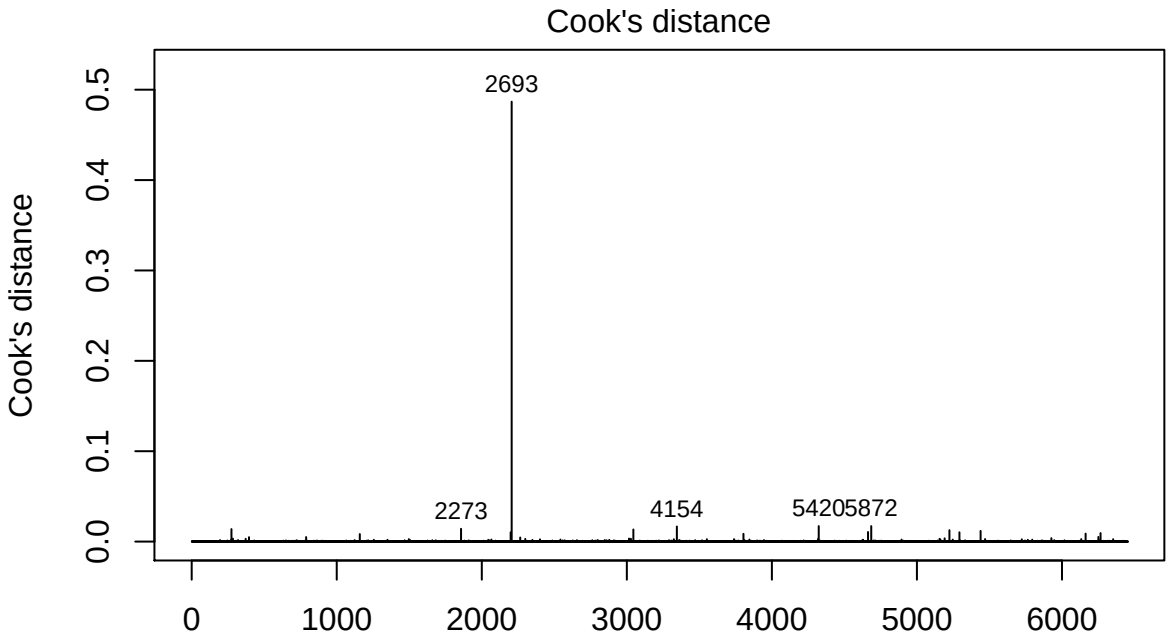
```
## EDUCATIONPhD                 2.194e-01  2.041e-01   1.075 0.282382
## JOBBlue Collar               3.740e-01  2.159e-01   1.732 0.083261 .
## JOBClerical                  5.228e-01  2.289e-01   2.284 0.022399 *
## JOBDoctor                   -2.656e-01  2.928e-01  -0.907 0.364448
## JOBHome Maker                3.352e-01  2.404e-01   1.395 0.163124
## JOBLawyer                    2.532e-01  1.945e-01   1.302 0.193004
## JOBManager                  -5.837e-01  2.006e-01  -2.909 0.003623 **
## JOBProfessional              2.210e-01  2.066e-01   1.070 0.284730
## JOBStudent                   2.214e-01  2.487e-01   0.890 0.373252
## CAR_USEPrivate              -8.182e-01  1.009e-01  -8.105 5.26e-16 ***
## BLUEBOOK                    -2.507e-05  5.464e-06  -4.589 4.46e-06 ***
## TIF10                       -7.405e-01  1.307e-01  -5.664 1.48e-08 ***
## TIF11                       -4.095e-01  2.016e-01  -2.031 0.042218 *
## TIF12                       -4.316e-01  4.578e-01  -0.943 0.345758
## TIF13                       -4.232e-01  1.944e-01  -2.176 0.029522 *
## TIF14                       -1.066e+00  4.201e-01  -2.537 0.011195 *
## TIF15                        1.286e-01  4.847e-01   0.265 0.790791
## TIF16                       -1.205e+00  5.378e-01  -2.241 0.025037 *
## TIF17                       -5.741e-01  3.102e-01  -1.851 0.064163 .
## TIF18                       -8.457e-01  6.588e-01  -1.284 0.199235
## TIF19                       -1.296e+01  3.611e+02  -0.036 0.971360
## TIF2                         2.763e-01  9.822e-01   0.281 0.778435
## TIF20                       -1.388e+01  3.172e+02  -0.044 0.965090
## TIF21                        2.132e-01  7.520e-01   0.284 0.776786
## TIF22                       -1.460e+01  4.790e+02  -0.030 0.975684
## TIF25                       -1.239e+01  6.029e+02  -0.021 0.983602
## TIF3                        -1.696e-01  1.500e-01  -1.131 0.258253
## TIF4                        -2.484e-01  1.031e-01  -2.410 0.015949 *
## TIF5                        -6.463e-01  4.433e-01  -1.458 0.144845
## TIF6                        -4.073e-01  1.014e-01  -4.016 5.92e-05 ***
## TIF7                        -5.672e-01  1.388e-01  -4.088 4.36e-05 ***
## TIF8                         5.455e-01  3.939e-01   1.385 0.166070
## TIF9                        -6.856e-01  2.213e-01  -3.098 0.001948 **
## CAR_TYPEPanel Truck          6.873e-01  1.716e-01   4.005 6.20e-05 ***
## CAR_TYPEPickup               5.284e-01  1.150e-01   4.593 4.36e-06 ***
## CAR_TYPESports Car           1.005e+00  1.258e-01   7.988 1.37e-15 ***
## CAR_TYPESUV                  7.341e-01  9.938e-02   7.387 1.51e-13 ***
## CAR_TYPEVan                  6.706e-01  1.404e-01   4.776 1.79e-06 ***
## OLDCLAIM                    -1.771e-05  4.786e-06  -3.700 0.000215 ***
## CLM_FREQ1                    6.004e-01  1.161e-01   5.172 2.31e-07 ***
## CLM_FREQ2                    6.523e-01  1.084e-01   6.016 1.79e-09 ***
## CLM_FREQ3                    6.929e-01  1.216e-01   5.696 1.22e-08 ***
## CLM_FREQ4                    8.242e-01  1.985e-01   4.153 3.28e-05 ***
## CLM_FREQ5                    1.184e+00  6.484e-01   1.825 0.067953 .
## REVOKEDYes                   9.096e-01  1.068e-01   8.518  < 2e-16 ***
## MVR_PTS1                     8.386e-02  1.050e-01   0.798 0.424651
## MVR_PTS10                    1.045e+00  8.799e-01   1.188 0.234804
## MVR_PTS11                    1.817e+00  1.132e+00   1.606 0.108356
## MVR_PTS13                    1.552e+01  5.536e+02   0.028 0.977638
## MVR_PTS2                     2.448e-01  1.100e-01   2.226 0.025982 *
## MVR_PTS3                     3.048e-01  1.185e-01   2.573 0.010084 *
## MVR_PTS4                     2.905e-01  1.284e-01   2.262 0.023688 *
## MVR_PTS5                     1.689e-01  1.481e-01   1.140 0.254156
## MVR_PTS6                     2.389e-01  1.775e-01   1.346 0.178366
```

```
## MVR_PTS7                       6.357e-01  2.065e-01   3.078 0.002083 **
## MVR_PTS8                       1.240e+00  3.194e-01   3.883 0.000103 ***
## MVR_PTS9                       1.248e+00  3.999e-01   3.122 0.001799 **
## URBANICITYHighly Urban/ Urban  2.216e+00  1.268e-01  17.474  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 7445.1  on 6447  degrees of freedom
## Residual deviance: 5625.3  on 6321  degrees of freedom
## AIC: 5879.3
##
## Number of Fisher Scoring iterations: 13
```

```
vif(model_1)
```

```
##                 GVIF Df GVIF^(1/(2*Df))
## KIDSDRIV    1.374893  4        1.040599
## AGE         3.731650 58        1.011417
## INCOME      2.930509  1        1.711873
## PARENT1     1.705264  1        1.305858
## HOME_VAL    2.091848  1        1.446322
## MSTATUS     2.081513  1        1.442745
## EDUCATION   8.075751  3        1.416437
## JOB        23.379420  8        1.217733
## CAR_USE     2.283311  1        1.511063
## BLUEBOOK    1.834626  1        1.354484
## TIF         1.461604 22        1.008663
## CAR_TYPE    2.972147  5        1.115083
## OLDCLAIM    1.941762  1        1.393471
## CLM_FREQ    2.066599  5        1.075290
## REVOKED     1.392372  1        1.179988
## MVR_PTS     1.676936 12        1.021774
## URBANICITY  1.156896  1        1.075591
```

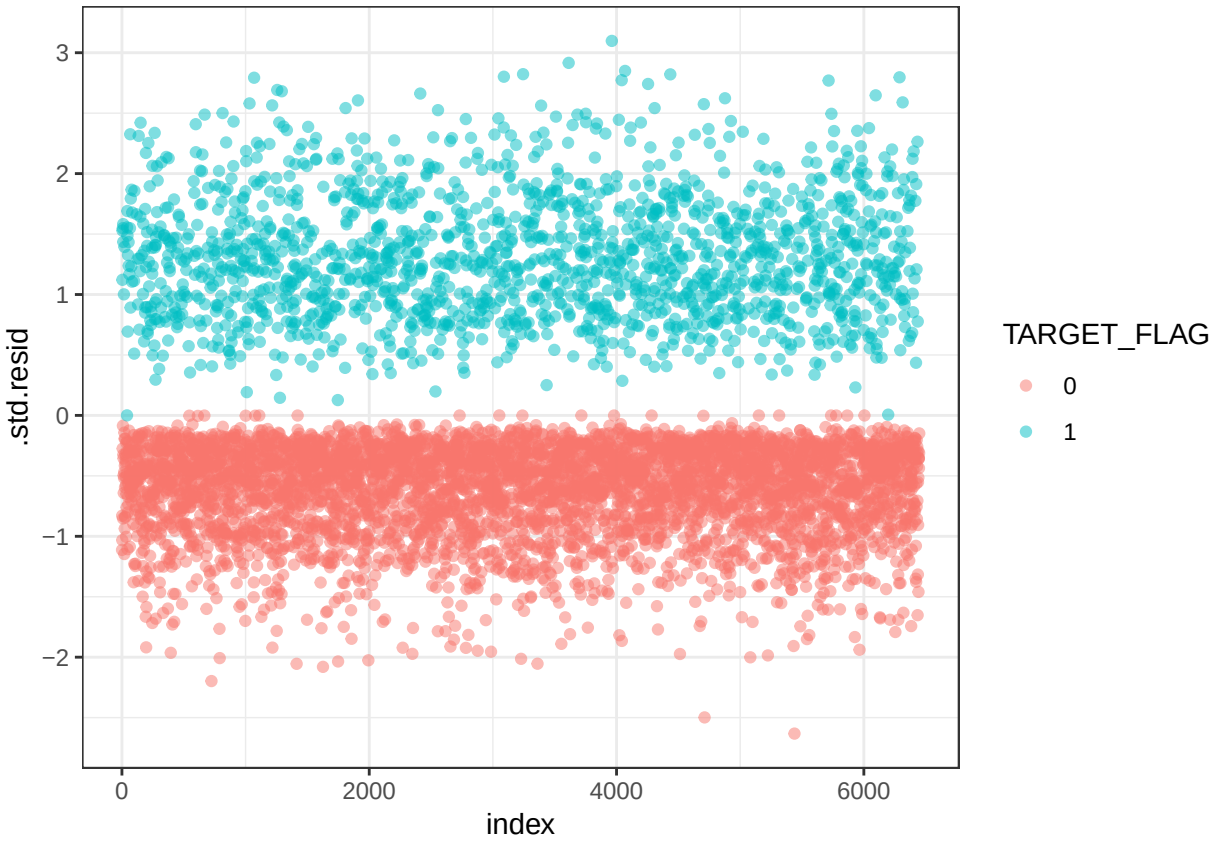
Checking model_1 for the presence of influential values.



ɱ(TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL + MSTATU

```
## # A tibble: 5 x 27
##   .rownames TARGET_FLAG KIDSDRIV AGE   INCOME PARENT1 HOME_VAL MSTATUS
##   <chr>     <fct>       <fct>    <fct>  <dbl> <fct>      <dbl> <fct>
## 1 2273      0           0        16         0 Yes            0 No
## 2 2693      0           4        59     79178 No        290382 Yes
## 3 4154      1           0        20      4209 No         80790 No
## 4 5420      1           0        18       479 No             0 Yes
## 5 5872      0           0        18      6284 Yes            0 No
## # ... with 19 more variables: EDUCATION <fct>, JOB <fct>, CAR_USE <fct>,
## #   BLUEBOOK <dbl>, TIF <fct>, CAR_TYPE <fct>, OLDCLAIM <dbl>,
## #   CLM_FREQ <fct>, REVOKED <fct>, MVR_PTS <fct>, URBANICITY <fct>,
## #   .fitted <dbl>, .se.fit <dbl>, .resid <dbl>, .hat <dbl>, .sigma <dbl>,
## #   .cooksd <dbl>, .std.resid <dbl>, index <int>
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```




```
## # A tibble: 1 x 27
##   .rownames TARGET_FLAG KIDSDRIV AGE   INCOME PARENT1 HOME_VAL MSTATUS
##   <chr>     <fct>       <fct>    <fct>  <dbl> <fct>      <dbl> <fct>
## 1 4958      1           0        44         0 No             0 Yes
## # ... with 19 more variables: EDUCATION <fct>, JOB <fct>, CAR_USE <fct>,
## #   BLUEBOOK <dbl>, TIF <fct>, CAR_TYPE <fct>, OLDCLAIM <dbl>,
## #   CLM_FREQ <fct>, REVOKED <fct>, MVR_PTS <fct>, URBANICITY <fct>,
## #   .fitted <dbl>, .se.fit <dbl>, .resid <dbl>, .hat <dbl>, .sigma <dbl>,
## #   .cooksd <dbl>, .std.resid <dbl>, index <int>
```

Eliminating the row from training data set with influential value.

```
training_no_infl <-training %>%
  filter(!(INDEX==4958 & AGE==44))
```

MODEl 2

2. Building a model with removed influential values.

```
## Start:  AIC=5968.06
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + TRAVTIME + CAR_USE +
##     BLUEBOOK + TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ +
##     REVOKED + MVR_PTS + CAR_AGE + URBANICITY
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##              Df Deviance    AIC
## - TRAVTIME   95   5554.6 5918.6
```

```
## - CAR_AGE    29   5447.3 5943.3
## - YOJ        19   5439.8 5955.8
## - HOMEKIDS    5   5419.9 5963.9
## - SEX         1   5415.3 5967.3
## - INCOME      1   5415.5 5967.5
## <none>            5414.1 5968.1
## - RED_CAR     1   5416.4 5968.4
## - PARENT1     1   5417.1 5969.1
## - HOME_VAL    1   5426.4 5978.4
## - OLDCLAIM    1   5426.9 5978.9
## - EDUCATION   3   5432.6 5980.6
## - AGE        57   5540.7 5980.7
## - BLUEBOOK    1   5432.6 5984.6
## - MVR_PTS    12   5454.8 5984.8
## - KIDSDRIV    4   5443.9 5989.9
## - MSTATUS     1   5440.4 5992.4
## - TIF        22   5488.2 5998.2
## - CLM_FREQ    5   5465.0 6009.0
## - JOB         8   5478.4 6016.4
## - CAR_USE     1   5478.9 6030.9
## - CAR_TYPE    5   5488.9 6032.9
## - REVOKED     1   5483.0 6035.0
## - URBANICITY  1   5856.9 6408.9
##
## Step:  AIC=5918.56
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + CAR_AGE + URBANICITY
##
##              Df Deviance    AIC
## - CAR_AGE    29   5587.4 5893.4
## - YOJ        19   5584.1 5910.1
## - HOMEKIDS    5   5560.6 5914.6
## - INCOME      1   5556.4 5918.4
## <none>            5554.6 5918.6
## - SEX         1   5556.9 5918.9
## - RED_CAR     1   5557.4 5919.4
## - PARENT1     1   5557.4 5919.4
## - EDUCATION   3   5570.3 5928.3
## - HOME_VAL    1   5567.2 5929.2
## - AGE        57   5680.7 5930.7
## - OLDCLAIM    1   5569.3 5931.3
## - BLUEBOOK    1   5569.8 5931.8
## - MVR_PTS    12   5596.1 5936.1
## - KIDSDRIV    4   5582.5 5938.5
## - MSTATUS     1   5580.6 5942.6
## - TIF        22   5629.9 5949.9
## - CLM_FREQ    5   5610.8 5964.8
## - JOB         8   5621.7 5969.7
## - CAR_USE     1   5617.3 5979.3
## - CAR_TYPE    5   5629.8 5983.8
## - REVOKED     1   5624.0 5986.0
## - URBANICITY  1   5974.8 6336.8
```

```
##
## Step:  AIC=5893.41
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - YOJ        19   5616.6 5884.6
## - HOMEKIDS    5   5594.1 5890.1
## - INCOME      1   5589.2 5893.2
## <none>            5587.4 5893.4
## - SEX         1   5589.5 5893.5
## - PARENT1     1   5589.7 5893.7
## - RED_CAR     1   5590.2 5894.2
## - HOME_VAL    1   5598.5 5902.5
## - AGE        57   5712.2 5904.2
## - OLDCLAIM    1   5602.3 5906.3
## - BLUEBOOK    1   5602.4 5906.4
## - MVR_PTS    12   5628.2 5910.2
## - EDUCATION   3   5612.4 5912.4
## - KIDSDRIV    4   5616.7 5914.7
## - MSTATUS     1   5616.3 5920.3
## - TIF        22   5663.0 5925.0
## - CLM_FREQ    5   5645.1 5941.1
## - JOB         8   5655.2 5945.2
## - CAR_USE     1   5652.8 5956.8
## - CAR_TYPE    5   5662.2 5958.2
## - REVOKED     1   5658.2 5962.2
## - URBANICITY  1   6007.4 6311.4
##
## Step:  AIC=5884.61
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - HOMEKIDS    5   5622.3 5880.3
## <none>            5616.6 5884.6
## - PARENT1     1   5618.6 5884.6
## - SEX         1   5618.7 5884.7
## - RED_CAR     1   5619.0 5885.0
## - INCOME      1   5619.9 5885.9
## - HOME_VAL    1   5627.4 5893.4
## - AGE        58   5744.5 5896.5
## - BLUEBOOK    1   5631.1 5897.1
## - OLDCLAIM    1   5631.2 5897.2
## - EDUCATION   3   5641.4 5903.4
## - MVR_PTS    12   5660.0 5904.0
## - KIDSDRIV    4   5645.5 5905.5
## - MSTATUS     1   5645.3 5911.3
## - TIF        22   5694.4 5918.4
## - JOB         8   5677.9 5929.9
```

```
## - CLM_FREQ    5   5673.1 5931.1
## - CAR_USE     1   5684.0 5950.0
## - CAR_TYPE    5   5692.2 5950.2
## - REVOKED     1   5689.0 5955.0
## - URBANICITY  1   6036.6 6302.6
##
## Step:  AIC=5880.32
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF +
##     CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
##     URBANICITY
##
##              Df Deviance    AIC
## - SEX         1   5624.2 5880.2
## <none>            5622.3 5880.3
## - RED_CAR     1   5624.7 5880.7
## - INCOME      1   5625.5 5881.5
## - PARENT1     1   5628.4 5884.4
## - HOME_VAL    1   5633.4 5889.4
## - OLDCLAIM    1   5636.1 5892.1
## - BLUEBOOK    1   5637.3 5893.3
## - AGE        58   5755.3 5897.3
## - EDUCATION   3   5646.7 5898.7
## - MVR_PTS    12   5666.5 5900.5
## - MSTATUS     1   5650.6 5906.6
## - KIDSDRIV    4   5660.8 5910.8
## - TIF        22   5699.7 5913.7
## - JOB         8   5683.8 5925.8
## - CLM_FREQ    5   5678.1 5926.1
## - CAR_TYPE    5   5697.4 5945.4
## - CAR_USE     1   5689.6 5945.6
## - REVOKED     1   5693.7 5949.7
## - URBANICITY  1   6042.2 6298.2
##
## Step:  AIC=5880.19
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - RED_CAR     1   5625.3 5879.3
## <none>            5624.2 5880.2
## - INCOME      1   5627.4 5881.4
## - PARENT1     1   5630.2 5884.2
## - HOME_VAL    1   5635.1 5889.1
## - OLDCLAIM    1   5638.1 5892.1
## - AGE        58   5758.0 5898.0
## - EDUCATION   3   5648.6 5898.6
## - MVR_PTS    12   5668.1 5900.1
## - BLUEBOOK    1   5646.8 5900.8
## - MSTATUS     1   5652.8 5906.8
## - KIDSDRIV    4   5662.2 5910.2
## - TIF        22   5701.1 5913.1
## - JOB         8   5685.2 5925.2
```

```
## - CLM_FREQ    5   5680.2 5926.2
## - CAR_USE     1   5691.2 5945.2
## - CAR_TYPE    5   5700.0 5946.0
## - REVOKED     1   5695.7 5949.7
## - URBANICITY  1   6043.9 6297.9
##
## Step:  AIC=5879.31
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## <none>            5625.3 5879.3
## - INCOME      1   5628.6 5880.6
## - PARENT1     1   5631.5 5883.5
## - HOME_VAL    1   5636.0 5888.0
## - OLDCLAIM    1   5639.3 5891.3
## - AGE        58   5758.2 5896.2
## - EDUCATION   3   5649.9 5897.9
## - BLUEBOOK    1   5646.8 5898.8
## - MVR_PTS    12   5669.4 5899.4
## - MSTATUS     1   5653.8 5905.8
## - KIDSDRIV    4   5663.4 5909.4
## - TIF        22   5702.3 5912.3
## - JOB         8   5686.8 5924.8
## - CLM_FREQ    5   5681.3 5925.3
## - CAR_USE     1   5692.4 5944.4
## - REVOKED     1   5696.7 5948.7
## - CAR_TYPE    5   5712.8 5956.8
## - URBANICITY  1   6044.9 6296.9
```

```
summary(model_2)
```

```
##
## Call:
## glm(formula = TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
##     URBANICITY, family = "binomial", data = training_no_infl %>%
##     select(-INDEX, -TARGET_AMT))
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.5621  -0.6928  -0.3840   0.5741   3.0962
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 -1.575e+00  1.310e+00  -1.202 0.229283
## KIDSDRIV1                    5.495e-01  1.283e-01   4.284 1.84e-05 ***
## KIDSDRIV2                    8.263e-01  1.771e-01   4.667 3.06e-06 ***
## KIDSDRIV3                    8.989e-01  3.376e-01   2.662 0.007762 **
## KIDSDRIV4                   -1.095e+01  5.218e+02  -0.021 0.983255
## AGE18                       -1.326e+00  1.913e+00  -0.693 0.488268
## AGE19                       -3.497e-02  1.760e+00  -0.020 0.984149
## AGE20                       -1.922e+00  1.857e+00  -1.035 0.300674
```

```
## AGE21                    -3.968e-01  1.492e+00  -0.266 0.790206
## AGE22                    -4.770e-01  1.432e+00  -0.333 0.739075
## AGE23                    -9.352e-02  1.505e+00  -0.062 0.950467
## AGE24                     7.723e-01  1.457e+00   0.530 0.596145
## AGE25                     5.064e-01  1.396e+00   0.363 0.716726
## AGE26                     1.441e-01  1.353e+00   0.107 0.915167
## AGE27                    -6.181e-01  1.329e+00  -0.465 0.641794
## AGE28                    -7.625e-01  1.321e+00  -0.577 0.563919
## AGE29                    -1.527e+00  1.320e+00  -1.157 0.247371
## AGE30                    -9.278e-01  1.318e+00  -0.704 0.481391
## AGE31                    -9.272e-01  1.305e+00  -0.710 0.477453
## AGE32                    -1.009e+00  1.302e+00  -0.775 0.438217
## AGE33                    -1.302e+00  1.298e+00  -1.003 0.315818
## AGE34                    -1.424e+00  1.298e+00  -1.097 0.272726
## AGE35                    -1.123e+00  1.293e+00  -0.868 0.385255
## AGE36                    -1.041e+00  1.292e+00  -0.805 0.420750
## AGE37                    -1.161e+00  1.292e+00  -0.899 0.368676
## AGE38                    -9.992e-01  1.291e+00  -0.774 0.438954
## AGE39                    -1.048e+00  1.290e+00  -0.812 0.416795
## AGE40                    -1.526e+00  1.290e+00  -1.183 0.236611
## AGE41                    -1.411e+00  1.290e+00  -1.094 0.274149
## AGE42                    -1.201e+00  1.289e+00  -0.931 0.351611
## AGE43                    -1.452e+00  1.290e+00  -1.125 0.260479
## AGE44                    -1.732e+00  1.291e+00  -1.341 0.179824
## AGE45                    -1.412e+00  1.289e+00  -1.096 0.273237
## AGE46                    -1.481e+00  1.290e+00  -1.148 0.250949
## AGE47                    -1.549e+00  1.291e+00  -1.200 0.230318
## AGE48                    -1.655e+00  1.291e+00  -1.282 0.199819
## AGE49                    -1.599e+00  1.292e+00  -1.238 0.215854
## AGE50                    -1.387e+00  1.292e+00  -1.074 0.283013
## AGE51                    -1.622e+00  1.295e+00  -1.252 0.210449
## AGE52                    -1.295e+00  1.295e+00  -1.000 0.317166
## AGE53                    -1.316e+00  1.294e+00  -1.016 0.309501
## AGE54                    -1.198e+00  1.297e+00  -0.923 0.355873
## AGE55                    -1.469e+00  1.300e+00  -1.130 0.258422
## AGE56                    -1.212e+00  1.305e+00  -0.929 0.353020
## AGE57                    -5.848e-01  1.299e+00  -0.450 0.652507
## AGE58                    -5.293e-01  1.308e+00  -0.405 0.685708
## AGE59                    -4.454e-01  1.322e+00  -0.337 0.736223
## AGE60                    -4.377e-01  1.316e+00  -0.333 0.739441
## AGE61                    -7.757e-01  1.325e+00  -0.585 0.558314
## AGE62                    -9.034e-01  1.337e+00  -0.676 0.499242
## AGE63                    -8.643e-01  1.347e+00  -0.642 0.521192
## AGE64                    -2.867e-01  1.376e+00  -0.208 0.834932
## AGE65                    -1.387e+00  1.466e+00  -0.946 0.344266
## AGE66                    -1.290e+00  1.446e+00  -0.892 0.372443
## AGE67                    -2.105e-01  1.529e+00  -0.138 0.890475
## AGE68                    -4.814e-01  1.790e+00  -0.269 0.787987
## AGE69                    -6.551e-01  1.759e+00  -0.373 0.709480
## AGE70                    -1.400e+01  4.001e+02  -0.035 0.972092
## AGE72                     3.295e-01  1.902e+00   0.173 0.862476
## AGE73                    -8.550e-01  1.962e+00  -0.436 0.663046
## AGE76                     1.745e+01  8.827e+02   0.020 0.984232
## AGE80                    -1.279e+01  8.827e+02  -0.014 0.988441
```

```
## AGE81                       -1.380e+01  8.827e+02  -0.016 0.987524
## INCOME                      -2.303e-06  1.284e-06  -1.793 0.072943 .
## PARENT1Yes                   2.895e-01  1.167e-01   2.481 0.013103 *
## HOME_VAL                    -1.294e-06  3.959e-07  -3.268 0.001083 **
## MSTATUSYes                  -5.153e-01  9.588e-02  -5.374 7.70e-08 ***
## EDUCATIONHigh School         4.523e-01  9.430e-02   4.797 1.61e-06 ***
## EDUCATIONMasters             5.554e-02  1.576e-01   0.352 0.724531
## EDUCATIONPhD                 2.194e-01  2.041e-01   1.075 0.282382
## JOBBlue Collar               3.740e-01  2.159e-01   1.732 0.083261 .
## JOBClerical                  5.228e-01  2.289e-01   2.284 0.022399 *
## JOBDoctor                   -2.656e-01  2.928e-01  -0.907 0.364448
## JOBHome Maker                3.352e-01  2.404e-01   1.395 0.163124
## JOBLawyer                    2.532e-01  1.945e-01   1.302 0.193004
## JOBManager                  -5.837e-01  2.006e-01  -2.909 0.003623 **
## JOBProfessional              2.210e-01  2.066e-01   1.070 0.284730
## JOBStudent                   2.214e-01  2.487e-01   0.890 0.373252
## CAR_USEPrivate              -8.182e-01  1.009e-01  -8.105 5.26e-16 ***
## BLUEBOOK                    -2.507e-05  5.464e-06  -4.589 4.46e-06 ***
## TIF10                       -7.405e-01  1.307e-01  -5.664 1.48e-08 ***
## TIF11                       -4.095e-01  2.016e-01  -2.031 0.042218 *
## TIF12                       -4.316e-01  4.578e-01  -0.943 0.345758
## TIF13                       -4.232e-01  1.944e-01  -2.176 0.029522 *
## TIF14                       -1.066e+00  4.201e-01  -2.537 0.011195 *
## TIF15                        1.286e-01  4.847e-01   0.265 0.790791
## TIF16                       -1.205e+00  5.378e-01  -2.241 0.025037 *
## TIF17                       -5.741e-01  3.102e-01  -1.851 0.064163 .
## TIF18                       -8.457e-01  6.588e-01  -1.284 0.199235
## TIF19                       -1.296e+01  3.611e+02  -0.036 0.971360
## TIF2                         2.763e-01  9.822e-01   0.281 0.778435
## TIF20                       -1.388e+01  3.172e+02  -0.044 0.965090
## TIF21                        2.132e-01  7.520e-01   0.284 0.776786
## TIF22                       -1.460e+01  4.790e+02  -0.030 0.975684
## TIF25                       -1.239e+01  6.029e+02  -0.021 0.983602
## TIF3                        -1.696e-01  1.500e-01  -1.131 0.258253
## TIF4                        -2.484e-01  1.031e-01  -2.410 0.015949 *
## TIF5                        -6.463e-01  4.433e-01  -1.458 0.144845
## TIF6                        -4.073e-01  1.014e-01  -4.016 5.92e-05 ***
## TIF7                        -5.672e-01  1.388e-01  -4.088 4.36e-05 ***
## TIF8                         5.455e-01  3.939e-01   1.385 0.166070
## TIF9                        -6.856e-01  2.213e-01  -3.098 0.001948 **
## CAR_TYPEPanel Truck          6.873e-01  1.716e-01   4.005 6.20e-05 ***
## CAR_TYPEPickup               5.284e-01  1.150e-01   4.593 4.36e-06 ***
## CAR_TYPESports Car           1.005e+00  1.258e-01   7.988 1.37e-15 ***
## CAR_TYPESUV                  7.341e-01  9.938e-02   7.387 1.51e-13 ***
## CAR_TYPEVan                  6.706e-01  1.404e-01   4.776 1.79e-06 ***
## OLDCLAIM                    -1.771e-05  4.786e-06  -3.700 0.000215 ***
## CLM_FREQ1                    6.004e-01  1.161e-01   5.172 2.31e-07 ***
## CLM_FREQ2                    6.523e-01  1.084e-01   6.016 1.79e-09 ***
## CLM_FREQ3                    6.929e-01  1.216e-01   5.696 1.22e-08 ***
## CLM_FREQ4                    8.242e-01  1.985e-01   4.153 3.28e-05 ***
## CLM_FREQ5                    1.184e+00  6.484e-01   1.825 0.067953 .
## REVOKEDYes                   9.096e-01  1.068e-01   8.518  < 2e-16 ***
## MVR_PTS1                     8.386e-02  1.050e-01   0.798 0.424651
## MVR_PTS10                    1.045e+00  8.799e-01   1.188 0.234804
```

```
## MVR_PTS11                      1.817e+00  1.132e+00   1.606 0.108356
## MVR_PTS13                      1.552e+01  5.536e+02   0.028 0.977638
## MVR_PTS2                       2.448e-01  1.100e-01   2.226 0.025982 *
## MVR_PTS3                       3.048e-01  1.185e-01   2.573 0.010084 *
## MVR_PTS4                       2.905e-01  1.284e-01   2.262 0.023688 *
## MVR_PTS5                       1.689e-01  1.481e-01   1.140 0.254156
## MVR_PTS6                       2.389e-01  1.775e-01   1.346 0.178366
## MVR_PTS7                       6.357e-01  2.065e-01   3.078 0.002083 **
## MVR_PTS8                       1.240e+00  3.194e-01   3.883 0.000103 ***
## MVR_PTS9                       1.248e+00  3.999e-01   3.122 0.001799 **
## URBANICITYHighly Urban/ Urban  2.216e+00  1.268e-01  17.474  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 7445.1  on 6447  degrees of freedom
## Residual deviance: 5625.3  on 6321  degrees of freedom
## AIC: 5879.3
##
## Number of Fisher Scoring iterations: 13
```

```
vif(model_2)
```

```
##                 GVIF Df GVIF^(1/(2*Df))
## KIDSDRIV    1.374893  4        1.040599
## AGE         3.731650 58        1.011417
## INCOME      2.930509  1        1.711873
## PARENT1     1.705264  1        1.305858
## HOME_VAL    2.091848  1        1.446322
## MSTATUS     2.081513  1        1.442745
## EDUCATION   8.075751  3        1.416437
## JOB        23.379420  8        1.217733
## CAR_USE     2.283311  1        1.511063
## BLUEBOOK    1.834626  1        1.354484
## TIF         1.461604 22        1.008663
## CAR_TYPE    2.972147  5        1.115083
## OLDCLAIM    1.941762  1        1.393471
## CLM_FREQ    2.066599  5        1.075290
## REVOKED     1.392372  1        1.179988
## MVR_PTS     1.676936 12        1.021774
## URBANICITY  1.156896  1        1.075591
```

Model is not improved significantly after removing influential value as it usually the case in smaller data sets.

MODEl 3

3. Building a model with removed JOB variable to avoid multicollinearity.

```
## Start:  AIC=6016.43
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + TRAVTIME + CAR_USE +
##     BLUEBOOK + TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ +
##     REVOKED + MVR_PTS + CAR_AGE + URBANICITY
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
##              Df Deviance    AIC
## - TRAVTIME   95   5621.7 5969.7
## - CAR_AGE    29   5512.2 5992.2
## - YOJ        19   5497.2 5997.2
## - HOMEKIDS    5   5484.5 6012.5
## - SEX         1   5479.6 6015.6
## <none>            5478.4 6016.4
## - PARENT1     1   5481.0 6017.0
## - RED_CAR     1   5481.1 6017.1
## - INCOME      1   5482.1 6018.1
## - HOME_VAL    1   5488.2 6024.2
## - OLDCLAIM    1   5492.3 6028.3
## - AGE        57   5606.1 6030.1
## - BLUEBOOK    1   5497.1 6033.1
## - KIDSDRIV    4   5505.9 6035.9
## - MVR_PTS    12   5522.6 6036.6
## - MSTATUS     1   5506.9 6042.9
## - EDUCATION   3   5512.4 6044.4
## - TIF        22   5551.3 6045.3
## - CLM_FREQ    5   5531.2 6059.2
## - CAR_TYPE    5   5547.8 6075.8
## - REVOKED     1   5550.9 6086.9
## - CAR_USE     1   5589.9 6125.9
## - URBANICITY  1   5898.4 6434.4
##
## Step:  AIC=5969.73
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + CAR_AGE + URBANICITY
##
##              Df Deviance    AIC
## - CAR_AGE    29   5655.2 5945.2
## - YOJ        19   5644.2 5954.2
## - HOMEKIDS    5   5628.0 5966.0
## <none>            5621.7 5969.7
## - SEX         1   5623.8 5969.8
## - PARENT1     1   5624.0 5970.0
## - RED_CAR     1   5624.8 5970.8
## - INCOME      1   5626.2 5972.2
## - HOME_VAL    1   5631.5 5977.5
## - BLUEBOOK    1   5637.2 5983.2
## - OLDCLAIM    1   5637.6 5983.6
## - AGE        57   5750.1 5984.1
## - KIDSDRIV    4   5647.7 5987.7
## - MVR_PTS    12   5667.0 5991.0
## - EDUCATION   3   5653.3 5995.3
## - MSTATUS     1   5650.1 5996.1
## - TIF        22   5696.0 6000.0
## - CLM_FREQ    5   5680.1 6018.1
## - CAR_TYPE    5   5691.2 6029.2
## - REVOKED     1   5694.2 6040.2
```

```
## - CAR_USE     1   5734.4 6080.4
## - URBANICITY  1   6017.8 6363.8
##
## Step:  AIC=5945.23
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - YOJ        19   5677.9 5929.9
## - HOMEKIDS    5   5662.2 5942.2
## - SEX         1   5657.0 5945.0
## - PARENT1     1   5657.1 5945.1
## <none>            5655.2 5945.2
## - RED_CAR     1   5658.2 5946.2
## - INCOME      1   5659.7 5947.7
## - HOME_VAL    1   5663.7 5951.7
## - AGE        57   5782.3 5958.3
## - BLUEBOOK    1   5670.4 5958.4
## - OLDCLAIM    1   5671.2 5959.2
## - KIDSDRIV    4   5682.2 5964.2
## - MVR_PTS    12   5699.7 5965.7
## - MSTATUS     1   5686.4 5974.4
## - TIF        22   5730.1 5976.1
## - CLM_FREQ    5   5714.9 5994.9
## - EDUCATION   3   5713.9 5997.9
## - CAR_TYPE    5   5724.3 6004.3
## - REVOKED     1   5728.8 6016.8
## - CAR_USE     1   5768.6 6056.6
## - URBANICITY  1   6050.8 6338.8
##
## Step:  AIC=5929.87
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - HOMEKIDS    5   5683.8 5925.8
## - SEX         1   5679.5 5929.5
## - PARENT1     1   5679.5 5929.5
## <none>            5677.9 5929.9
## - RED_CAR     1   5680.6 5930.6
## - HOME_VAL    1   5687.2 5937.2
## - INCOME      1   5687.5 5937.5
## - BLUEBOOK    1   5693.2 5943.2
## - OLDCLAIM    1   5693.6 5943.6
## - AGE        58   5807.6 5943.6
## - KIDSDRIV    4   5704.7 5948.7
## - MVR_PTS    12   5723.5 5951.5
## - MSTATUS     1   5708.1 5958.1
## - TIF        22   5754.5 5962.5
## - CLM_FREQ    5   5736.3 5978.3
```

```
## - EDUCATION   3   5733.9 5979.9
## - CAR_TYPE    5   5749.1 5991.1
## - REVOKED     1   5752.7 6002.7
## - CAR_USE     1   5792.7 6042.7
## - URBANICITY  1   6071.3 6321.3
##
## Step:  AIC=5925.78
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + SEX + EDUCATION + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - SEX         1   5685.2 5925.2
## <none>            5683.8 5925.8
## - RED_CAR     1   5686.5 5926.5
## - PARENT1     1   5689.5 5929.5
## - INCOME      1   5693.0 5933.0
## - HOME_VAL    1   5693.3 5933.3
## - OLDCLAIM    1   5698.6 5938.6
## - BLUEBOOK    1   5699.5 5939.5
## - AGE        58   5820.1 5946.1
## - MVR_PTS    12   5730.2 5948.2
## - MSTATUS     1   5713.4 5953.4
## - KIDSDRIV    4   5720.6 5954.6
## - TIF        22   5759.9 5957.9
## - CLM_FREQ    5   5741.5 5973.5
## - EDUCATION   3   5739.2 5975.2
## - CAR_TYPE    5   5754.5 5986.5
## - REVOKED     1   5757.7 5997.7
## - CAR_USE     1   5798.0 6038.0
## - URBANICITY  1   6077.2 6317.2
##
## Step:  AIC=5925.18
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + EDUCATION + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## - RED_CAR     1   5686.8 5924.8
## <none>            5685.2 5925.2
## - PARENT1     1   5690.8 5928.8
## - INCOME      1   5694.2 5932.2
## - HOME_VAL    1   5694.5 5932.5
## - OLDCLAIM    1   5700.1 5938.1
## - BLUEBOOK    1   5708.1 5946.1
## - AGE        58   5822.2 5946.2
## - MVR_PTS    12   5731.3 5947.3
## - MSTATUS     1   5715.1 5953.1
## - KIDSDRIV    4   5721.6 5953.6
## - TIF        22   5760.9 5956.9
## - CLM_FREQ    5   5743.1 5973.1
## - EDUCATION   3   5741.1 5975.1
## - CAR_TYPE    5   5758.2 5988.2
## - REVOKED     1   5759.1 5997.1
```

```
## - CAR_USE     1   5799.5 6037.5
## - URBANICITY  1   6079.0 6317.0
##
## Step:  AIC=5924.76
## TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
##     MSTATUS + EDUCATION + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
##
##              Df Deviance    AIC
## <none>            5686.8 5924.8
## - PARENT1     1   5692.6 5928.6
## - HOME_VAL    1   5695.9 5931.9
## - INCOME      1   5696.0 5932.0
## - OLDCLAIM    1   5701.8 5937.8
## - BLUEBOOK    1   5708.1 5944.1
## - AGE        58   5822.5 5944.5
## - MVR_PTS    12   5733.2 5947.2
## - MSTATUS     1   5716.5 5952.5
## - KIDSDRIV    4   5723.3 5953.3
## - TIF        22   5762.7 5956.7
## - CLM_FREQ    5   5744.6 5972.6
## - EDUCATION   3   5742.7 5974.7
## - REVOKED     1   5760.6 5996.6
## - CAR_TYPE    5   5774.6 6002.6
## - CAR_USE     1   5801.2 6037.2
## - URBANICITY  1   6080.2 6316.2
```

```
summary(model_3)
```

```
##
## Call:
## glm(formula = TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 +
##     HOME_VAL + MSTATUS + EDUCATION + CAR_USE + BLUEBOOK + TIF +
##     CAR_TYPE + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY,
##     family = "binomial", data = training %>% select(-INDEX, -TARGET_AMT,
##         -JOB))
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.4796  -0.7011  -0.3980   0.5782   3.0296
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 -1.173e+00  1.302e+00  -0.901 0.367673
## KIDSDRIV1                    5.518e-01  1.278e-01   4.319 1.57e-05 ***
## KIDSDRIV2                    7.855e-01  1.756e-01   4.472 7.74e-06 ***
## KIDSDRIV3                    8.567e-01  3.333e-01   2.571 0.010149 *
## KIDSDRIV4                   -1.098e+01  5.402e+02  -0.020 0.983784
## AGE18                       -1.381e+00  1.920e+00  -0.719 0.471849
## AGE19                       -4.135e-01  1.731e+00  -0.239 0.811176
## AGE20                       -1.995e+00  1.865e+00  -1.070 0.284732
## AGE21                       -7.374e-01  1.494e+00  -0.494 0.621488
## AGE22                       -5.465e-01  1.439e+00  -0.380 0.704119
## AGE23                       -1.805e-01  1.510e+00  -0.120 0.904863
## AGE24                        7.748e-01  1.466e+00   0.529 0.597092
```

```
## AGE25                      4.397e-01  1.402e+00   0.314 0.753750
## AGE26                      1.939e-02  1.363e+00   0.014 0.988653
## AGE27                     -6.171e-01  1.338e+00  -0.461 0.644598
## AGE28                     -8.490e-01  1.330e+00  -0.638 0.523321
## AGE29                     -1.613e+00  1.329e+00  -1.214 0.224819
## AGE30                     -9.934e-01  1.326e+00  -0.749 0.453643
## AGE31                     -9.831e-01  1.314e+00  -0.748 0.454412
## AGE32                     -1.069e+00  1.310e+00  -0.816 0.414449
## AGE33                     -1.381e+00  1.307e+00  -1.056 0.290755
## AGE34                     -1.463e+00  1.307e+00  -1.119 0.263106
## AGE35                     -1.168e+00  1.302e+00  -0.897 0.369933
## AGE36                     -1.082e+00  1.302e+00  -0.831 0.405895
## AGE37                     -1.229e+00  1.301e+00  -0.945 0.344852
## AGE38                     -1.029e+00  1.300e+00  -0.791 0.428854
## AGE39                     -1.121e+00  1.299e+00  -0.862 0.388430
## AGE40                     -1.575e+00  1.299e+00  -1.213 0.225292
## AGE41                     -1.452e+00  1.300e+00  -1.117 0.263795
## AGE42                     -1.250e+00  1.299e+00  -0.962 0.335895
## AGE43                     -1.525e+00  1.299e+00  -1.174 0.240560
## AGE44                     -1.818e+00  1.301e+00  -1.398 0.162137
## AGE45                     -1.457e+00  1.298e+00  -1.122 0.261867
## AGE46                     -1.549e+00  1.299e+00  -1.193 0.233031
## AGE47                     -1.631e+00  1.300e+00  -1.254 0.209822
## AGE48                     -1.753e+00  1.300e+00  -1.348 0.177645
## AGE49                     -1.680e+00  1.302e+00  -1.291 0.196851
## AGE50                     -1.464e+00  1.301e+00  -1.125 0.260396
## AGE51                     -1.741e+00  1.304e+00  -1.335 0.181803
## AGE52                     -1.398e+00  1.304e+00  -1.072 0.283528
## AGE53                     -1.441e+00  1.304e+00  -1.106 0.268873
## AGE54                     -1.272e+00  1.306e+00  -0.974 0.330044
## AGE55                     -1.590e+00  1.309e+00  -1.215 0.224254
## AGE56                     -1.312e+00  1.314e+00  -0.999 0.317856
## AGE57                     -6.650e-01  1.308e+00  -0.508 0.611106
## AGE58                     -6.342e-01  1.317e+00  -0.481 0.630178
## AGE59                     -5.458e-01  1.331e+00  -0.410 0.681769
## AGE60                     -5.798e-01  1.325e+00  -0.438 0.661646
## AGE61                     -8.358e-01  1.332e+00  -0.628 0.530263
## AGE62                     -1.046e+00  1.344e+00  -0.778 0.436430
## AGE63                     -1.023e+00  1.356e+00  -0.755 0.450492
## AGE64                     -3.411e-01  1.380e+00  -0.247 0.804829
## AGE65                     -1.485e+00  1.472e+00  -1.009 0.312817
## AGE66                     -1.432e+00  1.448e+00  -0.989 0.322702
## AGE67                     -4.860e-01  1.554e+00  -0.313 0.754436
## AGE68                     -6.005e-01  1.785e+00  -0.337 0.736490
## AGE69                     -9.884e-01  1.751e+00  -0.564 0.572429
## AGE70                     -1.460e+01  4.058e+02  -0.036 0.971292
## AGE72                      4.786e-01  1.923e+00   0.249 0.803404
## AGE73                     -9.673e-01  1.971e+00  -0.491 0.623496
## AGE76                      1.729e+01  8.827e+02   0.020 0.984370
## AGE80                     -1.282e+01  8.827e+02  -0.015 0.988415
## AGE81                     -1.379e+01  8.827e+02  -0.016 0.987535
## INCOME                    -3.493e-06  1.155e-06  -3.025 0.002489 **
## PARENT1Yes                 2.796e-01  1.157e-01   2.417 0.015667 *
## HOME_VAL                  -1.166e-06  3.854e-07  -3.024 0.002493 **
```

```
## MSTATUSYes                    -5.190e-01  9.451e-02  -5.492 3.97e-08 ***
## EDUCATIONHigh School           5.868e-01  8.709e-02   6.738 1.61e-11 ***
## EDUCATIONMasters              -1.118e-02  1.060e-01  -0.105 0.916021
## EDUCATIONPhD                   2.318e-02  1.491e-01   0.155 0.876471
## CAR_USEPrivate                -8.690e-01  8.181e-02 -10.621  < 2e-16 ***
## BLUEBOOK                      -2.479e-05  5.429e-06  -4.567 4.96e-06 ***
## TIF10                         -7.309e-01  1.297e-01  -5.636 1.74e-08 ***
## TIF11                         -3.995e-01  2.004e-01  -1.993 0.046230 *
## TIF12                         -5.099e-01  4.523e-01  -1.127 0.259551
## TIF13                         -4.031e-01  1.929e-01  -2.090 0.036633 *
## TIF14                         -1.071e+00  4.153e-01  -2.580 0.009884 **
## TIF15                          1.702e-01  4.784e-01   0.356 0.721951
## TIF16                         -1.131e+00  5.376e-01  -2.104 0.035354 *
## TIF17                         -5.244e-01  3.089e-01  -1.698 0.089540 .
## TIF18                         -9.397e-01  6.514e-01  -1.443 0.149097
## TIF19                         -1.309e+01  3.656e+02  -0.036 0.971439
## TIF2                           2.843e-01  9.823e-01   0.289 0.772237
## TIF20                         -1.372e+01  3.206e+02  -0.043 0.965867
## TIF21                          3.935e-01  7.528e-01   0.523 0.601148
## TIF22                         -1.443e+01  4.807e+02  -0.030 0.976043
## TIF25                         -1.234e+01  5.933e+02  -0.021 0.983407
## TIF3                          -1.374e-01  1.484e-01  -0.926 0.354450
## TIF4                          -2.458e-01  1.026e-01  -2.396 0.016559 *
## TIF5                          -6.470e-01  4.452e-01  -1.453 0.146152
## TIF6                          -3.982e-01  1.007e-01  -3.954 7.69e-05 ***
## TIF7                          -5.494e-01  1.379e-01  -3.983 6.79e-05 ***
## TIF8                           5.174e-01  3.851e-01   1.344 0.179061
## TIF9                          -6.776e-01  2.202e-01  -3.077 0.002094 **
## CAR_TYPEPanel Truck            5.887e-01  1.626e-01   3.622 0.000293 ***
## CAR_TYPEPickup                 4.725e-01  1.123e-01   4.208 2.57e-05 ***
## CAR_TYPESports Car             9.844e-01  1.236e-01   7.966 1.64e-15 ***
## CAR_TYPESUV                    7.360e-01  9.807e-02   7.504 6.18e-14 ***
## CAR_TYPEVan                    6.336e-01  1.377e-01   4.601 4.20e-06 ***
## OLDCLAIM                      -1.815e-05  4.738e-06  -3.830 0.000128 ***
## CLM_FREQ1                      6.127e-01  1.153e-01   5.315 1.07e-07 ***
## CLM_FREQ2                      6.682e-01  1.078e-01   6.198 5.73e-10 ***
## CLM_FREQ3                      7.011e-01  1.208e-01   5.803 6.52e-09 ***
## CLM_FREQ4                      8.281e-01  1.960e-01   4.226 2.38e-05 ***
## CLM_FREQ5                      9.451e-01  6.459e-01   1.463 0.143383
## REVOKEDYes                     9.164e-01  1.057e-01   8.667  < 2e-16 ***
## MVR_PTS1                       1.018e-01  1.045e-01   0.975 0.329607
## MVR_PTS10                      1.179e+00  8.835e-01   1.334 0.182075
## MVR_PTS11                      1.925e+00  1.137e+00   1.693 0.090464 .
## MVR_PTS13                      1.550e+01  5.567e+02   0.028 0.977784
## MVR_PTS2                       2.642e-01  1.092e-01   2.419 0.015580 *
## MVR_PTS3                       3.154e-01  1.176e-01   2.683 0.007293 **
## MVR_PTS4                       3.168e-01  1.274e-01   2.487 0.012874 *
## MVR_PTS5                       2.383e-01  1.471e-01   1.620 0.105318
## MVR_PTS6                       2.152e-01  1.761e-01   1.222 0.221747
## MVR_PTS7                       6.504e-01  2.048e-01   3.175 0.001499 **
## MVR_PTS8                       1.248e+00  3.163e-01   3.946 7.94e-05 ***
## MVR_PTS9                       1.255e+00  3.985e-01   3.150 0.001635 **
## URBANICITYHighly Urban/ Urban  2.141e+00  1.264e-01  16.943  < 2e-16 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 7445.1  on 6447  degrees of freedom
## Residual deviance: 5686.8  on 6329  degrees of freedom
## AIC: 5924.8
##
## Number of Fisher Scoring iterations: 13
```

```
vif(model_3)
```

```
##                GVIF Df GVIF^(1/(2*Df))
## KIDSDRIV   1.360126  4        1.039196
## AGE        3.228207 58        1.010154
## INCOME     2.362897  1        1.537172
## PARENT1    1.700422  1        1.304002
## HOME_VAL   2.010175  1        1.417807
## MSTATUS    2.048182  1        1.431147
## EDUCATION  1.846946  3        1.107666
## CAR_USE    1.516373  1        1.231411
## BLUEBOOK   1.818495  1        1.348516
## TIF        1.416742 22        1.007949
## CAR_TYPE   2.535545  5        1.097507
## OLDCLAIM   1.938003  1        1.392122
## CLM_FREQ   2.045672  5        1.074196
## REVOKED    1.386616  1        1.177547
## MVR_PTS    1.658826 12        1.021312
## URBANICITY 1.141031  1        1.068191
```

MODEl 4

4. Taking log 10 of INCOME (1 unit increase in income has a consistent increase in the income variable).

```
training$INCOME<- log10(training$INCOME+1)
model_4<-step(glm(TARGET_FLAG~., training %>% select(-INDEX, -TARGET_AMT), family = "binomial"), direct
```

```
FALSE Start:  AIC=5966.49
FALSE TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
FALSE     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + TRAVTIME + CAR_USE +
FALSE     BLUEBOOK + TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ +
FALSE     REVOKED + MVR_PTS + CAR_AGE + URBANICITY
FALSE
FALSE              Df Deviance    AIC
FALSE - TRAVTIME   95   5552.7 5916.7
FALSE - CAR_AGE    29   5446.1 5942.1
FALSE - YOJ        19   5427.0 5943.0
FALSE - HOMEKIDS    5   5418.3 5962.3
FALSE - SEX         1   5413.7 5965.7
FALSE <none>            5412.5 5966.5
FALSE - RED_CAR     1   5414.8 5966.8
FALSE - PARENT1     1   5415.5 5967.5
FALSE - INCOME      1   5415.5 5967.5
FALSE - OLDCLAIM    1   5425.7 5977.7
FALSE - EDUCATION   3   5429.8 5977.8
```

```
FALSE - AGE        57   5538.2 5978.2
FALSE - HOME_VAL    1   5426.5 5978.5
FALSE - BLUEBOOK    1   5431.2 5983.2
FALSE - MVR_PTS    12   5453.6 5983.6
FALSE - KIDSDRIV    4   5442.2 5988.2
FALSE - MSTATUS     1   5439.6 5991.6
FALSE - TIF        22   5486.3 5996.3
FALSE - CLM_FREQ    5   5463.9 6007.9
FALSE - JOB         8   5480.9 6018.9
FALSE - CAR_USE     1   5478.0 6030.0
FALSE - CAR_TYPE    5   5486.7 6030.7
FALSE - REVOKED     1   5481.7 6033.7
FALSE - URBANICITY  1   5854.8 6406.8
FALSE
FALSE Step:  AIC=5916.75
FALSE TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
FALSE     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
FALSE     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
FALSE     MVR_PTS + CAR_AGE + URBANICITY
FALSE
FALSE              Df Deviance    AIC
FALSE - CAR_AGE    29   5585.9 5891.9
FALSE - YOJ        19   5570.4 5896.4
FALSE - HOMEKIDS    5   5558.7 5912.7
FALSE <none>            5552.7 5916.7
FALSE - SEX         1   5555.0 5917.0
FALSE - PARENT1     1   5555.5 5917.5
FALSE - RED_CAR     1   5555.5 5917.5
FALSE - INCOME      1   5556.4 5918.4
FALSE - EDUCATION   3   5567.2 5925.2
FALSE - AGE        57   5678.0 5928.0
FALSE - HOME_VAL    1   5567.1 5929.1
FALSE - OLDCLAIM    1   5567.8 5929.8
FALSE - BLUEBOOK    1   5568.2 5930.2
FALSE - MVR_PTS    12   5594.7 5934.7
FALSE - KIDSDRIV    4   5580.5 5936.5
FALSE - MSTATUS     1   5579.4 5941.4
FALSE - TIF        22   5627.8 5947.8
FALSE - CLM_FREQ    5   5609.6 5963.6
FALSE - JOB         8   5624.4 5972.4
FALSE - CAR_USE     1   5616.1 5978.1
FALSE - CAR_TYPE    5   5627.5 5981.5
FALSE - REVOKED     1   5622.5 5984.5
FALSE - URBANICITY  1   5972.4 6334.4
FALSE
FALSE Step:  AIC=5891.94
FALSE TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + INCOME + PARENT1 +
FALSE     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
FALSE     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
FALSE     MVR_PTS + URBANICITY
FALSE
FALSE              Df Deviance    AIC
FALSE - YOJ        19   5603.4 5871.4
FALSE - HOMEKIDS    5   5592.5 5888.5
```

```
FALSE <none>              5585.9 5891.9
FALSE - SEX          1    5587.9 5891.9
FALSE - PARENT1      1    5588.2 5892.2
FALSE - RED_CAR      1    5588.7 5892.7
FALSE - INCOME       1    5589.2 5893.2
FALSE - AGE         57    5710.0 5902.0
FALSE - HOME_VAL     1    5598.6 5902.6
FALSE - BLUEBOOK     1    5601.1 5905.1
FALSE - OLDCLAIM     1    5601.1 5905.1
FALSE - MVR_PTS     12    5627.1 5909.1
FALSE - EDUCATION    3    5609.5 5909.5
FALSE - KIDSDRIV     4    5615.1 5913.1
FALSE - MSTATUS      1    5615.4 5919.4
FALSE - TIF         22    5661.3 5923.3
FALSE - CLM_FREQ     5    5644.2 5940.2
FALSE - JOB          8    5657.9 5947.9
FALSE - CAR_USE      1    5651.9 5955.9
FALSE - CAR_TYPE     5    5660.2 5956.2
FALSE - REVOKED      1    5657.0 5961.0
FALSE - URBANICITY   1    6005.4 6309.4
FALSE
FALSE Step:  AIC=5871.39
FALSE TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + INCOME + PARENT1 +
FALSE     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
FALSE     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
FALSE     MVR_PTS + URBANICITY
FALSE
FALSE               Df Deviance    AIC
FALSE - HOMEKIDS     5   5609.3 5867.3
FALSE - PARENT1      1   5605.3 5871.3
FALSE <none>             5603.4 5871.4
FALSE - SEX          1   5605.5 5871.5
FALSE - RED_CAR      1   5605.9 5871.9
FALSE - HOME_VAL     1   5618.0 5884.0
FALSE - OLDCLAIM     1   5618.3 5884.3
FALSE - BLUEBOOK     1   5618.3 5884.3
FALSE - INCOME       1   5619.9 5885.9
FALSE - AGE         58   5734.2 5886.2
FALSE - MVR_PTS     12   5644.8 5888.8
FALSE - KIDSDRIV     4   5631.6 5891.6
FALSE - EDUCATION    3   5629.7 5891.7
FALSE - MSTATUS      1   5632.5 5898.5
FALSE - TIF         22   5678.8 5902.8
FALSE - CLM_FREQ     5   5660.3 5918.3
FALSE - JOB          8   5674.4 5926.4
FALSE - CAR_USE      1   5669.5 5935.5
FALSE - CAR_TYPE     5   5678.3 5936.3
FALSE - REVOKED      1   5675.6 5941.6
FALSE - URBANICITY   1   6024.7 6290.7
FALSE
FALSE Step:  AIC=5867.3
FALSE TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
FALSE     MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF +
FALSE     CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
```

```
FALSE     URBANICITY
FALSE
FALSE               Df Deviance    AIC
FALSE - SEX          1   5611.2 5867.2
FALSE <none>             5609.3 5867.3
FALSE - RED_CAR      1   5611.8 5867.8
FALSE - PARENT1      1   5615.4 5871.4
FALSE - OLDCLAIM     1   5623.3 5879.3
FALSE - HOME_VAL     1   5624.2 5880.2
FALSE - BLUEBOOK     1   5624.7 5880.7
FALSE - INCOME       1   5625.5 5881.5
FALSE - MVR_PTS     12   5651.4 5885.4
FALSE - AGE         58   5745.1 5887.1
FALSE - EDUCATION    3   5635.3 5887.3
FALSE - MSTATUS      1   5637.7 5893.7
FALSE - KIDSDRIV     4   5647.4 5897.4
FALSE - TIF         22   5684.2 5898.2
FALSE - CLM_FREQ     5   5665.6 5913.6
FALSE - JOB          8   5680.6 5922.6
FALSE - CAR_USE      1   5675.4 5931.4
FALSE - CAR_TYPE     5   5683.7 5931.7
FALSE - REVOKED      1   5680.5 5936.5
FALSE - URBANICITY   1   6030.4 6286.4
FALSE
FALSE Step:  AIC=5867.17
FALSE TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
FALSE     MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
FALSE     RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
FALSE
FALSE               Df Deviance    AIC
FALSE - RED_CAR      1   5612.4 5866.4
FALSE <none>             5611.2 5867.2
FALSE - PARENT1      1   5617.1 5871.1
FALSE - OLDCLAIM     1   5625.3 5879.3
FALSE - HOME_VAL     1   5625.9 5879.9
FALSE - INCOME       1   5627.4 5881.4
FALSE - MVR_PTS     12   5653.0 5885.0
FALSE - EDUCATION    3   5637.3 5887.3
FALSE - AGE         58   5748.0 5888.0
FALSE - BLUEBOOK     1   5634.6 5888.6
FALSE - MSTATUS      1   5639.9 5893.9
FALSE - KIDSDRIV     4   5648.8 5896.8
FALSE - TIF         22   5685.6 5897.6
FALSE - CLM_FREQ     5   5667.7 5913.7
FALSE - JOB          8   5682.3 5922.3
FALSE - CAR_USE      1   5677.0 5931.0
FALSE - CAR_TYPE     5   5686.3 5932.3
FALSE - REVOKED      1   5682.5 5936.5
FALSE - URBANICITY   1   6032.1 6286.1
FALSE
FALSE Step:  AIC=5866.37
FALSE TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 + HOME_VAL +
FALSE     MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
FALSE     OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY
```

```
FALSE
FALSE              Df Deviance    AIC
FALSE <none>            5612.4 5866.4
FALSE - PARENT1     1   5618.5 5870.5
FALSE - OLDCLAIM    1   5626.6 5878.6
FALSE - HOME_VAL    1   5626.9 5878.9
FALSE - INCOME      1   5628.6 5880.6
FALSE - MVR_PTS    12   5654.5 5884.5
FALSE - AGE        58   5748.2 5886.2
FALSE - BLUEBOOK    1   5634.6 5886.6
FALSE - EDUCATION   3   5638.7 5886.7
FALSE - MSTATUS     1   5641.0 5893.0
FALSE - KIDSDRIV    4   5650.1 5896.1
FALSE - TIF        22   5687.0 5897.0
FALSE - CLM_FREQ    5   5668.9 5912.9
FALSE - JOB         8   5683.8 5921.8
FALSE - CAR_USE     1   5678.3 5930.3
FALSE - REVOKED     1   5683.6 5935.6
FALSE - CAR_TYPE    5   5699.5 5943.5
FALSE - URBANICITY  1   6033.2 6285.2
```

```
summary(model_4)
```

```
FALSE
FALSE Call:
FALSE glm(formula = TARGET_FLAG ~ KIDSDRIV + AGE + INCOME + PARENT1 +
FALSE     HOME_VAL + MSTATUS + EDUCATION + JOB + CAR_USE + BLUEBOOK +
FALSE     TIF + CAR_TYPE + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
FALSE     URBANICITY, family = "binomial", data = training %>% select(-INDEX,
FALSE     -TARGET_AMT))
FALSE
FALSE Deviance Residuals:
FALSE     Min       1Q   Median       3Q      Max
FALSE -2.5947  -0.6899  -0.3827   0.5591   3.0126
FALSE
FALSE Coefficients:
FALSE                                Estimate Std. Error z value Pr(>|z|)
FALSE (Intercept)                  -1.113e+00  1.317e+00  -0.845 0.397844
FALSE KIDSDRIV1                     5.473e-01  1.285e-01   4.260 2.05e-05 ***
FALSE KIDSDRIV2                     8.176e-01  1.773e-01   4.612 3.99e-06 ***
FALSE KIDSDRIV3                     9.142e-01  3.388e-01   2.699 0.006965 **
FALSE KIDSDRIV4                    -1.099e+01  5.259e+02  -0.021 0.983324
FALSE AGE18                        -1.194e+00  1.916e+00  -0.623 0.533091
FALSE AGE19                        -3.177e-02  1.747e+00  -0.018 0.985489
FALSE AGE20                        -1.891e+00  1.846e+00  -1.024 0.305645
FALSE AGE21                        -2.492e-01  1.496e+00  -0.167 0.867762
FALSE AGE22                        -3.800e-01  1.432e+00  -0.265 0.790689
FALSE AGE23                        -9.819e-03  1.504e+00  -0.007 0.994790
FALSE AGE24                         8.938e-01  1.457e+00   0.613 0.539675
FALSE AGE25                         5.915e-01  1.398e+00   0.423 0.672330
FALSE AGE26                         2.345e-01  1.354e+00   0.173 0.862511
FALSE AGE27                        -4.888e-01  1.330e+00  -0.368 0.713246
FALSE AGE28                        -6.565e-01  1.323e+00  -0.496 0.619752
FALSE AGE29                        -1.452e+00  1.321e+00  -1.099 0.271698
FALSE AGE30                        -8.230e-01  1.319e+00  -0.624 0.532541
```

```
FALSE AGE31                      -7.986e-01  1.306e+00  -0.611 0.540961
FALSE AGE32                      -9.193e-01  1.303e+00  -0.706 0.480318
FALSE AGE33                      -1.224e+00  1.299e+00  -0.942 0.345975
FALSE AGE34                      -1.319e+00  1.299e+00  -1.015 0.310127
FALSE AGE35                      -1.017e+00  1.294e+00  -0.786 0.432042
FALSE AGE36                      -9.516e-01  1.293e+00  -0.736 0.461876
FALSE AGE37                      -1.055e+00  1.293e+00  -0.816 0.414751
FALSE AGE38                      -9.038e-01  1.292e+00  -0.700 0.484236
FALSE AGE39                      -9.405e-01  1.291e+00  -0.728 0.466408
FALSE AGE40                      -1.415e+00  1.291e+00  -1.096 0.272909
FALSE AGE41                      -1.305e+00  1.291e+00  -1.011 0.312207
FALSE AGE42                      -1.086e+00  1.290e+00  -0.842 0.400023
FALSE AGE43                      -1.372e+00  1.291e+00  -1.062 0.288034
FALSE AGE44                      -1.644e+00  1.292e+00  -1.272 0.203296
FALSE AGE45                      -1.317e+00  1.290e+00  -1.021 0.307221
FALSE AGE46                      -1.381e+00  1.291e+00  -1.070 0.284693
FALSE AGE47                      -1.449e+00  1.292e+00  -1.122 0.261940
FALSE AGE48                      -1.548e+00  1.292e+00  -1.198 0.230811
FALSE AGE49                      -1.504e+00  1.293e+00  -1.163 0.244982
FALSE AGE50                      -1.292e+00  1.293e+00  -0.999 0.317705
FALSE AGE51                      -1.539e+00  1.296e+00  -1.187 0.235113
FALSE AGE52                      -1.188e+00  1.296e+00  -0.917 0.359346
FALSE AGE53                      -1.217e+00  1.295e+00  -0.940 0.347401
FALSE AGE54                      -1.113e+00  1.298e+00  -0.858 0.391085
FALSE AGE55                      -1.365e+00  1.301e+00  -1.050 0.293924
FALSE AGE56                      -1.121e+00  1.306e+00  -0.858 0.390816
FALSE AGE57                      -4.778e-01  1.300e+00  -0.368 0.713153
FALSE AGE58                      -4.273e-01  1.309e+00  -0.326 0.744059
FALSE AGE59                      -3.399e-01  1.323e+00  -0.257 0.797262
FALSE AGE60                      -3.026e-01  1.317e+00  -0.230 0.818303
FALSE AGE61                      -6.454e-01  1.326e+00  -0.487 0.626443
FALSE AGE62                      -7.947e-01  1.338e+00  -0.594 0.552509
FALSE AGE63                      -7.529e-01  1.348e+00  -0.558 0.576548
FALSE AGE64                      -1.654e-01  1.377e+00  -0.120 0.904404
FALSE AGE65                      -1.256e+00  1.472e+00  -0.853 0.393388
FALSE AGE66                      -1.192e+00  1.447e+00  -0.824 0.409841
FALSE AGE67                      -1.133e-01  1.531e+00  -0.074 0.940980
FALSE AGE68                      -4.026e-01  1.785e+00  -0.226 0.821533
FALSE AGE69                      -5.196e-01  1.758e+00  -0.296 0.767599
FALSE AGE70                      -1.390e+01  4.002e+02  -0.035 0.972284
FALSE AGE72                       4.773e-01  1.904e+00   0.251 0.802011
FALSE AGE73                      -6.282e-01  1.981e+00  -0.317 0.751186
FALSE AGE76                       1.757e+01  8.827e+02   0.020 0.984116
FALSE AGE80                      -1.271e+01  8.827e+02  -0.014 0.988514
FALSE AGE81                      -1.374e+01  8.827e+02  -0.016 0.987579
FALSE INCOME                     -1.570e-01  3.916e-02  -4.009 6.11e-05 ***
FALSE PARENT1Yes                  2.899e-01  1.168e-01   2.482 0.013072 *
FALSE HOME_VAL                   -1.379e-06  3.655e-07  -3.772 0.000162 ***
FALSE MSTATUSYes                 -5.021e-01  9.335e-02  -5.379 7.49e-08 ***
FALSE EDUCATIONHigh School        4.669e-01  9.303e-02   5.018 5.21e-07 ***
FALSE EDUCATIONMasters            3.463e-02  1.579e-01   0.219 0.826436
FALSE EDUCATIONPhD                1.341e-01  1.999e-01   0.671 0.502464
FALSE JOBBlue Collar              3.952e-01  2.150e-01   1.838 0.066026 .
FALSE JOBClerical                 5.533e-01  2.255e-01   2.453 0.014156 *
```

```
FALSE JOBDoctor                  -2.720e-01  2.925e-01  -0.930 0.352383
FALSE JOBHome Maker               2.722e-02  2.563e-01   0.106 0.915421
FALSE JOBLawyer                   2.657e-01  1.939e-01   1.370 0.170616
FALSE JOBManager                 -5.714e-01  2.001e-01  -2.855 0.004298 **
FALSE JOBProfessional             2.325e-01  2.061e-01   1.128 0.259343
FALSE JOBStudent                 -8.699e-02  2.641e-01  -0.329 0.741848
FALSE CAR_USEPrivate             -8.120e-01  1.011e-01  -8.035 9.38e-16 ***
FALSE BLUEBOOK                   -2.509e-05  5.387e-06  -4.659 3.18e-06 ***
FALSE TIF10                      -7.222e-01  1.308e-01  -5.519 3.40e-08 ***
FALSE TIF11                      -3.977e-01  2.021e-01  -1.968 0.049037 *
FALSE TIF12                      -4.311e-01  4.572e-01  -0.943 0.345735
FALSE TIF13                      -4.114e-01  1.948e-01  -2.112 0.034729 *
FALSE TIF14                      -1.046e+00  4.202e-01  -2.490 0.012761 *
FALSE TIF15                       1.253e-01  4.847e-01   0.259 0.795946
FALSE TIF16                      -1.191e+00  5.362e-01  -2.221 0.026351 *
FALSE TIF17                      -5.705e-01  3.110e-01  -1.834 0.066590 .
FALSE TIF18                      -8.591e-01  6.579e-01  -1.306 0.191642
FALSE TIF19                      -1.296e+01  3.631e+02  -0.036 0.971526
FALSE TIF2                        2.396e-01  9.849e-01   0.243 0.807796
FALSE TIF20                      -1.384e+01  3.169e+02  -0.044 0.965166
FALSE TIF21                       2.270e-01  7.533e-01   0.301 0.763127
FALSE TIF22                      -1.461e+01  4.782e+02  -0.031 0.975625
FALSE TIF25                      -1.236e+01  6.024e+02  -0.021 0.983631
FALSE TIF3                       -1.651e-01  1.503e-01  -1.099 0.271826
FALSE TIF4                       -2.361e-01  1.032e-01  -2.288 0.022154 *
FALSE TIF5                       -6.153e-01  4.468e-01  -1.377 0.168513
FALSE TIF6                       -3.967e-01  1.015e-01  -3.907 9.34e-05 ***
FALSE TIF7                       -5.553e-01  1.389e-01  -3.997 6.41e-05 ***
FALSE TIF8                        5.517e-01  3.946e-01   1.398 0.162023
FALSE TIF9                       -6.994e-01  2.219e-01  -3.152 0.001623 **
FALSE CAR_TYPEPanel Truck         6.802e-01  1.716e-01   3.963 7.39e-05 ***
FALSE CAR_TYPEPickup              5.391e-01  1.151e-01   4.684 2.81e-06 ***
FALSE CAR_TYPESports Car          9.990e-01  1.262e-01   7.916 2.45e-15 ***
FALSE CAR_TYPESUV                 7.433e-01  9.958e-02   7.465 8.34e-14 ***
FALSE CAR_TYPEVan                 6.678e-01  1.404e-01   4.756 1.98e-06 ***
FALSE OLDCLAIM                   -1.789e-05  4.798e-06  -3.728 0.000193 ***
FALSE CLM_FREQ1                   6.099e-01  1.163e-01   5.246 1.55e-07 ***
FALSE CLM_FREQ2                   6.576e-01  1.086e-01   6.056 1.40e-09 ***
FALSE CLM_FREQ3                   6.892e-01  1.217e-01   5.661 1.51e-08 ***
FALSE CLM_FREQ4                   8.389e-01  1.987e-01   4.221 2.43e-05 ***
FALSE CLM_FREQ5                   1.149e+00  6.531e-01   1.760 0.078480 .
FALSE REVOKEDYes                  9.098e-01  1.070e-01   8.506  < 2e-16 ***
FALSE MVR_PTS1                    7.678e-02  1.052e-01   0.730 0.465307
FALSE MVR_PTS10                   1.064e+00  8.816e-01   1.207 0.227275
FALSE MVR_PTS11                   1.827e+00  1.134e+00   1.611 0.107167
FALSE MVR_PTS13                   1.556e+01  5.509e+02   0.028 0.977470
FALSE MVR_PTS2                    2.424e-01  1.100e-01   2.203 0.027576 *
FALSE MVR_PTS3                    3.070e-01  1.187e-01   2.586 0.009720 **
FALSE MVR_PTS4                    2.984e-01  1.285e-01   2.322 0.020234 *
FALSE MVR_PTS5                    1.747e-01  1.485e-01   1.177 0.239248
FALSE MVR_PTS6                    2.258e-01  1.782e-01   1.267 0.205099
FALSE MVR_PTS7                    6.224e-01  2.067e-01   3.012 0.002597 **
FALSE MVR_PTS8                    1.206e+00  3.208e-01   3.759 0.000171 ***
FALSE MVR_PTS9                    1.175e+00  4.015e-01   2.926 0.003434 **
```

```
FALSE URBANICITYHighly Urban/ Urban  2.226e+00  1.272e-01  17.493  < 2e-16 ***
FALSE ---
FALSE Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
FALSE
FALSE (Dispersion parameter for binomial family taken to be 1)
FALSE
FALSE     Null deviance: 7445.1  on 6447  degrees of freedom
FALSE Residual deviance: 5612.4  on 6321  degrees of freedom
FALSE AIC: 5866.4
FALSE
FALSE Number of Fisher Scoring iterations: 13
```

```
vif(model_4)
```

```
FALSE                 GVIF Df GVIF^(1/(2*Df))
FALSE KIDSDRIV    1.375126  4        1.040622
FALSE AGE         3.668116 58        1.011267
FALSE INCOME      2.683910  1        1.638264
FALSE PARENT1     1.702396  1        1.304759
FALSE HOME_VAL    1.808496  1        1.344803
FALSE MSTATUS     1.967872  1        1.402809
FALSE EDUCATION   7.392410  3        1.395718
FALSE JOB        38.972352  8        1.257252
FALSE CAR_USE     2.283576  1        1.511151
FALSE BLUEBOOK    1.790810  1        1.338212
FALSE TIF         1.459261 22        1.008626
FALSE CAR_TYPE    2.970088  5        1.115005
FALSE OLDCLAIM    1.946561  1        1.395192
FALSE CLM_FREQ    2.058156  5        1.074850
FALSE REVOKED     1.395272  1        1.181216
FALSE MVR_PTS     1.682928 12        1.021926
FALSE URBANICITY  1.157788  1        1.076006
```

MODEl 5

5. Using derived variable - wealth accumulation which is INCOME/AGE and removing INCOME to avoid multicollinearity.

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
## Start:  AIC=5966.96
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + PARENT1 + HOME_VAL +
##     MSTATUS + SEX + EDUCATION + JOB + TRAVTIME + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + CAR_AGE + URBANICITY + wealth_acc
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

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## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
##              Df Deviance    AIC
## - TRAVTIME   95   5665.7 5917.7
## - CAR_AGE    29   5556.7 5940.7
## - HOMEKIDS    5   5532.8 5964.8
## - RED_CAR     1   5526.7 5966.7
## <none>            5525.0 5967.0
## - SEX         1   5527.2 5967.2
## - PARENT1     1   5529.5 5969.5
## - AGE         1   5531.1 5971.1
## - YOJ        20   5572.0 5974.0
## - OLDCLAIM    1   5539.5 5979.5
## - EDUCATION   3   5544.8 5980.8
## - BLUEBOOK    1   5544.0 5984.0
## - wealth_acc  1   5544.3 5984.3
## - KIDSDRIV    4   5552.3 5986.3
## - MSTATUS     1   5546.9 5986.9
## - HOME_VAL    1   5547.5 5987.5
## - MVR_PTS    12   5575.0 5993.0
## - TIF        22   5597.8 5995.8
## - CLM_FREQ    5   5578.2 6010.2
## - JOB         8   5592.6 6018.6
## - CAR_USE     1   5589.2 6029.2
## - REVOKED     1   5595.9 6035.9
## - CAR_TYPE    5   5609.7 6041.7
## - URBANICITY  1   5964.6 6404.6
##
## Step:  AIC=5917.7
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + PARENT1 + HOME_VAL +
##     MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF +
##     CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
##     CAR_AGE + URBANICITY + wealth_acc
```

```
##
##              Df Deviance    AIC
## - CAR_AGE    29   5697.1 5891.1
## - HOMEKIDS    5   5673.4 5915.4
## <none>            5665.7 5917.7
## - RED_CAR     1   5668.1 5918.1
## - SEX         1   5669.2 5919.2
## - PARENT1     1   5670.0 5920.0
## - AGE         1   5671.2 5921.2
## - YOJ        20   5715.1 5927.1
## - EDUCATION   3   5682.0 5928.0
## - BLUEBOOK    1   5682.2 5932.2
## - OLDCLAIM    1   5682.3 5932.3
## - wealth_acc  1   5684.4 5934.4
## - KIDSDRIV    4   5691.9 5935.9
## - MSTATUS     1   5687.2 5937.2
## - HOME_VAL    1   5689.4 5939.4
## - MVR_PTS    12   5715.1 5943.1
## - TIF        22   5739.9 5947.9
## - CLM_FREQ    5   5723.8 5965.8
## - JOB         8   5737.5 5973.5
## - CAR_USE     1   5727.9 5977.9
## - REVOKED     1   5737.8 5987.8
## - CAR_TYPE    5   5750.9 5992.9
## - URBANICITY  1   6082.0 6332.0
##
## Step:  AIC=5891.08
## TARGET_FLAG ~ KIDSDRIV + AGE + HOMEKIDS + YOJ + PARENT1 + HOME_VAL +
##     MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF +
##     CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS +
##     URBANICITY + wealth_acc
##
##              Df Deviance    AIC
## - HOMEKIDS    5   5705.7 5889.7
## <none>            5697.1 5891.1
## - RED_CAR     1   5699.5 5891.5
## - SEX         1   5700.2 5892.2
## - PARENT1     1   5700.7 5892.7
## - AGE         1   5703.1 5895.1
## - YOJ        20   5746.1 5900.1
## - BLUEBOOK    1   5713.2 5905.2
## - OLDCLAIM    1   5713.9 5905.9
## - wealth_acc  1   5716.1 5908.1
## - KIDSDRIV    4   5724.0 5910.0
## - HOME_VAL    1   5718.3 5910.3
## - EDUCATION   3   5724.4 5912.4
## - MSTATUS     1   5721.0 5913.0
## - MVR_PTS    12   5745.5 5915.5
## - TIF        22   5772.2 5922.2
## - CLM_FREQ    5   5757.1 5941.1
## - JOB         8   5770.0 5948.0
## - CAR_USE     1   5761.5 5953.5
## - REVOKED     1   5770.7 5962.7
## - CAR_TYPE    5   5781.7 5965.7
```

```
## - URBANICITY  1   6113.7 6305.7
##
## Step:  AIC=5889.73
## TARGET_FLAG ~ KIDSDRIV + AGE + YOJ + PARENT1 + HOME_VAL + MSTATUS +
##     SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK + TIF + CAR_TYPE +
##     RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED + MVR_PTS + URBANICITY +
##     wealth_acc
##
##              Df Deviance    AIC
## <none>            5705.7 5889.7
## - RED_CAR     1   5708.1 5890.1
## - SEX         1   5708.6 5890.6
## - AGE         1   5711.1 5893.1
## - YOJ        20   5755.3 5899.3
## - PARENT1     1   5717.9 5899.9
## - OLDCLAIM    1   5721.5 5903.5
## - BLUEBOOK    1   5722.3 5904.3
## - wealth_acc  1   5725.6 5907.6
## - MSTATUS     1   5726.2 5908.2
## - HOME_VAL    1   5727.7 5909.7
## - EDUCATION   3   5732.9 5910.9
## - MVR_PTS    12   5755.2 5915.2
## - KIDSDRIV    4   5742.5 5918.5
## - TIF        22   5780.1 5920.1
## - CLM_FREQ    5   5765.0 5939.0
## - JOB         8   5779.0 5947.0
## - CAR_USE     1   5770.3 5952.3
## - REVOKED     1   5778.2 5960.2
## - CAR_TYPE    5   5790.0 5964.0
## - URBANICITY  1   6121.9 6303.9
```

```
summary(model_5)
```

```
##
## Call:
## glm(formula = TARGET_FLAG ~ KIDSDRIV + AGE + YOJ + PARENT1 +
##     HOME_VAL + MSTATUS + SEX + EDUCATION + JOB + CAR_USE + BLUEBOOK +
##     TIF + CAR_TYPE + RED_CAR + OLDCLAIM + CLM_FREQ + REVOKED +
##     MVR_PTS + URBANICITY + wealth_acc, family = "binomial", data = training %>%
##     select(-INDEX, -TARGET_AMT, -INCOME))
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.5528  -0.7011  -0.3973   0.5915   3.1138
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 -3.033e+00  3.848e-01  -7.881 3.25e-15 ***
## KIDSDRIV1                    4.875e-01  1.220e-01   3.996 6.45e-05 ***
## KIDSDRIV2                    7.463e-01  1.714e-01   4.354 1.34e-05 ***
## KIDSDRIV3                    8.140e-01  3.372e-01   2.414 0.015764 *
## KIDSDRIV4                   -1.377e+01  4.862e+02  -0.028 0.977410
## AGE                          1.536e-02  6.657e-03   2.307 0.021037 *
## YOJ1                        -1.459e+01  3.162e+02  -0.046 0.963183
## YOJ10                       -9.776e-01  2.267e-01  -4.312 1.62e-05 ***
```

```
## YOJ11                      -1.100e+00  2.186e-01  -5.031 4.87e-07 ***
## YOJ12                      -1.082e+00  2.170e-01  -4.988 6.11e-07 ***
## YOJ13                      -1.060e+00  2.202e-01  -4.814 1.48e-06 ***
## YOJ14                      -1.020e+00  2.262e-01  -4.508 6.54e-06 ***
## YOJ15                      -9.603e-01  2.450e-01  -3.920 8.85e-05 ***
## YOJ16                      -8.601e-01  2.748e-01  -3.130 0.001750 **
## YOJ17                      -5.508e-01  3.389e-01  -1.625 0.104141
## YOJ18                      -1.191e+00  6.053e-01  -1.967 0.049178 *
## YOJ19                       7.440e-01  7.395e-01   1.006 0.314360
## YOJ2                       -1.468e+00  8.821e-01  -1.664 0.096136 .
## YOJ23                      -1.344e+01  5.997e+02  -0.022 0.982118
## YOJ3                       -1.221e+00  5.798e-01  -2.106 0.035173 *
## YOJ4                       -1.908e+00  5.940e-01  -3.213 0.001314 **
## YOJ5                       -1.104e+00  3.639e-01  -3.035 0.002408 **
## YOJ6                       -1.159e+00  2.965e-01  -3.907 9.34e-05 ***
## YOJ7                       -1.286e+00  2.651e-01  -4.851 1.23e-06 ***
## YOJ8                       -9.498e-01  2.515e-01  -3.776 0.000159 ***
## YOJ9                       -9.609e-01  2.353e-01  -4.084 4.44e-05 ***
## PARENT1Yes                  3.981e-01  1.139e-01   3.495 0.000474 ***
## HOME_VAL                   -1.661e-06  3.583e-07  -4.636 3.55e-06 ***
## MSTATUSYes                 -4.264e-01  9.381e-02  -4.545 5.50e-06 ***
## SEXM                        2.116e-01  1.253e-01   1.689 0.091165 .
## EDUCATIONHigh School        4.600e-01  9.139e-02   5.033 4.82e-07 ***
## EDUCATIONMasters           -2.753e-02  1.562e-01  -0.176 0.860080
## EDUCATIONPhD                5.441e-02  1.983e-01   0.274 0.783793
## JOBBlue Collar              3.897e-01  2.127e-01   1.832 0.066973 .
## JOBClerical                 5.850e-01  2.228e-01   2.626 0.008643 **
## JOBDoctor                  -2.152e-01  2.901e-01  -0.742 0.458240
## JOBHome Maker               2.312e-01  2.437e-01   0.949 0.342761
## JOBLawyer                   3.142e-01  1.917e-01   1.639 0.101271
## JOBManager                 -6.023e-01  1.980e-01  -3.042 0.002354 **
## JOBProfessional             2.462e-01  2.042e-01   1.206 0.227795
## JOBStudent                  1.755e-01  2.522e-01   0.696 0.486549
## CAR_USEPrivate             -7.944e-01  9.985e-02  -7.956 1.78e-15 ***
## BLUEBOOK                   -2.361e-05  5.861e-06  -4.029 5.60e-05 ***
## TIF10                      -7.214e-01  1.289e-01  -5.596 2.19e-08 ***
## TIF11                      -3.297e-01  1.982e-01  -1.664 0.096173 .
## TIF12                      -5.506e-01  4.582e-01  -1.202 0.229488
## TIF13                      -4.611e-01  1.934e-01  -2.384 0.017134 *
## TIF14                      -1.009e+00  4.063e-01  -2.485 0.012961 *
## TIF15                       1.497e-01  4.739e-01   0.316 0.752119
## TIF16                      -1.195e+00  5.420e-01  -2.204 0.027509 *
## TIF17                      -6.415e-01  3.094e-01  -2.073 0.038129 *
## TIF18                      -6.087e-01  6.107e-01  -0.997 0.318871
## TIF19                      -1.302e+01  3.624e+02  -0.036 0.971333
## TIF2                        1.603e-01  9.820e-01   0.163 0.870301
## TIF20                      -1.347e+01  3.331e+02  -0.040 0.967745
## TIF21                       1.039e-01  7.542e-01   0.138 0.890453
## TIF22                      -1.442e+01  4.767e+02  -0.030 0.975864
## TIF25                      -1.235e+01  6.019e+02  -0.021 0.983636
## TIF3                       -2.139e-01  1.483e-01  -1.442 0.149196
## TIF4                       -2.519e-01  1.022e-01  -2.466 0.013666 *
## TIF5                       -6.027e-01  4.382e-01  -1.376 0.168942
## TIF6                       -3.830e-01  1.001e-01  -3.824 0.000131 ***
```

```
## TIF7                          -5.755e-01  1.364e-01  -4.218 2.47e-05 ***
## TIF8                           5.367e-01  3.939e-01   1.362 0.173067
## TIF9                          -6.971e-01  2.193e-01  -3.179 0.001480 **
## CAR_TYPEPanel Truck            6.369e-01  1.809e-01   3.520 0.000432 ***
## CAR_TYPEPickup                 5.455e-01  1.140e-01   4.784 1.72e-06 ***
## CAR_TYPESports Car             1.114e+00  1.466e-01   7.597 3.03e-14 ***
## CAR_TYPESUV                    8.405e-01  1.253e-01   6.706 2.00e-11 ***
## CAR_TYPEVan                    6.247e-01  1.434e-01   4.357 1.32e-05 ***
## RED_CARyes                    -1.516e-01  9.836e-02  -1.541 0.123258
## OLDCLAIM                      -1.862e-05  4.754e-06  -3.917 8.96e-05 ***
## CLM_FREQ1                      6.197e-01  1.147e-01   5.402 6.61e-08 ***
## CLM_FREQ2                      6.811e-01  1.071e-01   6.359 2.03e-10 ***
## CLM_FREQ3                      6.695e-01  1.204e-01   5.560 2.69e-08 ***
## CLM_FREQ4                      8.542e-01  1.968e-01   4.340 1.43e-05 ***
## CLM_FREQ5                      1.131e+00  6.597e-01   1.714 0.086478 .
## REVOKEDYes                     9.056e-01  1.055e-01   8.587  < 2e-16 ***
## MVR_PTS1                       6.696e-02  1.038e-01   0.645 0.519044
## MVR_PTS10                      8.875e-01  8.725e-01   1.017 0.309039
## MVR_PTS11                      1.951e+00  1.090e+00   1.790 0.073485 .
## MVR_PTS13                      1.517e+01  5.697e+02   0.027 0.978756
## MVR_PTS2                       2.283e-01  1.089e-01   2.097 0.036032 *
## MVR_PTS3                       2.969e-01  1.171e-01   2.536 0.011208 *
## MVR_PTS4                       3.215e-01  1.268e-01   2.535 0.011238 *
## MVR_PTS5                       2.208e-01  1.467e-01   1.506 0.132084
## MVR_PTS6                       2.927e-01  1.752e-01   1.671 0.094743 .
## MVR_PTS7                       7.388e-01  2.031e-01   3.637 0.000276 ***
## MVR_PTS8                       1.288e+00  3.137e-01   4.104 4.05e-05 ***
## MVR_PTS9                       1.284e+00  3.979e-01   3.226 0.001255 **
## URBANICITYHighly Urban/ Urban  2.172e+00  1.246e-01  17.435  < 2e-16 ***
## wealth_acc                     3.425e+00  8.834e-01   3.877 0.000106 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 7445.1  on 6447  degrees of freedom
## Residual deviance: 5705.7  on 6356  degrees of freedom
## AIC: 5889.7
##
## Number of Fisher Scoring iterations: 13
```

```
vif(model_5)
```

```
##                 GVIF Df GVIF^(1/(2*Df))
## KIDSDRIV    1.208927  4        1.024000
## AGE         3.213013  1        1.792488
## YOJ         4.651641 20        1.039179
## PARENT1     1.648777  1        1.284047
## HOME_VAL    1.778284  1        1.333523
## MSTATUS     2.023930  1        1.422649
## SEX         3.612611  1        1.900687
## EDUCATION   7.210922  3        1.389948
## JOB        30.089479  8        1.237089
## CAR_USE     2.269510  1        1.506489
## BLUEBOOK    2.154222  1        1.467727
```

```
## TIF         1.281940 22        1.005661
## CAR_TYPE    6.564468  5        1.207035
## RED_CAR     1.843016  1        1.357577
## OLDCLAIM    1.922974  1        1.386714
## CLM_FREQ    1.983235  5        1.070872
## REVOKED     1.376466  1        1.173229
## MVR_PTS     1.468636 12        1.016143
## URBANICITY  1.133679  1        1.064743
## wealth_acc  4.346726  1        2.084880
```

MODEl 6

6. Building a model on a data set where bins are created for the following continuous variables: AGE, YOJ, INCOME, TRAVTIME, BLUEBOOK, TIF, OLDCLAIM, CAR_AGE, HOME_VAL and converting them to factors.

```
## 'data.frame':    6448 obs. of  35 variables:
##  $ INDEX        : Factor w/ 8161 levels "1","100","1000",..: 1 1132 2898 5531 430 508 602 690 778 871
##  $ TARGET_FLAG  : Factor w/ 2 levels "0","1": 1 1 1 2 2 1 2 1 1 2 ...
##  $ TARGET_AMT   : Factor w/ 1949 levels "0","1005.214379",..: 1 1 1 612 460 1 1581 1 1 83 ...
##  $ KIDSDRIV     : Factor w/ 5 levels "0","1","2","3",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ AGE          : int  45 28 20 19 19 35 38 28 40 38 ...
##  $ HOMEKIDS     : Factor w/ 6 levels "0","1","2","3",..: 1 1 2 2 1 1 1 1 1 1 ...
##  $ YOJ          : int  4 4 3 5 3 19 7 17 4 4 ...
##  $ INCOME       : int  67349 91449 16039 125301 62978 106952 77100 52642 59162 130795 ...
##  $ PARENT1      : Factor w/ 2 levels "No","Yes": 1 1 1 2 1 1 1 1 1 1 ...
##  $ HOME_VAL     : int  0 257252 124191 0 0 0 0 209970 180232 0 ...
##  $ MSTATUS      : Factor w/ 2 levels "No","Yes": 1 1 2 1 1 1 1 2 2 1 ...
##  $ SEX          : Factor w/ 2 levels "F","M": 2 2 1 1 1 2 1 1 2 2 ...
##  $ EDUCATION    : Factor w/ 4 levels "Bachelors","High School",..: 4 2 2 1 1 1 3 3 1 4 ...
##  $ JOB          : Factor w/ 9 levels "","Blue Collar",..: 8 2 3 2 3 8 6 8 7 1 ...
##  $ TRAVTIME     : int  10 19 47 43 31 45 12 33 22 63 ...
##  $ CAR_USE      : Factor w/ 2 levels "Commercial","Private": 2 1 2 1 2 1 2 2 1 1 ...
##  $ BLUEBOOK     : int  14230 14940 4010 17430 11200 18510 18300 22420 17600 28340 ...
##  $ TIF          : int  3 1 18 1 1 21 1 21 21 20 ...
##  $ CAR_TYPE     : Factor w/ 6 levels "Minivan","Panel Truck",..: 1 1 5 4 5 6 4 1 6 2 ...
##  $ RED_CAR      : Factor w/ 2 levels "no","yes": 2 2 1 1 1 1 1 1 2 2 ...
##  $ OLDCLAIM     : int  4461 0 38690 0 0 0 0 0 5028 0 ...
##  $ CLM_FREQ     : Factor w/ 6 levels "0","1","2","3",..: 3 1 3 1 1 1 1 1 3 1 ...
##  $ REVOKED      : Factor w/ 2 levels "No","Yes": 1 1 1 1 1 1 1 1 2 1 ...
##  $ MVR_PTS      : Factor w/ 13 levels "0","1","10","11",..: 7 1 7 1 1 2 1 1 7 7 ...
##  $ CAR_AGE      : int  12 3 4 28 3 11 5 3 30 4 ...
##  $ URBANICITY   : Factor w/ 2 levels "Highly Rural/ Rural",..: 2 2 2 2 2 1 2 1 2 2 ...
##  $ HOME_VAL_BINS: Factor w/ 2 levels "<1000","5000+": 1 2 2 1 1 1 1 2 2 1 ...
##  $ AGE_BINS     : Factor w/ 6 levels "<20","20-30",..: 4 2 2 1 1 3 3 2 4 3 ...
##  $ INCOME_BINS  : Factor w/ 8 levels "<1000","1000-20000",..: 7 8 2 4 7 3 7 6 6 4 ...
##  $ YOJ_BINS     : Factor w/ 5 levels "<5","10-15","15-20",..: 1 1 1 5 1 3 5 3 1 1 ...
##  $ TRAVTIME_BINS: Factor w/ 6 levels "<5","25-45","45-65",..: 4 4 3 2 2 3 4 2 4 3 ...
##  $ BLUEBOOK_BINS: Factor w/ 7 levels "11500-21500",..: 1 1 2 1 2 1 1 3 1 3 ...
##  $ TIF_BINS     : Factor w/ 5 levels "1-5","10-15",..: 1 1 3 1 1 4 1 4 4 4 ...
##  $ OLDCLAIM_BINS: Factor w/ 7 levels "<500","1000-1500",..: 6 1 6 1 1 1 1 1 6 1 ...
##  $ CAR_AGE_BINS : Factor w/ 6 levels "1-5","10-15",..: 2 1 1 5 1 2 6 1 5 1 ...
##  - attr(*, "na.action")= 'omit' Named int  4 5 7 8 21 29 45 46 49 54 ...
##   ..- attr(*, "names")= chr  "4" "5" "7" "8" ...
```

```
## Start:  AIC=5901.86
## TARGET_FLAG ~ KIDSDRIV + HOMEKIDS + PARENT1 + MSTATUS + SEX +
##     EDUCATION + JOB + CAR_USE + CAR_TYPE + RED_CAR + CLM_FREQ +
##     REVOKED + MVR_PTS + URBANICITY + HOME_VAL_BINS + AGE_BINS +
##     INCOME_BINS + YOJ_BINS + TRAVTIME_BINS + BLUEBOOK_BINS +
##     TIF_BINS + OLDCLAIM_BINS + CAR_AGE_BINS
##
##                 Df Deviance    AIC
## - CLM_FREQ       4   5719.2 5895.2
## - HOMEKIDS       5   5722.6 5896.6
## - OLDCLAIM_BINS  5   5724.9 5898.9
## - YOJ_BINS       4   5724.7 5900.7
## - RED_CAR        1   5719.2 5901.2
## <none>               5717.9 5901.9
## - PARENT1        1   5720.7 5902.7
## - CAR_AGE_BINS   5   5729.1 5903.1
## - SEX            1   5721.2 5903.2
## - BLUEBOOK_BINS  6   5732.1 5904.1
## - EDUCATION      3   5726.7 5904.7
## - TIF_BINS       4   5734.1 5910.1
## - TRAVTIME_BINS  5   5736.4 5910.4
## - HOME_VAL_BINS  1   5735.2 5917.2
## - MSTATUS        1   5736.5 5918.5
## - INCOME_BINS    7   5754.2 5924.2
## - KIDSDRIV       4   5749.9 5925.9
## - AGE_BINS       5   5753.7 5927.7
## - MVR_PTS       12   5776.5 5936.5
## - REVOKED        1   5778.0 5960.0
## - JOB            8   5794.9 5962.9
## - CAR_TYPE       5   5789.3 5963.3
## - CAR_USE        1   5785.0 5967.0
## - URBANICITY     1   6151.3 6333.3
##
## Step:  AIC=5895.21
## TARGET_FLAG ~ KIDSDRIV + HOMEKIDS + PARENT1 + MSTATUS + SEX +
##     EDUCATION + JOB + CAR_USE + CAR_TYPE + RED_CAR + REVOKED +
##     MVR_PTS + URBANICITY + HOME_VAL_BINS + AGE_BINS + INCOME_BINS +
##     YOJ_BINS + TRAVTIME_BINS + BLUEBOOK_BINS + TIF_BINS + OLDCLAIM_BINS +
##     CAR_AGE_BINS
##
##                 Df Deviance    AIC
## - HOMEKIDS       5   5724.0 5890.0
## - YOJ_BINS       4   5726.1 5894.1
## - RED_CAR        1   5720.5 5894.5
## <none>               5719.2 5895.2
## - PARENT1        1   5722.0 5896.0
## - CAR_AGE_BINS   5   5730.4 5896.4
## - SEX            1   5722.5 5896.5
## - BLUEBOOK_BINS  6   5733.6 5897.6
## - EDUCATION      3   5728.0 5898.0
## - TIF_BINS       4   5735.6 5903.6
## - TRAVTIME_BINS  5   5737.8 5903.8
## - HOME_VAL_BINS  1   5736.6 5910.6
## - MSTATUS        1   5738.0 5912.0
```

```
## - INCOME_BINS    7   5756.1 5918.1
## - KIDSDRIV       4   5751.5 5919.5
## - AGE_BINS       5   5755.2 5921.2
## - OLDCLAIM_BINS  6   5764.0 5928.0
## - MVR_PTS       12   5777.5 5929.5
## - REVOKED        1   5779.1 5953.1
## - JOB            8   5796.2 5956.2
## - CAR_TYPE       5   5790.6 5956.6
## - CAR_USE        1   5786.5 5960.5
## - URBANICITY     1   6152.9 6326.9
##
## Step:  AIC=5889.98
## TARGET_FLAG ~ KIDSDRIV + PARENT1 + MSTATUS + SEX + EDUCATION +
##     JOB + CAR_USE + CAR_TYPE + RED_CAR + REVOKED + MVR_PTS +
##     URBANICITY + HOME_VAL_BINS + AGE_BINS + INCOME_BINS + YOJ_BINS +
##     TRAVTIME_BINS + BLUEBOOK_BINS + TIF_BINS + OLDCLAIM_BINS +
##     CAR_AGE_BINS
##
##                 Df Deviance    AIC
## - YOJ_BINS       4   5731.1 5889.1
## - RED_CAR        1   5725.3 5889.3
## <none>               5724.0 5890.0
## - SEX            1   5727.0 5891.0
## - CAR_AGE_BINS   5   5735.5 5891.5
## - EDUCATION      3   5732.4 5892.4
## - BLUEBOOK_BINS  6   5738.6 5892.6
## - PARENT1        1   5730.9 5894.9
## - TIF_BINS       4   5740.2 5898.2
## - TRAVTIME_BINS  5   5742.9 5898.9
## - HOME_VAL_BINS  1   5741.6 5905.6
## - MSTATUS        1   5742.0 5906.0
## - INCOME_BINS    7   5760.5 5912.5
## - AGE_BINS       5   5764.3 5920.3
## - OLDCLAIM_BINS  6   5769.0 5923.0
## - KIDSDRIV       4   5765.4 5923.4
## - MVR_PTS       12   5782.9 5924.9
## - REVOKED        1   5783.5 5947.5
## - CAR_TYPE       5   5794.8 5950.8
## - JOB            8   5801.4 5951.4
## - CAR_USE        1   5791.3 5955.3
## - URBANICITY     1   6157.0 6321.0
##
## Step:  AIC=5889.1
## TARGET_FLAG ~ KIDSDRIV + PARENT1 + MSTATUS + SEX + EDUCATION +
##     JOB + CAR_USE + CAR_TYPE + RED_CAR + REVOKED + MVR_PTS +
##     URBANICITY + HOME_VAL_BINS + AGE_BINS + INCOME_BINS + TRAVTIME_BINS +
##     BLUEBOOK_BINS + TIF_BINS + OLDCLAIM_BINS + CAR_AGE_BINS
##
##                 Df Deviance    AIC
## - RED_CAR        1   5732.4 5888.4
## <none>               5731.1 5889.1
## - SEX            1   5734.1 5890.1
## - CAR_AGE_BINS   5   5742.7 5890.7
## - BLUEBOOK_BINS  6   5745.3 5891.3
```

```
## - EDUCATION      3   5739.6 5891.6
## - PARENT1        1   5738.3 5894.3
## - TIF_BINS       4   5746.9 5896.9
## - TRAVTIME_BINS  5   5749.9 5897.9
## - HOME_VAL_BINS  1   5748.2 5904.2
## - MSTATUS        1   5749.9 5905.9
## - INCOME_BINS    7   5770.8 5914.8
## - AGE_BINS       5   5772.4 5920.4
## - OLDCLAIM_BINS  6   5775.3 5921.3
## - KIDSDRIV       4   5772.6 5922.6
## - MVR_PTS       12   5789.7 5923.7
## - REVOKED        1   5791.4 5947.4
## - JOB            8   5807.5 5949.5
## - CAR_TYPE       5   5802.8 5950.8
## - CAR_USE        1   5799.4 5955.4
## - URBANICITY     1   6164.2 6320.2
##
## Step:  AIC=5888.36
## TARGET_FLAG ~ KIDSDRIV + PARENT1 + MSTATUS + SEX + EDUCATION +
##     JOB + CAR_USE + CAR_TYPE + REVOKED + MVR_PTS + URBANICITY +
##     HOME_VAL_BINS + AGE_BINS + INCOME_BINS + TRAVTIME_BINS +
##     BLUEBOOK_BINS + TIF_BINS + OLDCLAIM_BINS + CAR_AGE_BINS
##
##                 Df Deviance    AIC
## - SEX            1   5734.3 5888.3
## <none>               5732.4 5888.4
## - CAR_AGE_BINS   5   5743.9 5889.9
## - BLUEBOOK_BINS  6   5746.3 5890.3
## - EDUCATION      3   5741.0 5891.0
## - PARENT1        1   5739.7 5893.7
## - TIF_BINS       4   5748.3 5896.3
## - TRAVTIME_BINS  5   5751.2 5897.2
## - HOME_VAL_BINS  1   5749.3 5903.3
## - MSTATUS        1   5751.1 5905.1
## - INCOME_BINS    7   5771.9 5913.9
## - AGE_BINS       5   5773.4 5919.4
## - OLDCLAIM_BINS  6   5776.7 5920.7
## - KIDSDRIV       4   5773.7 5921.7
## - MVR_PTS       12   5790.9 5922.9
## - REVOKED        1   5792.4 5946.4
## - JOB            8   5809.0 5949.0
## - CAR_TYPE       5   5804.6 5950.6
## - CAR_USE        1   5800.5 5954.5
## - URBANICITY     1   6165.3 6319.3
##
## Step:  AIC=5888.28
## TARGET_FLAG ~ KIDSDRIV + PARENT1 + MSTATUS + EDUCATION + JOB +
##     CAR_USE + CAR_TYPE + REVOKED + MVR_PTS + URBANICITY + HOME_VAL_BINS +
##     AGE_BINS + INCOME_BINS + TRAVTIME_BINS + BLUEBOOK_BINS +
##     TIF_BINS + OLDCLAIM_BINS + CAR_AGE_BINS
##
##                 Df Deviance    AIC
## <none>               5734.3 5888.3
## - CAR_AGE_BINS   5   5745.9 5889.9
```

```
## - EDUCATION      3   5742.8 5890.8
## - PARENT1        1   5741.4 5893.4
## - BLUEBOOK_BINS  6   5752.6 5894.6
## - TIF_BINS       4   5750.2 5896.2
## - TRAVTIME_BINS  5   5753.2 5897.2
## - HOME_VAL_BINS  1   5751.1 5903.1
## - MSTATUS        1   5753.3 5905.3
## - INCOME_BINS    7   5774.5 5914.5
## - AGE_BINS       5   5776.4 5920.4
## - OLDCLAIM_BINS  6   5778.9 5920.9
## - KIDSDRIV       4   5775.2 5921.2
## - MVR_PTS       12   5792.4 5922.4
## - REVOKED        1   5794.5 5946.5
## - JOB            8   5810.5 5948.5
## - CAR_USE        1   5802.3 5954.3
## - CAR_TYPE       5   5815.7 5959.7
## - URBANICITY     1   6167.2 6319.2
```

```
summary(model_6)
```

```
##
## Call:
## glm(formula = TARGET_FLAG ~ KIDSDRIV + PARENT1 + MSTATUS + EDUCATION +
##     JOB + CAR_USE + CAR_TYPE + REVOKED + MVR_PTS + URBANICITY +
##     HOME_VAL_BINS + AGE_BINS + INCOME_BINS + TRAVTIME_BINS +
##     BLUEBOOK_BINS + TIF_BINS + OLDCLAIM_BINS + CAR_AGE_BINS,
##     family = "binomial", data = training_BINS %>% select(-INDEX,
##         -TARGET_AMT, -AGE, -YOJ, -TRAVTIME, -BLUEBOOK, -OLDCLAIM,
##         -CAR_AGE, -TIF, -HOME_VAL, -INCOME))
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.5417  -0.7048  -0.3981   0.6101   2.9265
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   -2.47488    0.43057  -5.748 9.04e-09 ***
## KIDSDRIV1                      0.52031    0.12475   4.171 3.04e-05 ***
## KIDSDRIV2                      0.80656    0.17430   4.627 3.70e-06 ***
## KIDSDRIV3                      0.96750    0.33412   2.896 0.003784 **
## KIDSDRIV4                    -13.05643  292.81781  -0.045 0.964435
## PARENT1Yes                     0.30441    0.11413   2.667 0.007649 **
## MSTATUSYes                    -0.43023    0.09805  -4.388 1.14e-05 ***
## EDUCATIONHigh School           0.28995    0.10092   2.873 0.004064 **
## EDUCATIONMasters              -0.02865    0.16711  -0.171 0.863858
## EDUCATIONPhD                   0.02190    0.21118   0.104 0.917394
## JOBBlue Collar                 0.36954    0.21242   1.740 0.081915 .
## JOBClerical                    0.55765    0.22569   2.471 0.013478 *
## JOBDoctor                     -0.14131    0.28983  -0.488 0.625855
## JOBHome Maker                  0.02082    0.25992   0.080 0.936158
## JOBLawyer                      0.34810    0.19213   1.812 0.070028 .
## JOBManager                    -0.55791    0.19886  -2.806 0.005022 **
## JOBProfessional                0.26733    0.20416   1.309 0.190409
## JOBStudent                    -0.24326    0.27438  -0.887 0.375315
## CAR_USEPrivate                -0.81455    0.09979  -8.163 3.27e-16 ***
```

```
## CAR_TYPEPanel Truck             0.52180    0.17670   2.953 0.003147 **
## CAR_TYPEPickup                  0.47742    0.11783   4.052 5.08e-05 ***
## CAR_TYPESports Car              0.96280    0.12426   7.749 9.29e-15 ***
## CAR_TYPESUV                     0.72548    0.09874   7.347 2.02e-13 ***
## CAR_TYPEVan                     0.61664    0.13695   4.502 6.72e-06 ***
## REVOKEDYes                      0.71777    0.09170   7.827 4.98e-15 ***
## MVR_PTS1                        0.09838    0.10347   0.951 0.341683
## MVR_PTS10                       0.88767    0.82232   1.079 0.280375
## MVR_PTS11                       2.27770    1.09482   2.080 0.037486 *
## MVR_PTS13                      14.92806  313.76010   0.048 0.962053
## MVR_PTS2                        0.28320    0.10827   2.616 0.008906 **
## MVR_PTS3                        0.31999    0.11659   2.745 0.006060 **
## MVR_PTS4                        0.33598    0.12604   2.666 0.007686 **
## MVR_PTS5                        0.24591    0.14687   1.674 0.094063 .
## MVR_PTS6                        0.32690    0.17473   1.871 0.061357 .
## MVR_PTS7                        0.80027    0.20094   3.983 6.81e-05 ***
## MVR_PTS8                        1.38478    0.31406   4.409 1.04e-05 ***
## MVR_PTS9                        1.26570    0.39717   3.187 0.001439 **
## URBANICITYHighly Urban/ Urban   2.20281    0.12430  17.722  < 2e-16 ***
## HOME_VAL_BINS5000+             -0.39792    0.09747  -4.082 4.46e-05 ***
## AGE_BINS20-30                  -0.34432    0.11037  -3.120 0.001809 **
## AGE_BINS30-40                  -0.53465    0.11450  -4.670 3.02e-06 ***
## AGE_BINS40-50                   0.05676    0.13656   0.416 0.677669
## AGE_BINS50-60                   0.01095    0.35156   0.031 0.975161
## AGE_BINS60-70                 -11.98257  535.41123  -0.022 0.982145
## INCOME_BINS1000-20000          -0.56757    0.16335  -3.475 0.000512 ***
## INCOME_BINS100000-120000       -1.20507    0.23912  -5.040 4.66e-07 ***
## INCOME_BINS120000+             -1.26013    0.23690  -5.319 1.04e-07 ***
## INCOME_BINS20000-40000         -0.82333    0.19122  -4.306 1.66e-05 ***
## INCOME_BINS40000-60000         -0.74864    0.19952  -3.752 0.000175 ***
## INCOME_BINS60000-80000         -0.86174    0.20890  -4.125 3.71e-05 ***
## INCOME_BINS80000-100000        -1.18133    0.22549  -5.239 1.61e-07 ***
## TRAVTIME_BINS25-45              0.38692    0.26036   1.486 0.137263
## TRAVTIME_BINS45-65              0.52378    0.26609   1.968 0.049017 *
## TRAVTIME_BINS5-25               0.17065    0.26348   0.648 0.517189
## TRAVTIME_BINS65-85              0.21226    0.31641   0.671 0.502337
## TRAVTIME_BINS85-105            -0.11805    0.41511  -0.284 0.776127
## BLUEBOOK_BINS1500-11500         0.27412    0.08472   3.235 0.001215 **
## BLUEBOOK_BINS21500-31500       -0.14954    0.11328  -1.320 0.186815
## BLUEBOOK_BINS31500-41500       -0.05066    0.19620  -0.258 0.796234
## BLUEBOOK_BINS41500-51500        0.11412    0.47755   0.239 0.811127
## BLUEBOOK_BINS51500-61500        1.08353    1.43642   0.754 0.450651
## BLUEBOOK_BINS61500-71500        1.17139    1.33939   0.875 0.381807
## TIF_BINS10-15                  -0.36951    0.40439  -0.914 0.360858
## TIF_BINS15-20                  -0.06061    0.08625  -0.703 0.482247
## TIF_BINS20-25                  -0.26606    0.08088  -3.290 0.001004 **
## TIF_BINS5-10                   -0.37804    0.14352  -2.634 0.008439 **
## OLDCLAIM_BINS1000-1500          0.62472    0.21268   2.937 0.003310 **
## OLDCLAIM_BINS1500-2000          0.50691    0.25669   1.975 0.048290 *
## OLDCLAIM_BINS2000-2500          0.94970    0.25954   3.659 0.000253 ***
## OLDCLAIM_BINS2500-3000          0.09229    0.26552   0.348 0.728159
## OLDCLAIM_BINS3000+              0.44105    0.07787   5.664 1.48e-08 ***
## OLDCLAIM_BINS500-1000           0.36142    0.26817   1.348 0.177746
## CAR_AGE_BINS10-15               0.07794    0.15327   0.508 0.611103
```

```
## CAR_AGE_BINS15-20              -0.49564    0.26284  -1.886 0.059332 .
## CAR_AGE_BINS20-25              -0.16757    0.35600  -0.471 0.637857
## CAR_AGE_BINS25+                -0.10616    0.08158  -1.301 0.193146
## CAR_AGE_BINS5-10               -0.24499    0.11198  -2.188 0.028683 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 7445.1  on 6447  degrees of freedom
## Residual deviance: 5734.3  on 6371  degrees of freedom
## AIC: 5888.3
##
## Number of Fisher Scoring iterations: 12
```

```
vif(model_6)
```

```
##                    GVIF Df GVIF^(1/(2*Df))
## KIDSDRIV       1.299621  4        1.033302
## PARENT1        1.664139  1        1.290015
## MSTATUS        2.220832  1        1.490246
## EDUCATION     11.311217  3        1.498252
## JOB           57.363514  8        1.287997
## CAR_USE        2.279000  1        1.509636
## CAR_TYPE       3.388980  5        1.129814
## REVOKED        1.031809  1        1.015780
## MVR_PTS        1.425387 12        1.014878
## URBANICITY     1.133109  1        1.064476
## HOME_VAL_BINS  2.005902  1        1.416299
## AGE_BINS       1.576845  5        1.046596
## INCOME_BINS    7.691790  7        1.156878
## TRAVTIME_BINS  1.073954  5        1.007160
## BLUEBOOK_BINS  2.514857  6        1.079882
## TIF_BINS       1.053493  4        1.006535
## OLDCLAIM_BINS  1.400568  6        1.028471
## CAR_AGE_BINS   2.431326  5        1.092910
```

Assessing selected models

Cleaning Test Data (test data set should have same variables, order of variables, format of variables and type of variables as a training set for model testing).

```
##       INDEX TARGET_FLAG  TARGET_AMT    KIDSDRIV         AGE    HOMEKIDS
##           0           0           0           0           0           0
##         YOJ      INCOME     PARENT1    HOME_VAL     MSTATUS         SEX
##           0           0           0           0           0           0
##   EDUCATION         JOB    TRAVTIME     CAR_USE    BLUEBOOK         TIF
##           0           0           0           0           0           0
##    CAR_TYPE     RED_CAR    OLDCLAIM    CLM_FREQ     REVOKED     MVR_PTS
##           0           0           0           0           0           0
##     CAR_AGE  URBANICITY
##           0           0
```

AIC, BIC, Loglik, pseudoR2

```
##              AIC      BIC    loglik  pseudoR2
## model_1 5879.306 6739.290 -2812.653 0.2444238
## model_2 5879.306 6739.290 -2812.653 0.2444238
## model_3 5924.762 6730.574 -2843.381 0.2361692
## model_4 5866.371 6726.355 -2806.186 0.2461612
## model_5 5889.726 6512.706 -2852.863 0.2336221
## model_6 5888.275 6409.683 -2867.138 0.2297874
```

Choosing the best model and applying it on test data set, saving results as a csv file

Model_1 was selected as the best model based on AIC, BIC, Loglik and pseudoR2

Assessing the performance of the choosen model: ROC and AUC