STAT448 Bigdata - Assignment 2

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1. (20 marks) R exercise. On learn, in the folder for the assignment 2 you will find 2 files: the RData file "Residen" and the excel file "Residential-Building-Data-Set.xlsx". Residen is a copy of the dataset in the excel file were the variables names have been changed for use in R. The excel file contains also a description of the variables. More information on the dataset can be obtained on the UCI webpage: https://archive.ics.uci.edu/ml/datasets/Residential+Building+Data+Set.

   Clearing the objects from history and adding necessary libraries.

```
rm(list=ls()) # To clear the objects
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 3.6.3
```

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

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

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

```
library(scorecard) # Used to create seed and for splitting the dataset.
```

```
## Warning: package 'scorecard' was built under R version 3.6.3
```

```
library(MASS)
```

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

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

```r
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.6.3
```

```r
library(leaps)
```

```
## Warning: package 'leaps' was built under R version 3.6.3
```

```r
library(glmnet)
```

```
## Warning: package 'glmnet' was built under R version 3.6.3

## Loading required package: Matrix

## Loaded glmnet 3.0-2
```

```r
library(Metrics) # To calcuate RMSE
```

(a) Set a seed at the beginning of your code equal to the last 4 numbers of your student id (or one of your student id's if you work in pairs).

Loading the data, setting seed and split the dataset into Training and test is combined into one chunk of code in answer to question (b). The library *scorecard* helps to perform the seed and dataset split process in one go. The test and train data are stored in a list and can be accessed by calling $df\_Residentrain * and * df_Residentest$.

(b) Split the data set into a training set and a test set.

```r
# Load the "Residen" R Data file.
load("Residen.RData")
ls.str(Residen)
```

```
## COMPLETION QUARTER :  num [1:372] 1 4 4 2 2 1 1 3 4 4 ...
## COMPLETION YEAR :  num [1:372] 85 89 81 73 90 90 90 89 77 80 ...
## START QUARTER :  num [1:372] 1 1 1 2 1 1 2 1 3 1 ...
## START YEAR :  num [1:372] 81 84 78 72 87 87 87 88 76 80 ...
## V1 :  num [1:372] 1 1 1 1 1 1 1 1 1 1 ...
## V10 :  num [1:372] 56.2 106 41 12.1 203.8 ...
## V100 :  num [1:372] 54.26 89.79 32.04 8.34 140.2 ...
## V101 :  num [1:372] 2978 11379 1653 686 9821 ...
## V102 :  num [1:372] 41407 44835 37933 8194 48260 ...
## V103 :  num [1:372] 601988 929027 377829 122032 1734974 ...
## V104 :  num [1:372] 2200 5000 1200 165 5500 5200 5800 4600 870 1700 ...
## V105 :  num [1:372] 410 1000 170 30 700 700 900 600 110 190 ...
## V11 :  num [1:372] 61.5 103 41.2 10 162.8 ...
## V12 :  num [1:372] 6.11 3.15 1.74 1.24 6.46 6.46 6.73 3.44 2.28 5.97 ...
## V13 :  num [1:372] 320957 685698 160402 38194 1640293 ...
## V14 :  num [1:372] 3486 3526 1218 287 10855 ...
## V15 :  num [1:372] 64.5 105.5 34.4 13.6 229.3 ...
## V16 :  num [1:372] 240 209 286 17 393 ...
## V17 :  num [1:372] 12457 17584 6489 154 69445 ...
```

```
## V18 :  num [1:372] 15 15 15 12 11 11 11 11 15 15 ...
## V19 :  num [1:372] 797 1408 614 184 2739 ...
## V2 :  num [1:372] 3150 7600 4800 685 3000 2500 1810 1150 2110 3030 ...
## V20 :  num [1:372] 810 1474 608 211 3148 ...
## V21 :  num [1:372] 1755 8842 1755 1613 9248 ...
## V22 :  num [1:372] 8003 8864 7773 1649 9380 ...
## V23 :  num [1:372] 67.8 105.5 45.9 11.6 158.6 ...
## V24 :  num [1:372] 63.2 105.3 38.3 10.1 169.5 ...
## V25 :  num [1:372] 3759 12113 1538 393 10082 ...
## V26 :  num [1:372] 42587 45966 39066 8436 49572 ...
## V27 :  num [1:372] 628133 1188996 524765 141543 2318397 ...
## V28 :  num [1:372] 4986 2700 1580 2952 6370 ...
## V29 :  num [1:372] 55.5 103 40.3 11.6 190.3 ...
## V3 :  num [1:372] 920 1140 840 202 800 640 492 380 540 930 ...
## V30 :  num [1:372] 60.8 101.8 40.8 8.5 154.4 ...
## V31 :  num [1:372] 3.94 2.65 1.15 1.99 5.33 5.33 6.46 3.8 2.32 4.3 ...
## V32 :  num [1:372] 297210 625829 150267 35859 1523167 ...
## V33 :  num [1:372] 3664 4387 1150 322 12930 ...
## V34 :  num [1:372] 61.5 100.4 34.1 12.7 210.7 ...
## V35 :  num [1:372] 179.6 156.6 214.3 56.6 295 ...
## V36 :  num [1:372] 9342 13188 4867 610 52084 ...
## V37 :  num [1:372] 15 15 15 12 11 11 11 11 15 15 ...
## V38 :  num [1:372] 758 1424 574 165 2595 ...
## V39 :  num [1:372] 862 1584 680 209 3000 ...
## V4 :  num [1:372] 598.5 3040 480 13.7 1230 ...
## V40 :  num [1:372] 1755 8777 1755 1504 9330 ...
## V41 :  num [1:372] 8018 8799 6714 1582 9396 ...
## V42 :  num [1:372] 65 101 43.4 10.9 148.8 ...
## V43 :  num [1:372] 60.53 101.89 36.45 9.79 159 ...
## V44 :  num [1:372] 3539 13572 1535 435 9700 ...
## V45 :  num [1:372] 31940 34475 29300 32776 37179 ...
## V46 :  num [1:372] 610503 1067772 466212 129102 1908976 ...
## V47 :  num [1:372] 6788 3561 2628 2649 5909 ...
## V48 :  num [1:372] 54.2 98.2 39.3 11.4 177.6 ...
## V49 :  num [1:372] 59.4 98.64 40.21 6.97 147.44 ...
## V5 :  num [1:372] 190 400 100 20 410 420 640 500 90 170 ...
## V50 :  num [1:372] 5.41 2.76 1.52 2.25 6.88 6.88 5.33 6.54 2.69 3.53 ...
## V51 :  num [1:372] 280452 602225 143738 32794 1451176 ...
## V52 :  num [1:372] 3756 3819 1284 389 8146 ...
## V53 :  num [1:372] 58.1 97.2 33.5 11.7 188.9 ...
## V54 :  num [1:372] 119.8 104.4 142.9 42.5 196.7 ...
## V55 :  num [1:372] 6228 8792 3245 458 34722 ...
## V56 :  num [1:372] 15 15 15 12 11 11 11 11 15 15 ...
## V57 :  num [1:372] 795 1299 554 168 2284 ...
## V58 :  num [1:372] 818 1390 664 210 2628 ...
## V59 :  num [1:372] 1755 8700 1755 1450 9297 ...
## V6 :  num [1:372] 1011 964 690 460 632 ...
## V60 :  num [1:372] 8001 8735 5827 1507 9347 ...
## V61 :  num [1:372] 63.7 98.1 41.8 10.2 140.9 ...
## V62 :  num [1:372] 58.55 98.45 34.76 9.35 146.2 ...
## V63 :  num [1:372] 3348 13596 1528 509 10149 ...
## V64 :  num [1:372] 21294 22983 19533 24582 24786 ...
## V65 :  num [1:372] 589390 973524 409678 123618 1681849 ...
## V66 :  num [1:372] 5728 3157 2374 2312 7045 ...
```

```
## V67 :  num [1:372] 52.4 92.8 38 10.6 160 ...
## V68 :  num [1:372] 57.65 96.49 39.43 5.44 141.34 ...
## V69 :  num [1:372] 5.4 3.05 0.92 2.58 4.72 4.72 6.88 6.73 2.68 3.39 ...
## V7 :  num [1:372] 16 23 15 4 13 12 11 6 5 3 ...
## V70 :  num [1:372] 262789 552124 134548 30012 1341073 ...
## V71 :  num [1:372] 2931 3897 1191 345 8245 ...
## V72 :  num [1:372] 54.2 96.9 33.7 10.8 173.8 ...
## V73 :  num [1:372] 59.9 52.2 71.5 28.3 98.3 ...
## V74 :  num [1:372] 3114 4396 1622 305 17361 ...
## V75 :  num [1:372] 15 15 15 12 11 11 11 11 15 15 ...
## V76 :  num [1:372] 747 1294 575 180 2451 ...
## V77 :  num [1:372] 816 1288 680 158 2526 ...
## V78 :  num [1:372] 1755 8556 1755 1439 9254 ...
## V79 :  num [1:372] 8013 8585 5565 1450 9306 ...
## V8 :  num [1:372] 1200 2900 630 140 5000 4800 5700 5300 690 1500 ...
## V80 :  num [1:372] 62.78 95.35 41.03 9.91 136.56 ...
## V81 :  num [1:372] 56.45 94.34 33.37 8.85 138.8 ...
## V82 :  num [1:372] 3388 12064 1602 591 9291 ...
## V83 :  num [1:372] 10647 11492 9766 16388 12393 ...
## V84 :  num [1:372] 606524 954629 403875 121857 1732938 ...
## V85 :  num [1:372] 7196 3678 2693 1381 5606 ...
## V86 :  num [1:372] 51.3 86.2 36.2 10 149.1 ...
## V87 :  num [1:372] 56.13 83.21 37.64 3.91 134.8 ...
## V88 :  num [1:372] 5.97 3.25 1.55 3 4.09 4.09 4.72 6.46 3.56 3.25 ...
## V89 :  num [1:372] 249111 526596 134313 27231 1284199 ...
## V9 :  num [1:372] 6713 3152 1627 2581 6790 ...
## V90 :  num [1:372] 2562 2791 1529 316 6622 ...
## V91 :  num [1:372] 52.8 94.1 31.43 9.85 147.6 ...
## V92 :  num [1:372] 217 334.8 175.7 14.2 432.4 ...
## V93 :  num [1:372] 10446 14489 3995 153 73144 ...
## V94 :  num [1:372] 15 15 15 12 14 14 11 11 15 15 ...
## V95 :  num [1:372] 734 1144 590 198 2221 ...
## V96 :  num [1:372] 816 1316 766 152 2244 ...
## V97 :  num [1:372] 1755 8365 1755 1442 9232 ...
## V98 :  num [1:372] 8002 8393 4930 1456 9286 ...
## V99 :  num [1:372] 60.74 90.95 38.7 9.73 136.6 ...
```

```
Residen = na.omit(Residen)  # removes rows with "N/A" values

# Split the dataset into Training set and test set in the ratio (Train-80%; Test-20%)
df_Residen <- split_df(Residen, ratio = c(0.80, 0.20), seed = 4765, name_dfs = c("train_Residen", '

   # dimension of Training set and test set is given by,

dim(df_Residen$train_Residen)
```

```
## [1] 297 109
```

```
dim(df_Residen$test_Residen)
```

```
## [1]  75 109
```

```r
    # create matricies for the regression equation
    x_Residen = model.matrix(V104~.,Residen)[,-1]
    y_Residen = Residen %>%
      dplyr::select(V104) %>%
      unlist() %>%
      as.numeric()

    x_train_Residen = model.matrix(V104~., df_Residen$train_Residen)[,-1]
    x_test_Residen = model.matrix(V104~., df_Residen$test_Residen)[,-1]

    y_train_Residen = df_Residen$train_Residen %>%
      dplyr::select(V104) %>%
      unlist() %>%
      as.numeric()

    y_test_Residen = df_Residen$test_Residen %>%
      dplyr::select(V104) %>%
      unlist() %>%
      as.numeric()
```

(c) Fit a linear regression model on the training set to explain the "actual sales price" (V104) in ter


```r
lm_model = lm(V104 ~. -V105, data=df_Residen$train_Residen)
summary(lm_model)
```

```
##
## Call:
## lm(formula = V104 ~ . - V105, data = df_Residen$train_Residen)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -872.52  -52.42    0.00   44.56  490.09
##
## Coefficients: (32 not defined because of singularities)
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)             2.635e+04  2.367e+05   0.111  0.91146
## `START YEAR`           -5.838e+02  3.987e+03  -0.146  0.88373
## `START QUARTER`        -2.471e+01  2.742e+03  -0.009  0.99282
## `COMPLETION YEAR`       1.683e+02  1.914e+01   8.795 4.12e-16 ***
## `COMPLETION QUARTER`    6.645e+01  1.010e+01   6.581 3.35e-10 ***
## V1                     -4.484e+00  2.631e+00  -1.704  0.08971 .
## V2                      5.989e-02  2.613e-02   2.292  0.02284 *
## V3                     -2.246e-01  7.694e-02  -2.919  0.00388 **
## V4                      1.796e-02  3.913e-02   0.459  0.64669
## V5                     -1.226e+00  3.976e-01  -3.083  0.00231 **
## V6                      1.667e-01  7.050e-02   2.364  0.01894 *
## V7                             NA         NA      NA       NA
## V8                      1.242e+00  2.055e-02  60.459  < 2e-16 ***
```

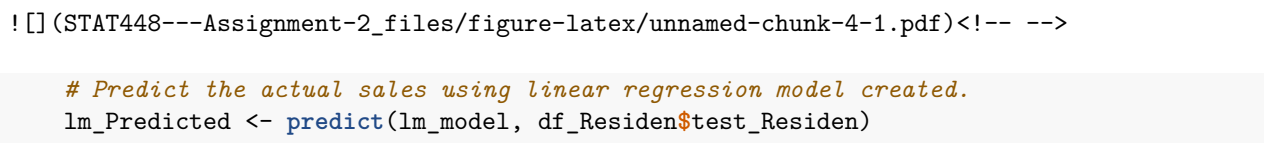
```
## V9                   1.180e-01  1.274e+00   0.093  0.92628
## V10                  8.466e+01  1.107e+03   0.077  0.93909
## V11                 -6.907e+00  8.007e+01  -0.086  0.93133
## V12                 -1.659e+02  7.825e+02  -0.212  0.83234
## V13                 -8.780e-04  1.286e-01  -0.007  0.99456
## V14                 -1.830e-02  5.157e-01  -0.035  0.97172
## V15                  5.344e-02  5.827e+01   0.001  0.99927
## V16                  2.668e-01  3.254e+00   0.082  0.93473
## V17                  1.246e-02  2.096e-01   0.059  0.95264
## V18                  1.238e+02  1.422e+03   0.087  0.93071
## V19                 -2.255e-01  5.310e+00  -0.042  0.96616
## V20                 -5.245e-01  1.327e+00  -0.395  0.69298
## V21                  4.909e-02  4.107e-01   0.120  0.90498
## V22                 -1.507e-01  5.240e-01  -0.288  0.77399
## V23                 -2.721e+00  6.993e+02  -0.004  0.99690
## V24                 -4.574e+01  2.747e+02  -0.167  0.86790
## V25                  6.374e-03  1.127e-01   0.057  0.95496
## V26                  1.673e-02  4.816e-01   0.035  0.97232
## V27                  4.384e-04  1.128e-02   0.039  0.96904
## V28                 -1.086e-02  1.898e-01  -0.057  0.95443
## V29                 -4.055e+01  9.876e+02  -0.041  0.96729
## V30                 -4.683e+00  1.639e+02  -0.029  0.97724
## V31                  5.711e+01  3.250e+02   0.176  0.86066
## V32                  8.338e-04  9.612e-02   0.009  0.99309
## V33                 -1.363e-01  4.318e-01  -0.316  0.75263
## V34                  5.875e+00  1.228e+02   0.048  0.96189
## V35                  8.572e-01  2.319e+00   0.370  0.71196
## V36                 -1.530e-02  9.019e-02  -0.170  0.86549
## V37                  4.561e+01  7.124e+02   0.064  0.94901
## V38                  3.129e-01  7.208e+00   0.043  0.96541
## V39                 -3.384e-01  2.324e+00  -0.146  0.88438
## V40                 -7.732e-02  2.101e-01  -0.368  0.71326
## V41                  3.610e-02  6.799e-01   0.053  0.95770
## V42                  1.237e+02  7.361e+02   0.168  0.86667
## V43                 -3.889e+01  1.047e+03  -0.037  0.97041
## V44                 -9.322e-02  6.084e-01  -0.153  0.87836
## V45                  1.302e-02  3.989e-01   0.033  0.97398
## V46                  3.559e-04  9.530e-03   0.037  0.97025
## V47                  3.990e-02  2.765e-01   0.144  0.88537
## V48                  1.068e+02  1.525e+03   0.070  0.94424
## V49                 -1.242e+01  5.762e+01  -0.215  0.82958
## V50                 -3.648e+00  4.847e+02  -0.008  0.99400
## V51                 -3.117e-04  1.604e-01  -0.002  0.99845
## V52                  1.338e-02  5.755e-01   0.023  0.98147
## V53                  4.252e+00  1.473e+02   0.029  0.97699
## V54                  2.306e+00  5.435e+00   0.424  0.67184
## V55                 -1.497e-02  1.835e-01  -0.082  0.93509
## V56                 -4.105e+01  3.425e+02  -0.120  0.90469
## V57                  5.529e-01  2.621e+00   0.211  0.83312
## V58                 -1.221e+00  3.672e+00  -0.333  0.73982
## V59                  1.542e-02  6.172e-01   0.025  0.98009
## V60                 -1.641e-01  1.503e+00  -0.109  0.91317
## V61                 -1.282e+01  1.770e+02  -0.072  0.94229
## V62                  9.738e+01  1.571e+03   0.062  0.95062
```

```
## V63                 -4.730e-02  9.774e-01  -0.048  0.96145
## V64                  2.204e-03  4.229e-01   0.005  0.99585
## V65                 -5.740e-04  9.110e-03  -0.063  0.94982
## V66                 -2.774e-02  8.094e-01  -0.034  0.97269
## V67                 -1.089e+02  8.942e+02  -0.122  0.90314
## V68                  2.677e+01  7.894e+01   0.339  0.73484
## V69                  1.043e+02  1.662e+02   0.628  0.53087
## V70                 -5.257e-03  5.081e-02  -0.103  0.91769
## V71                 -5.157e-02  4.960e-01  -0.104  0.91728
## V72                 -3.418e+01  2.545e+02  -0.134  0.89329
## V73                         NA         NA      NA       NA
## V74                         NA         NA      NA       NA
## V75                         NA         NA      NA       NA
## V76                         NA         NA      NA       NA
## V77                         NA         NA      NA       NA
## V78                         NA         NA      NA       NA
## V79                         NA         NA      NA       NA
## V80                         NA         NA      NA       NA
## V81                         NA         NA      NA       NA
## V82                         NA         NA      NA       NA
## V83                         NA         NA      NA       NA
## V84                         NA         NA      NA       NA
## V85                         NA         NA      NA       NA
## V86                         NA         NA      NA       NA
## V87                         NA         NA      NA       NA
## V88                         NA         NA      NA       NA
## V89                         NA         NA      NA       NA
## V90                         NA         NA      NA       NA
## V91                         NA         NA      NA       NA
## V92                         NA         NA      NA       NA
## V93                         NA         NA      NA       NA
## V94                         NA         NA      NA       NA
## V95                         NA         NA      NA       NA
## V96                         NA         NA      NA       NA
## V97                         NA         NA      NA       NA
## V98                         NA         NA      NA       NA
## V99                         NA         NA      NA       NA
## V100                        NA         NA      NA       NA
## V101                        NA         NA      NA       NA
## V102                        NA         NA      NA       NA
## V103                        NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 149.7 on 221 degrees of freedom
## Multiple R-squared:  0.9891, Adjusted R-squared:  0.9854
## F-statistic: 266.7 on 75 and 221 DF,  p-value: < 2.2e-16
```

```r
par(mfrow=c(2,2))
plot(lm_model)
```

```
## Warning: not plotting observations with leverage one:
##   28, 51, 78, 87, 97, 151, 187, 277

## Warning: not plotting observations with leverage one:
##   28, 51, 78, 87, 97, 151, 187, 277
```



```
    # Predict the actual sales using linear regression model created.
    lm_Predicted <- predict(lm_model, df_Residen$test_Residen)
```

```
## Warning in predict.lm(lm_model, df_Residen$test_Residen): prediction from a
## rank-deficient fit may be misleading
```

```
    # Create the actuals (V104 from test set) and lm_Predicted dataframe for metics calcuations.
    df_actuals_preds <- data.frame(cbind(actuals=df_Residen$test_Residen$V104, predicteds=lm_Predicted))
```

```
    # Calculating correlation of actuals and predicted.
    correlation_accuracy <- cor(df_actuals_preds)
    correlation_accuracy
```

```
##              actuals predicteds
## actuals    1.0000000  0.9920497
## predicteds 0.9920497  1.0000000
```

```
    lm_MSE <- mean((lm_Predicted - y_test_Residen)^2) # Calculate test MSE

    # Calcuating the RMSE of Linear regression model
    lm_model_RMSE = rmse(df_Residen$test_Residen$V104, lm_Predicted)
    lm_model_RMSE
```

```
## [1] 168.7208
```

```
    head(df_actuals_preds)
```

```
##   actuals predicteds
## 1    5500   6336.105
## 2    4600   5446.543
## 3    1700   1831.670
## 4    1500   1424.303
## 5    3800   3914.155
## 6    4600   4643.750
```

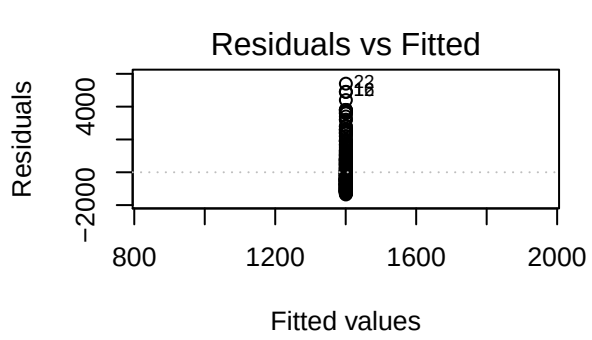
(d) Fit a linear regression model using stepwise selection on the training set. Report the test RMSE ob

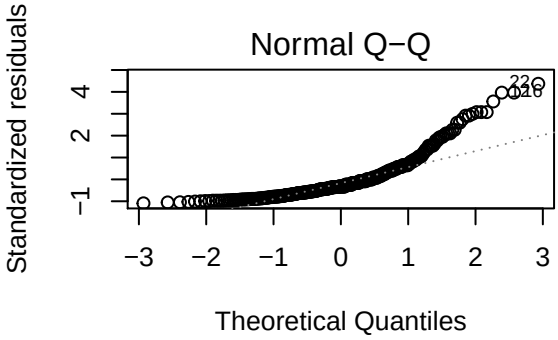

```r
    # Linear regression model using stepwise selection with "stepAIC"
    # Defining the initial model in the stepwise search.
    lm_model_0 = lm(V104 ~1, data=df_Residen$train_Residen)
    summary(lm_model_0)
```

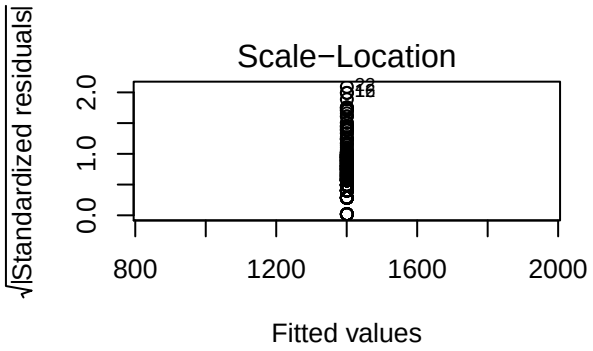
```
##
## Call:
## lm(formula = V104 ~ 1, data = df_Residen$train_Residen)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1350.5  -820.5  -400.5   399.5  5399.5
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1400.45      71.81    19.5   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1238 on 296 degrees of freedom
```

```r
    par(mfrow=c(2,2))
    plot(lm_model_0)
```

```
## hat values (leverages) are all = 0.003367003
##  and there are no factor predictors; no plot no. 5
```








```
    # Defining the upper limit model in the stepwise search.
    lm_model_1 = lm(V104 ~., data=df_Residen$train_Residen)
    summary(lm_model_1)
```

```
##
## Call:
## lm(formula = V104 ~ ., data = df_Residen$train_Residen)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -825.46  -43.61    0.00   38.99  506.95
##
## Coefficients: (32 not defined because of singularities)
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)             1.066e+05  2.146e+05   0.497 0.619840
## `START YEAR`           -1.774e+03  3.613e+03  -0.491 0.623972
## `START QUARTER`         6.731e+02  2.484e+03   0.271 0.786632
## `COMPLETION YEAR`       2.242e+01  2.697e+01   0.831 0.406649
## `COMPLETION QUARTER`    3.190e+01  1.037e+01   3.077 0.002354 **
## V1                     -3.982e+00  2.382e+00  -1.672 0.096017 .
## V2                      4.544e-02  2.374e-02   1.914 0.056900 .
## V3                     -1.734e-01  7.001e-02  -2.476 0.014038 *
## V4                      1.143e-02  3.542e-02   0.323 0.747246
## V5                     -4.963e+00  6.403e-01  -7.752 3.32e-13 ***
## V6                      2.473e-01  6.482e-02   3.816 0.000176 ***
## V7                             NA         NA      NA       NA
```

```
## V8                   1.256e+00  1.870e-02  67.174  < 2e-16 ***
## V9                   3.685e-01  1.154e+00   0.319 0.749703
## V10                  2.584e+02  1.002e+03   0.258 0.796699
## V11                  6.945e+01  7.327e+01   0.948 0.344252
## V12                 -3.436e+02  7.087e+02  -0.485 0.628253
## V13                  1.648e-02  1.164e-01   0.142 0.887577
## V14                 -7.470e-02  4.668e-01  -0.160 0.873021
## V15                 -1.867e+01  5.280e+01  -0.354 0.723913
## V16                  2.739e-01  2.945e+00   0.093 0.925988
## V17                 -5.521e-02  1.900e-01  -0.291 0.771593
## V18                  4.549e+02  1.288e+03   0.353 0.724337
## V19                 -1.399e+00  4.808e+00  -0.291 0.771286
## V20                  3.460e-01  1.207e+00   0.287 0.774677
## V21                  1.221e-01  3.719e-01   0.328 0.742956
## V22                  3.154e-01  4.788e-01   0.659 0.510815
## V23                 -1.616e+02  6.333e+02  -0.255 0.798795
## V24                  1.211e+02  2.497e+02   0.485 0.628128
## V25                  9.457e-02  1.028e-01   0.920 0.358584
## V26                  1.579e-01  4.364e-01   0.362 0.717882
## V27                  8.272e-05  1.021e-02   0.008 0.993543
## V28                 -9.095e-02  1.722e-01  -0.528 0.597802
## V29                 -2.716e+02  8.944e+02  -0.304 0.761645
## V30                 -4.447e+01  1.485e+02  -0.299 0.764864
## V31                  1.842e+02  2.947e+02   0.625 0.532657
## V32                 -8.541e-03  8.700e-02  -0.098 0.921890
## V33                 -5.354e-02  3.910e-01  -0.137 0.891196
## V34                  1.537e+01  1.112e+02   0.138 0.890155
## V35                  3.843e-01  2.099e+00   0.183 0.854946
## V36                 -1.634e-02  8.163e-02  -0.200 0.841488
## V37                 -1.144e+02  6.451e+02  -0.177 0.859414
## V38                 -1.217e+00  6.527e+00  -0.186 0.852278
## V39                 -5.760e-01  2.104e+00  -0.274 0.784502
## V40                 -1.175e-01  1.903e-01  -0.618 0.537486
## V41                 -1.120e-02  6.153e-01  -0.018 0.985500
## V42                  3.243e+02  6.668e+02   0.486 0.627206
## V43                 -3.112e+02  9.485e+02  -0.328 0.743138
## V44                 -3.279e-01  5.516e-01  -0.594 0.552862
## V45                  1.287e-01  3.614e-01   0.356 0.722098
## V46                 -1.509e-03  8.629e-03  -0.175 0.861330
## V47                  1.298e-02  2.502e-01   0.052 0.958680
## V48                  4.118e+02  1.381e+03   0.298 0.765839
## V49                 -1.907e+01  5.216e+01  -0.366 0.715082
## V50                  2.019e+01  4.387e+02   0.046 0.963335
## V51                 -1.773e-02  1.452e-01  -0.122 0.902911
## V52                 -1.356e-01  5.213e-01  -0.260 0.795026
## V53                 -3.302e+01  1.334e+02  -0.248 0.804705
## V54                 -7.384e-01  4.938e+00  -0.150 0.881275
## V55                 -6.241e-02  1.662e-01  -0.375 0.707719
## V56                  1.011e+02  3.106e+02   0.326 0.745054
## V57                 -4.498e-01  2.376e+00  -0.189 0.850018
## V58                  5.548e-01  3.333e+00   0.166 0.867923
## V59                  1.150e-01  5.588e-01   0.206 0.837085
## V60                 -4.996e-01  1.361e+00  -0.367 0.714001
## V61                  4.508e+00  1.602e+02   0.028 0.977575
```

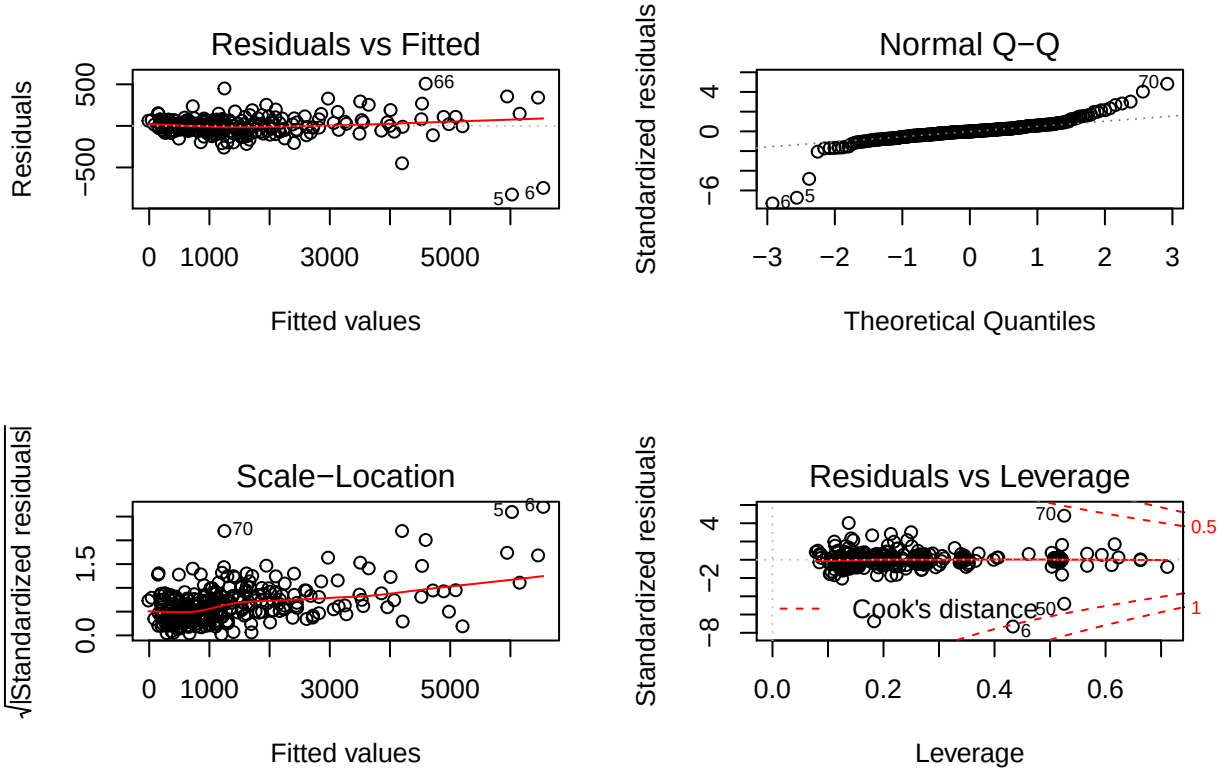
```
## V62                  3.623e+02  1.422e+03   0.255 0.799131
## V63                 -2.621e-01  8.851e-01  -0.296 0.767444
## V64                  1.414e-01  3.832e-01   0.369 0.712515
## V65                  8.056e-04  8.247e-03   0.098 0.922272
## V66                  1.242e-01  7.329e-01   0.169 0.865626
## V67                 -3.265e+02  8.099e+02  -0.403 0.687204
## V68                  4.451e+01  7.149e+01   0.623 0.534184
## V69                  1.070e+02  1.505e+02   0.711 0.477789
## V70                 -7.479e-05  4.599e-02  -0.002 0.998704
## V71                 -1.423e-01  4.491e-01  -0.317 0.751690
## V72                 -6.520e+01  2.304e+02  -0.283 0.777421
## V73                         NA         NA      NA       NA
## V74                         NA         NA      NA       NA
## V75                         NA         NA      NA       NA
## V76                         NA         NA      NA       NA
## V77                         NA         NA      NA       NA
## V78                         NA         NA      NA       NA
## V79                         NA         NA      NA       NA
## V80                         NA         NA      NA       NA
## V81                         NA         NA      NA       NA
## V82                         NA         NA      NA       NA
## V83                         NA         NA      NA       NA
## V84                         NA         NA      NA       NA
## V85                         NA         NA      NA       NA
## V86                         NA         NA      NA       NA
## V87                         NA         NA      NA       NA
## V88                         NA         NA      NA       NA
## V89                         NA         NA      NA       NA
## V90                         NA         NA      NA       NA
## V91                         NA         NA      NA       NA
## V92                         NA         NA      NA       NA
## V93                         NA         NA      NA       NA
## V94                         NA         NA      NA       NA
## V95                         NA         NA      NA       NA
## V96                         NA         NA      NA       NA
## V97                         NA         NA      NA       NA
## V98                         NA         NA      NA       NA
## V99                         NA         NA      NA       NA
## V100                        NA         NA      NA       NA
## V101                        NA         NA      NA       NA
## V102                        NA         NA      NA       NA
## V103                        NA         NA      NA       NA
## V105                 2.466e+00  3.493e-01   7.058 2.18e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 135.5 on 220 degrees of freedom
## Multiple R-squared:  0.9911, Adjusted R-squared:  0.988
## F-statistic:   322 on 76 and 220 DF,  p-value: < 2.2e-16
```

```
    par(mfrow=c(2,2))
    plot(lm_model_1)
```

```
## Warning: not plotting observations with leverage one:
```

```
##   28, 51, 78, 87, 97, 151, 187, 277

## Warning: not plotting observations with leverage one:
##   28, 51, 78, 87, 97, 151, 187, 277
```




```r
# Automatic stepwise search using AIC
  lm_model_st <- stepAIC(lm_model_0,direction="both",scope=list(upper=lm_model_1,lower=lm_model_0))
```

```
## Start:  AIC=4230.79
## V104 ~ 1
##
##                        Df Sum of Sq       RSS    AIC
## + V8                    1 432498248  20803816 3317.6
## + V105                  1 289984357 163317706 3929.6
## + V5                    1 279545849 173756214 3948.0
## + V80                   1 174373467 278928597 4088.6
## + `COMPLETION YEAR`     1 173852575 279449488 4089.1
## + V99                   1 173553730 279748334 4089.4
## + V100                  1 173369139 279932924 4089.6
## + V81                   1 172399305 280902758 4090.7
## + V61                   1 170792369 282509695 4092.4
## + V62                   1 170669736 282632328 4092.5
```

```
## + V76                  1 170223384 283078680 4092.9
## + `START YEAR`         1 170089955 283212109 4093.1
## + V103                 1 169853342 283448721 4093.3
## + V42                  1 168708789 284593275 4094.5
## + V68                  1 168643137 284658927 4094.6
## + V43                  1 168419175 284882889 4094.8
## + V13                  1 167904641 285397423 4095.4
## + V23                  1 167871530 285430534 4095.4
## + V24                  1 167244343 286057721 4096.1
## + V87                  1 167097805 286204259 4096.2
## + V84                  1 164426641 288875422 4099.0
## + V32                  1 164152868 289149196 4099.3
## + V49                  1 164139988 289162076 4099.3
## + V86                  1 162487279 290814785 4101.0
## + V57                  1 162457699 290844365 4101.0
## + V65                  1 161736314 291565750 4101.7
## + V51                  1 161468513 291833551 4102.0
## + V38                  1 161467715 291834349 4102.0
## + V27                  1 160883215 292418849 4102.6
## + V67                  1 160866717 292435347 4102.6
## + V95                  1 160057649 293244415 4103.4
## + V77                  1 159977893 293324171 4103.5
## + V19                  1 159965773 293336291 4103.5
## + V46                  1 158886737 294415326 4104.6
## + V30                  1 158707374 294594690 4104.8
## + V48                  1 158506585 294795479 4105.0
## + V70                  1 157300232 296001831 4106.2
## + V10                  1 157059917 296242147 4106.4
## + V29                  1 157030815 296271249 4106.5
## + V89                  1 156660341 296641723 4106.8
## + V11                  1 156172906 297129158 4107.3
## + V20                  1 153872313 299429751 4109.6
## + V101                 1 152512640 300789424 4111.0
## + V96                  1 152335093 300966970 4111.1
## + V39                  1 150287273 303014791 4113.2
## + V58                  1 150249514 303052550 4113.2
## + V82                  1 147188452 306113611 4116.2
## + V97                  1 145001275 308300789 4118.3
## + V78                  1 142483790 310818274 4120.7
## + V40                  1 141949540 311352523 4121.2
## + V59                  1 140678023 312624041 4122.4
## + V91                  1 139011750 314290313 4124.0
## + V72                  1 136415682 316886382 4126.5
## + V15                  1 135829742 317472322 4127.0
## + V21                  1 133509780 319792283 4129.2
## + V34                  1 131970924 321331140 4130.6
## + V55                  1 131879900 321422164 4130.7
## + V53                  1 131233688 322068375 4131.3
## + V17                  1 129950856 323351208 4132.5
## + V71                  1 129899052 323403011 4132.5
## + V63                  1 129333149 323968915 4133.0
## + V36                  1 128301238 325000826 4134.0
## + V44                  1 124791907 328510156 4137.2
## + V98                  1 119795404 333506660 4141.6
```

```
## + V79                    1 118500233 334801831 4142.8
## + V60                    1 118394468 334907596 4142.9
## + V14                    1 118059304 335242759 4143.2
## + V25                    1 117925412 335376651 4143.3
## + V41                    1 117684310 335617754 4143.5
## + V4                     1 117333295 335968769 4143.8
## + V52                    1 116097382 337204682 4144.9
## + V22                    1 115166519 338135544 4145.7
## + V33                    1 112089280 341212784 4148.4
## + V74                    1 110565348 342736716 4149.7
## + V93                    1 109272559 344029504 4150.9
## + V90                    1 103928091 349373972 4155.4
## + V1                     1  86770444 366531620 4169.7
## + V18                    1  72756820 380545243 4180.8
## + V16                    1  58147419 395154644 4192.0
## + V37                    1  54266920 399035144 4194.9
## + V92                    1  51988273 401313791 4196.6
## + V12                    1  51456038 401846026 4197.0
## + V35                    1  48351983 404950080 4199.3
## + V54                    1  45170784 408131280 4201.6
## + V31                    1  38929752 414372311 4206.1
## + V28                    1  37630462 415671601 4207.0
## + V9                     1  36708606 416593457 4207.7
## + V50                    1  36505743 416796321 4207.8
## + V73                    1  33941304 419360759 4209.7
## + V56                    1  33104133 420197930 4210.3
## + V2                     1  32159321 421142742 4210.9
## + V47                    1  23817050 429485013 4216.8
## + V69                    1  23631124 429670939 4216.9
## + V66                    1  22471338 430830725 4217.7
## + V102                   1  21651686 431650378 4218.3
## + V26                    1  21299570 432002494 4218.5
## + V88                    1  18631538 434670525 4220.3
## + V85                    1  17714169 435587894 4220.9
## + V75                    1  17466893 435835171 4221.1
## + V6                     1  15129688 438172376 4222.7
## + V3                     1  13020601 440281463 4224.1
## + V45                    1  11834255 441467809 4224.9
## + V64                    1  10072614 443229450 4226.1
## + V7                     1   8427810 444874253 4227.2
## + V94                    1   3325075 449976988 4230.6
## <none>                               453302064 4230.8
## + `START QUARTER`        1   2426983 450875081 4231.2
## + V83                    1   2078168 451223895 4231.4
## + `COMPLETION QUARTER`   1    272936 453029128 4232.6
##
## Step:  AIC=3317.6
## V104 ~ V8
##
##                         Df Sum of Sq       RSS    AIC
## + V94                    1   3597978  17205838 3263.2
## + V7                     1   2946082  17857734 3274.3
## + V71                    1   2921210  17882606 3274.7
## + V75                    1   2592704  18211112 3280.1
```

```
## + V52                  1   2567692  18236124 3280.5
## + V90                  1   2557950  18245865 3280.6
## + V72                  1   2466589  18337227 3282.1
## + V91                  1   2175270  18628546 3286.8
## + V56                  1   2136395  18667421 3287.4
## + V53                  1   2087463  18716353 3288.2
## + V88                  1   1781984  19021831 3293.0
## + V33                  1   1745311  19058505 3293.6
## + V69                  1   1732266  19071550 3293.8
## + V14                  1   1693338  19110478 3294.4
## + V34                  1   1571222  19232593 3296.3
## + V37                  1   1242369  19561447 3301.3
## + V15                  1   1216500  19587316 3301.7
## + V85                  1   1023767  19780049 3304.6
## + V77                  1   1012200  19791615 3304.8
## + V58                  1    950626  19853190 3305.7
## + V20                  1    921137  19882678 3306.2
## + V39                  1    873770  19930046 3306.9
## + V9                   1    866468  19937348 3307.0
## + V48                  1    805803  19998012 3307.9
## + V29                  1    766704  20037111 3308.5
## + V67                  1    748812  20055004 3308.7
## + V96                  1    734888  20068928 3308.9
## + V10                  1    663486  20140329 3310.0
## + V86                  1    623414  20180402 3310.6
## + V105                 1    613656  20190160 3310.7
## + V68                  1    609003  20194812 3310.8
## + V89                  1    580651  20223165 3311.2
## + V49                  1    579491  20224325 3311.2
## + V66                  1    549441  20254375 3311.7
## + V38                  1    543642  20260174 3311.7
## + V57                  1    533805  20270011 3311.9
## + V87                  1    530009  20273806 3311.9
## + V19                  1    524888  20278928 3312.0
## + V76                  1    492526  20311290 3312.5
## + V50                  1    488422  20315394 3312.5
## + V70                  1    471523  20332293 3312.8
## + V30                  1    443749  20360067 3313.2
## + V95                  1    431910  20371906 3313.4
## + V16                  1    403498  20400318 3313.8
## + V11                  1    346269  20457547 3314.6
## + V18                  1    346238  20457578 3314.6
## + V5                   1    331487  20472329 3314.8
## + V51                  1    327467  20476349 3314.9
## + V24                  1    327039  20476777 3314.9
## + V103                 1    308554  20495262 3315.2
## + V43                  1    304721  20499094 3315.2
## + V55                  1    296334  20507482 3315.3
## + V17                  1    293418  20510398 3315.4
## + V6                   1    264921  20538894 3315.8
## + V32                  1    259836  20543980 3315.9
## + V2                   1    256073  20547742 3315.9
## + V62                  1    255291  20548525 3315.9
## + V23                  1    246688  20557128 3316.1
```

```
## + V4                    1    238416  20565400 3316.2
## + V42                   1    237779  20566037 3316.2
## + V61                   1    220475  20583340 3316.4
## + V54                   1    212843  20590973 3316.5
## + V81                   1    203472  20600344 3316.7
## + V36                   1    199391  20604425 3316.7
## + `COMPLETION QUARTER`  1    189289  20614527 3316.9
## + V80                   1    181234  20622582 3317.0
## + V13                   1    179871  20623945 3317.0
## + V84                   1    177966  20625850 3317.1
## + V1                    1    173221  20630595 3317.1
## + V65                   1    162678  20641138 3317.3
## + V100                  1    159713  20644103 3317.3
## + V35                   1    145070  20658746 3317.5
## <none>                               20803816 3317.6
## + V99                   1    139573  20664243 3317.6
## + V46                   1    135842  20667974 3317.7
## + `START QUARTER`       1    135083  20668733 3317.7
## + V83                   1    132004  20671812 3317.7
## + V101                  1    124016  20679800 3317.8
## + V28                   1    121401  20682415 3317.9
## + V12                   1    116250  20687565 3317.9
## + V44                   1    106305  20697511 3318.1
## + V27                   1    101081  20702735 3318.2
## + `COMPLETION YEAR`     1    100501  20703314 3318.2
## + V82                   1     76373  20727443 3318.5
## + V63                   1     73919  20729897 3318.5
## + V31                   1     73128  20730688 3318.6
## + V97                   1     72418  20731397 3318.6
## + V26                   1     68611  20735205 3318.6
## + V102                  1     68088  20735728 3318.6
## + V79                   1     68079  20735737 3318.6
## + V98                   1     67652  20736164 3318.6
## + V78                   1     56646  20747170 3318.8
## + V60                   1     48579  20755237 3318.9
## + V59                   1     45607  20758209 3319.0
## + V25                   1     44271  20759545 3319.0
## + V40                   1     44174  20759642 3319.0
## + V41                   1     34542  20769274 3319.1
## + V22                   1     34193  20769622 3319.1
## + V21                   1     26793  20777023 3319.2
## + V93                   1     24487  20779329 3319.3
## + V64                   1     21942  20781874 3319.3
## + V3                    1     18109  20785706 3319.3
## + V92                   1     14833  20788982 3319.4
## + V47                   1     13589  20790227 3319.4
## + `START YEAR`          1     11527  20792289 3319.4
## + V74                   1      5283  20798533 3319.5
## + V73                   1      2571  20801245 3319.6
## + V45                   1      1722  20802094 3319.6
## - V8                    1 432498248 453302064 4230.8
##
## Step:  AIC=3263.21
## V104 ~ V8 + V94
```

```
##
##                         Df Sum of Sq       RSS    AIC
## + V7                     1   2499984  14705854 3218.6
## + V55                    1   1262615  15943223 3242.6
## + V105                   1   1188799  16017039 3243.9
## + V71                    1    759234  16446605 3251.8
## + V36                    1    756098  16449740 3251.9
## + V88                    1    751139  16454700 3251.9
## + V69                    1    660161  16545677 3253.6
## + V74                    1    629420  16576418 3254.1
## + V90                    1    617171  16588667 3254.4
## + V18                    1    576257  16629581 3255.1
## + V9                     1    572902  16632937 3255.1
## + V72                    1    568959  16636879 3255.2
## + V91                    1    486788  16719050 3256.7
## + V52                    1    423191  16782647 3257.8
## + `COMPLETION QUARTER`   1    388003  16817836 3258.4
## + V17                    1    383121  16822717 3258.5
## + V97                    1    319784  16886054 3259.6
## + V53                    1    311851  16893988 3259.8
## + V54                    1    287977  16917862 3260.2
## + V85                    1    270979  16934860 3260.5
## + V78                    1    252063  16953776 3260.8
## + V4                     1    215658  16990180 3261.5
## + V59                    1    213605  16992233 3261.5
## + V2                     1    197276  17008562 3261.8
## + V28                    1    197030  17008809 3261.8
## + V33                    1    195190  17010648 3261.8
## + V40                    1    189454  17016384 3261.9
## + V12                    1    181500  17024338 3262.1
## + V66                    1    153864  17051974 3262.5
## + V35                    1    151172  17054667 3262.6
## + V50                    1    130631  17075208 3262.9
## + V21                    1    125292  17080546 3263.0
## + V16                    1    116947  17088891 3263.2
## <none>                                17205838 3263.2
## + V14                    1    114393  17091445 3263.2
## + V37                    1    111424  17094414 3263.3
## + V13                    1    107489  17098350 3263.3
## + V27                    1    102389  17103450 3263.4
## + V34                    1    102053  17103785 3263.4
## + V46                    1    101432  17104407 3263.5
## + V44                    1     94388  17111450 3263.6
## + `COMPLETION YEAR`      1     92293  17113545 3263.6
## + V101                   1     87981  17117857 3263.7
## + V32                    1     87266  17118573 3263.7
## + V77                    1     85532  17120306 3263.7
## + V93                    1     85069  17120770 3263.7
## + V22                    1     75415  17130423 3263.9
## + V41                    1     74536  17131302 3263.9
## + V65                    1     72804  17133034 3263.9
## + V6                     1     67796  17138042 3264.0
## + V51                    1     64520  17141319 3264.1
## + `START QUARTER`        1     63137  17142702 3264.1
```

```
## + V68                  1     56158  17149680 3264.2
## + V60                  1     55521  17150317 3264.2
## + V63                  1     51826  17154012 3264.3
## + V87                  1     49161  17156677 3264.4
## + V25                  1     47448  17158390 3264.4
## + V83                  1     45889  17159949 3264.4
## + V1                   1     44749  17161089 3264.4
## + V64                  1     43199  17162639 3264.5
## + V58                  1     41660  17164178 3264.5
## + V82                  1     40823  17165015 3264.5
## + V84                  1     39461  17166377 3264.5
## + V79                  1     32331  17173507 3264.6
## + V49                  1     28753  17177085 3264.7
## + V70                  1     28192  17177647 3264.7
## + V20                  1     26415  17179424 3264.8
## + V3                   1     25807  17180031 3264.8
## + V48                  1     25537  17180302 3264.8
## + V96                  1     25005  17180833 3264.8
## + V98                  1     22934  17182904 3264.8
## + V67                  1     21338  17184500 3264.8
## + V73                  1     19422  17186416 3264.9
## + V39                  1     19329  17186509 3264.9
## + V5                   1     18426  17187412 3264.9
## + `START YEAR`         1     15082  17190756 3264.9
## + V15                  1     14349  17191489 3265.0
## + V29                  1     13290  17192549 3265.0
## + V47                  1     12756  17193083 3265.0
## + V86                  1     10905  17194933 3265.0
## + V11                  1      8590  17197248 3265.1
## + V89                  1      8536  17197302 3265.1
## + V100                 1      8130  17197709 3265.1
## + V75                  1      7141  17198697 3265.1
## + V81                  1      5313  17200526 3265.1
## + V76                  1      3363  17202475 3265.1
## + V103                 1      3201  17202638 3265.2
## + V92                  1      2756  17203083 3265.2
## + V26                  1      2685  17203153 3265.2
## + V102                 1      2602  17203236 3265.2
## + V62                  1      2550  17203289 3265.2
## + V45                  1      2000  17203838 3265.2
## + V57                  1      1481  17204357 3265.2
## + V10                  1      1098  17204740 3265.2
## + V30                  1      1029  17204810 3265.2
## + V56                  1       712  17205126 3265.2
## + V99                  1       589  17205249 3265.2
## + V95                  1       520  17205318 3265.2
## + V43                  1       354  17205484 3265.2
## + V19                  1       171  17205667 3265.2
## + V23                  1       138  17205701 3265.2
## + V24                  1        85  17205753 3265.2
## + V31                  1        74  17205765 3265.2
## + V38                  1        73  17205765 3265.2
## + V61                  1        65  17205773 3265.2
## + V42                  1        23  17205815 3265.2
```

```
## + V80                    1        19  17205819 3265.2
## - V94                    1   3597978  20803816 3317.6
## - V8                     1 432771150 449976988 4230.6
##
## Step:  AIC=3218.58
## V104 ~ V8 + V94 + V7
##
##                         Df Sum of Sq       RSS    AIC
## + V55                    1   1251571  13454284 3194.2
## + V74                    1    780942  13924913 3204.4
## + V36                    1    778439  13927416 3204.4
## + V71                    1    698785  14007070 3206.1
## + V18                    1    696665  14009189 3206.2
## + V88                    1    695968  14009886 3206.2
## + V72                    1    630692  14075163 3207.6
## + V90                    1    622503  14083351 3207.7
## + V69                    1    608248  14097607 3208.0
## + V91                    1    546588  14159267 3209.3
## + V9                     1    508839  14197015 3210.1
## + V52                    1    390392  14315463 3212.6
## + V17                    1    356254  14349601 3213.3
## + V53                    1    330116  14375739 3213.8
## + V54                    1    308487  14397367 3214.3
## + `COMPLETION QUARTER`   1    272583  14433271 3215.0
## + V85                    1    262937  14442917 3215.2
## + V28                    1    226383  14479472 3216.0
## + V97                    1    219669  14486185 3216.1
## + V105                   1    217836  14488019 3216.1
## + V35                    1    183714  14522140 3216.8
## + V33                    1    182950  14522905 3216.9
## + V78                    1    179244  14526611 3216.9
## + V5                     1    149366  14556488 3217.5
## + V50                    1    144799  14561055 3217.6
## + V59                    1    143435  14562420 3217.7
## + V12                    1    137583  14568271 3217.8
## + V22                    1    123234  14582620 3218.1
## + V37                    1    120745  14585110 3218.1
## + V40                    1    116967  14588888 3218.2
## + V41                    1    115830  14590025 3218.2
## + V34                    1    103369  14602486 3218.5
## <none>                                14705854 3218.6
## + V13                    1     97664  14608190 3218.6
## + V66                    1     95708  14610147 3218.6
## + V60                    1     92018  14613836 3218.7
## + V21                    1     89535  14616320 3218.8
## + V46                    1     86260  14619595 3218.8
## + V1                     1     85171  14620684 3218.9
## + V32                    1     83092  14622763 3218.9
## + V77                    1     82738  14623116 3218.9
## + V68                    1     81955  14623899 3218.9
## + V27                    1     76007  14629847 3219.0
## + V93                    1     73321  14632534 3219.1
## + V65                    1     72388  14633467 3219.1
## + V14                    1     71471  14634384 3219.1
```

```
## + V73                    1     64229  14641626 3219.3
## + V16                    1     63805  14642050 3219.3
## + V79                    1     62839  14643015 3219.3
## + V87                    1     61233  14644622 3219.3
## + V51                    1     58977  14646877 3219.4
## + V2                     1     58524  14647330 3219.4
## + V98                    1     48243  14657611 3219.6
## + V49                    1     46629  14659225 3219.6
## + V64                    1     46317  14659537 3219.6
## + V96                    1     45613  14660242 3219.7
## + V58                    1     43167  14662688 3219.7
## + V84                    1     37460  14668395 3219.8
## + V48                    1     34762  14671092 3219.9
## + V101                   1     34494  14671361 3219.9
## + V4                     1     33468  14672386 3219.9
## + V67                    1     29733  14676122 3220.0
## + V70                    1     26453  14679401 3220.0
## + V39                    1     23081  14682773 3220.1
## + V20                    1     21637  14684217 3220.1
## + V102                   1     21305  14684550 3220.1
## + V26                    1     21031  14684823 3220.2
## + V44                    1     20253  14685602 3220.2
## + V29                    1     19868  14685986 3220.2
## + V92                    1     19417  14686438 3220.2
## + V15                    1     16284  14689570 3220.2
## + V86                    1     15674  14690181 3220.3
## + V47                    1     10186  14695668 3220.4
## + V89                    1      6417  14699438 3220.4
## + V82                    1      5966  14699889 3220.5
## + V63                    1      5165  14700690 3220.5
## + V30                    1      4916  14700938 3220.5
## + `START QUARTER`        1      4855  14700999 3220.5
## + V57                    1      4032  14701822 3220.5
## + V25                    1      3651  14702203 3220.5
## + V61                    1      3333  14702522 3220.5
## + V11                    1      3057  14702797 3220.5
## + V3                     1      2982  14702873 3220.5
## + V80                    1      2954  14702900 3220.5
## + V10                    1      2915  14702939 3220.5
## + V31                    1      2792  14703063 3220.5
## + V83                    1      2770  14703084 3220.5
## + V103                   1      2700  14703155 3220.5
## + V76                    1      2653  14703202 3220.5
## + V75                    1      2544  14703310 3220.5
## + V100                   1      1734  14704121 3220.5
## + V24                    1      1630  14704224 3220.5
## + V42                    1      1560  14704295 3220.5
## + V45                    1      1480  14704375 3220.5
## + `START YEAR`           1      1386  14704469 3220.5
## + V23                    1      1220  14704635 3220.6
## + V38                    1      1086  14704769 3220.6
## + V43                    1       887  14704968 3220.6
## + V99                    1       770  14705084 3220.6
## + V81                    1       628  14705227 3220.6
```

```
## + V6                    1       611  14705244 3220.6
## + V56                   1       509  14705345 3220.6
## + V95                   1       320  14705535 3220.6
## + `COMPLETION YEAR`     1       147  14705707 3220.6
## + V19                   1       125  14705729 3220.6
## + V62                   1         0  14705854 3220.6
## - V7                    1   2499984  17205838 3263.2
## - V94                   1   3151880  17857734 3274.3
## - V8                    1 426137265 440843120 4226.5
##
## Step:  AIC=3194.16
## V104 ~ V8 + V94 + V7 + V55
##
##                         Df Sum of Sq       RSS    AIC
## + V71                    1   3528683   9925601 3105.8
## + V72                    1   2820560  10633723 3126.3
## + V91                    1   2638982  10815301 3131.3
## + V52                    1   2169055  11285229 3143.9
## + V53                    1   1941463  11512821 3149.9
## + V90                    1   1911538  11542746 3150.6
## + V68                    1   1848822  11605461 3152.3
## + V77                    1   1823338  11630946 3152.9
## + V87                    1   1682055  11772229 3156.5
## + V34                    1   1636096  11818188 3157.7
## + V67                    1   1597865  11856419 3158.6
## + V96                    1   1570711  11883573 3159.3
## + V48                    1   1528616  11925668 3160.3
## + V58                    1   1477747  11976537 3161.6
## + V86                    1   1447472  12006812 3162.4
## + V20                    1   1440649  12013635 3162.5
## + V49                    1   1438695  12015589 3162.6
## + V39                    1   1413688  12040596 3163.2
## + V29                    1   1357709  12096575 3164.6
## + V15                    1   1328196  12126088 3165.3
## + V33                    1   1327421  12126862 3165.3
## + V57                    1   1260475  12193809 3166.9
## + V38                    1   1250137  12204147 3167.2
## + V10                    1   1245145  12209138 3167.3
## + V103                   1   1206769  12247515 3168.2
## + V61                    1   1185553  12268731 3168.8
## + V76                    1   1182186  12272097 3168.8
## + V42                    1   1155983  12298301 3169.5
## + V14                    1   1131874  12322409 3170.1
## + V95                    1   1126043  12328241 3170.2
## + V22                    1   1120135  12334149 3170.3
## + V19                    1   1119342  12334941 3170.4
## + V41                    1   1107541  12346743 3170.6
## + V80                    1   1105747  12348537 3170.7
## + V43                    1   1088928  12365356 3171.1
## + V62                    1   1086090  12368194 3171.2
## + V30                    1   1085516  12368768 3171.2
## + V23                    1   1080146  12374138 3171.3
## + V99                    1   1069320  12384964 3171.6
## + V24                    1   1038813  12415470 3172.3
```

```
## + V60                   1   1038566  12415718 3172.3
## + V11                   1    979626  12474658 3173.7
## + V89                   1    970221  12484063 3173.9
## + V81                   1    952373  12501911 3174.4
## + V79                   1    919838  12534446 3175.1
## + `COMPLETION YEAR`     1    891075  12563209 3175.8
## + V100                  1    884270  12570014 3176.0
## + V98                   1    839441  12614843 3177.0
## + V69                   1    824936  12629347 3177.4
## + V1                    1    822505  12631778 3177.4
## + V88                   1    821712  12632572 3177.4
## + `START YEAR`          1    795079  12659205 3178.1
## + V70                   1    753553  12700731 3179.0
## + V46                   1    727401  12726883 3179.7
## + V5                    1    721346  12732938 3179.8
## + V51                   1    706744  12747540 3180.1
## + V84                   1    637933  12816351 3181.7
## + V65                   1    618920  12835364 3182.2
## + V32                   1    606176  12848107 3182.5
## + V13                   1    563814  12890469 3183.4
## + V27                   1    504976  12949308 3184.8
## + V50                   1    425256  13029028 3186.6
## + V85                   1    355576  13098708 3188.2
## + V82                   1    267697  13186587 3190.2
## + V25                   1    237513  13216771 3190.9
## + V63                   1    216265  13238019 3191.3
## + `COMPLETION QUARTER`  1    213187  13241097 3191.4
## + V101                  1    210821  13243463 3191.5
## + V64                   1    200565  13253718 3191.7
## + V66                   1    180440  13273844 3192.1
## + V54                   1    151485  13302799 3192.8
## + V44                   1    135661  13318622 3193.1
## + V6                    1    119657  13334627 3193.5
## + V2                    1    116955  13337329 3193.6
## + V21                   1     97710  13356574 3194.0
## + V75                   1     96858  13357426 3194.0
## + V74                   1     95028  13359256 3194.1
## <none>                               13454284 3194.2
## + V9                    1     86287  13367997 3194.2
## + V40                   1     77276  13377007 3194.4
## + V31                   1     62993  13391290 3194.8
## + V36                   1     62317  13391967 3194.8
## + V59                   1     61479  13392805 3194.8
## + V92                   1     60144  13394140 3194.8
## + V78                   1     45891  13408393 3195.1
## + V4                    1     39593  13414691 3195.3
## + V93                   1     32654  13421630 3195.4
## + V97                   1     31350  13422934 3195.5
## + V18                   1     31265  13423019 3195.5
## + V56                   1     23430  13430854 3195.6
## + V17                   1     20544  13433739 3195.7
## + V12                   1     16782  13437502 3195.8
## + V83                   1     15788  13438496 3195.8
## + V3                    1     14141  13440143 3195.8
```

```
## + V37                    1     12866  13441418 3195.9
## + V47                    1     11878  13442406 3195.9
## + V16                    1      6333  13447951 3196.0
## + V35                    1      4358  13449926 3196.1
## + V73                    1      3289  13450995 3196.1
## + V102                   1      2564  13451720 3196.1
## + V26                    1      2363  13451921 3196.1
## + V28                    1       641  13453643 3196.1
## + `START QUARTER`        1       264  13454020 3196.2
## + V105                   1       126  13454158 3196.2
## + V45                    1       113  13454171 3196.2
## - V55                    1   1251571  14705854 3218.6
## - V7                     1   2488939  15943223 3242.6
## - V94                    1   4072965  17527249 3270.7
## - V8                     1 296994608 310448891 4124.4
##
## Step:  AIC=3105.82
## V104 ~ V8 + V94 + V7 + V55 + V71
##
##                         Df Sum of Sq       RSS    AIC
## + V17                    1    874133   9051468 3080.4
## + V16                    1    778763   9146838 3083.6
## + V74                    1    652288   9273313 3087.6
## + V21                    1    610050   9315551 3089.0
## + V93                    1    591341   9334260 3089.6
## + V100                   1    559535   9366067 3090.6
## + V81                    1    547406   9378195 3091.0
## + V13                    1    540539   9385062 3091.2
## + V78                    1    516933   9408668 3091.9
## + V40                    1    511386   9414215 3092.1
## + V59                    1    505329   9420272 3092.3
## + V92                    1    503008   9422593 3092.4
## + V97                    1    501383   9424218 3092.4
## + `START YEAR`           1    485124   9440477 3092.9
## + V80                    1    475403   9450198 3093.2
## + V51                    1    472622   9452979 3093.3
## + V84                    1    471870   9453731 3093.4
## + V32                    1    463693   9461908 3093.6
## + V99                    1    459598   9466003 3093.7
## + V64                    1    450671   9474930 3094.0
## + V102                   1    445160   9480441 3094.2
## + V26                    1    441984   9483617 3094.3
## + V24                    1    432614   9492987 3094.6
## + V62                    1    432490   9493111 3094.6
## + V70                    1    406175   9519426 3095.4
## + V76                    1    405610   9519991 3095.4
## + V43                    1    397089   9528512 3095.7
## + V23                    1    386019   9539582 3096.0
## + V65                    1    385016   9540585 3096.1
## + V61                    1    373558   9552043 3096.4
## + `COMPLETION YEAR`      1    366793   9558808 3096.6
## + V42                    1    366612   9558989 3096.6
## + V105                   1    361544   9564057 3096.8
## + V30                    1    341356   9584245 3097.4
```

```
## + V89                    1    325911   9599690 3097.9
## + V27                    1    310069   9615532 3098.4
## + V44                    1    306115   9619486 3098.5
## + V38                    1    300072   9625529 3098.7
## + V19                    1    258181   9667420 3100.0
## + V95                    1    249104   9676497 3100.3
## + V11                    1    245106   9680495 3100.4
## + V36                    1    241439   9684162 3100.5
## + V86                    1    227341   9698260 3100.9
## + V39                    1    226673   9698928 3101.0
## + `COMPLETION QUARTER`   1    224014   9701587 3101.0
## + V10                    1    214813   9710788 3101.3
## + V49                    1    207773   9717828 3101.5
## + V33                    1    205472   9720129 3101.6
## + V103                   1    204009   9721593 3101.6
## + V29                    1    201331   9724270 3101.7
## + V34                    1    198579   9727022 3101.8
## + V101                   1    195473   9730128 3101.9
## + V87                    1    194297   9731304 3101.9
## + V63                    1    177180   9748421 3102.5
## + V46                    1    168917   9756684 3102.7
## + V57                    1    167807   9757794 3102.8
## + V25                    1    164440   9761162 3102.9
## + V18                    1    153262   9772340 3103.2
## + V48                    1    151113   9774488 3103.3
## + V54                    1    148335   9777266 3103.3
## + V58                    1    148301   9777300 3103.3
## + V67                    1    145701   9779900 3103.4
## + V56                    1    137366   9788235 3103.7
## + V77                    1    131074   9794527 3103.9
## + V82                    1    125169   9800432 3104.0
## + V68                    1    117891   9807710 3104.3
## + V15                    1    109838   9815763 3104.5
## + V1                     1    107625   9817976 3104.6
## + V35                    1    107541   9818060 3104.6
## + V90                    1    104227   9821374 3104.7
## + V53                    1    101897   9823704 3104.8
## + V20                    1    101389   9824212 3104.8
## + V96                    1     99078   9826523 3104.8
## + V66                    1     98217   9827384 3104.9
## + V14                    1     93456   9832145 3105.0
## + V98                    1     89525   9836076 3105.1
## + V73                    1     85819   9839782 3105.2
## + V47                    1     84195   9841406 3105.3
## + V9                     1     77247   9848354 3105.5
## + V2                     1     75758   9849843 3105.5
## <none>                                 9925601 3105.8
## + V4                     1     65143   9860458 3105.9
## + V37                    1     61472   9864129 3106.0
## + V79                    1     56856   9868745 3106.1
## + V31                    1     33506   9892095 3106.8
## + V85                    1     30796   9894805 3106.9
## + V60                    1     28628   9896973 3107.0
## + V69                    1     22269   9903332 3107.2
```

```
## + V22                    1     19574   9906027 3107.2
## + V41                    1     18489   9907112 3107.3
## + V28                    1     17106   9908495 3107.3
## + V3                     1     16734   9908867 3107.3
## + V45                    1     14800   9910801 3107.4
## + V75                    1      7122   9918479 3107.6
## + V88                    1      6057   9919544 3107.6
## + V72                    1      6050   9919552 3107.6
## + `START QUARTER`        1      6020   9919581 3107.6
## + V12                    1      4737   9920864 3107.7
## + V50                    1      2920   9922681 3107.7
## + V6                     1      2032   9923569 3107.8
## + V5                     1       320   9925281 3107.8
## + V52                    1       165   9925436 3107.8
## + V83                    1        71   9925530 3107.8
## + V91                    1        12   9925589 3107.8
## - V94                    1    987313  10912914 3132.0
## - V7                     1   2309596  12235197 3166.0
## - V71                    1   3528683  13454284 3194.2
## - V55                    1   4081469  14007070 3206.1
## - V8                     1 270065151 279990752 4095.7
##
## Step:  AIC=3080.44
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17
##
##                         Df Sum of Sq       RSS    AIC
## + V74                    1    452877   8598591 3067.2
## + V72                    1    389083   8662385 3069.4
## + V21                    1    384077   8667391 3069.6
## + V75                    1    254107   8797361 3074.0
## + V40                    1    249050   8802418 3074.2
## + V78                    1    227512   8823956 3074.9
## + V59                    1    226361   8825107 3074.9
## + V97                    1    206026   8845442 3075.6
## + `COMPLETION QUARTER`   1    197139   8854329 3075.9
## + V1                     1    186774   8864694 3076.2
## + `START YEAR`           1    176363   8875105 3076.6
## + V73                    1    170135   8881333 3076.8
## + V44                    1    160187   8891281 3077.1
## + V105                   1    146543   8904925 3077.6
## + `COMPLETION YEAR`      1    121906   8929562 3078.4
## + V91                    1    116282   8935186 3078.6
## + V81                    1    106423   8945045 3078.9
## + V25                    1    104174   8947294 3079.0
## + V85                    1     92055   8959413 3079.4
## + V77                    1     84809   8966659 3079.6
## + V100                   1     81984   8969484 3079.7
## + V35                    1     74935   8976533 3080.0
## + V80                    1     71978   8979490 3080.1
## + V98                    1     71371   8980097 3080.1
## + V2                     1     65590   8985878 3080.3
## + V99                    1     64516   8986952 3080.3
## + V33                    1     63782   8987686 3080.3
## + V63                    1     61573   8989895 3080.4
```

```
## + V88                  1     61399   8990069 3080.4
## <none>                             9051468 3080.4
## + V62                  1     59324   8992144 3080.5
## + V37                  1     58308   8993160 3080.5
## + V96                  1     58087   8993381 3080.5
## + V47                  1     56556   8994912 3080.6
## + V48                  1     53047   8998421 3080.7
## + V20                  1     52795   8998673 3080.7
## + V64                  1     49961   9001507 3080.8
## + V16                  1     49064   9002404 3080.8
## + V4                   1     47550   9003918 3080.9
## + V90                  1     47329   9004139 3080.9
## + V79                  1     46370   9005098 3080.9
## + V56                  1     45701   9005767 3080.9
## + V61                  1     42023   9009445 3081.1
## + V66                  1     41406   9010062 3081.1
## + V5                   1     38692   9012776 3081.2
## + V42                  1     38347   9013121 3081.2
## + V101                 1     34502   9016966 3081.3
## + V67                  1     32661   9018807 3081.4
## + V23                  1     30969   9020499 3081.4
## + V58                  1     30508   9020960 3081.4
## + V29                  1     29588   9021880 3081.5
## + V43                  1     29334   9022134 3081.5
## + V82                  1     27293   9024175 3081.5
## + V53                  1     26525   9024943 3081.6
## + V24                  1     25778   9025690 3081.6
## + V89                  1     25575   9025893 3081.6
## + V6                   1     25531   9025937 3081.6
## + V46                  1     24401   9027067 3081.6
## + V9                   1     23617   9027851 3081.7
## + V45                  1     22745   9028723 3081.7
## + V52                  1     21728   9029740 3081.7
## + V60                  1     21523   9029945 3081.7
## + V31                  1     21245   9030223 3081.7
## + V57                  1     19542   9031926 3081.8
## + V92                  1     17986   9033481 3081.8
## + V28                  1     17593   9033875 3081.9
## + V83                  1     17544   9033924 3081.9
## + V10                  1     16624   9034844 3081.9
## + V50                  1     16151   9035317 3081.9
## + V39                  1     15828   9035640 3081.9
## + V18                  1     14773   9036695 3082.0
## + V22                  1     13247   9038221 3082.0
## + V30                  1     13153   9038315 3082.0
## + V3                   1     12377   9039091 3082.0
## + V41                  1     11075   9040393 3082.1
## + V93                  1      9705   9041763 3082.1
## + V15                  1      9164   9042304 3082.1
## + V103                 1      8807   9042661 3082.1
## + V27                  1      8641   9042827 3082.2
## + V36                  1      8554   9042914 3082.2
## + V68                  1      8509   9042959 3082.2
## + V54                  1      6365   9045103 3082.2
```

```
## + V84                    1      6253   9045215 3082.2
## + V11                    1      4846   9046622 3082.3
## + V32                    1      4825   9046643 3082.3
## + V86                    1      4593   9046875 3082.3
## + V95                    1      4398   9047070 3082.3
## + V65                    1      4202   9047266 3082.3
## + V69                    1      4145   9047323 3082.3
## + `START QUARTER`        1      3327   9048141 3082.3
## + V87                    1      3059   9048409 3082.3
## + V13                    1      2704   9048764 3082.3
## + V102                   1      2690   9048778 3082.3
## + V26                    1      2461   9049007 3082.4
## + V12                    1      1996   9049472 3082.4
## + V34                    1      1762   9049706 3082.4
## + V19                    1       750   9050718 3082.4
## + V51                    1       706   9050762 3082.4
## + V76                    1       564   9050904 3082.4
## + V49                    1       461   9051007 3082.4
## + V14                    1       355   9051113 3082.4
## + V38                    1       341   9051127 3082.4
## + V70                    1        85   9051383 3082.4
## - V94                    1    520695   9572163 3095.0
## - V17                    1    874133   9925601 3105.8
## - V7                     1   2229628  11281096 3143.8
## - V55                    1   3457612  12509080 3174.5
## - V71                    1   4382271  13433739 3195.7
## - V8                     1 258911158 267962626 4084.6
##
## Step:  AIC=3067.19
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74
##
##                          Df Sum of Sq       RSS    AIC
## + V72                     1    547718   8050873 3049.6
## + V77                     1    338756   8259835 3057.3
## + V96                     1    318176   8280415 3058.0
## + V21                     1    314487   8284104 3058.1
## + V57                     1    300218   8298373 3058.6
## + V20                     1    298477   8300114 3058.7
## + `COMPLETION QUARTER`    1    292886   8305705 3058.9
## + V58                     1    284982   8313609 3059.2
## + V91                     1    274644   8323947 3059.6
## + V48                     1    268352   8330238 3059.8
## + V29                     1    263883   8334708 3059.9
## + V89                     1    254698   8343893 3060.3
## + V67                     1    241871   8356720 3060.7
## + V1                      1    236140   8362451 3060.9
## + V10                     1    232808   8365783 3061.0
## + V83                     1    229124   8369467 3061.2
## + V53                     1    223937   8374654 3061.4
## + `START QUARTER`         1    223549   8375042 3061.4
## + V14                     1    219650   8378941 3061.5
## + V46                     1    207903   8390688 3061.9
## + V37                     1    193217   8405374 3062.4
## + V40                     1    193214   8405377 3062.4
```

```
## + V86                  1    185451   8413140 3062.7
## + V39                  1    179813   8418777 3062.9
## + V78                  1    174260   8424331 3063.1
## + V59                  1    172303   8426288 3063.2
## + V70                  1    168408   8430183 3063.3
## + V85                  1    167839   8430752 3063.3
## + V35                  1    166590   8432001 3063.4
## + V65                  1    154547   8444044 3063.8
## + V103                 1    144484   8454107 3064.2
## + V97                  1    141891   8456700 3064.3
## + V51                  1    134223   8464368 3064.5
## + V88                  1    131732   8466859 3064.6
## + V16                  1    126389   8472202 3064.8
## + V15                  1    125466   8473125 3064.8
## + V95                  1    122430   8476161 3064.9
## + V45                  1    119488   8479103 3065.0
## + V105                 1    114758   8483833 3065.2
## + V38                  1    111566   8487025 3065.3
## + V34                  1    111074   8487517 3065.3
## + V19                  1    110618   8487973 3065.3
## + V56                  1    108151   8490440 3065.4
## + V44                  1    106775   8491816 3065.5
## + `START YEAR`         1    100697   8497894 3065.7
## + V13                  1     97448   8501143 3065.8
## + V32                  1     95977   8502614 3065.9
## + V68                  1     94339   8504252 3065.9
## + V52                  1     88433   8510158 3066.1
## + V33                  1     82270   8516321 3066.3
## + V27                  1     81574   8517017 3066.4
## + V84                  1     77085   8521506 3066.5
## + V25                  1     77037   8521554 3066.5
## + V75                  1     71872   8526719 3066.7
## + V49                  1     70372   8528219 3066.8
## + V76                  1     69597   8528994 3066.8
## <none>                               8598591 3067.2
## + V87                  1     53807   8544784 3067.3
## + V90                  1     50800   8547791 3067.4
## + V66                  1     48688   8549903 3067.5
## + V5                   1     48345   8550246 3067.5
## + V2                   1     48020   8550571 3067.5
## + V6                   1     46716   8551875 3067.6
## + V73                  1     46357   8552234 3067.6
## + V11                  1     43454   8555137 3067.7
## + V102                 1     42257   8556334 3067.7
## + V92                  1     42087   8556504 3067.7
## + V63                  1     42055   8556536 3067.7
## + V26                  1     41161   8557430 3067.8
## + V93                  1     37802   8560789 3067.9
## + V4                   1     33694   8564897 3068.0
## + V30                  1     33199   8565392 3068.0
## + V54                  1     29628   8568963 3068.2
## + `COMPLETION YEAR`    1     28383   8570208 3068.2
## + V98                  1     24081   8574510 3068.4
## + V36                  1     21905   8576686 3068.4
```

```
## + V50                   1     14918   8583673 3068.7
## + V82                   1     14348   8584243 3068.7
## + V101                  1     11609   8586982 3068.8
## + V18                   1     11545   8587046 3068.8
## + V9                    1     11531   8587060 3068.8
## + V79                   1     10816   8587775 3068.8
## + V47                   1      8463   8590128 3068.9
## + V69                   1      7381   8591210 3068.9
## + V12                   1      6918   8591673 3069.0
## + V64                   1      6497   8592094 3069.0
## + V24                   1      5890   8592701 3069.0
## + V81                   1      3736   8594855 3069.1
## + V3                    1      3348   8595242 3069.1
## + V31                   1      3168   8595423 3069.1
## + V61                   1      2817   8595774 3069.1
## + V100                  1      2400   8596191 3069.1
## + V23                   1      2300   8596291 3069.1
## + V60                   1      1562   8597029 3069.1
## + V99                   1      1477   8597114 3069.1
## + V42                   1      1322   8597269 3069.1
## + V28                   1      1263   8597328 3069.1
## + V43                   1      1007   8597584 3069.2
## + V80                   1       401   8598190 3069.2
## + V62                   1       245   8598346 3069.2
## + V22                   1       146   8598445 3069.2
## + V41                   1        12   8598579 3069.2
## - V74                   1    452877   9051468 3080.4
## - V94                   1    659618   9258209 3087.1
## - V17                   1    674722   9273313 3087.6
## - V55                   1   2233114  10831705 3133.8
## - V7                    1   2360346  10958937 3137.2
## - V71                   1   4755252  13353843 3195.9
## - V8                    1 255541981 264140572 4082.4
##
## Step:  AIC=3049.65
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72
##
##                         Df Sum of Sq       RSS    AIC
## + V43                    1   1263200   6787673 3001.0
## + V24                    1   1229686   6821186 3002.4
## + V42                    1   1201202   6849671 3003.7
## + V62                    1   1170194   6880679 3005.0
## + V23                    1   1157496   6893377 3005.5
## + V81                    1   1145474   6905399 3006.1
## + V100                   1   1102148   6948725 3007.9
## + V61                    1   1013984   7036889 3011.7
## + V99                    1   1007217   7043656 3012.0
## + V80                    1   1004027   7046845 3012.1
## + `START YEAR`           1   1003561   7047312 3012.1
## + V44                    1    983340   7067533 3013.0
## + V63                    1    877434   7173438 3017.4
## + V21                    1    860054   7190819 3018.1
## + V25                    1    814790   7236083 3020.0
## + V78                    1    757359   7293513 3022.3
```

```
## + V40                    1    740516   7310357 3023.0
## + V59                    1    735279   7315594 3023.2
## + V30                    1    733036   7317837 3023.3
## + V97                    1    718676   7332197 3023.9
## + `COMPLETION YEAR`      1    703759   7347114 3024.5
## + V11                    1    632351   7418522 3027.4
## + V49                    1    621018   7429854 3027.8
## + V82                    1    516366   7534507 3032.0
## + V101                   1    446421   7604451 3034.7
## + V68                    1    435084   7615789 3035.1
## + V87                    1    387956   7662917 3037.0
## + V35                    1    326051   7724821 3039.4
## + `COMPLETION QUARTER`   1    300075   7750798 3040.4
## + V13                    1    296455   7754418 3040.5
## + V45                    1    291624   7759249 3040.7
## + V29                    1    290530   7760343 3040.7
## + V10                    1    276266   7774607 3041.3
## + V37                    1    273452   7777421 3041.4
## + V105                   1    264982   7785890 3041.7
## + V53                    1    263842   7787031 3041.7
## + V32                    1    261182   7789691 3041.9
## + V51                    1    259677   7791196 3041.9
## + V27                    1    257360   7793513 3042.0
## + V38                    1    240140   7810733 3042.7
## + V19                    1    232163   7818710 3043.0
## + V70                    1    231282   7819591 3043.0
## + V48                    1    225488   7825385 3043.2
## + V98                    1    222604   7828269 3043.3
## + V36                    1    209235   7841638 3043.8
## + V79                    1    191671   7859202 3044.5
## + V34                    1    189707   7861166 3044.6
## + V86                    1    188789   7862084 3044.6
## + `START QUARTER`        1    176648   7874225 3045.1
## + V67                    1    173674   7877199 3045.2
## + V84                    1    166486   7884387 3045.4
## + V46                    1    156526   7894347 3045.8
## + V60                    1    151739   7899133 3046.0
## + V89                    1    140846   7910027 3046.4
## + V41                    1    140533   7910340 3046.4
## + V22                    1    139340   7911533 3046.5
## + V95                    1    136822   7914051 3046.6
## + V83                    1    135700   7915173 3046.6
## + V76                    1    132156   7918717 3046.7
## + V65                    1    125020   7925853 3047.0
## + V85                    1    112628   7938244 3047.5
## + V15                    1     99000   7951873 3048.0
## + V1                     1     89683   7961190 3048.3
## + V56                    1     84641   7966232 3048.5
## + V39                    1     82686   7968187 3048.6
## + V91                    1     82227   7968646 3048.6
## + V92                    1     59477   7991396 3049.4
## <none>                                8050873 3049.6
## + V2                     1     52258   7998615 3049.7
## + V103                   1     48656   8002217 3049.8
```

```
## + V4                    1     46118   8004755 3049.9
## + V88                   1     45468   8005404 3050.0
## + V75                   1     43239   8007634 3050.0
## + V58                   1     41973   8008900 3050.1
## + V90                   1     36684   8014189 3050.3
## + V52                   1     31966   8018907 3050.5
## + V54                   1     31272   8019601 3050.5
## + V16                   1     28734   8022139 3050.6
## + V66                   1     28313   8022560 3050.6
## + V57                   1     28217   8022656 3050.6
## + V93                   1     17294   8033579 3051.0
## + V6                    1     13906   8036966 3051.1
## + V73                   1     12725   8038147 3051.2
## + V18                   1     12130   8038743 3051.2
## + V96                   1      8242   8042631 3051.3
## + V12                   1      7816   8043057 3051.4
## + V102                  1      6918   8043955 3051.4
## + V26                   1      6429   8044443 3051.4
## + V20                   1      6292   8044581 3051.4
## + V9                    1      5920   8044953 3051.4
## + V50                   1      5452   8045421 3051.4
## + V3                    1      5311   8045562 3051.4
## + V14                   1      2589   8048284 3051.5
## + V64                   1      1967   8048906 3051.6
## + V47                   1      1640   8049233 3051.6
## + V28                   1      1265   8049608 3051.6
## + V33                   1       644   8050229 3051.6
## + V31                   1       242   8050630 3051.6
## + V69                   1       132   8050740 3051.6
## + V77                   1       115   8050757 3051.6
## + V5                    1         1   8050872 3051.6
## - V71                   1    242721   8293594 3056.5
## - V94                   1    470425   8521298 3064.5
## - V72                   1    547718   8598591 3067.2
## - V74                   1    611512   8662385 3069.4
## - V17                   1   1157536   9208409 3087.5
## - V55                   1   1906325   9957198 3110.8
## - V7                    1   2613293  10664166 3131.1
## - V8                    1 256021734 264072606 4084.3
##
## Step:  AIC=3000.96
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72 + V43
##
##                         Df Sum of Sq       RSS    AIC
## + `COMPLETION QUARTER`   1    192380   6595294 2994.4
## + V1                     1    157233   6630440 2996.0
## + V87                    1    156547   6631126 2996.0
## + V68                    1    123682   6663991 2997.5
## + V34                    1    115997   6671676 2997.8
## + V105                   1    115160   6672513 2997.9
## + V53                    1    115157   6672517 2997.9
## + V60                    1    103767   6683906 2998.4
## + V93                    1     91776   6695897 2998.9
## + V80                    1     91490   6696183 2998.9
```

```
## + V41                   1     91363   6696310 2998.9
## + V44                   1     88000   6699673 2999.1
## + `COMPLETION YEAR`     1     86845   6700828 2999.1
## + V91                   1     84605   6703068 2999.2
## + V86                   1     84447   6703226 2999.2
## + V99                   1     83548   6704125 2999.3
## - V94                   1      8111   6795784 2999.3
## + V61                   1     82649   6705024 2999.3
## - V71                   1      8568   6796241 2999.3
## + V67                   1     82307   6705366 2999.3
## + V22                   1     78857   6708816 2999.5
## + V79                   1     75204   6712469 2999.6
## + V21                   1     70950   6716723 2999.8
## + V98                   1     70364   6717309 2999.9
## + V2                    1     67927   6719746 3000.0
## + V63                   1     66482   6721191 3000.0
## + V83                   1     63673   6724000 3000.2
## + V57                   1     61383   6726290 3000.3
## + V4                    1     59508   6728165 3000.3
## + `START QUARTER`       1     49667   6738006 3000.8
## + V78                   1     49646   6738028 3000.8
## + V33                   1     49299   6738374 3000.8
## + V40                   1     47568   6740105 3000.9
## + V97                   1     46068   6741605 3000.9
## + V76                   1     45842   6741831 3000.9
## <none>                                6787673 3001.0
## + V59                   1     40563   6747111 3001.2
## + V25                   1     40379   6747294 3001.2
## + V84                   1     38742   6748931 3001.3
## + V77                   1     38691   6748983 3001.3
## + V73                   1     37758   6749915 3001.3
## + V92                   1     33710   6753963 3001.5
## + V6                    1     31517   6756156 3001.6
## + V30                   1     28618   6759055 3001.7
## + V20                   1     28469   6759204 3001.7
## + V48                   1     27853   6759820 3001.7
## + V96                   1     25855   6761818 3001.8
## + V51                   1     23707   6763966 3001.9
## + V88                   1     23531   6764142 3001.9
## + V95                   1     19507   6768166 3002.1
## + V70                   1     15480   6772193 3002.3
## + V50                   1     14674   6773000 3002.3
## + V18                   1     14540   6773133 3002.3
## + V58                   1     14332   6773341 3002.3
## + V89                   1     14121   6773552 3002.3
## + V3                    1     13805   6773868 3002.4
## + V45                   1     13341   6774332 3002.4
## + V85                   1     13300   6774373 3002.4
## + V39                   1     12731   6774942 3002.4
## + V11                   1     12523   6775150 3002.4
## + V62                   1     12420   6775253 3002.4
## + V27                   1     10640   6777033 3002.5
## + V13                   1      9452   6778221 3002.5
## + V15                   1      9187   6778486 3002.6
```

```
## + V31                   1      8632   6779041 3002.6
## + V90                   1      8282   6779391 3002.6
## + V100                  1      8083   6779591 3002.6
## + V66                   1      7529   6780144 3002.6
## + V19                   1      7063   6780610 3002.6
## + V26                   1      6540   6781133 3002.7
## + V102                  1      6489   6781184 3002.7
## + V37                   1      5463   6782210 3002.7
## + V5                    1      4952   6782721 3002.7
## + V35                   1      4945   6782728 3002.7
## + V103                  1      3858   6783815 3002.8
## + V10                   1      3850   6783823 3002.8
## + V47                   1      3509   6784164 3002.8
## + V24                   1      3355   6784318 3002.8
## + V32                   1      3227   6784446 3002.8
## + V38                   1      2992   6784681 3002.8
## + V56                   1      2123   6785550 3002.9
## + V28                   1      1826   6785847 3002.9
## + V23                   1      1749   6785924 3002.9
## + V82                   1      1557   6786116 3002.9
## + V81                   1      1543   6786130 3002.9
## + V52                   1       965   6786708 3002.9
## + V69                   1       765   6786908 3002.9
## + V75                   1       665   6787008 3002.9
## + V16                   1       629   6787044 3002.9
## + V46                   1       623   6787050 3002.9
## + `START YEAR`          1       474   6787199 3002.9
## + V29                   1       352   6787321 3002.9
## + V12                   1       314   6787359 3002.9
## + V101                  1       270   6787403 3002.9
## + V49                   1       238   6787435 3002.9
## + V9                    1       226   6787447 3002.9
## + V14                   1       213   6787460 3002.9
## + V54                   1       130   6787543 3002.9
## + V42                   1       101   6787572 3003.0
## + V36                   1        95   6787578 3003.0
## + V65                   1        13   6787660 3003.0
## + V64                   1         2   6787671 3003.0
## - V74                   1    151931   6939605 3005.5
## - V55                   1    240305   7027978 3009.3
## - V17                   1    720751   7508424 3028.9
## - V43                   1   1263200   8050873 3049.6
## - V72                   1   1809911   8597584 3069.2
## - V7                    1   2501908   9289581 3092.1
## - V8                    1 251314987 258102660 4079.5
##
## Step:  AIC=2994.42
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER`
##
##                         Df Sum of Sq       RSS    AIC
## + V87                    1    150140   6445153 2989.6
## + V68                    1    146144   6449149 2989.8
## + V1                     1    130290   6465003 2990.5
## + V67                    1     98626   6496668 2991.9
```

```
## + V60                  1     97018   6498275 2992.0
## + V86                  1     96386   6498907 2992.0
## + V53                  1     91616   6503677 2992.3
## + V44                  1     90966   6504327 2992.3
## + V105                 1     88415   6506879 2992.4
## + V80                  1     88410   6506884 2992.4
## - V94                  1       914   6596208 2992.5
## + V57                  1     86430   6508864 2992.5
## + V41                  1     86419   6508875 2992.5
## + V93                  1     83167   6512126 2992.6
## + V99                  1     83033   6512261 2992.7
## + V34                  1     81831   6513463 2992.7
## + V61                  1     81028   6514265 2992.7
## + V79                  1     79250   6516044 2992.8
## - V71                  1     11621   6606914 2992.9
## + V22                  1     74211   6521083 2993.1
## + V98                  1     73927   6521367 2993.1
## + V63                  1     67479   6527814 2993.4
## + V91                  1     67436   6527857 2993.4
## + V21                  1     66943   6528350 2993.4
## + V97                  1     61349   6533944 2993.6
## + V78                  1     59236   6536057 2993.7
## + V40                  1     55255   6540038 2993.9
## + V2                   1     51735   6543559 2994.1
## + V59                  1     49771   6545523 2994.2
## + V25                  1     48809   6546484 2994.2
## + V20                  1     47591   6547703 2994.3
## <none>                               6595294 2994.4
## + V4                   1     43249   6552045 2994.5
## + V48                  1     39490   6555804 2994.6
## + V77                  1     39195   6556098 2994.6
## + V33                  1     37967   6557326 2994.7
## + V92                  1     37466   6557828 2994.7
## + V83                  1     32205   6563089 2995.0
## + V76                  1     28273   6567020 2995.1
## + V96                  1     27372   6567922 2995.2
## + V58                  1     27056   6568238 2995.2
## + V84                  1     25821   6569473 2995.3
## + V95                  1     23927   6571367 2995.3
## + `START QUARTER`      1     22681   6572613 2995.4
## + V6                   1     20633   6574660 2995.5
## + V88                  1     17931   6577362 2995.6
## + V19                  1     17568   6577726 2995.6
## + V51                  1     17054   6578239 2995.6
## + V50                  1     15359   6579934 2995.7
## + V5                   1     15133   6580161 2995.7
## + V73                  1     14463   6580831 2995.8
## + V30                  1     14294   6581000 2995.8
## + V18                  1     14144   6581150 2995.8
## + `COMPLETION YEAR`    1     11018   6584275 2995.9
## + V90                  1      9691   6585603 2996.0
## + V85                  1      9225   6586069 2996.0
## + V70                  1      8379   6586915 2996.0
## + V13                  1      7991   6587302 2996.1
```

```
## + V62                    1      7887   6587406 2996.1
## + V26                    1      7883   6587410 2996.1
## + V102                   1      7844   6587450 2996.1
## + V89                    1      7418   6587876 2996.1
## + V39                    1      6922   6588371 2996.1
## + V3                     1      6608   6588685 2996.1
## + V46                    1      6141   6589152 2996.1
## + V27                    1      5934   6589360 2996.1
## + V100                   1      5135   6590159 2996.2
## + V31                    1      5123   6590171 2996.2
## + V38                    1      4869   6590425 2996.2
## + V66                    1      4351   6590943 2996.2
## + V15                    1      4033   6591260 2996.2
## + V11                    1      3803   6591491 2996.2
## + V37                    1      3695   6591598 2996.2
## + V29                    1      3514   6591780 2996.3
## + V45                    1      3153   6592141 2996.3
## + V82                    1      2495   6592799 2996.3
## + V47                    1      2429   6592864 2996.3
## + `START YEAR`           1      2212   6593081 2996.3
## + V24                    1      2176   6593118 2996.3
## + V32                    1      2028   6593266 2996.3
## + V28                    1      1993   6593300 2996.3
## + V56                    1      1882   6593411 2996.3
## + V14                    1      1753   6593541 2996.3
## + V42                    1      1672   6593622 2996.3
## + V65                    1      1647   6593647 2996.3
## + V103                   1      1575   6593719 2996.3
## + V35                    1      1341   6593953 2996.4
## + V101                   1      1050   6594243 2996.4
## + V49                    1      1033   6594260 2996.4
## + V81                    1       967   6594326 2996.4
## + V9                     1       959   6594335 2996.4
## + V75                    1       932   6594362 2996.4
## + V54                    1       785   6594508 2996.4
## + V10                    1       585   6594708 2996.4
## + V16                    1       460   6594834 2996.4
## + V69                    1       379   6594914 2996.4
## + V36                    1       371   6594922 2996.4
## + V52                    1       268   6595026 2996.4
## + V23                    1       246   6595047 2996.4
## + V12                    1        61   6595232 2996.4
## + V64                    1        39   6595254 2996.4
## - `COMPLETION QUARTER`   1    192380   6787673 3001.0
## - V74                    1    207184   6802478 3001.6
## - V55                    1    235349   6830643 3002.8
## - V17                    1    703441   7298734 3022.5
## - V43                    1   1155504   7750798 3040.4
## - V72                    1   1706271   8301564 3060.8
## - V7                     1   2426415   9021709 3085.5
## - V8                     1 250749269 257344563 4080.6
##
## Step:  AIC=2989.58
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER` +
```

```
##     V87
##
##                         Df Sum of Sq       RSS    AIC
## + V1                     1    115980   6329173 2986.2
## - V71                    1      1217   6446370 2987.6
## + V105                   1     81518   6363635 2987.8
## + V93                    1     73259   6371895 2988.2
## + V60                    1     61594   6383560 2988.7
## - V94                    1     25698   6470852 2988.8
## + V41                    1     56776   6388377 2988.9
## + V90                    1     55963   6389190 2989.0
## + V34                    1     53015   6392138 2989.1
## + V2                     1     51585   6393569 2989.2
## + V22                    1     51257   6393897 2989.2
## + V53                    1     49180   6395974 2989.3
## + V51                    1     48014   6397140 2989.4
## + V79                    1     44246   6400907 2989.5
## <none>                                6445153 2989.6
## + V44                    1     42903   6402250 2989.6
## + V98                    1     42325   6402828 2989.6
## + V4                     1     39251   6405903 2989.8
## + V61                    1     39041   6406112 2989.8
## + V68                    1     37556   6407597 2989.8
## + V13                    1     35595   6409558 2989.9
## + V97                    1     31351   6413802 2990.1
## + V63                    1     30978   6414175 2990.1
## + V73                    1     29690   6415464 2990.2
## + V84                    1     29528   6415625 2990.2
## + V39                    1     28757   6416397 2990.2
## + V6                     1     25920   6419233 2990.4
## + V83                    1     23474   6421680 2990.5
## + V70                    1     22909   6422244 2990.5
## + V25                    1     22471   6422682 2990.5
## + V32                    1     22036   6423117 2990.6
## + V57                    1     20830   6424323 2990.6
## + V78                    1     20409   6424745 2990.6
## + V92                    1     20003   6425151 2990.7
## + V103                   1     18956   6426198 2990.7
## + V89                    1     18611   6426543 2990.7
## + `COMPLETION YEAR`      1     17121   6428033 2990.8
## + `START QUARTER`        1     16018   6429135 2990.8
## + V80                    1     14916   6430237 2990.9
## + V67                    1     14665   6430488 2990.9
## + V27                    1     13592   6431562 2990.9
## + V77                    1     13439   6431714 2991.0
## + V5                     1     13163   6431990 2991.0
## + V46                    1     12699   6432454 2991.0
## + V81                    1     11815   6433338 2991.0
## + V59                    1     11627   6433526 2991.0
## + V91                    1     11236   6433918 2991.1
## + V33                    1     10884   6434269 2991.1
## + V100                   1     10657   6434496 2991.1
## + V40                    1      9745   6435408 2991.1
## + V50                    1      9525   6435628 2991.1
```

```
## + V65                    1      8282   6436871 2991.2
## + V86                    1      7361   6437792 2991.2
## + V21                    1      6917   6438236 2991.3
## + V20                    1      6622   6438532 2991.3
## + `START YEAR`           1      6516   6438637 2991.3
## + V15                    1      6305   6438848 2991.3
## + V31                    1      6192   6438961 2991.3
## + V14                    1      6085   6439069 2991.3
## + V3                     1      5914   6439240 2991.3
## + V18                    1      5741   6439412 2991.3
## + V102                   1      5058   6440096 2991.3
## + V26                    1      5034   6440120 2991.3
## + V11                    1      5029   6440124 2991.3
## + V37                    1      5027   6440127 2991.3
## + V10                    1      4913   6440240 2991.4
## + V49                    1      4840   6440314 2991.4
## + V69                    1      3208   6441946 2991.4
## + V42                    1      3162   6441992 2991.4
## + V95                    1      3131   6442023 2991.4
## + V30                    1      2740   6442413 2991.5
## + V48                    1      2562   6442592 2991.5
## + V56                    1      2315   6442838 2991.5
## + V45                    1      2170   6442983 2991.5
## + V12                    1      1854   6443299 2991.5
## + V58                    1      1579   6443575 2991.5
## + V99                    1      1555   6443598 2991.5
## + V75                    1      1400   6443754 2991.5
## + V52                    1      1166   6443988 2991.5
## + V54                    1      1142   6444011 2991.5
## + V28                    1       992   6444161 2991.5
## + V101                   1       943   6444210 2991.5
## + V96                    1       727   6444426 2991.5
## + V38                    1       719   6444434 2991.5
## + V23                    1       672   6444482 2991.5
## + V76                    1       662   6444491 2991.5
## + V36                    1       661   6444492 2991.5
## + V88                    1       656   6444497 2991.5
## + V9                     1       596   6444557 2991.5
## + V47                    1       420   6444734 2991.6
## + V29                    1       343   6444810 2991.6
## + V62                    1       320   6444834 2991.6
## + V19                    1       311   6444842 2991.6
## + V16                    1       289   6444864 2991.6
## + V85                    1       126   6445027 2991.6
## + V24                    1        75   6445078 2991.6
## + V64                    1        51   6445103 2991.6
## + V82                    1        31   6445123 2991.6
## + V35                    1        19   6445135 2991.6
## + V66                    1         0   6445153 2991.6
## - V87                    1    150140   6595294 2994.4
## - `COMPLETION QUARTER`   1    185973   6631126 2996.0
## - V55                    1    200317   6645470 2996.7
## - V74                    1    315998   6761151 3001.8
## - V17                    1    510923   6956076 3010.2
```

```
## - V43                    1    959365   7404518 3028.8
## - V72                    1   1577841   8022995 3052.6
## - V7                     1   2405401   8850554 3081.8
## - V8                     1 250864429 257309582 4082.6
##
## Step:  AIC=2986.18
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1
##
##                         Df Sum of Sq       RSS    AIC
## + V93                    1     95527   6233647 2983.7
## + V5                     1     87340   6241833 2984.1
## - V71                    1        54   6329228 2984.2
## + V34                    1     65034   6264139 2985.1
## + V51                    1     64840   6264333 2985.1
## + V60                    1     55824   6273349 2985.6
## + V41                    1     55004   6274169 2985.6
## + V90                    1     52797   6276376 2985.7
## - V94                    1     32437   6361610 2985.7
## + V53                    1     50619   6278554 2985.8
## + V44                    1     50550   6278623 2985.8
## + V22                    1     48621   6280553 2985.9
## + V13                    1     46776   6282398 2986.0
## + V79                    1     43385   6285788 2986.1
## <none>                                6329173 2986.2
## + V61                    1     41141   6288033 2986.2
## + V98                    1     40283   6288890 2986.3
## + V97                    1     36912   6292262 2986.4
## + V39                    1     35080   6294093 2986.5
## + V68                    1     33897   6295277 2986.6
## + V25                    1     32022   6297151 2986.7
## + V63                    1     31962   6297212 2986.7
## + V92                    1     31606   6297567 2986.7
## + V2                     1     31231   6297943 2986.7
## + V70                    1     31195   6297978 2986.7
## + V32                    1     30982   6298191 2986.7
## + V89                    1     27852   6301322 2986.9
## + V57                    1     24932   6304242 2987.0
## + V78                    1     24924   6304249 2987.0
## + V84                    1     24883   6304290 2987.0
## + V83                    1     23850   6305324 2987.1
## + V105                   1     23787   6305387 2987.1
## + V73                    1     23469   6305705 2987.1
## + V4                     1     22914   6306259 2987.1
## + V67                    1     20611   6308563 2987.2
## + V103                   1     20556   6308618 2987.2
## + V27                    1     18405   6310769 2987.3
## + V77                    1     17928   6311246 2987.3
## + `START QUARTER`        1     16166   6313008 2987.4
## + V46                    1     15993   6313180 2987.4
## + V91                    1     15509   6313665 2987.5
## + V15                    1     15408   6313765 2987.5
## + V59                    1     15115   6314059 2987.5
## + V86                    1     14899   6314275 2987.5
```

```
## + `COMPLETION YEAR`     1     13210   6315964 2987.6
## + V65                   1     12542   6316632 2987.6
## + V80                   1     11971   6317203 2987.6
## + V40                   1     11842   6317331 2987.6
## + V10                   1     11493   6317680 2987.6
## + V21                   1     11435   6317739 2987.6
## + V33                   1      9825   6319349 2987.7
## + V18                   1      9598   6319576 2987.7
## + V31                   1      9495   6319679 2987.7
## + V50                   1      9411   6319762 2987.7
## + V100                  1      9048   6320126 2987.8
## + V81                   1      7746   6321427 2987.8
## + V49                   1      5982   6323191 2987.9
## + V14                   1      5615   6323558 2987.9
## + V75                   1      5241   6323933 2987.9
## + V102                  1      4632   6324542 2988.0
## + V26                   1      4617   6324556 2988.0
## + V30                   1      4272   6324902 2988.0
## + `START YEAR`          1      4238   6324935 2988.0
## + V42                   1      3863   6325310 2988.0
## + V45                   1      3436   6325737 2988.0
## + V95                   1      3288   6325885 2988.0
## + V69                   1      2773   6326401 2988.1
## + V48                   1      2682   6326491 2988.1
## + V12                   1      2645   6326528 2988.1
## + V11                   1      2478   6326695 2988.1
## + V20                   1      2431   6326742 2988.1
## + V52                   1      2303   6326870 2988.1
## + V3                    1      2117   6327056 2988.1
## + V96                   1      2050   6327124 2988.1
## + V58                   1      1627   6327546 2988.1
## + V29                   1      1480   6327694 2988.1
## + V19                   1      1480   6327694 2988.1
## + V24                   1      1378   6327796 2988.1
## + V47                   1       863   6328310 2988.1
## + V38                   1       860   6328313 2988.1
## + V76                   1       809   6328365 2988.1
## + V37                   1       803   6328370 2988.1
## + V101                  1       719   6328454 2988.1
## + V9                    1       682   6328491 2988.2
## + V36                   1       619   6328554 2988.2
## + V54                   1       504   6328670 2988.2
## + V99                   1       483   6328691 2988.2
## + V28                   1       291   6328882 2988.2
## + V64                   1       228   6328946 2988.2
## + V56                   1       168   6329005 2988.2
## + V66                   1       154   6329019 2988.2
## + V62                   1       145   6329028 2988.2
## + V88                   1       129   6329045 2988.2
## + V35                   1        76   6329097 2988.2
## + V85                   1        56   6329117 2988.2
## + V6                    1        31   6329143 2988.2
## + V16                   1        26   6329148 2988.2
## + V82                   1         6   6329167 2988.2
```

```
## + V23                   1         0   6329173 2988.2
## - V1                    1    115980   6445153 2989.6
## - V87                   1    135830   6465003 2990.5
## - `COMPLETION QUARTER`  1    161163   6490337 2991.7
## - V55                   1    240061   6569234 2995.2
## - V74                   1    306408   6635581 2998.2
## - V17                   1    489190   6818364 3006.3
## - V43                   1    970694   7299867 3026.6
## - V72                   1   1519506   7848679 3048.1
## - V7                    1   2445487   8774660 3081.2
## - V8                    1 128866061 135195234 3893.5
##
## Step:  AIC=2983.67
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93
##
##                         Df Sum of Sq       RSS    AIC
## + V60                    1     84776   6148870 2981.6
## - V71                    1       359   6234005 2981.7
## + V44                    1     82582   6151065 2981.7
## + V41                    1     81075   6152572 2981.8
## + V37                    1     73848   6159799 2982.1
## - V17                    1     10615   6244262 2982.2
## + V79                    1     72417   6161230 2982.2
## + V98                    1     71273   6162373 2982.3
## + V5                     1     68552   6165094 2982.4
## + V22                    1     68033   6165614 2982.4
## + V97                    1     67215   6166431 2982.4
## + V63                    1     66962   6166685 2982.5
## - V94                    1     28058   6261705 2983.0
## + V81                    1     53009   6180638 2983.1
## + V56                    1     49749   6183897 2983.3
## + V78                    1     49594   6184052 2983.3
## + V90                    1     48307   6185340 2983.4
## + V68                    1     45543   6188104 2983.5
## + V25                    1     44215   6189431 2983.6
## + V101                   1     42061   6191586 2983.7
## <none>                                 6233647 2983.7
## + V2                     1     38778   6194868 2983.8
## + V28                    1     38297   6195349 2983.8
## + V4                     1     35545   6198102 2984.0
## + V59                    1     35463   6198184 2984.0
## + V62                    1     32958   6200689 2984.1
## + V21                    1     30717   6202930 2984.2
## + V40                    1     29972   6203674 2984.2
## + V61                    1     29277   6204369 2984.3
## + `COMPLETION YEAR`      1     28290   6205356 2984.3
## + V73                    1     27782   6205864 2984.3
## + V105                   1     27296   6206351 2984.4
## + V82                    1     27169   6206477 2984.4
## + V9                     1     26286   6207361 2984.4
## + V75                    1     25283   6208364 2984.5
## + V18                    1     22484   6211163 2984.6
## + V66                    1     22194   6211453 2984.6
```

```
## + V14                  1     22014   6211632 2984.6
## + V99                  1     20967   6212680 2984.7
## + V84                  1     20618   6213029 2984.7
## + V69                  1     19229   6214418 2984.7
## + `START YEAR`         1     19195   6214451 2984.8
## + V12                  1     14981   6218666 2985.0
## + V47                  1     14910   6218737 2985.0
## + V20                  1     14805   6218841 2985.0
## + V85                  1     12904   6220742 2985.1
## + V39                  1     12601   6221045 2985.1
## + V34                  1     12187   6221460 2985.1
## + V53                  1     11330   6222317 2985.1
## + V49                  1     11085   6222562 2985.1
## + V51                  1     10969   6222677 2985.1
## + V46                  1     10845   6222802 2985.1
## + V42                  1     10191   6223456 2985.2
## + V57                  1      9453   6224193 2985.2
## + V100                 1      9185   6224461 2985.2
## + V83                  1      8381   6225266 2985.3
## + V30                  1      8270   6225377 2985.3
## + V11                  1      8231   6225416 2985.3
## + V13                  1      7033   6226614 2985.3
## + V77                  1      6089   6227557 2985.4
## + `START QUARTER`      1      5041   6228606 2985.4
## + V36                  1      4682   6228964 2985.4
## + V54                  1      4248   6229399 2985.5
## + V3                   1      4178   6229469 2985.5
## + V23                  1      3973   6229674 2985.5
## + V50                  1      3935   6229712 2985.5
## + V24                  1      3849   6229798 2985.5
## + V35                  1      3697   6229950 2985.5
## + V76                  1      3631   6230015 2985.5
## + V80                  1      3605   6230042 2985.5
## + V16                  1      3515   6230131 2985.5
## + V91                  1      3460   6230187 2985.5
## + V67                  1      3402   6230244 2985.5
## + V48                  1      3166   6230480 2985.5
## + V15                  1      2217   6231430 2985.6
## + V103                 1      1988   6231659 2985.6
## + V52                  1      1941   6231706 2985.6
## + V19                  1      1886   6231760 2985.6
## + V27                  1      1654   6231992 2985.6
## + V32                  1      1479   6232167 2985.6
## + V102                 1      1434   6232212 2985.6
## + V26                  1      1366   6232281 2985.6
## + V33                  1      1196   6232451 2985.6
## + V88                  1      1075   6232572 2985.6
## + V31                  1       932   6232714 2985.6
## + V29                  1       804   6232842 2985.6
## + V65                  1       804   6232842 2985.6
## + V95                  1       744   6232903 2985.6
## + V96                  1       718   6232929 2985.6
## + V86                  1       681   6232966 2985.6
## + V70                  1       673   6232974 2985.6
```

```
## + V45                   1       277   6233370 2985.7
## + V6                    1       170   6233476 2985.7
## + V89                   1       110   6233536 2985.7
## + V58                   1        97   6233550 2985.7
## + V10                   1        64   6233583 2985.7
## + V38                   1        43   6233603 2985.7
## + V64                   1         6   6233641 2985.7
## + V92                   1         0   6233647 2985.7
## - V93                   1     95527   6329173 2986.2
## - V87                   1    123772   6357419 2987.5
## - V1                    1    138248   6371895 2988.2
## - `COMPLETION QUARTER`  1    150693   6384340 2988.8
## - V74                   1    209884   6443530 2991.5
## - V55                   1    216664   6450311 2991.8
## - V43                   1   1057748   7291394 3028.2
## - V72                   1   1591529   7825175 3049.2
## - V7                    1   2427571   8661218 3079.3
## - V8                    1 128694722 134928369 3894.9
##
## Step:  AIC=2981.6
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60
##
##                         Df Sum of Sq       RSS    AIC
## + V37                    1     95600   6053270 2978.9
## - V17                    1        50   6148920 2979.6
## + V56                    1     79806   6069064 2979.7
## - V71                    1      4127   6152997 2979.8
## + V18                    1     62646   6086225 2980.6
## + V20                    1     60613   6088257 2980.7
## + V5                     1     56510   6092360 2980.9
## + V75                    1     48140   6100730 2981.3
## <none>                                6148870 2981.6
## + V2                     1     40686   6108184 2981.6
## + V81                    1     36988   6111882 2981.8
## + V4                     1     36394   6112477 2981.8
## + V42                    1     35915   6112955 2981.9
## + V32                    1     35564   6113306 2981.9
## + V90                    1     35034   6113836 2981.9
## + V44                    1     33499   6115371 2982.0
## + V13                    1     32078   6116792 2982.0
## + V19                    1     28055   6120815 2982.2
## + V62                    1     25526   6123344 2982.4
## + V105                   1     25526   6123344 2982.4
## + V89                    1     23522   6125348 2982.5
## + V70                    1     23219   6125651 2982.5
## + V68                    1     22240   6126630 2982.5
## + V80                    1     19544   6129326 2982.7
## + V97                    1     19187   6129683 2982.7
## + V34                    1     19140   6129730 2982.7
## + V63                    1     18102   6130768 2982.7
## + V76                    1     17678   6131192 2982.7
## + V48                    1     17654   6131216 2982.7
## + V77                    1     17479   6131391 2982.8
```

```
## + V84                  1     16847   6132023 2982.8
## + V67                  1     16443   6132427 2982.8
## + V36                  1     16180   6132691 2982.8
## + V53                  1     15891   6132979 2982.8
## + V92                  1     15071   6133799 2982.9
## + V23                  1     15030   6133840 2982.9
## + V25                  1     14740   6134130 2982.9
## + V57                  1     14431   6134440 2982.9
## - V94                  1     70199   6219070 2983.0
## + `START YEAR`         1     11725   6137145 2983.0
## + V28                  1     10692   6138178 2983.1
## + V78                  1      9621   6139249 2983.1
## + V51                  1      9013   6139857 2983.2
## + V86                  1      9007   6139863 2983.2
## + V29                  1      8848   6140022 2983.2
## + V14                  1      7369   6141501 2983.2
## + V102                 1      7274   6141596 2983.2
## + V26                  1      7192   6141678 2983.3
## + `COMPLETION YEAR`    1      6758   6142112 2983.3
## + V31                  1      6684   6142186 2983.3
## + V46                  1      6654   6142216 2983.3
## + V10                  1      6177   6142693 2983.3
## + V73                  1      5961   6142909 2983.3
## + V3                   1      5390   6143481 2983.3
## + V66                  1      4936   6143934 2983.4
## + V83                  1      4936   6143935 2983.4
## + V38                  1      4244   6144626 2983.4
## + V58                  1      4128   6144742 2983.4
## + V69                  1      3999   6144871 2983.4
## + V21                  1      3960   6144910 2983.4
## + V59                  1      3702   6145168 2983.4
## + `START QUARTER`      1      3628   6145242 2983.4
## + V9                   1      3202   6145668 2983.4
## + V101                 1      3058   6145813 2983.5
## + V40                  1      3024   6145846 2983.5
## + V91                  1      2740   6146130 2983.5
## + V35                  1      2263   6146608 2983.5
## + V30                  1      1685   6147185 2983.5
## + V16                  1      1406   6147464 2983.5
## + V85                  1      1345   6147525 2983.5
## + V61                  1      1259   6147611 2983.5
## + V15                  1      1158   6147712 2983.5
## + V88                  1      1039   6147831 2983.5
## + V11                  1       999   6147871 2983.6
## + V39                  1       919   6147952 2983.6
## + V50                  1       896   6147974 2983.6
## + V33                  1       789   6148081 2983.6
## + V47                  1       768   6148102 2983.6
## + V79                  1       729   6148141 2983.6
## + V82                  1       694   6148177 2983.6
## + V54                  1       429   6148441 2983.6
## + V65                  1       401   6148470 2983.6
## + V103                 1       382   6148488 2983.6
## + V100                 1       377   6148493 2983.6
```

```
## + V45                    1       372   6148498 2983.6
## + V24                    1       358   6148512 2983.6
## + V99                    1       353   6148517 2983.6
## + V41                    1       342   6148528 2983.6
## + V27                    1       267   6148603 2983.6
## + V12                    1       233   6148638 2983.6
## + V64                    1       143   6148728 2983.6
## + V52                    1       134   6148736 2983.6
## + V95                    1       112   6148759 2983.6
## + V6                     1       102   6148768 2983.6
## + V98                    1        45   6148825 2983.6
## + V96                    1        43   6148827 2983.6
## + V49                    1         1   6148870 2983.6
## + V22                    1         0   6148870 2983.6
## - V60                    1     84776   6233647 2983.7
## - V87                    1     85926   6234797 2983.7
## - V93                    1    124479   6273349 2985.6
## - V1                     1    134389   6283260 2986.0
## - V55                    1    138829   6287699 2986.2
## - `COMPLETION QUARTER`   1    144825   6293695 2986.5
## - V74                    1    153440   6302310 2986.9
## - V43                    1   1138037   7286908 3030.0
## - V72                    1   1650298   7799169 3050.2
## - V7                     1   2457400   8606271 3079.5
## - V8                     1 128704077 134852947 3896.7
##
## Step:  AIC=2978.95
## V104 ~ V8 + V94 + V7 + V55 + V71 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37
##
##                         Df Sum of Sq       RSS    AIC
## - V71                    1      3180   6056451 2977.1
## - V94                    1      3523   6056794 2977.1
## - V17                    1      5189   6058460 2977.2
## + V5                     1     61670   5991600 2977.9
## + V20                    1     44011   6009259 2978.8
## <none>                                6053270 2978.9
## + V19                    1     38663   6014607 2979.0
## + V68                    1     38660   6014610 2979.0
## + V81                    1     38216   6015054 2979.1
## + V90                    1     33600   6019670 2979.3
## + V77                    1     32803   6020467 2979.3
## + V67                    1     30675   6022595 2979.4
## + V4                     1     30418   6022852 2979.4
## + V2                     1     30080   6023190 2979.5
## + V48                    1     28439   6024831 2979.5
## + V62                    1     28359   6024912 2979.6
## + V36                    1     26848   6026422 2979.6
## + V13                    1     26197   6027073 2979.7
## + V44                    1     25844   6027426 2979.7
## + V23                    1     24005   6029265 2979.8
## + V86                    1     23298   6029972 2979.8
## + V32                    1     22881   6030390 2979.8
## + V34                    1     22271   6031000 2979.9
```

```
## + V31                  1     21880   6031390 2979.9
## + V80                  1     21068   6032203 2979.9
## + V105                 1     20869   6032401 2979.9
## + V46                  1     20309   6032961 2979.9
## + V24                  1     19929   6033341 2980.0
## + V63                  1     19301   6033969 2980.0
## + V88                  1     18897   6034373 2980.0
## + V89                  1     18081   6035190 2980.1
## + V76                  1     17542   6035728 2980.1
## + V21                  1     17089   6036182 2980.1
## + V18                  1     16435   6036835 2980.1
## + V57                  1     16387   6036883 2980.1
## + V25                  1     14965   6038306 2980.2
## + V70                  1     14887   6038383 2980.2
## + V65                  1     14665   6038606 2980.2
## + `START YEAR`         1     14263   6039007 2980.2
## + V58                  1     13228   6040042 2980.3
## + V53                  1     13228   6040042 2980.3
## + V29                  1     12958   6040312 2980.3
## + V40                  1     11516   6041754 2980.4
## + V97                  1      9356   6043914 2980.5
## + V56                  1      9159   6044111 2980.5
## + V78                  1      8890   6044380 2980.5
## + V103                 1      8842   6044428 2980.5
## + V101                 1      8820   6044450 2980.5
## + V50                  1      8591   6044680 2980.5
## + `COMPLETION YEAR`    1      8315   6044955 2980.5
## + V38                  1      7842   6045428 2980.6
## + V49                  1      7576   6045694 2980.6
## + V73                  1      7134   6046136 2980.6
## + V59                  1      5963   6047307 2980.7
## + V75                  1      5290   6047980 2980.7
## + V47                  1      5047   6048224 2980.7
## + V83                  1      4971   6048299 2980.7
## + V82                  1      4738   6048532 2980.7
## + V42                  1      4664   6048607 2980.7
## + `START QUARTER`      1      4285   6048985 2980.7
## + V100                 1      3831   6049439 2980.8
## + V10                  1      3481   6049790 2980.8
## + V96                  1      3370   6049900 2980.8
## + V91                  1      3215   6050055 2980.8
## + V64                  1      2774   6050496 2980.8
## + V3                   1      2279   6050991 2980.8
## + V52                  1      2267   6051004 2980.8
## + V51                  1      2264   6051006 2980.8
## + V92                  1      2189   6051082 2980.8
## + V99                  1      1956   6051314 2980.8
## + V39                  1      1797   6051473 2980.9
## + V30                  1      1783   6051487 2980.9
## + V35                  1      1678   6051592 2980.9
## + V33                  1      1607   6051663 2980.9
## + V66                  1      1523   6051747 2980.9
## + V79                  1      1520   6051750 2980.9
## + V41                  1      1377   6051894 2980.9
```

```
## + V12                    1      1362   6051908 2980.9
## + V11                    1      1357   6051914 2980.9
## + V9                     1      1353   6051917 2980.9
## + V95                    1      1267   6052004 2980.9
## + V54                    1      1023   6052248 2980.9
## + V15                    1       949   6052321 2980.9
## + V14                    1       641   6052629 2980.9
## + V98                    1       510   6052761 2980.9
## + V69                    1       459   6052811 2980.9
## + V27                    1       456   6052814 2980.9
## + V85                    1       450   6052820 2980.9
## + V22                    1       328   6052943 2980.9
## + V45                    1       231   6053039 2980.9
## + V102                   1       138   6053133 2980.9
## + V26                    1       125   6053145 2980.9
## + V16                    1       100   6053171 2980.9
## + V84                    1        95   6053176 2980.9
## + V61                    1        70   6053200 2980.9
## + V6                     1        39   6053231 2980.9
## + V28                    1        18   6053253 2980.9
## - V87                    1     82180   6135450 2981.0
## - V37                    1     95600   6148870 2981.6
## - V60                    1    106528   6159799 2982.1
## - V1                     1    116355   6169625 2982.6
## - `COMPLETION QUARTER`   1    130410   6183680 2983.3
## - V55                    1    194661   6247932 2986.3
## - V74                    1    214764   6268034 2987.3
## - V93                    1    219345   6272615 2987.5
## - V43                    1   1054063   7107333 3024.6
## - V72                    1   1618514   7671784 3047.3
## - V7                     1   2473743   8527014 3078.7
## - V8                     1 127411743 133465013 3895.6
##
## Step:  AIC=2977.1
## V104 ~ V8 + V94 + V7 + V55 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37
##
##                         Df Sum of Sq       RSS    AIC
## - V94                    1      2853   6059303 2975.2
## - V17                    1      4920   6061371 2975.3
## + V5                     1     63993   5992458 2975.9
## + V20                    1     47153   6009298 2976.8
## + V19                    1     41817   6014634 2977.0
## + V81                    1     41373   6015078 2977.1
## <none>                                6056451 2977.1
## + V68                    1     39177   6017274 2977.2
## + V90                    1     36771   6019679 2977.3
## + V67                    1     33608   6022843 2977.4
## + V62                    1     31539   6024912 2977.6
## + V48                    1     31031   6025420 2977.6
## + V77                    1     30489   6025962 2977.6
## + V4                     1     29351   6027100 2977.7
## + V36                    1     29325   6027125 2977.7
## + V13                    1     29194   6027257 2977.7
```

```
## + V2                    1     28732   6027719 2977.7
## + V86                   1     26380   6030071 2977.8
## + V32                   1     25922   6030529 2977.8
## + V44                   1     24610   6031841 2977.9
## + V80                   1     24146   6032304 2977.9
## + V34                   1     23599   6032852 2977.9
## + V46                   1     21866   6034584 2978.0
## + V88                   1     21418   6035032 2978.0
## + V89                   1     21195   6035256 2978.1
## + V23                   1     20700   6035751 2978.1
## + V31                   1     20546   6035905 2978.1
## + V21                   1     20238   6036213 2978.1
## + V105                  1     19813   6036638 2978.1
## + V57                   1     19554   6036897 2978.1
## + V70                   1     18040   6038411 2978.2
## + V65                   1     17838   6038613 2978.2
## + V24                   1     17828   6038623 2978.2
## + `START YEAR`          1     17419   6039032 2978.2
## + V29                   1     16130   6040321 2978.3
## + V18                   1     16023   6040427 2978.3
## + V58                   1     15971   6040479 2978.3
## + V63                   1     15561   6040890 2978.3
## + V76                   1     14899   6041552 2978.4
## + V25                   1     14312   6042139 2978.4
## + V40                   1     13931   6042520 2978.4
## + V53                   1     13429   6043022 2978.4
## + `COMPLETION YEAR`     1     11288   6045162 2978.5
## + V103                  1     10404   6046047 2978.6
## + V78                   1     10332   6046119 2978.6
## + V97                   1      9938   6046513 2978.6
## + V56                   1      9613   6046838 2978.6
## + V50                   1      9068   6047383 2978.7
## + V49                   1      9043   6047407 2978.7
## + V38                   1      8634   6047817 2978.7
## + V59                   1      7499   6048952 2978.7
## + V73                   1      7353   6049098 2978.7
## + V101                  1      6600   6049850 2978.8
## + V83                   1      6446   6050005 2978.8
## + V47                   1      6116   6050335 2978.8
## + V10                   1      6113   6050338 2978.8
## + V75                   1      5790   6050661 2978.8
## + `START QUARTER`       1      5654   6050797 2978.8
## + V96                   1      5295   6051156 2978.8
## + V100                  1      4972   6051478 2978.9
## + V51                   1      4419   6052031 2978.9
## + V42                   1      4184   6052266 2978.9
## + V99                   1      3622   6052828 2978.9
## + V82                   1      3415   6053036 2978.9
## + V92                   1      3271   6053179 2978.9
## + V71                   1      3180   6053270 2978.9
## + V66                   1      3069   6053382 2979.0
## + V33                   1      2855   6053596 2979.0
## + V64                   1      2822   6053629 2979.0
## + V30                   1      2426   6054024 2979.0
```

```
## + V91                    1      2136   6054315 2979.0
## + V3                     1      2011   6054439 2979.0
## + V27                    1      1983   6054467 2979.0
## + V85                    1      1911   6054540 2979.0
## + V41                    1      1904   6054547 2979.0
## - V87                    1     80219   6136670 2979.0
## + V79                    1      1842   6054608 2979.0
## + V54                    1      1721   6054729 2979.0
## + V9                     1      1656   6054795 2979.0
## + V52                    1      1606   6054845 2979.0
## + V39                    1      1463   6054987 2979.0
## + V35                    1      1255   6055196 2979.0
## + V98                    1      1008   6055442 2979.1
## + V69                    1       960   6055491 2979.1
## + V14                    1       955   6055496 2979.1
## + V12                    1       886   6055565 2979.1
## + V102                   1       517   6055934 2979.1
## + V26                    1       490   6055961 2979.1
## + V22                    1       454   6055997 2979.1
## + V15                    1       337   6056114 2979.1
## + V45                    1       279   6056172 2979.1
## + V95                    1       264   6056186 2979.1
## + V11                    1       217   6056234 2979.1
## + V16                    1        77   6056374 2979.1
## + V6                     1        24   6056427 2979.1
## + V84                    1        16   6056435 2979.1
## + V61                    1         3   6056448 2979.1
## + V28                    1         0   6056451 2979.1
## - V37                    1     96546   6152997 2979.8
## - V60                    1    103395   6159845 2980.1
## - V1                     1    119960   6176411 2980.9
## - `COMPLETION QUARTER`   1    132041   6188492 2981.5
## - V74                    1    214183   6270633 2985.4
## - V93                    1    217822   6274273 2985.6
## - V55                    1    273338   6329789 2988.2
## - V43                    1   1302364   7358814 3033.0
## - V72                    1   2423198   8479648 3075.1
## - V7                     1   2478266   8534717 3077.0
## - V8                     1 127524149 133580600 3893.9
##
## Step:  AIC=2975.24
## V104 ~ V8 + V7 + V55 + V17 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37
##
##                         Df Sum of Sq       RSS    AIC
## - V17                    1      4743   6064047 2973.5
## + V5                     1     63680   5995623 2974.1
## + V20                    1     47521   6011782 2974.9
## + V19                    1     42758   6016545 2975.1
## + V81                    1     42725   6016579 2975.1
## <none>                                6059303 2975.2
## + V68                    1     37346   6021957 2975.4
## + V67                    1     35616   6023687 2975.5
## + V90                    1     33941   6025363 2975.6
```

```
## + V48                  1     32200   6027103 2975.7
## + V62                  1     32142   6027161 2975.7
## + V36                  1     31812   6027491 2975.7
## + V13                  1     30404   6028900 2975.7
## + V77                  1     30347   6028956 2975.8
## + V4                   1     29708   6029595 2975.8
## + V86                  1     28523   6030780 2975.8
## + V2                   1     28224   6031079 2975.9
## + V32                  1     27700   6031604 2975.9
## + V44                  1     27344   6031960 2975.9
## + V80                  1     26999   6032305 2975.9
## + V89                  1     23475   6035829 2976.1
## + V23                  1     23258   6036046 2976.1
## + V21                  1     23054   6036250 2976.1
## + V88                  1     22906   6036397 2976.1
## + V46                  1     21934   6037370 2976.2
## + V31                  1     21420   6037883 2976.2
## + `START YEAR`         1     20245   6039058 2976.2
## + V24                  1     20166   6039138 2976.3
## + V70                  1     19861   6039443 2976.3
## + V105                 1     19611   6039692 2976.3
## + V57                  1     19424   6039879 2976.3
## + V34                  1     19225   6040079 2976.3
## + V65                  1     19160   6040143 2976.3
## + V63                  1     18406   6040897 2976.3
## + V58                  1     17207   6042096 2976.4
## + V18                  1     17159   6042145 2976.4
## + V25                  1     16504   6042800 2976.4
## + V29                  1     16425   6042879 2976.4
## + V40                  1     16398   6042905 2976.4
## + V76                  1     15894   6043410 2976.5
## + `COMPLETION YEAR`    1     14116   6045188 2976.5
## + V56                  1     12463   6046840 2976.6
## + V78                  1     11684   6047619 2976.7
## + V53                  1     10561   6048743 2976.7
## + V97                  1     10339   6048965 2976.7
## + V50                  1     10074   6049229 2976.7
## + V103                 1      9666   6049638 2976.8
## + V38                  1      9547   6049756 2976.8
## + V101                 1      9213   6050090 2976.8
## + V59                  1      9042   6050262 2976.8
## + V49                  1      8799   6050505 2976.8
## + V75                  1      8452   6050852 2976.8
## + V47                  1      6862   6052441 2976.9
## + V42                  1      6456   6052848 2976.9
## + V73                  1      6272   6053032 2976.9
## + V100                 1      6058   6053245 2976.9
## + V10                  1      5925   6053378 2977.0
## + V99                  1      5803   6053501 2977.0
## + V96                  1      5789   6053514 2977.0
## + V82                  1      5684   6053620 2977.0
## + V83                  1      5401   6053903 2977.0
## + V51                  1      5370   6053934 2977.0
## + `START QUARTER`      1      4913   6054390 2977.0
```

```
## + V64                    1      3894   6055410 2977.1
## - V87                    1     78543   6137847 2977.1
## + V66                    1      3506   6055797 2977.1
## + V91                    1      2917   6056386 2977.1
## + V94                    1      2853   6056451 2977.1
## + V52                    1      2737   6056567 2977.1
## + V71                    1      2510   6056794 2977.1
## + V30                    1      2270   6057034 2977.1
## + V54                    1      2225   6057078 2977.1
## + V92                    1      2160   6057144 2977.1
## + V9                     1      2127   6057176 2977.1
## + V33                    1      2111   6057193 2977.1
## + V27                    1      2008   6057296 2977.1
## + V3                     1      1895   6057408 2977.1
## + V79                    1      1815   6057488 2977.2
## + V35                    1      1623   6057680 2977.2
## + V85                    1      1570   6057733 2977.2
## + V39                    1      1438   6057865 2977.2
## + V69                    1      1395   6057908 2977.2
## + V41                    1      1326   6057977 2977.2
## + V14                    1      1155   6058148 2977.2
## + V98                    1       998   6058306 2977.2
## + V12                    1       648   6058655 2977.2
## + V61                    1       400   6058903 2977.2
## + V11                    1       250   6059054 2977.2
## + V45                    1       193   6059110 2977.2
## + V102                   1       169   6059134 2977.2
## + V26                    1       154   6059149 2977.2
## + V22                    1       144   6059160 2977.2
## + V95                    1        79   6059224 2977.2
## + V84                    1        58   6059246 2977.2
## + V6                     1        18   6059285 2977.2
## + V15                    1        18   6059286 2977.2
## + V28                    1        16   6059288 2977.2
## + V16                    1         4   6059299 2977.2
## - V60                    1    101136   6160439 2978.2
## - V1                     1    117639   6176943 2979.0
## - `COMPLETION QUARTER`   1    129364   6188667 2979.5
## - V37                    1    160910   6220213 2981.0
## - V74                    1    211570   6270874 2983.4
## - V93                    1    259937   6319240 2985.7
## - V55                    1    274062   6333366 2986.4
## - V43                    1   1317119   7376423 3031.7
## - V7                     1   2486440   8545743 3075.4
## - V72                    1   2984017   9043321 3092.2
## - V8                     1 129455972 135515276 3896.2
##
## Step:  AIC=2973.47
## V104 ~ V8 + V7 + V55 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37
##
##                        Df Sum of Sq       RSS    AIC
## + V5                    1     66528   5997519 2972.2
## + V20                   1     44318   6019729 2973.3
```

```
## + V19                  1     43348   6020699 2973.3
## <none>                               6064047 2973.5
## + V67                  1     40358   6023689 2973.5
## + V90                  1     36983   6027064 2973.7
## + V48                  1     35926   6028121 2973.7
## + V68                  1     35221   6028826 2973.7
## + V77                  1     34986   6029061 2973.8
## + V86                  1     33241   6030806 2973.8
## + V81                  1     32762   6031285 2973.9
## + V13                  1     31797   6032250 2973.9
## + V44                  1     31465   6032582 2973.9
## + V36                  1     28827   6035220 2974.1
## + V4                   1     27724   6036323 2974.1
## + V2                   1     27540   6036507 2974.1
## + V31                  1     24936   6039111 2974.3
## + V62                  1     24594   6039453 2974.3
## + V89                  1     24474   6039573 2974.3
## + V21                  1     24257   6039790 2974.3
## + V46                  1     24183   6039864 2974.3
## + V65                  1     23729   6040318 2974.3
## + V34                  1     23599   6040448 2974.3
## + V23                  1     23567   6040480 2974.3
## + V57                  1     23554   6040493 2974.3
## + `START YEAR`         1     23466   6040581 2974.3
## + V32                  1     23295   6040752 2974.3
## + V88                  1     22974   6041073 2974.3
## + V63                  1     21553   6042494 2974.4
## + V25                  1     20417   6043629 2974.5
## + V58                  1     20231   6043816 2974.5
## + V105                 1     18980   6045067 2974.5
## + V76                  1     18855   6045192 2974.5
## + V29                  1     18096   6045951 2974.6
## + V80                  1     17790   6046257 2974.6
## + V70                  1     17234   6046813 2974.6
## + V40                  1     17154   6046893 2974.6
## + `COMPLETION YEAR`    1     16969   6047078 2974.6
## + V24                  1     15185   6048862 2974.7
## + V53                  1     14284   6049763 2974.8
## + V78                  1     12874   6051173 2974.8
## + V50                  1     12799   6051248 2974.8
## + V97                  1     11694   6052353 2974.9
## + V38                  1     10324   6053723 2975.0
## + V56                  1     10033   6054014 2975.0
## + V59                  1      9934   6054113 2975.0
## + V42                  1      9529   6054518 2975.0
## + V47                  1      9087   6054960 2975.0
## + V49                  1      8394   6055653 2975.1
## + V96                  1      8393   6055654 2975.1
## + V103                 1      6704   6057343 2975.1
## + V99                  1      6649   6057398 2975.1
## + V75                  1      6417   6057630 2975.2
## + V101                 1      6248   6057799 2975.2
## + V83                  1      5673   6058374 2975.2
## + V18                  1      5478   6058569 2975.2
```

```
## + V64                    1      5187   6058860 2975.2
## + `START QUARTER`        1      5181   6058866 2975.2
## + V10                    1      5110   6058937 2975.2
## + V66                    1      5087   6058960 2975.2
## + V17                    1      4743   6059303 2975.2
## + V51                    1      4700   6059347 2975.2
## + V91                    1      4670   6059376 2975.2
## + V82                    1      4520   6059527 2975.3
## + V73                    1      4399   6059648 2975.3
## + V100                   1      4034   6060013 2975.3
## + V54                    1      3989   6060058 2975.3
## - V87                    1     78588   6142635 2975.3
## + V85                    1      2918   6061129 2975.3
## + V92                    1      2840   6061207 2975.3
## + V94                    1      2676   6061371 2975.3
## + V30                    1      2300   6061747 2975.4
## + V71                    1      2296   6061751 2975.4
## + V69                    1      2227   6061820 2975.4
## + V79                    1      2181   6061866 2975.4
## + V52                    1      1993   6062054 2975.4
## + V27                    1      1880   6062167 2975.4
## + V33                    1      1814   6062233 2975.4
## + V12                    1      1739   6062307 2975.4
## + V3                     1      1718   6062329 2975.4
## + V39                    1      1607   6062440 2975.4
## + V98                    1      1325   6062722 2975.4
## + V41                    1      1166   6062881 2975.4
## + V16                    1      1025   6063022 2975.4
## + V15                    1       857   6063190 2975.4
## + V14                    1       849   6063198 2975.4
## + V45                    1       790   6063257 2975.4
## + V35                    1       587   6063460 2975.4
## + V9                     1       583   6063464 2975.4
## + V28                    1       484   6063563 2975.5
## + V11                    1       430   6063616 2975.5
## + V84                    1       339   6063708 2975.5
## + V61                    1       182   6063864 2975.5
## + V26                    1       103   6063943 2975.5
## + V22                    1        96   6063951 2975.5
## + V102                   1        95   6063952 2975.5
## + V6                     1        30   6064017 2975.5
## + V95                    1         9   6064038 2975.5
## - V60                    1     97934   6161981 2976.2
## - V1                     1    114620   6178667 2977.0
## - `COMPLETION QUARTER`   1    132251   6196298 2977.9
## - V37                    1    160018   6224065 2979.2
## - V74                    1    224335   6288382 2982.3
## - V55                    1    279420   6343466 2984.9
## - V93                    1    763653   6827700 3006.7
## - V43                    1   1490237   7554284 3036.7
## - V7                     1   2490973   8555020 3073.7
## - V72                    1   3453542   9517589 3105.4
## - V8                     1 129590448 135654495 3894.5
##
```

```
## Step:  AIC=2972.2
## V104 ~ V8 + V7 + V55 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37 + V5
##
##                         Df Sum of Sq       RSS    AIC
## + V105                   1    675403   5322116 2938.7
## + V4                     1     81583   5915936 2970.1
## + V6                     1     78024   5919494 2970.3
## + V19                    1     42961   5954557 2972.1
## <none>                                5997519 2972.2
## + V2                     1     34045   5963474 2972.5
## + V20                    1     33142   5964377 2972.6
## + V90                    1     30603   5966916 2972.7
## + V81                    1     29249   5968270 2972.7
## + V44                    1     24958   5972560 2973.0
## + V67                    1     24253   5973266 2973.0
## + V23                    1     23531   5973987 2973.0
## + V80                    1     23146   5974373 2973.0
## + V77                    1     22920   5974598 2973.1
## + V86                    1     21662   5975856 2973.1
## + V48                    1     20994   5976525 2973.2
## + V31                    1     20825   5976694 2973.2
## + V68                    1     19939   5977580 2973.2
## + V63                    1     18526   5978992 2973.3
## + V62                    1     18293   5979226 2973.3
## + `START YEAR`           1     18088   5979431 2973.3
## + V65                    1     17327   5980192 2973.3
## + V13                    1     16880   5980639 2973.4
## + V21                    1     16098   5981421 2973.4
## + V36                    1     15824   5981695 2973.4
## + V24                    1     14650   5982869 2973.5
## - V5                     1     66528   6064047 2973.5
## + V46                    1     14430   5983089 2973.5
## + V89                    1     14162   5983357 2973.5
## + V57                    1     13842   5983677 2973.5
## + V25                    1     13727   5983792 2973.5
## + V58                    1     13229   5984290 2973.5
## + V32                    1     13109   5984410 2973.5
## + V34                    1     13028   5984491 2973.6
## + V97                    1     12708   5984811 2973.6
## + V40                    1     12371   5985148 2973.6
## + V88                    1     12277   5985242 2973.6
## + V76                    1     12167   5985351 2973.6
## + V78                    1     12159   5985360 2973.6
## + V73                    1     11837   5985682 2973.6
## + V83                    1     11131   5986388 2973.6
## + V53                    1     10251   5987268 2973.7
## + `COMPLETION YEAR`      1      9814   5987705 2973.7
## + V75                    1      9769   5987750 2973.7
## + V70                    1      9766   5987752 2973.7
## + `START QUARTER`        1      9284   5988235 2973.7
## + V59                    1      9014   5988505 2973.8
## + V29                    1      8787   5988732 2973.8
## + V101                   1      8577   5988941 2973.8
```

```
## + V99                    1      8196   5989322 2973.8
## + V56                    1      7324   5990195 2973.8
## + V91                    1      6409   5991110 2973.9
## + V18                    1      5649   5991870 2973.9
## + V42                    1      5388   5992131 2973.9
## + V82                    1      5106   5992413 2973.9
## + V38                    1      5075   5992443 2973.9
## + V45                    1      4783   5992735 2974.0
## + V50                    1      4329   5993190 2974.0
## + V49                    1      3800   5993719 2974.0
## + V92                    1      3652   5993867 2974.0
## + V100                   1      3485   5994033 2974.0
## + V47                    1      3393   5994126 2974.0
## + V30                    1      3357   5994162 2974.0
## + V94                    1      3052   5994467 2974.0
## + V39                    1      2881   5994638 2974.1
## + V3                     1      2558   5994961 2974.1
## - V87                    1     78808   6076326 2974.1
## + V14                    1      2419   5995099 2974.1
## + V64                    1      2080   5995438 2974.1
## + V96                    1      1974   5995545 2974.1
## + V17                    1      1896   5995623 2974.1
## + V52                    1      1884   5995635 2974.1
## + V103                   1      1831   5995687 2974.1
## + V10                    1      1676   5995843 2974.1
## + V41                    1      1493   5996026 2974.1
## + V79                    1      1291   5996228 2974.1
## + V66                    1      1272   5996247 2974.1
## + V51                    1      1196   5996323 2974.1
## + V12                    1      1146   5996372 2974.1
## + V16                    1       976   5996543 2974.1
## + V95                    1       922   5996597 2974.2
## + V98                    1       785   5996734 2974.2
## + V54                    1       730   5996789 2974.2
## + V69                    1       713   5996806 2974.2
## + V15                    1       706   5996813 2974.2
## + V9                     1       553   5996966 2974.2
## + V11                    1       459   5997060 2974.2
## + V71                    1       442   5997077 2974.2
## + V85                    1       191   5997328 2974.2
## + V26                    1       107   5997412 2974.2
## + V102                   1        99   5997420 2974.2
## + V22                    1        59   5997460 2974.2
## + V35                    1        56   5997463 2974.2
## + V33                    1        54   5997465 2974.2
## + V84                    1        20   5997499 2974.2
## + V61                    1         2   5997516 2974.2
## + V28                    1         1   5997518 2974.2
## + V27                    1         0   5997519 2974.2
## - V60                    1     91607   6089126 2974.7
## - `COMPLETION QUARTER`   1    147932   6145451 2977.4
## - V1                     1    173629   6171148 2978.7
## - V37                    1    175671   6173190 2978.8
## - V74                    1    226418   6223936 2981.2
```

```
## - V55                    1    295494   6293013 2984.5
## - V93                    1    770744   6768263 3006.1
## - V43                    1   1525626   7523145 3037.5
## - V7                     1   2551481   8549000 3075.5
## - V72                    1   3197257   9194776 3097.1
## - V8                     1 112644829 118642348 3856.7
##
## Step:  AIC=2938.71
## V104 ~ V8 + V7 + V55 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37 + V5 + V105
##
##                         Df Sum of Sq       RSS    AIC
## + V6                     1    114761   5207355 2934.2
## - V60                    1     19727   5341843 2937.8
## <none>                                5322116 2938.7
## + V4                     1     33711   5288405 2938.8
## + V95                    1     29857   5292259 2939.0
## + V19                    1     29634   5292482 2939.1
## + V23                    1     29265   5292851 2939.1
## + V62                    1     27155   5294961 2939.2
## + V96                    1     26960   5295156 2939.2
## + V90                    1     24565   5297551 2939.3
## + V81                    1     23279   5298836 2939.4
## + V80                    1     23055   5299061 2939.4
## + V31                    1     22492   5299624 2939.5
## - V87                    1     50561   5372677 2939.5
## + V84                    1     17783   5304333 2939.7
## + V56                    1     15974   5306142 2939.8
## + V44                    1     15426   5306690 2939.9
## + V76                    1     15343   5306773 2939.9
## + V75                    1     15162   5306954 2939.9
## + V20                    1     14609   5307507 2939.9
## + V39                    1     14067   5308049 2939.9
## + V2                     1     13755   5308361 2939.9
## + V24                    1     12422   5309694 2940.0
## + V77                    1     12314   5309801 2940.0
## + V36                    1     12262   5309854 2940.0
## + V34                    1     11920   5310195 2940.0
## + V73                    1     11793   5310323 2940.1
## + V53                    1     11230   5310886 2940.1
## + V33                    1     10733   5311383 2940.1
## + V46                    1     10624   5311492 2940.1
## + V42                    1     10603   5311513 2940.1
## + V94                    1     10090   5312026 2940.2
## + V18                    1      9413   5312703 2940.2
## + V63                    1      9190   5312926 2940.2
## + V32                    1      8596   5313520 2940.2
## + V22                    1      6557   5315559 2940.3
## + V61                    1      6008   5316108 2940.4
## + V92                    1      5927   5316189 2940.4
## + V11                    1      5404   5316712 2940.4
## + V38                    1      5375   5316741 2940.4
## + V13                    1      4622   5317494 2940.5
## + V14                    1      4498   5317618 2940.5
```

```
## + V86                    1      4361   5317755 2940.5
## + V70                    1      3962   5318154 2940.5
## + V47                    1      3829   5318287 2940.5
## + V17                    1      3741   5318375 2940.5
## + V30                    1      3436   5318680 2940.5
## + V83                    1      3393   5318723 2940.5
## + V85                    1      3185   5318931 2940.5
## + V89                    1      3099   5319017 2940.5
## + V88                    1      2990   5319126 2940.5
## + V27                    1      2362   5319754 2940.6
## + V49                    1      2328   5319788 2940.6
## + V59                    1      2306   5319810 2940.6
## + V101                   1      2301   5319815 2940.6
## + V67                    1      2105   5320010 2940.6
## + V71                    1      2005   5320111 2940.6
## + V98                    1      1870   5320246 2940.6
## + V15                    1      1843   5320273 2940.6
## + V50                    1      1843   5320273 2940.6
## + V78                    1      1437   5320679 2940.6
## + V99                    1      1270   5320846 2940.6
## + V25                    1      1180   5320936 2940.6
## + `START QUARTER`        1      1165   5320951 2940.6
## + V54                    1      1106   5321010 2940.7
## + V45                    1       959   5321157 2940.7
## + V29                    1       944   5321172 2940.7
## + V68                    1       892   5321224 2940.7
## + V41                    1       864   5321251 2940.7
## + V35                    1       775   5321340 2940.7
## + V10                    1       731   5321385 2940.7
## + V97                    1       658   5321458 2940.7
## + V82                    1       603   5321513 2940.7
## + V28                    1       551   5321565 2940.7
## + V69                    1       517   5321599 2940.7
## + V40                    1       435   5321681 2940.7
## + V58                    1       366   5321750 2940.7
## + V102                   1       337   5321779 2940.7
## + V26                    1       308   5321808 2940.7
## + V9                     1       167   5321949 2940.7
## + V12                    1       142   5321974 2940.7
## + V65                    1       128   5321987 2940.7
## + V100                   1       128   5321988 2940.7
## + V91                    1       125   5321991 2940.7
## + V21                    1       121   5321995 2940.7
## + V3                     1       119   5321997 2940.7
## + `START YEAR`           1       115   5322001 2940.7
## + V52                    1       115   5322001 2940.7
## + V48                    1        95   5322021 2940.7
## + V66                    1        93   5322023 2940.7
## + V51                    1        39   5322077 2940.7
## + V103                   1        34   5322081 2940.7
## + V57                    1        33   5322083 2940.7
## + `COMPLETION YEAR`      1        24   5322092 2940.7
## + V64                    1         5   5322111 2940.7
## + V79                    1         2   5322114 2940.7
```

```
## + V16                    1         1   5322115 2940.7
## - V1                     1    122866   5444982 2943.5
## - `COMPLETION QUARTER`   1    165105   5487221 2945.8
## - V37                    1    188561   5510677 2947.1
## - V74                    1    217551   5539667 2948.6
## - V55                    1    221207   5543323 2948.8
## - V7                     1    340206   5662322 2955.1
## - V93                    1    622603   5944719 2969.6
## - V105                   1    675403   5997519 2972.2
## - V5                     1    722951   6045067 2974.5
## - V43                    1    834459   6156575 2980.0
## - V72                    1   1896999   7219115 3027.3
## - V8                     1 111892233 117214349 3855.1
##
## Step:  AIC=2934.24
## V104 ~ V8 + V7 + V55 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37 + V5 + V105 + V6
##
##                         Df Sum of Sq      RSS    AIC
## + V96                    1     65933  5141422 2932.5
## + V95                    1     57667  5149688 2932.9
## - V60                    1     26494  5233849 2933.7
## + V80                    1     40025  5167330 2933.9
## + V62                    1     37323  5170032 2934.1
## <none>                                5207355 2934.2
## + V81                    1     31737  5175618 2934.4
## + V4                     1     31320  5176035 2934.4
## + V84                    1     29882  5177473 2934.5
## + V19                    1     29756  5177600 2934.5
## + V23                    1     24670  5182685 2934.8
## + V75                    1     21779  5185576 2935.0
## + V90                    1     21377  5185978 2935.0
## + V56                    1     19912  5187443 2935.1
## + V86                    1     17637  5189719 2935.2
## + V61                    1     16666  5190689 2935.3
## + V73                    1     15039  5192316 2935.4
## + V39                    1     14526  5192829 2935.4
## + V31                    1     14258  5193097 2935.4
## + V44                    1     14087  5193269 2935.4
## + V67                    1     13427  5193928 2935.5
## + V94                    1     12590  5194765 2935.5
## + V18                    1     12316  5195039 2935.5
## + V17                    1     12032  5195324 2935.6
## + V63                    1     11190  5196165 2935.6
## + V24                    1     11033  5196322 2935.6
## - V1                     1     59533  5266888 2935.6
## + V38                    1     10904  5196451 2935.6
## + V14                    1     10866  5196489 2935.6
## + V42                    1     10447  5196908 2935.6
## + V20                    1     10060  5197296 2935.7
## + V76                    1     10045  5197310 2935.7
## + V85                    1     10036  5197319 2935.7
## + V2                     1      9149  5198206 2935.7
## + V46                    1      7033  5200322 2935.8
```

```
## + V36                  1      7006  5200349 2935.8
## - V87                  1     64077  5271432 2935.9
## + V92                  1      6438  5200918 2935.9
## + V101                 1      5953  5201402 2935.9
## + V54                  1      5896  5201460 2935.9
## + V33                  1      5676  5201679 2935.9
## + V71                  1      5280  5202075 2935.9
## + V77                  1      5246  5202110 2935.9
## + V29                  1      5031  5202324 2936.0
## + V49                  1      4827  5202528 2936.0
## + V48                  1      4163  5203192 2936.0
## + V32                  1      3875  5203480 2936.0
## + V53                  1      3804  5203552 2936.0
## + V11                  1      3398  5203958 2936.0
## + V66                  1      3386  5203969 2936.0
## + V99                  1      3355  5204000 2936.0
## + V59                  1      2754  5204601 2936.1
## + V57                  1      2470  5204886 2936.1
## + V30                  1      2186  5205169 2936.1
## + V78                  1      2184  5205172 2936.1
## + V82                  1      2090  5205266 2936.1
## + V10                  1      2079  5205276 2936.1
## + V34                  1      2078  5205277 2936.1
## + V27                  1      1828  5205528 2936.1
## + V64                  1      1678  5205677 2936.1
## + V70                  1      1645  5205711 2936.1
## + V41                  1      1546  5205809 2936.2
## + V102                 1      1462  5205893 2936.2
## + V103                 1      1443  5205913 2936.2
## + V26                  1      1396  5205960 2936.2
## + V83                  1      1305  5206050 2936.2
## + `COMPLETION YEAR`    1      1194  5206162 2936.2
## + V47                  1      1179  5206177 2936.2
## + V51                  1      1092  5206263 2936.2
## + V22                  1      1083  5206272 2936.2
## + V35                  1       974  5206381 2936.2
## + `START YEAR`         1       942  5206413 2936.2
## + V97                  1       934  5206421 2936.2
## + V16                  1       910  5206445 2936.2
## + V40                  1       855  5206500 2936.2
## + V79                  1       818  5206538 2936.2
## + V65                  1       804  5206551 2936.2
## + V89                  1       795  5206560 2936.2
## + V88                  1       726  5206630 2936.2
## + V12                  1       694  5206662 2936.2
## + V91                  1       663  5206692 2936.2
## + V21                  1       601  5206754 2936.2
## + V45                  1       485  5206871 2936.2
## + V25                  1       271  5207084 2936.2
## + V3                   1       267  5207088 2936.2
## + V15                  1       240  5207115 2936.2
## + V58                  1       217  5207139 2936.2
## + V68                  1       176  5207179 2936.2
## + V13                  1       151  5207204 2936.2
```

```
## + V100                  1       140  5207215 2936.2
## + V52                   1       120  5207235 2936.2
## + V9                    1       113  5207242 2936.2
## + V69                   1        92  5207263 2936.2
## + V50                   1        83  5207272 2936.2
## + `START QUARTER`       1        11  5207344 2936.2
## + V98                   1         3  5207353 2936.2
## + V28                   1         0  5207355 2936.2
## - V6                    1    114761  5322116 2938.7
## - `COMPLETION QUARTER`  1    172329  5379684 2941.9
## - V37                   1    212021  5419376 2944.1
## - V55                   1    223022  5430377 2944.7
## - V74                   1    238432  5445788 2945.5
## - V7                    1    292616  5499972 2948.5
## - V93                   1    627882  5835237 2966.1
## - V105                  1    712139  5919494 2970.3
## - V5                    1    826983  6034338 2976.0
## - V43                   1    922081  6129436 2980.7
## - V72                   1   1711752  6919108 3016.7
## - V8                    1  94259415 99466771 3808.3
##
## Step:  AIC=2932.46
## V104 ~ V8 + V7 + V55 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37 + V5 + V105 + V6 + V96
##
##                         Df Sum of Sq      RSS    AIC
## + V80                    1     65510  5075912 2930.6
## - V60                    1      6138  5147559 2930.8
## + V44                    1     49500  5091922 2931.6
## + V19                    1     47499  5093922 2931.7
## + V81                    1     44015  5097406 2931.9
## + V62                    1     42630  5098792 2932.0
## + V63                    1     39890  5101532 2932.1
## <none>                                5141422 2932.5
## + V31                    1     32392  5109030 2932.6
## + V46                    1     30265  5111156 2932.7
## + V75                    1     26260  5115161 2932.9
## + V61                    1     23601  5117820 2933.1
## + V76                    1     22573  5118849 2933.1
## + V36                    1     22476  5118945 2933.2
## + V4                     1     21897  5119525 2933.2
## + V56                    1     19816  5121605 2933.3
## + V77                    1     19688  5121734 2933.3
## + V42                    1     19385  5122036 2933.3
## + V84                    1     19186  5122236 2933.3
## + V82                    1     19009  5122413 2933.4
## + V94                    1     18267  5123154 2933.4
## + V27                    1     16534  5124888 2933.5
## + V101                   1     16391  5125031 2933.5
## + V32                    1     16242  5125180 2933.5
## + V23                    1     15615  5125807 2933.6
## + V70                    1     15266  5126156 2933.6
## + V20                    1     14119  5127302 2933.6
## - V1                     1     56830  5198252 2933.7
```

```
## + V89                    1     12689  5128733 2933.7
## + V25                    1     12319  5129102 2933.7
## + V95                    1     12248  5129174 2933.7
## + V18                    1      8938  5132484 2933.9
## + V24                    1      8296  5133126 2934.0
## + V35                    1      7995  5133427 2934.0
## + V58                    1      7806  5133616 2934.0
## + V50                    1      7575  5133847 2934.0
## + V47                    1      6924  5134498 2934.1
## + V14                    1      6160  5135262 2934.1
## + V41                    1      5985  5135437 2934.1
## + V73                    1      5455  5135967 2934.1
## + V92                    1      5269  5136153 2934.2
## + V88                    1      5196  5136226 2934.2
## + V13                    1      5173  5136249 2934.2
## + V91                    1      4881  5136541 2934.2
## + V34                    1      4798  5136624 2934.2
## + V2                     1      4421  5137000 2934.2
## + V99                    1      4209  5137212 2934.2
## + V48                    1      4155  5137266 2934.2
## + V21                    1      4040  5137381 2934.2
## + V98                    1      3944  5137477 2934.2
## + V69                    1      3879  5137543 2934.2
## - V96                    1     65933  5207355 2934.2
## + V49                    1      3722  5137700 2934.2
## + V85                    1      3504  5137917 2934.3
## + V90                    1      3461  5137961 2934.3
## + V17                    1      3453  5137968 2934.3
## + V53                    1      2895  5138527 2934.3
## + V40                    1      2708  5138713 2934.3
## + V33                    1      2598  5138824 2934.3
## + V103                   1      2112  5139310 2934.3
## + V38                    1      2090  5139331 2934.3
## + V57                    1      1863  5139559 2934.3
## + V39                    1      1853  5139569 2934.3
## + V28                    1      1572  5139850 2934.4
## + V3                     1      1531  5139890 2934.4
## + `COMPLETION YEAR`      1      1455  5139967 2934.4
## + V52                    1      1397  5140025 2934.4
## + V30                    1      1110  5140312 2934.4
## + V100                   1      1052  5140370 2934.4
## + V29                    1       987  5140434 2934.4
## + V67                    1       892  5140530 2934.4
## + V54                    1       891  5140530 2934.4
## + V51                    1       795  5140627 2934.4
## + V65                    1       759  5140662 2934.4
## + V11                    1       660  5140762 2934.4
## + `START YEAR`           1       631  5140791 2934.4
## + V102                   1       578  5140844 2934.4
## + V78                    1       546  5140876 2934.4
## + V26                    1       532  5140889 2934.4
## + V12                    1       504  5140917 2934.4
## + `START QUARTER`        1       462  5140960 2934.4
## + V59                    1       460  5140962 2934.4
```

```
## + V16                   1       440  5140982 2934.4
## + V97                   1       421  5141001 2934.4
## + V68                   1       418  5141003 2934.4
## + V45                   1       372  5141050 2934.4
## + V10                   1       333  5141089 2934.4
## + V86                   1       249  5141173 2934.4
## + V64                   1       130  5141292 2934.4
## + V71                   1        89  5141332 2934.4
## + V66                   1        76  5141345 2934.5
## + V83                   1        64  5141357 2934.5
## + V79                   1        61  5141361 2934.5
## + V15                   1        35  5141387 2934.5
## + V22                   1        14  5141407 2934.5
## + V9                    1        11  5141411 2934.5
## - V87                   1    101714  5243136 2936.3
## - V74                   1    135194  5276616 2938.2
## - V55                   1    144681  5286103 2938.7
## - V37                   1    146154  5287576 2938.8
## - V6                    1    153734  5295156 2939.2
## - `COMPLETION QUARTER`  1    180594  5322016 2940.7
## - V7                    1    207374  5348796 2942.2
## - V93                   1    427065  5568487 2954.2
## - V105                  1    777733  5919155 2972.3
## - V43                   1    857598  5999020 2976.3
## - V5                    1    881503  6022924 2977.5
## - V72                   1   1744821  6886243 3017.2
## - V8                    1  90074545 95215967 3797.3
##
## Step:  AIC=2930.65
## V104 ~ V8 + V7 + V55 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37 + V5 + V105 + V6 + V96 + V80
##
##                         Df Sum of Sq      RSS    AIC
## + V31                    1     73036  5002876 2928.3
## + V34                    1     36328  5039584 2930.5
## - V43                    1     33203  5109115 2930.6
## <none>                                5075912 2930.6
## + V95                    1     33407  5042505 2930.7
## + V50                    1     31675  5044238 2930.8
## + V53                    1     28924  5046988 2930.9
## - V60                    1     40023  5115935 2931.0
## + V42                    1     27421  5048491 2931.0
## + V16                    1     26409  5049503 2931.1
## + V33                    1     26108  5049804 2931.1
## + V15                    1     25430  5050482 2931.2
## + V23                    1     25106  5050806 2931.2
## + V84                    1     23683  5052229 2931.3
## + V4                     1     22966  5052946 2931.3
## + V19                    1     22220  5053693 2931.3
## + V76                    1     21312  5054600 2931.4
## + V44                    1     19853  5056059 2931.5
## + V11                    1     19744  5056168 2931.5
## + V77                    1     18131  5057781 2931.6
## + V100                   1     17178  5058734 2931.6
```

```
## + V47                   1     16707  5059205 2931.7
## + `START YEAR`          1     16334  5059578 2931.7
## + `START QUARTER`       1     14092  5061820 2931.8
## + V26                   1     12500  5063412 2931.9
## + V102                  1     12352  5063560 2931.9
## + V63                   1     12134  5063778 2931.9
## + V69                   1     11843  5064069 2932.0
## - V1                    1     57172  5133084 2932.0
## + V28                   1     11457  5064455 2932.0
## + V71                   1     10949  5064963 2932.0
## + V39                   1     10258  5065654 2932.0
## + V99                   1      8852  5067060 2932.1
## + V30                   1      8788  5067124 2932.1
## + V59                   1      8569  5067343 2932.1
## + V78                   1      7897  5068015 2932.2
## + V51                   1      7703  5068209 2932.2
## + V38                   1      7553  5068359 2932.2
## + V83                   1      6950  5068962 2932.2
## + V10                   1      6732  5069180 2932.3
## + V41                   1      5623  5070289 2932.3
## + V9                    1      5059  5070854 2932.4
## + V2                    1      4994  5070918 2932.4
## + V12                   1      4831  5071081 2932.4
## + `COMPLETION YEAR`     1      4733  5071179 2932.4
## + V24                   1      4650  5071262 2932.4
## + V97                   1      4529  5071384 2932.4
## + V36                   1      4517  5071395 2932.4
## + V35                   1      4405  5071507 2932.4
## - V74                   1     64612  5140525 2932.4
## + V46                   1      4134  5071778 2932.4
## + V14                   1      4090  5071822 2932.4
## + V29                   1      3850  5072062 2932.4
## + V94                   1      3584  5072328 2932.4
## + V40                   1      3553  5072359 2932.4
## + V49                   1      3286  5072626 2932.5
## - V80                   1     65510  5141422 2932.5
## + V62                   1      3164  5072748 2932.5
## + V21                   1      2660  5073252 2932.5
## + V91                   1      2614  5073298 2932.5
## + V57                   1      2590  5073322 2932.5
## + V90                   1      2394  5073519 2932.5
## + V66                   1      2372  5073540 2932.5
## + V64                   1      2244  5073668 2932.5
## + V103                  1      2239  5073674 2932.5
## + V81                   1      2098  5073814 2932.5
## + V65                   1      2047  5073865 2932.5
## + V98                   1      1963  5073949 2932.5
## + V25                   1      1861  5074051 2932.5
## + V68                   1      1471  5074441 2932.6
## + V17                   1      1310  5074602 2932.6
## + V92                   1      1268  5074644 2932.6
## + V3                    1      1142  5074770 2932.6
## + V20                   1      1002  5074910 2932.6
## + V67                   1       919  5074994 2932.6
```

```
## + V88                    1       890  5075022 2932.6
## + V27                    1       826  5075086 2932.6
## + V48                    1       759  5075154 2932.6
## + V101                   1       647  5075265 2932.6
## + V79                    1       594  5075318 2932.6
## + V58                    1       519  5075393 2932.6
## + V86                    1       457  5075455 2932.6
## + V18                    1       435  5075478 2932.6
## + V32                    1       303  5075609 2932.6
## + V70                    1       251  5075661 2932.6
## + V45                    1       243  5075669 2932.6
## + V85                    1       220  5075692 2932.6
## + V89                    1       168  5075745 2932.6
## + V82                    1       164  5075748 2932.6
## + V13                    1       153  5075759 2932.6
## + V22                    1       141  5075771 2932.6
## + V52                    1        90  5075822 2932.6
## + V75                    1        55  5075857 2932.6
## + V61                    1        19  5075893 2932.6
## + V56                    1        18  5075895 2932.6
## + V54                    1         5  5075908 2932.6
## + V73                    1         0  5075912 2932.6
## - V37                    1     78209  5154121 2933.2
## - V96                    1     91418  5167330 2933.9
## - V87                    1    167197  5243110 2938.3
## - V55                    1    174290  5250202 2938.7
## - V7                     1    176340  5252252 2938.8
## - V6                     1    186985  5262897 2939.4
## - `COMPLETION QUARTER`   1    187462  5263374 2939.4
## - V93                    1    293534  5369446 2945.3
## - V105                   1    803616  5879528 2972.3
## - V5                     1    937028  6012941 2979.0
## - V72                    1   1454976  6530888 3003.5
## - V8                     1  90099007 95174919 3799.2
##
## Step:  AIC=2928.34
## V104 ~ V8 + V7 + V55 + V74 + V72 + V43 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37 + V5 + V105 + V6 + V96 + V80 +
##     V31
##
##                         Df Sum of Sq      RSS    AIC
## - V43                    1     13304  5016180 2927.1
## + V12                    1     53573  4949303 2927.1
## - V74                    1     17346  5020222 2927.4
## + V28                    1     48989  4953887 2927.4
## + V9                     1     43839  4959037 2927.7
## + `START YEAR`           1     39823  4963053 2928.0
## + V62                    1     37257  4965619 2928.1
## + V95                    1     36218  4966658 2928.2
## + V81                    1     33942  4968934 2928.3
## <none>                                5002876 2928.3
## + V44                    1     28632  4974244 2928.6
## + `START QUARTER`        1     25393  4977483 2928.8
## + V4                     1     24476  4978400 2928.9
```

```
## + V19                   1     22629  4980247 2929.0
## + V42                   1     21148  4981728 2929.1
## + V36                   1     19877  4983000 2929.2
## + V63                   1     18576  4984300 2929.2
## + V79                   1     16697  4986179 2929.3
## + V83                   1     16419  4986457 2929.4
## + V88                   1     16000  4986877 2929.4
## + V38                   1     15955  4986922 2929.4
## + V16                   1     15815  4987061 2929.4
## + V76                   1     15076  4987801 2929.4
## + `COMPLETION YEAR`     1     13742  4989134 2929.5
## + V99                   1     13296  4989580 2929.6
## + V66                   1     12372  4990505 2929.6
## + V34                   1     11964  4990913 2929.6
## + V85                   1     11365  4991511 2929.7
## + V35                   1     11118  4991758 2929.7
## + V69                   1     10831  4992045 2929.7
## + V22                   1     10673  4992204 2929.7
## + V53                   1     10408  4992468 2929.7
## + V73                   1      9956  4992921 2929.8
## + V77                   1      9833  4993044 2929.8
## + V14                   1      9657  4993220 2929.8
## + V84                   1      8576  4994300 2929.8
## - V1                    1     59167  5062043 2929.8
## + V98                   1      8082  4994794 2929.9
## + V86                   1      8028  4994848 2929.9
## + V26                   1      8006  4994870 2929.9
## + V45                   1      7995  4994881 2929.9
## + V102                  1      7831  4995045 2929.9
## + V71                   1      7651  4995225 2929.9
## + V23                   1      7370  4995506 2929.9
## + V18                   1      7123  4995753 2929.9
## + V39                   1      6685  4996191 2929.9
## + V33                   1      6552  4996324 2930.0
## + V46                   1      6524  4996352 2930.0
## + V25                   1      6360  4996516 2930.0
## + V54                   1      5666  4997210 2930.0
## + V32                   1      5634  4997243 2930.0
## + V101                  1      5244  4997633 2930.0
## + V11                   1      5200  4997676 2930.0
## + V59                   1      5193  4997684 2930.0
## + V30                   1      4942  4997934 2930.0
## + V78                   1      4841  4998035 2930.1
## + V97                   1      4560  4998316 2930.1
## + V67                   1      4559  4998317 2930.1
## + V64                   1      4520  4998356 2930.1
## + V40                   1      4277  4998599 2930.1
## + V20                   1      4077  4998799 2930.1
## + V52                   1      3506  4999370 2930.1
## + V2                    1      3490  4999386 2930.1
## + V47                   1      3297  4999579 2930.1
## + V90                   1      2859  5000017 2930.2
## + V75                   1      2846  5000030 2930.2
## + V82                   1      2828  5000049 2930.2
```

```
## + V70                   1      2344  5000532 2930.2
## + V29                   1      2310  5000566 2930.2
## + V10                   1      2267  5000609 2930.2
## + V3                    1      2131  5000745 2930.2
## + V13                   1      2010  5000866 2930.2
## + V27                   1      1943  5000934 2930.2
## + V50                   1      1767  5001109 2930.2
## + V15                   1      1758  5001118 2930.2
## + V68                   1      1728  5001148 2930.2
## + V49                   1      1713  5001163 2930.2
## + V51                   1      1524  5001352 2930.3
## + V61                   1      1478  5001398 2930.3
## + V48                   1      1401  5001475 2930.3
## + V89                   1      1189  5001687 2930.3
## + V103                  1      1044  5001832 2930.3
## + V21                   1       693  5002183 2930.3
## + V57                   1       630  5002246 2930.3
## + V100                  1       619  5002257 2930.3
## + V94                   1       416  5002460 2930.3
## + V92                   1       327  5002549 2930.3
## + V17                   1       301  5002575 2930.3
## + V65                   1       129  5002748 2930.3
## + V91                   1        95  5002781 2930.3
## + V24                   1        33  5002843 2930.3
## + V58                   1         3  5002874 2930.3
## + V41                   1         1  5002876 2930.3
## + V56                   1         0  5002876 2930.3
## - V31                   1     73036  5075912 2930.6
## - V60                   1     94201  5097077 2931.9
## - V37                   1     95319  5098195 2931.9
## - V80                   1    106154  5109030 2932.6
## - V96                   1    134142  5137018 2934.2
## - V7                    1    158368  5161244 2935.6
## - V55                   1    168169  5171046 2936.2
## - `COMPLETION QUARTER`  1    172959  5175835 2936.4
## - V6                    1    192023  5194899 2937.5
## - V87                   1    207818  5210694 2938.4
## - V93                   1    211815  5214691 2938.7
## - V105                  1    839035  5841912 2972.4
## - V5                    1    973642  5976518 2979.2
## - V72                   1   1511341  6514217 3004.7
## - V8                    1  90074276 95077152 3800.9
##
## Step:  AIC=2927.13
## V104 ~ V8 + V7 + V55 + V74 + V72 + `COMPLETION QUARTER` + V87 +
##     V1 + V93 + V60 + V37 + V5 + V105 + V6 + V96 + V80 + V31
##
##                         Df Sum of Sq      RSS    AIC
## + V12                    1     62763  4953417 2925.4
## - V74                    1      9143  5025323 2925.7
## + V28                    1     50250  4965930 2926.1
## + V81                    1     47243  4968937 2926.3
## + V95                    1     46896  4969284 2926.3
## + V9                     1     43066  4973114 2926.6
```

```
## + V62                   1     41188  4974992 2926.7
## + `START YEAR`          1     38746  4977434 2926.8
## + `START QUARTER`       1     34906  4981274 2927.1
## + V44                   1     34769  4981411 2927.1
## <none>                              5016180 2927.1
## + V42                   1     29758  4986422 2927.4
## + V16                   1     25437  4990743 2927.6
## + V83                   1     24766  4991414 2927.7
## + V88                   1     24520  4991660 2927.7
## + V38                   1     24513  4991667 2927.7
## + V4                    1     24246  4991934 2927.7
## + V63                   1     22602  4993578 2927.8
## + V79                   1     22371  4993809 2927.8
## + V34                   1     21447  4994733 2927.9
## + V23                   1     20400  4995780 2927.9
## + V53                   1     20066  4996114 2927.9
## + V73                   1     17946  4998233 2928.1
## + V71                   1     17503  4998677 2928.1
## + V26                   1     16533  4999647 2928.2
## + V11                   1     16489  4999691 2928.2
## + V102                  1     16314  4999866 2928.2
## + V30                   1     15065  5001115 2928.2
## + V86                   1     14954  5001226 2928.2
## + V22                   1     14651  5001529 2928.3
## + V75                   1     13718  5002462 2928.3
## + V43                   1     13304  5002876 2928.3
## + V33                   1     12895  5003285 2928.4
## + V76                   1     12060  5004120 2928.4
## + V67                   1     11768  5004412 2928.4
## + V84                   1     11490  5004690 2928.4
## + V39                   1     11185  5004995 2928.5
## + V69                   1     10905  5005275 2928.5
## + V98                   1     10811  5005369 2928.5
## + V29                   1     10339  5005841 2928.5
## + V10                   1     10084  5006096 2928.5
## + V51                   1      9950  5006230 2928.5
## + V61                   1      9828  5006352 2928.5
## + V24                   1      9753  5006427 2928.6
## + V66                   1      9515  5006665 2928.6
## + V25                   1      9432  5006748 2928.6
## - V1                    1     58584  5074764 2928.6
## + V15                   1      9198  5006982 2928.6
## + V59                   1      9071  5007109 2928.6
## + V77                   1      8896  5007284 2928.6
## + `COMPLETION YEAR`     1      8863  5007317 2928.6
## + V85                   1      8857  5007323 2928.6
## + V54                   1      8634  5007546 2928.6
## + V48                   1      8430  5007750 2928.6
## + V78                   1      8345  5007835 2928.6
## + V97                   1      8204  5007976 2928.6
## + V19                   1      7540  5008640 2928.7
## + V40                   1      7007  5009173 2928.7
## + V35                   1      6938  5009242 2928.7
## + V45                   1      6578  5009602 2928.7
```

```
## + V64                    1      6027  5010153 2928.8
## + V36                    1      5802  5010378 2928.8
## + V101                   1      5761  5010419 2928.8
## + V49                    1      5218  5010962 2928.8
## + V56                    1      4096  5012084 2928.9
## + V47                    1      3535  5012645 2928.9
## + V65                    1      3516  5012664 2928.9
## + V2                     1      3352  5012828 2928.9
## + V82                    1      2797  5013383 2929.0
## + V18                    1      2665  5013515 2929.0
## + V68                    1      2171  5014009 2929.0
## + V3                     1      2166  5014014 2929.0
## + V89                    1      2055  5014125 2929.0
## + V100                   1      1978  5014202 2929.0
## + V52                    1      1850  5014330 2929.0
## + V99                    1      1714  5014466 2929.0
## + V70                    1      1626  5014554 2929.0
## + V103                   1      1536  5014644 2929.0
## + V58                    1      1276  5014904 2929.1
## + V17                    1      1065  5015115 2929.1
## + V14                    1      1010  5015170 2929.1
## + V50                    1       943  5015237 2929.1
## + V90                    1       816  5015364 2929.1
## + V91                    1       629  5015551 2929.1
## + V27                    1       520  5015660 2929.1
## + V94                    1       478  5015702 2929.1
## + V13                    1       469  5015711 2929.1
## + V20                    1       390  5015790 2929.1
## + V21                    1       346  5015834 2929.1
## + V92                    1       339  5015841 2929.1
## + V57                    1       198  5015982 2929.1
## + V41                    1       111  5016069 2929.1
## + V32                    1        69  5016111 2929.1
## + V46                    1         4  5016176 2929.1
## - V37                    1     84868  5101048 2930.1
## - V31                    1     92935  5109115 2930.6
## - V7                     1    146311  5162491 2933.7
## - V60                    1    158165  5174345 2934.4
## - V96                    1    171363  5187543 2935.1
## - `COMPLETION QUARTER`   1    177869  5194049 2935.5
## - V93                    1    198533  5214713 2936.7
## - V55                    1    204109  5220289 2937.0
## - V6                     1    204513  5220693 2937.0
## - V87                    1    297933  5314113 2942.3
## - V105                   1    924347  5940527 2975.4
## - V80                    1    976125  5992305 2977.9
## - V5                     1   1083605  6099785 2983.2
## - V72                    1   1599378  6615558 3007.3
## - V8                     1  90063606 95079786 3798.9
##
## Step:  AIC=2925.39
## V104 ~ V8 + V7 + V55 + V74 + V72 + `COMPLETION QUARTER` + V87 +
##     V1 + V93 + V60 + V37 + V5 + V105 + V6 + V96 + V80 + V31 +
##     V12
```

```
##
##                         Df Sum of Sq      RSS    AIC
## - V74                    1      2153  4955570 2923.5
## + V28                    1     42557  4910860 2924.8
## + V95                    1     42145  4911273 2924.9
## + V44                    1     39460  4913957 2925.0
## + `START YEAR`           1     36526  4916891 2925.2
## + V81                    1     34473  4918944 2925.3
## <none>                                4953417 2925.4
## + V62                    1     30250  4923167 2925.6
## + V38                    1     23677  4929740 2926.0
## + V66                    1     22726  4930691 2926.0
## + V4                     1     22034  4931384 2926.1
## + V34                    1     21667  4931750 2926.1
## + V53                    1     21398  4932019 2926.1
## + V63                    1     21362  4932055 2926.1
## + V88                    1     21196  4932221 2926.1
## + `COMPLETION YEAR`      1     19889  4933528 2926.2
## + V15                    1     19397  4934020 2926.2
## + V71                    1     18806  4934611 2926.3
## + V21                    1     17692  4935725 2926.3
## + V19                    1     17545  4935872 2926.3
## + V76                    1     17350  4936068 2926.3
## + V92                    1     14609  4938808 2926.5
## + V86                    1     14598  4938819 2926.5
## + V84                    1     13714  4939703 2926.6
## + V35                    1     13620  4939797 2926.6
## + V51                    1     13420  4939997 2926.6
## + V67                    1     13355  4940062 2926.6
## + V42                    1     11982  4941435 2926.7
## + V16                    1     11353  4942064 2926.7
## + V11                    1     11287  4942130 2926.7
## + V25                    1     10728  4942689 2926.7
## + V75                    1     10173  4943244 2926.8
## + V79                    1     10075  4943342 2926.8
## + V10                    1      9978  4943439 2926.8
## + `START QUARTER`        1      9823  4943594 2926.8
## + V77                    1      9525  4943892 2926.8
## + V29                    1      9413  4944004 2926.8
## + V23                    1      9050  4944367 2926.8
## + V9                     1      8867  4944551 2926.9
## + V85                    1      8791  4944627 2926.9
## + V99                    1      8435  4944982 2926.9
## + V39                    1      8390  4945027 2926.9
## + V98                    1      8135  4945282 2926.9
## + V36                    1      7899  4945518 2926.9
## + V30                    1      7823  4945594 2926.9
## + V48                    1      7199  4946219 2927.0
## + V45                    1      6955  4946463 2927.0
## + V61                    1      6840  4946577 2927.0
## + V22                    1      5860  4947557 2927.0
## + V69                    1      5153  4948264 2927.1
## + V14                    1      5104  4948314 2927.1
## + V83                    1      4867  4948550 2927.1
```

```
## - V12                    1     62763  5016180 2927.1
## + V43                    1      4114  4949303 2927.1
## + V2                     1      4090  4949327 2927.1
## + V33                    1      4064  4949354 2927.1
## + V94                    1      4057  4949360 2927.1
## + V17                    1      3992  4949426 2927.2
## - V1                     1     63124  5016541 2927.2
## + V65                    1      3750  4949667 2927.2
## + V49                    1      3051  4950366 2927.2
## + V97                    1      2793  4950624 2927.2
## + V89                    1      2730  4950687 2927.2
## + V24                    1      2459  4950958 2927.2
## + V52                    1      2282  4951136 2927.3
## + V70                    1      2264  4951153 2927.3
## + V18                    1      2235  4951182 2927.3
## + V101                   1      2045  4951372 2927.3
## + V73                    1      1858  4951559 2927.3
## + V82                    1      1749  4951668 2927.3
## + V91                    1      1743  4951674 2927.3
## + V56                    1      1410  4952007 2927.3
## + V78                    1      1297  4952120 2927.3
## + V59                    1      1228  4952189 2927.3
## + V3                     1      1214  4952203 2927.3
## + V40                    1       985  4952432 2927.3
## + V13                    1       947  4952470 2927.3
## + V64                    1       806  4952611 2927.3
## + V20                    1       671  4952746 2927.4
## + V32                    1       531  4952887 2927.4
## + V54                    1       508  4952909 2927.4
## + V47                    1       478  4952939 2927.4
## + V27                    1       435  4952983 2927.4
## + V68                    1       428  4952989 2927.4
## + V50                    1       347  4953070 2927.4
## + V58                    1       245  4953172 2927.4
## + V57                    1       224  4953193 2927.4
## + V100                   1       130  4953287 2927.4
## + V103                   1        77  4953340 2927.4
## + V41                    1        55  4953362 2927.4
## + V46                    1        42  4953375 2927.4
## + V26                    1        34  4953383 2927.4
## + V102                   1        25  4953392 2927.4
## + V90                    1        12  4953405 2927.4
## - V37                    1     90400  5043817 2928.8
## - V60                    1    101087  5054505 2929.4
## - V31                    1    149561  5102978 2932.2
## - V7                     1    157997  5111414 2932.7
## - V96                    1    159793  5113211 2932.8
## - `COMPLETION QUARTER`   1    187546  5140963 2934.4
## - V6                     1    216278  5169695 2936.1
## - V93                    1    258800  5212217 2938.5
## - V87                    1    259590  5213007 2938.6
## - V55                    1    266744  5220161 2939.0
## - V80                    1    845541  5798958 2970.2
## - V105                   1    930924  5884341 2974.5
```

```
## - V5                    1   1094077  6047494 2982.7
## - V72                   1   1620790  6574207 3007.5
## - V8                    1  90041646 94995064 3800.7
##
## Step:  AIC=2923.52
## V104 ~ V8 + V7 + V55 + V72 + `COMPLETION QUARTER` + V87 + V1 +
##     V93 + V60 + V37 + V5 + V105 + V6 + V96 + V80 + V31 + V12
##
##                         Df Sum of Sq      RSS    AIC
## + V28                    1     44298  4911272 2922.9
## + V95                    1     36875  4918695 2923.3
## + V81                    1     36620  4918950 2923.3
## + V44                    1     35057  4920513 2923.4
## + `START YEAR`           1     34624  4920946 2923.4
## <none>                                4955570 2923.5
## + V62                    1     26129  4929441 2924.0
## + V38                    1     25316  4930254 2924.0
## + V66                    1     24872  4930698 2924.0
## + V34                    1     23820  4931750 2924.1
## + V53                    1     23274  4932296 2924.1
## + V88                    1     23079  4932491 2924.1
## + V4                     1     22742  4932828 2924.2
## + `COMPLETION YEAR`      1     22006  4933564 2924.2
## + V21                    1     19745  4935825 2924.3
## + V15                    1     19452  4936118 2924.4
## + V76                    1     17870  4937700 2924.4
## + V19                    1     16845  4938725 2924.5
## + V86                    1     16726  4938844 2924.5
## + V71                    1     16179  4939391 2924.5
## + V84                    1     15834  4939736 2924.6
## + V63                    1     15720  4939850 2924.6
## + V35                    1     15716  4939854 2924.6
## + V92                    1     15270  4940300 2924.6
## + V51                    1     14909  4940661 2924.6
## + V67                    1     14701  4940869 2924.6
## + V11                    1     12679  4942891 2924.8
## + V16                    1     12417  4943153 2924.8
## + V42                    1     12078  4943492 2924.8
## + V10                    1     11633  4943937 2924.8
## + `START QUARTER`        1     11608  4943962 2924.8
## + V29                    1     11121  4944449 2924.9
## + V9                     1     10797  4944773 2924.9
## + V79                    1     10545  4945025 2924.9
## + V99                    1     10317  4945253 2924.9
## + V85                    1     10130  4945440 2924.9
## + V36                    1     10036  4945534 2924.9
## + V30                    1      9922  4945648 2924.9
## + V98                    1      9185  4946385 2925.0
## + V45                    1      9106  4946464 2925.0
## + V39                    1      8638  4946932 2925.0
## + V25                    1      8441  4947129 2925.0
## + V61                    1      8423  4947147 2925.0
## + V77                    1      7684  4947886 2925.1
## + V48                    1      7634  4947936 2925.1
```

```
## + V83                    1      6950  4948620 2925.1
## + V23                    1      6827  4948743 2925.1
## + V22                    1      6717  4948853 2925.1
## + V69                    1      6122  4949448 2925.2
## + V65                    1      5849  4949721 2925.2
## + V17                    1      5401  4950169 2925.2
## + V75                    1      4831  4950739 2925.2
## + V94                    1      4625  4950945 2925.2
## + V2                     1      4393  4951177 2925.3
## + V49                    1      4094  4951476 2925.3
## + V73                    1      3972  4951598 2925.3
## + V70                    1      3330  4952240 2925.3
## + V33                    1      3297  4952273 2925.3
## + V89                    1      3226  4952344 2925.3
## + V97                    1      2374  4953196 2925.4
## + V74                    1      2153  4953417 2925.4
## - V1                     1     65109  5020679 2925.4
## + V52                    1      1981  4953589 2925.4
## + V14                    1      1958  4953612 2925.4
## + V18                    1      1732  4953838 2925.4
## + V40                    1      1661  4953909 2925.4
## + V43                    1      1584  4953986 2925.4
## + V91                    1      1487  4954083 2925.4
## + V24                    1      1343  4954227 2925.4
## + V13                    1      1069  4954501 2925.5
## + V3                     1       946  4954624 2925.5
## + V78                    1       874  4954696 2925.5
## + V57                    1       870  4954700 2925.5
## + V56                    1       852  4954718 2925.5
## + V101                   1       845  4954725 2925.5
## + V50                    1       807  4954763 2925.5
## + V59                    1       801  4954769 2925.5
## + V58                    1       752  4954818 2925.5
## + V32                    1       698  4954872 2925.5
## + V82                    1       620  4954950 2925.5
## + V54                    1       603  4954967 2925.5
## + V64                    1       595  4954975 2925.5
## + V20                    1       565  4955005 2925.5
## + V68                    1       557  4955013 2925.5
## + V47                    1       434  4955136 2925.5
## + V103                   1       247  4955323 2925.5
## + V46                    1       175  4955395 2925.5
## + V90                    1       170  4955400 2925.5
## + V27                    1       123  4955447 2925.5
## + V26                    1        34  4955536 2925.5
## + V102                   1        26  4955544 2925.5
## + V41                    1        16  4955554 2925.5
## + V100                   1         1  4955569 2925.5
## - V12                    1     69753  5025323 2925.7
## - V37                    1     96046  5051616 2927.2
## - V60                    1    108519  5064089 2928.0
## - V7                     1    155861  5111431 2930.7
## - V31                    1    185134  5140704 2932.4
## - `COMPLETION QUARTER`   1    185395  5140965 2932.4
```

```
## - V96                   1    202661  5158231 2933.4
## - V6                    1    220059  5175629 2934.4
## - V87                   1    257894  5213464 2936.6
## - V55                   1    265060  5220630 2937.0
## - V93                   1    265365  5220935 2937.0
## - V80                   1    888769  5844339 2970.5
## - V105                  1    941621  5897191 2973.2
## - V5                    1   1116023  6071593 2981.8
## - V72                   1   2314459  7270029 3035.3
## - V8                    1  90059395 95014965 3798.7
##
## Step:  AIC=2922.85
## V104 ~ V8 + V7 + V55 + V72 + `COMPLETION QUARTER` + V87 + V1 +
##     V93 + V60 + V37 + V5 + V105 + V6 + V96 + V80 + V31 + V12 +
##     V28
##
##                         Df Sum of Sq      RSS    AIC
## <none>                                 4911272 2922.9
## + V95                    1     32628  4878644 2922.9
## + V62                    1     31855  4879417 2922.9
## + V44                    1     30470  4880802 2923.0
## + V81                    1     28837  4882435 2923.1
## + V19                    1     25296  4885975 2923.3
## - V28                    1     44298  4955570 2923.5
## + V4                     1     21653  4889619 2923.5
## + V38                    1     20982  4890290 2923.6
## + V92                    1     18543  4892729 2923.7
## + `START YEAR`           1     17910  4893362 2923.8
## + `START QUARTER`        1     15819  4895452 2923.9
## + V63                    1     15450  4895821 2923.9
## + V35                    1     14418  4896854 2924.0
## + V21                    1     14274  4896998 2924.0
## + V53                    1     12928  4898344 2924.1
## + V15                    1     12387  4898885 2924.1
## + V34                    1     12256  4899016 2924.1
## - V12                    1     54936  4966208 2924.2
## + V76                    1     10659  4900612 2924.2
## + V42                    1      9494  4901777 2924.3
## + V45                    1      9256  4902016 2924.3
## + V86                    1      9049  4902223 2924.3
## + V61                    1      8997  4902275 2924.3
## + V83                    1      8939  4902333 2924.3
## + V88                    1      8449  4902823 2924.3
## + V14                    1      7982  4903290 2924.4
## + V17                    1      7924  4903348 2924.4
## + V75                    1      7844  4903427 2924.4
## + V71                    1      7781  4903491 2924.4
## + V16                    1      6999  4904273 2924.4
## + V33                    1      6853  4904419 2924.4
## + V36                    1      6427  4904845 2924.5
## + V25                    1      6301  4904971 2924.5
## + `COMPLETION YEAR`      1      6109  4905163 2924.5
## + V67                    1      5974  4905298 2924.5
## + V47                    1      5793  4905479 2924.5
```

```
## + V79                  1      5200  4906072 2924.5
## + V11                  1      4720  4906552 2924.6
## + V77                  1      4486  4906786 2924.6
## + V66                  1      4460  4906812 2924.6
## + V46                  1      4265  4907007 2924.6
## + V43                  1      4236  4907035 2924.6
## + V84                  1      4115  4907156 2924.6
## + V51                  1      3859  4907413 2924.6
## + V30                  1      3825  4907446 2924.6
## + V39                  1      3594  4907677 2924.6
## + V50                  1      3365  4907907 2924.6
## + V49                  1      3362  4907910 2924.7
## + V2                   1      3118  4908154 2924.7
## - V37                  1     63734  4975005 2924.7
## + V20                  1      2755  4908517 2924.7
## + V94                  1      2447  4908824 2924.7
## + V99                  1      2206  4909066 2924.7
## + V10                  1      2086  4909186 2924.7
## + V41                  1      1984  4909288 2924.7
## + V48                  1      1920  4909352 2924.7
## + V3                   1      1863  4909409 2924.7
## + V27                  1      1848  4909424 2924.7
## + V73                  1      1784  4909488 2924.7
## + V29                  1      1730  4909542 2924.7
## + V23                  1      1462  4909810 2924.8
## + V40                  1      1320  4909952 2924.8
## + V78                  1      1110  4910162 2924.8
## + V85                  1      1007  4910265 2924.8
## + V98                  1       885  4910387 2924.8
## + V24                  1       785  4910487 2924.8
## + V22                  1       661  4910611 2924.8
## + V101                 1       588  4910684 2924.8
## + V82                  1       501  4910771 2924.8
## + V102                 1       462  4910810 2924.8
## + V26                  1       430  4910842 2924.8
## + V74                  1       412  4910860 2924.8
## + V32                  1       332  4910940 2924.8
## + V65                  1       327  4910945 2924.8
## + V52                  1       319  4910953 2924.8
## + V69                  1       273  4910999 2924.8
## + V100                 1       258  4911014 2924.8
## + V54                  1       236  4911036 2924.8
## + V18                  1       227  4911045 2924.8
## + V68                  1       217  4911055 2924.8
## + V56                  1       215  4911057 2924.8
## + V13                  1       201  4911071 2924.8
## + V58                  1       191  4911081 2924.8
## + V59                  1       121  4911151 2924.8
## + V57                  1        69  4911203 2924.8
## + V97                  1        45  4911227 2924.9
## + V90                  1        40  4911232 2924.9
## + V91                  1        35  4911237 2924.9
## + V64                  1        19  4911253 2924.9
## + V70                  1        17  4911255 2924.9
```

```
## + V9                    1        10  4911261 2924.9
## + V103                  1         8  4911264 2924.9
## + V89                   1         6  4911266 2924.9
## - V1                    1     72809  4984081 2925.2
## - V60                   1     80383  4991655 2925.7
## - V7                    1    164140  5075412 2930.6
## - `COMPLETION QUARTER`  1    179943  5091215 2931.5
## - V96                   1    192705  5103977 2932.3
## - V6                    1    214511  5125783 2933.6
## - V31                   1    215883  5127155 2933.6
## - V87                   1    240727  5151999 2935.1
## - V93                   1    277133  5188405 2937.2
## - V55                   1    308030  5219302 2938.9
## - V80                   1    863288  5774560 2968.9
## - V105                  1    920432  5831704 2971.9
## - V5                    1   1104732  6016004 2981.1
## - V72                   1   2341539  7252810 3036.6
## - V8                    1  90076521 94987792 3800.6
```

```r
  summary(lm_model_st)
```

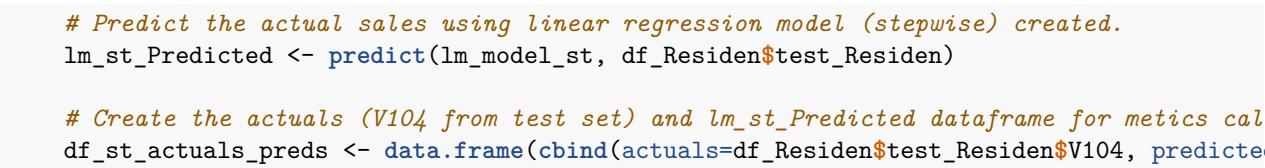
```
##
## Call:
## lm(formula = V104 ~ V8 + V7 + V55 + V72 + `COMPLETION QUARTER` +
##     V87 + V1 + V93 + V60 + V37 + V5 + V105 + V6 + V96 + V80 +
##     V31 + V12 + V28, data = df_Residen$train_Residen)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -880.89  -45.25    2.14   41.35  577.50
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -5.286e+02  1.848e+02  -2.861 0.004544 **
## V8                    1.245e+00  1.743e-02  71.405  < 2e-16 ***
## V7                    1.596e+01  5.236e+00   3.048 0.002524 **
## V55                   4.473e-03  1.071e-03   4.176 3.98e-05 ***
## V72                  -9.458e+00  8.215e-01 -11.513  < 2e-16 ***
## `COMPLETION QUARTER`  2.250e+01  7.049e+00   3.191 0.001578 **
## V87                  -8.335e+00  2.258e+00  -3.691 0.000268 ***
## V1                   -3.927e+00  1.934e+00  -2.030 0.043297 *
## V93                   4.005e-03  1.011e-03   3.961 9.50e-05 ***
## V60                  -2.334e-02  1.094e-02  -2.133 0.033794 *
## V37                   2.403e+01  1.265e+01   1.899 0.058551 .
## V5                   -3.755e+00  4.749e-01  -7.908 6.21e-14 ***
## V105                  1.950e+00  2.701e-01   7.218 5.05e-12 ***
## V6                    1.832e-01  5.257e-02   3.485 0.000573 ***
## V96                   2.626e-01  7.952e-02   3.303 0.001083 **
## V80                   1.603e+01  2.293e+00   6.990 2.04e-11 ***
## V31                   5.229e+01  1.496e+01   3.496 0.000550 ***
```

```
## V12                  -2.106e+01  1.195e+01  -1.763 0.078929 .
## V28                  -2.040e-02  1.288e-02  -1.584 0.114444
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 132.9 on 278 degrees of freedom
## Multiple R-squared:  0.9892, Adjusted R-squared:  0.9885
## F-statistic:  1410 on 18 and 278 DF,  p-value: < 2.2e-16
```

```r
  par(mfrow=c(2,2))
  plot(lm_model_1)
```

```
## Warning: not plotting observations with leverage one:
##   28, 51, 78, 87, 97, 151, 187, 277

## Warning: not plotting observations with leverage one:
##   28, 51, 78, 87, 97, 151, 187, 277
```



```r
    # Predict the actual sales using linear regression model (stepwise) created.
    lm_st_Predicted <- predict(lm_model_st, df_Residen$test_Residen)

    # Create the actuals (V104 from test set) and lm_st_Predicted dataframe for metics calcuations.
    df_st_actuals_preds <- data.frame(cbind(actuals=df_Residen$test_Residen$V104, predicteds=lm_st_Predi
```

```r
    # Calculating correlation of actuals and predicted.
    st_correlation_accuracy <- cor(df_st_actuals_preds)
    st_correlation_accuracy
```

```
##              actuals predicteds
## actuals    1.0000000  0.9895076
## predicteds 0.9895076  1.0000000
```

```r
    lm_st_MSE <- mean((lm_st_Predicted - y_test_Residen)^2) # Calculate test MSE

    # Calcuating the RMSE of Linear regression model
    lm_st_model_RMSE = rmse(df_Residen$test_Residen$V104, lm_st_Predicted)
    lm_st_model_RMSE
```

```
## [1] 182.623
```

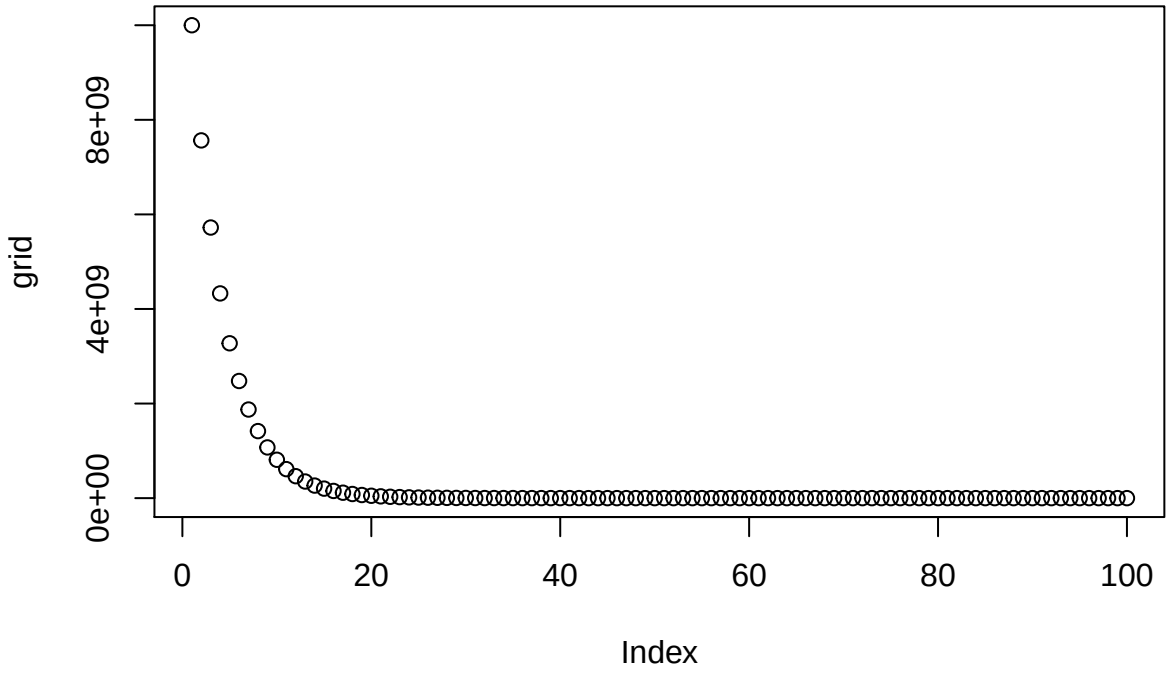
```r
    head(df_st_actuals_preds)
```

```
##   actuals predicteds
## 1    5500   6403.034
```

```
## 2    4600   5471.887
## 3    1700   1853.429
## 4    1500   1376.702
## 5    3800   3956.245
## 6    4600   4461.853
```

(e) Fit a linear regression model using ridge regression on the training set, with λ chosen by c


```
grid=10^seq(10,-2,length=100)  # a range of values to try for lambda
plot(grid)  # notice how they y tends towards zero as x moves forward
```




```
# fit ridge model on training set
ridge_mod = glmnet(x_train_Residen, y_train_Residen, alpha=0, lambda = grid, thresh = 1e-12)
```

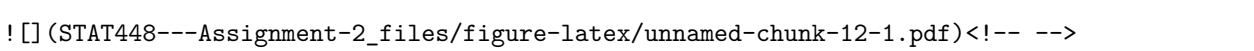
```
## Warning: from glmnet Fortran code (error code -81); Convergence for 81th lambda
## value not reached after maxit=100000 iterations; solutions for larger lambdas
## returned
```

```r
# lets be smart and select the best lambda via cross validation
cv.out <- cv.glmnet(x_train_Residen, y_train_Residen, alpha = 0) # Fit ridge regression model on traini
bestlam <- cv.out$lambda.min  # Select lamda that minimizes training MSE
bestlam
```

```

```
[1] 120.6741
```

```r
plot(cv.out) # Draw plot of training MSE as a function of lambda
```



```r
log(bestlam)
```

```
## [1] 4.793093
```

```r
ridge_pred <- predict(ridge_mod, s = bestlam, newx = x_test_Residen) # Use best lambda to predict test c


# now that we have our best lambda, we can try generating a model on the entire dataset
ridge_full_model <- glmnet(x_Residen, y_Residen, alpha = 0) # Fit ridge regression model on full dataset
predict(ridge_full_model, type = "coefficients", s = bestlam)[1:20,] # Display coefficients using lambda
```

```
##          (Intercept)         `START YEAR`      `START QUARTER`
##        -8.289689e+02         2.179846e+00        -6.193975e+00
##    `COMPLETION YEAR` `COMPLETION QUARTER`                   V1
##         3.725876e+00         4.357187e+00        -2.043472e+01
##                   V2                   V3                   V4
##         1.665279e-02        -5.805616e-02         7.242397e-02
##                   V5                   V6                   V7
##         4.573859e-01        -1.975723e-01         2.627646e+01
##                   V8                   V9                  V10
##         8.643084e-01         1.125799e-02        -3.819095e-02
##                  V11                  V12                  V13
##        -1.550888e-02         3.217259e-01         2.411563e-05
##                  V14                  V15
##        -2.361958e-03         7.393460e-03
```

```r
ridge_full_predict <- predict(ridge_full_model, s = bestlam, newx = x_test_Residen)[1:20,]
```

```r
```
```

```r
# Create the actuals (V104 from test set) and ridge_Predicted dataframe for metics calcuations.
df_ridge_actuals_preds <- data.frame(cbind(actuals=df_Residen$test_Residen$V104, predicteds=ridge_full_
```

```
## Warning in cbind(actuals = df_Residen$test_Residen$V104, predicteds =
## ridge_full_predict): number of rows of result is not a multiple of vector length
## (arg 2)
```

```r
# Calculating correlation of actuals and predicted.
ridge_correlation_accuracy <- cor(df_ridge_actuals_preds)
ridge_correlation_accuracy
```

```
##             actuals predicteds
## actuals    1.000000   0.337332
## predicteds 0.337332   1.000000
```

```r
ridge_MSE <- mean((ridge_pred - y_test_Residen)^2) # Calculate test MSE

# Calcuating the RMSE of Linear regression model
ridge_model_RMSE = rmse(df_Residen$test_Residen$V104, ridge_full_predict)
```

```
## Warning in actual - predicted: longer object length is not a multiple of shorter
## object length
```

```r
ridge_model_RMSE
```

```
## [1] 1768.301
```

```r
head(df_ridge_actuals_preds)
```

```
##   actuals predicteds
## 1    5500   5670.557
## 2    4600   4819.851
## 3    1700   1732.776
## 4    1500   1347.532
## 5    3800   3541.456
## 6    4600   3924.936
```

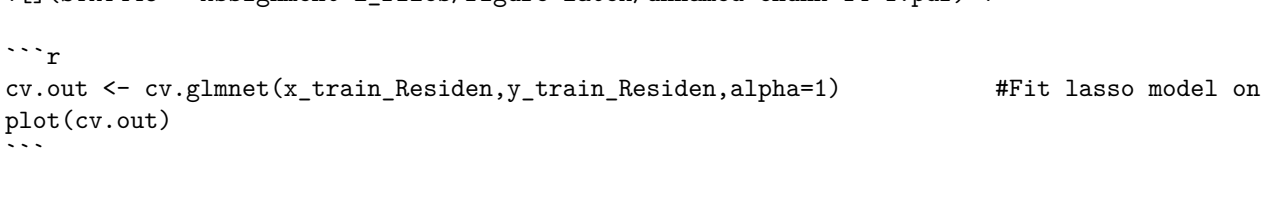
```

(f) Fit a linear regression model using lasso on the training set, with $\lambda$ chosen by cross valida
     

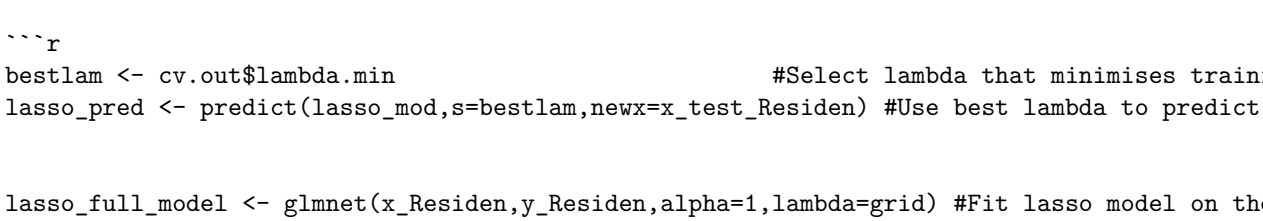


```r
lasso_mod <- glmnet(x_train_Residen,y_train_Residen,alpha=1,lambda=grid) #fit lasso model on training da
plot(lasso_mod)                                          #Draw plot of coefficients
```

```
## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to unique
## 'x' values
```



```r
cv.out <- cv.glmnet(x_train_Residen,y_train_Residen,alpha=1)           #Fit lasso model on training data
plot(cv.out)
```



```r
bestlam <- cv.out$lambda.min                             #Select lambda that minimises training data
lasso_pred <- predict(lasso_mod,s=bestlam,newx=x_test_Residen) #Use best lambda to predict test data


lasso_full_model <- glmnet(x_Residen,y_Residen,alpha=1,lambda=grid) #Fit lasso model on the full dataset
lasso_coeff <- predict(lasso_full_model,type="coefficients",s=bestlam)[1:20,] #Display coefficients usi
lasso_coeff
```

```
##          (Intercept)         `START YEAR`      `START QUARTER`
##        -3.829440e+02         0.000000e+00         0.000000e+00
##    `COMPLETION YEAR` `COMPLETION QUARTER`                   V1
##         0.000000e+00         1.709708e+01        -4.100784e+00
##                   V2                   V3                   V4
##         3.331166e-02        -1.059203e-01         6.791254e-03
##                   V5                   V6                   V7
##        -1.479799e+00         2.197451e-02         2.288006e+01
##                   V8                   V9                  V10
##         1.182032e+00         1.615814e-03         0.000000e+00
##                  V11                  V12                  V13
##         0.000000e+00        -9.521330e-02         0.000000e+00
##                  V14                  V15
##        -2.503092e-06         0.000000e+00
```

```r
```
```

```r
# lasso can have some coefficients set to zero.
lasso_coeff[lasso_coeff !=0] # display non-zeros only
```

```
##          (Intercept) `COMPLETION QUARTER`                  V1
##        -3.829440e+02         1.709708e+01        -4.100784e+00
##                   V2                   V3                  V4
##         3.331166e-02        -1.059203e-01         6.791254e-03
##                   V5                   V6                  V7
##        -1.479799e+00         2.197451e-02         2.288006e+01
##                   V8                   V9                 V12
##         1.182032e+00         1.615814e-03        -9.521330e-02
##                  V14
##        -2.503092e-06
```

```r
lasso_coeff[lasso_coeff == 0]  # display zeros only
```

```
##      `START YEAR`   `START QUARTER` `COMPLETION YEAR`               V10
##                 0                 0                 0                 0
##               V11               V13               V15
##                 0                 0                 0
```

```r
lasso_full_predict <- predict(lasso_full_model, s = bestlam, newx = x_test_Residen)[1:20,]
```

```r
# Create the actuals (V104 from test set) and lasso_Predicted dataframe for metics calcuations.
df_lasso_actuals_preds <- data.frame(cbind(actuals=df_Residen$test_Residen$V104, predicteds=lasso_full_
```

```
## Warning in cbind(actuals = df_Residen$test_Residen$V104, predicteds =
## lasso_full_predict): number of rows of result is not a multiple of vector length
## (arg 2)
```

```r
# Calculating correlation of actuals and predicted.
lasso_correlation_accuracy <- cor(df_lasso_actuals_preds)
lasso_correlation_accuracy
```

```
##             actuals predicteds
## actuals    1.000000   0.344958
```

```
## predicteds 0.344958   1.000000
```

```r
lasso_MSE <- mean((lasso_pred-y_test_Residen)^2) #calculate test MSE

# Calcuating the RMSE of Linear regression model
lasso_model_RMSE = rmse(df_Residen$test_Residen$V104, lasso_full_predict)
```

```
## Warning in actual - predicted: longer object length is not a multiple of shorter
## object length
```

```r
lasso_model_RMSE
```

```
## [1] 1922.441
```

```r
head(df_lasso_actuals_preds)
```

```
##   actuals predicteds
## 1    5500   6220.429
## 2    4600   5218.184
## 3    1700   1813.999
## 4    1500   1356.070
## 5    3800   3917.335
## 6    4600   4439.809
```

(g) Comment on the results obtained. How accurately can we predict the actual sale price? Is there much


```r
RMSE_value <- matrix(c(lm_model_RMSE,
                       lm_MSE,
                       lm_st_model_RMSE,
                       lm_st_MSE,
                       ridge_model_RMSE,
                       ridge_MSE,
                       lasso_model_RMSE,
                       lasso_MSE),
             ncol=2,byrow=TRUE)
colnames(RMSE_value) <- c("RMSE Value", "MSE Value")
rownames(RMSE_value) <- c("Linear Regression",
                  "Linear Regression (Stepwise)",
```

```
                  "Ridge",
                  "Lasso")
RMSE_value <- as.table(RMSE_value)
RMSE_value
```

```
##                               RMSE Value  MSE Value
## Linear Regression              168.7208 28466.6972
## Linear Regression (Stepwise)   182.6230 33351.1706
## Ridge                         1768.3013 40124.0206
## Lasso                         1922.4412 27812.9873
```