

Lab_Week6

Load Libraries

```
library(tidyverse)
```

```
## — Attaching core tidyverse packages ————— tidyverse 2.0.0 —
## ✓ dplyr      1.1.4      ✓ readr      2.1.5
## ✓ forcats    1.0.0      ✓ stringr    1.5.1
## ✓ ggplot2    3.5.1      ✓ tibble     3.2.1
## ✓ lubridate  1.9.4      ✓ tidyr      1.3.1
## ✓ purrr      1.0.2
## — Conflicts ————— tidyverse_conflicts() —
## ✗ dplyr::filter() masks stats::filter()
## ✗ dplyr::lag()     masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(data.table)
```

```
##
## Attaching package: 'data.table'
##
## The following objects are masked from 'package:lubridate':
##
##   hour, isoweek, mday, minute, month, quarter, second, wday, week,
##   yday, year
##
## The following objects are masked from 'package:dplyr':
##
##   between, first, last
##
## The following object is masked from 'package:purrr':
##
##   transpose
```

```
library(dplyr)
suppressWarnings(expr)
```

```
## function (expr)
## {
##   enexpr(expr)
## }
## <bytecode: 0x000001a52111a890>
## <environment: namespace:rlang>
```

```
data <- read_csv("C:/Users/miche/Documents/MSDS660/Week6/loans_full_schema.csv", show_col_types = FALSE)
data<-as.data.table(data)
```

Let's check the structure of the data as we've done before!

```
str(data)
```

```

## Classes 'data.table' and 'data.frame': 10000 obs. of 55 variables:
## $ emp_title : chr "global config engineer" "warehouse office clerk"
"assembly" "customer service" ...
## $ emp_length : num 3 10 3 1 10 NA 10 10 10 3 ...
## $ state : chr "NJ" "HI" "WI" "PA" ...
## $ homeownership : chr "MORTGAGE" "RENT" "RENT" "RENT" ...
## $ annual_income : num 90000 40000 40000 30000 35000 34000 35000 110000 65
000 30000 ...
## $ verified_income : chr "Verified" "Not Verified" "Source Verified" "Not Ve
rified" ...
## $ debt_to_income : num 18.01 5.04 21.15 10.16 57.96 ...
## $ annual_income_joint : num NA NA NA NA 57000 NA 155000 NA NA NA ...
## $ verification_income_joint : chr NA NA NA NA ...
## $ debt_to_income_joint : num NA NA NA NA 37.7 ...
## $ delinq_2y : num 0 0 0 0 0 1 0 1 1 0 ...
## $ months_since_last_delinq : num 38 NA 28 NA NA 3 NA 19 18 NA ...
## $ earliest_credit_line : num 2001 1996 2006 2007 2008 ...
## $ inquiries_last_12m : num 6 1 4 0 7 6 1 1 3 0 ...
## $ total_credit_lines : num 28 30 31 4 22 32 12 30 35 9 ...
## $ open_credit_lines : num 10 14 10 4 16 12 10 15 21 6 ...
## $ total_credit_limit : num 70795 28800 24193 25400 69839 ...
## $ total_credit_utilized : num 38767 4321 16000 4997 52722 ...
## $ num_collections_last_12m : num 0 0 0 0 0 0 0 0 0 0 ...
## $ num_historical_failed_to_pay : num 0 1 0 1 0 0 0 0 0 0 ...
## $ months_since_90d_late : num 38 NA 28 NA NA 60 NA 71 18 NA ...
## $ current_accounts_delinq : num 0 0 0 0 0 0 0 0 0 0 ...
## $ total_collection_amount_ever : num 1250 0 432 0 0 0 0 0 0 0 ...
## $ current_installment_accounts : num 2 0 1 1 1 0 2 2 6 1 ...
## $ accounts_opened_24m : num 5 11 13 1 6 2 1 4 10 5 ...
## $ months_since_last_credit_inquiry : num 5 8 7 15 4 5 9 7 4 17 ...
## $ num_satisfactory_accounts : num 10 14 10 4 16 12 10 15 21 6 ...
## $ num_accounts_120d_past_due : num 0 0 0 0 0 0 0 NA 0 0 ...
## $ num_accounts_30d_past_due : num 0 0 0 0 0 0 0 0 0 0 ...
## $ num_active_debit_accounts : num 2 3 3 2 10 1 3 5 11 3 ...
## $ total_debit_limit : num 11100 16500 4300 19400 32700 ...
## $ num_total_cc_accounts : num 14 24 14 3 20 27 8 16 19 7 ...
## $ num_open_cc_accounts : num 8 14 8 3 15 12 7 12 14 5 ...
## $ num_cc_carrying_balance : num 6 4 6 2 13 5 6 10 14 3 ...
## $ num_mort_accounts : num 1 0 0 0 0 3 2 7 2 0 ...
## $ account_never_delinq_percent : num 92.9 100 93.5 100 100 78.1 100 93 97.1 100 ...
## $ tax_liens : num 0 0 0 1 0 0 0 0 0 0 ...
## $ public_record_bankrupt : num 0 1 0 0 0 0 0 0 0 0 ...
## $ loan_purpose : chr "moving" "debt_consolidation" "other" "debt_consoli
dation" ...
## $ application_type : chr "individual" "individual" "individual" "individual"
...
## $ loan_amount : num 28000 5000 2000 21600 23000 5000 24000 20000 20000
6400 ...
## $ term : num 60 36 36 36 36 36 60 60 36 36 ...
## $ interest_rate : num 14.07 12.61 17.09 6.72 14.07 ...
## $ installment : num 652.5 167.5 71.4 664.2 786.9 ...
## $ grade : chr "C" "C" "D" "A" ...

```

```

## $ sub_grade           : chr "C3" "C1" "D1" "A3" ...
## $ issue_month         : chr "Mar-2018" "Feb-2018" "Feb-2018" "Jan-2018" ...
## $ loan_status         : chr "Current" "Current" "Current" "Current" ...
## $ initial_listing_status : chr "whole" "whole" "fractional" "whole" ...
## $ disbursement_method : chr "Cash" "Cash" "Cash" "Cash" ...
## $ balance             : num 27016 4651 1825 18853 21430 ...
## $ paid_total          : num 1999 499 282 3313 2325 ...
## $ paid_principal      : num 984 349 175 2747 1570 ...
## $ paid_interest       : num 1015 150 106 566 755 ...
## $ paid_late_fees      : num 0 0 0 0 0 0 0 0 0 ...
## - attr(*, "spec")=
## .. cols(
## ..   emp_title = col_character(),
## ..   emp_length = col_double(),
## ..   state = col_character(),
## ..   homeownership = col_character(),
## ..   annual_income = col_double(),
## ..   verified_income = col_character(),
## ..   debt_to_income = col_double(),
## ..   annual_income_joint = col_double(),
## ..   verification_income_joint = col_character(),
## ..   debt_to_income_joint = col_double(),
## ..   delinq_2y = col_double(),
## ..   months_since_last_delinq = col_double(),
## ..   earliest_credit_line = col_double(),
## ..   inquiries_last_12m = col_double(),
## ..   total_credit_lines = col_double(),
## ..   open_credit_lines = col_double(),
## ..   total_credit_limit = col_double(),
## ..   total_credit_utilized = col_double(),
## ..   num_collections_last_12m = col_double(),
## ..   num_historical_failed_to_pay = col_double(),
## ..   months_since_90d_late = col_double(),
## ..   current_accounts_delinq = col_double(),
## ..   total_collection_amount_ever = col_double(),
## ..   current_installment_accounts = col_double(),
## ..   accounts_opened_24m = col_double(),
## ..   months_since_last_credit_inquiry = col_double(),
## ..   num_satisfactory_accounts = col_double(),
## ..   num_accounts_120d_past_due = col_double(),
## ..   num_accounts_30d_past_due = col_double(),
## ..   num_active_debit_accounts = col_double(),
## ..   total_debit_limit = col_double(),
## ..   num_total_cc_accounts = col_double(),
## ..   num_open_cc_accounts = col_double(),
## ..   num_cc_carrying_balance = col_double(),
## ..   num_mort_accounts = col_double(),
## ..   account_never_delinq_percent = col_double(),
## ..   tax_liens = col_double(),
## ..   public_record_bankrupt = col_double(),
## ..   loan_purpose = col_character(),
## ..   application_type = col_character(),

```

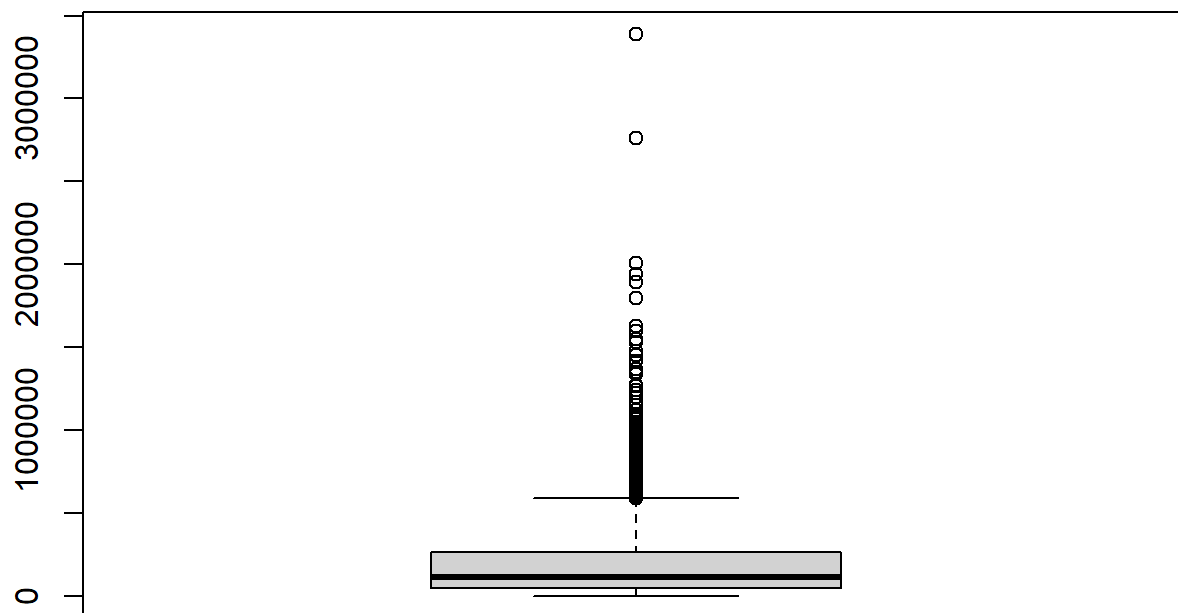
```
## .. loan_amount = col_double(),
## .. term = col_double(),
## .. interest_rate = col_double(),
## .. installment = col_double(),
## .. grade = col_character(),
## .. sub_grade = col_character(),
## .. issue_month = col_character(),
## .. loan_status = col_character(),
## .. initial_listing_status = col_character(),
## .. disbursement_method = col_character(),
## .. balance = col_double(),
## .. paid_total = col_double(),
## .. paid_principal = col_double(),
## .. paid_interest = col_double(),
## .. paid_late_fees = col_double()
## .. )
## - attr(*, "problems")=<externalptr>
## - attr(*, ".internal.selfref")=<externalptr>
```

If there are only a few cases that are missing, we can potentially remove them with `complete.cases()`. However, doing this for this dataset would remove most of the data, so we won't do this here. Let's revisit some of the EDA on loan amount and credit limit.

```
summary(data$loan_amount)
```

```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      1000    8000   14500   16362   24000   40000
```

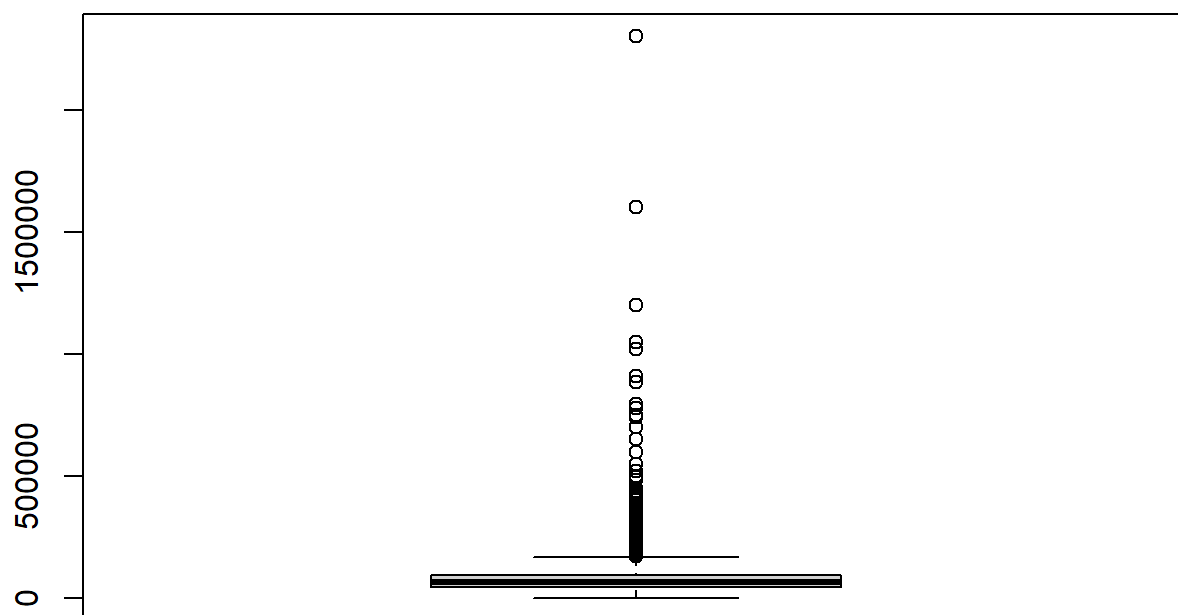
```
boxplot(data$total_credit_limit)
```



```
summary(data$total_credit_limit)
```

```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##         0   51594  114667 183606  267550 3386034
```

```
boxplot(data$annual_income)
```



This

looks good! We don't see any outliers in the loan amount box plot. But there are outliers in the total credit limit plot.

Who had the borrowed the highest loan amount and who had the lowest on the list?

```
data[which.max(data$total_credit_limit),]
```

```

##   emp_title emp_length  state homeownership annual_income verified_income
##   <char>      <num> <char>      <char>      <num>      <char>
## 1:  analyst      10    CA          OWN        740000    Verified
##   debt_to_income annual_income_joint verification_income_joint
##   <num>          <num>          <char>
## 1:      3.41          NA          <NA>
##   debt_to_income_joint delinq_2y months_since_last_delinq earliest_credit_line
##   <num>      <num>          <num>          <num>
## 1:      NA          1          4          2000
##   inquiries_last_12m total_credit_lines open_credit_lines total_credit_limit
##   <num>          <num>          <num>          <num>
## 1:      4          22          14          3386034
##   total_credit_utilized num_collections_last_12m num_historical_failed_to_pay
##   <num>          <num>          <num>
## 1:    193589          0          0
##   months_since_90d_late current_accounts_delinq total_collection_amount_ever
##   <num>          <num>          <num>
## 1:      NA          0          0
##   current_installment_accounts accounts_opened_24m
##   <num>          <num>
## 1:      6          7
##   months_since_last_credit_inquiry num_satisfactory_accounts
##   <num>          <num>
## 1:      4          14
##   num_accounts_120d_past_due num_accounts_30d_past_due
##   <num>          <num>
## 1:      0          0
##   num_active_debit_accounts total_debit_limit num_total_cc_accounts
##   <num>          <num>          <num>
## 1:      4          10800          10
##   num_open_cc_accounts num_cc_carrying_balance num_mort_accounts
##   <num>          <num>          <num>
## 1:      5          5          1
##   account_never_delinq_percent tax_liens public_record_bankrupt
##   <num>      <num>          <num>
## 1:    85.7          0          0
##   loan_purpose application_type loan_amount  term interest_rate
##   <char>      <char>      <num> <num>          <num>
## 1: debt_consolidation  individual    20000   60          18.45
##   installment grade sub_grade issue_month loan_status initial_listing_status
##   <num> <char>      <char>      <char>      <char>          <char>
## 1:    512.78  D      D2      Mar-2018    Current          whole
##   disbursement_method balance paid_total paid_principal paid_interest
##   <char>      <num>      <num>          <num>          <num>
## 1:    DirectPay 19374.64   1517.84          625.36          892.48
##   paid_late_fees
##   <num>
## 1:      0

```

```
data[which.min(data$total_credit_limit),]
```



```

##   emp_title emp_length  state homeownership annual_income verified_income
##   <char>      <num> <char>      <char>      <num>      <char>
## 1:   <NA>      NA    NY      RENT      28000 Source Verified
##   debt_to_income annual_income_joint verification_income_joint
##   <num>          <num>          <char>
## 1:   0          NA          <NA>
##   debt_to_income_joint delinq_2y months_since_last_delinq earliest_credit_line
##   <num>      <num>          <num>          <num>
## 1:   NA      0          NA          2000
##   inquiries_last_12m total_credit_lines open_credit_lines total_credit_limit
##   <num>          <num>          <num>          <num>
## 1:   0          4          0          0
##   total_credit_utilized num_collections_last_12m num_historical_failed_to_pay
##   <num>          <num>          <num>
## 1:   0          0          0
##   months_since_90d_late current_accounts_delinq total_collection_amount_ever
##   <num>          <num>          <num>
## 1:   NA          0          0
##   current_installment_accounts accounts_opened_24m
##   <num>          <num>
## 1:   0          0
##   months_since_last_credit_inquiry num_satisfactory_accounts
##   <num>          <num>
## 1:   20          0
##   num_accounts_120d_past_due num_accounts_30d_past_due
##   <num>          <num>
## 1:   0          0
##   num_active_debit_accounts total_debit_limit num_total_cc_accounts
##   <num>          <num>          <num>
## 1:   0          0          2
##   num_open_cc_accounts num_cc_carrying_balance num_mort_accounts
##   <num>          <num>          <num>
## 1:   0          0          0
##   account_never_delinq_percent tax_liens public_record_bankrupt loan_purpose
##   <num>      <num>          <num>          <char>
## 1:   100      0          0 major_purchase
##   application_type loan_amount term interest_rate installment grade
##   <char>      <num> <num>      <num>      <num> <char>
## 1:   individual    2500  36      21.85    95.29  D
##   sub_grade issue_month loan_status initial_listing_status
##   <char>      <char>      <char>          <char>
## 1:   D5    Mar-2018 In Grace Period whole
##   disbursement_method balance paid_total paid_principal paid_interest
##   <char>      <num>      <num>          <num>          <num>
## 1:   Cash 2399.56    187.55    100.44    87.11
##   paid_late_fees
##   <num>
## 1:   0

```

Let's narrow down our data set to a subset of data that we'll evaluate. Fix from here.

```
dt<-data %>% select(verified_income, sub_grade, homeownership,annual_income, loan_amount, interest_rate, term, loan_status, loan_purpose, delinq_2y, tax_liens, total_credit_limit, total_credit_utilized)
```

We can use the `plot()` function to look for variable correlations. We have a lot of data here, so we'll take a random sample of 500 observations from the data set and only limit it to numeric variables since we can't plot character variables. We'll set the seed, so the analysis we do is reproducible.

```
set.seed(1)
dt_sample<-sample_n(dt, 500)
dtnum_sample<-dt_sample %>% select(where(is.numeric))
```

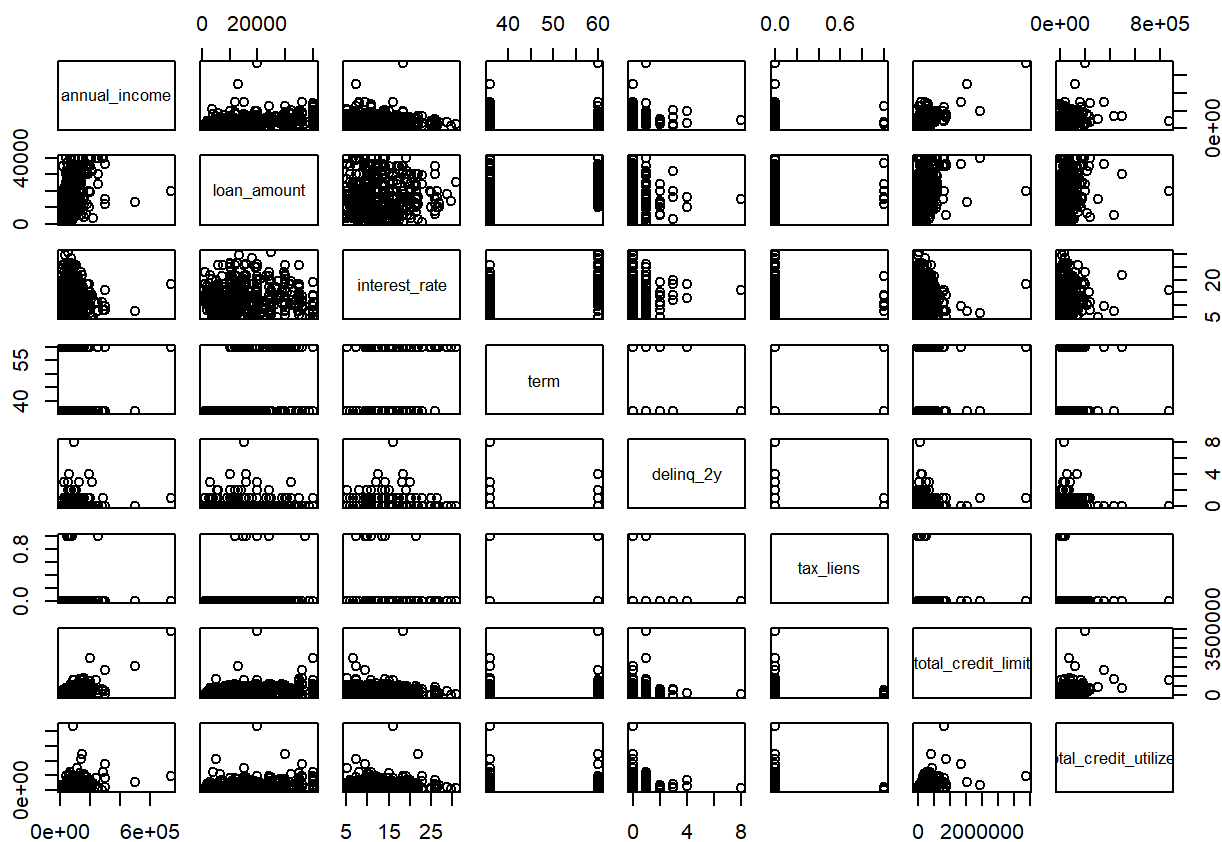
We'll use the default figure margins (5.1,4.1,4.1,2.1), but these can be adjusted depending on your data.

Plot our sample

```
par(mar=c(5.1,4.1,4.1,2.1))
par("mar")
```

```
## [1] 5.1 4.1 4.1 2.1
```

```
plot(dtnum_sample)
```



We are looking for variables that are correlated with one another Annual income and interest rate look correlated to total credit limit.

Let's start by fitting a simple linear regression to the data. What is the single most correlated variable with total credit limit? It could be annual income. The plot() function will provide us with regression diagnostics.

Simple Linear Regression with annual income

```
slm <- lm(total_credit_limit ~ dt$annual_income, data = dt)
summary(slm)
```

```
##
## Call:
## lm(formula = total_credit_limit ~ dt$annual_income, data = dt)
##
## Residuals:
```

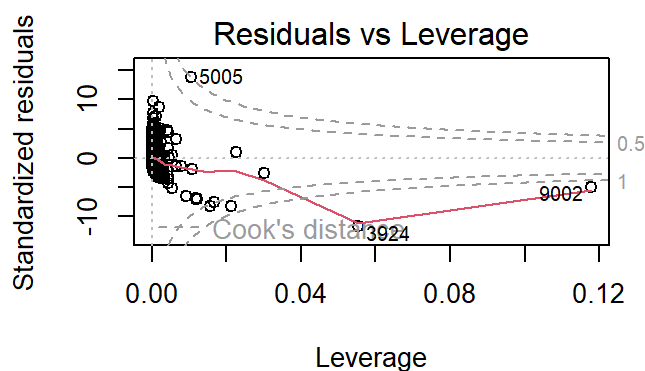
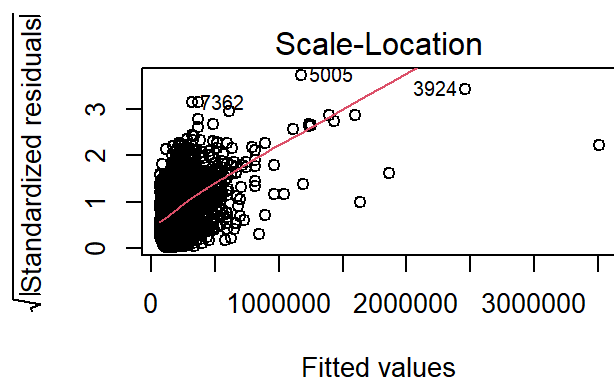
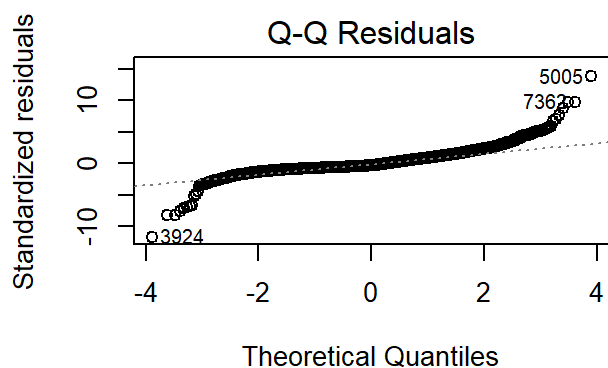
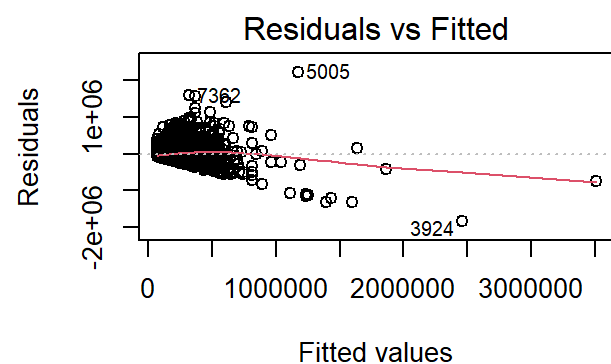
	Min	1Q	Median	3Q	Max
	-1831012	-97695	-48303	82526	2212804

```
##
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	6.496e+04	2.539e+03	25.58	<2e-16 ***
dt\$annual_income	1.498e+00	2.482e-02	60.34	<2e-16 ***

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 160700 on 9998 degrees of freedom
## Multiple R-squared:  0.267, Adjusted R-squared:  0.2669
## F-statistic: 3641 on 1 and 9998 DF, p-value: < 2.2e-16
```

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



Wow! we do have several outliers that may exert influence on our model. We'll need to deal with them later.

Let's fit total credit limit to all the numeric variables to make a MLR model.

MLR Model with numeric variables

```
dtnum <- select_if(dt, is.numeric)
fit <- lm(total_credit_limit ~ ., data = dtnum)
summary(fit)
```

```
##
## Call:
## lm(formula = total_credit_limit ~ ., data = dtnum)
##
## Residuals:
```

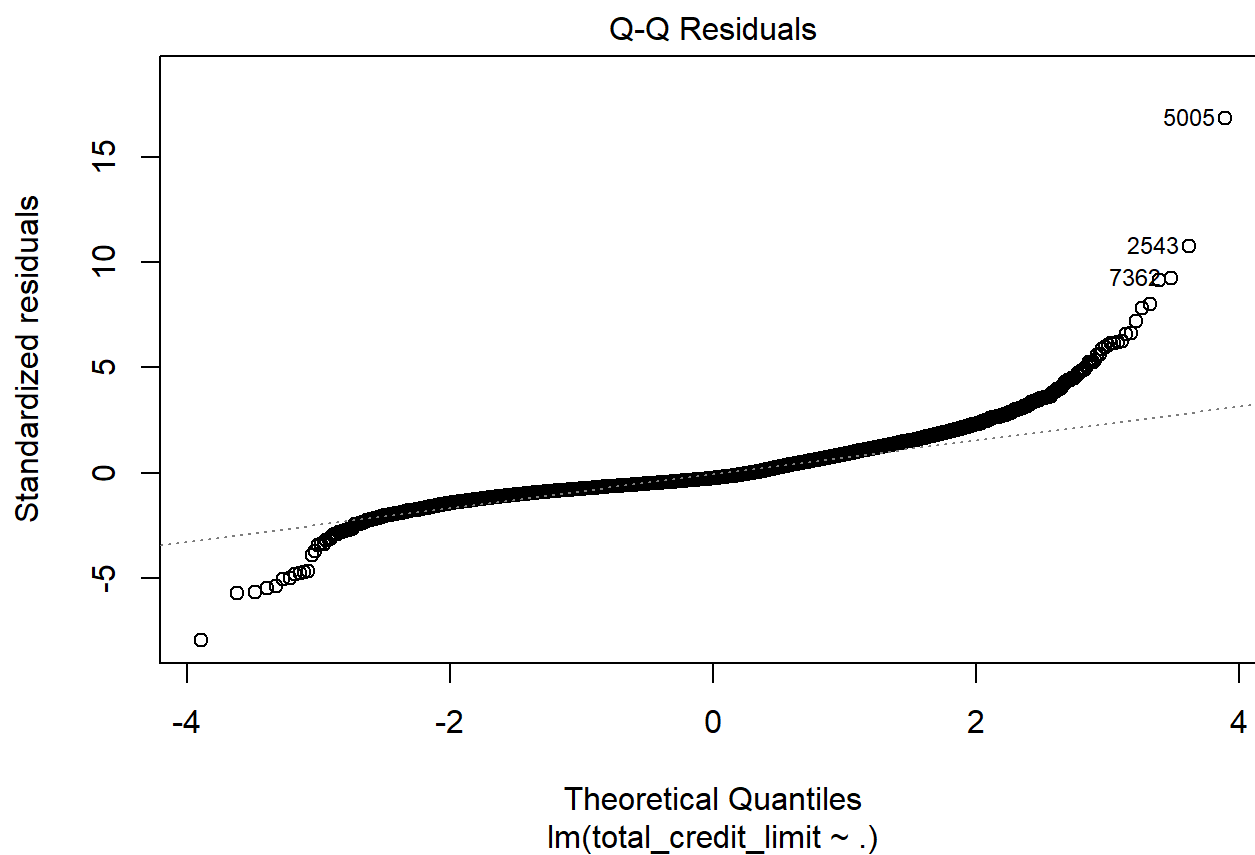
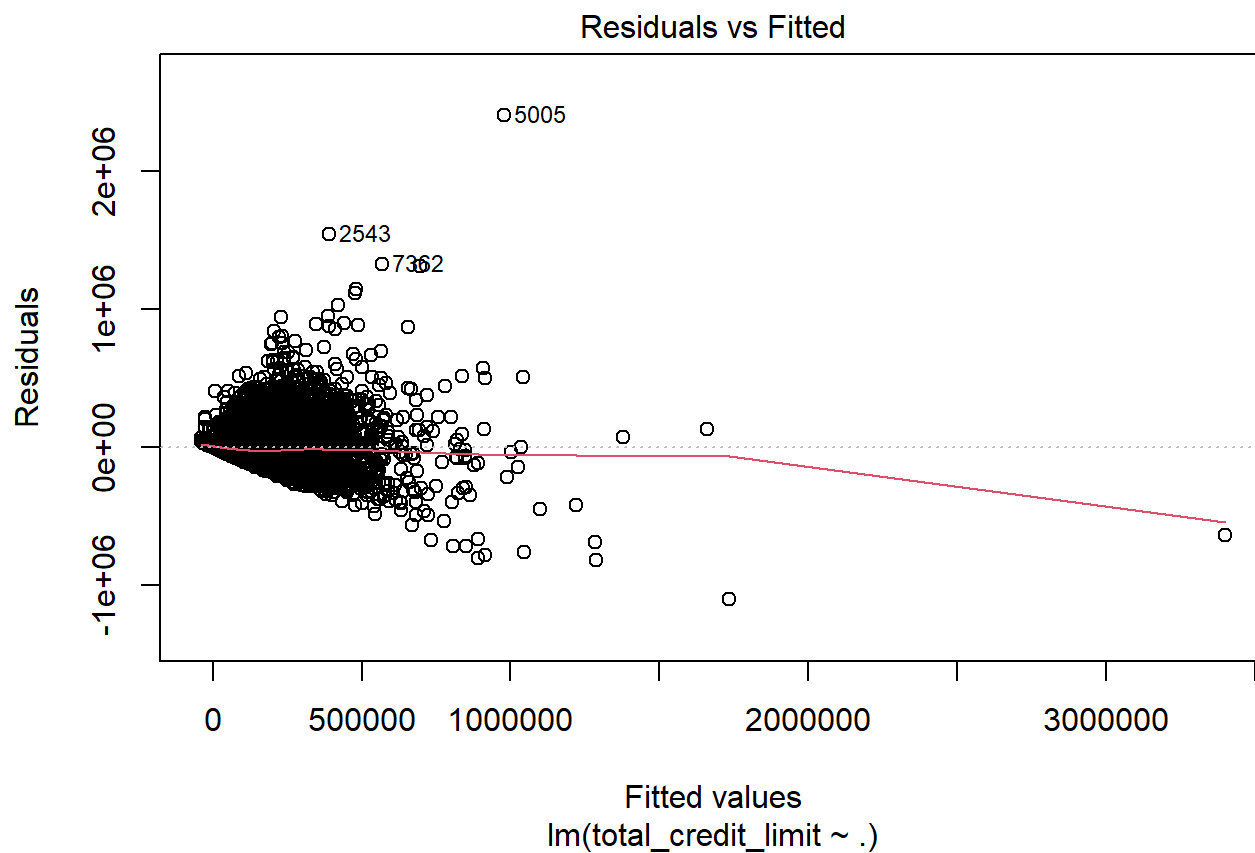
	Min	1Q	Median	3Q	Max
	-1102426	-85205	-35767	70742	2407013

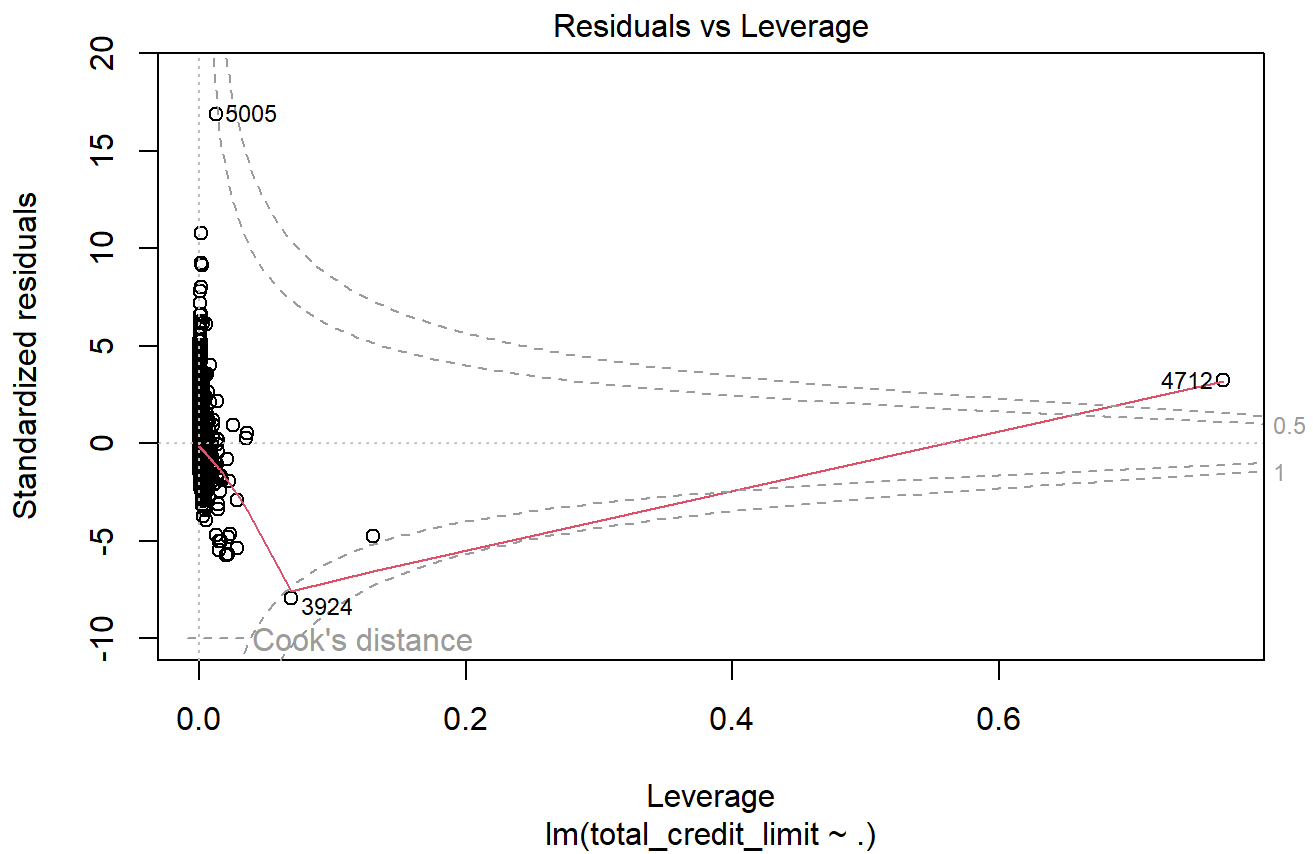
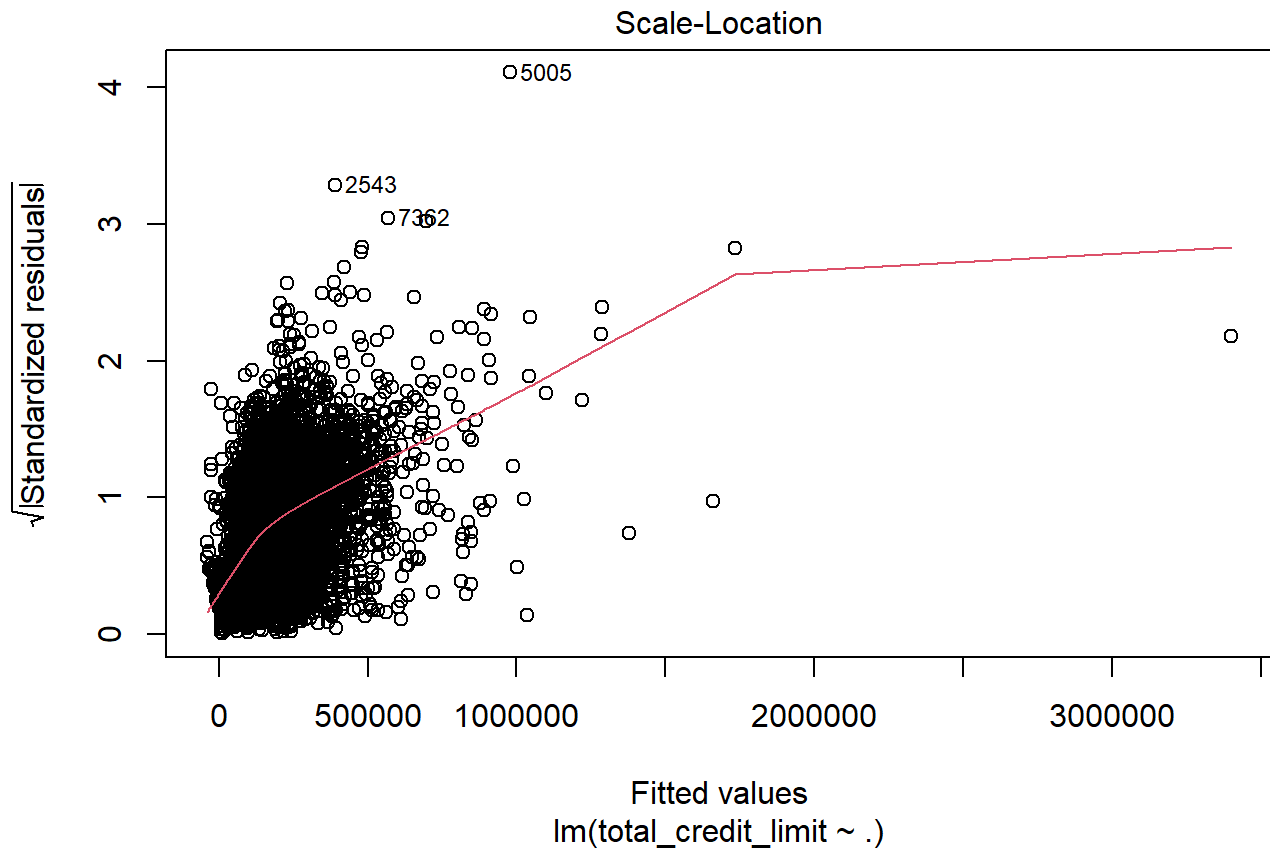
```
##
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	2.320e+04	6.303e+03	3.681	0.000233 ***
annual_income	9.141e-01	2.552e-02	35.821	< 2e-16 ***
loan_amount	1.709e+00	1.606e-01	10.641	< 2e-16 ***
interest_rate	-5.693e+03	3.130e+02	-18.192	< 2e-16 ***
term	1.431e+03	1.510e+02	9.475	< 2e-16 ***
delinq_2y	1.515e+04	2.120e+03	7.145	9.63e-13 ***
tax_liens	-3.066e+03	2.422e+03	-1.266	0.205475
total_credit_utilized	1.288e+00	2.959e-02	43.511	< 2e-16 ***

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 143600 on 9992 degrees of freedom
## Multiple R-squared:  0.415, Adjusted R-squared:  0.4146
## F-statistic: 1013 on 7 and 9992 DF, p-value: < 2.2e-16
```

```
plot(fit)
```





Already we see an improvement with MLR vs the simple linear model with annual income, but there is some strange distribution of residuals. This data may not be perfectly linear but we will try to model the data using a MLR. Observations like #4466 seem like outliers. We will see what they are. What are those pesky outliers? This was taken care of on the main “dt” data set above.

```
dtnum[4712,]
```

```
##      annual_income loan_amount interest_rate  term delinq_2y tax_liens
##              <num>      <num>          <num> <num>      <num>      <num>
## 1:          74000      15000          17.47   36          0          52
##      total_credit_limit total_credit_utilized
##              <num>          <num>
## 1:          195823          49814
```

General Linear Model (GLM)

There is another way of performing a General Linear Model (glm), but the p-values are calculated slightly differently. This model will show AIC and not F-score by default

```
fit_glm <- glm(total_credit_limit ~ ., data = dtnum)
summary(fit_glm)
```

```
##
## Call:
## glm(formula = total_credit_limit ~ ., data = dtnum)
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    2.320e+04  6.303e+03   3.681 0.000233 ***
## annual_income    9.141e-01  2.552e-02  35.821 < 2e-16 ***
## loan_amount     1.709e+00  1.606e-01  10.641 < 2e-16 ***
## interest_rate  -5.693e+03  3.130e+02 -18.192 < 2e-16 ***
## term            1.431e+03  1.510e+02   9.475 < 2e-16 ***
## delinq_2y       1.515e+04  2.120e+03   7.145 9.63e-13 ***
## tax_liens       -3.066e+03  2.422e+03  -1.266 0.205475
## total_credit_utilized 1.288e+00  2.959e-02  43.511 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 20610134606)
##
##      Null deviance: 3.5203e+14  on 9999  degrees of freedom
## Residual deviance: 2.0594e+14  on 9992  degrees of freedom
## AIC: 265879
##
## Number of Fisher Scoring iterations: 2
```

Let's check for multicollinearity between our predictor variables. We'll check for it using the variance inflation factor(vif). As a rule of thumb, VIF values above 5 indicate problems.


```
library(car)
```

```
## Loading required package: carData
```

```
##  
## Attaching package: 'car'
```

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

```
## The following object is masked from 'package:purrr':  
##  
##      some
```

```
vif(fit)
```

```
##      annual_income      loan_amount      interest_rate  
##      1.323904          1.327699          1.188491  
##      term              delinq_2y          tax_liens  
##      1.345945          1.019244          1.003452  
## total_credit_utilized  
##      1.222147
```

Let's check the pearson correlation coefficient. If independent variables are above 0.8 or -0.8, we could have multicollinearity. We would then need to do something about them. ## Pearson Correlation

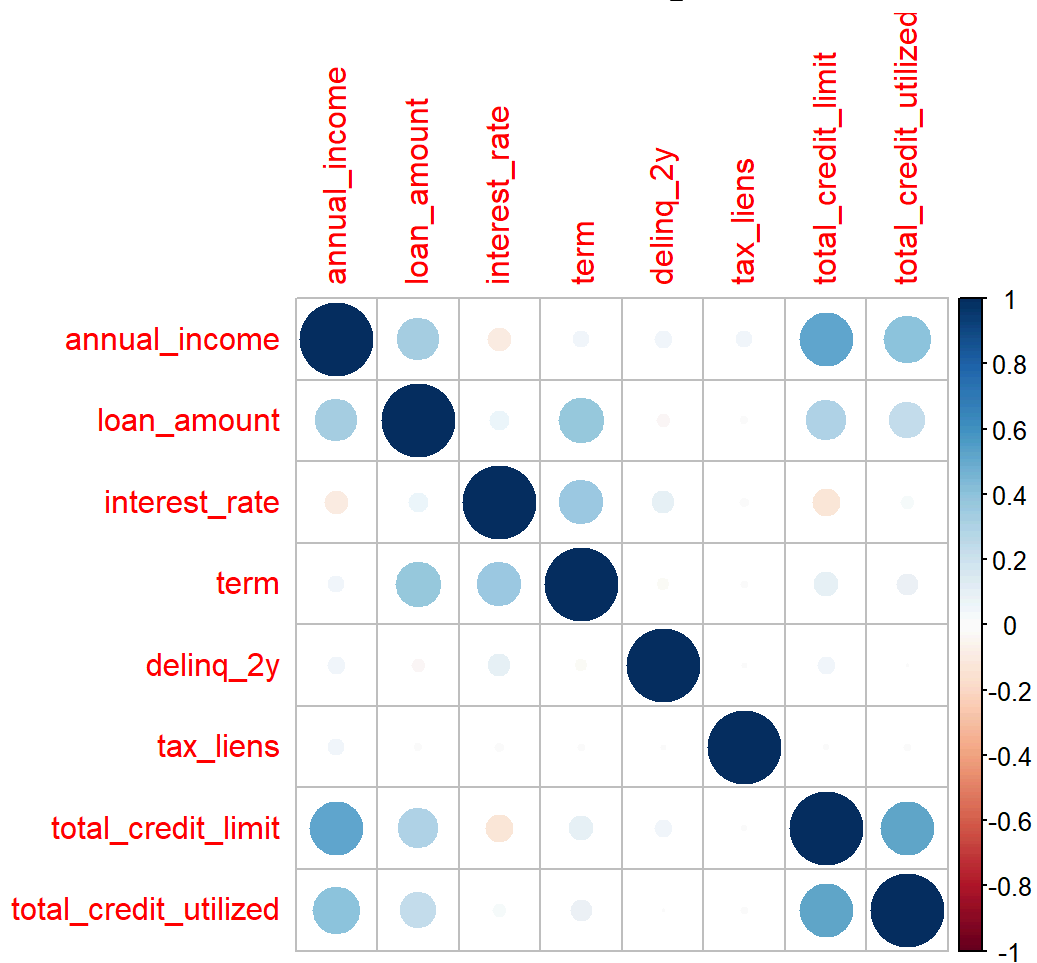
```
par(mfrow=c(1,1))  
library(corrplot)
```

```
## corrplot 0.95 loaded
```

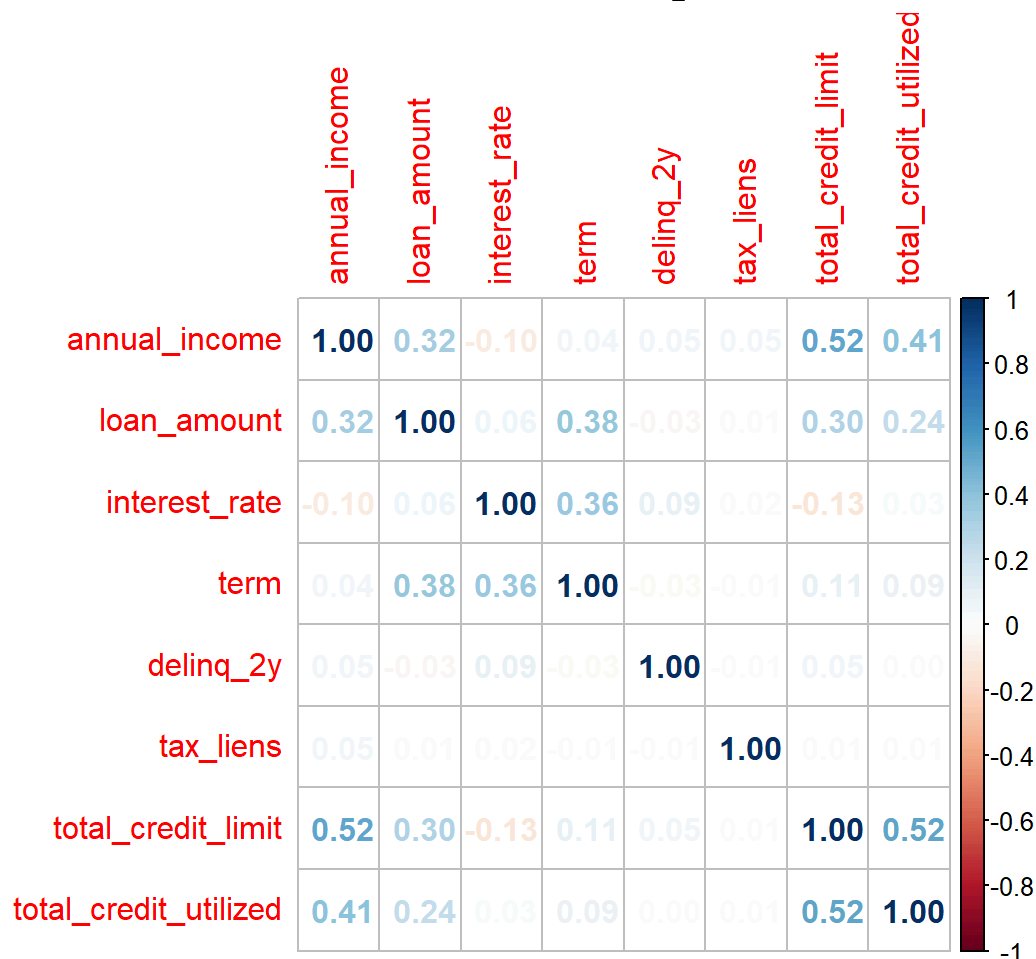
```
cor(dtnum)
```

```
##          annual_income loan_amount interest_rate      term
## annual_income      1.00000000  0.32466492  -0.09958434  0.044842726
## loan_amount        0.32466492  1.00000000   0.06452689  0.375661058
## interest_rate     -0.09958434  0.06452689   1.00000000  0.358663898
## term              0.04484273  0.37566106   0.35866390  1.000000000
## delinq_2y         0.05223558 -0.03325785   0.09045622 -0.025935521
## tax_liens         0.04743917  0.01195905   0.01654731 -0.009233981
## total_credit_limit 0.51670257  0.30325427  -0.13049658  0.109235368
## total_credit_utilized 0.40636971  0.23689269   0.03152743  0.085596506
##          delinq_2y      tax_liens total_credit_limit
## annual_income      0.052235579  0.047439166      0.516702571
## loan_amount       -0.033257853  0.011959055      0.303254266
## interest_rate      0.090456221  0.016547307     -0.130496580
## term             -0.025935521 -0.009233981      0.109235368
## delinq_2y         1.000000000 -0.005303087      0.053373331
## tax_liens        -0.005303087  1.000000000      0.005842102
## total_credit_limit 0.053373331  0.005842102      1.000000000
## total_credit_utilized 0.001854552  0.008272624      0.520875533
##          total_credit_utilized
## annual_income      0.406369709
## loan_amount        0.236892689
## interest_rate      0.031527432
## term              0.085596506
## delinq_2y         0.001854552
## tax_liens         0.008272624
## total_credit_limit 0.520875533
## total_credit_utilized 1.000000000
```

```
corrplot(cor(dtnum))
```



```
corrplot(cor(dtnum), method='number')
```



Since we don't have any multicollinearity issues, we'll leave our model as is. But if you were to remove a variable you could do it using "-" in the `lm()` function after "~.". Let's rerun the regression model without outliers and use AIC to check the value. ## Diagnostics: AIC

```
fit1 <- lm(total_credit_limit ~ ., data = dtnum)
summary(fit1)
```

```
##
## Call:
## lm(formula = total_credit_limit ~ ., data = dtnum)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1102426   -85205   -35767    70742   2407013
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    2.320e+04  6.303e+03   3.681 0.000233 ***
## annual_income    9.141e-01  2.552e-02  35.821 < 2e-16 ***
## loan_amount     1.709e+00  1.606e-01  10.641 < 2e-16 ***
## interest_rate   -5.693e+03  3.130e+02 -18.192 < 2e-16 ***
## term            1.431e+03  1.510e+02   9.475 < 2e-16 ***
## delinq_2y        1.515e+04  2.120e+03   7.145 9.63e-13 ***
## tax_liens        -3.066e+03  2.422e+03  -1.266 0.205475
## total_credit_utilized 1.288e+00  2.959e-02  43.511 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 143600 on 9992 degrees of freedom
## Multiple R-squared:  0.415, Adjusted R-squared:  0.4146
## F-statistic: 1013 on 7 and 9992 DF, p-value: < 2.2e-16
```

```
AIC(fit1)
```

```
## [1] 265879.3
```

We can try to remove variables that are detrimental to the model. For example, we can use `stepAIC()` function in the MASS library to pick an optimal configuration of predictors. There are a number of options that could be used, we'll use "both" which combines both forward and backward selection to arrive at the best AIC score. On other words, the algo is adding or removing predictors and this will result in the lowest AIC score.

```
library(MASS)
```

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

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

```
stepAIC(fit1, direction = 'both')
```

```
## Start: AIC=237498.5
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized
##
##           Df Sum of Sq      RSS   AIC
## - tax_liens      1 3.3043e+10 2.0597e+14 237498
## <none>                2.0594e+14 237498
## - delinq_2y      1 1.0522e+12 2.0699e+14 237547
## - term           1 1.8504e+12 2.0779e+14 237586
## - loan_amount    1 2.3338e+12 2.0827e+14 237609
## - interest_rate  1 6.8207e+12 2.1276e+14 237822
## - annual_income  1 2.6446e+13 2.3238e+14 238705
## - total_credit_utilized 1 3.9019e+13 2.4496e+14 239232
##
## Step: AIC=237498.1
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized
##
##           Df Sum of Sq      RSS   AIC
## <none>                2.0597e+14 237498
## + tax_liens      1 3.3043e+10 2.0594e+14 237498
## - delinq_2y      1 1.0566e+12 2.0703e+14 237547
## - term           1 1.8613e+12 2.0783e+14 237586
## - loan_amount    1 2.3323e+12 2.0830e+14 237609
## - interest_rate  1 6.8546e+12 2.1282e+14 237823
## - annual_income  1 2.6418e+13 2.3239e+14 238703
## - total_credit_utilized 1 3.9056e+13 2.4503e+14 239232
```

```
##
## Call:
## lm(formula = total_credit_limit ~ annual_income + loan_amount +
##   interest_rate + term + delinq_2y + total_credit_utilized,
##   data = dtnum)
##
## Coefficients:
##           (Intercept)      annual_income      loan_amount
##           23149.5656           0.9125           1.7082
##           interest_rate           term           delinq_2y
##           -5705.0058          1434.7590          15179.2998
## total_credit_utilized
##           1.2880
```

```
fit2 <- lm(total_credit_limit ~ annual_income + term + delinq_2y + loan_amount + total_credit_utilized, data = dtnum)
summary(fit2)
```

```
##
## Call:
## lm(formula = total_credit_limit ~ annual_income + term + delinq_2y +
##      loan_amount + total_credit_utilized, data = dtnum)
##
## Residuals:
```

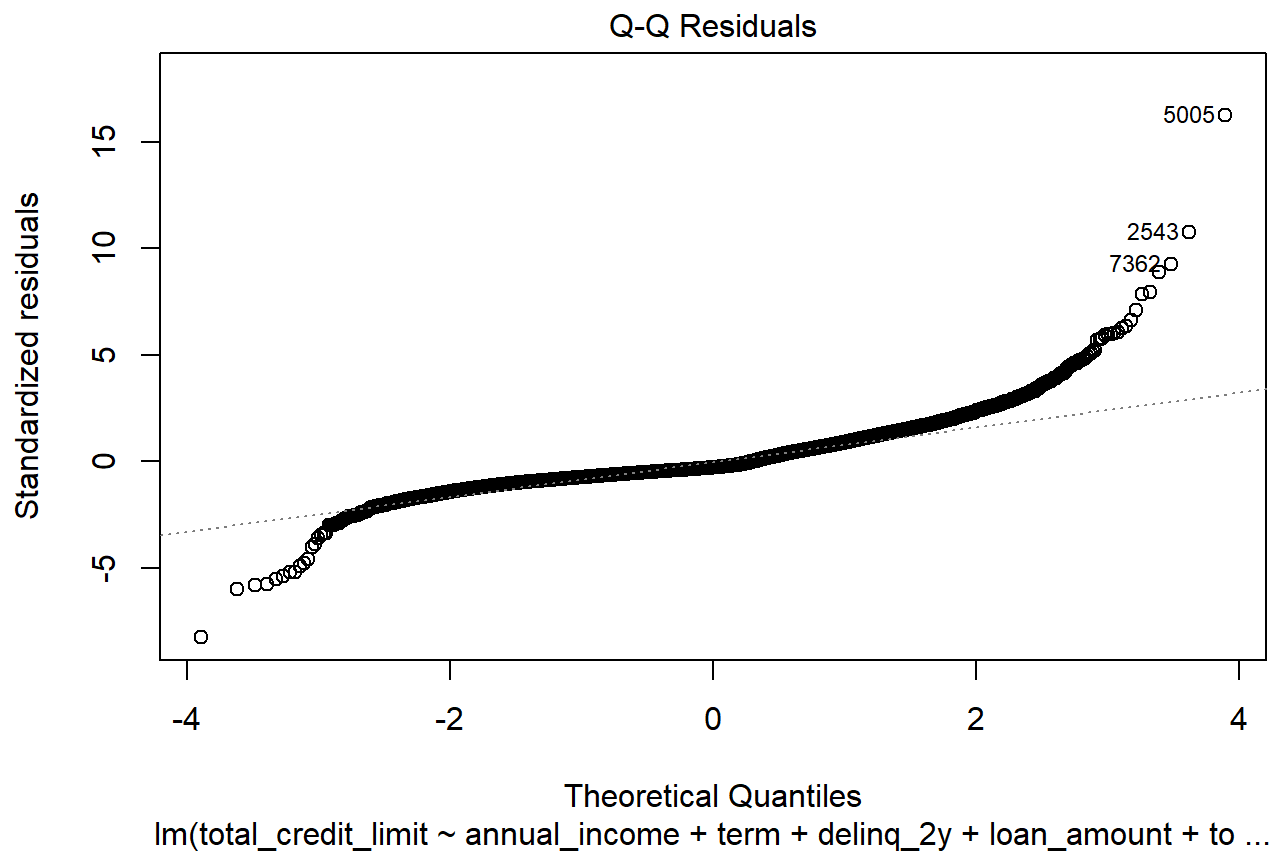
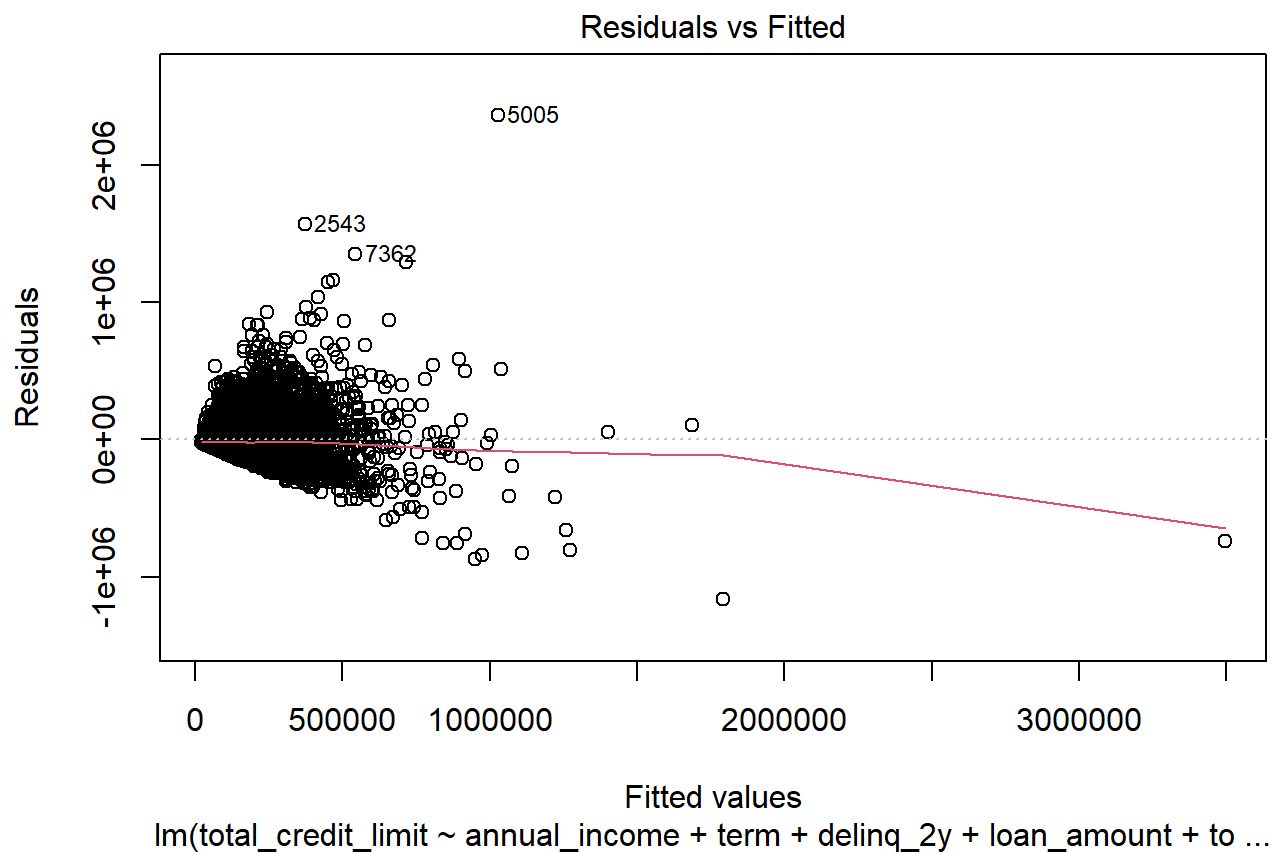
	Min	1Q	Median	3Q	Max
	-1163602	-85663	-41458	74660	2359272

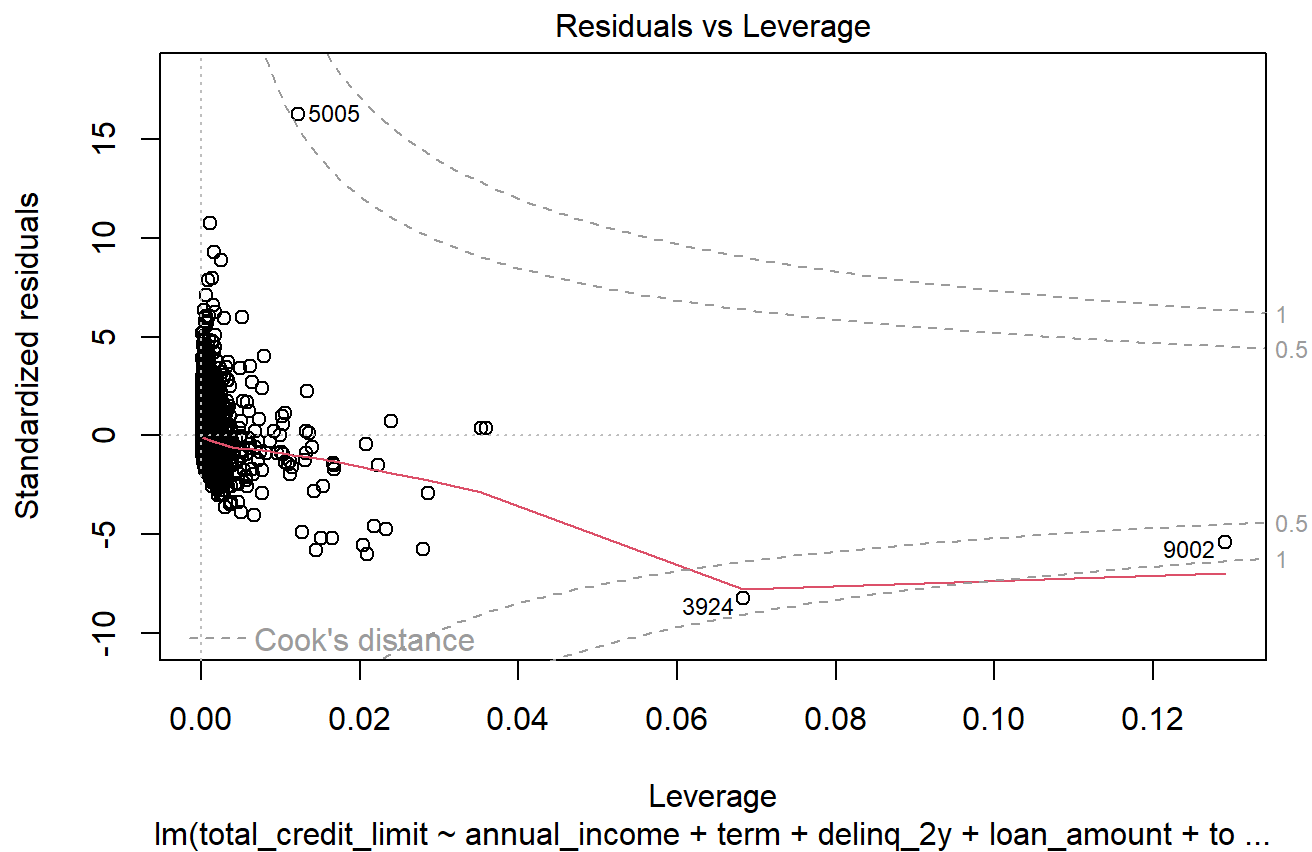
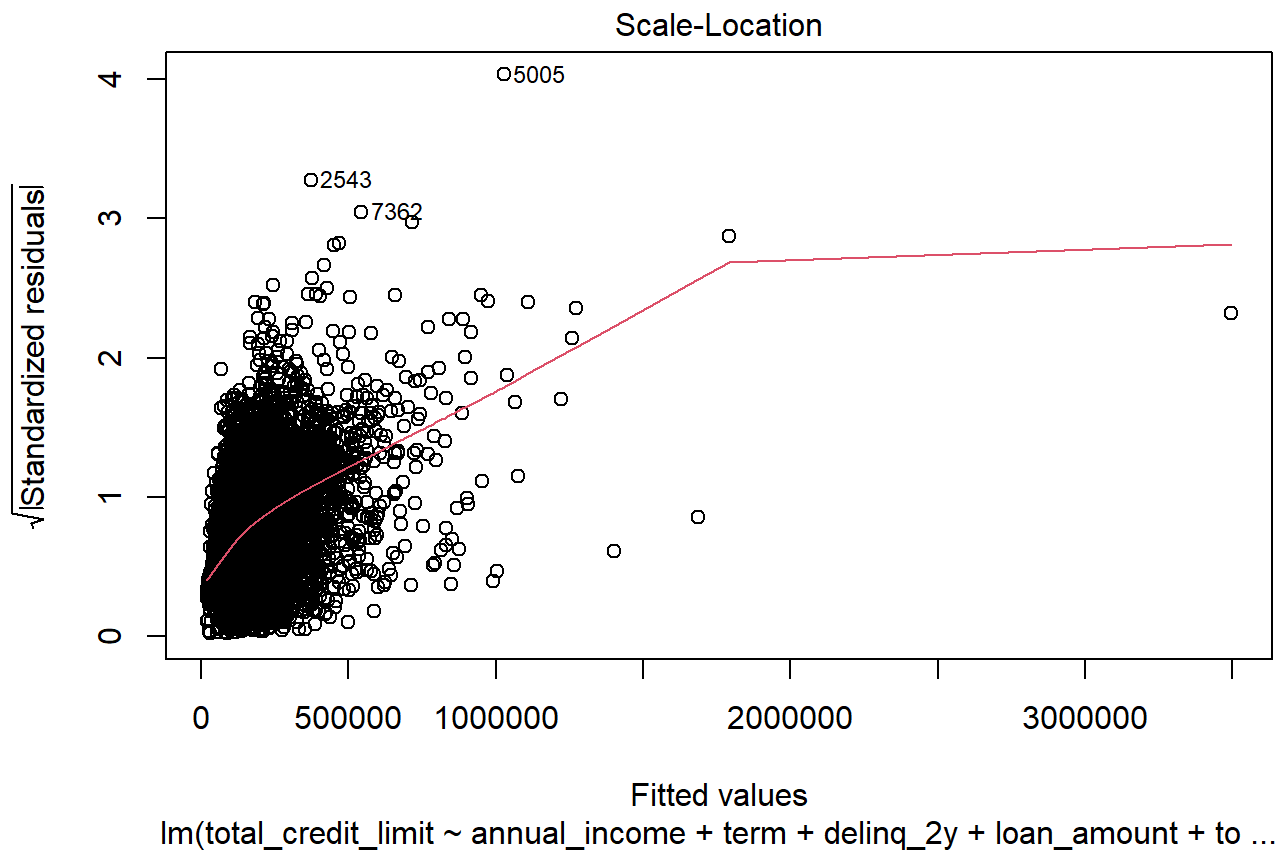
```
##
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-9.350e+03	6.145e+03	-1.522	0.12815
annual_income	9.711e-01	2.570e-02	37.786	< 2e-16 ***
term	4.535e+02	1.434e+02	3.163	0.00157 **
delinq_2y	1.077e+04	2.141e+03	5.032	4.94e-07 ***
loan_amount	1.837e+00	1.631e-01	11.264	< 2e-16 ***
total_credit_utilized	1.254e+00	3.002e-02	41.778	< 2e-16 ***

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 145900 on 9994 degrees of freedom
## Multiple R-squared:  0.3954, Adjusted R-squared:  0.3951
## F-statistic: 1307 on 5 and 9994 DF, p-value: < 2.2e-16
```

```
plot(fit2)
```





Look at the VIF of the last model.

```
vif(fit2)
```

```
##          annual_income          term          delinq_2y
##          1.299611          1.174520          1.005870
##          loan_amount total_credit_utilized
##          1.325130          1.217079
```

We are missing a lot of information because we have excluded the character variables. We will create dummy variables for the character variables. We do not want to make factors because factors imply ordinality to the data. But we do not want to include too many dummy variables because it increases computational strain and we begin to get the curse of dimensionality. ISLR, pg. 265.

Deal with Outliers with the IQR method

Remember the IQR method we learned about last week? Let's apply it on annual income.

```
Q <- quantile(dt$annual_income, probs=c(.25, .75), na.rm = TRUE)
iqr <- IQR(dt$annual_income, na.rm = TRUE)
up <- Q[2]+1.5*iqr # Upper Range
low<- Q[1]-1.5*iqr # Lower Range
dt<- subset(dt, dt$annual_income > (Q[1] - 1.5*iqr) & dt$annual_income < (Q[2]+1.5*iqr))
```

Working with Character Variables

To help make dummy variables we load the dummies library.

```
library('fastDummies')

dummies<-dummy_cols(dt,select_columns=c('verified_income','sub_grade','homeownership','loan_status','loan_purpose'), remove_selected_columns = TRUE)
dummies
```

```

##      annual_income loan_amount interest_rate  term delinq_2y tax_liens
##      <num>         <num>         <num> <num>         <num>         <num>
##  1:      90000      28000         14.07  60          0          0
##  2:      40000       5000         12.61  36          0          0
##  3:      40000       2000         17.09  36          0          0
##  4:      30000      21600          6.72  36          0          1
##  5:      35000      23000         14.07  36          0          0
##  ---
## 9457:     108000      24000          7.35  36          0          0
## 9458:     121000      10000         19.03  36          4          0
## 9459:      67000      30000         23.88  36          2          0
## 9460:      80000      24000          5.32  36          0          0
## 9461:      66000      12800         10.91  36          0          0
##      total_credit_limit total_credit_utilized verified_income_Not Verified
##      <num>         <num>         <int>         <int>
##  1:      70795      38767          0          0
##  2:      28800      4321          1          1
##  3:      24193     16000          0          0
##  4:      25400      4997          1          1
##  5:      69839     52722          0          0
##  ---
## 9457:     199195      77963          0          0
## 9458:     382061     101571          0          0
## 9459:     346402      95421          0          0
## 9460:     294475      27641          0          0
## 9461:       91887      53413          1          1
##      verified_income_Source Verified verified_income_Verified sub_grade_A1
##      <int>         <int>         <int>         <int>
##  1:          0          1          0          0
##  2:          0          0          0          0
##  3:          1          0          0          0
##  4:          0          0          0          0
##  5:          0          1          0          0
##  ---
## 9457:          1          0          0          0
## 9458:          0          1          0          0
## 9459:          0          1          0          0
## 9460:          1          0          1          1
## 9461:          0          0          0          0
##      sub_grade_A2 sub_grade_A3 sub_grade_A4 sub_grade_A5 sub_grade_B1
##      <int>         <int>         <int>         <int>         <int>
##  1:          0          0          0          0          0
##  2:          0          0          0          0          0
##  3:          0          0          0          0          0
##  4:          0          1          0          0          0
##  5:          0          0          0          0          0
##  ---
## 9457:          0          0          1          0          0
## 9458:          0          0          0          0          0
## 9459:          0          0          0          0          0
## 9460:          0          0          0          0          0
## 9461:          0          0          0          0          0

```

```

##      sub_grade_B2 sub_grade_B3 sub_grade_B4 sub_grade_B5 sub_grade_C1
##      <int>      <int>      <int>      <int>      <int>
##    1:          0          0          0          0          0
##    2:          0          0          0          0          1
##    3:          0          0          0          0          0
##    4:          0          0          0          0          0
##    5:          0          0          0          0          0
##    ---
## 9457:          0          0          0          0          0
## 9458:          0          0          0          0          0
## 9459:          0          0          0          0          0
## 9460:          0          0          0          0          0
## 9461:          0          0          1          0          0
##      sub_grade_C2 sub_grade_C3 sub_grade_C4 sub_grade_C5 sub_grade_D1
##      <int>      <int>      <int>      <int>      <int>
##    1:          0          1          0          0          0
##    2:          0          0          0          0          0
##    3:          0          0          0          0          1
##    4:          0          0          0          0          0
##    5:          0          1          0          0          0
##    ---
## 9457:          0          0          0          0          0
## 9458:          0          0          0          0          0
## 9459:          0          0          0          0          0
## 9460:          0          0          0          0          0
## 9461:          0          0          0          0          0
##      sub_grade_D2 sub_grade_D3 sub_grade_D4 sub_grade_D5 sub_grade_E1
##      <int>      <int>      <int>      <int>      <int>
##    1:          0          0          0          0          0
##    2:          0          0          0          0          0
##    3:          0          0          0          0          0
##    4:          0          0          0          0          0
##    5:          0          0          0          0          0
##    ---
## 9457:          0          0          0          0          0
## 9458:          0          1          0          0          0
## 9459:          0          0          0          0          0
## 9460:          0          0          0          0          0
## 9461:          0          0          0          0          0
##      sub_grade_E2 sub_grade_E3 sub_grade_E4 sub_grade_E5 sub_grade_F1
##      <int>      <int>      <int>      <int>      <int>
##    1:          0          0          0          0          0
##    2:          0          0          0          0          0
##    3:          0          0          0          0          0
##    4:          0          0          0          0          0
##    5:          0          0          0          0          0
##    ---
## 9457:          0          0          0          0          0
## 9458:          0          0          0          0          0
## 9459:          1          0          0          0          0
## 9460:          0          0          0          0          0
## 9461:          0          0          0          0          0

```

```

##      sub_grade_F2 sub_grade_F3 sub_grade_F4 sub_grade_F5 sub_grade_G1
##      <int>      <int>      <int>      <int>      <int>
##  1:          0          0          0          0          0
##  2:          0          0          0          0          0
##  3:          0          0          0          0          0
##  4:          0          0          0          0          0
##  5:          0          0          0          0          0
##  ---
## 9457:        0          0          0          0          0
## 9458:        0          0          0          0          0
## 9459:        0          0          0          0          0
## 9460:        0          0          0          0          0
## 9461:        0          0          0          0          0
##      sub_grade_G4 homeownership_MORTGAGE homeownership_OWNS homeownership_RENT
##      <int>      <int>      <int>      <int>
##  1:          0          1          0          0
##  2:          0          0          0          1
##  3:          0          0          0          1
##  4:          0          0          0          1
##  5:          0          0          0          1
##  ---
## 9457:        0          0          0          1
## 9458:        0          1          0          0
## 9459:        0          1          0          0
## 9460:        0          1          0          0
## 9461:        0          0          0          1
##      loan_status_Charged Off loan_status_Current loan_status_Fully Paid
##      <int>      <int>      <int>
##  1:          0          1          0
##  2:          0          1          0
##  3:          0          1          0
##  4:          0          1          0
##  5:          0          1          0
##  ---
## 9457:        0          1          0
## 9458:        0          1          0
## 9459:        0          1          0
## 9460:        0          1          0
## 9461:        0          1          0
##      loan_status_In Grace Period loan_status_Late (16-30 days)
##      <int>      <int>
##  1:          0          0
##  2:          0          0
##  3:          0          0
##  4:          0          0
##  5:          0          0
##  ---
## 9457:        0          0
## 9458:        0          0
## 9459:        0          0
## 9460:        0          0
## 9461:        0          0

```

```

##      loan_status_Late (31-120 days) loan_purpose_car loan_purpose_credit_card
##                                     <int>          <int>          <int>
##    1:              0              0              0
##    2:              0              0              0
##    3:              0              0              0
##    4:              0              0              0
##    5:              0              0              1
##    ---
## 9457:              0              0              0
## 9458:              0              0              0
## 9459:              0              0              0
## 9460:              0              0              0
## 9461:              0              0              1
##      loan_purpose_debt_consolidation loan_purpose_home_improvement
##                                     <int>          <int>
##    1:              0              0
##    2:              1              0
##    3:              0              0
##    4:              1              0
##    5:              0              0
##    ---
## 9457:              0              0
## 9458:              1              0
## 9459:              1              0
## 9460:              0              0
## 9461:              0              0
##      loan_purpose_house loan_purpose_major_purchase loan_purpose_medical
##                                     <int>          <int>          <int>
##    1:              0              0              0
##    2:              0              0              0
##    3:              0              0              0
##    4:              0              0              0
##    5:              0              0              0
##    ---
## 9457:              0              0              0
## 9458:              0              0              0
## 9459:              0              0              0
## 9460:              0              0              0
## 9461:              0              0              0
##      loan_purpose_moving loan_purpose_other loan_purpose_renewable_energy
##                                     <int>          <int>          <int>
##    1:              1              0              0
##    2:              0              0              0
##    3:              0              1              0
##    4:              0              0              0
##    5:              0              0              0
##    ---
## 9457:              0              1              0
## 9458:              0              0              0
## 9459:              0              0              0
## 9460:              0              1              0
## 9461:              0              0              0

```

```
##      loan_purpose_small_business loan_purpose_vacation
##                                <int>              <int>
##    1:                          0                    0
##    2:                          0                    0
##    3:                          0                    0
##    4:                          0                    0
##    5:                          0                    0
##    ---
## 9457:                          0                    0
## 9458:                          0                    0
## 9459:                          0                    0
## 9460:                          0                    0
## 9461:                          0                    0
```

Rename the new dummy variables and numeric data as our new data set.

```
dtf <- dummies
str(dtf)
```

```

## Classes 'data.table' and 'data.frame':  9461 obs. of  64 variables:
## $ annual_income      : num  90000 40000 40000 30000 35000 34000 35000 110000 650
00 30000 ...
## $ loan_amount        : num  28000 5000 2000 21600 23000 5000 24000 20000 20000 6
400 ...
## $ interest_rate      : num  14.07 12.61 17.09 6.72 14.07 ...
## $ term               : num  60 36 36 36 36 60 60 36 36 ...
## $ delinq_2y          : num  0 0 0 0 0 1 0 1 1 0 ...
## $ tax_liens          : num  0 0 0 1 0 0 0 0 0 0 ...
## $ total_credit_limit  : num  70795 28800 24193 25400 69839 ...
## $ total_credit_utilized : num  38767 4321 16000 4997 52722 ...
## $ verified_income_Not Verified : int  0 1 0 1 0 1 0 0 0 1 ...
## $ verified_income_Source Verified: int  0 0 1 0 0 0 1 1 1 0 ...
## $ verified_income_Verified : int  1 0 0 0 1 0 0 0 0 0 ...
## $ sub_grade_A1       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_A2       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_A3       : int  0 0 0 1 0 1 0 0 0 1 ...
## $ sub_grade_A4       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_A5       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_B1       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_B2       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_B3       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_B4       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_B5       : int  0 0 0 0 0 0 0 1 0 0 ...
## $ sub_grade_C1       : int  0 1 0 0 0 0 0 0 0 0 ...
## $ sub_grade_C2       : int  0 0 0 0 0 0 1 0 1 0 ...
## $ sub_grade_C3       : int  1 0 0 0 1 0 0 0 0 0 ...
## $ sub_grade_C4       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_C5       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_D1       : int  0 0 1 0 0 0 0 0 0 0 ...
## $ sub_grade_D2       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_D3       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_D4       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_D5       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_E1       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_E2       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_E3       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_E4       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_E5       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_F1       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_F2       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_F3       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_F4       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_F5       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_G1       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sub_grade_G4       : int  0 0 0 0 0 0 0 0 0 0 ...
## $ homeownership_MORTGAGE : int  1 0 0 0 0 0 1 1 1 0 ...
## $ homeownership_OWEN : int  0 0 0 0 0 1 0 0 0 0 ...
## $ homeownership_RENT : int  0 1 1 1 1 0 0 0 0 1 ...
## $ loan_status_Charged Off : int  0 0 0 0 0 0 0 0 0 0 ...
## $ loan_status_Current : int  1 1 1 1 1 1 1 1 1 1 ...
## $ loan_status_Fully Paid : int  0 0 0 0 0 0 0 0 0 0 ...

```



```
## $ loan_status_In Grace Period : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_status_Late (16-30 days) : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_status_Late (31-120 days) : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_car : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_credit_card : int 0 0 0 0 1 0 1 0 0 1 ...
## $ loan_purpose_debt_consolidation: int 0 1 0 1 0 0 0 1 0 0 ...
## $ loan_purpose_home_improvement : int 0 0 0 0 0 0 0 0 1 0 ...
## $ loan_purpose_house : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_major_purchase : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_medical : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_moving : int 1 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_other : int 0 0 1 0 0 1 0 0 0 0 ...
## $ loan_purpose_renewable_energy : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_small_business : int 0 0 0 0 0 0 0 0 0 0 ...
## $ loan_purpose_vacation : int 0 0 0 0 0 0 0 0 0 0 ...
```

Let's make a new MLR model with the dummy variables added.

MLR model with numeric variables and dummies

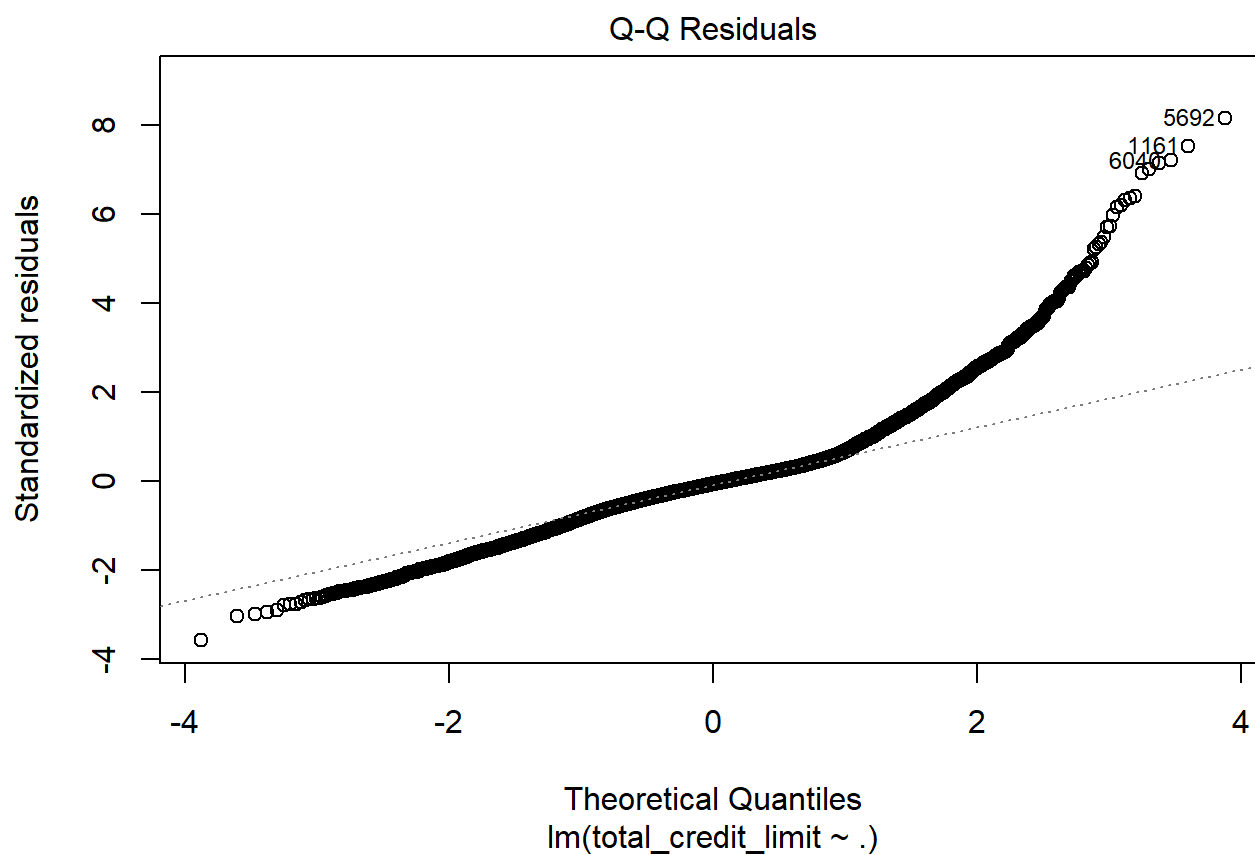
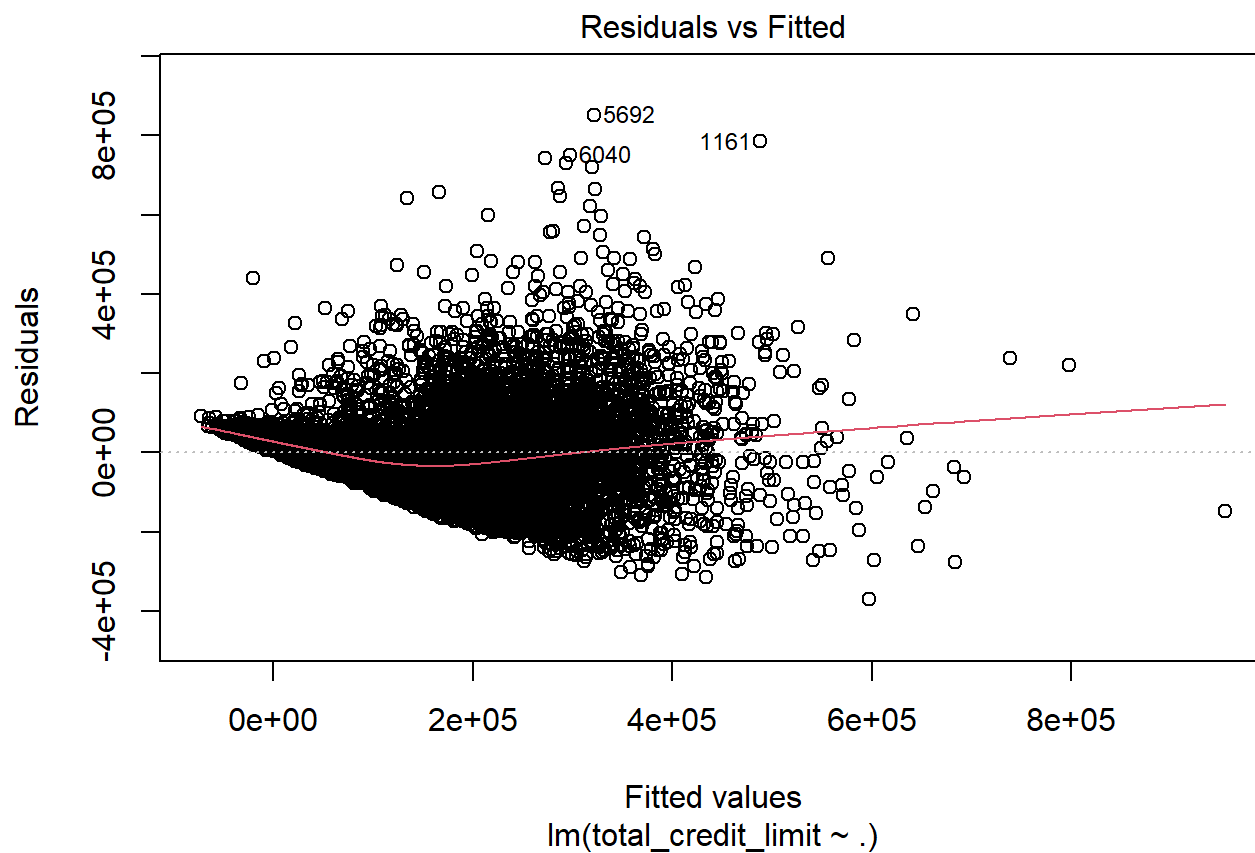
```
fit3 <- lm(total_credit_limit ~ ., data = dtf)
summary(fit3)
```

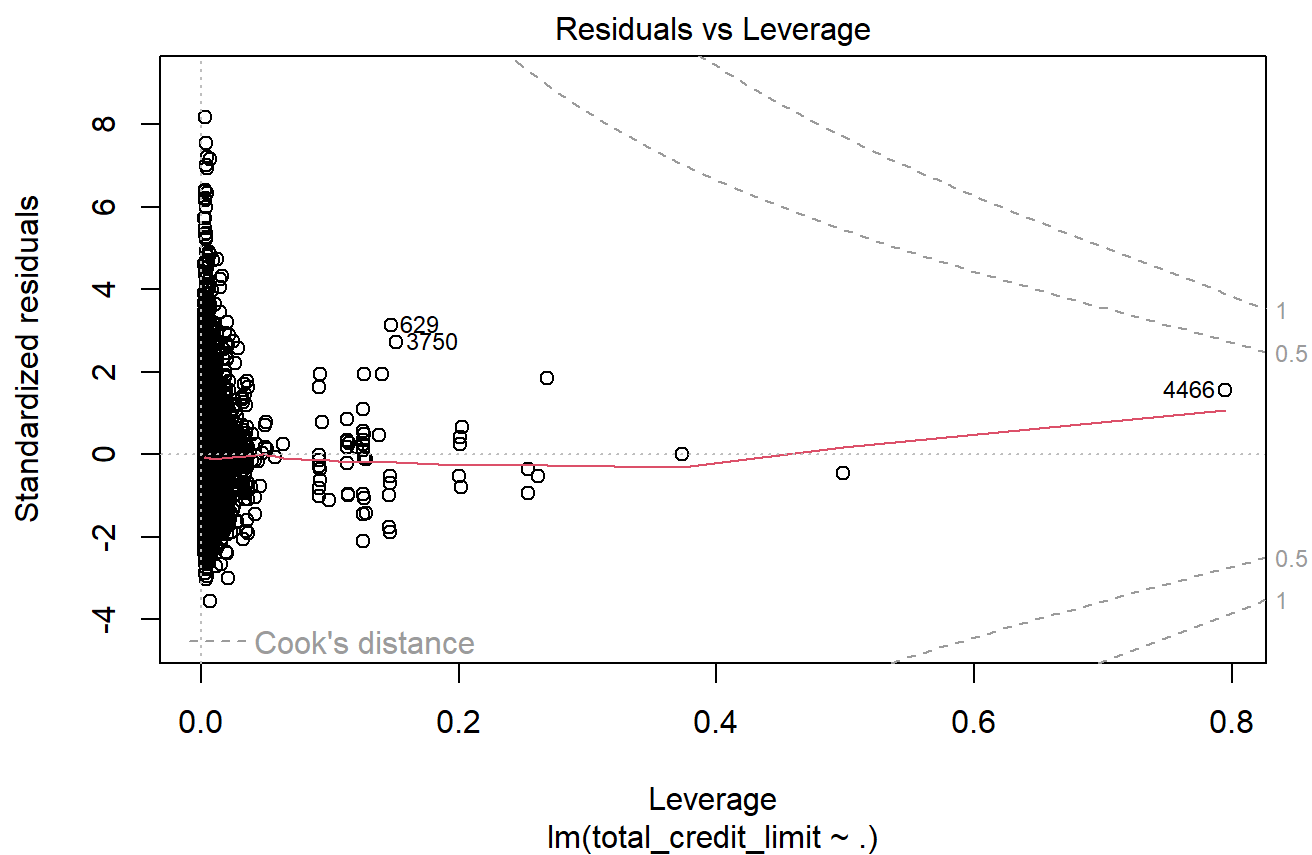
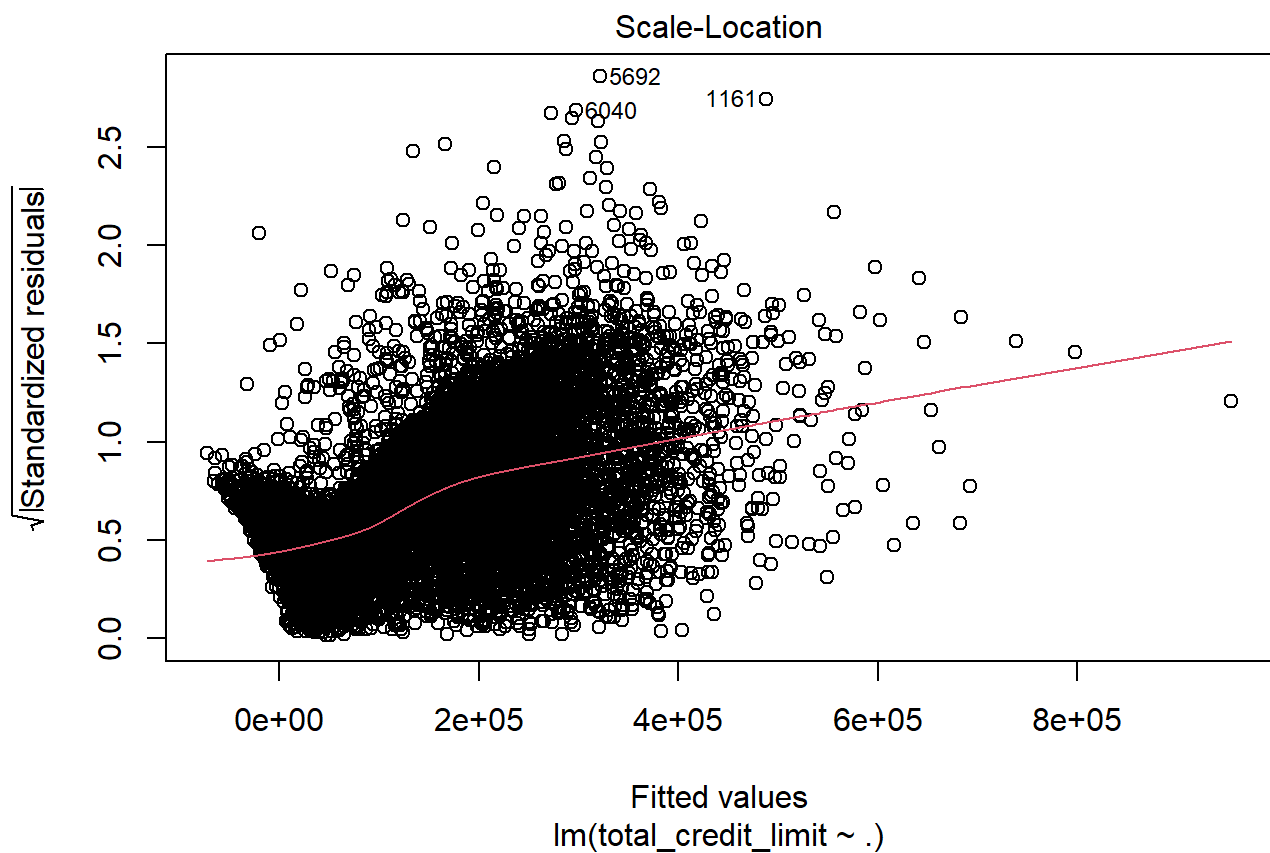
```
##
## Call:
## lm(formula = total_credit_limit ~ ., data = dtf)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -371201  -54226   -5618   37037   851104
##
## Coefficients: (5 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -7.766e+04  1.941e+05  -0.400   0.6890
## annual_income    1.227e+00  3.885e-02  31.583 < 2e-16 ***
## loan_amount      3.229e-01  1.329e-01   2.429  0.0152 *
## interest_rate   -3.510e+03  5.201e+03  -0.675   0.4998
## term            7.267e+02  1.161e+02   6.259 4.03e-10 ***
## delinq_2y       8.665e+03  1.628e+03   5.322 1.05e-07 ***
## tax_liens       -1.662e+03  1.793e+03  -0.927   0.3541
## total_credit_utilized 1.054e+00  2.536e-02  41.549 < 2e-16 ***
## `verified_income_Not Verified` -2.862e+04  3.088e+03  -9.268 < 2e-16 ***
## `verified_income_Source Verified` -2.373e+04  2.888e+03  -8.216 2.38e-16 ***
## verified_income_Verified          NA          NA          NA          NA
## sub_grade_A1      8.143e+04  1.707e+05   0.477   0.6333
## sub_grade_A2      7.454e+04  1.676e+05   0.445   0.6565
## sub_grade_A3      6.109e+04  1.650e+05   0.370   0.7113
## sub_grade_A4      6.686e+04  1.626e+05   0.411   0.6809
## sub_grade_A5      5.072e+04  1.601e+05   0.317   0.7514
## sub_grade_B1      5.664e+04  1.545e+05   0.367   0.7139
## sub_grade_B2      5.308e+04  1.527e+05   0.348   0.7281
## sub_grade_B3      5.126e+04  1.509e+05   0.340   0.7340
## sub_grade_B4      5.533e+04  1.491e+05   0.371   0.7105
## sub_grade_B5      5.202e+04  1.452e+05   0.358   0.7201
## sub_grade_C1      4.750e+04  1.430e+05   0.332   0.7398
## sub_grade_C2      4.363e+04  1.397e+05   0.312   0.7548
## sub_grade_C3      5.553e+04  1.380e+05   0.402   0.6875
## sub_grade_C4      5.192e+04  1.349e+05   0.385   0.7003
## sub_grade_C5      5.151e+04  1.318e+05   0.391   0.6960
## sub_grade_D1      5.303e+04  1.282e+05   0.414   0.6792
## sub_grade_D2      6.309e+04  1.255e+05   0.503   0.6153
## sub_grade_D3      5.695e+04  1.229e+05   0.463   0.6432
## sub_grade_D4      5.447e+04  1.207e+05   0.451   0.6516
## sub_grade_D5      5.274e+04  1.172e+05   0.450   0.6527
## sub_grade_E1      8.806e+04  1.155e+05   0.762   0.4459
## sub_grade_E2      5.985e+04  1.134e+05   0.528   0.5977
## sub_grade_E3      6.303e+04  1.117e+05   0.564   0.5725
## sub_grade_E4      7.976e+04  1.104e+05   0.723   0.4700
## sub_grade_E5      6.344e+04  1.095e+05   0.580   0.5622
## sub_grade_F1      8.686e+04  1.087e+05   0.799   0.4242
## sub_grade_F2      6.098e+04  1.128e+05   0.541   0.5888
## sub_grade_F3      1.249e+05  1.127e+05   1.108   0.2678
## sub_grade_F4      1.248e+05  1.162e+05   1.074   0.2830
## sub_grade_F5      1.222e+05  1.179e+05   1.036   0.3001
## sub_grade_G1      9.721e+04  1.110e+05   0.876   0.3810
```

```
## sub_grade_G4                NA                NA                NA                NA
## homeownership_MORTGAGE      1.411e+05      2.463e+03      57.271      < 2e-16 ***
## homeownership_OWEN         5.127e+04      3.398e+03      15.089      < 2e-16 ***
## homeownership_RENT          NA                NA                NA                NA
## `loan_status_Charged Off`   9.386e+04      4.171e+04      2.250      0.0245 *
## loan_status_Current         6.058e+03      1.342e+04      0.451      0.6518
## `loan_status_Fully Paid`    1.284e+04      1.431e+04      0.897      0.3695
## `loan_status_In Grace Period` 1.574e+03      1.881e+04      0.084      0.9333
## `loan_status_Late (16-30 days)` 3.493e+04      2.237e+04      1.562      0.1184
## `loan_status_Late (31-120 days)` NA                NA                NA                NA
## loan_purpose_car              4.653e+03      1.637e+04      0.284      0.7763
## loan_purpose_credit_card      -4.471e+03      1.374e+04     -0.325      0.7449
## loan_purpose_debt_consolidation 1.471e+03      1.364e+04      0.108      0.9142
## loan_purpose_home_improvement  2.983e+03      1.422e+04      0.210      0.8338
## loan_purpose_house            1.588e+03      1.620e+04      0.098      0.9219
## loan_purpose_major_purchase   -3.140e+03      1.494e+04     -0.210      0.8336
## loan_purpose_medical          9.769e+03      1.595e+04      0.613      0.5402
## loan_purpose_moving           -1.297e+04      1.848e+04     -0.702      0.4830
## loan_purpose_other            -5.870e+01      1.399e+04     -0.004      0.9967
## loan_purpose_renewable_energy  -3.662e+04      3.738e+04     -0.980      0.3273
## loan_purpose_small_business   -1.201e+04      1.667e+04     -0.720      0.4714
## loan_purpose_vacation          NA                NA                NA                NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 104400 on 9402 degrees of freedom
## Multiple R-squared:  0.5551, Adjusted R-squared:  0.5523
## F-statistic: 202.2 on 58 and 9402 DF, p-value: < 2.2e-16
```

```
plot(fit3)
```

```
## Warning: not plotting observations with leverage one:
##      3627
```





```
#if you choose to remove outliers  
#dtf <- dtf[-c(4466),]
```

New MLR model with stepAIC()

The last dummy variable is listed as NA because it is considered the baseline. The baseline variable is incorporated into the intercept. We can remove the baseline variable using the stepAIC() function

```
stepAIC(fit3, direction = 'both')
```

```

## Start: AIC=218712.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + verified_income_Verified +
## sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
## sub_grade_A5 + sub_grade_B1 + sub_grade_B2 + sub_grade_B3 +
## sub_grade_B4 + sub_grade_B5 + sub_grade_C1 + sub_grade_C2 +
## sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
## sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
## sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
## sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
## sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + sub_grade_G4 +
## homeownership_MORTGAGE + homeownership_OWEN + homeownership_RENT +
## `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
## `loan_status_In Grace Period` + `loan_status_Late (16-30 days)` +
## `loan_status_Late (31-120 days)` + loan_purpose_car + loan_purpose_credit_card +
## loan_purpose_debt_consolidation + loan_purpose_home_improvement +
## loan_purpose_house + loan_purpose_major_purchase + loan_purpose_medical +
## loan_purpose_moving + loan_purpose_other + loan_purpose_renewable_energy +
## loan_purpose_small_business + loan_purpose_vacation
##
##
## Step: AIC=218712.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + verified_income_Verified +
## sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
## sub_grade_A5 + sub_grade_B1 + sub_grade_B2 + sub_grade_B3 +
## sub_grade_B4 + sub_grade_B5 + sub_grade_C1 + sub_grade_C2 +
## sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
## sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
## sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
## sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
## sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + sub_grade_G4 +
## homeownership_MORTGAGE + homeownership_OWEN + homeownership_RENT +
## `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
## `loan_status_In Grace Period` + `loan_status_Late (16-30 days)` +
## `loan_status_Late (31-120 days)` + loan_purpose_car + loan_purpose_credit_card +
## loan_purpose_debt_consolidation + loan_purpose_home_improvement +
## loan_purpose_house + loan_purpose_major_purchase + loan_purpose_medical +
## loan_purpose_moving + loan_purpose_other + loan_purpose_renewable_energy +
## loan_purpose_small_business
##
##
## Step: AIC=218712.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + verified_income_Verified +
## sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
## sub_grade_A5 + sub_grade_B1 + sub_grade_B2 + sub_grade_B3 +
## sub_grade_B4 + sub_grade_B5 + sub_grade_C1 + sub_grade_C2 +
## sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +

```

```

##      sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
##      sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##      sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
##      sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + sub_grade_G4 +
##      homeownership_MORTGAGE + homeownership_OWEN + homeownership_RENT +
##      `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
##      `loan_status_In Grace Period` + `loan_status_Late (16-30 days)` +
##      loan_purpose_car + loan_purpose_credit_card + loan_purpose_debt_consolidation +
##      loan_purpose_home_improvement + loan_purpose_house + loan_purpose_major_purchase +
##      loan_purpose_medical + loan_purpose_moving + loan_purpose_other +
##      loan_purpose_renewable_energy + loan_purpose_small_business
##
##
## Step: AIC=218712.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##      term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##      `verified_income_Source Verified` + verified_income_Verified +
##      sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
##      sub_grade_A5 + sub_grade_B1 + sub_grade_B2 + sub_grade_B3 +
##      sub_grade_B4 + sub_grade_B5 + sub_grade_C1 + sub_grade_C2 +
##      sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
##      sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
##      sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##      sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
##      sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + sub_grade_G4 +
##      homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
##      loan_status_Current + `loan_status_Fully Paid` + `loan_status_In Grace Period` +
##      `loan_status_Late (16-30 days)` + loan_purpose_car + loan_purpose_credit_card +
##      loan_purpose_debt_consolidation + loan_purpose_home_improvement +
##      loan_purpose_house + loan_purpose_major_purchase + loan_purpose_medical +
##      loan_purpose_moving + loan_purpose_other + loan_purpose_renewable_energy +
##      loan_purpose_small_business
##
##
## Step: AIC=218712.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##      term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##      `verified_income_Source Verified` + verified_income_Verified +
##      sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
##      sub_grade_A5 + sub_grade_B1 + sub_grade_B2 + sub_grade_B3 +
##      sub_grade_B4 + sub_grade_B5 + sub_grade_C1 + sub_grade_C2 +
##      sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
##      sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
##      sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##      sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
##      sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##      homeownership_OWEN + `loan_status_Charged Off` + loan_status_Current +
##      `loan_status_Fully Paid` + `loan_status_In Grace Period` +
##      `loan_status_Late (16-30 days)` + loan_purpose_car + loan_purpose_credit_card +
##      loan_purpose_debt_consolidation + loan_purpose_home_improvement +
##      loan_purpose_house + loan_purpose_major_purchase + loan_purpose_medical +
##      loan_purpose_moving + loan_purpose_other + loan_purpose_renewable_energy +

```



```

##      loan_purpose_small_business
##
##
## Step: AIC=218712.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##      term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##      `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##      sub_grade_A3 + sub_grade_A4 + sub_grade_A5 + sub_grade_B1 +
##      sub_grade_B2 + sub_grade_B3 + sub_grade_B4 + sub_grade_B5 +
##      sub_grade_C1 + sub_grade_C2 + sub_grade_C3 + sub_grade_C4 +
##      sub_grade_C5 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
##      sub_grade_D4 + sub_grade_D5 + sub_grade_E1 + sub_grade_E2 +
##      sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
##      sub_grade_F2 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
##      sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
##      `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
##      `loan_status_In Grace Period` + `loan_status_Late (16-30 days)` +
##      loan_purpose_car + loan_purpose_credit_card + loan_purpose_debt_consolidation +
##      loan_purpose_home_improvement + loan_purpose_house + loan_purpose_major_purchase +
##      loan_purpose_medical + loan_purpose_moving + loan_purpose_other +
##      loan_purpose_renewable_energy + loan_purpose_small_business
##
##
##      Df      Sum of Sq      RSS      AIC
## - loan_purpose_other      1 1.9181e+05 1.0238e+14 218711
## - `loan_status_In Grace Period`      1 7.6193e+07 1.0238e+14 218711
## - loan_purpose_house      1 1.0463e+08 1.0238e+14 218711
## - loan_purpose_debt_consolidation      1 1.2653e+08 1.0238e+14 218711
## - loan_purpose_home_improvement      1 4.7960e+08 1.0238e+14 218711
## - loan_purpose_major_purchase      1 4.8086e+08 1.0238e+14 218711
## - loan_purpose_car      1 8.7940e+08 1.0238e+14 218711
## - sub_grade_C2      1 1.0625e+09 1.0239e+14 218711
## - sub_grade_A5      1 1.0926e+09 1.0239e+14 218711
## - loan_purpose_credit_card      1 1.1529e+09 1.0239e+14 218711
## - sub_grade_C1      1 1.2017e+09 1.0239e+14 218711
## - sub_grade_B3      1 1.2572e+09 1.0239e+14 218711
## - sub_grade_B2      1 1.3163e+09 1.0239e+14 218711
## - sub_grade_B5      1 1.3982e+09 1.0239e+14 218711
## - sub_grade_B1      1 1.4636e+09 1.0239e+14 218711
## - sub_grade_A3      1 1.4921e+09 1.0239e+14 218711
## - sub_grade_B4      1 1.5003e+09 1.0239e+14 218711
## - sub_grade_C4      1 1.6132e+09 1.0239e+14 218711
## - sub_grade_C5      1 1.6624e+09 1.0239e+14 218711
## - sub_grade_C3      1 1.7624e+09 1.0239e+14 218711
## - sub_grade_A4      1 1.8422e+09 1.0239e+14 218711
## - sub_grade_D1      1 1.8621e+09 1.0239e+14 218711
## - sub_grade_A2      1 2.1539e+09 1.0239e+14 218711
## - sub_grade_D5      1 2.2057e+09 1.0239e+14 218711
## - loan_status_Current      1 2.2177e+09 1.0239e+14 218711
## - sub_grade_D4      1 2.2197e+09 1.0239e+14 218711
## - sub_grade_D3      1 2.3373e+09 1.0239e+14 218711
## - sub_grade_A1      1 2.4787e+09 1.0239e+14 218711
## - sub_grade_D2      1 2.7502e+09 1.0239e+14 218711

```

```

## - sub_grade_E2          1 3.0320e+09 1.0239e+14 218711
## - sub_grade_F2          1 3.1817e+09 1.0239e+14 218711
## - sub_grade_E3          1 3.4690e+09 1.0239e+14 218711
## - sub_grade_E5          1 3.6582e+09 1.0239e+14 218711
## - loan_purpose_medical    1 4.0855e+09 1.0239e+14 218711
## - interest_rate        1 4.9588e+09 1.0239e+14 218711
## - loan_purpose_moving     1 5.3595e+09 1.0239e+14 218711
## - loan_purpose_small_business 1 5.6497e+09 1.0239e+14 218711
## - sub_grade_E4          1 5.6855e+09 1.0239e+14 218711
## - sub_grade_E1          1 6.3276e+09 1.0239e+14 218711
## - sub_grade_F1          1 6.9560e+09 1.0239e+14 218711
## - sub_grade_G1          1 8.3579e+09 1.0239e+14 218711
## - `loan_status_Fully Paid` 1 8.7697e+09 1.0239e+14 218711
## - tax_liens             1 9.3525e+09 1.0239e+14 218712
## - loan_purpose_renewable_energy 1 1.0450e+10 1.0239e+14 218712
## - sub_grade_F5          1 1.1696e+10 1.0240e+14 218712
## - sub_grade_F4          1 1.2550e+10 1.0240e+14 218712
## - sub_grade_F3          1 1.3375e+10 1.0240e+14 218712
## <none>                  1.0238e+14 218713
## - `loan_status_Late (16-30 days)` 1 2.6562e+10 1.0241e+14 218713
## - `loan_status_Charged Off` 1 5.5138e+10 1.0244e+14 218716
## - loan_amount           1 6.4241e+10 1.0245e+14 218717
## - delinq_2y             1 3.0842e+11 1.0269e+14 218739
## - term                  1 4.2665e+11 1.0281e+14 218750
## - `verified_income_Source Verified` 1 7.3511e+11 1.0312e+14 218778
## - `verified_income_Not Verified` 1 9.3536e+11 1.0332e+14 218797
## - homeownership_OWEN    1 2.4794e+12 1.0486e+14 218937
## - annual_income         1 1.0862e+13 1.1325e+14 219665
## - total_credit_utilized  1 1.8799e+13 1.2118e+14 220306
## - homeownership_MORTGAGE 1 3.5717e+13 1.3810e+14 221542
##
## Step: AIC=218710.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_A5 + sub_grade_B1 +
## sub_grade_B2 + sub_grade_B3 + sub_grade_B4 + sub_grade_B5 +
## sub_grade_C1 + sub_grade_C2 + sub_grade_C3 + sub_grade_C4 +
## sub_grade_C5 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
## sub_grade_D4 + sub_grade_D5 + sub_grade_E1 + sub_grade_E2 +
## sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
## sub_grade_F2 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
## sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
## `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
## `loan_status_In Grace Period` + `loan_status_Late (16-30 days)` +
## loan_purpose_car + loan_purpose_credit_card + loan_purpose_debt_consolidation +
## loan_purpose_home_improvement + loan_purpose_house + loan_purpose_major_purchase +
## loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
## loan_purpose_small_business
##
## Df Sum of Sq RSS AIC
## - `loan_status_In Grace Period` 1 7.6195e+07 1.0238e+14 218709

```

## - loan_purpose_house	1	3.2755e+08	1.0238e+14	218709
## - sub_grade_C2	1	1.0629e+09	1.0239e+14	218709
## - sub_grade_A5	1	1.0930e+09	1.0239e+14	218709
## - sub_grade_C1	1	1.2021e+09	1.0239e+14	218709
## - sub_grade_B3	1	1.2578e+09	1.0239e+14	218709
## - sub_grade_B2	1	1.3168e+09	1.0239e+14	218709
## - sub_grade_B5	1	1.3987e+09	1.0239e+14	218709
## - sub_grade_B1	1	1.4642e+09	1.0239e+14	218709
## - sub_grade_A3	1	1.4928e+09	1.0239e+14	218709
## - sub_grade_B4	1	1.5009e+09	1.0239e+14	218709
## - sub_grade_C4	1	1.6138e+09	1.0239e+14	218709
## - sub_grade_C5	1	1.6629e+09	1.0239e+14	218709
## - loan_purpose_debt_consolidation	1	1.7559e+09	1.0239e+14	218709
## - sub_grade_C3	1	1.7630e+09	1.0239e+14	218709
## - sub_grade_A4	1	1.8430e+09	1.0239e+14	218709
## - sub_grade_D1	1	1.8627e+09	1.0239e+14	218709
## - loan_purpose_major_purchase	1	2.0000e+09	1.0239e+14	218709
## - sub_grade_A2	1	2.1548e+09	1.0239e+14	218709
## - sub_grade_D5	1	2.2062e+09	1.0239e+14	218709
## - loan_status_Current	1	2.2180e+09	1.0239e+14	218709
## - sub_grade_D4	1	2.2203e+09	1.0239e+14	218709
## - sub_grade_D3	1	2.3379e+09	1.0239e+14	218709
## - sub_grade_A1	1	2.4796e+09	1.0239e+14	218709
## - loan_purpose_car	1	2.4818e+09	1.0239e+14	218709
## - sub_grade_D2	1	2.7510e+09	1.0239e+14	218709
## - sub_grade_E2	1	3.0326e+09	1.0239e+14	218709
## - sub_grade_F2	1	3.1818e+09	1.0239e+14	218709
## - loan_purpose_home_improvement	1	3.3023e+09	1.0239e+14	218709
## - sub_grade_E3	1	3.4694e+09	1.0239e+14	218709
## - sub_grade_E5	1	3.6585e+09	1.0239e+14	218709
## - interest_rate	1	4.9590e+09	1.0239e+14	218709
## - sub_grade_E4	1	5.6860e+09	1.0239e+14	218709
## - sub_grade_E1	1	6.3283e+09	1.0239e+14	218709
## - sub_grade_F1	1	6.9563e+09	1.0239e+14	218709
## - sub_grade_G1	1	8.3582e+09	1.0239e+14	218709
## - `loan_status_Fully Paid`	1	8.7702e+09	1.0239e+14	218709
## - tax_liens	1	9.3535e+09	1.0239e+14	218710
## - loan_purpose_moving	1	1.0616e+10	1.0239e+14	218710
## - sub_grade_F5	1	1.1696e+10	1.0240e+14	218710
## - loan_purpose_renewable_energy	1	1.1871e+10	1.0240e+14	218710
## - loan_purpose_credit_card	1	1.2255e+10	1.0240e+14	218710
## - sub_grade_F4	1	1.2551e+10	1.0240e+14	218710
## - loan_purpose_medical	1	1.2625e+10	1.0240e+14	218710
## - sub_grade_F3	1	1.3375e+10	1.0240e+14	218710
## - loan_purpose_small_business	1	1.4674e+10	1.0240e+14	218710
## <none>			1.0238e+14	218711
## - `loan_status_Late (16-30 days)`	1	2.6570e+10	1.0241e+14	218711
## + loan_purpose_other	1	1.9181e+05	1.0238e+14	218713
## + loan_purpose_vacation	1	1.9181e+05	1.0238e+14	218713
## - `loan_status_Charged Off`	1	5.5138e+10	1.0244e+14	218714
## - loan_amount	1	6.4328e+10	1.0245e+14	218715
## - delinq_2y	1	3.0869e+11	1.0269e+14	218737

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## - term 1 4.2672e+11 1.0281e+14 218748
## - `verified_income_Source Verified` 1 7.3540e+11 1.0312e+14 218776
## - `verified_income_Not Verified` 1 9.3573e+11 1.0332e+14 218795
## - homeownership_OWEN 1 2.4804e+12 1.0486e+14 218935
## - annual_income 1 1.0864e+13 1.1325e+14 219663
## - total_credit_utilized 1 1.8806e+13 1.2119e+14 220304
## - homeownership_MORTGAGE 1 3.5718e+13 1.3810e+14 221540
##
## Step: AIC=218708.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_A5 + sub_grade_B1 +
## sub_grade_B2 + sub_grade_B3 + sub_grade_B4 + sub_grade_B5 +
## sub_grade_C1 + sub_grade_C2 + sub_grade_C3 + sub_grade_C4 +
## sub_grade_C5 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
## sub_grade_D4 + sub_grade_D5 + sub_grade_E1 + sub_grade_E2 +
## sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
## sub_grade_F2 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
## sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
## `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
## `loan_status_Late (16-30 days)` + loan_purpose_car + loan_purpose_credit_card +
## loan_purpose_debt_consolidation + loan_purpose_home_improvement +
## loan_purpose_house + loan_purpose_major_purchase + loan_purpose_medical +
## loan_purpose_moving + loan_purpose_renewable_energy + loan_purpose_small_business
##
## Df Sum of Sq RSS AIC
## - loan_purpose_house 1 3.3045e+08 1.0238e+14 218707
## - sub_grade_C2 1 1.0643e+09 1.0239e+14 218707
## - sub_grade_A5 1 1.0946e+09 1.0239e+14 218707
## - sub_grade_C1 1 1.2033e+09 1.0239e+14 218707
## - sub_grade_B3 1 1.2592e+09 1.0239e+14 218707
## - sub_grade_B2 1 1.3182e+09 1.0239e+14 218707
## - sub_grade_B5 1 1.3998e+09 1.0239e+14 218707
## - sub_grade_B1 1 1.4656e+09 1.0239e+14 218707
## - sub_grade_A3 1 1.4944e+09 1.0239e+14 218707
## - sub_grade_B4 1 1.5024e+09 1.0239e+14 218707
## - sub_grade_C4 1 1.6150e+09 1.0239e+14 218707
## - sub_grade_C5 1 1.6642e+09 1.0239e+14 218707
## - loan_purpose_debt_consolidation 1 1.7610e+09 1.0239e+14 218707
## - sub_grade_C3 1 1.7644e+09 1.0239e+14 218707
## - sub_grade_A4 1 1.8448e+09 1.0239e+14 218707
## - sub_grade_D1 1 1.8638e+09 1.0239e+14 218707
## - loan_purpose_major_purchase 1 2.0056e+09 1.0239e+14 218707
## - sub_grade_A2 1 2.1566e+09 1.0239e+14 218707
## - sub_grade_D5 1 2.2085e+09 1.0239e+14 218707
## - sub_grade_D4 1 2.2223e+09 1.0239e+14 218707
## - sub_grade_D3 1 2.3395e+09 1.0239e+14 218707
## - sub_grade_A1 1 2.4816e+09 1.0239e+14 218707
## - loan_purpose_car 1 2.4888e+09 1.0239e+14 218707
## - sub_grade_D2 1 2.7524e+09 1.0239e+14 218707
## - sub_grade_E2 1 3.0342e+09 1.0239e+14 218707

```

```

## - sub_grade_F2          1 3.1728e+09 1.0239e+14 218707
## - loan_purpose_home_improvement 1 3.3011e+09 1.0239e+14 218707
## - loan_status_Current   1 3.3258e+09 1.0239e+14 218707
## - sub_grade_E3          1 3.4709e+09 1.0239e+14 218707
## - sub_grade_E5          1 3.6610e+09 1.0239e+14 218707
## - interest_rate         1 4.9564e+09 1.0239e+14 218707
## - sub_grade_E4          1 5.6864e+09 1.0239e+14 218707
## - sub_grade_E1          1 6.3306e+09 1.0239e+14 218707
## - sub_grade_F1          1 6.9578e+09 1.0239e+14 218707
## - sub_grade_G1          1 8.3595e+09 1.0239e+14 218707
## - tax_liens             1 9.3544e+09 1.0239e+14 218708
## - loan_purpose_moving     1 1.0632e+10 1.0239e+14 218708
## - sub_grade_F5          1 1.1664e+10 1.0240e+14 218708
## - loan_purpose_renewable_energy 1 1.1870e+10 1.0240e+14 218708
## - loan_purpose_credit_card 1 1.2248e+10 1.0240e+14 218708
## - sub_grade_F4          1 1.2552e+10 1.0240e+14 218708
## - loan_purpose_medical    1 1.2603e+10 1.0240e+14 218708
## - sub_grade_F3          1 1.3357e+10 1.0240e+14 218708
## - `loan_status_Fully Paid` 1 1.3695e+10 1.0240e+14 218708
## - loan_purpose_small_business 1 1.4656e+10 1.0240e+14 218708
## <none>                  1.0238e+14 218709
## - `loan_status_Late (16-30 days)` 1 3.0815e+10 1.0241e+14 218710
## + `loan_status_In Grace Period` 1 7.6195e+07 1.0238e+14 218711
## + `loan_status_Late (31-120 days)` 1 7.6195e+07 1.0238e+14 218711
## + loan_purpose_other      1 1.9423e+05 1.0238e+14 218711
## + loan_purpose_vacation   1 1.9423e+05 1.0238e+14 218711
## - `loan_status_Charged Off` 1 5.7153e+10 1.0244e+14 218712
## - loan_amount           1 6.4322e+10 1.0245e+14 218713
## - delinq_2y             1 3.0885e+11 1.0269e+14 218735
## - term                  1 4.2674e+11 1.0281e+14 218746
## - `verified_income_Source Verified` 1 7.3534e+11 1.0312e+14 218774
## - `verified_income_Not Verified` 1 9.3571e+11 1.0332e+14 218793
## - homeownership_OWEN   1 2.4804e+12 1.0486e+14 218933
## - annual_income         1 1.0864e+13 1.1325e+14 219661
## - total_credit_utilized 1 1.8812e+13 1.2120e+14 220303
## - homeownership_MORTGAGE 1 3.5726e+13 1.3811e+14 221539
##
## Step: AIC=218706.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_A5 + sub_grade_B1 +
## sub_grade_B2 + sub_grade_B3 + sub_grade_B4 + sub_grade_B5 +
## sub_grade_C1 + sub_grade_C2 + sub_grade_C3 + sub_grade_C4 +
## sub_grade_C5 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
## sub_grade_D4 + sub_grade_D5 + sub_grade_E1 + sub_grade_E2 +
## sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
## sub_grade_F2 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
## sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
## `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
## `loan_status_Late (16-30 days)` + loan_purpose_car + loan_purpose_credit_card +
## loan_purpose_debt_consolidation + loan_purpose_home_improvement +

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##      loan_purpose_major_purchase + loan_purpose_medical + loan_purpose_moving +
##      loan_purpose_renewable_energy + loan_purpose_small_business
##
##              Df  Sum of Sq      RSS    AIC
## - sub_grade_C2      1 1.0014e+09 1.0239e+14 218705
## - sub_grade_A5      1 1.0404e+09 1.0239e+14 218705
## - sub_grade_C1      1 1.1385e+09 1.0239e+14 218705
## - sub_grade_B3      1 1.1974e+09 1.0239e+14 218705
## - sub_grade_B2      1 1.2550e+09 1.0239e+14 218705
## - sub_grade_B5      1 1.3321e+09 1.0239e+14 218705
## - sub_grade_B1      1 1.4006e+09 1.0239e+14 218705
## - sub_grade_A3      1 1.4334e+09 1.0239e+14 218705
## - sub_grade_B4      1 1.4338e+09 1.0239e+14 218705
## - loan_purpose_debt_consolidation      1 1.4498e+09 1.0239e+14 218705
## - sub_grade_C4      1 1.5355e+09 1.0239e+14 218705
## - sub_grade_C5      1 1.5821e+09 1.0239e+14 218705
## - sub_grade_C3      1 1.6833e+09 1.0239e+14 218705
## - sub_grade_D1      1 1.7745e+09 1.0239e+14 218705
## - sub_grade_A4      1 1.7757e+09 1.0239e+14 218705
## - sub_grade_A2      1 2.0860e+09 1.0239e+14 218705
## - sub_grade_D5      1 2.1015e+09 1.0239e+14 218705
## - sub_grade_D4      1 2.1200e+09 1.0239e+14 218705
## - sub_grade_D3      1 2.2349e+09 1.0239e+14 218705
## - loan_purpose_car      1 2.3027e+09 1.0239e+14 218705
## - loan_purpose_major_purchase      1 2.3768e+09 1.0239e+14 218705
## - sub_grade_A1      1 2.4081e+09 1.0239e+14 218705
## - sub_grade_D2      1 2.6420e+09 1.0239e+14 218705
## - sub_grade_E2      1 2.9073e+09 1.0239e+14 218705
## - loan_purpose_home_improvement      1 2.9925e+09 1.0239e+14 218705
## - sub_grade_F2      1 3.0370e+09 1.0239e+14 218705
## - loan_status_Current      1 3.2472e+09 1.0239e+14 218705
## - sub_grade_E3      1 3.3353e+09 1.0239e+14 218705
## - sub_grade_E5      1 3.5170e+09 1.0239e+14 218705
## - interest_rate      1 4.9431e+09 1.0239e+14 218705
## - sub_grade_E4      1 5.5137e+09 1.0239e+14 218705
## - sub_grade_E1      1 6.1582e+09 1.0239e+14 218705
## - sub_grade_F1      1 6.7651e+09 1.0239e+14 218705
## - sub_grade_G1      1 8.1565e+09 1.0239e+14 218705
## - tax_liens      1 9.3543e+09 1.0239e+14 218706
## - loan_purpose_moving      1 1.1068e+10 1.0240e+14 218706
## - sub_grade_F5      1 1.1444e+10 1.0240e+14 218706
## - loan_purpose_renewable_energy      1 1.2028e+10 1.0240e+14 218706
## - loan_purpose_medical      1 1.2280e+10 1.0240e+14 218706
## - sub_grade_F4      1 1.2326e+10 1.0240e+14 218706
## - sub_grade_F3      1 1.3118e+10 1.0240e+14 218706
## - `loan_status_Fully Paid`      1 1.3537e+10 1.0240e+14 218706
## - loan_purpose_credit_card      1 1.4868e+10 1.0240e+14 218706
## - loan_purpose_small_business      1 1.5445e+10 1.0240e+14 218706
## <none>      1.0238e+14 218707
## - `loan_status_Late (16-30 days)`      1 3.0658e+10 1.0242e+14 218708
## + loan_purpose_house      1 3.3045e+08 1.0238e+14 218709
## + loan_purpose_other      1 2.2510e+08 1.0238e+14 218709

```

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## + `loan_status_In Grace Period`      1 7.9104e+07 1.0238e+14 218709
## + `loan_status_Late (31-120 days)`    1 7.9104e+07 1.0238e+14 218709
## + loan_purpose_vacation                 1 1.3930e+06 1.0238e+14 218709
## - `loan_status_Charged Off`          1 5.7305e+10 1.0244e+14 218710
## - loan_amount                        1 6.4711e+10 1.0245e+14 218711
## - delinq_2y                          1 3.0872e+11 1.0269e+14 218733
## - term                               1 4.2793e+11 1.0281e+14 218744
## - `verified_income_Source Verified`   1 7.3506e+11 1.0312e+14 218772
## - `verified_income_Not Verified`      1 9.3618e+11 1.0332e+14 218791
## - homeownership_OWEN                 1 2.4894e+12 1.0487e+14 218932
## - annual_income                      1 1.0865e+13 1.1325e+14 219659
## - total_credit_utilized               1 1.8815e+13 1.2120e+14 220301
## - homeownership_MORTGAGE              1 3.5770e+13 1.3815e+14 221540
##
## Step: AIC=218704.8
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_A5 + sub_grade_B1 +
##   sub_grade_B2 + sub_grade_B3 + sub_grade_B4 + sub_grade_B5 +
##   sub_grade_C1 + sub_grade_C3 + sub_grade_C4 + sub_grade_C5 +
##   sub_grade_D1 + sub_grade_D2 + sub_grade_D3 + sub_grade_D4 +
##   sub_grade_D5 + sub_grade_E1 + sub_grade_E2 + sub_grade_E3 +
##   sub_grade_E4 + sub_grade_E5 + sub_grade_F1 + sub_grade_F2 +
##   sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
##   homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
##   loan_status_Current + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_car + loan_purpose_credit_card + loan_purpose_debt_consolidation +
##   loan_purpose_home_improvement + loan_purpose_major_purchase +
##   loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
##   loan_purpose_small_business
##
##           Df Sum of Sq      RSS      AIC
## - sub_grade_A5      1 4.2235e+07 1.0239e+14 218703
## - sub_grade_B3      1 1.0804e+09 1.0239e+14 218703
## - sub_grade_B2      1 1.4437e+09 1.0239e+14 218703
## - loan_purpose_debt_consolidation 1 1.5330e+09 1.0239e+14 218703
## - sub_grade_A3      1 1.5351e+09 1.0239e+14 218703
## - sub_grade_C1      1 1.7102e+09 1.0239e+14 218703
## - sub_grade_F2      1 2.2683e+09 1.0239e+14 218703
## - loan_purpose_major_purchase 1 2.3215e+09 1.0239e+14 218703
## - loan_purpose_car     1 2.3310e+09 1.0239e+14 218703
## - sub_grade_B1      1 2.7379e+09 1.0239e+14 218703
## - loan_purpose_home_improvement 1 3.0728e+09 1.0239e+14 218703
## - sub_grade_D5      1 3.0834e+09 1.0239e+14 218703
## - loan_status_Current 1 3.2414e+09 1.0239e+14 218703
## - sub_grade_E2      1 4.1662e+09 1.0239e+14 218703
## - sub_grade_E5      1 4.3195e+09 1.0239e+14 218703
## - sub_grade_D4      1 4.6123e+09 1.0239e+14 218703
## - sub_grade_A4      1 4.7621e+09 1.0239e+14 218703
## - sub_grade_E3      1 4.8576e+09 1.0239e+14 218703
## - sub_grade_B4      1 5.7439e+09 1.0239e+14 218703

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## - sub_grade_B5      1 6.3394e+09 1.0239e+14 218703
## - sub_grade_A2      1 6.3482e+09 1.0239e+14 218703
## - sub_grade_D1      1 7.2323e+09 1.0239e+14 218703
## - sub_grade_D3      1 7.3234e+09 1.0239e+14 218703
## - sub_grade_A1      1 8.3827e+09 1.0239e+14 218704
## - sub_grade_C5      1 8.8432e+09 1.0239e+14 218704
## - tax_liens         1 9.3058e+09 1.0239e+14 218704
## - sub_grade_F1      1 9.4531e+09 1.0239e+14 218704
## - sub_grade_G1      1 9.7735e+09 1.0240e+14 218704
## - sub_grade_E4      1 1.0280e+10 1.0240e+14 218704
## - loan_purpose_moving 1 1.1017e+10 1.0240e+14 218704
## - loan_purpose_renewable_energy 1 1.1978e+10 1.0240e+14 218704
## - loan_purpose_medical 1 1.2375e+10 1.0240e+14 218704
## - `loan_status_Fully Paid` 1 1.3528e+10 1.0240e+14 218704
## - sub_grade_F5      1 1.3761e+10 1.0240e+14 218704
## - sub_grade_C4      1 1.4089e+10 1.0240e+14 218704
## - interest_rate     1 1.4248e+10 1.0240e+14 218704
## - loan_purpose_credit_card 1 1.4692e+10 1.0240e+14 218704
## - loan_purpose_small_business 1 1.5350e+10 1.0240e+14 218704
## - sub_grade_F4      1 1.5664e+10 1.0240e+14 218704
## - sub_grade_D2      1 1.6614e+10 1.0240e+14 218704
## - sub_grade_F3      1 1.8445e+10 1.0240e+14 218705
## - sub_grade_E1      1 1.9264e+10 1.0240e+14 218705
## <none>              1.0239e+14 218705
## - `loan_status_Late (16-30 days)` 1 2.9773e+10 1.0242e+14 218706
## - sub_grade_C3      1 3.6927e+10 1.0242e+14 218706
## + sub_grade_C2      1 1.0014e+09 1.0238e+14 218707
## + sub_grade_G4      1 1.0014e+09 1.0238e+14 218707
## + loan_purpose_house   1 2.6762e+08 1.0239e+14 218707
## + loan_purpose_other   1 1.8876e+08 1.0239e+14 218707
## + `loan_status_In Grace Period` 1 8.0121e+07 1.0239e+14 218707
## + `loan_status_Late (31-120 days)` 1 8.0121e+07 1.0239e+14 218707
## + loan_purpose_vacation 1 4.6063e+05 1.0239e+14 218707
## - `loan_status_Charged Off` 1 5.7251e+10 1.0244e+14 218708
## - loan_amount        1 6.4222e+10 1.0245e+14 218709
## - delinq_2y          1 3.0864e+11 1.0269e+14 218731
## - term               1 4.2959e+11 1.0281e+14 218742
## - `verified_income_Source Verified` 1 7.3480e+11 1.0312e+14 218770
## - `verified_income_Not Verified` 1 9.3668e+11 1.0332e+14 218789
## - homeownership_OWEN 1 2.4907e+12 1.0488e+14 218930
## - annual_income      1 1.0866e+13 1.1325e+14 219657
## - total_credit_utilized 1 1.8816e+13 1.2120e+14 220299
## - homeownership_MORTGAGE 1 3.5769e+13 1.3815e+14 221538
##
## Step: AIC=218702.8
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B2 +
## sub_grade_B3 + sub_grade_B4 + sub_grade_B5 + sub_grade_C1 +
## sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
## sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +

```



```
## sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
## sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
## sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
## homeownership_OWEN + `loan_status_Charged Off` + loan_status_Current +
## `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
## loan_purpose_car + loan_purpose_credit_card + loan_purpose_debt_consolidation +
## loan_purpose_home_improvement + loan_purpose_major_purchase +
## loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
## loan_purpose_small_business
```

	Df	Sum of Sq	RSS	AIC
## - loan_purpose_debt_consolidation	1	1.5307e+09	1.0239e+14	218701
## - sub_grade_C1	1	2.2948e+09	1.0239e+14	218701
## - loan_purpose_major_purchase	1	2.3176e+09	1.0239e+14	218701
## - loan_purpose_car	1	2.3267e+09	1.0239e+14	218701
## - loan_purpose_home_improvement	1	3.0721e+09	1.0239e+14	218701
## - loan_status_Current	1	3.2436e+09	1.0239e+14	218701
## - sub_grade_B3	1	4.4546e+09	1.0239e+14	218701
## - sub_grade_B2	1	8.2513e+09	1.0239e+14	218702
## - sub_grade_F2	1	8.3840e+09	1.0239e+14	218702
## - tax_liens	1	9.3018e+09	1.0239e+14	218702
## - loan_purpose_moving	1	1.1020e+10	1.0240e+14	218702
## - loan_purpose_renewable_energy	1	1.1969e+10	1.0240e+14	218702
## - loan_purpose_medical	1	1.2383e+10	1.0240e+14	218702
## - `loan_status_Fully Paid`	1	1.3530e+10	1.0240e+14	218702
## - sub_grade_B5	1	1.4612e+10	1.0240e+14	218702
## - sub_grade_A3	1	1.4688e+10	1.0240e+14	218702
## - loan_purpose_credit_card	1	1.4704e+10	1.0240e+14	218702
## - loan_purpose_small_business	1	1.5357e+10	1.0240e+14	218702
## - sub_grade_C5	1	1.9822e+10	1.0241e+14	218703
## - sub_grade_D5	1	2.0449e+10	1.0241e+14	218703
## - sub_grade_B1	1	2.0473e+10	1.0241e+14	218703
## - sub_grade_C4	1	2.0758e+10	1.0241e+14	218703
## <none>			1.0239e+14	218703
## - sub_grade_E2	1	2.1731e+10	1.0241e+14	218703
## - sub_grade_D1	1	2.2391e+10	1.0241e+14	218703
## - sub_grade_D4	1	2.4062e+10	1.0241e+14	218703
## - sub_grade_B4	1	2.4698e+10	1.0241e+14	218703
## - `loan_status_Late (16-30 days)`	1	3.0233e+10	1.0242e+14	218704
## - sub_grade_E3	1	3.0540e+10	1.0242e+14	218704
## - sub_grade_E5	1	3.1979e+10	1.0242e+14	218704
## - sub_grade_F5	1	3.3583e+10	1.0242e+14	218704
## - sub_grade_D3	1	3.4325e+10	1.0242e+14	218704
## - sub_grade_C3	1	3.7924e+10	1.0242e+14	218704
## - sub_grade_G1	1	4.1052e+10	1.0243e+14	218705
## - sub_grade_F4	1	4.2689e+10	1.0243e+14	218705
## + sub_grade_G4	1	4.2306e+08	1.0238e+14	218705
## + loan_purpose_house	1	2.7896e+08	1.0239e+14	218705
## + loan_purpose_other	1	1.9740e+08	1.0239e+14	218705
## + `loan_status_In Grace Period`	1	8.0524e+07	1.0239e+14	218705
## + `loan_status_Late (31-120 days)`	1	8.0524e+07	1.0239e+14	218705
## + sub_grade_A5	1	4.2235e+07	1.0239e+14	218705

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## + sub_grade_C2          1 3.2821e+06 1.0239e+14 218705
## + loan_purpose_vacation    1 4.3917e+05 1.0239e+14 218705
## - sub_grade_A4          1 5.2589e+10 1.0244e+14 218706
## - sub_grade_F1          1 5.3869e+10 1.0244e+14 218706
## - `loan_status_Charged Off` 1 5.7251e+10 1.0244e+14 218706
## - sub_grade_F3          1 6.1610e+10 1.0245e+14 218707
## - sub_grade_D2          1 6.2681e+10 1.0245e+14 218707
## - loan_amount           1 6.4230e+10 1.0245e+14 218707
## - sub_grade_E4          1 6.6023e+10 1.0245e+14 218707
## - sub_grade_E1          1 7.3797e+10 1.0246e+14 218708
## - sub_grade_A2          1 7.5099e+10 1.0246e+14 218708
## - sub_grade_A1          1 9.9516e+10 1.0248e+14 218710
## - interest_rate         1 1.9165e+11 1.0258e+14 218719
## - delinq_2y             1 3.0860e+11 1.0269e+14 218729
## - term                  1 4.2974e+11 1.0282e+14 218740
## - `verified_income_Source Verified` 1 7.3505e+11 1.0312e+14 218768
## - `verified_income_Not Verified` 1 9.3675e+11 1.0332e+14 218787
## - homeownership_OWEN    1 2.4913e+12 1.0488e+14 218928
## - annual_income         1 1.0867e+13 1.1325e+14 219655
## - total_credit_utilized  1 1.8819e+13 1.2120e+14 220297
## - homeownership_MORTGAGE 1 3.5778e+13 1.3816e+14 221536
##
## Step: AIC=218701
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B2 +
##   sub_grade_B3 + sub_grade_B4 + sub_grade_B5 + sub_grade_C1 +
##   sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
##   sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
##   sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##   sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
##   sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##   homeownership_OWEN + `loan_status_Charged Off` + loan_status_Current +
##   `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_car + loan_purpose_credit_card + loan_purpose_home_improvement +
##   loan_purpose_major_purchase + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##
##      Df Sum of Sq      RSS      AIC
## - loan_purpose_car          1 1.4868e+09 1.0239e+14 218699
## - loan_purpose_home_improvement 1 1.6500e+09 1.0239e+14 218699
## - sub_grade_C1           1 2.3064e+09 1.0239e+14 218699
## - loan_status_Current     1 3.3148e+09 1.0239e+14 218699
## - sub_grade_B3            1 4.4385e+09 1.0239e+14 218699
## - loan_purpose_major_purchase 1 4.9159e+09 1.0239e+14 218699
## - sub_grade_B2            1 8.0709e+09 1.0239e+14 218700
## - sub_grade_F2            1 8.4283e+09 1.0240e+14 218700
## - tax_liens               1 9.2843e+09 1.0240e+14 218700
## - loan_purpose_medical       1 1.0873e+10 1.0240e+14 218700
## - loan_purpose_renewable_energy 1 1.2755e+10 1.0240e+14 218700
## - loan_purpose_moving        1 1.3438e+10 1.0240e+14 218700

```

```

## - `loan_status_Fully Paid`      1 1.3517e+10 1.0240e+14 218700
## - sub_grade_A3                  1 1.4605e+10 1.0240e+14 218700
## - sub_grade_B5                  1 1.4643e+10 1.0240e+14 218700
## - sub_grade_C5                  1 1.9954e+10 1.0241e+14 218701
## - loan_purpose_small_business     1 2.0009e+10 1.0241e+14 218701
## - sub_grade_B1                  1 2.0294e+10 1.0241e+14 218701
## - sub_grade_D5                  1 2.0514e+10 1.0241e+14 218701
## - sub_grade_C4                  1 2.0828e+10 1.0241e+14 218701
## <none>                          1.0239e+14 218701
## - sub_grade_E2                  1 2.1778e+10 1.0241e+14 218701
## - sub_grade_D1                  1 2.2589e+10 1.0241e+14 218701
## - sub_grade_D4                  1 2.4202e+10 1.0241e+14 218701
## - sub_grade_B4                  1 2.4679e+10 1.0241e+14 218701
## - `loan_status_Late (16-30 days)` 1 3.0225e+10 1.0242e+14 218702
## - sub_grade_E3                  1 3.0597e+10 1.0242e+14 218702
## - sub_grade_E5                  1 3.2157e+10 1.0242e+14 218702
## - sub_grade_F5                  1 3.3723e+10 1.0242e+14 218702
## - sub_grade_D3                  1 3.4464e+10 1.0242e+14 218702
## - sub_grade_C3                  1 3.8197e+10 1.0243e+14 218702
## - sub_grade_G1                  1 4.1264e+10 1.0243e+14 218703
## + loan_purpose_other               1 1.6889e+09 1.0239e+14 218703
## + loan_purpose_debt_consolidation 1 1.5307e+09 1.0239e+14 218703
## + sub_grade_G4                  1 4.7037e+08 1.0239e+14 218703
## - sub_grade_F4                  1 4.2940e+10 1.0243e+14 218703
## + `loan_status_In Grace Period`  1 8.3448e+07 1.0239e+14 218703
## + `loan_status_Late (31-120 days)` 1 8.3448e+07 1.0239e+14 218703
## + loan_purpose_vacation           1 7.7715e+07 1.0239e+14 218703
## + sub_grade_A5                  1 3.9942e+07 1.0239e+14 218703
## + loan_purpose_house              1 6.7604e+06 1.0239e+14 218703
## + sub_grade_C2                  1 2.0857e+06 1.0239e+14 218703
## - loan_purpose_credit_card        1 4.9482e+10 1.0244e+14 218704
## - sub_grade_A4                  1 5.2347e+10 1.0244e+14 218704
## - sub_grade_F1                  1 5.4042e+10 1.0244e+14 218704
## - `loan_status_Charged Off`      1 5.7030e+10 1.0244e+14 218704
## - sub_grade_F3                  1 6.1903e+10 1.0245e+14 218705
## - sub_grade_D2                  1 6.2643e+10 1.0245e+14 218705
## - sub_grade_E4                  1 6.6352e+10 1.0245e+14 218705
## - loan_amount                   1 6.7526e+10 1.0245e+14 218705
## - sub_grade_E1                  1 7.4086e+10 1.0246e+14 218706
## - sub_grade_A2                  1 7.4735e+10 1.0246e+14 218706
## - sub_grade_A1                  1 9.9322e+10 1.0249e+14 218708
## - interest_rate                 1 1.9183e+11 1.0258e+14 218717
## - delinq_2y                     1 3.0898e+11 1.0270e+14 218727
## - term                          1 4.2964e+11 1.0282e+14 218739
## - `verified_income_Source Verified` 1 7.3423e+11 1.0312e+14 218767
## - `verified_income_Not Verified`  1 9.3602e+11 1.0332e+14 218785
## - homeownership_OWEN            1 2.4899e+12 1.0488e+14 218926
## - annual_income                 1 1.0869e+13 1.1326e+14 219653
## - total_credit_utilized          1 1.8857e+13 1.2124e+14 220298
## - homeownership_MORTGAGE        1 3.5861e+13 1.3825e+14 221540
##
## Step: AIC=218699.1

```

```

## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B2 +
##   sub_grade_B3 + sub_grade_B4 + sub_grade_B5 + sub_grade_C1 +
##   sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
##   sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
##   sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##   sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
##   sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##   homeownership_OWN + `loan_status_Charged Off` + loan_status_Current +
##   `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_home_improvement +
##   loan_purpose_major_purchase + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##
##      Df  Sum of Sq      RSS   AIC
## - loan_purpose_home_improvement    1 1.5209e+09 1.0239e+14 218697
## - sub_grade_C1                    1 2.2980e+09 1.0239e+14 218697
## - loan_status_Current              1 3.2533e+09 1.0239e+14 218697
## - sub_grade_B3                    1 4.4837e+09 1.0239e+14 218698
## - loan_purpose_major_purchase        1 5.1066e+09 1.0239e+14 218698
## - sub_grade_B2                    1 8.1210e+09 1.0240e+14 218698
## - sub_grade_F2                    1 8.3680e+09 1.0240e+14 218698
## - tax_liens                      1 9.2544e+09 1.0240e+14 218698
## - loan_purpose_medical              1 1.0653e+10 1.0240e+14 218698
## - loan_purpose_renewable_energy      1 1.2819e+10 1.0240e+14 218698
## - `loan_status_Fully Paid`        1 1.3407e+10 1.0240e+14 218698
## - loan_purpose_moving               1 1.3627e+10 1.0240e+14 218698
## - sub_grade_B5                    1 1.4505e+10 1.0240e+14 218698
## - sub_grade_A3                    1 1.4704e+10 1.0240e+14 218698
## - sub_grade_C5                    1 1.9944e+10 1.0241e+14 218699
## - loan_purpose_small_business        1 2.0229e+10 1.0241e+14 218699
## - sub_grade_B1                    1 2.0295e+10 1.0241e+14 218699
## - sub_grade_D5                    1 2.0396e+10 1.0241e+14 218699
## - sub_grade_C4                    1 2.0643e+10 1.0241e+14 218699
## <none>                            1.0239e+14 218699
## - sub_grade_E2                    1 2.1728e+10 1.0241e+14 218699
## - sub_grade_D1                    1 2.2420e+10 1.0241e+14 218699
## - sub_grade_D4                    1 2.4134e+10 1.0241e+14 218699
## - sub_grade_B4                    1 2.4718e+10 1.0241e+14 218699
## - `loan_status_Late (16-30 days)` 1 3.0221e+10 1.0242e+14 218700
## - sub_grade_E3                    1 3.0505e+10 1.0242e+14 218700
## - sub_grade_E5                    1 3.2105e+10 1.0242e+14 218700
## - sub_grade_F5                    1 3.3634e+10 1.0242e+14 218700
## - sub_grade_D3                    1 3.4261e+10 1.0242e+14 218700
## - sub_grade_C3                    1 3.8225e+10 1.0243e+14 218701
## - sub_grade_G1                    1 4.1146e+10 1.0243e+14 218701
## + loan_purpose_other                1 1.9099e+09 1.0239e+14 218701
## + loan_purpose_car                  1 1.4868e+09 1.0239e+14 218701
## + loan_purpose_debt_consolidation    1 6.9080e+08 1.0239e+14 218701
## - sub_grade_F4                    1 4.2810e+10 1.0243e+14 218701

```

```

## + sub_grade_G4          1 4.7593e+08 1.0239e+14 218701
## + loan_purpose_vacation    1 9.2186e+07 1.0239e+14 218701
## + `loan_status_In Grace Period` 1 8.7602e+07 1.0239e+14 218701
## + `loan_status_Late (31-120 days)` 1 8.7602e+07 1.0239e+14 218701
## + sub_grade_A5          1 3.7123e+07 1.0239e+14 218701
## + loan_purpose_house       1 2.8827e+06 1.0239e+14 218701
## + sub_grade_C2          1 1.4940e+06 1.0239e+14 218701
## - loan_purpose_credit_card 1 5.1186e+10 1.0244e+14 218702
## - sub_grade_A4          1 5.2479e+10 1.0244e+14 218702
## - sub_grade_F1          1 5.3852e+10 1.0244e+14 218702
## - `loan_status_Charged Off` 1 5.6914e+10 1.0245e+14 218702
## - sub_grade_F3          1 6.1745e+10 1.0245e+14 218703
## - sub_grade_D2          1 6.2289e+10 1.0245e+14 218703
## - sub_grade_E4          1 6.6225e+10 1.0245e+14 218703
## - loan_amount           1 6.6536e+10 1.0245e+14 218703
## - sub_grade_E1          1 7.3813e+10 1.0246e+14 218704
## - sub_grade_A2          1 7.5070e+10 1.0246e+14 218704
## - sub_grade_A1          1 9.9372e+10 1.0249e+14 218706
## - interest_rate         1 1.9154e+11 1.0258e+14 218715
## - delinq_2y             1 3.0900e+11 1.0270e+14 218726
## - term                  1 4.3004e+11 1.0282e+14 218737
## - `verified_income_Source Verified` 1 7.3326e+11 1.0312e+14 218765
## - `verified_income_Not Verified` 1 9.3545e+11 1.0332e+14 218783
## - homeownership_OWEN    1 2.4895e+12 1.0488e+14 218924
## - annual_income         1 1.0870e+13 1.1326e+14 219652
## - total_credit_utilized  1 1.8857e+13 1.2125e+14 220296
## - homeownership_MORTGAGE 1 3.5861e+13 1.3825e+14 221538
##
## Step: AIC=218697.2
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B2 +
## sub_grade_B3 + sub_grade_B4 + sub_grade_B5 + sub_grade_C1 +
## sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
## sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
## sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
## sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
## sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
## homeownership_OWEN + `loan_status_Charged Off` + loan_status_Current +
## `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
## loan_purpose_credit_card + loan_purpose_major_purchase +
## loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
## loan_purpose_small_business
##
## Df Sum of Sq RSS AIC
## - sub_grade_C1          1 2.3339e+09 1.0239e+14 218695
## - loan_status_Current    1 3.1783e+09 1.0239e+14 218696
## - sub_grade_B3          1 4.4327e+09 1.0239e+14 218696
## - loan_purpose_major_purchase 1 5.4663e+09 1.0240e+14 218696
## - sub_grade_B2          1 8.2180e+09 1.0240e+14 218696
## - sub_grade_F2          1 8.3142e+09 1.0240e+14 218696

```

## - tax_liens	1	9.3072e+09	1.0240e+14	218696
## - loan_purpose_medical	1	1.0285e+10	1.0240e+14	218696
## - loan_purpose_renewable_energy	1	1.2916e+10	1.0240e+14	218696
## - `loan_status_Fully Paid`	1	1.3277e+10	1.0240e+14	218696
## - loan_purpose_moving	1	1.3863e+10	1.0240e+14	218697
## - sub_grade_B5	1	1.4592e+10	1.0240e+14	218697
## - sub_grade_A3	1	1.4847e+10	1.0240e+14	218697
## - sub_grade_C5	1	1.9955e+10	1.0241e+14	218697
## - sub_grade_D5	1	2.0325e+10	1.0241e+14	218697
## - sub_grade_C4	1	2.0628e+10	1.0241e+14	218697
## - sub_grade_B1	1	2.0655e+10	1.0241e+14	218697
## - loan_purpose_small_business	1	2.0687e+10	1.0241e+14	218697
## <none>			1.0239e+14	218697
## - sub_grade_E2	1	2.1730e+10	1.0241e+14	218697
## - sub_grade_D1	1	2.2570e+10	1.0241e+14	218697
## - sub_grade_D4	1	2.4071e+10	1.0241e+14	218697
## - sub_grade_B4	1	2.4810e+10	1.0241e+14	218698
## - `loan_status_Late (16-30 days)`	1	3.0029e+10	1.0242e+14	218698
## - sub_grade_E3	1	3.0643e+10	1.0242e+14	218698
## - sub_grade_E5	1	3.2122e+10	1.0242e+14	218698
## - sub_grade_F5	1	3.3598e+10	1.0242e+14	218698
## - sub_grade_D3	1	3.4193e+10	1.0242e+14	218698
## - sub_grade_C3	1	3.8325e+10	1.0243e+14	218699
## + loan_purpose_other	1	2.3035e+09	1.0239e+14	218699
## - sub_grade_G1	1	4.1088e+10	1.0243e+14	218699
## + loan_purpose_home_improvement	1	1.5209e+09	1.0239e+14	218699
## + loan_purpose_car	1	1.3577e+09	1.0239e+14	218699
## - sub_grade_F4	1	4.2707e+10	1.0243e+14	218699
## + sub_grade_G4	1	4.8055e+08	1.0239e+14	218699
## + loan_purpose_vacation	1	1.1452e+08	1.0239e+14	218699
## + `loan_status_In Grace Period`	1	8.2506e+07	1.0239e+14	218699
## + `loan_status_Late (31-120 days)`	1	8.2506e+07	1.0239e+14	218699
## + sub_grade_A5	1	3.8129e+07	1.0239e+14	218699
## + loan_purpose_debt_consolidation	1	3.6555e+06	1.0239e+14	218699
## + sub_grade_C2	1	1.6231e+06	1.0239e+14	218699
## + loan_purpose_house	1	1.8779e+05	1.0239e+14	218699
## - sub_grade_A4	1	5.2581e+10	1.0244e+14	218700
## - sub_grade_F1	1	5.3875e+10	1.0244e+14	218700
## - loan_purpose_credit_card	1	5.5092e+10	1.0245e+14	218700
## - `loan_status_Charged Off`	1	5.7264e+10	1.0245e+14	218701
## - sub_grade_F3	1	6.1579e+10	1.0245e+14	218701
## - sub_grade_D2	1	6.2456e+10	1.0245e+14	218701
## - loan_amount	1	6.6035e+10	1.0246e+14	218701
## - sub_grade_E4	1	6.6284e+10	1.0246e+14	218701
## - sub_grade_E1	1	7.3723e+10	1.0246e+14	218702
## - sub_grade_A2	1	7.5366e+10	1.0247e+14	218702
## - sub_grade_A1	1	9.9635e+10	1.0249e+14	218704
## - interest_rate	1	1.9163e+11	1.0258e+14	218713
## - delinq_2y	1	3.1108e+11	1.0270e+14	218724
## - term	1	4.3081e+11	1.0282e+14	218735
## - `verified_income_Source Verified`	1	7.3390e+11	1.0312e+14	218763
## - `verified_income_Not Verified`	1	9.3532e+11	1.0333e+14	218781

```

## - homeownership_OWn          1 2.5124e+12 1.0490e+14 218925
## - annual_income              1 1.0890e+13 1.1328e+14 219652
## - total_credit_utilized      1 1.8859e+13 1.2125e+14 220295
## - homeownership_MORTGAGE     1 3.6664e+13 1.3905e+14 221591
##
## Step: AIC=218695.5
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B2 +
##   sub_grade_B3 + sub_grade_B4 + sub_grade_B5 + sub_grade_C3 +
##   sub_grade_C4 + sub_grade_C5 + sub_grade_D1 + sub_grade_D2 +
##   sub_grade_D3 + sub_grade_D4 + sub_grade_D5 + sub_grade_E1 +
##   sub_grade_E2 + sub_grade_E3 + sub_grade_E4 + sub_grade_E5 +
##   sub_grade_F1 + sub_grade_F2 + sub_grade_F3 + sub_grade_F4 +
##   sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWn +
##   `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
##   `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
##   loan_purpose_major_purchase + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##
##           Df Sum of Sq      RSS      AIC
## - sub_grade_B3          1 3.0056e+09 1.0240e+14 218694
## - loan_status_Current   1 3.2229e+09 1.0240e+14 218694
## - loan_purpose_major_purchase 1 5.4868e+09 1.0240e+14 218694
## - sub_grade_B2          1 6.4700e+09 1.0240e+14 218694
## - sub_grade_F2          1 6.9606e+09 1.0240e+14 218694
## - tax_liens             1 9.3134e+09 1.0240e+14 218694
## - loan_purpose_medical     1 1.0395e+10 1.0240e+14 218694
## - sub_grade_B5          1 1.2258e+10 1.0240e+14 218695
## - loan_purpose_renewable_energy 1 1.2806e+10 1.0241e+14 218695
## - `loan_status_Fully Paid` 1 1.3304e+10 1.0241e+14 218695
## - loan_purpose_moving      1 1.3791e+10 1.0241e+14 218695
## - sub_grade_A3          1 1.4243e+10 1.0241e+14 218695
## - sub_grade_C5          1 1.7863e+10 1.0241e+14 218695
## - sub_grade_D5          1 1.8055e+10 1.0241e+14 218695
## - sub_grade_B1          1 1.8519e+10 1.0241e+14 218695
## - sub_grade_C4          1 1.8598e+10 1.0241e+14 218695
## - sub_grade_E2          1 1.9414e+10 1.0241e+14 218695
## - sub_grade_D1          1 2.0446e+10 1.0241e+14 218695
## - loan_purpose_small_business 1 2.0709e+10 1.0241e+14 218695
## <none>                    1.0239e+14 218695
## - sub_grade_D4          1 2.1898e+10 1.0241e+14 218695
## - sub_grade_B4          1 2.2496e+10 1.0241e+14 218696
## - sub_grade_E3          1 2.8404e+10 1.0242e+14 218696
## - `loan_status_Late (16-30 days)` 1 2.9722e+10 1.0242e+14 218696
## - sub_grade_E5          1 2.9966e+10 1.0242e+14 218696
## - sub_grade_F5          1 3.1726e+10 1.0242e+14 218696
## - sub_grade_D3          1 3.2705e+10 1.0242e+14 218696
## - sub_grade_C3          1 3.7705e+10 1.0243e+14 218697
## - sub_grade_G1          1 3.8765e+10 1.0243e+14 218697
## - sub_grade_F4          1 4.0584e+10 1.0243e+14 218697

```

```

## + sub_grade_C1          1 2.3339e+09 1.0239e+14 218697
## + loan_purpose_other      1 2.3093e+09 1.0239e+14 218697
## + sub_grade_C2          1 2.1125e+09 1.0239e+14 218697
## + loan_purpose_home_improvement 1 1.5568e+09 1.0239e+14 218697
## + loan_purpose_car        1 1.3481e+09 1.0239e+14 218697
## + sub_grade_G4          1 6.6263e+08 1.0239e+14 218697
## + sub_grade_A5          1 6.5255e+08 1.0239e+14 218697
## + loan_purpose_vacation    1 1.1472e+08 1.0239e+14 218697
## + `loan_status_In Grace Period` 1 7.3467e+07 1.0239e+14 218697
## + `loan_status_Late (31-120 days)` 1 7.3467e+07 1.0239e+14 218697
## + loan_purpose_debt_consolidation 1 3.3098e+06 1.0239e+14 218697
## + loan_purpose_house      1 6.2840e+05 1.0239e+14 218697
## - sub_grade_A4          1 5.0978e+10 1.0244e+14 218698
## - sub_grade_F1          1 5.1867e+10 1.0244e+14 218698
## - loan_purpose_credit_card 1 5.5559e+10 1.0245e+14 218699
## - `loan_status_Charged Off` 1 5.7251e+10 1.0245e+14 218699
## - sub_grade_F3          1 5.9245e+10 1.0245e+14 218699
## - sub_grade_D2          1 6.3626e+10 1.0246e+14 218699
## - sub_grade_E4          1 6.5467e+10 1.0246e+14 218699
## - loan_amount           1 6.6468e+10 1.0246e+14 218700
## - sub_grade_E1          1 7.2076e+10 1.0246e+14 218700
## - sub_grade_A2          1 7.4723e+10 1.0247e+14 218700
## - sub_grade_A1          1 9.9760e+10 1.0249e+14 218703
## - interest_rate         1 1.9644e+11 1.0259e+14 218712
## - delinq_2y             1 3.1135e+11 1.0270e+14 218722
## - term                   1 4.3450e+11 1.0283e+14 218734
## - `verified_income_Source Verified` 1 7.3355e+11 1.0313e+14 218761
## - `verified_income_Not Verified` 1 9.3404e+11 1.0333e+14 218779
## - homeownership_OWEN    1 2.5171e+12 1.0491e+14 218923
## - annual_income         1 1.0896e+13 1.1329e+14 219650
## - total_credit_utilized  1 1.8857e+13 1.2125e+14 220293
## - homeownership_MORTGAGE 1 3.6672e+13 1.3906e+14 221590
##
## Step: AIC=218693.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B2 +
## sub_grade_B4 + sub_grade_B5 + sub_grade_C3 + sub_grade_C4 +
## sub_grade_C5 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
## sub_grade_D4 + sub_grade_D5 + sub_grade_E1 + sub_grade_E2 +
## sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
## sub_grade_F2 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
## sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
## `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
## `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
## loan_purpose_major_purchase + loan_purpose_medical + loan_purpose_moving +
## loan_purpose_renewable_energy + loan_purpose_small_business
##
##
## Df Sum of Sq RSS AIC
## - loan_status_Current 1 3.3286e+09 1.0240e+14 218692
## - sub_grade_B2 1 4.4213e+09 1.0240e+14 218692

```


## - loan_purpose_major_purchase	1	5.4371e+09	1.0240e+14	218692
## - sub_grade_F2	1	7.7605e+09	1.0240e+14	218692
## - tax_liens	1	9.3444e+09	1.0240e+14	218693
## - sub_grade_B5	1	1.0149e+10	1.0241e+14	218693
## - loan_purpose_medical	1	1.0224e+10	1.0241e+14	218693
## - sub_grade_A3	1	1.1506e+10	1.0241e+14	218693
## - loan_purpose_renewable_energy	1	1.2844e+10	1.0241e+14	218693
## - `loan_status_Fully Paid`	1	1.3471e+10	1.0241e+14	218693
## - loan_purpose_moving	1	1.3873e+10	1.0241e+14	218693
## - sub_grade_B1	1	1.5626e+10	1.0241e+14	218693
## - sub_grade_C5	1	1.7576e+10	1.0241e+14	218693
## - sub_grade_C4	1	1.7780e+10	1.0241e+14	218693
## - sub_grade_B4	1	1.9682e+10	1.0241e+14	218694
## - sub_grade_D5	1	1.9735e+10	1.0242e+14	218694
## - sub_grade_D1	1	2.0747e+10	1.0242e+14	218694
## - loan_purpose_small_business	1	2.0938e+10	1.0242e+14	218694
## - sub_grade_E2	1	2.1061e+10	1.0242e+14	218694
## <none>			1.0240e+14	218694
## - sub_grade_D4	1	2.3276e+10	1.0242e+14	218694
## - `loan_status_Late (16-30 days)`	1	2.9919e+10	1.0243e+14	218694
## - sub_grade_E3	1	3.0877e+10	1.0243e+14	218695
## - sub_grade_E5	1	3.2986e+10	1.0243e+14	218695
## - sub_grade_F5	1	3.3128e+10	1.0243e+14	218695
## - sub_grade_D3	1	3.4094e+10	1.0243e+14	218695
## - sub_grade_C3	1	3.5884e+10	1.0243e+14	218695
## + sub_grade_A5	1	3.6158e+09	1.0239e+14	218695
## + sub_grade_C2	1	3.4039e+09	1.0239e+14	218695
## + sub_grade_B3	1	3.0056e+09	1.0239e+14	218695
## + loan_purpose_other	1	2.3368e+09	1.0239e+14	218696
## - sub_grade_G1	1	4.1243e+10	1.0244e+14	218696
## + loan_purpose_home_improvement	1	1.4998e+09	1.0239e+14	218696
## + loan_purpose_car	1	1.3900e+09	1.0239e+14	218696
## - sub_grade_F4	1	4.2354e+10	1.0244e+14	218696
## + sub_grade_C1	1	9.0690e+08	1.0239e+14	218696
## + sub_grade_G4	1	5.6500e+08	1.0239e+14	218696
## + loan_purpose_vacation	1	9.6360e+07	1.0240e+14	218696
## + `loan_status_In Grace Period`	1	6.9212e+07	1.0240e+14	218696
## + `loan_status_Late (31-120 days)`	1	6.9212e+07	1.0240e+14	218696
## + loan_purpose_debt_consolidation	1	3.5394e+06	1.0240e+14	218696
## + loan_purpose_house	1	4.0000e+00	1.0240e+14	218696
## - sub_grade_A4	1	4.8480e+10	1.0244e+14	218696
## - sub_grade_F1	1	5.5519e+10	1.0245e+14	218697
## - loan_purpose_credit_card	1	5.5565e+10	1.0245e+14	218697
## - `loan_status_Charged Off`	1	5.7511e+10	1.0245e+14	218697
## - sub_grade_F3	1	6.1891e+10	1.0246e+14	218697
## - sub_grade_D2	1	6.4916e+10	1.0246e+14	218698
## - loan_amount	1	6.6575e+10	1.0246e+14	218698
## - sub_grade_E4	1	6.9841e+10	1.0247e+14	218698
## - sub_grade_A2	1	7.3043e+10	1.0247e+14	218698
## - sub_grade_E1	1	7.4823e+10	1.0247e+14	218699
## - sub_grade_A1	1	9.8996e+10	1.0249e+14	218701
## - interest_rate	1	2.2008e+11	1.0262e+14	218712

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## - delinq_2y          1 3.1150e+11 1.0271e+14 218720
## - term              1 4.3453e+11 1.0283e+14 218732
## - `verified_income_Source Verified` 1 7.3388e+11 1.0313e+14 218759
## - `verified_income_Not Verified`    1 9.3373e+11 1.0333e+14 218778
## - homeownership_OWEN 1 2.5155e+12 1.0491e+14 218921
## - annual_income     1 1.0895e+13 1.1329e+14 219648
## - total_credit_utilized 1 1.8856e+13 1.2125e+14 220291
## - homeownership_MORTGAGE 1 3.6669e+13 1.3906e+14 221588
##
## Step: AIC=218692
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B2 +
##   sub_grade_B4 + sub_grade_B5 + sub_grade_C3 + sub_grade_C4 +
##   sub_grade_C5 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
##   sub_grade_D4 + sub_grade_D5 + sub_grade_E1 + sub_grade_E2 +
##   sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
##   sub_grade_F2 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
##   sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
##   `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_major_purchase +
##   loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
##   loan_purpose_small_business
##
##
##           Df Sum of Sq      RSS   AIC
## - sub_grade_B2          1 4.3395e+09 1.0240e+14 218690
## - loan_purpose_major_purchase 1 5.6548e+09 1.0240e+14 218691
## - sub_grade_F2          1 7.5822e+09 1.0241e+14 218691
## - tax_liens             1 9.2768e+09 1.0241e+14 218691
## - loan_purpose_medical     1 9.8727e+09 1.0241e+14 218691
## - sub_grade_B5          1 1.0023e+10 1.0241e+14 218691
## - sub_grade_A3          1 1.1374e+10 1.0241e+14 218691
## - loan_purpose_renewable_energy 1 1.2785e+10 1.0241e+14 218691
## - loan_purpose_moving      1 1.3895e+10 1.0241e+14 218691
## - sub_grade_B1          1 1.5815e+10 1.0241e+14 218691
## - sub_grade_C5          1 1.7659e+10 1.0242e+14 218692
## - sub_grade_C4          1 1.7808e+10 1.0242e+14 218692
## - `loan_status_Fully Paid` 1 1.8108e+10 1.0242e+14 218692
## - sub_grade_D5          1 1.9663e+10 1.0242e+14 218692
## - sub_grade_B4          1 1.9709e+10 1.0242e+14 218692
## - sub_grade_D1          1 2.0666e+10 1.0242e+14 218692
## - loan_purpose_small_business 1 2.0834e+10 1.0242e+14 218692
## - sub_grade_E2          1 2.1342e+10 1.0242e+14 218692
## <none>                    1.0240e+14 218692
## - sub_grade_D4          1 2.3424e+10 1.0242e+14 218692
## - `loan_status_Late (16-30 days)` 1 2.7205e+10 1.0243e+14 218693
## - sub_grade_E3          1 3.0954e+10 1.0243e+14 218693
## - sub_grade_F5          1 3.2429e+10 1.0243e+14 218693
## - sub_grade_E5          1 3.2559e+10 1.0243e+14 218693
## - sub_grade_D3          1 3.4207e+10 1.0243e+14 218693
## - sub_grade_C3          1 3.6061e+10 1.0243e+14 218693

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## + sub_grade_A5          1 3.7248e+09 1.0239e+14 218694
## + sub_grade_C2          1 3.4890e+09 1.0240e+14 218694
## + loan_status_Current   1 3.3286e+09 1.0240e+14 218694
## + sub_grade_B3          1 3.1113e+09 1.0240e+14 218694
## + loan_purpose_other       1 2.3223e+09 1.0240e+14 218694
## + `loan_status_Late (31-120 days)` 1 2.1504e+09 1.0240e+14 218694
## - sub_grade_G1          1 4.1538e+10 1.0244e+14 218694
## + loan_purpose_home_improvement 1 1.4229e+09 1.0240e+14 218694
## + loan_purpose_car         1 1.3337e+09 1.0240e+14 218694
## + `loan_status_In Grace Period` 1 1.2080e+09 1.0240e+14 218694
## + sub_grade_C1          1 9.1687e+08 1.0240e+14 218694
## - sub_grade_F4          1 4.2550e+10 1.0244e+14 218694
## + sub_grade_G4          1 5.5754e+08 1.0240e+14 218694
## + loan_purpose_vacation    1 8.7549e+07 1.0240e+14 218694
## + loan_purpose_debt_consolidation 1 1.1153e+07 1.0240e+14 218694
## + loan_purpose_house      1 5.6875e+06 1.0240e+14 218694
## - sub_grade_A4          1 4.8319e+10 1.0245e+14 218694
## - `loan_status_Charged Off` 1 5.4188e+10 1.0245e+14 218695
## - loan_purpose_credit_card 1 5.5216e+10 1.0245e+14 218695
## - sub_grade_F1          1 5.5270e+10 1.0245e+14 218695
## - sub_grade_F3          1 6.1375e+10 1.0246e+14 218696
## - sub_grade_D2          1 6.5062e+10 1.0246e+14 218696
## - loan_amount           1 6.5948e+10 1.0246e+14 218696
## - sub_grade_E4          1 6.9805e+10 1.0247e+14 218696
## - sub_grade_A2          1 7.3094e+10 1.0247e+14 218697
## - sub_grade_E1          1 7.5329e+10 1.0247e+14 218697
## - sub_grade_A1          1 9.9003e+10 1.0250e+14 218699
## - interest_rate         1 2.2116e+11 1.0262e+14 218710
## - delinq_2y             1 3.1173e+11 1.0271e+14 218719
## - term                  1 4.3649e+11 1.0284e+14 218730
## - `verified_income_Source Verified` 1 7.3328e+11 1.0313e+14 218758
## - `verified_income_Not Verified` 1 9.3309e+11 1.0333e+14 218776
## - homeownership_OWEN   1 2.5137e+12 1.0491e+14 218919
## - annual_income         1 1.0892e+13 1.1329e+14 219646
## - total_credit_utilized 1 1.8856e+13 1.2125e+14 220289
## - homeownership_MORTGAGE 1 3.6702e+13 1.3910e+14 221588
##
## Step: AIC=218690.4
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_B5 + sub_grade_C3 + sub_grade_C4 + sub_grade_C5 +
## sub_grade_D1 + sub_grade_D2 + sub_grade_D3 + sub_grade_D4 +
## sub_grade_D5 + sub_grade_E1 + sub_grade_E2 + sub_grade_E3 +
## sub_grade_E4 + sub_grade_E5 + sub_grade_F1 + sub_grade_F2 +
## sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
## homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
## `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
## loan_purpose_credit_card + loan_purpose_major_purchase +
## loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
## loan_purpose_small_business

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##
##
## - loan_purpose_major_purchase      1 5.7802e+09 1.0241e+14 218689
## - sub_grade_A3                   1 8.0443e+09 1.0241e+14 218689
## - sub_grade_B5                   1 8.1374e+09 1.0241e+14 218689
## - sub_grade_F2                   1 9.0046e+09 1.0241e+14 218689
## - tax_liens                      1 9.1936e+09 1.0241e+14 218689
## - loan_purpose_medical              1 1.0006e+10 1.0241e+14 218689
## - sub_grade_B1                   1 1.2267e+10 1.0242e+14 218690
## - loan_purpose_renewable_energy     1 1.2809e+10 1.0242e+14 218690
## - loan_purpose_moving              1 1.3742e+10 1.0242e+14 218690
## - sub_grade_B4                   1 1.6559e+10 1.0242e+14 218690
## - `loan_status_Fully Paid`       1 1.7874e+10 1.0242e+14 218690
## - sub_grade_C4                   1 1.8094e+10 1.0242e+14 218690
## - sub_grade_C5                   1 1.8725e+10 1.0242e+14 218690
## - loan_purpose_small_business       1 2.1068e+10 1.0242e+14 218690
## <none>                           1.0240e+14 218690
## - sub_grade_D1                   1 2.2537e+10 1.0243e+14 218691
## - sub_grade_D5                   1 2.3480e+10 1.0243e+14 218691
## - sub_grade_E2                   1 2.4746e+10 1.0243e+14 218691
## - sub_grade_D4                   1 2.6919e+10 1.0243e+14 218691
## - `loan_status_Late (16-30 days)` 1 2.7286e+10 1.0243e+14 218691
## - sub_grade_F5                   1 3.4798e+10 1.0244e+14 218692
## - sub_grade_C3                   1 3.5290e+10 1.0244e+14 218692
## + sub_grade_A5                   1 7.8768e+09 1.0240e+14 218692
## - sub_grade_E3                   1 3.5841e+10 1.0244e+14 218692
## - sub_grade_D3                   1 3.8181e+10 1.0244e+14 218692
## - sub_grade_E5                   1 3.8390e+10 1.0244e+14 218692
## + sub_grade_C2                   1 4.3651e+09 1.0240e+14 218692
## + sub_grade_B2                   1 4.3395e+09 1.0240e+14 218692
## + loan_status_Current            1 3.2468e+09 1.0240e+14 218692
## + loan_purpose_other               1 2.1498e+09 1.0240e+14 218692
## + `loan_status_Late (31-120 days)` 1 2.0655e+09 1.0240e+14 218692
## + loan_purpose_home_improvement    1 1.5061e+09 1.0240e+14 218692
## + loan_purpose_car                 1 1.3564e+09 1.0240e+14 218692
## + `loan_status_In Grace Period`   1 1.2024e+09 1.0240e+14 218692
## + sub_grade_B3                   1 1.0257e+09 1.0240e+14 218692
## + sub_grade_G4                   1 4.1122e+08 1.0240e+14 218692
## + sub_grade_C1                   1 3.0003e+08 1.0240e+14 218692
## + loan_purpose_vacation             1 8.3240e+07 1.0240e+14 218692
## + loan_purpose_house               1 6.1635e+06 1.0240e+14 218692
## + loan_purpose_debt_consolidation   1 1.3080e+06 1.0240e+14 218692
## - sub_grade_A4                   1 4.4081e+10 1.0245e+14 218693
## - sub_grade_F4                   1 4.5616e+10 1.0245e+14 218693
## - sub_grade_G1                   1 4.5907e+10 1.0245e+14 218693
## - `loan_status_Charged Off`       1 5.3826e+10 1.0246e+14 218693
## - loan_purpose_credit_card         1 5.5409e+10 1.0246e+14 218694
## - sub_grade_F1                   1 6.1870e+10 1.0246e+14 218694
## - sub_grade_F3                   1 6.5918e+10 1.0247e+14 218695
## - loan_amount                    1 6.6283e+10 1.0247e+14 218695
## - sub_grade_A2                   1 6.9506e+10 1.0247e+14 218695
## - sub_grade_D2                   1 6.9830e+10 1.0247e+14 218695

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## - sub_grade_E4          1 7.8354e+10 1.0248e+14 218696
## - sub_grade_E1          1 8.1234e+10 1.0248e+14 218696
## - sub_grade_A1          1 9.6336e+10 1.0250e+14 218697
## - interest_rate         1 2.6265e+11 1.0267e+14 218713
## - delinq_2y             1 3.1237e+11 1.0272e+14 218717
## - term                  1 4.4350e+11 1.0285e+14 218729
## - `verified_income_Source Verified` 1 7.3205e+11 1.0313e+14 218756
## - `verified_income_Not Verified`    1 9.3065e+11 1.0333e+14 218774
## - homeownership_OWEN    1 2.5154e+12 1.0492e+14 218918
## - annual_income         1 1.0889e+13 1.1329e+14 219645
## - total_credit_utilized  1 1.8868e+13 1.2127e+14 220288
## - homeownership_MORTGAGE 1 3.6718e+13 1.3912e+14 221588
##
## Step: AIC=218689
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
##   sub_grade_B5 + sub_grade_C3 + sub_grade_C4 + sub_grade_C5 +
##   sub_grade_D1 + sub_grade_D2 + sub_grade_D3 + sub_grade_D4 +
##   sub_grade_D5 + sub_grade_E1 + sub_grade_E2 + sub_grade_E3 +
##   sub_grade_E4 + sub_grade_E5 + sub_grade_F1 + sub_grade_F2 +
##   sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
##   homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
##   `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##
##           Df Sum of Sq      RSS   AIC
## - sub_grade_B5          1 8.1842e+09 1.0242e+14 218688
## - sub_grade_A3          1 8.2196e+09 1.0242e+14 218688
## - sub_grade_F2          1 9.0184e+09 1.0242e+14 218688
## - tax_liens             1 9.0797e+09 1.0242e+14 218688
## - loan_purpose_medical    1 1.0507e+10 1.0242e+14 218688
## - sub_grade_B1          1 1.2227e+10 1.0242e+14 218688
## - loan_purpose_renewable_energy 1 1.2653e+10 1.0242e+14 218688
## - loan_purpose_moving     1 1.3322e+10 1.0242e+14 218688
## - sub_grade_B4          1 1.6702e+10 1.0243e+14 218689
## - `loan_status_Fully Paid` 1 1.7714e+10 1.0243e+14 218689
## - sub_grade_C4          1 1.8083e+10 1.0243e+14 218689
## - sub_grade_C5          1 1.8779e+10 1.0243e+14 218689
## - loan_purpose_small_business 1 2.0494e+10 1.0243e+14 218689
## <none>                  1.0241e+14 218689
## - sub_grade_D1          1 2.2584e+10 1.0243e+14 218689
## - sub_grade_D5          1 2.3488e+10 1.0243e+14 218689
## - sub_grade_E2          1 2.4821e+10 1.0243e+14 218689
## - sub_grade_D4          1 2.6798e+10 1.0244e+14 218689
## - `loan_status_Late (16-30 days)` 1 2.7507e+10 1.0244e+14 218690
## - sub_grade_F5          1 3.4755e+10 1.0244e+14 218690
## + sub_grade_A5          1 7.9792e+09 1.0240e+14 218690
## - sub_grade_C3          1 3.5327e+10 1.0244e+14 218690
## - sub_grade_E3          1 3.5789e+10 1.0244e+14 218690

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## + loan_purpose_major_purchase      1 5.7802e+09 1.0240e+14 218690
## - sub_grade_E5                    1 3.7896e+10 1.0245e+14 218690
## - sub_grade_D3                    1 3.8095e+10 1.0245e+14 218690
## + sub_grade_B2                    1 4.4650e+09 1.0240e+14 218691
## + sub_grade_C2                    1 4.3655e+09 1.0240e+14 218691
## + loan_status_Current              1 3.4631e+09 1.0241e+14 218691
## + `loan_status_Late (31-120 days)` 1 2.2422e+09 1.0241e+14 218691
## + loan_purpose_home_improvement      1 1.8744e+09 1.0241e+14 218691
## + loan_purpose_other                 1 1.5811e+09 1.0241e+14 218691
## + loan_purpose_car                   1 1.5340e+09 1.0241e+14 218691
## + `loan_status_In Grace Period`     1 1.2538e+09 1.0241e+14 218691
## + sub_grade_B3                    1 9.8028e+08 1.0241e+14 218691
## + loan_purpose_debt_consolidation     1 6.0051e+08 1.0241e+14 218691
## + sub_grade_G4                    1 4.1665e+08 1.0241e+14 218691
## + sub_grade_C1                    1 3.0579e+08 1.0241e+14 218691
## + loan_purpose_vacation              1 5.6255e+07 1.0241e+14 218691
## + loan_purpose_house                 1 3.6264e+04 1.0241e+14 218691
## - sub_grade_A4                    1 4.4251e+10 1.0245e+14 218691
## - sub_grade_F4                    1 4.5632e+10 1.0245e+14 218691
## - sub_grade_G1                    1 4.5870e+10 1.0245e+14 218691
## - loan_purpose_credit_card           1 5.2451e+10 1.0246e+14 218692
## - `loan_status_Charged Off`        1 5.4003e+10 1.0246e+14 218692
## - sub_grade_F1                    1 6.1862e+10 1.0247e+14 218693
## - sub_grade_F3                    1 6.5910e+10 1.0247e+14 218693
## - loan_amount                     1 6.7172e+10 1.0248e+14 218693
## - sub_grade_D2                    1 6.9442e+10 1.0248e+14 218693
## - sub_grade_A2                    1 6.9457e+10 1.0248e+14 218693
## - sub_grade_E4                    1 7.7522e+10 1.0249e+14 218694
## - sub_grade_E1                    1 8.1403e+10 1.0249e+14 218694
## - sub_grade_A1                    1 9.6367e+10 1.0251e+14 218696
## - interest_rate                   1 2.6179e+11 1.0267e+14 218711
## - delinq_2y                       1 3.1313e+11 1.0272e+14 218716
## - term                            1 4.4293e+11 1.0285e+14 218728
## - `verified_income_Source Verified` 1 7.3281e+11 1.0314e+14 218754
## - `verified_income_Not Verified`    1 9.2963e+11 1.0334e+14 218772
## - homeownership_OWEN              1 2.5257e+12 1.0493e+14 218917
## - annual_income                   1 1.0884e+13 1.1329e+14 219643
## - total_credit_utilized            1 1.8907e+13 1.2132e+14 220290
## - homeownership_MORTGAGE           1 3.6809e+13 1.3922e+14 221592
##
## Step: AIC=218687.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
##   sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
##   sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
##   sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##   sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
##   sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##   homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
##   `loan_status_Late (16-30 days)` + loan_purpose_credit_card +

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##      loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
##      loan_purpose_small_business
##
##              Df  Sum of Sq      RSS   AIC
## - sub_grade_F2      1 7.3385e+09 1.0242e+14 218686
## - sub_grade_A3      1 8.2665e+09 1.0243e+14 218686
## - tax_liens          1 9.1709e+09 1.0243e+14 218687
## - loan_purpose_medical 1 1.0307e+10 1.0243e+14 218687
## - sub_grade_B1      1 1.0326e+10 1.0243e+14 218687
## - loan_purpose_renewable_energy 1 1.2489e+10 1.0243e+14 218687
## - sub_grade_C4      1 1.3350e+10 1.0243e+14 218687
## - sub_grade_B4      1 1.3380e+10 1.0243e+14 218687
## - loan_purpose_moving 1 1.3481e+10 1.0243e+14 218687
## - sub_grade_C5      1 1.3932e+10 1.0243e+14 218687
## - sub_grade_D1      1 1.7635e+10 1.0243e+14 218687
## - `loan_status_Fully Paid` 1 1.7732e+10 1.0243e+14 218687
## - sub_grade_D5      1 1.8501e+10 1.0244e+14 218687
## - loan_purpose_small_business 1 2.0290e+10 1.0244e+14 218688
## - sub_grade_E2      1 2.0733e+10 1.0244e+14 218688
## - sub_grade_D4      1 2.1632e+10 1.0244e+14 218688
## <none>                                1.0242e+14 218688
## - `loan_status_Late (16-30 days)` 1 2.7972e+10 1.0244e+14 218688
## - sub_grade_C3      1 2.9301e+10 1.0245e+14 218688
## - sub_grade_E3      1 3.0654e+10 1.0245e+14 218689
## - sub_grade_D3      1 3.1989e+10 1.0245e+14 218689
## - sub_grade_F5      1 3.2176e+10 1.0245e+14 218689
## - sub_grade_E5      1 3.2438e+10 1.0245e+14 218689
## + sub_grade_C2      1 9.4195e+09 1.0241e+14 218689
## + sub_grade_A5      1 9.1492e+09 1.0241e+14 218689
## + sub_grade_B5      1 8.1842e+09 1.0241e+14 218689
## + loan_purpose_major_purchase 1 5.8270e+09 1.0241e+14 218689
## + loan_status_Current 1 3.3654e+09 1.0241e+14 218689
## + sub_grade_B2      1 2.5430e+09 1.0241e+14 218689
## + `loan_status_Late (31-120 days)` 1 2.0879e+09 1.0241e+14 218690
## + loan_purpose_home_improvement 1 1.9268e+09 1.0241e+14 218690
## + loan_purpose_other 1 1.6592e+09 1.0242e+14 218690
## - sub_grade_G1      1 4.1759e+10 1.0246e+14 218690
## + loan_purpose_car      1 1.3985e+09 1.0242e+14 218690
## + `loan_status_In Grace Period` 1 1.2875e+09 1.0242e+14 218690
## - sub_grade_F4      1 4.2492e+10 1.0246e+14 218690
## + loan_purpose_debt_consolidation 1 6.3919e+08 1.0242e+14 218690
## + sub_grade_G4      1 6.1740e+08 1.0242e+14 218690
## + sub_grade_B3      1 2.3268e+08 1.0242e+14 218690
## + sub_grade_C1      1 1.3450e+08 1.0242e+14 218690
## + loan_purpose_vacation 1 6.6075e+07 1.0242e+14 218690
## + loan_purpose_house 1 7.7764e+05 1.0242e+14 218690
## - sub_grade_A4      1 4.3586e+10 1.0246e+14 218690
## - loan_purpose_credit_card 1 5.2326e+10 1.0247e+14 218691
## - `loan_status_Charged Off` 1 5.3891e+10 1.0247e+14 218691
## - sub_grade_F1      1 5.6193e+10 1.0247e+14 218691
## - sub_grade_F3      1 6.1620e+10 1.0248e+14 218691
## - sub_grade_D2      1 6.2088e+10 1.0248e+14 218691

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## - loan_amount          1 6.7139e+10 1.0248e+14 218692
## - sub_grade_A2         1 7.0454e+10 1.0249e+14 218692
## - sub_grade_E4         1 7.0715e+10 1.0249e+14 218692
## - sub_grade_E1         1 7.5403e+10 1.0249e+14 218693
## - sub_grade_A1         1 9.8578e+10 1.0252e+14 218695
## - interest_rate        1 2.5369e+11 1.0267e+14 218709
## - delinq_2y            1 3.1591e+11 1.0273e+14 218715
## - term                 1 4.4314e+11 1.0286e+14 218727
## - `verified_income_Source Verified` 1 7.3170e+11 1.0315e+14 218753
## - `verified_income_Not Verified`    1 9.3121e+11 1.0335e+14 218771
## - homeownership_OWEN 1 2.5297e+12 1.0495e+14 218917
## - annual_income        1 1.0877e+13 1.1329e+14 219641
## - total_credit_utilized 1 1.8910e+13 1.2133e+14 220289
## - homeownership_MORTGAGE 1 3.6808e+13 1.3922e+14 221591
##
## Step: AIC=218686.4
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
##   sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
##   sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
##   sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##   sub_grade_E5 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
##   sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
##   `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##
##           Df Sum of Sq      RSS   AIC
## - sub_grade_C4      1 9.1632e+09 1.0243e+14 218685
## - sub_grade_C5      1 9.2884e+09 1.0243e+14 218685
## - tax_liens         1 9.3023e+09 1.0243e+14 218685
## - loan_purpose_medical 1 1.0283e+10 1.0243e+14 218685
## - sub_grade_D1      1 1.2472e+10 1.0244e+14 218686
## - loan_purpose_renewable_energy 1 1.2565e+10 1.0244e+14 218686
## - sub_grade_D5      1 1.2595e+10 1.0244e+14 218686
## - sub_grade_B1      1 1.3092e+10 1.0244e+14 218686
## - loan_purpose_moving  1 1.3473e+10 1.0244e+14 218686
## - sub_grade_B4      1 1.3558e+10 1.0244e+14 218686
## - sub_grade_A3      1 1.4025e+10 1.0244e+14 218686
## - sub_grade_E2      1 1.5487e+10 1.0244e+14 218686
## - sub_grade_D4      1 1.5670e+10 1.0244e+14 218686
## - `loan_status_Fully Paid` 1 1.7535e+10 1.0244e+14 218686
## - loan_purpose_small_business 1 2.0466e+10 1.0244e+14 218686
## <none>                                1.0242e+14 218686
## - sub_grade_E3      1 2.4219e+10 1.0245e+14 218687
## - sub_grade_C3      1 2.4276e+10 1.0245e+14 218687
## - sub_grade_D3      1 2.5256e+10 1.0245e+14 218687
## - sub_grade_E5      1 2.5654e+10 1.0245e+14 218687
## - `loan_status_Late (16-30 days)` 1 2.7565e+10 1.0245e+14 218687
## - sub_grade_F5      1 2.8334e+10 1.0245e+14 218687

```



```

## + sub_grade_C2          1 1.4196e+10 1.0241e+14 218687
## + sub_grade_F2          1 7.3385e+09 1.0242e+14 218688
## - sub_grade_G1          1 3.5987e+10 1.0246e+14 218688
## + sub_grade_B5          1 6.5042e+09 1.0242e+14 218688
## + loan_purpose_major_purchase 1 5.8348e+09 1.0242e+14 218688
## - sub_grade_F4          1 3.7843e+10 1.0246e+14 218688
## + sub_grade_B2          1 3.7103e+09 1.0242e+14 218688
## + sub_grade_A5          1 3.3026e+09 1.0242e+14 218688
## + loan_status_Current   1 3.1853e+09 1.0242e+14 218688
## + `loan_status_Late (31-120 days)` 1 1.8599e+09 1.0242e+14 218688
## + loan_purpose_home_improvement 1 1.8570e+09 1.0242e+14 218688
## + loan_purpose_other      1 1.6287e+09 1.0242e+14 218688
## + loan_purpose_car        1 1.3711e+09 1.0242e+14 218688
## + `loan_status_In Grace Period` 1 1.3122e+09 1.0242e+14 218688
## + sub_grade_G4          1 1.0167e+09 1.0242e+14 218688
## + sub_grade_C1          1 7.3368e+08 1.0242e+14 218688
## + loan_purpose_debt_consolidation 1 6.6893e+08 1.0242e+14 218688
## + sub_grade_B3          1 4.1293e+08 1.0242e+14 218688
## + loan_purpose_vacation   1 7.0531e+07 1.0242e+14 218688
## + loan_purpose_house      1 1.1051e+05 1.0242e+14 218688
## - sub_grade_F1          1 4.9140e+10 1.0247e+14 218689
## - loan_purpose_credit_card 1 5.2690e+10 1.0248e+14 218689
## - `loan_status_Charged Off` 1 5.4108e+10 1.0248e+14 218689
## - sub_grade_D2          1 5.4754e+10 1.0248e+14 218689
## - sub_grade_F3          1 5.5652e+10 1.0248e+14 218690
## - sub_grade_A4          1 5.6817e+10 1.0248e+14 218690
## - sub_grade_E4          1 6.3395e+10 1.0249e+14 218690
## - loan_amount           1 6.7316e+10 1.0249e+14 218691
## - sub_grade_E1          1 6.8330e+10 1.0249e+14 218691
## - sub_grade_A2          1 9.1852e+10 1.0252e+14 218693
## - sub_grade_A1          1 1.2669e+11 1.0255e+14 218696
## - interest_rate         1 2.6889e+11 1.0269e+14 218709
## - delinq_2y             1 3.1447e+11 1.0274e+14 218713
## - term                  1 4.4047e+11 1.0286e+14 218725
## - `verified_income_Source Verified` 1 7.3361e+11 1.0316e+14 218752
## - `verified_income_Not Verified` 1 9.2974e+11 1.0335e+14 218770
## - homeownership_OWEN   1 2.5305e+12 1.0495e+14 218915
## - annual_income         1 1.0876e+13 1.1330e+14 219639
## - total_credit_utilized 1 1.8911e+13 1.2134e+14 220287
## - homeownership_MORTGAGE 1 3.6815e+13 1.3924e+14 221590
##
## Step: AIC=218685.2
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_C3 + sub_grade_C5 + sub_grade_D1 + sub_grade_D2 +
## sub_grade_D3 + sub_grade_D4 + sub_grade_D5 + sub_grade_E1 +
## sub_grade_E2 + sub_grade_E3 + sub_grade_E4 + sub_grade_E5 +
## sub_grade_F1 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
## sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
## `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +

```

```

##      loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
##      loan_purpose_renewable_energy + loan_purpose_small_business
##
##              Df  Sum of Sq      RSS    AIC
## - sub_grade_C5      1 3.7655e+09 1.0244e+14 218684
## - sub_grade_D5      1 5.6537e+09 1.0244e+14 218684
## - sub_grade_D1      1 6.1960e+09 1.0244e+14 218684
## - sub_grade_D4      1 8.4165e+09 1.0244e+14 218684
## - sub_grade_E2      1 9.2584e+09 1.0244e+14 218684
## - tax_liens         1 9.3334e+09 1.0244e+14 218684
## - loan_purpose_medical 1 1.0577e+10 1.0244e+14 218684
## - sub_grade_B4      1 1.1898e+10 1.0245e+14 218684
## - loan_purpose_renewable_energy 1 1.2464e+10 1.0245e+14 218684
## - loan_purpose_moving 1 1.3228e+10 1.0245e+14 218684
## - sub_grade_B1      1 1.4656e+10 1.0245e+14 218685
## - sub_grade_E3      1 1.6242e+10 1.0245e+14 218685
## - sub_grade_D3      1 1.6699e+10 1.0245e+14 218685
## - sub_grade_C3      1 1.7207e+10 1.0245e+14 218685
## - sub_grade_E5      1 1.7211e+10 1.0245e+14 218685
## - `loan_status_Fully Paid` 1 1.8063e+10 1.0245e+14 218685
## - loan_purpose_small_business 1 2.0642e+10 1.0245e+14 218685
## + sub_grade_C2      1 2.2140e+10 1.0241e+14 218685
## - sub_grade_A3      1 2.1592e+10 1.0245e+14 218685
## <none>              1.0243e+14 218685
## - sub_grade_F5      1 2.3613e+10 1.0246e+14 218685
## - `loan_status_Late (16-30 days)` 1 2.6963e+10 1.0246e+14 218686
## - sub_grade_G1      1 2.8830e+10 1.0246e+14 218686
## - sub_grade_F4      1 3.2057e+10 1.0247e+14 218686
## + sub_grade_C4      1 9.1632e+09 1.0242e+14 218686
## + loan_purpose_major_purchase 1 5.8101e+09 1.0243e+14 218687
## + sub_grade_B2      1 4.0147e+09 1.0243e+14 218687
## + loan_status_Current 1 3.2881e+09 1.0243e+14 218687
## + sub_grade_B5      1 3.1963e+09 1.0243e+14 218687
## + sub_grade_F2      1 3.1520e+09 1.0243e+14 218687
## - sub_grade_F1      1 4.0259e+10 1.0247e+14 218687
## + sub_grade_C1      1 3.0241e+09 1.0243e+14 218687
## + `loan_status_Late (31-120 days)` 1 1.9561e+09 1.0243e+14 218687
## + loan_purpose_home_improvement 1 1.8184e+09 1.0243e+14 218687
## + sub_grade_G4      1 1.6716e+09 1.0243e+14 218687
## + loan_purpose_other   1 1.6180e+09 1.0243e+14 218687
## + `loan_status_In Grace Period` 1 1.3246e+09 1.0243e+14 218687
## + loan_purpose_car     1 1.2781e+09 1.0243e+14 218687
## + sub_grade_A5      1 8.1630e+08 1.0243e+14 218687
## + loan_purpose_debt_consolidation 1 7.0532e+08 1.0243e+14 218687
## + sub_grade_B3      1 2.8440e+08 1.0243e+14 218687
## + loan_purpose_vacation 1 6.2428e+07 1.0243e+14 218687
## + loan_purpose_house   1 4.1292e+05 1.0243e+14 218687
## - sub_grade_D2      1 4.5699e+10 1.0248e+14 218687
## - sub_grade_F3      1 4.8141e+10 1.0248e+14 218688
## - loan_purpose_credit_card 1 5.2993e+10 1.0249e+14 218688
## - `loan_status_Charged Off` 1 5.4281e+10 1.0249e+14 218688
## - sub_grade_E4      1 5.4391e+10 1.0249e+14 218688

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## - sub_grade_E1          1 5.9354e+10 1.0249e+14 218689
## - loan_amount           1 6.7632e+10 1.0250e+14 218689
## - sub_grade_A4          1 7.0983e+10 1.0250e+14 218690
## - sub_grade_A2          1 1.1778e+11 1.0255e+14 218694
## - sub_grade_A1          1 1.6230e+11 1.0260e+14 218698
## - interest_rate         1 3.0968e+11 1.0274e+14 218712
## - delinq_2y             1 3.1428e+11 1.0275e+14 218712
## - term                  1 4.3729e+11 1.0287e+14 218724
## - `verified_income_Source Verified` 1 7.3082e+11 1.0316e+14 218751
## - `verified_income_Not Verified`    1 9.2714e+11 1.0336e+14 218768
## - homeownership_OWEN 1 2.5305e+12 1.0496e+14 218914
## - annual_income         1 1.0872e+13 1.1331e+14 219638
## - total_credit_utilized 1 1.8912e+13 1.2135e+14 220286
## - homeownership_MORTGAGE 1 3.6806e+13 1.3924e+14 221588
##
## Step: AIC=218683.6
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_C3 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
## sub_grade_D4 + sub_grade_D5 + sub_grade_E1 + sub_grade_E2 +
## sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
## sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
## homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
## `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
## loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
## loan_purpose_renewable_energy + loan_purpose_small_business
##
##
## Df Sum of Sq RSS AIC
## - sub_grade_D5          1 2.9298e+09 1.0244e+14 218682
## - sub_grade_D1          1 3.7350e+09 1.0244e+14 218682
## - sub_grade_D4          1 5.4224e+09 1.0244e+14 218682
## - sub_grade_E2          1 6.6301e+09 1.0244e+14 218682
## - tax_liens             1 9.3851e+09 1.0245e+14 218682
## - loan_purpose_medical    1 1.0565e+10 1.0245e+14 218683
## - sub_grade_B4          1 1.1440e+10 1.0245e+14 218683
## - loan_purpose_renewable_energy 1 1.2431e+10 1.0245e+14 218683
## - sub_grade_E3          1 1.2791e+10 1.0245e+14 218683
## - sub_grade_D3          1 1.3040e+10 1.0245e+14 218683
## - loan_purpose_moving     1 1.3118e+10 1.0245e+14 218683
## - sub_grade_E5          1 1.3572e+10 1.0245e+14 218683
## - sub_grade_C3          1 1.4246e+10 1.0245e+14 218683
## - sub_grade_B1          1 1.6041e+10 1.0245e+14 218683
## + sub_grade_C2          1 2.5679e+10 1.0241e+14 218683
## - `loan_status_Fully Paid` 1 1.7940e+10 1.0246e+14 218683
## - loan_purpose_small_business 1 2.0695e+10 1.0246e+14 218684
## - sub_grade_F5          1 2.1410e+10 1.0246e+14 218684
## <none>                  1.0244e+14 218684
## - sub_grade_G1          1 2.5632e+10 1.0246e+14 218684
## - `loan_status_Late (16-30 days)` 1 2.7202e+10 1.0246e+14 218684
## - sub_grade_A3          1 2.7260e+10 1.0246e+14 218684

```

```

## - sub_grade_F4          1 2.9402e+10 1.0247e+14 218684
## - sub_grade_F1          1 3.6494e+10 1.0247e+14 218685
## + loan_purpose_major_purchase 1 5.8352e+09 1.0243e+14 218685
## + sub_grade_B2          1 4.4802e+09 1.0243e+14 218685
## + sub_grade_C1          1 4.3743e+09 1.0243e+14 218685
## + sub_grade_C5          1 3.7655e+09 1.0243e+14 218685
## + sub_grade_C4          1 3.6403e+09 1.0243e+14 218685
## + loan_status_Current   1 3.3633e+09 1.0243e+14 218685
## + sub_grade_B5          1 2.2096e+09 1.0243e+14 218685
## + sub_grade_G4          1 2.0858e+09 1.0244e+14 218685
## + `loan_status_Late (31-120 days)` 1 2.0333e+09 1.0244e+14 218685
## + loan_purpose_home_improvement 1 1.8224e+09 1.0244e+14 218685
## + sub_grade_F2          1 1.7696e+09 1.0244e+14 218685
## + loan_purpose_other      1 1.6530e+09 1.0244e+14 218685
## + loan_purpose_car        1 1.3404e+09 1.0244e+14 218685
## + `loan_status_In Grace Period` 1 1.3286e+09 1.0244e+14 218685
## - sub_grade_D2          1 4.2422e+10 1.0248e+14 218686
## + loan_purpose_debt_consolidation 1 7.1635e+08 1.0244e+14 218686
## + sub_grade_B3          1 2.9299e+08 1.0244e+14 218686
## + sub_grade_A5          1 1.5491e+08 1.0244e+14 218686
## + loan_purpose_vacation   1 7.0137e+07 1.0244e+14 218686
## + loan_purpose_house      1 4.6110e+05 1.0244e+14 218686
## - sub_grade_F3          1 4.4762e+10 1.0248e+14 218686
## - sub_grade_E4          1 5.1270e+10 1.0249e+14 218686
## - loan_purpose_credit_card 1 5.2831e+10 1.0249e+14 218686
## - `loan_status_Charged Off` 1 5.4807e+10 1.0249e+14 218687
## - sub_grade_E1          1 5.5592e+10 1.0249e+14 218687
## - loan_amount           1 6.7855e+10 1.0251e+14 218688
## - sub_grade_A4          1 8.1382e+10 1.0252e+14 218689
## - sub_grade_A2          1 1.3712e+11 1.0257e+14 218694
## - sub_grade_A1          1 1.8913e+11 1.0263e+14 218699
## - delinq_2y             1 3.1563e+11 1.0275e+14 218711
## - interest_rate         1 3.7717e+11 1.0281e+14 218716
## - term                  1 4.3424e+11 1.0287e+14 218722
## - `verified_income_Source Verified` 1 7.3126e+11 1.0317e+14 218749
## - `verified_income_Not Verified` 1 9.2734e+11 1.0336e+14 218767
## - homeownership_OWEN   1 2.5301e+12 1.0497e+14 218912
## - annual_income         1 1.0868e+13 1.1331e+14 219636
## - total_credit_utilized 1 1.8927e+13 1.2136e+14 220286
## - homeownership_MORTGAGE 1 3.6823e+13 1.3926e+14 221587
##
## Step: AIC=218681.9
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_C3 + sub_grade_D1 + sub_grade_D2 + sub_grade_D3 +
## sub_grade_D4 + sub_grade_E1 + sub_grade_E2 + sub_grade_E3 +
## sub_grade_E4 + sub_grade_E5 + sub_grade_F1 + sub_grade_F3 +
## sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
## homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
## `loan_status_Late (16-30 days)` + loan_purpose_credit_card +

```

```

##      loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
##      loan_purpose_small_business
##
##                                     Df  Sum of Sq      RSS    AIC
## - sub_grade_D1                    1  2.0703e+09  1.0244e+14  218680
## - sub_grade_D4                    1  3.2047e+09  1.0244e+14  218680
## - sub_grade_E2                    1  4.6059e+09  1.0244e+14  218680
## - tax_liens                       1  9.4274e+09  1.0245e+14  218681
## - sub_grade_E3                    1  1.0029e+10  1.0245e+14  218681
## - sub_grade_D3                    1  1.0170e+10  1.0245e+14  218681
## - loan_purpose_medical              1  1.0481e+10  1.0245e+14  218681
## - sub_grade_E5                    1  1.0672e+10  1.0245e+14  218681
## - sub_grade_B4                    1  1.2062e+10  1.0245e+14  218681
## - sub_grade_C3                    1  1.2238e+10  1.0245e+14  218681
## - loan_purpose_renewable_energy     1  1.2593e+10  1.0245e+14  218681
## - loan_purpose_moving              1  1.3179e+10  1.0245e+14  218681
## + sub_grade_C2                    1  2.8206e+10  1.0241e+14  218681
## - `loan_status_Fully Paid`       1  1.7881e+10  1.0246e+14  218682
## - sub_grade_B1                    1  1.9083e+10  1.0246e+14  218682
## - sub_grade_F5                    1  1.9571e+10  1.0246e+14  218682
## - loan_purpose_small_business       1  2.0791e+10  1.0246e+14  218682
## <none>                           1.0244e+14  218682
## - sub_grade_G1                    1  2.2993e+10  1.0246e+14  218682
## - `loan_status_Late (16-30 days)` 1  2.7143e+10  1.0247e+14  218682
## - sub_grade_F4                    1  2.7177e+10  1.0247e+14  218682
## - sub_grade_F1                    1  3.3615e+10  1.0247e+14  218683
## - sub_grade_A3                    1  3.6828e+10  1.0248e+14  218683
## + loan_purpose_major_purchase       1  5.8256e+09  1.0243e+14  218683
## + sub_grade_B2                    1  5.6667e+09  1.0243e+14  218683
## + sub_grade_C1                    1  5.1516e+09  1.0243e+14  218683
## + loan_status_Current             1  3.3160e+09  1.0244e+14  218684
## - sub_grade_D2                    1  4.0200e+10  1.0248e+14  218684
## + sub_grade_D5                    1  2.9298e+09  1.0244e+14  218684
## + sub_grade_G4                    1  2.4746e+09  1.0244e+14  218684
## + `loan_status_Late (31-120 days)` 1  2.1061e+09  1.0244e+14  218684
## + sub_grade_B5                    1  1.9627e+09  1.0244e+14  218684
## + loan_purpose_home_improvement     1  1.7828e+09  1.0244e+14  218684
## + loan_purpose_other                1  1.6177e+09  1.0244e+14  218684
## + sub_grade_C4                    1  1.5077e+09  1.0244e+14  218684
## + loan_purpose_car                  1  1.3323e+09  1.0244e+14  218684
## - sub_grade_F3                    1  4.1992e+10  1.0248e+14  218684
## + `loan_status_In Grace Period`   1  1.2296e+09  1.0244e+14  218684
## + sub_grade_C5                    1  1.0417e+09  1.0244e+14  218684
## + sub_grade_F2                    1  8.9447e+08  1.0244e+14  218684
## + loan_purpose_debt_consolidation   1  7.0857e+08  1.0244e+14  218684
## + sub_grade_B3                    1  5.1215e+08  1.0244e+14  218684
## + loan_purpose_vacation             1  5.9292e+07  1.0244e+14  218684
## + sub_grade_A5                    1  5.6074e+07  1.0244e+14  218684
## + loan_purpose_house                1  5.1679e+05  1.0244e+14  218684
## - sub_grade_E4                    1  4.9734e+10  1.0249e+14  218684
## - sub_grade_E1                    1  5.2724e+10  1.0249e+14  218685
## - loan_purpose_credit_card          1  5.2992e+10  1.0249e+14  218685

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```

## - `loan_status_Charged Off`      1 5.4800e+10 1.0249e+14 218685
## - loan_amount                    1 6.7592e+10 1.0251e+14 218686
## - sub_grade_A4                   1 9.9579e+10 1.0254e+14 218689
## - sub_grade_A2                   1 1.7069e+11 1.0261e+14 218696
## - sub_grade_A1                   1 2.3515e+11 1.0268e+14 218702
## - delinq_2y                      1 3.1519e+11 1.0276e+14 218709
## - term                           1 4.3310e+11 1.0287e+14 218720
## - interest_rate                  1 5.7584e+11 1.0302e+14 218733
## - `verified_income_Source Verified` 1 7.3423e+11 1.0317e+14 218747
## - `verified_income_Not Verified`    1 9.2740e+11 1.0337e+14 218765
## - homeownership_OWEN             1 2.5301e+12 1.0497e+14 218911
## - annual_income                   1 1.0876e+13 1.1332e+14 219634
## - total_credit_utilized           1 1.8925e+13 1.2136e+14 220284
## - homeownership_MORTGAGE          1 3.6822e+13 1.3926e+14 221585
##
## Step: AIC=218680.1
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
##   sub_grade_C3 + sub_grade_D2 + sub_grade_D3 + sub_grade_D4 +
##   sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
##   sub_grade_E5 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
##   sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
##   `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##
##           Df Sum of Sq      RSS      AIC
## - sub_grade_D4      1 2.3883e+09 1.0244e+14 218678
## - sub_grade_E2      1 3.8725e+09 1.0245e+14 218678
## - sub_grade_D3      1 8.7821e+09 1.0245e+14 218679
## - sub_grade_E3      1 8.8271e+09 1.0245e+14 218679
## - tax_liens         1 9.0973e+09 1.0245e+14 218679
## - sub_grade_E5      1 9.2970e+09 1.0245e+14 218679
## - loan_purpose_medical 1 1.0399e+10 1.0245e+14 218679
## - sub_grade_C3      1 1.1250e+10 1.0245e+14 218679
## - sub_grade_B4      1 1.1873e+10 1.0245e+14 218679
## - loan_purpose_renewable_energy 1 1.2670e+10 1.0245e+14 218679
## - loan_purpose_moving 1 1.3221e+10 1.0246e+14 218679
## + sub_grade_C2      1 2.9661e+10 1.0241e+14 218679
## - `loan_status_Fully Paid`      1 1.7830e+10 1.0246e+14 218680
## - sub_grade_F5      1 1.8895e+10 1.0246e+14 218680
## - sub_grade_B1      1 1.9467e+10 1.0246e+14 218680
## - loan_purpose_small_business 1 2.0741e+10 1.0246e+14 218680
## <none>                                1.0244e+14 218680
## - sub_grade_G1      1 2.1883e+10 1.0246e+14 218680
## - sub_grade_F4      1 2.6318e+10 1.0247e+14 218680
## - `loan_status_Late (16-30 days)` 1 2.7033e+10 1.0247e+14 218681
## - sub_grade_F1      1 3.1976e+10 1.0247e+14 218681
## + loan_purpose_major_purchase 1 5.8375e+09 1.0244e+14 218682
## + sub_grade_B2      1 5.7836e+09 1.0244e+14 218682

```

```

## + sub_grade_C1      1 5.6949e+09 1.0244e+14 218682
## - sub_grade_D2      1 3.8206e+10 1.0248e+14 218682
## - sub_grade_A3      1 3.8880e+10 1.0248e+14 218682
## + loan_status_Current 1 3.2951e+09 1.0244e+14 218682
## + sub_grade_G4      1 2.6071e+09 1.0244e+14 218682
## - sub_grade_F3      1 4.0765e+10 1.0248e+14 218682
## + `loan_status_Late (31-120 days)` 1 2.0723e+09 1.0244e+14 218682
## + sub_grade_D1      1 2.0703e+09 1.0244e+14 218682
## + loan_purpose_home_improvement 1 1.8663e+09 1.0244e+14 218682
## + sub_grade_B5      1 1.6996e+09 1.0244e+14 218682
## + loan_purpose_other   1 1.6739e+09 1.0244e+14 218682
## + loan_purpose_car     1 1.2975e+09 1.0244e+14 218682
## + sub_grade_D5      1 1.2651e+09 1.0244e+14 218682
## + `loan_status_In Grace Period` 1 1.2374e+09 1.0244e+14 218682
## + sub_grade_C4      1 9.4341e+08 1.0244e+14 218682
## + loan_purpose_debt_consolidation 1 7.1640e+08 1.0244e+14 218682
## + sub_grade_F2      1 6.7804e+08 1.0244e+14 218682
## + sub_grade_C5      1 5.0618e+08 1.0244e+14 218682
## + sub_grade_B3      1 5.0463e+08 1.0244e+14 218682
## + sub_grade_A5      1 1.3299e+08 1.0244e+14 218682
## + loan_purpose_vacation 1 6.2265e+07 1.0244e+14 218682
## + loan_purpose_house   1 7.2485e+05 1.0244e+14 218682
## - sub_grade_E4      1 4.7712e+10 1.0249e+14 218682
## - sub_grade_E1      1 5.1040e+10 1.0249e+14 218683
## - loan_purpose_credit_card 1 5.2965e+10 1.0250e+14 218683
## - `loan_status_Charged Off` 1 5.5207e+10 1.0250e+14 218683
## - loan_amount       1 6.7435e+10 1.0251e+14 218684
## - sub_grade_A4      1 1.0280e+11 1.0254e+14 218688
## - sub_grade_A2      1 1.7698e+11 1.0262e+14 218694
## - sub_grade_A1      1 2.4380e+11 1.0269e+14 218701
## - delinq_2y         1 3.1606e+11 1.0276e+14 218707
## - term              1 4.3350e+11 1.0288e+14 218718
## - interest_rate     1 6.1579e+11 1.0306e+14 218735
## - `verified_income_Source Verified` 1 7.3506e+11 1.0318e+14 218746
## - `verified_income_Not Verified` 1 9.2876e+11 1.0337e+14 218763
## - homeownership_OWEN 1 2.5334e+12 1.0498e+14 218909
## - annual_income     1 1.0874e+13 1.1332e+14 219632
## - total_credit_utilized 1 1.8922e+13 1.2136e+14 220282
## - homeownership_MORTGAGE 1 3.6820e+13 1.3926e+14 221583
##
## Step: AIC=218678.3
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_C3 + sub_grade_D2 + sub_grade_D3 + sub_grade_E1 +
## sub_grade_E2 + sub_grade_E3 + sub_grade_E4 + sub_grade_E5 +
## sub_grade_F1 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
## sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
## `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
## loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
## loan_purpose_renewable_energy + loan_purpose_small_business

```

```

##
##
## - sub_grade_E2      1 3.0887e+09 1.0245e+14 218677
## - sub_grade_D3      1 7.3008e+09 1.0245e+14 218677
## - sub_grade_E3      1 7.4885e+09 1.0245e+14 218677
## - sub_grade_E5      1 7.7594e+09 1.0245e+14 218677
## - tax_liens         1 9.2958e+09 1.0245e+14 218677
## - sub_grade_C3      1 1.0365e+10 1.0245e+14 218677
## - loan_purpose_medical 1 1.0427e+10 1.0245e+14 218677
## - sub_grade_B4      1 1.2067e+10 1.0246e+14 218677
## + sub_grade_C2      1 3.0989e+10 1.0241e+14 218677
## - loan_purpose_renewable_energy 1 1.2732e+10 1.0246e+14 218677
## - loan_purpose_moving 1 1.3202e+10 1.0246e+14 218677
## - `loan_status_Fully Paid` 1 1.7767e+10 1.0246e+14 218678
## - sub_grade_F5      1 1.8105e+10 1.0246e+14 218678
## - loan_purpose_small_business 1 2.0558e+10 1.0247e+14 218678
## - sub_grade_G1      1 2.0583e+10 1.0247e+14 218678
## - sub_grade_B1      1 2.0616e+10 1.0247e+14 218678
## <none>              1.0244e+14 218678
## - sub_grade_F4      1 2.5301e+10 1.0247e+14 218679
## - `loan_status_Late (16-30 days)` 1 2.6796e+10 1.0247e+14 218679
## - sub_grade_F1      1 3.0080e+10 1.0247e+14 218679
## - sub_grade_D2      1 3.5962e+10 1.0248e+14 218680
## + sub_grade_B2      1 6.3065e+09 1.0244e+14 218680
## + sub_grade_C1      1 6.0703e+09 1.0244e+14 218680
## + loan_purpose_major_purchase 1 5.7721e+09 1.0244e+14 218680
## - sub_grade_F3      1 3.9336e+10 1.0248e+14 218680
## + loan_status_Current 1 3.3817e+09 1.0244e+14 218680
## + sub_grade_G4      1 2.7705e+09 1.0244e+14 218680
## + sub_grade_D4      1 2.3883e+09 1.0244e+14 218680
## + `loan_status_Late (31-120 days)` 1 2.1675e+09 1.0244e+14 218680
## + loan_purpose_home_improvement 1 1.8304e+09 1.0244e+14 218680
## + loan_purpose_other  1 1.6961e+09 1.0244e+14 218680
## + sub_grade_B5      1 1.5979e+09 1.0244e+14 218680
## + loan_purpose_car     1 1.3244e+09 1.0244e+14 218680
## + sub_grade_D1      1 1.2539e+09 1.0244e+14 218680
## + `loan_status_In Grace Period` 1 1.2389e+09 1.0244e+14 218680
## - sub_grade_A3      1 4.2572e+10 1.0249e+14 218680
## + loan_purpose_debt_consolidation 1 7.2052e+08 1.0244e+14 218680
## + sub_grade_B3      1 5.9928e+08 1.0244e+14 218680
## + sub_grade_C4      1 5.3470e+08 1.0244e+14 218680
## + sub_grade_F2      1 4.5955e+08 1.0244e+14 218680
## + sub_grade_A5      1 3.4712e+08 1.0244e+14 218680
## + sub_grade_D5      1 2.9048e+08 1.0244e+14 218680
## + sub_grade_C5      1 1.6797e+08 1.0244e+14 218680
## + loan_purpose_vacation 1 6.9952e+07 1.0244e+14 218680
## + loan_purpose_house  1 7.5192e+04 1.0244e+14 218680
## - sub_grade_E4      1 4.5372e+10 1.0249e+14 218680
## - sub_grade_E1      1 4.9093e+10 1.0249e+14 218681
## - loan_purpose_credit_card 1 5.3143e+10 1.0250e+14 218681
## - `loan_status_Charged Off` 1 5.5115e+10 1.0250e+14 218681
## - loan_amount       1 6.7654e+10 1.0251e+14 218683

```



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## - sub_grade_A4          1 1.0904e+11 1.0255e+14 218686
## - sub_grade_A2          1 1.8809e+11 1.0263e+14 218694
## - sub_grade_A1          1 2.5885e+11 1.0270e+14 218700
## - delinq_2y             1 3.1539e+11 1.0276e+14 218705
## - term                  1 4.3182e+11 1.0288e+14 218716
## - interest_rate         1 6.9716e+11 1.0314e+14 218740
## - `verified_income_Source Verified` 1 7.3495e+11 1.0318e+14 218744
## - `verified_income_Not Verified`    1 9.2781e+11 1.0337e+14 218762
## - homeownership_OWEN    1 2.5352e+12 1.0498e+14 218908
## - annual_income         1 1.0871e+13 1.1332e+14 219631
## - total_credit_utilized  1 1.8925e+13 1.2137e+14 220280
## - homeownership_MORTGAGE 1 3.6821e+13 1.3927e+14 221581
##
## Step: AIC=218676.6
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
##   sub_grade_C3 + sub_grade_D2 + sub_grade_D3 + sub_grade_E1 +
##   sub_grade_E3 + sub_grade_E4 + sub_grade_E5 + sub_grade_F1 +
##   sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
##   homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
##   `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##              Df Sum of Sq      RSS   AIC
## - sub_grade_D3      1 6.2600e+09 1.0245e+14 218675
## - sub_grade_E3      1 6.5262e+09 1.0245e+14 218675
## - sub_grade_E5      1 6.6262e+09 1.0245e+14 218675
## - tax_liens         1 9.3979e+09 1.0246e+14 218675
## - sub_grade_C3      1 9.8675e+09 1.0246e+14 218675
## - loan_purpose_medical 1 1.0340e+10 1.0246e+14 218676
## + sub_grade_C2      1 3.1757e+10 1.0242e+14 218676
## - sub_grade_B4      1 1.2431e+10 1.0246e+14 218676
## - loan_purpose_renewable_energy 1 1.2765e+10 1.0246e+14 218676
## - loan_purpose_moving  1 1.3106e+10 1.0246e+14 218676
## - sub_grade_F5      1 1.7511e+10 1.0247e+14 218676
## - `loan_status_Fully Paid` 1 1.7745e+10 1.0247e+14 218676
## - sub_grade_G1      1 1.9615e+10 1.0247e+14 218676
## - loan_purpose_small_business 1 2.0688e+10 1.0247e+14 218676
## <none>              1.0245e+14 218677
## - sub_grade_B1      1 2.1771e+10 1.0247e+14 218677
## - sub_grade_F4      1 2.4548e+10 1.0247e+14 218677
## - `loan_status_Late (16-30 days)` 1 2.6934e+10 1.0247e+14 218677
## - sub_grade_F1      1 2.8538e+10 1.0248e+14 218677
## - sub_grade_D2      1 3.4065e+10 1.0248e+14 218678
## + sub_grade_B2      1 6.8969e+09 1.0244e+14 218678
## + sub_grade_C1      1 6.1870e+09 1.0244e+14 218678
## + loan_purpose_major_purchase 1 5.8085e+09 1.0244e+14 218678
## - sub_grade_F3      1 3.8228e+10 1.0249e+14 218678
## + loan_status_Current 1 3.5176e+09 1.0244e+14 218678

```

```

## + sub_grade_E2          1 3.0887e+09 1.0244e+14 218678
## + sub_grade_G4          1 2.9098e+09 1.0244e+14 218678
## + `loan_status_Late (31-120 days)` 1 2.2484e+09 1.0245e+14 218678
## + loan_purpose_home_improvement 1 1.8429e+09 1.0245e+14 218678
## + loan_purpose_other       1 1.6802e+09 1.0245e+14 218678
## + sub_grade_B5          1 1.6134e+09 1.0245e+14 218678
## + sub_grade_D4          1 1.6044e+09 1.0245e+14 218678
## + loan_purpose_car        1 1.3451e+09 1.0245e+14 218678
## + `loan_status_In Grace Period` 1 1.2940e+09 1.0245e+14 218678
## + sub_grade_D1          1 8.5310e+08 1.0245e+14 218678
## + sub_grade_B3          1 7.2857e+08 1.0245e+14 218678
## + loan_purpose_debt_consolidation 1 7.0155e+08 1.0245e+14 218678
## + sub_grade_A5          1 6.1823e+08 1.0245e+14 218679
## + sub_grade_C4          1 3.5390e+08 1.0245e+14 218679
## + sub_grade_F2          1 3.3226e+08 1.0245e+14 218679
## - sub_grade_E4          1 4.3191e+10 1.0249e+14 218679
## + loan_purpose_vacation    1 6.3011e+07 1.0245e+14 218679
## + sub_grade_C5          1 5.1399e+07 1.0245e+14 218679
## + sub_grade_D5          1 3.1260e+07 1.0245e+14 218679
## + loan_purpose_house       1 8.1230e+03 1.0245e+14 218679
## - sub_grade_A3          1 4.5594e+10 1.0249e+14 218679
## - sub_grade_E1          1 4.7510e+10 1.0250e+14 218679
## - loan_purpose_credit_card 1 5.2751e+10 1.0250e+14 218679
## - `loan_status_Charged Off` 1 5.5071e+10 1.0250e+14 218680
## - loan_amount           1 6.7458e+10 1.0252e+14 218681
## - sub_grade_A4          1 1.1406e+11 1.0256e+14 218685
## - sub_grade_A2          1 1.9632e+11 1.0264e+14 218693
## - sub_grade_A1          1 2.6943e+11 1.0272e+14 218699
## - delinq_2y             1 3.1524e+11 1.0276e+14 218704
## - term                  1 4.3062e+11 1.0288e+14 218714
## - interest_rate         1 7.2907e+11 1.0318e+14 218742
## - `verified_income_Source Verified` 1 7.3744e+11 1.0319e+14 218742
## - `verified_income_Not Verified` 1 9.2965e+11 1.0338e+14 218760
## - homeownership_OWEN    1 2.5361e+12 1.0498e+14 218906
## - annual_income         1 1.0875e+13 1.1332e+14 219629
## - total_credit_utilized  1 1.8922e+13 1.2137e+14 220278
## - homeownership_MORTGAGE 1 3.6842e+13 1.3929e+14 221581
##
## Step: AIC=218675.1
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_C3 + sub_grade_D2 + sub_grade_E1 + sub_grade_E3 +
## sub_grade_E4 + sub_grade_E5 + sub_grade_F1 + sub_grade_F3 +
## sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
## homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
## `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
## loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
## loan_purpose_small_business
##
##
## Df Sum of Sq RSS AIC

```

## - sub_grade_E5	1	4.8011e+09	1.0246e+14	218674
## - sub_grade_E3	1	4.9499e+09	1.0246e+14	218674
## - sub_grade_C3	1	8.6760e+09	1.0246e+14	218674
## + sub_grade_C2	1	3.3888e+10	1.0242e+14	218674
## - tax_liens	1	9.5759e+09	1.0246e+14	218674
## - loan_purpose_medical	1	1.0517e+10	1.0246e+14	218674
## - sub_grade_B4	1	1.2479e+10	1.0247e+14	218674
## - loan_purpose_renewable_energy	1	1.2551e+10	1.0247e+14	218674
## - loan_purpose_moving	1	1.3118e+10	1.0247e+14	218674
## - sub_grade_F5	1	1.6521e+10	1.0247e+14	218675
## - `loan_status_Fully Paid`	1	1.7870e+10	1.0247e+14	218675
## - sub_grade_G1	1	1.7978e+10	1.0247e+14	218675
## - loan_purpose_small_business	1	2.0891e+10	1.0247e+14	218675
## <none>			1.0245e+14	218675
## - sub_grade_B1	1	2.2907e+10	1.0248e+14	218675
## - sub_grade_F4	1	2.3242e+10	1.0248e+14	218675
## - sub_grade_F1	1	2.5882e+10	1.0248e+14	218676
## - `loan_status_Late (16-30 days)`	1	2.6992e+10	1.0248e+14	218676
## - sub_grade_D2	1	3.0477e+10	1.0248e+14	218676
## + sub_grade_B2	1	7.4040e+09	1.0245e+14	218676
## - sub_grade_F3	1	3.6327e+10	1.0249e+14	218676
## + sub_grade_C1	1	6.8245e+09	1.0245e+14	218677
## + sub_grade_D3	1	6.2600e+09	1.0245e+14	218677
## + loan_purpose_major_purchase	1	5.7496e+09	1.0245e+14	218677
## - sub_grade_E4	1	3.9310e+10	1.0249e+14	218677
## + loan_status_Current	1	3.5723e+09	1.0245e+14	218677
## + sub_grade_G4	1	3.1344e+09	1.0245e+14	218677
## + `loan_status_Late (31-120 days)`	1	2.2838e+09	1.0245e+14	218677
## + sub_grade_E2	1	2.0478e+09	1.0245e+14	218677
## + loan_purpose_home_improvement	1	1.7968e+09	1.0245e+14	218677
## + loan_purpose_other	1	1.6472e+09	1.0245e+14	218677
## + sub_grade_B5	1	1.4110e+09	1.0245e+14	218677
## + `loan_status_In Grace Period`	1	1.3138e+09	1.0245e+14	218677
## + loan_purpose_car	1	1.2908e+09	1.0245e+14	218677
## + sub_grade_A5	1	1.0409e+09	1.0245e+14	218677
## + sub_grade_B3	1	8.0512e+08	1.0245e+14	218677
## + loan_purpose_debt_consolidation	1	7.1833e+08	1.0245e+14	218677
## + sub_grade_D4	1	5.9532e+08	1.0245e+14	218677
## + sub_grade_D1	1	2.9790e+08	1.0245e+14	218677
## + sub_grade_D5	1	1.9434e+08	1.0245e+14	218677
## + sub_grade_F2	1	1.6325e+08	1.0245e+14	218677
## + sub_grade_C4	1	8.4261e+07	1.0245e+14	218677
## + loan_purpose_vacation	1	6.1768e+07	1.0245e+14	218677
## + sub_grade_C5	1	2.1536e+07	1.0245e+14	218677
## + loan_purpose_house	1	6.9961e+05	1.0245e+14	218677
## - sub_grade_E1	1	4.4711e+10	1.0250e+14	218677
## - sub_grade_A3	1	4.9516e+10	1.0250e+14	218678
## - loan_purpose_credit_card	1	5.2813e+10	1.0251e+14	218678
## - `loan_status_Charged Off`	1	5.5684e+10	1.0251e+14	218678
## - loan_amount	1	6.7139e+10	1.0252e+14	218679
## - sub_grade_A4	1	1.1998e+11	1.0257e+14	218684
## - sub_grade_A2	1	2.0658e+11	1.0266e+14	218692

```

## - sub_grade_A1          1 2.8309e+11 1.0274e+14 218699
## - delinq_2y             1 3.1554e+11 1.0277e+14 218702
## - term                  1 4.2959e+11 1.0288e+14 218713
## - `verified_income_Source Verified` 1 7.4019e+11 1.0319e+14 218741
## - interest_rate         1 7.6817e+11 1.0322e+14 218744
## - `verified_income_Not Verified`    1 9.3173e+11 1.0339e+14 218759
## - homeownership_OWEN    1 2.5329e+12 1.0499e+14 218904
## - annual_income         1 1.0872e+13 1.1333e+14 219627
## - total_credit_utilized  1 1.8967e+13 1.2142e+14 220280
## - homeownership_MORTGAGE 1 3.6837e+13 1.3929e+14 221579
##
## Step: AIC=218673.6
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_C3 + sub_grade_D2 + sub_grade_E1 + sub_grade_E3 +
## sub_grade_E4 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
## sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
## `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
## loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
## loan_purpose_renewable_energy + loan_purpose_small_business
##
##
## Df Sum of Sq RSS AIC
## - sub_grade_E3          1 3.8018e+09 1.0246e+14 218672
## - sub_grade_C3          1 8.1449e+09 1.0247e+14 218672
## + sub_grade_C2          1 3.4714e+10 1.0242e+14 218672
## - tax_liens             1 9.6729e+09 1.0247e+14 218672
## - loan_purpose_medical     1 1.0378e+10 1.0247e+14 218673
## - loan_purpose_renewable_energy 1 1.2138e+10 1.0247e+14 218673
## - loan_purpose_moving     1 1.3104e+10 1.0247e+14 218673
## - sub_grade_B4          1 1.3295e+10 1.0247e+14 218673
## - sub_grade_F5          1 1.5716e+10 1.0247e+14 218673
## - sub_grade_G1          1 1.6622e+10 1.0248e+14 218673
## - `loan_status_Fully Paid` 1 1.8010e+10 1.0248e+14 218673
## - loan_purpose_small_business 1 2.0538e+10 1.0248e+14 218673
## <none>                  1.0246e+14 218674
## - sub_grade_F4          1 2.2178e+10 1.0248e+14 218674
## - sub_grade_F1          1 2.3742e+10 1.0248e+14 218674
## - sub_grade_B1          1 2.5074e+10 1.0248e+14 218674
## - `loan_status_Late (16-30 days)` 1 2.6878e+10 1.0249e+14 218674
## - sub_grade_D2          1 2.7985e+10 1.0249e+14 218674
## - sub_grade_F3          1 3.4751e+10 1.0249e+14 218675
## + sub_grade_B2          1 8.5333e+09 1.0245e+14 218675
## - sub_grade_E4          1 3.6222e+10 1.0249e+14 218675
## + sub_grade_C1          1 6.8645e+09 1.0245e+14 218675
## + loan_purpose_major_purchase 1 5.4787e+09 1.0245e+14 218675
## + sub_grade_E5          1 4.8011e+09 1.0245e+14 218675
## + sub_grade_D3          1 4.4349e+09 1.0245e+14 218675
## + sub_grade_G4          1 3.3197e+09 1.0246e+14 218675
## + loan_status_Current   1 3.2547e+09 1.0246e+14 218675
## + `loan_status_Late (31-120 days)` 1 2.1502e+09 1.0246e+14 218675

```

```

## + loan_purpose_home_improvement      1 1.8309e+09 1.0246e+14 218675
## + sub_grade_A5                      1 1.8200e+09 1.0246e+14 218675
## + loan_purpose_other                  1 1.6664e+09 1.0246e+14 218675
## + sub_grade_B5                      1 1.5186e+09 1.0246e+14 218675
## + sub_grade_E2                      1 1.3748e+09 1.0246e+14 218675
## + loan_purpose_car                    1 1.3432e+09 1.0246e+14 218675
## + `loan_status_In Grace Period`     1 1.1477e+09 1.0246e+14 218675
## + sub_grade_B3                      1 1.1098e+09 1.0246e+14 218675
## + sub_grade_D5                      1 8.0729e+08 1.0246e+14 218676
## - sub_grade_E1                      1 4.2585e+10 1.0250e+14 218676
## + loan_purpose_debt_consolidation     1 6.7323e+08 1.0246e+14 218676
## + sub_grade_D4                      1 1.6711e+08 1.0246e+14 218676
## + sub_grade_C5                      1 1.4021e+08 1.0246e+14 218676
## + sub_grade_D1                      1 8.5132e+07 1.0246e+14 218676
## + loan_purpose_vacation               1 7.6805e+07 1.0246e+14 218676
## + sub_grade_F2                      1 6.6690e+07 1.0246e+14 218676
## + sub_grade_C4                      1 1.4496e+07 1.0246e+14 218676
## + loan_purpose_house                  1 8.1498e+05 1.0246e+14 218676
## - loan_purpose_credit_card            1 5.2922e+10 1.0251e+14 218676
## - sub_grade_A3                      1 5.5281e+10 1.0251e+14 218677
## - `loan_status_Charged Off`        1 5.5561e+10 1.0251e+14 218677
## - loan_amount                      1 6.7020e+10 1.0253e+14 218678
## - sub_grade_A4                      1 1.2912e+11 1.0259e+14 218684
## - sub_grade_A2                      1 2.2162e+11 1.0268e+14 218692
## - sub_grade_A1                      1 3.0239e+11 1.0276e+14 218699
## - delinq_2y                        1 3.1487e+11 1.0277e+14 218701
## - term                             1 4.3189e+11 1.0289e+14 218711
## - `verified_income_Source Verified` 1 7.4031e+11 1.0320e+14 218740
## - interest_rate                    1 8.3483e+11 1.0329e+14 218748
## - `verified_income_Not Verified`    1 9.3092e+11 1.0339e+14 218757
## - homeownership_OWEN               1 2.5325e+12 1.0499e+14 218903
## - annual_income                    1 1.0874e+13 1.1333e+14 219626
## - total_credit_utilized             1 1.8968e+13 1.2143e+14 220279
## - homeownership_MORTGAGE           1 3.6842e+13 1.3930e+14 221578
##
## Step: AIC=218671.9
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
##   sub_grade_C3 + sub_grade_D2 + sub_grade_E1 + sub_grade_E4 +
##   sub_grade_F1 + sub_grade_F3 + sub_grade_F4 + sub_grade_F5 +
##   sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
##   `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##           Df Sum of Sq      RSS      AIC
## - sub_grade_C3      1 7.7778e+09 1.0247e+14 218671
## + sub_grade_C2      1 3.5345e+10 1.0243e+14 218671
## - tax_liens         1 9.7765e+09 1.0247e+14 218671
## - loan_purpose_medical 1 1.0514e+10 1.0247e+14 218671

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## - loan_purpose_renewable_energy	1	1.2251e+10	1.0247e+14	218671
## - loan_purpose_moving	1	1.3037e+10	1.0248e+14	218671
## - sub_grade_B4	1	1.3755e+10	1.0248e+14	218671
## - sub_grade_F5	1	1.5203e+10	1.0248e+14	218671
## - sub_grade_G1	1	1.5769e+10	1.0248e+14	218671
## - `loan_status_Fully Paid`	1	1.8322e+10	1.0248e+14	218672
## - loan_purpose_small_business	1	2.0558e+10	1.0248e+14	218672
## - sub_grade_F4	1	2.1497e+10	1.0248e+14	218672
## <none>			1.0246e+14	218672
## - sub_grade_F1	1	2.2363e+10	1.0248e+14	218672
## - sub_grade_B1	1	2.6345e+10	1.0249e+14	218672
## - sub_grade_D2	1	2.6363e+10	1.0249e+14	218672
## - `loan_status_Late (16-30 days)`	1	2.6897e+10	1.0249e+14	218672
## - sub_grade_F3	1	3.3730e+10	1.0250e+14	218673
## + sub_grade_B2	1	9.2136e+09	1.0245e+14	218673
## - sub_grade_E4	1	3.4201e+10	1.0250e+14	218673
## + sub_grade_C1	1	6.9434e+09	1.0246e+14	218673
## + loan_purpose_major_purchase	1	5.4924e+09	1.0246e+14	218673
## + sub_grade_E3	1	3.8018e+09	1.0246e+14	218674
## + sub_grade_E5	1	3.6530e+09	1.0246e+14	218674
## + sub_grade_D3	1	3.4612e+09	1.0246e+14	218674
## + sub_grade_G4	1	3.4439e+09	1.0246e+14	218674
## + loan_status_Current	1	3.3037e+09	1.0246e+14	218674
## + sub_grade_A5	1	2.3904e+09	1.0246e+14	218674
## + `loan_status_Late (31-120 days)`	1	2.1738e+09	1.0246e+14	218674
## - sub_grade_E1	1	4.1239e+10	1.0250e+14	218674
## + loan_purpose_home_improvement	1	1.9273e+09	1.0246e+14	218674
## + loan_purpose_other	1	1.6438e+09	1.0246e+14	218674
## + sub_grade_B5	1	1.5663e+09	1.0246e+14	218674
## + sub_grade_D5	1	1.4021e+09	1.0246e+14	218674
## + loan_purpose_car	1	1.3517e+09	1.0246e+14	218674
## + sub_grade_B3	1	1.3050e+09	1.0246e+14	218674
## + `loan_status_In Grace Period`	1	1.1714e+09	1.0246e+14	218674
## + sub_grade_E2	1	1.0231e+09	1.0246e+14	218674
## + loan_purpose_debt_consolidation	1	6.2253e+08	1.0246e+14	218674
## + sub_grade_C5	1	2.7511e+08	1.0246e+14	218674
## + loan_purpose_vacation	1	8.7957e+07	1.0246e+14	218674
## + sub_grade_D4	1	3.3004e+07	1.0246e+14	218674
## + sub_grade_F2	1	2.7770e+07	1.0246e+14	218674
## + sub_grade_D1	1	1.6821e+07	1.0246e+14	218674
## + loan_purpose_house	1	3.0072e+04	1.0246e+14	218674
## + sub_grade_C4	1	1.8523e+04	1.0246e+14	218674
## - loan_purpose_credit_card	1	5.2722e+10	1.0252e+14	218675
## - `loan_status_Charged Off`	1	5.5482e+10	1.0252e+14	218675
## - sub_grade_A3	1	5.8801e+10	1.0252e+14	218675
## - loan_amount	1	6.7176e+10	1.0253e+14	218676
## - sub_grade_A4	1	1.3450e+11	1.0260e+14	218682
## - sub_grade_A2	1	2.3045e+11	1.0269e+14	218691
## - sub_grade_A1	1	3.1353e+11	1.0278e+14	218699
## - delinq_2y	1	3.1470e+11	1.0278e+14	218699
## - term	1	4.3363e+11	1.0290e+14	218710
## - `verified_income_Source Verified`	1	7.3820e+11	1.0320e+14	218738

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## - interest_rate          1 8.7110e+11 1.0333e+14 218750
## - `verified_income_Not Verified` 1 9.2799e+11 1.0339e+14 218755
## - homeownership_OWEN    1 2.5306e+12 1.0499e+14 218901
## - annual_income          1 1.0877e+13 1.1334e+14 219624
## - total_credit_utilized   1 1.8970e+13 1.2143e+14 220277
## - homeownership_MORTGAGE 1 3.6848e+13 1.3931e+14 221576
##
## Step: AIC=218670.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
##   sub_grade_D2 + sub_grade_E1 + sub_grade_E4 + sub_grade_F1 +
##   sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
##   homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
##   `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
##   loan_purpose_renewable_energy + loan_purpose_small_business
##
##              Df Sum of Sq      RSS    AIC
## + sub_grade_C2      1 3.8220e+10 1.0243e+14 218669
## - tax_liens          1 9.8587e+09 1.0248e+14 218670
## - loan_purpose_medical 1 1.0545e+10 1.0248e+14 218670
## - sub_grade_B4       1 1.2163e+10 1.0248e+14 218670
## - loan_purpose_renewable_energy 1 1.2396e+10 1.0248e+14 218670
## - loan_purpose_moving  1 1.2969e+10 1.0248e+14 218670
## - sub_grade_F5       1 1.5056e+10 1.0249e+14 218670
## - sub_grade_G1       1 1.5491e+10 1.0249e+14 218670
## - `loan_status_Fully Paid` 1 1.8560e+10 1.0249e+14 218670
## - loan_purpose_small_business 1 1.9909e+10 1.0249e+14 218670
## - sub_grade_F4       1 2.1297e+10 1.0249e+14 218671
## <none>              1.0247e+14 218671
## - sub_grade_F1      1 2.1850e+10 1.0249e+14 218671
## - sub_grade_B1      1 2.4145e+10 1.0249e+14 218671
## - sub_grade_D2      1 2.4692e+10 1.0249e+14 218671
## - `loan_status_Late (16-30 days)` 1 2.6756e+10 1.0250e+14 218671
## - sub_grade_E4      1 3.3220e+10 1.0250e+14 218672
## - sub_grade_F3      1 3.3391e+10 1.0250e+14 218672
## + sub_grade_C1      1 8.3899e+09 1.0246e+14 218672
## + sub_grade_C3      1 7.7778e+09 1.0246e+14 218672
## + sub_grade_B2      1 7.4206e+09 1.0246e+14 218672
## + loan_purpose_major_purchase 1 5.5249e+09 1.0246e+14 218672
## + sub_grade_G4      1 3.4722e+09 1.0247e+14 218672
## + sub_grade_E3      1 3.4347e+09 1.0247e+14 218672
## + loan_status_Current 1 3.4207e+09 1.0247e+14 218672
## + sub_grade_E5      1 3.2533e+09 1.0247e+14 218672
## - sub_grade_E1      1 4.0446e+10 1.0251e+14 218672
## + sub_grade_D3      1 2.7612e+09 1.0247e+14 218672
## + `loan_status_Late (31-120 days)` 1 2.2125e+09 1.0247e+14 218672
## + loan_purpose_home_improvement 1 1.9735e+09 1.0247e+14 218672
## + sub_grade_D5      1 1.8606e+09 1.0247e+14 218672
## + loan_purpose_other   1 1.7389e+09 1.0247e+14 218672

```

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## + sub_grade_A5          1 1.6379e+09 1.0247e+14 218673
## + loan_purpose_car        1 1.4243e+09 1.0247e+14 218673
## + `loan_status_In Grace Period` 1 1.2414e+09 1.0247e+14 218673
## + sub_grade_B5          1 9.2983e+08 1.0247e+14 218673
## + sub_grade_E2          1 8.7022e+08 1.0247e+14 218673
## + sub_grade_B3          1 7.6870e+08 1.0247e+14 218673
## + loan_purpose_debt_consolidation 1 6.6254e+08 1.0247e+14 218673
## + sub_grade_C5          1 5.8153e+08 1.0247e+14 218673
## + loan_purpose_vacation   1 8.4543e+07 1.0247e+14 218673
## + sub_grade_C4          1 5.8219e+07 1.0247e+14 218673
## + sub_grade_F2          1 1.8882e+07 1.0247e+14 218673
## + sub_grade_D1          1 4.2880e+06 1.0247e+14 218673
## + loan_purpose_house      1 3.2540e+06 1.0247e+14 218673
## + sub_grade_D4          1 1.7326e+05 1.0247e+14 218673
## - loan_purpose_credit_card 1 5.2585e+10 1.0252e+14 218674
## - `loan_status_Charged Off` 1 5.5215e+10 1.0253e+14 218674
## - sub_grade_A3          1 5.6122e+10 1.0253e+14 218674
## - loan_amount           1 6.7604e+10 1.0254e+14 218675
## - sub_grade_A4          1 1.3036e+11 1.0260e+14 218681
## - sub_grade_A2          1 2.2580e+11 1.0270e+14 218689
## - sub_grade_A1          1 3.0861e+11 1.0278e+14 218697
## - delinq_2y             1 3.1586e+11 1.0279e+14 218698
## - term                  1 4.3512e+11 1.0291e+14 218709
## - `verified_income_Source Verified` 1 7.3872e+11 1.0321e+14 218737
## - interest_rate         1 8.7225e+11 1.0334e+14 218749
## - `verified_income_Not Verified` 1 9.2901e+11 1.0340e+14 218754
## - homeownership_OWN     1 2.5308e+12 1.0500e+14 218899
## - annual_income         1 1.0870e+13 1.1334e+14 219623
## - total_credit_utilized  1 1.8968e+13 1.2144e+14 220275
## - homeownership_MORTGAGE 1 3.6855e+13 1.3932e+14 221575
##
## Step: AIC=218669.1
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_B4 +
## sub_grade_D2 + sub_grade_E1 + sub_grade_E4 + sub_grade_F1 +
## sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
## homeownership_MORTGAGE + homeownership_OWN + `loan_status_Charged Off` +
## `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
## loan_purpose_credit_card + loan_purpose_medical + loan_purpose_moving +
## loan_purpose_renewable_energy + loan_purpose_small_business +
## sub_grade_C2
##
## Df Sum of Sq RSS AIC
## - sub_grade_B4 1 8.1950e+09 1.0244e+14 218668
## - tax_liens 1 9.6338e+09 1.0244e+14 218668
## - loan_purpose_medical 1 1.0281e+10 1.0244e+14 218668
## - loan_purpose_renewable_energy 1 1.2761e+10 1.0244e+14 218668
## - loan_purpose_moving 1 1.3292e+10 1.0245e+14 218668
## - sub_grade_F5 1 1.4879e+10 1.0245e+14 218668
## - sub_grade_G1 1 1.5172e+10 1.0245e+14 218669

```


## - sub_grade_B1	1	1.8138e+10	1.0245e+14	218669
## - `loan_status_Fully Paid`	1	1.8780e+10	1.0245e+14	218669
## - loan_purpose_small_business	1	1.9607e+10	1.0245e+14	218669
## - sub_grade_F4	1	2.1015e+10	1.0245e+14	218669
## - sub_grade_D2	1	2.1052e+10	1.0245e+14	218669
## - sub_grade_F1	1	2.1196e+10	1.0245e+14	218669
## <none>			1.0243e+14	218669
## - `loan_status_Late (16-30 days)`	1	2.6399e+10	1.0246e+14	218670
## + sub_grade_C1	1	1.2892e+10	1.0242e+14	218670
## - sub_grade_E4	1	3.1645e+10	1.0246e+14	218670
## - sub_grade_F3	1	3.2945e+10	1.0247e+14	218670
## + loan_purpose_major_purchase	1	5.5333e+09	1.0243e+14	218671
## - sub_grade_C2	1	3.8220e+10	1.0247e+14	218671
## + sub_grade_C3	1	4.9030e+09	1.0243e+14	218671
## - sub_grade_E1	1	3.8978e+10	1.0247e+14	218671
## + sub_grade_B2	1	3.8505e+09	1.0243e+14	218671
## + sub_grade_G4	1	3.4865e+09	1.0243e+14	218671
## + loan_status_Current	1	3.2415e+09	1.0243e+14	218671
## + sub_grade_D5	1	2.9189e+09	1.0243e+14	218671
## + sub_grade_E3	1	2.8827e+09	1.0243e+14	218671
## + sub_grade_E5	1	2.7052e+09	1.0243e+14	218671
## + `loan_status_Late (31-120 days)`	1	2.2106e+09	1.0243e+14	218671
## + loan_purpose_home_improvement	1	1.9013e+09	1.0243e+14	218671
## + sub_grade_C5	1	1.7066e+09	1.0243e+14	218671
## + sub_grade_D3	1	1.6068e+09	1.0243e+14	218671
## + loan_purpose_other	1	1.5995e+09	1.0243e+14	218671
## + loan_purpose_car	1	1.5702e+09	1.0243e+14	218671
## + `loan_status_In Grace Period`	1	1.0938e+09	1.0243e+14	218671
## + sub_grade_C4	1	6.6065e+08	1.0243e+14	218671
## + sub_grade_E2	1	6.3727e+08	1.0243e+14	218671
## + loan_purpose_debt_consolidation	1	6.2755e+08	1.0243e+14	218671
## + sub_grade_A5	1	3.0564e+08	1.0243e+14	218671
## + sub_grade_D1	1	2.3709e+08	1.0243e+14	218671
## + sub_grade_D4	1	9.7944e+07	1.0243e+14	218671
## + loan_purpose_vacation	1	9.0013e+07	1.0243e+14	218671
## + sub_grade_B5	1	6.8885e+07	1.0243e+14	218671
## + sub_grade_B3	1	3.4959e+07	1.0243e+14	218671
## + loan_purpose_house	1	1.1817e+07	1.0243e+14	218671
## + sub_grade_F2	1	1.0060e+07	1.0243e+14	218671
## - sub_grade_A3	1	4.7530e+10	1.0248e+14	218672
## - loan_purpose_credit_card	1	5.0974e+10	1.0248e+14	218672
## - `loan_status_Charged Off`	1	5.4502e+10	1.0249e+14	218672
## - loan_amount	1	6.5875e+10	1.0250e+14	218673
## - sub_grade_A4	1	1.1589e+11	1.0255e+14	218678
## - sub_grade_A2	1	2.0778e+11	1.0264e+14	218686
## - sub_grade_A1	1	2.8848e+11	1.0272e+14	218694
## - delinq_2y	1	3.1384e+11	1.0275e+14	218696
## - term	1	4.3790e+11	1.0287e+14	218707
## - `verified_income_Source Verified`	1	7.3771e+11	1.0317e+14	218735
## - interest_rate	1	8.8515e+11	1.0332e+14	218749
## - `verified_income_Not Verified`	1	9.3472e+11	1.0337e+14	218753
## - homeownership_OWEN	1	2.5162e+12	1.0495e+14	218897

```

## - annual_income          1 1.0877e+13 1.1331e+14 219622
## - total_credit_utilized   1 1.8966e+13 1.2140e+14 220274
## - homeownership_MORTGAGE 1 3.6840e+13 1.3927e+14 221574
##
## Step: AIC=218667.9
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + tax_liens + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_D2 +
##   sub_grade_E1 + sub_grade_E4 + sub_grade_F1 + sub_grade_F3 +
##   sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##   homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
##   `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
##   loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
##   loan_purpose_small_business + sub_grade_C2
##
##
##           Df Sum of Sq      RSS   AIC
## - tax_liens          1 9.6146e+09 1.0245e+14 218667
## - loan_purpose_medical  1 1.0132e+10 1.0245e+14 218667
## - loan_purpose_renewable_energy 1 1.2845e+10 1.0245e+14 218667
## - loan_purpose_moving   1 1.3355e+10 1.0245e+14 218667
## - sub_grade_B1        1 1.4838e+10 1.0246e+14 218667
## - sub_grade_F5        1 1.5232e+10 1.0246e+14 218667
## - sub_grade_G1        1 1.5728e+10 1.0246e+14 218667
## - `loan_status_Fully Paid` 1 1.8509e+10 1.0246e+14 218668
## - loan_purpose_small_business 1 1.9353e+10 1.0246e+14 218668
## - sub_grade_D2        1 2.0504e+10 1.0246e+14 218668
## - sub_grade_F4        1 2.1450e+10 1.0246e+14 218668
## <none>                                1.0244e+14 218668
## - sub_grade_F1        1 2.2086e+10 1.0246e+14 218668
## - `loan_status_Late (16-30 days)` 1 2.6043e+10 1.0247e+14 218668
## + sub_grade_C1        1 1.5411e+10 1.0242e+14 218668
## - sub_grade_E4        1 3.2761e+10 1.0247e+14 218669
## - sub_grade_F3        1 3.3613e+10 1.0247e+14 218669
## + sub_grade_B4        1 8.1950e+09 1.0243e+14 218669
## + loan_purpose_major_purchase 1 5.6045e+09 1.0243e+14 218669
## - sub_grade_E1        1 3.9357e+10 1.0248e+14 218670
## + sub_grade_C3        1 3.7584e+09 1.0244e+14 218670
## + sub_grade_G4        1 3.3859e+09 1.0244e+14 218670
## + loan_status_Current  1 3.2616e+09 1.0244e+14 218670
## + sub_grade_E3        1 3.1939e+09 1.0244e+14 218670
## + sub_grade_E5        1 3.1479e+09 1.0244e+14 218670
## + sub_grade_D5        1 2.7251e+09 1.0244e+14 218670
## + `loan_status_Late (31-120 days)` 1 2.2459e+09 1.0244e+14 218670
## + sub_grade_C5        1 2.1970e+09 1.0244e+14 218670
## + sub_grade_B2        1 1.9466e+09 1.0244e+14 218670
## + loan_purpose_home_improvement 1 1.9281e+09 1.0244e+14 218670
## + loan_purpose_car      1 1.6074e+09 1.0244e+14 218670
## + loan_purpose_other    1 1.5975e+09 1.0244e+14 218670
## + sub_grade_D3        1 1.5372e+09 1.0244e+14 218670
## - sub_grade_C2        1 4.2188e+10 1.0248e+14 218670
## + `loan_status_In Grace Period` 1 1.0856e+09 1.0244e+14 218670

```

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## + sub_grade_C4          1 1.0678e+09 1.0244e+14 218670
## - sub_grade_A3          1 4.2261e+10 1.0248e+14 218670
## + sub_grade_E2          1 7.3143e+08 1.0244e+14 218670
## + loan_purpose_debt_consolidation 1 6.2345e+08 1.0244e+14 218670
## + sub_grade_D1          1 3.4237e+08 1.0244e+14 218670
## + loan_purpose_vacation    1 9.9109e+07 1.0244e+14 218670
## + sub_grade_D4          1 9.6795e+07 1.0244e+14 218670
## + sub_grade_B3          1 7.6020e+07 1.0244e+14 218670
## + sub_grade_F2          1 2.4435e+07 1.0244e+14 218670
## + sub_grade_B5          1 2.2192e+07 1.0244e+14 218670
## + loan_purpose_house       1 1.1069e+07 1.0244e+14 218670
## + sub_grade_A5          1 1.3679e+06 1.0244e+14 218670
## - loan_purpose_credit_card 1 5.0501e+10 1.0249e+14 218671
## - `loan_status_Charged Off` 1 5.4168e+10 1.0249e+14 218671
## - loan_amount           1 6.5591e+10 1.0251e+14 218672
## - sub_grade_A4          1 1.0875e+11 1.0255e+14 218676
## - sub_grade_A2          1 1.9973e+11 1.0264e+14 218684
## - sub_grade_A1          1 2.8029e+11 1.0272e+14 218692
## - delinq_2y             1 3.1404e+11 1.0275e+14 218695
## - term                  1 4.3524e+11 1.0288e+14 218706
## - `verified_income_Source Verified` 1 7.3580e+11 1.0318e+14 218734
## - `verified_income_Not Verified` 1 9.3543e+11 1.0338e+14 218752
## - interest_rate         1 9.5953e+11 1.0340e+14 218754
## - homeownership_OWEN    1 2.5188e+12 1.0496e+14 218896
## - annual_income         1 1.0882e+13 1.1332e+14 219621
## - total_credit_utilized  1 1.8967e+13 1.2141e+14 220273
## - homeownership_MORTGAGE 1 3.6842e+13 1.3928e+14 221573
##
## Step: AIC=218666.8
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_D2 +
##   sub_grade_E1 + sub_grade_E4 + sub_grade_F1 + sub_grade_F3 +
##   sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##   homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
##   `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
##   loan_purpose_medical + loan_purpose_moving + loan_purpose_renewable_energy +
##   loan_purpose_small_business + sub_grade_C2
##
##
##           Df Sum of Sq      RSS      AIC
## - loan_purpose_medical      1 1.0202e+10 1.0246e+14 218666
## - loan_purpose_renewable_energy 1 1.2805e+10 1.0246e+14 218666
## - loan_purpose_moving       1 1.3410e+10 1.0246e+14 218666
## - sub_grade_B1            1 1.4773e+10 1.0246e+14 218666
## - sub_grade_F5            1 1.5091e+10 1.0246e+14 218666
## - sub_grade_G1            1 1.5848e+10 1.0247e+14 218666
## - `loan_status_Fully Paid` 1 1.8704e+10 1.0247e+14 218666
## - loan_purpose_small_business 1 1.9328e+10 1.0247e+14 218667
## - sub_grade_D2            1 2.0553e+10 1.0247e+14 218667
## - sub_grade_F4            1 2.1541e+10 1.0247e+14 218667
## <none>                    1.0245e+14 218667

```

## - sub_grade_F1	1	2.2181e+10	1.0247e+14	218667
## - `loan_status_Late (16-30 days)`	1	2.6127e+10	1.0248e+14	218667
## + sub_grade_C1	1	1.5488e+10	1.0243e+14	218667
## - sub_grade_E4	1	3.2967e+10	1.0248e+14	218668
## - sub_grade_F3	1	3.3528e+10	1.0248e+14	218668
## + tax_liens	1	9.6146e+09	1.0244e+14	218668
## + sub_grade_B4	1	8.1758e+09	1.0244e+14	218668
## + loan_purpose_major_purchase	1	5.4832e+09	1.0244e+14	218668
## + sub_grade_C3	1	3.8095e+09	1.0245e+14	218668
## - sub_grade_E1	1	3.9538e+10	1.0249e+14	218668
## + sub_grade_G4	1	3.3656e+09	1.0245e+14	218668
## + sub_grade_E3	1	3.2843e+09	1.0245e+14	218668
## + sub_grade_E5	1	3.2089e+09	1.0245e+14	218668
## + loan_status_Current	1	3.1962e+09	1.0245e+14	218668
## + sub_grade_D5	1	2.7207e+09	1.0245e+14	218669
## + `loan_status_Late (31-120 days)`	1	2.2143e+09	1.0245e+14	218669
## + sub_grade_C5	1	2.1882e+09	1.0245e+14	218669
## + loan_purpose_home_improvement	1	1.9755e+09	1.0245e+14	218669
## + sub_grade_B2	1	1.9197e+09	1.0245e+14	218669
## + loan_purpose_other	1	1.6028e+09	1.0245e+14	218669
## + sub_grade_D3	1	1.6022e+09	1.0245e+14	218669
## + loan_purpose_car	1	1.5769e+09	1.0245e+14	218669
## + sub_grade_C4	1	1.0822e+09	1.0245e+14	218669
## - sub_grade_A3	1	4.2253e+10	1.0249e+14	218669
## + `loan_status_In Grace Period`	1	1.0546e+09	1.0245e+14	218669
## - sub_grade_C2	1	4.2421e+10	1.0249e+14	218669
## + sub_grade_E2	1	7.6394e+08	1.0245e+14	218669
## + loan_purpose_debt_consolidation	1	5.9010e+08	1.0245e+14	218669
## + sub_grade_D1	1	5.2978e+08	1.0245e+14	218669
## + loan_purpose_vacation	1	8.7281e+07	1.0245e+14	218669
## + sub_grade_D4	1	7.2332e+07	1.0245e+14	218669
## + sub_grade_B3	1	6.5780e+07	1.0245e+14	218669
## + sub_grade_F2	1	2.8590e+07	1.0245e+14	218669
## + sub_grade_B5	1	1.8730e+07	1.0245e+14	218669
## + loan_purpose_house	1	1.0418e+07	1.0245e+14	218669
## + sub_grade_A5	1	1.2218e+05	1.0245e+14	218669
## - loan_purpose_credit_card	1	5.0044e+10	1.0250e+14	218669
## - `loan_status_Charged Off`	1	5.3992e+10	1.0250e+14	218670
## - loan_amount	1	6.5398e+10	1.0252e+14	218671
## - sub_grade_A4	1	1.0924e+11	1.0256e+14	218675
## - sub_grade_A2	1	2.0041e+11	1.0265e+14	218683
## - sub_grade_A1	1	2.8071e+11	1.0273e+14	218691
## - delinq_2y	1	3.1509e+11	1.0276e+14	218694
## - term	1	4.3811e+11	1.0289e+14	218705
## - `verified_income_Source Verified`	1	7.3693e+11	1.0319e+14	218733
## - `verified_income_Not Verified`	1	9.3858e+11	1.0339e+14	218751
## - interest_rate	1	9.6361e+11	1.0341e+14	218753
## - homeownership_OWEN	1	2.5179e+12	1.0497e+14	218894
## - annual_income	1	1.0873e+13	1.1332e+14	219619
## - total_credit_utilized	1	1.8980e+13	1.2143e+14	220273
## - homeownership_MORTGAGE	1	3.6841e+13	1.3929e+14	221571
##				

```

## Step: AIC=218665.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_D2 +
##   sub_grade_E1 + sub_grade_E4 + sub_grade_F1 + sub_grade_F3 +
##   sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##   homeownership_OWN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
##   `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
##   loan_purpose_moving + loan_purpose_renewable_energy + loan_purpose_small_business +
##   sub_grade_C2
##
##
##           Df Sum of Sq      RSS      AIC
## - loan_purpose_renewable_energy    1 1.2956e+10 1.0247e+14 218665
## - loan_purpose_moving              1 1.3863e+10 1.0247e+14 218665
## - sub_grade_B1                   1 1.5007e+10 1.0248e+14 218665
## - sub_grade_F5                   1 1.5082e+10 1.0248e+14 218665
## - sub_grade_G1                   1 1.5794e+10 1.0248e+14 218665
## - `loan_status_Fully Paid`       1 1.9205e+10 1.0248e+14 218665
## - loan_purpose_small_business      1 1.9836e+10 1.0248e+14 218666
## - sub_grade_D2                   1 2.0185e+10 1.0248e+14 218666
## - sub_grade_F4                   1 2.1416e+10 1.0248e+14 218666
## <none>                           1.0246e+14 218666
## - sub_grade_F1                   1 2.2499e+10 1.0248e+14 218666
## - `loan_status_Late (16-30 days)` 1 2.5855e+10 1.0249e+14 218666
## + sub_grade_C1                   1 1.5202e+10 1.0244e+14 218666
## - sub_grade_E4                   1 3.3008e+10 1.0249e+14 218667
## + loan_purpose_medical             1 1.0202e+10 1.0245e+14 218667
## - sub_grade_F3                   1 3.3414e+10 1.0249e+14 218667
## + tax_liens                      1 9.6841e+09 1.0245e+14 218667
## + sub_grade_B4                   1 8.0264e+09 1.0245e+14 218667
## + loan_purpose_major_purchase      1 5.9648e+09 1.0245e+14 218667
## - sub_grade_E1                   1 3.9148e+10 1.0250e+14 218667
## + sub_grade_C3                   1 3.8325e+09 1.0246e+14 218667
## + sub_grade_E3                   1 3.4037e+09 1.0246e+14 218667
## + sub_grade_G4                   1 3.3529e+09 1.0246e+14 218667
## + sub_grade_E5                   1 3.0752e+09 1.0246e+14 218667
## + loan_status_Current            1 2.8619e+09 1.0246e+14 218667
## + sub_grade_D5                   1 2.7812e+09 1.0246e+14 218667
## + loan_purpose_other               1 2.1664e+09 1.0246e+14 218668
## + sub_grade_C5                   1 2.1632e+09 1.0246e+14 218668
## + sub_grade_B2                   1 2.0144e+09 1.0246e+14 218668
## + `loan_status_Late (31-120 days)` 1 1.9215e+09 1.0246e+14 218668
## + sub_grade_D3                   1 1.6884e+09 1.0246e+14 218668
## + loan_purpose_home_improvement    1 1.5754e+09 1.0246e+14 218668
## + loan_purpose_car                 1 1.3796e+09 1.0246e+14 218668
## + `loan_status_In Grace Period`  1 9.8775e+08 1.0246e+14 218668
## + sub_grade_C4                   1 9.8279e+08 1.0246e+14 218668
## - sub_grade_A3                   1 4.2443e+10 1.0250e+14 218668
## + sub_grade_E2                   1 7.1406e+08 1.0246e+14 218668
## - sub_grade_C2                   1 4.2666e+10 1.0250e+14 218668
## + sub_grade_D1                   1 5.7730e+08 1.0246e+14 218668

```

```

## + loan_purpose_vacation      1 1.2575e+08 1.0246e+14 218668
## + sub_grade_B3             1 9.7331e+07 1.0246e+14 218668
## + sub_grade_D4             1 6.9425e+07 1.0246e+14 218668
## + sub_grade_B5             1 3.1485e+07 1.0246e+14 218668
## + loan_purpose_house         1 2.9580e+07 1.0246e+14 218668
## + sub_grade_F2             1 2.5164e+07 1.0246e+14 218668
## + loan_purpose_debt_consolidation 1 5.9820e+06 1.0246e+14 218668
## + sub_grade_A5             1 2.2950e+03 1.0246e+14 218668
## - loan_purpose_credit_card   1 5.3648e+10 1.0251e+14 218669
## - `loan_status_Charged Off` 1 5.3766e+10 1.0251e+14 218669
## - loan_amount              1 6.2835e+10 1.0252e+14 218670
## - sub_grade_A4             1 1.0948e+11 1.0257e+14 218674
## - sub_grade_A2             1 2.0096e+11 1.0266e+14 218682
## - sub_grade_A1             1 2.8000e+11 1.0274e+14 218690
## - delinq_2y                1 3.1505e+11 1.0278e+14 218693
## - term                     1 4.3703e+11 1.0290e+14 218704
## - `verified_income_Source Verified` 1 7.3540e+11 1.0320e+14 218731
## - `verified_income_Not Verified` 1 9.4086e+11 1.0340e+14 218750
## - interest_rate            1 9.6384e+11 1.0342e+14 218752
## - homeownership_OWEN      1 2.5225e+12 1.0498e+14 218894
## - annual_income            1 1.0880e+13 1.1334e+14 219619
## - total_credit_utilized    1 1.8983e+13 1.2144e+14 220272
## - homeownership_MORTGAGE   1 3.6836e+13 1.3930e+14 221569
##
## Step: AIC=218664.9
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_D2 +
##   sub_grade_E1 + sub_grade_E4 + sub_grade_F1 + sub_grade_F3 +
##   sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##   homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
##   `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
##   loan_purpose_moving + loan_purpose_small_business + sub_grade_C2
##
##           Df Sum of Sq      RSS      AIC
## - loan_purpose_moving      1 1.3683e+10 1.0249e+14 218664
## - sub_grade_B1           1 1.4701e+10 1.0249e+14 218664
## - sub_grade_F5           1 1.5138e+10 1.0249e+14 218664
## - sub_grade_G1           1 1.5895e+10 1.0249e+14 218664
## - `loan_status_Fully Paid` 1 1.9454e+10 1.0249e+14 218665
## - loan_purpose_small_business 1 1.9694e+10 1.0249e+14 218665
## - sub_grade_D2           1 2.0536e+10 1.0249e+14 218665
## - sub_grade_F4           1 2.1527e+10 1.0249e+14 218665
## <none>                                1.0247e+14 218665
## - sub_grade_F1           1 2.2691e+10 1.0250e+14 218665
## - `loan_status_Late (16-30 days)` 1 2.5962e+10 1.0250e+14 218665
## + sub_grade_C1           1 1.5419e+10 1.0246e+14 218665
## + loan_purpose_renewable_energy 1 1.2956e+10 1.0246e+14 218666
## + loan_purpose_medical     1 1.0354e+10 1.0246e+14 218666
## - sub_grade_E4           1 3.3352e+10 1.0251e+14 218666
## - sub_grade_F3           1 3.3562e+10 1.0251e+14 218666

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## + tax_liens 1 9.6443e+09 1.0246e+14 218666
## + sub_grade_B4 1 8.1081e+09 1.0246e+14 218666
## + loan_purpose_major_purchase 1 5.8213e+09 1.0247e+14 218666
## - sub_grade_E1 1 3.9378e+10 1.0251e+14 218667
## + sub_grade_C3 1 3.9433e+09 1.0247e+14 218667
## + sub_grade_E3 1 3.5157e+09 1.0247e+14 218667
## + sub_grade_G4 1 3.3512e+09 1.0247e+14 218667
## + loan_status_Current 1 2.8156e+09 1.0247e+14 218667
## + sub_grade_E5 1 2.7269e+09 1.0247e+14 218667
## + sub_grade_D5 1 2.6177e+09 1.0247e+14 218667
## + sub_grade_C5 1 2.2301e+09 1.0247e+14 218667
## + sub_grade_B2 1 2.0437e+09 1.0247e+14 218667
## + loan_purpose_other 1 2.0035e+09 1.0247e+14 218667
## + `loan_status_Late (31-120 days)` 1 1.8932e+09 1.0247e+14 218667
## + loan_purpose_home_improvement 1 1.6669e+09 1.0247e+14 218667
## + sub_grade_D3 1 1.6116e+09 1.0247e+14 218667
## + loan_purpose_car 1 1.4348e+09 1.0247e+14 218667
## - sub_grade_A3 1 4.2293e+10 1.0252e+14 218667
## - sub_grade_C2 1 4.2296e+10 1.0252e+14 218667
## + sub_grade_C4 1 1.0287e+09 1.0247e+14 218667
## + `loan_status_In Grace Period` 1 9.6980e+08 1.0247e+14 218667
## + sub_grade_E2 1 7.5421e+08 1.0247e+14 218667
## + sub_grade_D1 1 5.2412e+08 1.0247e+14 218667
## + loan_purpose_vacation 1 1.1373e+08 1.0247e+14 218667
## + sub_grade_B3 1 8.9997e+07 1.0247e+14 218667
## + loan_purpose_debt_consolidation 1 6.6724e+07 1.0247e+14 218667
## + sub_grade_D4 1 5.0778e+07 1.0247e+14 218667
## + sub_grade_B5 1 4.3199e+07 1.0247e+14 218667
## + sub_grade_F2 1 2.9425e+07 1.0247e+14 218667
## + loan_purpose_house 1 2.2634e+07 1.0247e+14 218667
## + sub_grade_A5 1 2.1800e+03 1.0247e+14 218667
## - loan_purpose_credit_card 1 5.2840e+10 1.0253e+14 218668
## - `loan_status_Charged Off` 1 5.3828e+10 1.0253e+14 218668
## - loan_amount 1 6.4297e+10 1.0254e+14 218669
## - sub_grade_A4 1 1.0936e+11 1.0258e+14 218673
## - sub_grade_A2 1 1.9797e+11 1.0267e+14 218681
## - sub_grade_A1 1 2.7938e+11 1.0275e+14 218689
## - delinq_2y 1 3.1562e+11 1.0279e+14 218692
## - term 1 4.3477e+11 1.0291e+14 218703
## - `verified_income_Source Verified` 1 7.3480e+11 1.0321e+14 218731
## - `verified_income_Not Verified` 1 9.3733e+11 1.0341e+14 218749
## - interest_rate 1 9.6696e+11 1.0344e+14 218752
## - homeownership_OWEN 1 2.5282e+12 1.0500e+14 218893
## - annual_income 1 1.0876e+13 1.1335e+14 219617
## - total_credit_utilized 1 1.8980e+13 1.2145e+14 220271
## - homeownership_MORTGAGE 1 3.6851e+13 1.3932e+14 221569
##
## Step: AIC=218664.2
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
## sub_grade_A3 + sub_grade_A4 + sub_grade_B1 + sub_grade_D2 +

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##      sub_grade_E1 + sub_grade_E4 + sub_grade_F1 + sub_grade_F3 +
##      sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE +
##      homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Fully Paid` +
##      `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
##      loan_purpose_small_business + sub_grade_C2
##
##
##      Df  Sum of Sq      RSS    AIC
## - sub_grade_B1      1 1.4188e+10 1.0250e+14 218663
## - sub_grade_F5      1 1.5217e+10 1.0250e+14 218664
## - sub_grade_G1      1 1.5964e+10 1.0250e+14 218664
## - `loan_status_Fully Paid`      1 1.8953e+10 1.0251e+14 218664
## - loan_purpose_small_business      1 1.9259e+10 1.0251e+14 218664
## - sub_grade_D2      1 2.1033e+10 1.0251e+14 218664
## <none>                                1.0249e+14 218664
## - sub_grade_F4      1 2.1703e+10 1.0251e+14 218664
## - sub_grade_F1      1 2.2864e+10 1.0251e+14 218664
## - `loan_status_Late (16-30 days)`      1 2.5416e+10 1.0251e+14 218665
## + sub_grade_C1      1 1.5478e+10 1.0247e+14 218665
## + loan_purpose_moving      1 1.3683e+10 1.0247e+14 218665
## + loan_purpose_renewable_energy      1 1.2776e+10 1.0247e+14 218665
## + loan_purpose_medical      1 1.0807e+10 1.0248e+14 218665
## - sub_grade_E4      1 3.3200e+10 1.0252e+14 218665
## + tax_liens      1 9.7011e+09 1.0248e+14 218665
## - sub_grade_F3      1 3.3707e+10 1.0252e+14 218665
## + sub_grade_B4      1 8.1676e+09 1.0248e+14 218665
## + loan_purpose_major_purchase      1 5.4054e+09 1.0248e+14 218666
## - sub_grade_E1      1 3.8923e+10 1.0253e+14 218666
## + sub_grade_C3      1 3.8998e+09 1.0248e+14 218666
## + sub_grade_E3      1 3.4572e+09 1.0248e+14 218666
## + sub_grade_G4      1 3.3137e+09 1.0248e+14 218666
## + loan_status_Current      1 2.8169e+09 1.0248e+14 218666
## + sub_grade_E5      1 2.7290e+09 1.0248e+14 218666
## + sub_grade_D5      1 2.5458e+09 1.0248e+14 218666
## + sub_grade_C5      1 2.3094e+09 1.0248e+14 218666
## + `loan_status_Late (31-120 days)`      1 1.9636e+09 1.0248e+14 218666
## + sub_grade_B2      1 1.9310e+09 1.0248e+14 218666
## + loan_purpose_home_improvement      1 1.8842e+09 1.0248e+14 218666
## + sub_grade_D3      1 1.6332e+09 1.0249e+14 218666
## + loan_purpose_car      1 1.5953e+09 1.0249e+14 218666
## - sub_grade_A3      1 4.1814e+10 1.0253e+14 218666
## + loan_purpose_other      1 1.5216e+09 1.0249e+14 218666
## - sub_grade_C2      1 4.1972e+10 1.0253e+14 218666
## + sub_grade_C4      1 1.0754e+09 1.0249e+14 218666
## + `loan_status_In Grace Period`      1 9.2165e+08 1.0249e+14 218666
## + sub_grade_E2      1 7.1014e+08 1.0249e+14 218666
## + loan_purpose_debt_consolidation      1 5.7136e+08 1.0249e+14 218666
## + sub_grade_D1      1 4.9491e+08 1.0249e+14 218666
## + loan_purpose_vacation      1 7.9071e+07 1.0249e+14 218666
## + sub_grade_B3      1 7.2735e+07 1.0249e+14 218666
## + sub_grade_D4      1 4.9662e+07 1.0249e+14 218666
## + sub_grade_F2      1 3.4206e+07 1.0249e+14 218666
## + sub_grade_B5      1 2.8178e+07 1.0249e+14 218666

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## + loan_purpose_house          1 1.0624e+07 1.0249e+14 218666
## + sub_grade_A5              1 1.9736e+04 1.0249e+14 218666
## - loan_purpose_credit_card    1 5.0497e+10 1.0254e+14 218667
## - `loan_status_Charged Off` 1 5.4033e+10 1.0254e+14 218667
## - loan_amount               1 6.8618e+10 1.0256e+14 218669
## - sub_grade_A4              1 1.0957e+11 1.0260e+14 218672
## - sub_grade_A2              1 1.9680e+11 1.0268e+14 218680
## - sub_grade_A1              1 2.7924e+11 1.0277e+14 218688
## - delinq_2y                 1 3.1518e+11 1.0280e+14 218691
## - term                      1 4.3371e+11 1.0292e+14 218702
## - `verified_income_Source Verified` 1 7.2829e+11 1.0322e+14 218729
## - `verified_income_Not Verified` 1 9.2676e+11 1.0341e+14 218747
## - interest_rate             1 9.6759e+11 1.0345e+14 218751
## - homeownership_OWEN       1 2.5517e+12 1.0504e+14 218895
## - annual_income             1 1.0862e+13 1.1335e+14 219615
## - total_credit_utilized     1 1.8972e+13 1.2146e+14 220269
## - homeownership_MORTGAGE    1 3.7094e+13 1.3958e+14 221585
##
## Step: AIC=218663.5
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_D2 + sub_grade_E1 +
##   sub_grade_E4 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
##   sub_grade_F5 + sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
##   `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_small_business +
##   sub_grade_C2
##
##
##           Df Sum of Sq      RSS      AIC
## - sub_grade_F5          1 1.5935e+10 1.0252e+14 218663
## - sub_grade_G1          1 1.7129e+10 1.0252e+14 218663
## - `loan_status_Fully Paid` 1 1.8993e+10 1.0252e+14 218663
## - loan_purpose_small_business 1 1.9065e+10 1.0252e+14 218663
## - sub_grade_D2          1 2.1245e+10 1.0252e+14 218663
## <none>                    1.0250e+14 218663
## - sub_grade_F4          1 2.2652e+10 1.0252e+14 218664
## + sub_grade_C1          1 1.9160e+10 1.0248e+14 218664
## - sub_grade_F1          1 2.4788e+10 1.0253e+14 218664
## - `loan_status_Late (16-30 days)` 1 2.5220e+10 1.0253e+14 218664
## + sub_grade_B1          1 1.4188e+10 1.0249e+14 218664
## + loan_purpose_moving      1 1.3170e+10 1.0249e+14 218664
## + loan_purpose_renewable_energy 1 1.2481e+10 1.0249e+14 218664
## + loan_purpose_medical     1 1.1030e+10 1.0249e+14 218664
## + tax_liens             1 9.6371e+09 1.0249e+14 218665
## - sub_grade_A3          1 3.4138e+10 1.0254e+14 218665
## - sub_grade_F3          1 3.5103e+10 1.0254e+14 218665
## - sub_grade_E4          1 3.5856e+10 1.0254e+14 218665
## + loan_purpose_major_purchase 1 5.3012e+09 1.0250e+14 218665
## + sub_grade_B4          1 4.9312e+09 1.0250e+14 218665
## + sub_grade_E3          1 4.2682e+09 1.0250e+14 218665
## + sub_grade_E5          1 3.7541e+09 1.0250e+14 218665

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## + sub_grade_G4          1 3.1427e+09 1.0250e+14 218665
## + loan_status_Current   1 2.9943e+09 1.0250e+14 218665
## - sub_grade_E1          1 4.0411e+10 1.0254e+14 218665
## + sub_grade_C3          1 2.7740e+09 1.0250e+14 218665
## + sub_grade_C5          1 2.7519e+09 1.0250e+14 218665
## + loan_purpose_home_improvement 1 2.1886e+09 1.0250e+14 218665
## + `loan_status_Late (31-120 days)` 1 2.0686e+09 1.0250e+14 218665
## + sub_grade_D5          1 1.8871e+09 1.0250e+14 218665
## + sub_grade_D3          1 1.8767e+09 1.0250e+14 218665
## + sub_grade_C4          1 1.5978e+09 1.0250e+14 218665
## + loan_purpose_car        1 1.5449e+09 1.0250e+14 218665
## + loan_purpose_other       1 1.4957e+09 1.0250e+14 218665
## + sub_grade_E2          1 9.9662e+08 1.0250e+14 218665
## + `loan_status_In Grace Period` 1 9.9273e+08 1.0250e+14 218665
## + sub_grade_B3          1 7.8637e+08 1.0250e+14 218665
## + sub_grade_A5          1 6.5375e+08 1.0250e+14 218665
## + sub_grade_D1          1 5.5372e+08 1.0250e+14 218665
## + sub_grade_B5          1 4.7523e+08 1.0250e+14 218665
## + loan_purpose_debt_consolidation 1 4.1074e+08 1.0250e+14 218665
## + sub_grade_B2          1 3.8489e+08 1.0250e+14 218665
## + sub_grade_F2          1 8.8675e+07 1.0250e+14 218665
## + loan_purpose_vacation    1 7.3035e+07 1.0250e+14 218665
## + sub_grade_D4          1 1.0226e+07 1.0250e+14 218665
## + loan_purpose_house       1 5.5740e+06 1.0250e+14 218665
## - sub_grade_C2          1 4.6736e+10 1.0255e+14 218666
## - loan_purpose_credit_card 1 5.1479e+10 1.0255e+14 218666
## - `loan_status_Charged Off` 1 5.4439e+10 1.0256e+14 218667
## - loan_amount           1 6.8843e+10 1.0257e+14 218668
## - sub_grade_A4          1 9.8405e+10 1.0260e+14 218671
## - sub_grade_A2          1 1.8357e+11 1.0268e+14 218678
## - sub_grade_A1          1 2.6531e+11 1.0277e+14 218686
## - delinq_2y             1 3.1313e+11 1.0281e+14 218690
## - term                  1 4.3661e+11 1.0294e+14 218702
## - `verified_income_Source Verified` 1 7.2586e+11 1.0323e+14 218728
## - `verified_income_Not Verified` 1 9.2067e+11 1.0342e+14 218746
## - interest_rate         1 1.1246e+12 1.0363e+14 218765
## - homeownership_OWEN    1 2.5576e+12 1.0506e+14 218895
## - annual_income         1 1.0892e+13 1.1339e+14 219617
## - total_credit_utilized  1 1.8962e+13 1.2146e+14 220267
## - homeownership_MORTGAGE 1 3.7150e+13 1.3965e+14 221587
##
## Step: AIC=218663
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_D2 + sub_grade_E1 +
##   sub_grade_E4 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
##   sub_grade_G1 + homeownership_MORTGAGE + homeownership_OWEN +
##   `loan_status_Charged Off` + `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_small_business +
##   sub_grade_C2
##

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##	Df	Sum of Sq	RSS	AIC
## - sub_grade_G1	1	1.6578e+10	1.0253e+14	218662
## - `loan_status_Fully Paid`	1	1.8766e+10	1.0254e+14	218663
## - loan_purpose_small_business	1	1.9187e+10	1.0254e+14	218663
## - sub_grade_D2	1	2.0278e+10	1.0254e+14	218663
## <none>			1.0252e+14	218663
## - sub_grade_F4	1	2.2234e+10	1.0254e+14	218663
## - sub_grade_F1	1	2.3775e+10	1.0254e+14	218663
## + sub_grade_C1	1	1.9157e+10	1.0250e+14	218663
## + sub_grade_F5	1	1.5935e+10	1.0250e+14	218663
## + sub_grade_B1	1	1.4905e+10	1.0250e+14	218664
## - `loan_status_Late (16-30 days)`	1	2.8640e+10	1.0255e+14	218664
## + loan_purpose_moving	1	1.3237e+10	1.0250e+14	218664
## + loan_purpose_renewable_energy	1	1.2529e+10	1.0250e+14	218664
## + loan_purpose_medical	1	1.1028e+10	1.0251e+14	218664
## + tax_liens	1	9.4901e+09	1.0251e+14	218664
## - sub_grade_E4	1	3.4447e+10	1.0255e+14	218664
## - sub_grade_F3	1	3.4462e+10	1.0255e+14	218664
## - sub_grade_A3	1	3.5602e+10	1.0255e+14	218664
## + loan_purpose_major_purchase	1	5.2950e+09	1.0251e+14	218664
## + sub_grade_B4	1	5.1411e+09	1.0251e+14	218664
## - sub_grade_E1	1	3.9501e+10	1.0256e+14	218665
## + sub_grade_E3	1	3.7417e+09	1.0251e+14	218665
## + sub_grade_G4	1	3.4217e+09	1.0251e+14	218665
## + sub_grade_E5	1	3.1559e+09	1.0251e+14	218665
## + sub_grade_C5	1	3.0950e+09	1.0251e+14	218665
## + sub_grade_C3	1	2.6353e+09	1.0251e+14	218665
## + loan_status_Current	1	2.4974e+09	1.0251e+14	218665
## + sub_grade_D5	1	2.4287e+09	1.0251e+14	218665
## + loan_purpose_home_improvement	1	2.1795e+09	1.0251e+14	218665
## + sub_grade_C4	1	1.7648e+09	1.0252e+14	218665
## + loan_purpose_car	1	1.5274e+09	1.0252e+14	218665
## + loan_purpose_other	1	1.5208e+09	1.0252e+14	218665
## + sub_grade_D3	1	1.4959e+09	1.0252e+14	218665
## + `loan_status_Late (31-120 days)`	1	1.4471e+09	1.0252e+14	218665
## + `loan_status_In Grace Period`	1	1.0394e+09	1.0252e+14	218665
## + sub_grade_E2	1	8.0160e+08	1.0252e+14	218665
## + sub_grade_D1	1	7.0934e+08	1.0252e+14	218665
## + sub_grade_B3	1	6.9338e+08	1.0252e+14	218665
## + sub_grade_B2	1	4.8356e+08	1.0252e+14	218665
## + sub_grade_A5	1	4.8132e+08	1.0252e+14	218665
## + sub_grade_B5	1	4.6409e+08	1.0252e+14	218665
## + loan_purpose_debt_consolidation	1	4.3257e+08	1.0252e+14	218665
## + loan_purpose_vacation	1	7.9809e+07	1.0252e+14	218665
## + sub_grade_F2	1	5.8374e+07	1.0252e+14	218665
## + sub_grade_D4	1	5.7117e+07	1.0252e+14	218665
## + loan_purpose_house	1	6.2595e+06	1.0252e+14	218665
## - sub_grade_C2	1	4.7139e+10	1.0256e+14	218665
## - loan_purpose_credit_card	1	5.1045e+10	1.0257e+14	218666
## - `loan_status_Charged Off`	1	5.4407e+10	1.0257e+14	218666
## - loan_amount	1	6.9759e+10	1.0259e+14	218667
## - sub_grade_A4	1	1.0088e+11	1.0262e+14	218670

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## - sub_grade_A2          1 1.8730e+11 1.0270e+14 218678
## - sub_grade_A1          1 2.6989e+11 1.0279e+14 218686
## - delinq_2y             1 3.1161e+11 1.0283e+14 218690
## - term                  1 4.3492e+11 1.0295e+14 218701
## - `verified_income_Source Verified` 1 7.2517e+11 1.0324e+14 218728
## - `verified_income_Not Verified`    1 9.1795e+11 1.0343e+14 218745
## - interest_rate         1 1.1093e+12 1.0363e+14 218763
## - homeownership_OWEN    1 2.5548e+12 1.0507e+14 218894
## - annual_income         1 1.0887e+13 1.1340e+14 219616
## - total_credit_utilized  1 1.8965e+13 1.2148e+14 220267
## - homeownership_MORTGAGE 1 3.7160e+13 1.3968e+14 221587
##
## Step: AIC=218662.5
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_D2 + sub_grade_E1 +
##   sub_grade_E4 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
##   homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
##   `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + loan_purpose_small_business +
##   sub_grade_C2
##
##
##           Df Sum of Sq      RSS   AIC
## - loan_purpose_small_business    1 1.8401e+10 1.0255e+14 218662
## - sub_grade_D2                 1 1.8719e+10 1.0255e+14 218662
## - `loan_status_Fully Paid`     1 1.8824e+10 1.0255e+14 218662
## - sub_grade_F4                 1 2.1510e+10 1.0255e+14 218662
## <none>                        1.0253e+14 218662
## - sub_grade_F1                 1 2.2220e+10 1.0256e+14 218663
## + sub_grade_C1                 1 1.9296e+10 1.0251e+14 218663
## + sub_grade_G1                 1 1.6578e+10 1.0252e+14 218663
## + sub_grade_B1                 1 1.6066e+10 1.0252e+14 218663
## + sub_grade_F5                 1 1.5384e+10 1.0252e+14 218663
## - `loan_status_Late (16-30 days)` 1 2.8127e+10 1.0256e+14 218663
## + loan_purpose_moving            1 1.3285e+10 1.0252e+14 218663
## + loan_purpose_renewable_energy  1 1.2617e+10 1.0252e+14 218663
## - sub_grade_E4                 1 3.2052e+10 1.0257e+14 218663
## + loan_purpose_medical           1 1.0982e+10 1.0252e+14 218663
## - sub_grade_F3                 1 3.3358e+10 1.0257e+14 218664
## + tax_liens                    1 9.6114e+09 1.0252e+14 218664
## + sub_grade_B4                 1 5.4759e+09 1.0253e+14 218664
## - sub_grade_E1                 1 3.8010e+10 1.0257e+14 218664
## + loan_purpose_major_purchase    1 5.3092e+09 1.0253e+14 218664
## - sub_grade_A3                 1 3.8258e+10 1.0257e+14 218664
## + sub_grade_C5                 1 3.6509e+09 1.0253e+14 218664
## + sub_grade_G4                 1 3.5266e+09 1.0253e+14 218664
## + sub_grade_D5                 1 3.4600e+09 1.0253e+14 218664
## + sub_grade_E3                 1 2.9300e+09 1.0253e+14 218664
## + loan_status_Current          1 2.7037e+09 1.0253e+14 218664
## + sub_grade_C3                 1 2.3976e+09 1.0253e+14 218664
## + sub_grade_E5                 1 2.2494e+09 1.0253e+14 218664

```

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## + loan_purpose_home_improvement      1 2.1499e+09 1.0253e+14 218664
## + sub_grade_C4                      1 2.0943e+09 1.0253e+14 218664
## + `loan_status_Late (31-120 days)`  1 1.5614e+09 1.0253e+14 218664
## + loan_purpose_other                  1 1.5613e+09 1.0253e+14 218664
## + loan_purpose_car                    1 1.5090e+09 1.0253e+14 218664
## + `loan_status_In Grace Period`     1 1.1301e+09 1.0253e+14 218664
## + sub_grade_D1                      1 1.0198e+09 1.0253e+14 218664
## + sub_grade_D3                      1 9.6913e+08 1.0253e+14 218664
## + sub_grade_B2                      1 6.7307e+08 1.0253e+14 218664
## + sub_grade_B3                      1 5.4232e+08 1.0253e+14 218664
## + sub_grade_E2                      1 5.3610e+08 1.0253e+14 218664
## + loan_purpose_debt_consolidation     1 4.7383e+08 1.0253e+14 218664
## + sub_grade_B5                      1 4.3233e+08 1.0253e+14 218664
## + sub_grade_A5                      1 2.3469e+08 1.0253e+14 218664
## + sub_grade_D4                      1 2.2651e+08 1.0253e+14 218664
## + loan_purpose_vacation                1 8.4995e+07 1.0253e+14 218664
## + sub_grade_F2                      1 2.0918e+07 1.0253e+14 218664
## + loan_purpose_house                  1 8.1780e+06 1.0253e+14 218664
## - sub_grade_C2                      1 4.7831e+10 1.0258e+14 218665
## - loan_purpose_credit_card            1 5.0538e+10 1.0258e+14 218665
## - `loan_status_Charged Off`         1 5.4353e+10 1.0259e+14 218665
## - loan_amount                      1 7.0727e+10 1.0260e+14 218667
## - sub_grade_A4                      1 1.0519e+11 1.0264e+14 218670
## - sub_grade_A2                      1 1.9408e+11 1.0273e+14 218678
## - sub_grade_A1                      1 2.7826e+11 1.0281e+14 218686
## - delinq_2y                        1 3.0920e+11 1.0284e+14 218689
## - term                              1 4.3568e+11 1.0297e+14 218701
## - `verified_income_Source Verified` 1 7.2194e+11 1.0326e+14 218727
## - `verified_income_Not Verified`    1 9.1258e+11 1.0345e+14 218744
## - interest_rate                    1 1.0942e+12 1.0363e+14 218761
## - homeownership_OWEN                1 2.5604e+12 1.0509e+14 218894
## - annual_income                    1 1.0892e+13 1.1343e+14 219616
## - total_credit_utilized              1 1.8965e+13 1.2150e+14 220266
## - homeownership_MORTGAGE            1 3.7158e+13 1.3969e+14 221586
##
## Step: AIC=218662.2
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_D2 + sub_grade_E1 +
##   sub_grade_E4 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
##   homeownership_MORTGAGE + homeownership_OWEN + `loan_status_Charged Off` +
##   `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + sub_grade_C2
##
##                                     Df Sum of Sq      RSS    AIC
## - `loan_status_Fully Paid`          1 1.8735e+10 1.0257e+14 218662
## - sub_grade_D2                      1 1.9619e+10 1.0257e+14 218662
## <none>                                1.0255e+14 218662
## - sub_grade_F4                      1 2.1684e+10 1.0257e+14 218662
## - sub_grade_F1                      1 2.2565e+10 1.0257e+14 218662
## + sub_grade_C1                      1 1.9348e+10 1.0253e+14 218662

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## + loan_purpose_small_business	1	1.8401e+10	1.0253e+14	218662
## + sub_grade_B1	1	1.5836e+10	1.0254e+14	218663
## + sub_grade_G1	1	1.5792e+10	1.0254e+14	218663
## - `loan_status_Late (16-30 days)`	1	2.7759e+10	1.0258e+14	218663
## + sub_grade_F5	1	1.5514e+10	1.0254e+14	218663
## + loan_purpose_moving	1	1.2869e+10	1.0254e+14	218663
## + loan_purpose_renewable_energy	1	1.2484e+10	1.0254e+14	218663
## - sub_grade_E4	1	3.1146e+10	1.0258e+14	218663
## + loan_purpose_medical	1	1.1480e+10	1.0254e+14	218663
## - sub_grade_F3	1	3.3586e+10	1.0259e+14	218663
## + tax_liens	1	9.5851e+09	1.0254e+14	218663
## - sub_grade_E1	1	3.7679e+10	1.0259e+14	218664
## + sub_grade_B4	1	5.2843e+09	1.0255e+14	218664
## + loan_purpose_major_purchase	1	4.8134e+09	1.0255e+14	218664
## - sub_grade_A3	1	3.8860e+10	1.0259e+14	218664
## + sub_grade_C5	1	3.5448e+09	1.0255e+14	218664
## + sub_grade_G4	1	3.4673e+09	1.0255e+14	218664
## + sub_grade_D5	1	3.2654e+09	1.0255e+14	218664
## + sub_grade_E3	1	2.9677e+09	1.0255e+14	218664
## + loan_purpose_home_improvement	1	2.6093e+09	1.0255e+14	218664
## + loan_status_Current	1	2.5949e+09	1.0255e+14	218664
## + loan_purpose_debt_consolidation	1	2.1974e+09	1.0255e+14	218664
## + sub_grade_C3	1	2.0748e+09	1.0255e+14	218664
## + sub_grade_E5	1	2.0394e+09	1.0255e+14	218664
## + sub_grade_C4	1	1.9930e+09	1.0255e+14	218664
## + loan_purpose_car	1	1.6820e+09	1.0255e+14	218664
## + `loan_status_Late (31-120 days)`	1	1.4403e+09	1.0255e+14	218664
## + `loan_status_In Grace Period`	1	1.1351e+09	1.0255e+14	218664
## + loan_purpose_other	1	1.1189e+09	1.0255e+14	218664
## + sub_grade_D3	1	1.0928e+09	1.0255e+14	218664
## + sub_grade_D1	1	1.0105e+09	1.0255e+14	218664
## + sub_grade_B2	1	7.9973e+08	1.0255e+14	218664
## + sub_grade_E2	1	5.9867e+08	1.0255e+14	218664
## + sub_grade_B5	1	4.6994e+08	1.0255e+14	218664
## + sub_grade_B3	1	4.5948e+08	1.0255e+14	218664
## + sub_grade_D4	1	2.7099e+08	1.0255e+14	218664
## + sub_grade_A5	1	2.5367e+08	1.0255e+14	218664
## + loan_purpose_vacation	1	6.1658e+07	1.0255e+14	218664
## + sub_grade_F2	1	2.7359e+07	1.0255e+14	218664
## + loan_purpose_house	1	1.8287e+05	1.0255e+14	218664
## - loan_purpose_credit_card	1	4.7105e+10	1.0260e+14	218665
## - sub_grade_C2	1	4.8069e+10	1.0260e+14	218665
## - `loan_status_Charged Off`	1	5.4559e+10	1.0261e+14	218665
## - loan_amount	1	6.8959e+10	1.0262e+14	218667
## - sub_grade_A4	1	1.0520e+11	1.0266e+14	218670
## - sub_grade_A2	1	1.9397e+11	1.0275e+14	218678
## - sub_grade_A1	1	2.7756e+11	1.0283e+14	218686
## - delinq_2y	1	3.1006e+11	1.0286e+14	218689
## - term	1	4.3865e+11	1.0299e+14	218701
## - `verified_income_Source Verified`	1	7.2657e+11	1.0328e+14	218727
## - `verified_income_Not Verified`	1	9.1415e+11	1.0347e+14	218744
## - interest_rate	1	1.0967e+12	1.0365e+14	218761

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## - homeownership_OWn          1 2.5656e+12 1.0512e+14 218894
## - annual_income              1 1.0881e+13 1.1343e+14 219614
## - total_credit_utilized      1 1.8954e+13 1.2151e+14 220265
## - homeownership_MORTGAGE     1 3.7214e+13 1.3977e+14 221589
##
## Step: AIC=218661.9
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_D2 + sub_grade_E1 +
##   sub_grade_E4 + sub_grade_F1 + sub_grade_F3 + sub_grade_F4 +
##   homeownership_MORTGAGE + homeownership_OWn + `loan_status_Charged Off` +
##   `loan_status_Late (16-30 days)` + loan_purpose_credit_card +
##   sub_grade_C2
##
##
##           Df Sum of Sq      RSS   AIC
## - sub_grade_D2          1 1.9007e+10 1.0259e+14 218662
## <none>                      1.0257e+14 218662
## - sub_grade_F1          1 2.2140e+10 1.0259e+14 218662
## - sub_grade_F4          1 2.2170e+10 1.0259e+14 218662
## + sub_grade_C1          1 1.9591e+10 1.0255e+14 218662
## + `loan_status_Fully Paid` 1 1.8735e+10 1.0255e+14 218662
## + loan_purpose_small_business 1 1.8312e+10 1.0255e+14 218662
## - `loan_status_Late (16-30 days)` 1 2.7053e+10 1.0260e+14 218662
## + sub_grade_B1          1 1.5875e+10 1.0255e+14 218662
## + sub_grade_G1          1 1.5850e+10 1.0255e+14 218662
## + sub_grade_F5          1 1.5289e+10 1.0256e+14 218662
## + loan_purpose_renewable_energy 1 1.2727e+10 1.0256e+14 218663
## - sub_grade_E4          1 3.0825e+10 1.0260e+14 218663
## + loan_purpose_moving      1 1.2387e+10 1.0256e+14 218663
## + loan_purpose_medical     1 1.1996e+10 1.0256e+14 218663
## + tax_liens              1 9.7821e+09 1.0256e+14 218663
## - sub_grade_F3          1 3.3881e+10 1.0260e+14 218663
## + loan_status_Current    1 8.9236e+09 1.0256e+14 218663
## - sub_grade_E1          1 3.6938e+10 1.0261e+14 218663
## + sub_grade_B4          1 5.0610e+09 1.0257e+14 218663
## + loan_purpose_major_purchase 1 4.6748e+09 1.0257e+14 218663
## - sub_grade_A3          1 3.8895e+10 1.0261e+14 218663
## + sub_grade_C5          1 3.6359e+09 1.0257e+14 218664
## + sub_grade_G4          1 3.4958e+09 1.0257e+14 218664
## + sub_grade_D5          1 3.3686e+09 1.0257e+14 218664
## + sub_grade_E3          1 3.2453e+09 1.0257e+14 218664
## + loan_purpose_home_improvement 1 2.5954e+09 1.0257e+14 218664
## + sub_grade_C3          1 2.2197e+09 1.0257e+14 218664
## + sub_grade_E5          1 2.0898e+09 1.0257e+14 218664
## + loan_purpose_debt_consolidation 1 1.8147e+09 1.0257e+14 218664
## + sub_grade_C4          1 1.7484e+09 1.0257e+14 218664
## + loan_purpose_car         1 1.6625e+09 1.0257e+14 218664
## + `loan_status_Late (31-120 days)` 1 1.6607e+09 1.0257e+14 218664
## + `loan_status_In Grace Period` 1 1.3268e+09 1.0257e+14 218664
## + sub_grade_D3          1 1.1142e+09 1.0257e+14 218664
## + sub_grade_D1          1 1.0694e+09 1.0257e+14 218664

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## + loan_purpose_other          1 8.5204e+08 1.0257e+14 218664
## + sub_grade_B2              1 7.1558e+08 1.0257e+14 218664
## + sub_grade_E2              1 5.6706e+08 1.0257e+14 218664
## + sub_grade_B5              1 4.7393e+08 1.0257e+14 218664
## + sub_grade_B3              1 4.5232e+08 1.0257e+14 218664
## + sub_grade_D4              1 3.1197e+08 1.0257e+14 218664
## + sub_grade_A5              1 2.0348e+08 1.0257e+14 218664
## + loan_purpose_vacation        1 5.0586e+07 1.0257e+14 218664
## + sub_grade_F2              1 1.2868e+07 1.0257e+14 218664
## + loan_purpose_house          1 1.7260e+06 1.0257e+14 218664
## - sub_grade_C2              1 4.7771e+10 1.0262e+14 218664
## - loan_purpose_credit_card     1 4.8828e+10 1.0262e+14 218664
## - `loan_status_Charged Off`  1 5.4124e+10 1.0262e+14 218665
## - loan_amount               1 6.6871e+10 1.0264e+14 218666
## - sub_grade_A4              1 1.0751e+11 1.0268e+14 218670
## - sub_grade_A2              1 1.9504e+11 1.0277e+14 218678
## - sub_grade_A1              1 2.7714e+11 1.0285e+14 218685
## - delinq_2y                 1 3.0936e+11 1.0288e+14 218688
## - term                      1 4.3709e+11 1.0301e+14 218700
## - `verified_income_Source Verified` 1 7.2853e+11 1.0330e+14 218727
## - `verified_income_Not Verified` 1 9.1552e+11 1.0349e+14 218744
## - interest_rate             1 1.0868e+12 1.0366e+14 218760
## - homeownership_OWEN       1 2.5752e+12 1.0515e+14 218895
## - annual_income             1 1.0908e+13 1.1348e+14 219616
## - total_credit_utilized      1 1.8955e+13 1.2153e+14 220264
## - homeownership_MORTGAGE    1 3.7259e+13 1.3983e+14 221592
##
## Step: AIC=218661.7
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_E1 + sub_grade_E4 +
##   sub_grade_F1 + sub_grade_F3 + sub_grade_F4 + homeownership_MORTGAGE +
##   homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + sub_grade_C2
##
##
##              Df Sum of Sq      RSS    AIC
## - sub_grade_F1      1 1.9691e+10 1.0261e+14 218661
## - sub_grade_F4      1 2.0925e+10 1.0261e+14 218662
## <none>                                1.0259e+14 218662
## + sub_grade_C1      1 2.1420e+10 1.0257e+14 218662
## + loan_purpose_small_business 1 1.9197e+10 1.0257e+14 218662
## + sub_grade_D2      1 1.9007e+10 1.0257e+14 218662
## + `loan_status_Fully Paid` 1 1.8123e+10 1.0257e+14 218662
## - `loan_status_Late (16-30 days)` 1 2.6295e+10 1.0262e+14 218662
## - sub_grade_E4      1 2.7057e+10 1.0262e+14 218662
## + sub_grade_B1      1 1.6002e+10 1.0257e+14 218662
## + sub_grade_F5      1 1.4403e+10 1.0258e+14 218662
## + sub_grade_G1      1 1.4297e+10 1.0258e+14 218662
## + loan_purpose_renewable_energy 1 1.3044e+10 1.0258e+14 218662
## + loan_purpose_moving  1 1.2827e+10 1.0258e+14 218662
## + loan_purpose_medical 1 1.1626e+10 1.0258e+14 218663

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## - sub_grade_F3      1 3.2051e+10 1.0262e+14 218663
## + tax_liens         1 9.8227e+09 1.0258e+14 218663
## - sub_grade_E1      1 3.4121e+10 1.0262e+14 218663
## + loan_status_Current 1 8.4577e+09 1.0258e+14 218663
## + sub_grade_D5      1 5.7686e+09 1.0258e+14 218663
## + sub_grade_C5      1 5.3559e+09 1.0258e+14 218663
## + sub_grade_B4      1 4.6164e+09 1.0258e+14 218663
## + loan_purpose_major_purchase 1 4.4281e+09 1.0259e+14 218663
## + sub_grade_G4      1 3.6829e+09 1.0259e+14 218663
## + loan_purpose_home_improvement 1 2.8013e+09 1.0259e+14 218663
## + sub_grade_C4      1 2.7963e+09 1.0259e+14 218663
## - sub_grade_A3      1 4.0879e+10 1.0263e+14 218663
## + sub_grade_D1      1 2.0249e+09 1.0259e+14 218663
## + sub_grade_E3      1 2.0010e+09 1.0259e+14 218663
## + loan_purpose_debt_consolidation 1 1.6974e+09 1.0259e+14 218664
## + `loan_status_Late (31-120 days)` 1 1.6475e+09 1.0259e+14 218664
## + loan_purpose_car     1 1.4630e+09 1.0259e+14 218664
## + `loan_status_In Grace Period` 1 1.4457e+09 1.0259e+14 218664
## + sub_grade_C3      1 1.4325e+09 1.0259e+14 218664
## + sub_grade_D4      1 1.0582e+09 1.0259e+14 218664
## + sub_grade_E5      1 9.4266e+08 1.0259e+14 218664
## + sub_grade_B5      1 7.4108e+08 1.0259e+14 218664
## + loan_purpose_other   1 7.2601e+08 1.0259e+14 218664
## + sub_grade_B2      1 6.8255e+08 1.0259e+14 218664
## + sub_grade_B3      1 5.3731e+08 1.0259e+14 218664
## + sub_grade_D3      1 2.9704e+08 1.0259e+14 218664
## + sub_grade_E2      1 2.0101e+08 1.0259e+14 218664
## + sub_grade_A5      1 1.2755e+08 1.0259e+14 218664
## + loan_purpose_vacation 1 9.3924e+06 1.0259e+14 218664
## + loan_purpose_house   1 4.2520e+06 1.0259e+14 218664
## + sub_grade_F2      1 2.2748e+06 1.0259e+14 218664
## - loan_purpose_credit_card 1 5.0368e+10 1.0264e+14 218664
## - sub_grade_C2      1 5.1533e+10 1.0264e+14 218664
## - `loan_status_Charged Off` 1 5.3735e+10 1.0264e+14 218665
## - loan_amount       1 6.5724e+10 1.0266e+14 218666
## - sub_grade_A4      1 1.1033e+11 1.0270e+14 218670
## - sub_grade_A2      1 2.0044e+11 1.0279e+14 218678
## - sub_grade_A1      1 2.8486e+11 1.0287e+14 218686
## - delinq_2y         1 3.1167e+11 1.0290e+14 218688
## - term              1 4.3232e+11 1.0302e+14 218699
## - `verified_income_Source Verified` 1 7.2764e+11 1.0332e+14 218727
## - `verified_income_Not Verified` 1 9.1602e+11 1.0351e+14 218744
## - interest_rate     1 1.0765e+12 1.0367e+14 218758
## - homeownership_OWn 1 2.5728e+12 1.0516e+14 218894
## - annual_income     1 1.0900e+13 1.1349e+14 219615
## - total_credit_utilized 1 1.8979e+13 1.2157e+14 220266
## - homeownership_MORTGAGE 1 3.7274e+13 1.3986e+14 221592
##
## Step: AIC=218661.5
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
## term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
## `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +

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##      sub_grade_A3 + sub_grade_A4 + sub_grade_E1 + sub_grade_E4 +
##      sub_grade_F3 + sub_grade_F4 + homeownership_MORTGAGE + homeownership_OWEN +
##      `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##      loan_purpose_credit_card + sub_grade_C2
##
##
##      Df  Sum of Sq      RSS    AIC
## - sub_grade_F4      1 1.9956e+10 1.0263e+14 218661
## <none>                      1.0261e+14 218661
## + sub_grade_C1      1 2.1593e+10 1.0259e+14 218661
## + sub_grade_F1      1 1.9691e+10 1.0259e+14 218662
## + loan_purpose_small_business      1 1.9469e+10 1.0259e+14 218662
## - sub_grade_E4      1 2.4167e+10 1.0263e+14 218662
## + `loan_status_Fully Paid`      1 1.7767e+10 1.0259e+14 218662
## + sub_grade_B1      1 1.7724e+10 1.0259e+14 218662
## + sub_grade_D2      1 1.6557e+10 1.0259e+14 218662
## - `loan_status_Late (16-30 days)`      1 2.6995e+10 1.0264e+14 218662
## + sub_grade_F5      1 1.3606e+10 1.0260e+14 218662
## + loan_purpose_renewable_energy      1 1.3176e+10 1.0260e+14 218662
## + sub_grade_G1      1 1.3024e+10 1.0260e+14 218662
## + loan_purpose_moving      1 1.2921e+10 1.0260e+14 218662
## - sub_grade_F3      1 3.0524e+10 1.0264e+14 218662
## + loan_purpose_medical      1 1.1987e+10 1.0260e+14 218662
## - sub_grade_E1      1 3.2286e+10 1.0264e+14 218662
## + tax_liens      1 9.9048e+09 1.0260e+14 218663
## + loan_status_Current      1 8.3977e+09 1.0260e+14 218663
## + sub_grade_D5      1 7.9053e+09 1.0260e+14 218663
## + sub_grade_C5      1 6.3886e+09 1.0260e+14 218663
## + sub_grade_B4      1 5.0937e+09 1.0260e+14 218663
## + loan_purpose_major_purchase      1 4.4974e+09 1.0260e+14 218663
## + sub_grade_G4      1 3.9175e+09 1.0261e+14 218663
## + sub_grade_C4      1 3.3540e+09 1.0261e+14 218663
## + loan_purpose_home_improvement      1 2.8591e+09 1.0261e+14 218663
## + sub_grade_D1      1 2.7401e+09 1.0261e+14 218663
## + sub_grade_D4      1 1.8086e+09 1.0261e+14 218663
## + loan_purpose_debt_consolidation      1 1.6966e+09 1.0261e+14 218663
## + `loan_status_Late (31-120 days)`      1 1.5564e+09 1.0261e+14 218663
## + loan_purpose_car      1 1.4273e+09 1.0261e+14 218663
## + `loan_status_In Grace Period`      1 1.3491e+09 1.0261e+14 218663
## + sub_grade_E3      1 1.2226e+09 1.0261e+14 218663
## + sub_grade_C3      1 1.1975e+09 1.0261e+14 218663
## + sub_grade_B2      1 9.9519e+08 1.0261e+14 218663
## + loan_purpose_other      1 7.0168e+08 1.0261e+14 218663
## + sub_grade_B5      1 6.9354e+08 1.0261e+14 218663
## + sub_grade_B3      1 3.5487e+08 1.0261e+14 218663
## + sub_grade_E5      1 3.5315e+08 1.0261e+14 218663
## + sub_grade_E2      1 4.8642e+07 1.0261e+14 218663
## + sub_grade_D3      1 4.7251e+07 1.0261e+14 218663
## + sub_grade_F2      1 3.2298e+07 1.0261e+14 218663
## + loan_purpose_vacation      1 1.7156e+07 1.0261e+14 218663
## + loan_purpose_house      1 7.3291e+06 1.0261e+14 218663
## + sub_grade_A5      1 3.2485e+06 1.0261e+14 218663
## - sub_grade_A3      1 4.5124e+10 1.0265e+14 218664

```

```

## - loan_purpose_credit_card      1 4.9915e+10 1.0266e+14 218664
## - sub_grade_C2                1 5.2502e+10 1.0266e+14 218664
## - `loan_status_Charged Off`   1 5.3706e+10 1.0266e+14 218664
## - loan_amount                 1 6.6950e+10 1.0268e+14 218666
## - sub_grade_A4                1 1.1695e+11 1.0273e+14 218670
## - sub_grade_A2                1 2.1101e+11 1.0282e+14 218679
## - sub_grade_A1                1 2.9779e+11 1.0291e+14 218687
## - delinq_2y                   1 3.1560e+11 1.0292e+14 218689
## - term                        1 4.3641e+11 1.0305e+14 218700
## - `verified_income_Source Verified` 1 7.2317e+11 1.0333e+14 218726
## - `verified_income_Not Verified` 1 9.0889e+11 1.0352e+14 218743
## - interest_rate               1 1.0621e+12 1.0367e+14 218757
## - homeownership_OWEN         1 2.5745e+12 1.0518e+14 218894
## - annual_income               1 1.0896e+13 1.1351e+14 219614
## - total_credit_utilized       1 1.8974e+13 1.2158e+14 220265
## - homeownership_MORTGAGE     1 3.7296e+13 1.3991e+14 221593
##
## Step: AIC=218661.3
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_E1 + sub_grade_E4 +
##   sub_grade_F3 + homeownership_MORTGAGE + homeownership_OWEN +
##   `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + sub_grade_C2
##
##                               Df Sum of Sq      RSS    AIC
## <none>                               1.0263e+14 218661
## + sub_grade_C1                     1 2.1602e+10 1.0261e+14 218661
## - sub_grade_E4                     1 2.2898e+10 1.0265e+14 218661
## + sub_grade_F4                     1 1.9956e+10 1.0261e+14 218661
## + loan_purpose_small_business        1 1.9603e+10 1.0261e+14 218662
## + sub_grade_F1                     1 1.8723e+10 1.0261e+14 218662
## + sub_grade_B1                     1 1.8629e+10 1.0261e+14 218662
## + `loan_status_Fully Paid`         1 1.8245e+10 1.0261e+14 218662
## - `loan_status_Late (16-30 days)`  1 2.6650e+10 1.0266e+14 218662
## + sub_grade_D2                     1 1.5482e+10 1.0261e+14 218662
## - sub_grade_F3                     1 2.9829e+10 1.0266e+14 218662
## + sub_grade_F5                     1 1.3294e+10 1.0262e+14 218662
## + loan_purpose_renewable_energy      1 1.3259e+10 1.0262e+14 218662
## + loan_purpose_moving                1 1.3043e+10 1.0262e+14 218662
## + sub_grade_G1                     1 1.2480e+10 1.0262e+14 218662
## - sub_grade_E1                     1 3.1401e+10 1.0266e+14 218662
## + loan_purpose_medical               1 1.1879e+10 1.0262e+14 218662
## + tax_liens                       1 9.9899e+09 1.0262e+14 218662
## + sub_grade_D5                     1 8.9906e+09 1.0262e+14 218662
## + loan_status_Current              1 8.5639e+09 1.0262e+14 218663
## + sub_grade_C5                     1 6.8769e+09 1.0262e+14 218663
## + sub_grade_B4                     1 5.3254e+09 1.0262e+14 218663
## + loan_purpose_major_purchase        1 4.5325e+09 1.0262e+14 218663
## + sub_grade_G4                     1 3.9783e+09 1.0263e+14 218663
## + sub_grade_C4                     1 3.6094e+09 1.0263e+14 218663

```

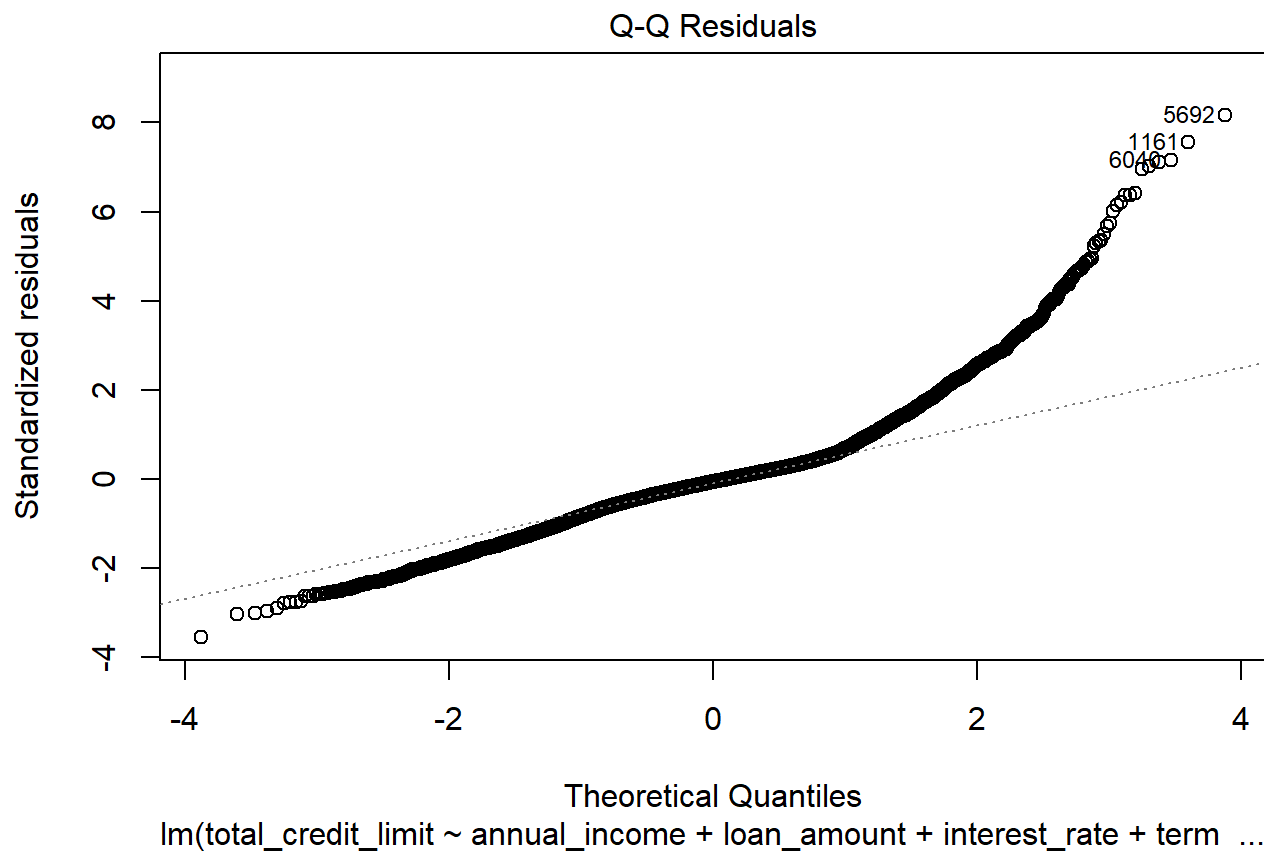
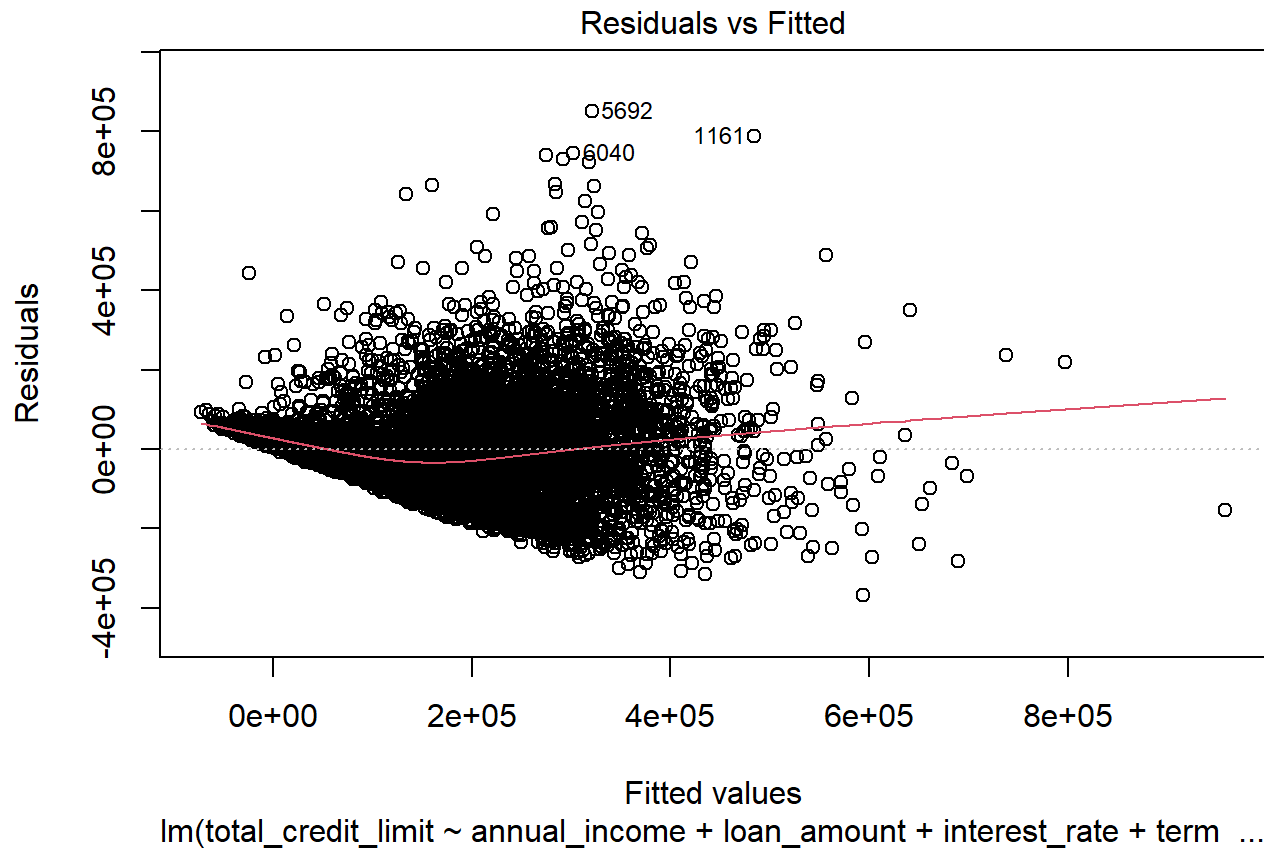
## + sub_grade_D1	1	3.0776e+09	1.0263e+14	218663
## + loan_purpose_home_improvement	1	2.7722e+09	1.0263e+14	218663
## + sub_grade_D4	1	2.2148e+09	1.0263e+14	218663
## + loan_purpose_debt_consolidation	1	1.8628e+09	1.0263e+14	218663
## + `loan_status_Late (31-120 days)`	1	1.6348e+09	1.0263e+14	218663
## + `loan_status_In Grace Period`	1	1.4221e+09	1.0263e+14	218663
## + loan_purpose_car	1	1.3957e+09	1.0263e+14	218663
## + sub_grade_B2	1	1.1720e+09	1.0263e+14	218663
## + sub_grade_C3	1	1.1137e+09	1.0263e+14	218663
## + sub_grade_E3	1	9.3684e+08	1.0263e+14	218663
## + loan_purpose_other	1	7.5329e+08	1.0263e+14	218663
## + sub_grade_B5	1	6.5765e+08	1.0263e+14	218663
## + sub_grade_B3	1	2.8142e+08	1.0263e+14	218663
## + sub_grade_E5	1	1.8085e+08	1.0263e+14	218663
## + sub_grade_F2	1	5.7595e+07	1.0263e+14	218663
## + loan_purpose_vacation	1	2.4498e+07	1.0263e+14	218663
## + sub_grade_E2	1	1.4085e+07	1.0263e+14	218663
## + loan_purpose_house	1	7.8921e+06	1.0263e+14	218663
## + sub_grade_A5	1	5.9629e+06	1.0263e+14	218663
## + sub_grade_D3	1	4.3695e+06	1.0263e+14	218663
## - sub_grade_A3	1	4.7102e+10	1.0268e+14	218664
## - loan_purpose_credit_card	1	5.0279e+10	1.0268e+14	218664
## - sub_grade_C2	1	5.2915e+10	1.0268e+14	218664
## - `loan_status_Charged Off`	1	5.3628e+10	1.0268e+14	218664
## - loan_amount	1	6.5576e+10	1.0269e+14	218665
## - sub_grade_A4	1	1.2000e+11	1.0275e+14	218670
## - sub_grade_A2	1	2.1555e+11	1.0284e+14	218679
## - sub_grade_A1	1	3.0349e+11	1.0293e+14	218687
## - delinq_2y	1	3.1540e+11	1.0294e+14	218688
## - term	1	4.3661e+11	1.0307e+14	218699
## - `verified_income_Source Verified`	1	7.2160e+11	1.0335e+14	218726
## - `verified_income_Not Verified`	1	9.0701e+11	1.0354e+14	218743
## - interest_rate	1	1.0438e+12	1.0367e+14	218755
## - homeownership_OWEN	1	2.5725e+12	1.0520e+14	218894
## - annual_income	1	1.0909e+13	1.1354e+14	219615
## - total_credit_utilized	1	1.9017e+13	1.2165e+14	220268
## - homeownership_MORTGAGE	1	3.7306e+13	1.3994e+14	221593

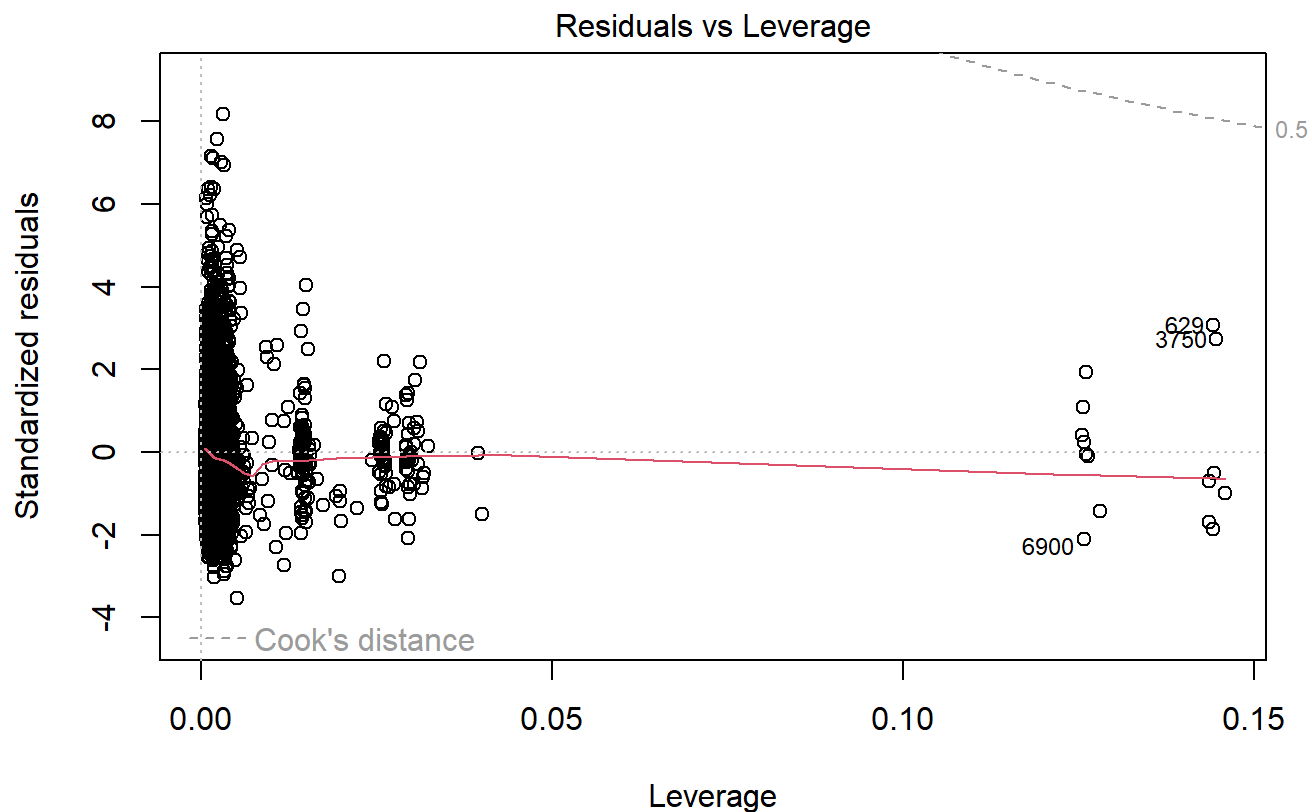
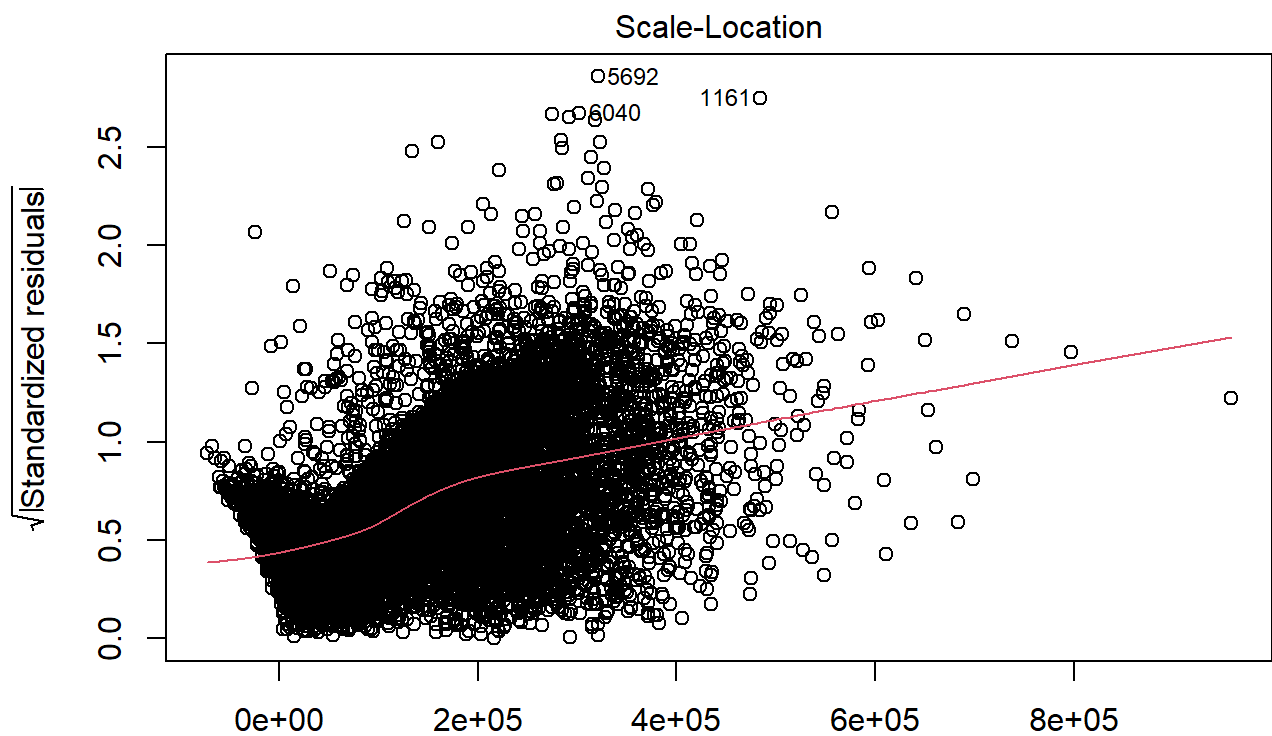
```
##
## Call:
## lm(formula = total_credit_limit ~ annual_income + loan_amount +
##      interest_rate + term + delinq_2y + total_credit_utilized +
##      `verified_income_Not Verified` + `verified_income_Source Verified` +
##      sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
##      sub_grade_E1 + sub_grade_E4 + sub_grade_F3 + homeownership_MORTGAGE +
##      homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##      loan_purpose_credit_card + sub_grade_C2, data = dtf)
##
## Coefficients:
##              (Intercept)              annual_income
##              -2.494e+04              1.224e+00
##              loan_amount              interest_rate
##              3.205e-01              -2.939e+03
##              term              delinq_2y
##              7.278e+02              8.735e+03
##              total_credit_utilized  `verified_income_Not Verified`
##              1.055e+00              -2.796e+04
##  `verified_income_Source Verified`              sub_grade_A1
##              -2.342e+04              3.215e+04
##              sub_grade_A2              sub_grade_A3
##              2.481e+04              1.121e+04
##              sub_grade_A4              sub_grade_E1
##              1.676e+04              2.852e+04
##              sub_grade_E4              sub_grade_F3
##              1.849e+04              6.161e+04
##              homeownership_MORTGAGE              homeownership_OWEN
##              1.418e+05              5.183e+04
##              `loan_status_Charged Off`  `loan_status_Late (16-30 days)`
##              8.761e+04              2.772e+04
##              loan_purpose_credit_card              sub_grade_C2
##              -5.600e+03              -1.021e+04
```

```
fit4<-lm(total_credit_limit ~ annual_income + loan_amount +
  interest_rate + term + delinq_2y + total_credit_utilized +
  `verified_income_Not Verified` + `verified_income_Source Verified` +
  sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
  sub_grade_E1 + sub_grade_E4 + sub_grade_F3 + homeownership_MORTGAGE +
  homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
  loan_purpose_credit_card + sub_grade_C2, data = dtf)
summary(fit4)
```

```
##
## Call:
## lm(formula = total_credit_limit ~ annual_income + loan_amount +
##      interest_rate + term + delinq_2y + total_credit_utilized +
##      `verified_income_Not Verified` + `verified_income_Source Verified` +
##      sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
##      sub_grade_E1 + sub_grade_E4 + sub_grade_F3 + homeownership_MORTGAGE +
##      homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##      loan_purpose_credit_card + sub_grade_C2, data = dtf)
##
## Residuals:
##      Min        1Q    Median        3Q        Max
## -368820  -53908   -5678    36977   851237
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -2.494e+04  6.553e+03  -3.806 0.000142 ***
## annual_income    1.224e+00  3.865e-02  31.675 < 2e-16 ***
## loan_amount      3.205e-01  1.305e-01   2.456 0.014074 *
## interest_rate   -2.939e+03  3.000e+02  -9.798 < 2e-16 ***
## term            7.278e+02  1.149e+02   6.337 2.45e-10 ***
## delinq_2y       8.735e+03  1.622e+03   5.386 7.38e-08 ***
## total_credit_utilized 1.055e+00  2.523e-02  41.822 < 2e-16 ***
## `verified_income_Not Verified` -2.796e+04  3.061e+03  -9.133 < 2e-16 ***
## `verified_income_Source Verified` -2.342e+04  2.874e+03  -8.147 4.22e-16 ***
## sub_grade_A1     3.215e+04  6.085e+03   5.283 1.30e-07 ***
## sub_grade_A2     2.481e+04  5.573e+03   4.452 8.59e-06 ***
## sub_grade_A3     1.121e+04  5.388e+03   2.081 0.037428 *
## sub_grade_A4     1.676e+04  5.044e+03   3.322 0.000897 ***
## sub_grade_E1     2.852e+04  1.678e+04   1.699 0.089272 .
## sub_grade_E4     1.849e+04  1.274e+04   1.451 0.146760
## sub_grade_F3     6.161e+04  3.720e+04   1.656 0.097691 .
## homeownership_MORTGAGE 1.418e+05  2.421e+03  58.576 < 2e-16 ***
## homeownership_OWEN 5.183e+04  3.370e+03  15.382 < 2e-16 ***
## `loan_status_Charged Off` 8.761e+04  3.945e+04   2.221 0.026383 *
## `loan_status_Late (16-30 days)` 2.772e+04  1.770e+04   1.566 0.117478
## loan_purpose_credit_card -5.600e+03  2.604e+03  -2.150 0.031548 *
## sub_grade_C2     -1.021e+04  4.627e+03  -2.206 0.027404 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 104300 on 9439 degrees of freedom
## Multiple R-squared:  0.554, Adjusted R-squared:  0.553
## F-statistic: 558.3 on 21 and 9439 DF, p-value: < 2.2e-16
```

```
plot(fit4)
```






```
vif(fit4)
```

```
##          annual_income          loan_amount
##          1.427741          1.480837
##          interest_rate          term
##          1.953955          1.395552
##          delinq_2y          total_credit_utilized
##          1.030945          1.191788
##  `verified_income_Not Verified` `verified_income_Source Verified`
##          1.890512          1.732028
##          sub_grade_A1          sub_grade_A2
##          1.213880          1.208805
##          sub_grade_A3          sub_grade_A4
##          1.185451          1.168601
##          sub_grade_E1          sub_grade_E4
##          1.031429          1.081244
##          sub_grade_F3          homeownership_MORTGAGE
##          1.017256          1.269523
##          homeownership_OWNS `loan_status_Charged Off`
##          1.169480          1.001048
##  `loan_status_Late (16-30 days)` loan_purpose_credit_card
##          1.005239          1.031341
##          sub_grade_C2
##          1.018058
```

Let's remove subgrade_b1, loan_purpose_debt_consolidation and interest rate because of high vif values.

```
fit5<-lm(total_credit_limit ~ annual_income + term +
  delinq_2y + loan_amount + total_credit_utilized +
  `verified_income_Not Verified` + `verified_income_Source Verified` +
  sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
  sub_grade_A5 + sub_grade_B2 + sub_grade_B3 +
  sub_grade_B4 + sub_grade_B5 + sub_grade_C1 + sub_grade_C2 +
  sub_grade_C3 + sub_grade_C4 + sub_grade_C5 + sub_grade_D1 +
  sub_grade_D2 + sub_grade_D3 + sub_grade_D4 + sub_grade_D5 +
  sub_grade_E1 + sub_grade_E2 + sub_grade_E3 + sub_grade_E4 +
  sub_grade_E5 + sub_grade_F1 + sub_grade_F2 + sub_grade_F3 +
  sub_grade_F4 + sub_grade_F5 + sub_grade_G1 + homeownership_OWNS +
  `loan_status_Charged Off` + loan_status_Current + `loan_status_Fully Paid` +
  `loan_status_Late (16-30 days)` + loan_purpose_car + loan_purpose_credit_card + loan_purpose
  _home_improvement +
  loan_purpose_house + loan_purpose_major_purchase + loan_purpose_medical + loan_purpose_other
+ loan_purpose_small_business, data = dtf)
summary(fit5)
```

```
##
## Call:
## lm(formula = total_credit_limit ~ annual_income + term + delinq_2y +
##      loan_amount + total_credit_utilized + `verified_income_Not Verified` +
##      `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##      sub_grade_A3 + sub_grade_A4 + sub_grade_A5 + sub_grade_B2 +
##      sub_grade_B3 + sub_grade_B4 + sub_grade_B5 + sub_grade_C1 +
##      sub_grade_C2 + sub_grade_C3 + sub_grade_C4 + sub_grade_C5 +
##      sub_grade_D1 + sub_grade_D2 + sub_grade_D3 + sub_grade_D4 +
##      sub_grade_D5 + sub_grade_E1 + sub_grade_E2 + sub_grade_E3 +
##      sub_grade_E4 + sub_grade_E5 + sub_grade_F1 + sub_grade_F2 +
##      sub_grade_F3 + sub_grade_F4 + sub_grade_F5 + sub_grade_G1 +
##      homeownership_OWEN + `loan_status_Charged Off` + loan_status_Current +
##      `loan_status_Fully Paid` + `loan_status_Late (16-30 days)` +
##      loan_purpose_car + loan_purpose_credit_card + loan_purpose_home_improvement +
##      loan_purpose_house + loan_purpose_major_purchase + loan_purpose_medical +
##      loan_purpose_other + loan_purpose_small_business, data = dtf)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -355103  -78153  -24833   62158   905120
##
## Coefficients:
##
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -2.741e+04  1.373e+04  -1.997  0.045869 *
## annual_income     1.515e+00  4.470e-02  33.889 < 2e-16 ***
## term             1.398e+03  1.341e+02  10.424 < 2e-16 ***
## delinq_2y        1.213e+04  1.890e+03   6.416 1.47e-10 ***
## loan_amount      4.920e-01  1.535e-01   3.205 0.001354 **
## total_credit_utilized 1.152e+00  2.940e-02  39.200 < 2e-16 ***
## `verified_income_Not Verified` -4.475e+04  3.563e+03 -12.562 < 2e-16 ***
## `verified_income_Source Verified` -3.625e+04  3.342e+03 -10.847 < 2e-16 ***
## sub_grade_A1      4.872e+04  8.071e+03   6.037 1.63e-09 ***
## sub_grade_A2      3.759e+04  7.631e+03   4.926 8.54e-07 ***
## sub_grade_A3      1.530e+04  7.512e+03   2.037 0.041713 *
## sub_grade_A4      1.883e+04  7.224e+03   2.606 0.009168 **
## sub_grade_A5     -3.546e+03  7.572e+03  -0.468 0.639552
## sub_grade_B2     -8.367e+03  6.999e+03  -1.195 0.231952
## sub_grade_B3     -1.680e+04  7.300e+03  -2.302 0.021357 *
## sub_grade_B4     -1.316e+04  7.144e+03  -1.843 0.065414 .
## sub_grade_B5     -2.241e+04  7.032e+03  -3.187 0.001441 **
## sub_grade_C1     -2.829e+04  7.083e+03  -3.995 6.53e-05 ***
## sub_grade_C2     -3.971e+04  7.184e+03  -5.527 3.34e-08 ***
## sub_grade_C3     -2.844e+04  7.434e+03  -3.826 0.000131 ***
## sub_grade_C4     -4.203e+04  7.435e+03  -5.653 1.63e-08 ***
## sub_grade_C5     -3.968e+04  7.543e+03  -5.260 1.47e-07 ***
## sub_grade_D1     -5.263e+04  8.585e+03  -6.131 9.11e-10 ***
## sub_grade_D2     -4.004e+04  8.519e+03  -4.700 2.64e-06 ***
## sub_grade_D3     -5.927e+04  8.682e+03  -6.827 9.23e-12 ***
## sub_grade_D4     -5.985e+04  9.592e+03  -6.240 4.56e-10 ***
## sub_grade_D5     -6.870e+04  9.257e+03  -7.422 1.25e-13 ***
## sub_grade_E1     -2.893e+04  1.987e+04  -1.456 0.145536
```

```

## sub_grade_E2          -6.114e+04  1.746e+04  -3.501  0.000465 ***
## sub_grade_E3          -7.357e+04  1.515e+04  -4.857  1.21e-06 ***
## sub_grade_E4          -6.354e+04  1.517e+04  -4.188  2.84e-05 ***
## sub_grade_E5          -8.059e+04  1.426e+04  -5.650  1.65e-08 ***
## sub_grade_F1          -5.931e+04  2.323e+04  -2.553  0.010707 *
## sub_grade_F2          -8.177e+04  4.327e+04  -1.890  0.058803 .
## sub_grade_F3          -2.683e+03  4.329e+04  -0.062  0.950587
## sub_grade_F4          -2.927e+04  5.457e+04  -0.536  0.591741
## sub_grade_F5          -2.620e+04  6.117e+04  -0.428  0.668466
## sub_grade_G1          -7.477e+04  3.700e+04  -2.021  0.043335 *
## homeownership_OWn     -2.194e+04  3.653e+03  -6.005  1.99e-09 ***
## `loan_status_Charged Off`  1.116e+05  4.721e+04  2.365  0.018075 *
## loan_status_Current     1.885e+04  1.107e+04  1.702  0.088764 .
## `loan_status_Fully Paid`  3.175e+04  1.248e+04  2.543  0.011001 *
## `loan_status_Late (16-30 days)` 4.156e+04  2.331e+04  1.783  0.074656 .
## loan_purpose_car         -3.060e+03  1.091e+04  -0.280  0.779121
## loan_purpose_credit_card  -1.218e+04  3.183e+03  -3.827  0.000131 ***
## loan_purpose_home_improvement 3.743e+04  5.203e+03  7.194  6.76e-13 ***
## loan_purpose_house       7.068e+03  1.036e+04  0.682  0.495079
## loan_purpose_major_purchase -1.595e+04  7.555e+03  -2.111  0.034781 *
## loan_purpose_medical      8.474e+03  1.001e+04  0.847  0.397088
## loan_purpose_other        -1.101e+04  4.512e+03  -2.440  0.014719 *
## loan_purpose_small_business -2.462e+04  1.137e+04  -2.164  0.030463 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 121300 on 9410 degrees of freedom
## Multiple R-squared:  0.3985, Adjusted R-squared:  0.3953
## F-statistic: 124.7 on 50 and 9410 DF, p-value: < 2.2e-16

```

```
vif(fit5)
```

```

##          annual_income          term
##          1.411576          1.406825
##          delinq_2y          loan_amount
##          1.035127          1.513636
##          total_credit_utilized `verified_income_Not Verified`
##          1.196301          1.893129
## `verified_income_Source Verified`          sub_grade_A1
##          1.730729          1.578518
##          sub_grade_A2          sub_grade_A3
##          1.675344          1.703060
##          sub_grade_A4          sub_grade_A5
##          1.772058          1.677707
##          sub_grade_B2          sub_grade_B3
##          1.865623          1.747815
##          sub_grade_B4          sub_grade_B5
##          1.806742          1.868266
##          sub_grade_C1          sub_grade_C2
##          1.844797          1.814281
##          sub_grade_C3          sub_grade_C4
##          1.728643          1.726001
##          sub_grade_C5          sub_grade_D1
##          1.703226          1.483763
##          sub_grade_D2          sub_grade_D3
##          1.493055          1.483629
##          sub_grade_D4          sub_grade_D5
##          1.355908          1.412320
##          sub_grade_E1          sub_grade_E2
##          1.069576          1.092560
##          sub_grade_E3          sub_grade_E4
##          1.130153          1.133690
##          sub_grade_E5          sub_grade_F1
##          1.164898          1.060930
##          sub_grade_F2          sub_grade_F3
##          1.017236          1.018521
##          sub_grade_F4          sub_grade_F5
##          1.011666          1.017197
##          sub_grade_G1          homeownership_OWEN
##          1.022522          1.016098
##          `loan_status_Charged Off`          loan_status_Current
##          1.059973          4.568238
##          `loan_status_Fully Paid`          `loan_status_Late (16-30 days)`
##          4.232243          1.288360
##          loan_purpose_car          loan_purpose_credit_card
##          1.021497          1.139401
##          loan_purpose_home_improvement          loan_purpose_house
##          1.066066          1.027492
##          loan_purpose_major_purchase          loan_purpose_medical
##          1.032323          1.024538
##          loan_purpose_other          loan_purpose_small_business
##          1.092327          1.016351

```

Whoa! what a change. Let's let stepAIC do its magic!

```
stepAIC(fit4, direction = 'both')
```

```
## Start:  AIC=218661.3
## total_credit_limit ~ annual_income + loan_amount + interest_rate +
##   term + delinq_2y + total_credit_utilized + `verified_income_Not Verified` +
##   `verified_income_Source Verified` + sub_grade_A1 + sub_grade_A2 +
##   sub_grade_A3 + sub_grade_A4 + sub_grade_E1 + sub_grade_E4 +
##   sub_grade_F3 + homeownership_MORTGAGE + homeownership_OWN +
##   `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##   loan_purpose_credit_card + sub_grade_C2
##
##
```

	Df	Sum of Sq	RSS	AIC
## <none>			1.0263e+14	218661
## - sub_grade_E4	1	2.2898e+10	1.0265e+14	218661
## - `loan_status_Late (16-30 days)`	1	2.6650e+10	1.0266e+14	218662
## - sub_grade_F3	1	2.9829e+10	1.0266e+14	218662
## - sub_grade_E1	1	3.1401e+10	1.0266e+14	218662
## - sub_grade_A3	1	4.7102e+10	1.0268e+14	218664
## - loan_purpose_credit_card	1	5.0279e+10	1.0268e+14	218664
## - sub_grade_C2	1	5.2915e+10	1.0268e+14	218664
## - `loan_status_Charged Off`	1	5.3628e+10	1.0268e+14	218664
## - loan_amount	1	6.5576e+10	1.0269e+14	218665
## - sub_grade_A4	1	1.2000e+11	1.0275e+14	218670
## - sub_grade_A2	1	2.1555e+11	1.0284e+14	218679
## - sub_grade_A1	1	3.0349e+11	1.0293e+14	218687
## - delinq_2y	1	3.1540e+11	1.0294e+14	218688
## - term	1	4.3661e+11	1.0307e+14	218699
## - `verified_income_Source Verified`	1	7.2160e+11	1.0335e+14	218726
## - `verified_income_Not Verified`	1	9.0701e+11	1.0354e+14	218743
## - interest_rate	1	1.0438e+12	1.0367e+14	218755
## - homeownership_OWN	1	2.5725e+12	1.0520e+14	218894
## - annual_income	1	1.0909e+13	1.1354e+14	219615
## - total_credit_utilized	1	1.9017e+13	1.2165e+14	220268
## - homeownership_MORTGAGE	1	3.7306e+13	1.3994e+14	221593

```
##
## Call:
## lm(formula = total_credit_limit ~ annual_income + loan_amount +
##      interest_rate + term + delinq_2y + total_credit_utilized +
##      `verified_income_Not Verified` + `verified_income_Source Verified` +
##      sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
##      sub_grade_E1 + sub_grade_E4 + sub_grade_F3 + homeownership_MORTGAGE +
##      homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##      loan_purpose_credit_card + sub_grade_C2, data = dtf)
##
## Coefficients:
##              (Intercept)              annual_income
##              -2.494e+04              1.224e+00
##              loan_amount              interest_rate
##              3.205e-01              -2.939e+03
##              term              delinq_2y
##              7.278e+02              8.735e+03
##              total_credit_utilized  `verified_income_Not Verified`
##              1.055e+00              -2.796e+04
##  `verified_income_Source Verified`              sub_grade_A1
##              -2.342e+04              3.215e+04
##              sub_grade_A2              sub_grade_A3
##              2.481e+04              1.121e+04
##              sub_grade_A4              sub_grade_E1
##              1.676e+04              2.852e+04
##              sub_grade_E4              sub_grade_F3
##              1.849e+04              6.161e+04
##              homeownership_MORTGAGE              homeownership_OWEN
##              1.418e+05              5.183e+04
##              `loan_status_Charged Off`  `loan_status_Late (16-30 days)`
##              8.761e+04              2.772e+04
##              loan_purpose_credit_card              sub_grade_C2
##              -5.600e+03              -1.021e+04
```

```
fit6<-lm(total_credit_limit ~ annual_income + loan_amount +
  interest_rate + term + delinq_2y + total_credit_utilized +
  `verified_income_Not Verified` + `verified_income_Source Verified` +
  sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
  sub_grade_E1 + sub_grade_E4 + sub_grade_F3 + homeownership_MORTGAGE +
  homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
  loan_purpose_credit_card + sub_grade_C2, data = dtf)
summary(fit6)
```

```
##
## Call:
## lm(formula = total_credit_limit ~ annual_income + loan_amount +
##      interest_rate + term + delinq_2y + total_credit_utilized +
##      `verified_income_Not Verified` + `verified_income_Source Verified` +
##      sub_grade_A1 + sub_grade_A2 + sub_grade_A3 + sub_grade_A4 +
##      sub_grade_E1 + sub_grade_E4 + sub_grade_F3 + homeownership_MORTGAGE +
##      homeownership_OWEN + `loan_status_Charged Off` + `loan_status_Late (16-30 days)` +
##      loan_purpose_credit_card + sub_grade_C2, data = dtf)
##
## Residuals:
##      Min        1Q    Median        3Q        Max
## -368820  -53908   -5678    36977   851237
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -2.494e+04  6.553e+03  -3.806 0.000142 ***
## annual_income     1.224e+00  3.865e-02  31.675 < 2e-16 ***
## loan_amount       3.205e-01  1.305e-01   2.456 0.014074 *
## interest_rate    -2.939e+03  3.000e+02  -9.798 < 2e-16 ***
## term              7.278e+02  1.149e+02   6.337 2.45e-10 ***
## delinq_2y         8.735e+03  1.622e+03   5.386 7.38e-08 ***
## total_credit_utilized 1.055e+00  2.523e-02  41.822 < 2e-16 ***
## `verified_income_Not Verified` -2.796e+04  3.061e+03  -9.133 < 2e-16 ***
## `verified_income_Source Verified` -2.342e+04  2.874e+03  -8.147 4.22e-16 ***
## sub_grade_A1      3.215e+04  6.085e+03   5.283 1.30e-07 ***
## sub_grade_A2      2.481e+04  5.573e+03   4.452 8.59e-06 ***
## sub_grade_A3      1.121e+04  5.388e+03   2.081 0.037428 *
## sub_grade_A4      1.676e+04  5.044e+03   3.322 0.000897 ***
## sub_grade_E1      2.852e+04  1.678e+04   1.699 0.089272 .
## sub_grade_E4      1.849e+04  1.274e+04   1.451 0.146760
## sub_grade_F3      6.161e+04  3.720e+04   1.656 0.097691 .
## homeownership_MORTGAGE 1.418e+05  2.421e+03  58.576 < 2e-16 ***
## homeownership_OWEN 5.183e+04  3.370e+03  15.382 < 2e-16 ***
## `loan_status_Charged Off` 8.761e+04  3.945e+04   2.221 0.026383 *
## `loan_status_Late (16-30 days)` 2.772e+04  1.770e+04   1.566 0.117478
## loan_purpose_credit_card -5.600e+03  2.604e+03  -2.150 0.031548 *
## sub_grade_C2      -1.021e+04  4.627e+03  -2.206 0.027404 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 104300 on 9439 degrees of freedom
## Multiple R-squared:  0.554, Adjusted R-squared:  0.553
## F-statistic: 558.3 on 21 and 9439 DF, p-value: < 2.2e-16
```

Final AIC values of all of our models!

```
#AIC(slm)
AIC(fit)
```

```
## [1] 265879.3
```

```
AIC(fit1)
```

```
## [1] 265879.3
```

```
AIC(fit2)
```

```
## [1] 266204.2
```

```
AIC(fit3)
```

```
## [1] 245563.8
```

```
AIC(fit4)
```

```
## [1] 245512.5
```

```
AIC(fit5)
```

```
## [1] 248400.8
```

```
AIC(fit6)
```

```
## [1] 245512.5
```

```
options(scipen = 999)
```

Summary

Looks like we have found the best model, though all of them are not great. Fit6 does provide the best evaluation metrics overall. The regression results above tell us that total credit limit is predicted to increase by about \$727 with a one unit increase in term (length of loan in months).

Discussion Activity: For Discussion, continue working on the loans file and respond to the following questions.

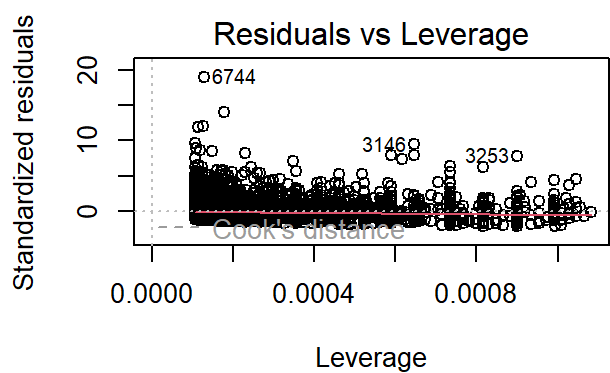
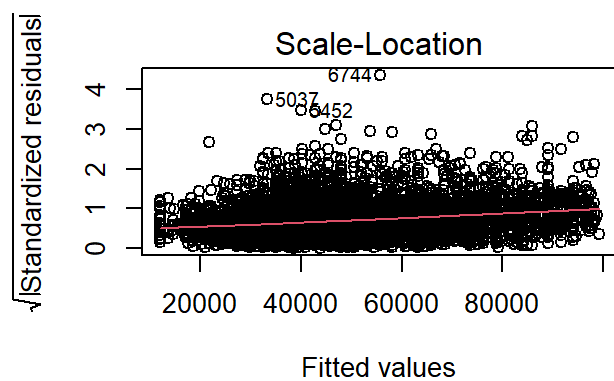
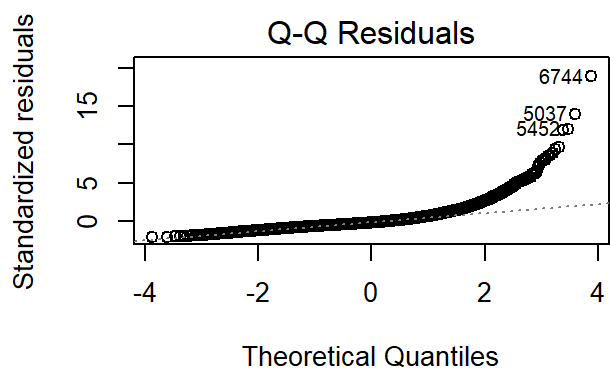
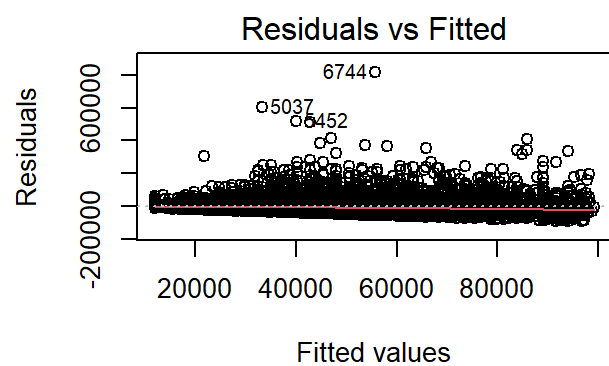
1. Does annual income matter for the loan amount or its interest rate? 2. Pick another DV (not total_credit_limit) and make a hypothesis of variables that maybe related. You need to include at least 3 IVs in the analysis. 3. Run several MLR models. Be sure to consider if you need to add/remove or transform variables. 4. Perform tests of diagnostics, i.e. with plot(), correlation, and vif. 5. Are there variables currently not in the data set that may be beneficial to your analysis? Does your initial hypothesis hold? 5. Post your rfile and responses to the questions to the Week 6 discussion.

From the analysis above, it seems that the annual income of a customer does matter to the loan amount, where the higher the annual income of an individual, then the loan amount is higher. Another hypothesis could be: There is a positive relationship between a person's annual income and the loan amount and individuals with higher income may utilize more credit.

```
slm_1 <- lm(total_credit_utilized ~ dt$annual_income, data = dt)
summary(slm_1)
```

```
##
## Call:
## lm(formula = total_credit_utilized ~ dt$annual_income, data = dt)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -92221 -23258  -9545  11546 818076
##
## Coefficients:
##              Estimate Std. Error t value      Pr(>|t|)
## (Intercept)   12059.78226   1026.79301    11.74 <0.0000000000000002 ***
## dt$annual_income    0.51267     0.01339    38.28 <0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 43170 on 9459 degrees of freedom
## Multiple R-squared:  0.1341, Adjusted R-squared:  0.1341
## F-statistic: 1465 on 1 and 9459 DF, p-value: < 0.00000000000000022
```

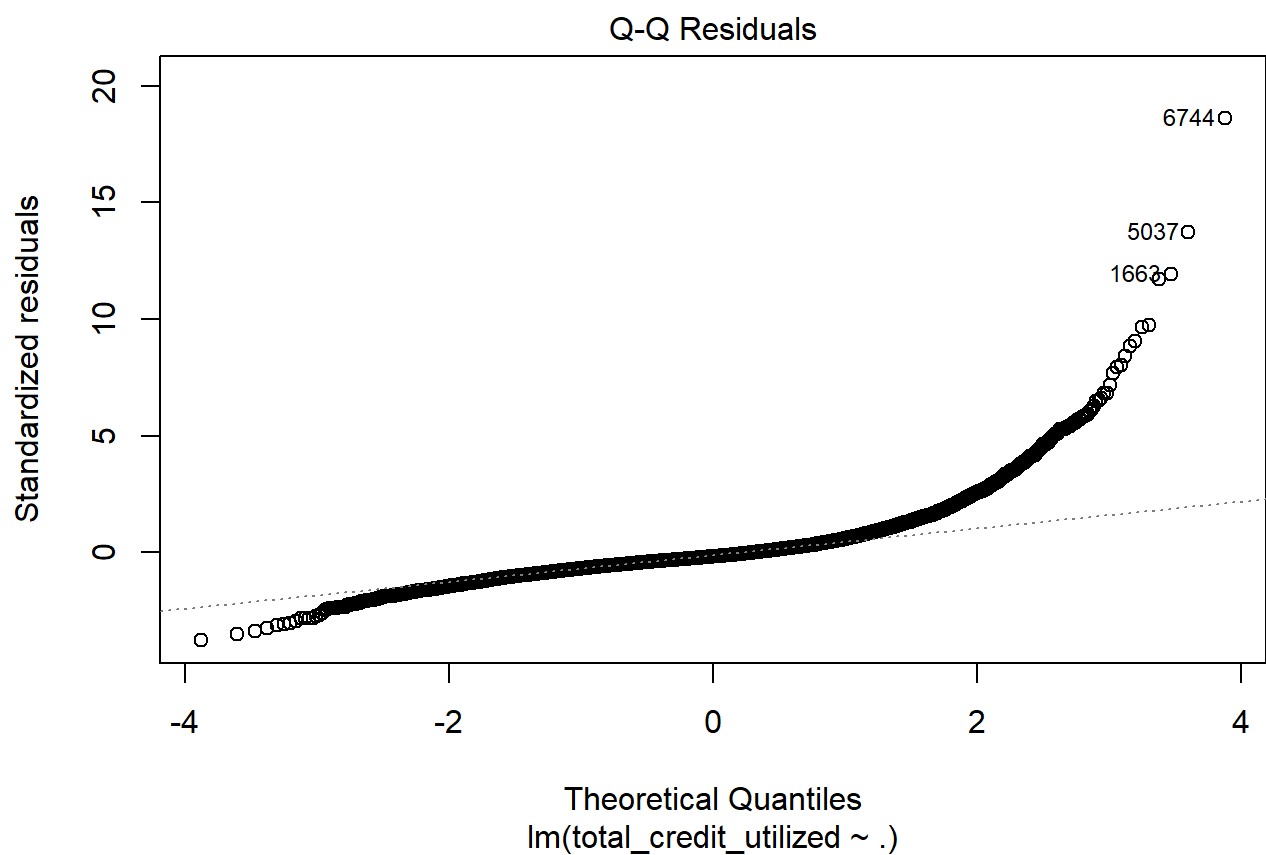
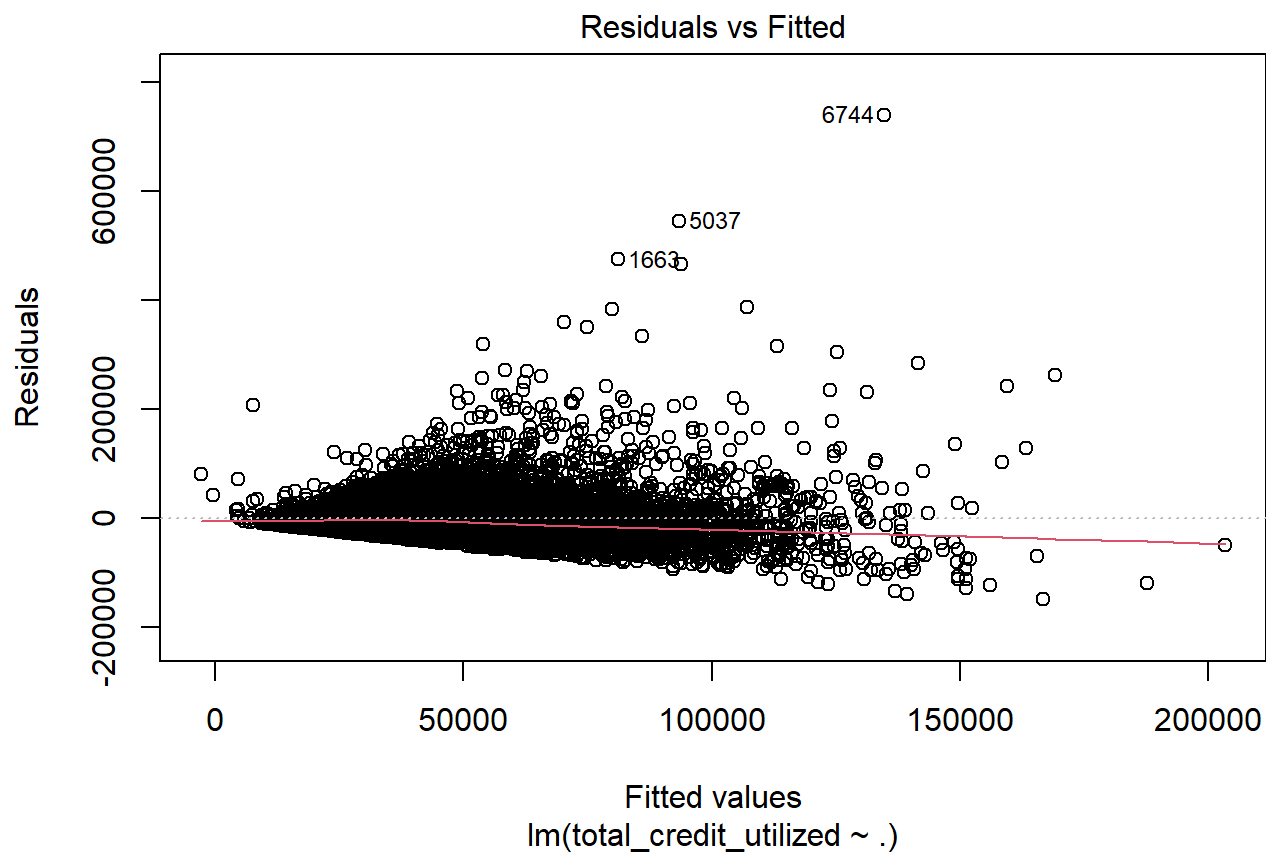
```
par(mfrow=c(2,2))
plot(slm_1)
```

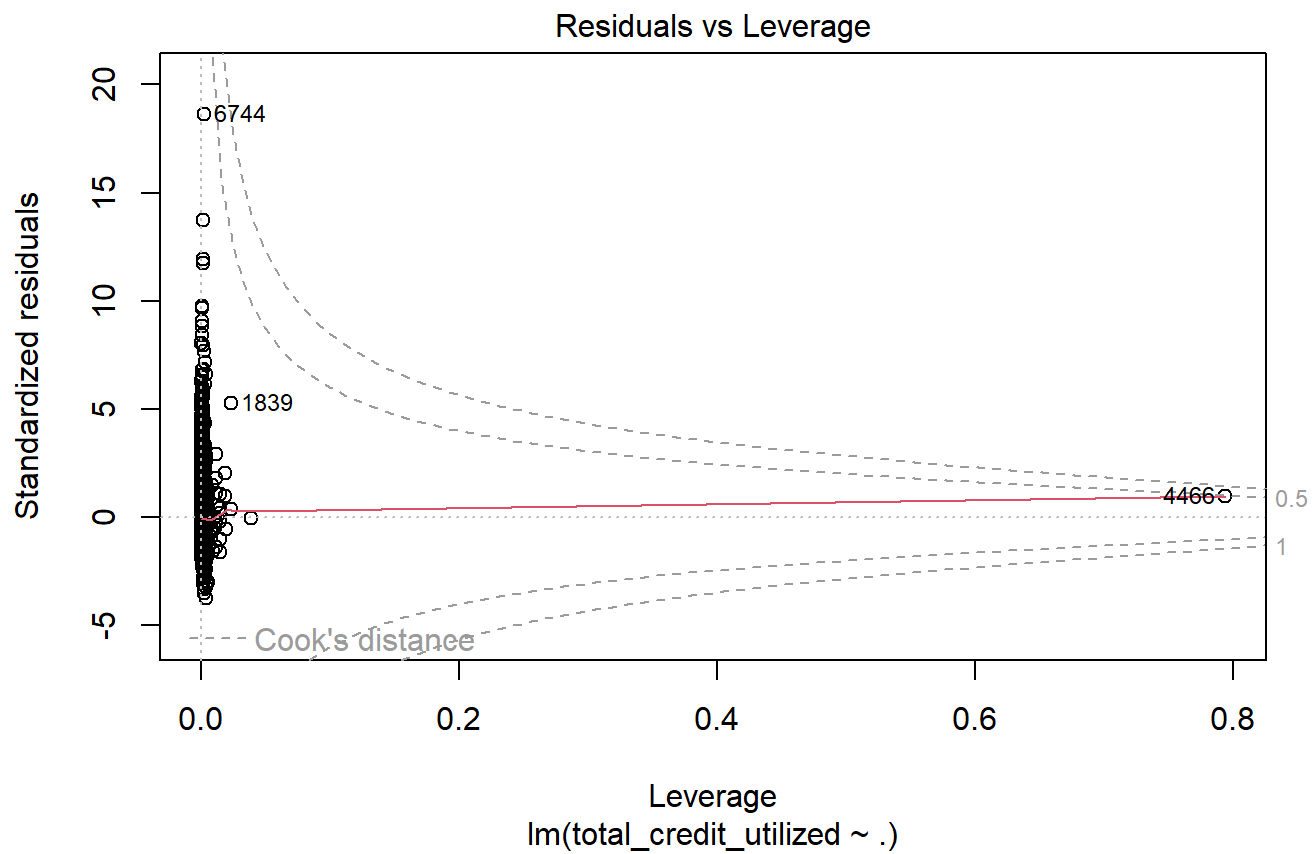
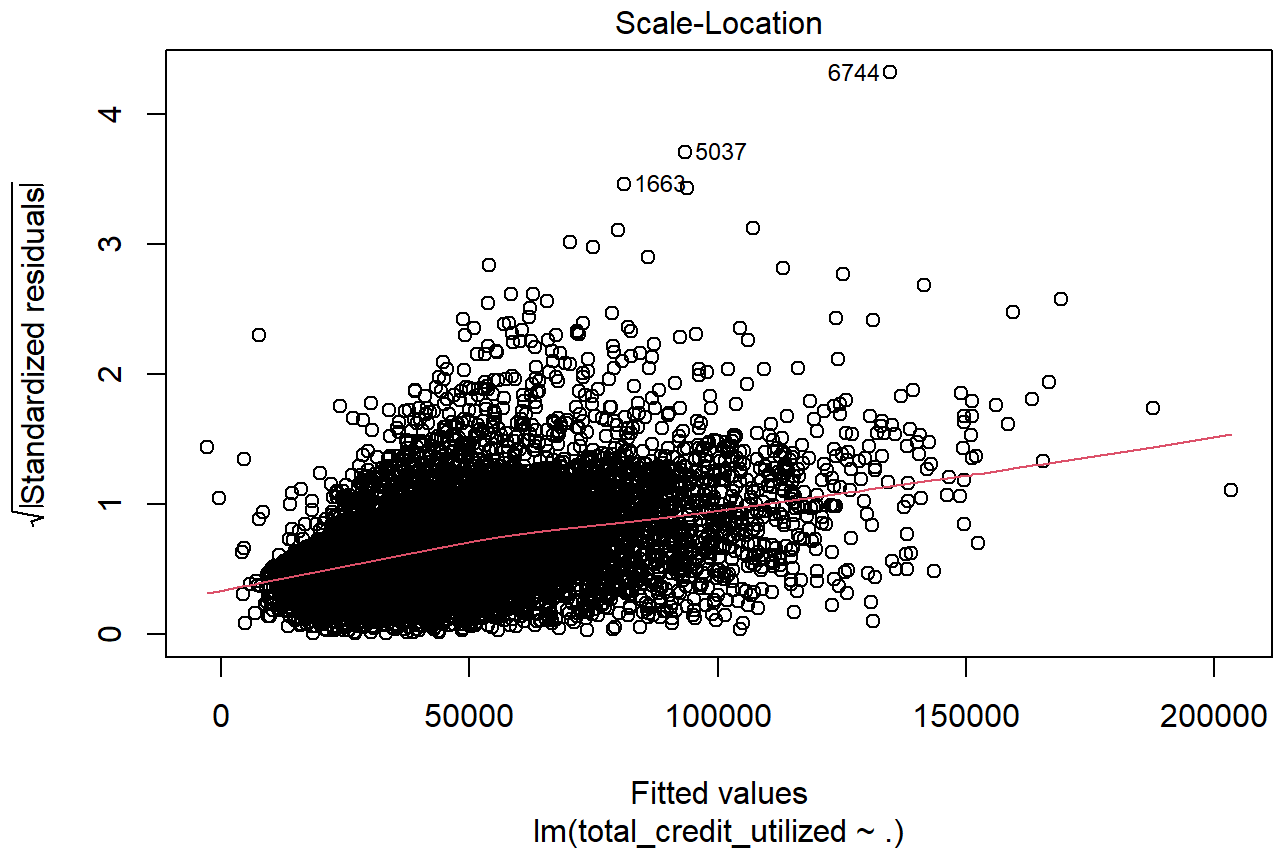


```
dtnum_1 <- select_if(dt, is.numeric)
fit_1 <- lm(total_credit_utilized ~ ., data = dtnum_1)
summary(fit_1)
```

```
##
## Call:
## lm(formula = total_credit_utilized ~ ., data = dtnum_1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -149063  -19668   -6478   10786  739034
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -960.301043   1909.713671  -0.503    0.615081
## annual_income    0.243795    0.015028  16.222 < 0.0000000000000002 ***
## loan_amount     0.170508    0.048392   3.523    0.000428 ***
## interest_rate  1293.212651    89.983063  14.372 < 0.0000000000000002 ***
## term          -151.479635    43.363586  -3.493    0.000479 ***
## delinq_2y      -3447.855810   616.239723  -5.595    0.000000227 ***
## tax_liens      -538.340261    681.377916  -0.790    0.429503
## total_credit_limit  0.119479    0.003067  38.952 < 0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 39730 on 9453 degrees of freedom
## Multiple R-squared:  0.2673, Adjusted R-squared:  0.2667
## F-statistic: 492.6 on 7 and 9453 DF, p-value: < 0.0000000000000022
```

```
plot(fit_1)
```





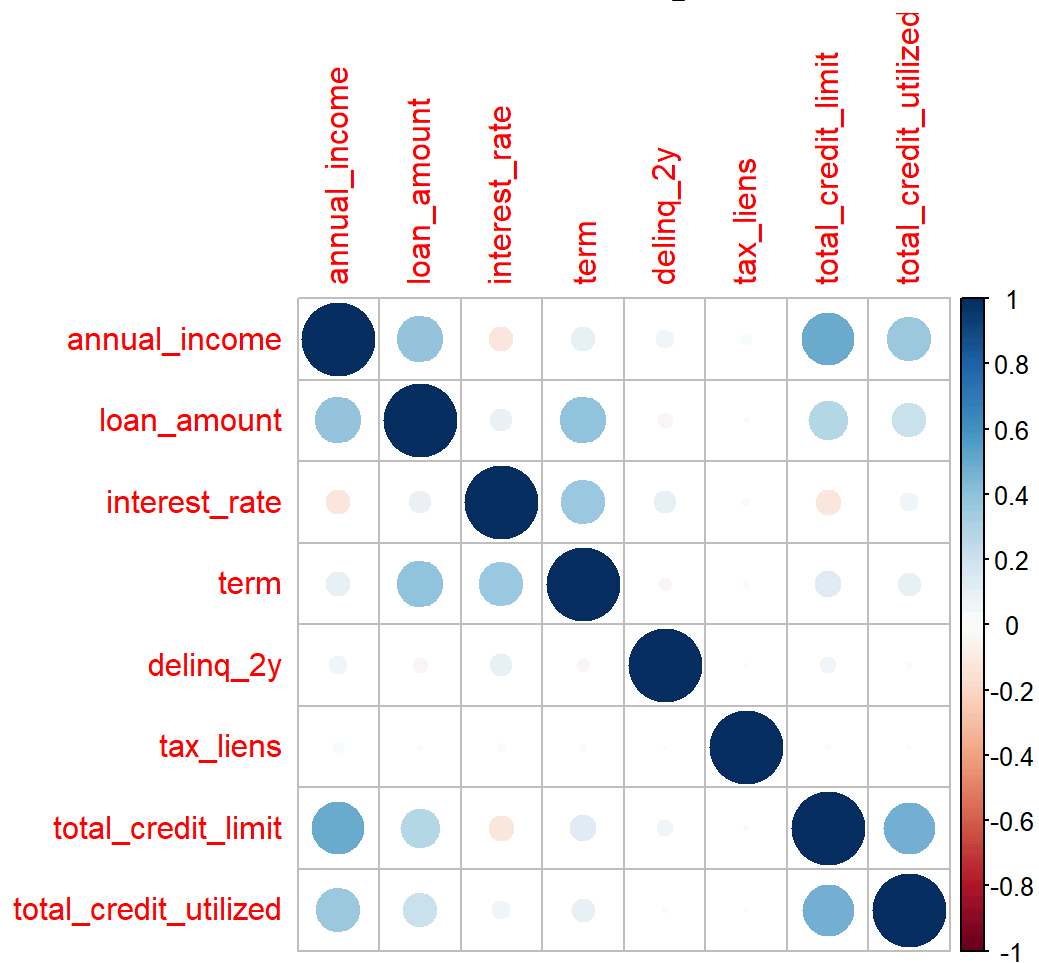
```
fit_glm_1 <- glm(total_credit_utilized ~ ., data = dtnum_1)
summary(fit_glm_1)
```

```
##
## Call:
## glm(formula = total_credit_utilized ~ ., data = dtnum_1)
##
## Coefficients:
##              Estimate   Std. Error t value      Pr(>|t|)
## (Intercept)   -960.301043  1909.713671  -0.503      0.615081
## annual_income    0.243795    0.015028  16.222 < 0.0000000000000002 ***
## loan_amount     0.170508    0.048392   3.523      0.000428 ***
## interest_rate  1293.212651   89.983063  14.372 < 0.0000000000000002 ***
## term           -151.479635   43.363586  -3.493      0.000479 ***
## delinq_2y      -3447.855810  616.239723  -5.595      0.0000000227 ***
## tax_liens      -538.340261   681.377916  -0.790      0.429503
## total_credit_limit  0.119479    0.003067  38.952 < 0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 1578380602)
##
##      Null deviance: 20363384416786  on 9460  degrees of freedom
## Residual deviance: 14920431830601  on 9453  degrees of freedom
## AIC: 227240
##
## Number of Fisher Scoring iterations: 2
```

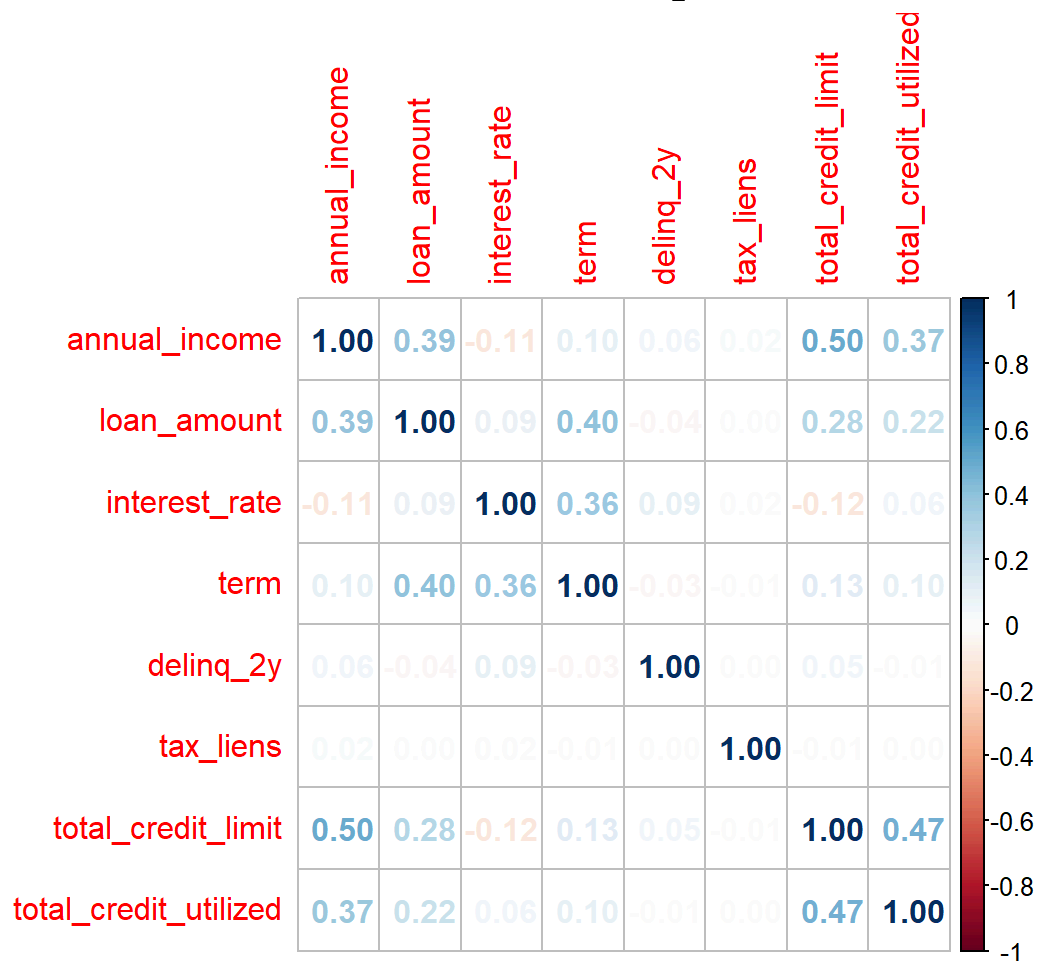
```
par(mfrow=c(1,1))
library(corrplot)
cor(dtnum_1)
```

```
##          annual_income loan_amount interest_rate      term
## annual_income      1.00000000  0.389233364  -0.11057718  0.102938778
## loan_amount        0.38923336  1.000000000   0.08619792  0.395930363
## interest_rate     -0.11057718  0.086197918   1.00000000  0.356554327
## term               0.10293878  0.395930363   0.35655433  1.000000000
## delinq_2y          0.05881595 -0.039763145   0.09017478 -0.031394220
## tax_liens           0.02057238  0.003866438   0.01580166 -0.009832315
## total_credit_limit  0.49789525  0.280631229  -0.11988784  0.129352516
## total_credit_utilized 0.36625742  0.216942713   0.05756747  0.099709323
##          delinq_2y      tax_liens total_credit_limit
## annual_income      0.058815951  0.020572382      0.49789525
## loan_amount        -0.039763145  0.003866438      0.28063123
## interest_rate       0.090174783  0.015801658     -0.11988784
## term               -0.031394220 -0.009832315      0.12935252
## delinq_2y          1.000000000 -0.003703266      0.04993056
## tax_liens           -0.003703266  1.000000000     -0.00587591
## total_credit_limit  0.049930558 -0.005875910      1.00000000
## total_credit_utilized -0.007329704 -0.002856529      0.47485822
##          total_credit_utilized
## annual_income      0.366257422
## loan_amount        0.216942713
## interest_rate       0.057567469
## term               0.099709323
## delinq_2y          -0.007329704
## tax_liens           -0.002856529
## total_credit_limit  0.474858217
## total_credit_utilized 1.000000000
```

```
corrplot(cor(dtnum_1))
```



```
corrplot(cor(dtnum_1), method='number')
```

```
fit3_1 <- lm(total_credit_utilized ~ ., data = dtf)
summary(fit3_1)
```

```
##
## Call:
## lm(formula = total_credit_utilized ~ ., data = dtf)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -164093  -19490   -6405   11480  710692
##
## Coefficients: (5 not defined because of singularities)
##              Estimate Std. Error t value
## (Intercept)    16774.474976   72549.036291    0.231
## annual_income      0.228370     0.015091   15.133
## loan_amount       0.185977     0.049671    3.744
## interest_rate    -187.752534   1944.304305   -0.097
## term            -120.230925     43.474597   -2.766
## delinq_2y       -3517.535217    608.500577   -5.781
## tax_liens        -428.049781    670.224550   -0.639
## total_credit_limit  0.147234     0.003544   41.549
## `verified_income_Not Verified`  907.355317   1159.574084    0.782
## `verified_income_Source Verified` 395.936836   1083.309451    0.365
## verified_income_Verified          NA          NA          NA
## sub_grade_A1    -14797.104635   63803.383511   -0.232
## sub_grade_A2    -8511.017358   62653.573452   -0.136
## sub_grade_A3    -8738.984957   61697.526439   -0.142
## sub_grade_A4    -4737.417052   60767.721944   -0.078
## sub_grade_A5    -377.416933   59861.216971   -0.006
## sub_grade_B1    -5287.532980   57756.171433   -0.092
## sub_grade_B2     4045.896776   57069.147671    0.071
## sub_grade_B3     1871.349010   56391.073120    0.033
## sub_grade_B4     3107.148398   55723.354928    0.056
## sub_grade_B5     4845.846003   54265.444259    0.089
## sub_grade_C1     4564.719897   53451.171015    0.085
## sub_grade_C2     7646.535341   52208.371817    0.146
## sub_grade_C3     6079.192486   51600.997498    0.118
## sub_grade_C4     7482.705648   50423.977836    0.148
## sub_grade_C5    11712.267059   49278.686709    0.238
## sub_grade_D1     8079.315581   47941.970511    0.169
## sub_grade_D2    14041.402980   46930.189096    0.299
## sub_grade_D3    18451.750461   45951.601149    0.402
## sub_grade_D4    13910.373286   45103.381521    0.308
## sub_grade_D5    13325.680277   43806.938941    0.304
## sub_grade_E1    13498.683354   43185.416890    0.313
## sub_grade_E2    10022.132136   42403.175140    0.236
## sub_grade_E3    20100.701810   41743.241522    0.482
## sub_grade_E4    11799.565564   41266.835187    0.286
## sub_grade_E5    20508.231272   40918.447033    0.501
## sub_grade_F1    18669.995080   40628.166536    0.460
## sub_grade_F2    21417.055675   42168.974883    0.508
## sub_grade_F3    20763.636192   42136.660535    0.493
## sub_grade_F4    57007.542905   43445.147445    1.312
## sub_grade_F5    24093.753276   44082.561089    0.547
## sub_grade_G1    21467.642365   41479.960452    0.518
```

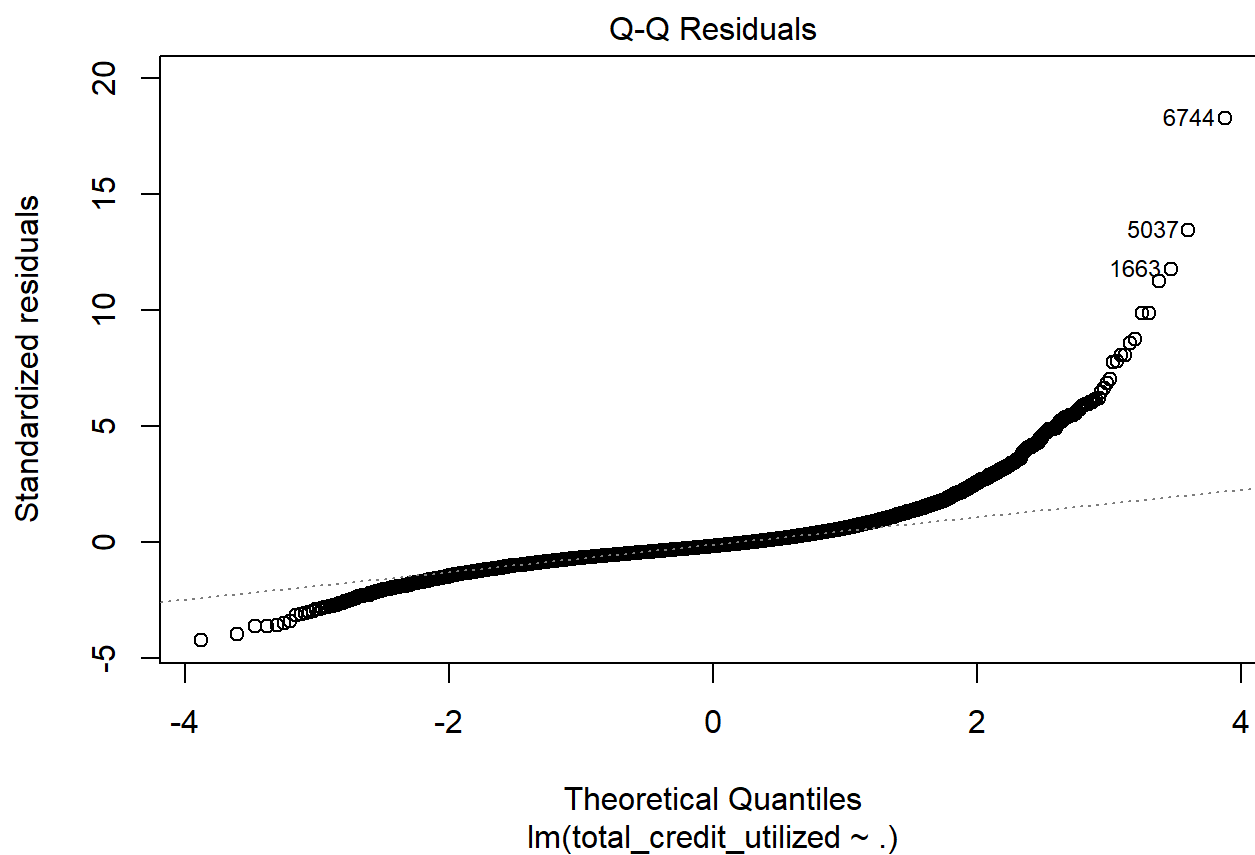
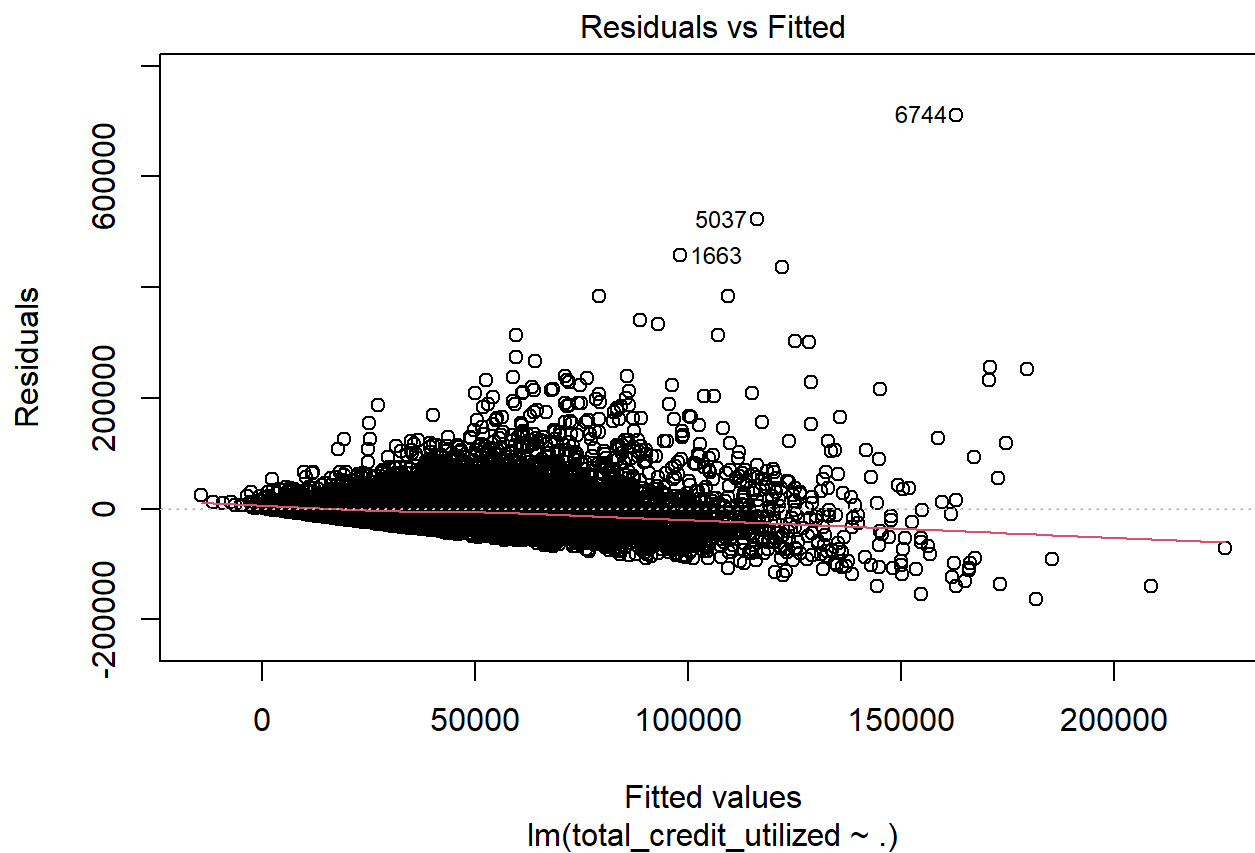
	NA	NA	NA
## sub_grade_G4	NA	NA	NA
## homeownership_MORTGAGE	-15212.553033	1057.879433	-14.380
## homeownership_OWEN	-7310.571231	1283.191777	-5.697
## homeownership_RENT	NA	NA	NA
## `loan_status_Charged Off`	2766.281499	15597.058041	0.177
## loan_status_Current	4028.518954	5017.928571	0.803
## `loan_status_Fully Paid`	3324.729817	5349.354592	0.622
## `loan_status_In Grace Period`	10477.773940	7031.461693	1.490
## `loan_status_Late (16-30 days)`	-1903.643971	8361.957344	-0.228
## `loan_status_Late (31-120 days)`	NA	NA	NA
## loan_purpose_car	-5450.655090	6120.071614	-0.891
## loan_purpose_credit_card	1535.063197	5136.315721	0.299
## loan_purpose_debt_consolidation	-4795.217178	5099.538133	-0.940
## loan_purpose_home_improvement	-8913.003241	5313.482544	-1.677
## loan_purpose_house	-13728.694658	6052.992573	-2.268
## loan_purpose_major_purchase	-11797.109780	5585.004877	-2.112
## loan_purpose_medical	-6592.273246	5961.928935	-1.106
## loan_purpose_moving	-60.583580	6909.241393	-0.009
## loan_purpose_other	-8771.902842	5227.141994	-1.678
## loan_purpose_renewable_energy	2667.500119	13974.360013	0.191
## loan_purpose_small_business	-108.703780	6232.476439	-0.017
## loan_purpose_vacation	NA	NA	NA
##	Pr(> t)		
## (Intercept)	0.817152		
## annual_income	< 0.0000000000000002	***	
## loan_amount	0.000182	***	
## interest_rate	0.923074		
## term	0.005694	**	
## delinq_2y	0.00000000768	***	
## tax_liens	0.523056		
## total_credit_limit	< 0.0000000000000002	***	
## `verified_income_Not Verified`	0.433946		
## `verified_income_Source Verified`	0.714755		
## verified_income_Verified	NA		
## sub_grade_A1	0.816607		
## sub_grade_A2	0.891949		
## sub_grade_A3	0.887366		
## sub_grade_A4	0.937862		
## sub_grade_A5	0.994970		
## sub_grade_B1	0.927058		
## sub_grade_B2	0.943483		
## sub_grade_B3	0.973528		
## sub_grade_B4	0.955534		
## sub_grade_B5	0.928846		
## sub_grade_C1	0.931945		
## sub_grade_C2	0.883560		
## sub_grade_C3	0.906220		
## sub_grade_C4	0.882034		
## sub_grade_C5	0.812139		
## sub_grade_D1	0.866176		
## sub_grade_D2	0.764796		
## sub_grade_D3	0.688026		

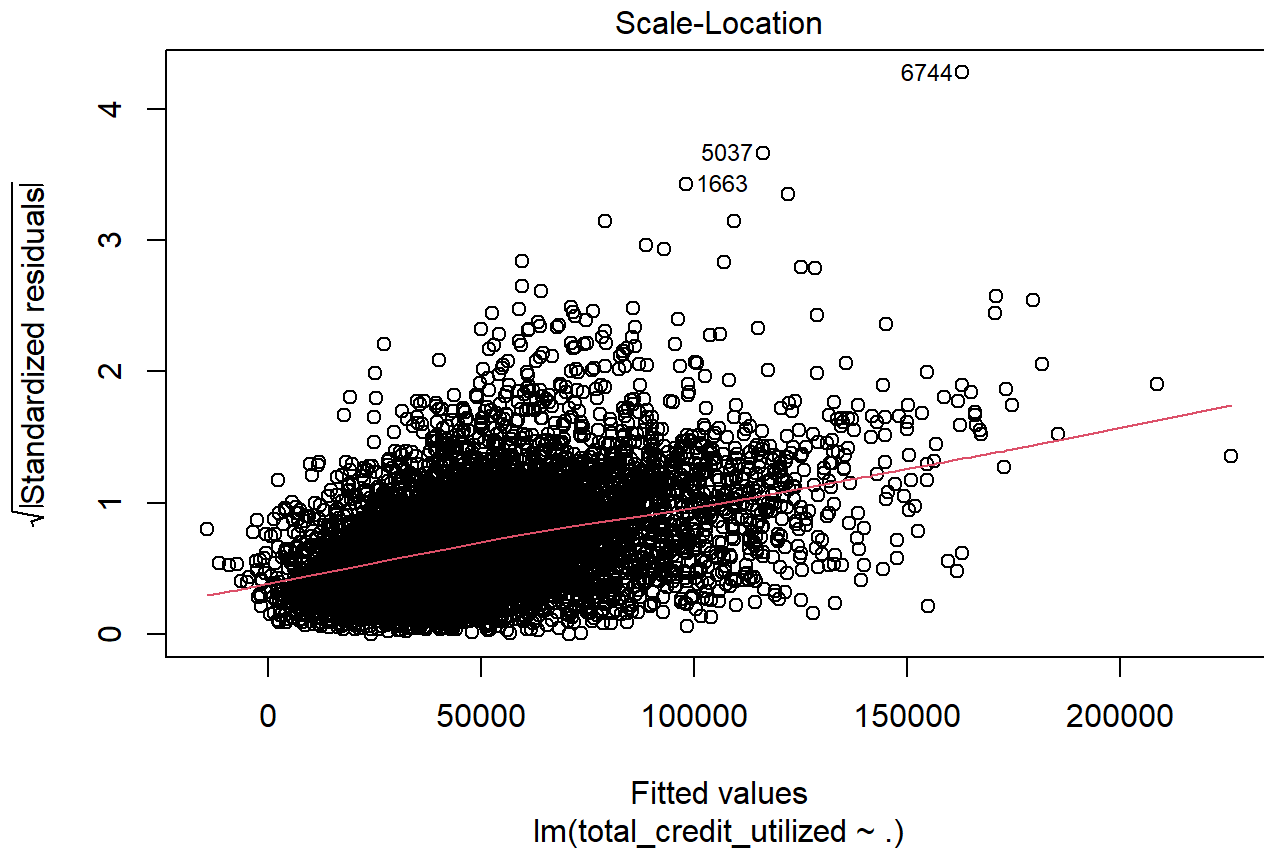
```

## sub_grade_D4          0.757777
## sub_grade_D5          0.760989
## sub_grade_E1          0.754610
## sub_grade_E2          0.813164
## sub_grade_E3          0.630150
## sub_grade_E4          0.774935
## sub_grade_E5          0.616244
## sub_grade_F1          0.645862
## sub_grade_F2          0.611545
## sub_grade_F3          0.622187
## sub_grade_F4          0.189494
## sub_grade_F5          0.584694
## sub_grade_G1          0.604790
## sub_grade_G4          NA
## homeownership_MORTGAGE < 0.000000000000002 ***
## homeownership_OWEN    0.00000001255 ***
## homeownership_RENT     NA
## `loan_status_Charged Off` 0.859230
## loan_status_Current      0.422096
## `loan_status_Fully Paid` 0.534273
## `loan_status_In Grace Period` 0.136224
## `loan_status_Late (16-30 days)` 0.819919
## `loan_status_Late (31-120 days)` NA
## loan_purpose_car          0.373156
## loan_purpose_credit_card  0.765050
## loan_purpose_debt_consolidation 0.347076
## loan_purpose_home_improvement 0.093491 .
## loan_purpose_house        0.023347 *
## loan_purpose_major_purchase 0.034688 *
## loan_purpose_medical       0.268872
## loan_purpose_moving        0.993004
## loan_purpose_other         0.093352 .
## loan_purpose_renewable_energy 0.848620
## loan_purpose_small_business 0.986085
## loan_purpose_vacation      NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 39010 on 9402 degrees of freedom
## Multiple R-squared:  0.2974, Adjusted R-squared:  0.2931
## F-statistic: 68.62 on 58 and 9402 DF,  p-value: < 0.0000000000000022

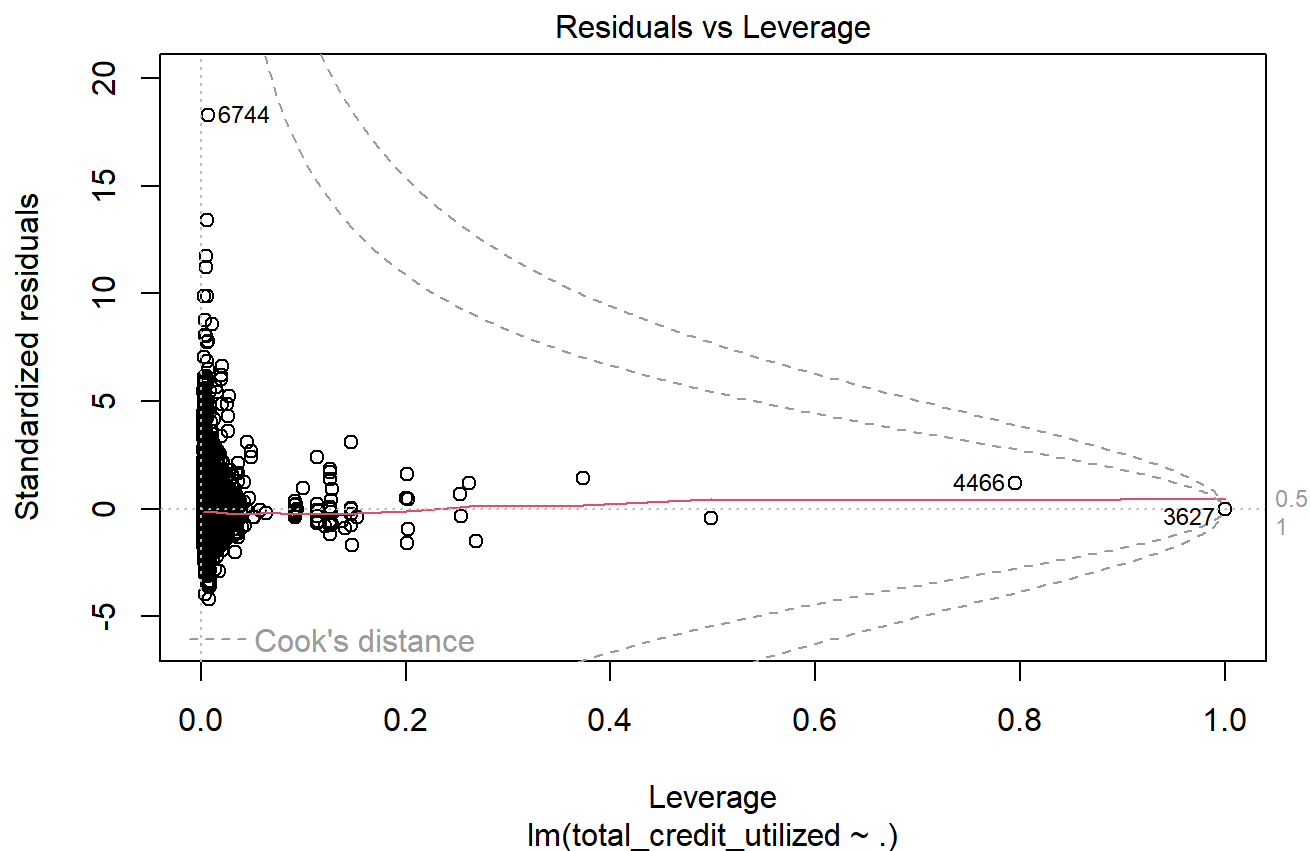
```

```
plot(fit3_1)
```





```
## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced  
## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced
```



```
AIC(fit_1)
```

```
## [1] 227240
```

```
AIC(fit3_1)
```

```
## [1] 226944.9
```

```
options(scipen = 999)
```

Are there variables currently not in the data set that may be beneficial to your analysis? Does your initial hypothesis hold? I think for future analysis, some variables not included in the current data set like, num_total_cc_accounts, num_open_cc_accounts and num_mort_accounts could be beneficial for the analysis. The original hypothesis does hold where the total_credit_utilized does correlate with annual income positively. The total_credit_utilized also positively correlates with loan amount, but not as much as annual income.