ltc_analysis_ON_deaths

Import and prepare the data

```
# library(skimr)
library(devtools)
```

```
## Loading required package: usethis
```

```
library(broom)

# Import the data
df <- read.csv("../data_output/merged_LTC_odhf_quality.csv", na.strings="", header=TRUE)
# skim(df)
# head(df)

# Change variable data types
df[, 'outbreak'] <- as.factor(df[, 'outbreak'])

listofcol = list('first_inspection_date', 'date_first_outbreak', 'date_max_cases', 'date
_max_HCWcases', 'date_first_resolved')
for (each in listofcol){
  df[, each] <- as.Date(df[, each])
}

listofcol = list('name', 'cleaned_name', 'address', 'city', 'postal_code', 'CSDname')
for (each in listofcol){
  df[, each] <- as.character(df[, each])
}

# skim(df)
str(df)
```

```
## 'data.frame':    625 obs. of  43 variables:
##  $ outbreak               : Factor w/ 2 levels "0","1": 2 1 1 2 2 2 2 1 1 1 ...
##  $ cleaned_name           : chr  "albright gardens" "atikokan general hospital" "bell
a senior care residences" "berkshire care centre" ...
##  $ name                   : chr  "ALBRIGHT GARDENS HOMES, INCORPORATED" "ATIKOKAN GEN
ERAL HOSPITAL" "BELLA SENIOR CARE RESIDENCES INC." "BERKSHIRE CARE CENTRE" ...
##  $ address                : chr  "5050 Hillside Drive" "120 Dorothy Street" "8720 Wil
loughby Drive" "350 Dougall Avenue" ...
##  $ city                   : chr  "Beamsville" "Atikokan" "Niagara Falls" "Windsor"
...
##  $ postal_code            : chr  " L0R1B2" " P0T1C0" " L2G7X3" " N9A4P4" ...
##  $ LHIN                   : Factor w/ 14 levels "Central","Central East",..: 6 10 6 5
4 13 13 14 10 9 ...
##  $ home_type              : Factor w/ 3 levels "For-Profit","Municipal",..: 3 3 1 1 3
3 1 3 3 3 ...
##  $ number_beds            : num  231 26 161 231 113 228 126 84 19 143 ...
##  $ short_stay             : Factor w/ 2 levels "No","Yes": 1 1 1 1 2 2 1 1 1 1 ...
##  $ residents_council      : Factor w/ 2 levels "No","Yes": 2 1 2 2 2 2 2 2 2 2 ...
##  $ family_council         : Factor w/ 2 levels "No","Yes": 2 2 2 2 2 2 1 2 2 1 ...
##  $ accreditation          : Factor w/ 2 levels "No","Yes": 1 2 2 2 1 1 2 2 2 2 ...
##  $ antipsychotic_percent  : num  26 41.4 29.2 21.2 11.5 29.8 28.8 16.1 62.8 12.3 ...
##  $ pressure_ulcers_percent: num  3.8 8.4 4.5 3.9 1.3 2.1 2 3.1 1.4 4.1 ...
##  $ falls_percent          : num  19.5 14.2 20.9 15.8 16.3 10.5 13.6 21.6 5.2 18.3 ...
##  $ restraints_percent     : num  5.4 9 2.2 6.4 6.1 4.9 0 2.9 8.8 1.5 ...
##  $ depression_percent     : num  34.8 42.4 13 16.8 30 23 6.5 47 7.5 30 ...
##  $ pain_percent           : num  2.3 11.2 7.4 3.8 0.3 2.1 0.2 2.8 48 6.4 ...
##  $ first_inspection_date  : Date, format: "2010-11-03" "2011-08-16" ...
##  $ total_inspections      : num  40 11 67 175 51 24 15 19 14 23 ...
##  $ X5y_inspections        : num  26 7 46 75 30 18 10 14 10 15 ...
##  $ X2y_inspections        : num  16 4 13 28 20 9 5 7 3 9 ...
##  $ total_complaints       : num  18 1 35 94 8 12 7 6 1 5 ...
##  $ X5y_complaints         : num  10 0 22 34 2 10 2 5 1 3 ...
##  $ X2y_complaints         : num  6 0 5 9 0 6 2 2 0 3 ...
##  $ total_critical         : num  13 2 12 61 19 4 3 4 5 9 ...
##  $ X5y_critical           : num  8 1 8 28 14 3 3 3 4 6 ...
##  $ X2y_critical           : num  7 1 4 14 14 2 2 3 2 5 ...
##  $ total_withOrders       : num  7 3 18 12 16 5 1 6 5 3 ...
##  $ X5y_withOrders         : num  7 2 12 8 8 4 1 6 3 1 ...
##  $ X2y_withOrders         : num  3 1 3 4 4 1 1 3 0 0 ...
##  $ cum_resident_deaths    : num  0 NA NA 0 0 0 18 NA NA NA ...
##  $ max_resident_cases     : num  1 NA NA 0 0 0 44 NA NA NA ...
##  $ max_hcw_cases          : num  1 NA NA 1 1 1 44 NA NA NA ...
##  $ date_first_outbreak    : Date, format: "2020-04-24" NA ...
##  $ date_max_cases         : Date, format: "2020-04-24" NA ...
##  $ date_max_HCWcases      : Date, format: "2020-04-24" NA ...
##  $ date_first_resolved    : Date, format: "2020-04-27" NA ...
##  $ CSDname                : chr  "Lincoln" "Atikokan" "Niagara Falls" "Windsor" ...
##  $ CSDuid                 : num  3526057 3559001 3526043 3537039 3502036 ...
##  $ latitude               : num  43.2 48.8 43.1 42.3 45.5 ...
##  $ longitude              : num  -79.5 -91.6 -79 -83 -75.2 ...
```

Determine number years since the first inspection for each home

```
# Create a new column for first inspection year
df$first_inspection_year <- format(df$first_inspection_date,"%Y")
df$first_inspection_year <- as.numeric(df$first_inspection_year)

# Earliest date of first inspection was in 2009 and latest date was 2016
summary(df[['first_inspection_year']])

# Create a new column with number of years since the first inspection was reported
df$years_since_first <- 2020 - df$first_inspection_year
# summary(df[['years_since_first']])

# There is only 1 home with fewer than 5 years of inspections -> Royal Rose Place
table(df['years_since_first'])
subset(df, years_since_first == 4)
```

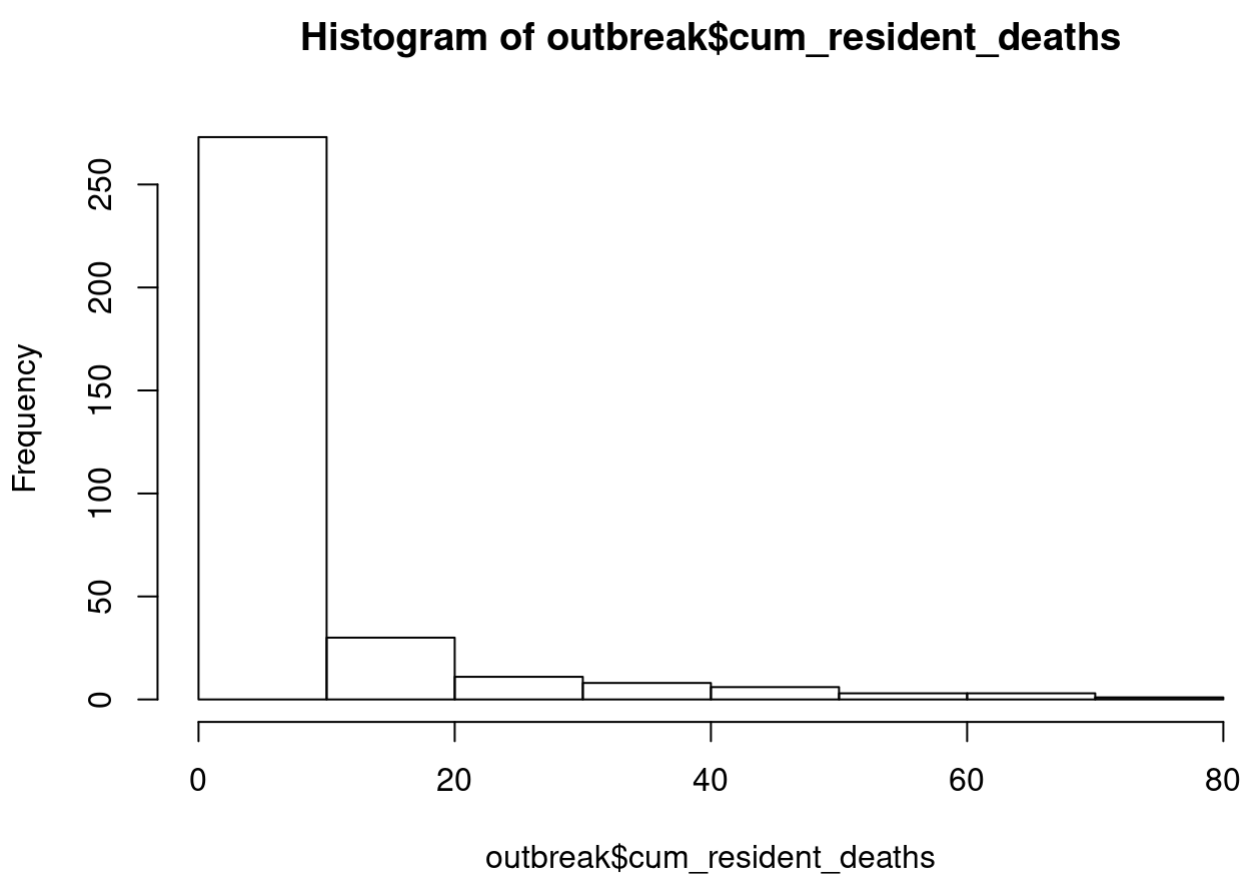
Normalize the number of inspections

```
# Number of inspections/beds
df$total_inspections_norm <- df$total_inspections/df$number_beds/df$years_since_first
df$X5y_inspections_norm <- df$X5y_inspections/df$number_beds/5
df[293, "X5y_inspections_norm"] <- df[293, "X5y_inspections_norm"]*5/4
df$X2y_inspections_norm <- df$X2y_inspections/df$number_beds/2

# Number of withOrders/beds
df$total_withOrders_norm <- df$total_withOrders/df$number_beds/df$years_since_first
df$X5y_withOrders_norm <- df$X5y_withOrders/df$number_beds/5
df[293, "X5y_withOrders_norm"] <- df[293, "X5y_withOrders_norm"]*5/4
df$X2y_withOrders_norm <- df$X2y_withOrders/df$number_beds/2

# Drop un-normalized inspections data
df <- df[,-c(21:32)]

# dput(names(df))
# skim(df)
str(df)
```

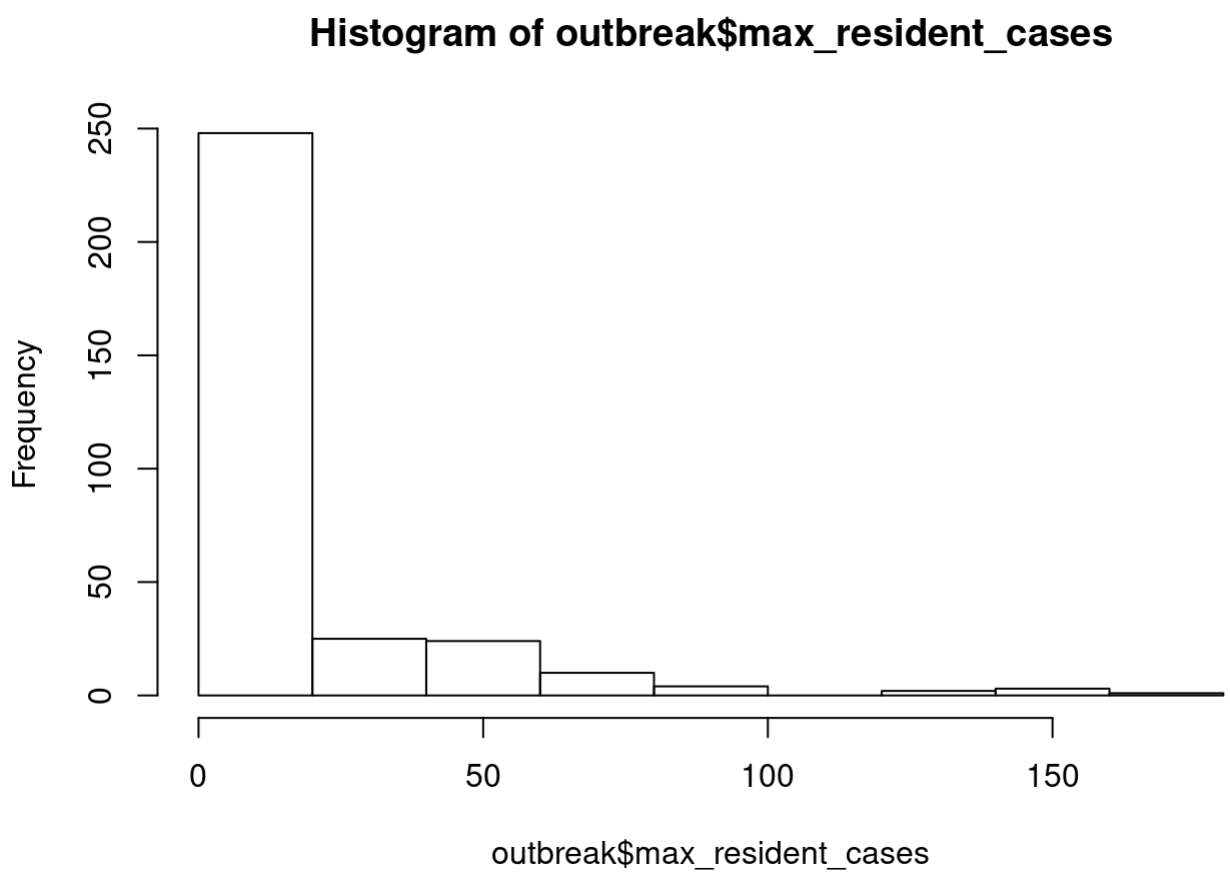
Subset the data

```
# Group the data for analysis
# Create lists of variables used to filter data for analysis

outcomes = c(
  "outbreak",
  "cum_resident_deaths",
  "max_resident_cases",
  "max_hcw_cases"
  )

profile = c(
  "home_type",
  "number_beds",
  "short_stay",
  "residents_council",
  "family_council",
  "accreditation"
  )

location = c(
  'address',
  'LHIN',
  'city',
  'postal_code',
  'CSDname',
  'CSDuid',
  'latitude',
  'longitude')

inspections_total = c(
  'total_inspections_norm',
  'total_withOrders_norm'
)

inspections_5y = c(
    'X5y_inspections_norm'
  , "X5y_withOrders_norm"
  )

inspections_2y = c(
    'X2y_inspections_norm'
  , "X2y_withOrders_norm"
  )

inspections = c(inspections_2y, inspections_5y, inspections_total)
```

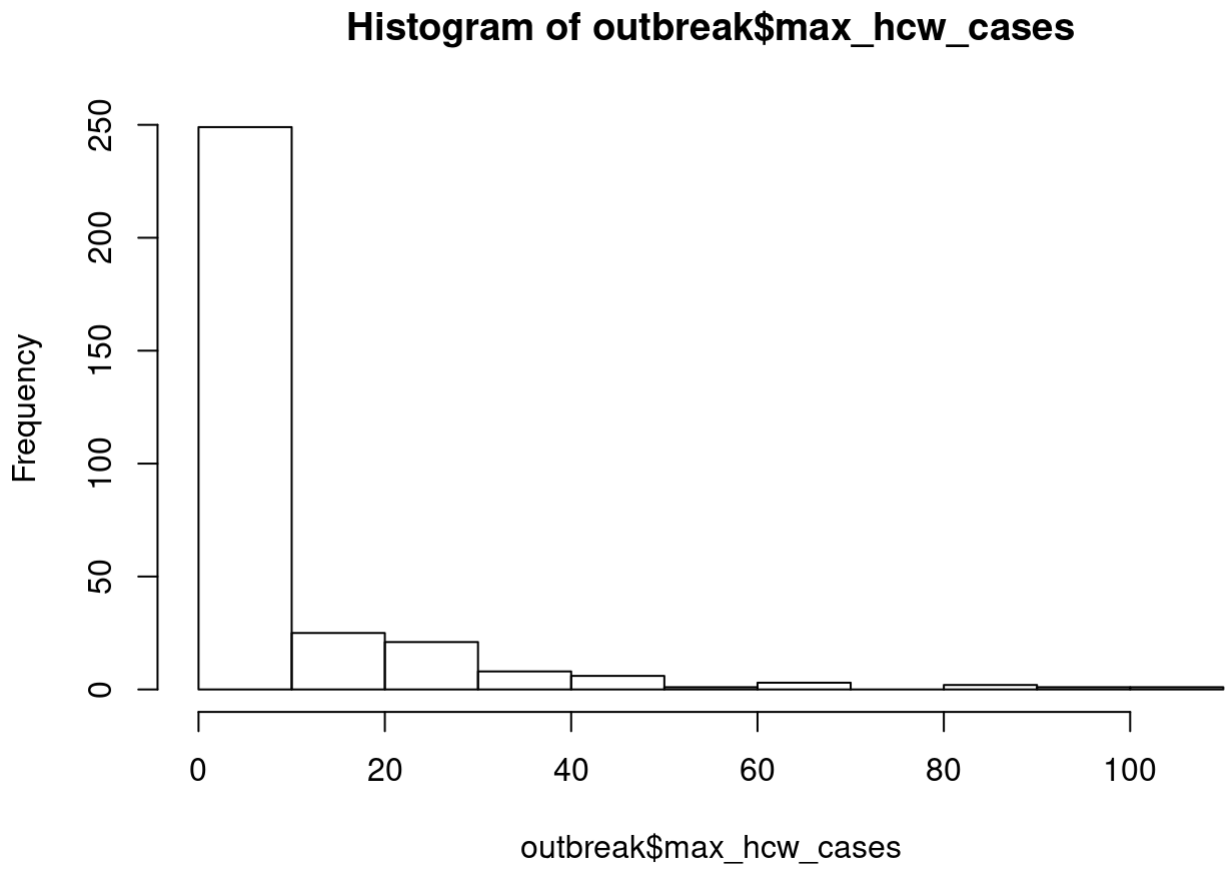
```
# As cases/deaths can only occur in homes with an outbreak will subset to include only h
omes with an outbreak
outbreak <- subset(df, outbreak == 1)

# Look at the distribution of count data
hist(outbreak$cum_resident_deaths)
```




```
hist(outbreak$max_resident_cases)
```




```
hist(outbreak$max_hcw_cases)
```




```
# Subset data, cumulative resident deaths as outcome
data <- subset(outbreak, select = c('cum_resident_deaths', profile, inspections))
# dput(names(data))
```

Modeling the number of deaths

LASSO for variable selection

```
library(glmnet)
```

```
## Loading required package: Matrix
```

```
## Loaded glmnet 4.0-2
```

```
# model.matrix() automatically transforms any qualitative variables into dummy variables
# Trim the first column leaving only predictors
x <- model.matrix(cum_resident_deaths/number_beds~., data = data)[,-c(1, 3)]
y <- data.matrix(data[,1])

# Note alpha=1 for lasso only and can blend with ridge penalty down to
# alpha=0 ridge only
glmmod <- glmnet(x, y, alpha = 1)
coef(glmmod)
```

```
## 12 x 78 sparse Matrix of class "dgCMatrix"
```

```
##    [[ suppressing 78 column names 's0', 's1', 's2' ... ]]
```

```
##
## (Intercept)            5.504478  5.5655098  5.6211201  5.671790  5.7123373
## home_typeMunicipal     .        -0.3857698 -0.7372688 -1.057542 -1.3517399
## short_stayYes          .         .          .          .         0.0184333
## residents_councilYes   .         .          .          .         .
## family_councilYes      .         .          .          .         .
## accreditationYes       .         .          .          .         .
## X2y_inspections_norm   .         .          .          .         .
## X2y_withOrders_norm    .         .          .          .         .
## X5y_inspections_norm   .         .          .          .         .
## X5y_withOrders_norm    .         .          .          .         .
## total_inspections_norm .         .          .          .         .
## total_withOrders_norm  .         .          .          .         .
##
## (Intercept)             5.5716051  5.3693741  5.1851087  5.5439006  5.9459369
## home_typeMunicipal     -1.6397007 -1.8970577 -2.1315516 -2.3314208 -2.5115593
## short_stayYes           0.2384230  0.4321259  0.6086208  0.7727936  0.9228557
## residents_councilYes    .          .          .         -0.5762879 -1.1835732
## family_councilYes       .          .          .          .          .
## accreditationYes        0.1348362  0.3463228  0.5390216  0.7569222  0.9615020
## X2y_inspections_norm    .          .          .          .          .
## X2y_withOrders_norm     .          .          .          .          .
## X5y_inspections_norm    .          .          .          .          .
## X5y_withOrders_norm     .          .          .          .          .
## total_inspections_norm  .          .          .          .          .
## total_withOrders_norm   .          .          .          .          .
##
## (Intercept)             6.312284  6.646086  6.950234  7.220823068  7.4136502
## home_typeMunicipal     -2.675680 -2.825221 -2.961477 -3.085628988 -3.2183577
## short_stayYes           1.059583  1.184163  1.297677  1.401105513  1.4939874
## residents_councilYes   -1.736940 -2.241147 -2.700562 -3.119163723 -3.5396904
## family_councilYes       .         .         .         0.009341018  0.1520343
## accreditationYes        1.147911  1.317760  1.472520  1.611614226  1.7128687
## X2y_inspections_norm    .         .         .         .            .
## X2y_withOrders_norm     .         .         .         .            .
## X5y_inspections_norm    .         .         .         .            .
## X5y_withOrders_norm     .         .         .         .            .
## total_inspections_norm  .         .         .         .            .
## total_withOrders_norm   .         .         .         .            .
##
## (Intercept)             7.5875956  7.7460869  7.8904982  8.0220805  8.1494967
## home_typeMunicipal     -3.3380710 -3.4471496 -3.5465380 -3.6370970 -3.7223008
## short_stayYes           1.5786788  1.6558467  1.7261592  1.7902253  1.8478923
## residents_councilYes   -3.9206020 -4.2676735 -4.5839121 -4.8720570 -5.1328082
## family_councilYes       0.2812186  0.3989271  0.5061787  0.6039023  0.6910695
## accreditationYes        1.8051869  1.8893035  1.9659474  2.0357825  2.0985719
## X2y_inspections_norm    .          .          .          .          .
## X2y_withOrders_norm     .          .          .          .          .
## X5y_inspections_norm    .          .          .          .          .
## X5y_withOrders_norm     .          .          .          .          .
## total_inspections_norm  .          .          .          .          .
## total_withOrders_norm   .          .          .          .         -0.9472295
##
```

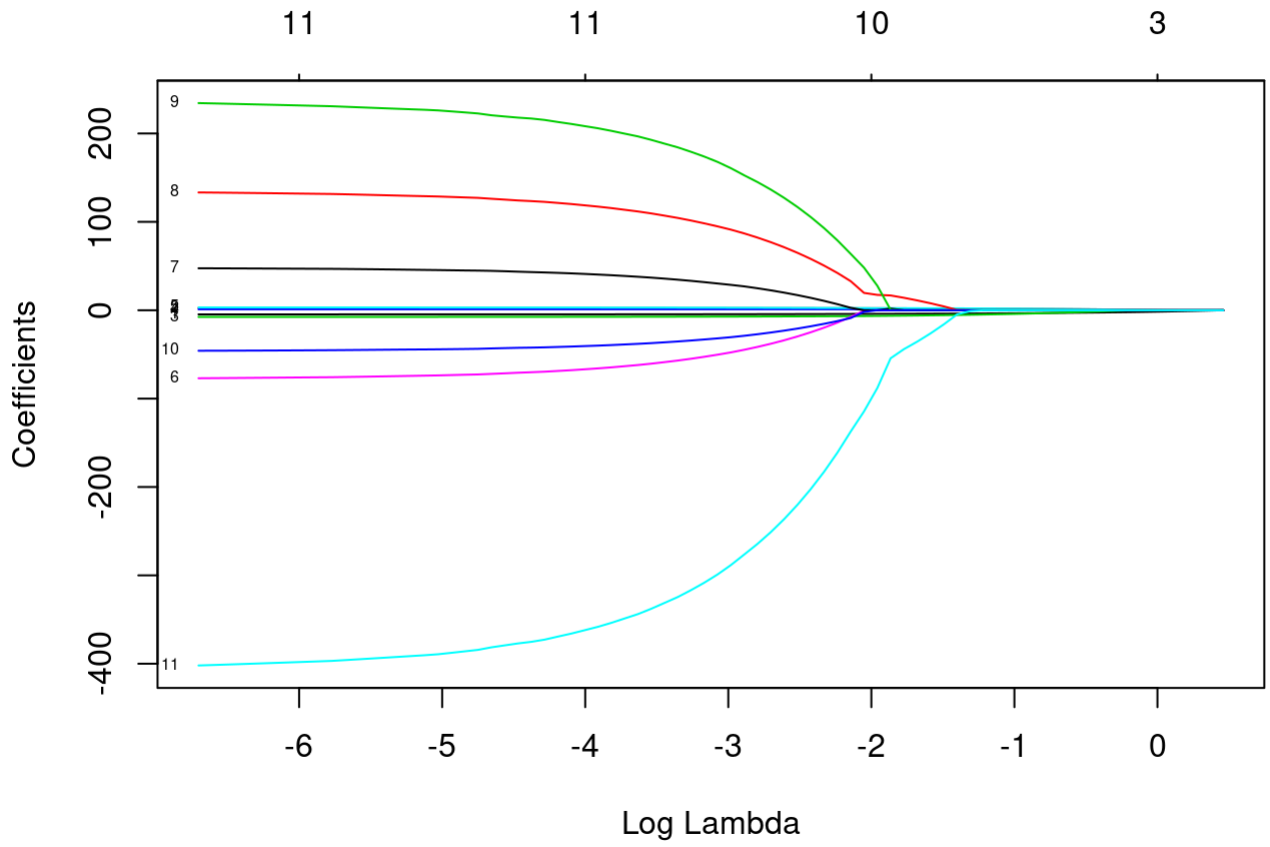
```
## (Intercept)             8.2739162   8.3144364   8.3511943   8.3846983
## home_typeMunicipal     -3.8040818  -3.8713097  -3.9324317  -3.9881220
## short_stayYes           1.9008735   1.9673166   2.0277795   2.0828687
## residents_councilYes   -5.3674011  -5.5903916  -5.7930537  -5.9777136
## family_councilYes       0.7671630   0.8387295   0.9039876   0.9634499
## accreditationYes        2.1538339   2.2005153   2.2430535   2.2818144
## X2y_inspections_norm    .           .           .           .
## X2y_withOrders_norm     .           .           .           .
## X5y_inspections_norm    0.3582656   4.3010023   7.8745231  11.1299867
## X5y_withOrders_norm     .           .           .           .
## total_inspections_norm  .           .           .           .
## total_withOrders_norm  -4.6629630 -15.9540724 -26.1992353 -35.5329105
##
## (Intercept)             8.415226   8.4368868   8.518891    8.601454
## home_typeMunicipal     -4.038865  -4.0843508  -4.129881   -4.175175
## short_stayYes           2.133064   2.1799264   2.222459    2.256569
## residents_councilYes   -6.145969  -6.2973336  -6.446253   -6.572869
## family_councilYes       1.017630   1.0665881   1.076181    1.083231
## accreditationYes        2.317132   2.3508879   2.400367    2.448968
## X2y_inspections_norm    .          .           .          -0.458015
## X2y_withOrders_norm     .          1.9013152   .           .
## X5y_inspections_norm   14.096225  16.7355552  17.379340   19.620109
## X5y_withOrders_norm     .          0.4658784  27.734648   48.218060
## total_inspections_norm  .          .           .          -1.863159
## total_withOrders_norm  -44.037366 -54.3597459 -88.075929 -114.481190
##
## (Intercept)              8.710451    8.799420    8.880309    8.953939
## home_typeMunicipal      -4.222486   -4.263886   -4.301530   -4.335830
## short_stayYes            2.284220    2.310919    2.335183    2.357264
## residents_councilYes    -6.661036   -6.743282   -6.818517   -6.887018
## family_councilYes        1.076688    1.077209    1.078125    1.079044
## accreditationYes         2.517084    2.572766    2.623046    2.668829
## X2y_inspections_norm    -7.627236  -13.990432  -19.713979  -24.927287
## X2y_withOrders_norm      2.732162    6.869796   10.595922   14.000567
## X5y_inspections_norm    32.888721   42.196506   50.508531   58.089740
## X5y_withOrders_norm     63.806192   79.084582   92.922215  105.448666
## total_inspections_norm  -8.825858  -12.301840  -15.375903  -18.187200
## total_withOrders_norm  -137.292731 -161.183703 -182.779084 -202.368443
##
## (Intercept)              9.020991    9.082049    9.137638    9.188236
## home_typeMunicipal      -4.367080   -4.395549   -4.421484   -4.445109
## short_stayYes            2.377370    2.395676    2.412338    2.427499
## residents_councilYes    -6.949425   -7.006288   -7.058098   -7.105301
## family_councilYes        1.079932    1.080800    1.081659    1.082521
## accreditationYes         2.710516    2.748459    2.782987    2.814396
## X2y_inspections_norm    -29.673866  -33.993146  -37.922351  -41.495402
## X2y_withOrders_norm      17.104892   19.933903   22.512412   24.863274
## X5y_inspections_norm     64.994628   71.278530   76.996211   82.198012
## X5y_withOrders_norm     116.824993  127.154020  136.521308  145.002723
## total_inspections_norm  -20.749990  -23.083656  -25.208991  -27.145412
## total_withOrders_norm  -220.174315 -236.353406 -251.041504 -264.360133
##
## (Intercept)              9.234276    9.277672    9.316792    9.351758
## home_typeMunicipal      -4.466630   -4.486212   -4.503993   -4.520205
```

```
## short_stayYes             2.441289    2.453993    2.465601    2.476109
## residents_councilYes     -7.148302   -7.187592   -7.224308   -7.257351
## family_councilYes         1.083401    1.082814    1.082916    1.083500
## accreditationYes          2.842957    2.869617    2.893271    2.914665
## X2y_inspections_norm    -44.742858  -47.701387  -50.289882  -52.676535
## X2y_withOrders_norm      27.007321   28.700482   30.263644   31.799331
## X5y_inspections_norm     86.929496   91.186780   94.884433   98.307326
## X5y_withOrders_norm     152.664958  160.721852  167.808014  173.872370
## total_inspections_norm  -28.910694  -30.491021  -31.835677  -33.080328
## total_withOrders_norm  -276.417026 -288.338761 -298.944688 -308.280464
##
## (Intercept)               9.383496    9.412592    9.438610    9.462915
## home_typeMunicipal       -4.535022   -4.548531   -4.560790   -4.572046
## short_stayYes             2.485668    2.494413    2.502252    2.509549
## residents_councilYes     -7.287120   -7.314305   -7.339038   -7.361463
## family_councilYes         1.084042    1.084355    1.085221    1.085250
## accreditationYes          2.934318    2.952323    2.968342    2.983522
## X2y_inspections_norm    -54.906602  -56.944621  -58.747162  -60.483816
## X2y_withOrders_norm      33.264541   34.581664   35.799575   36.913397
## X5y_inspections_norm    101.526589  104.467934  107.083886  109.601600
## X5y_withOrders_norm     179.283631  184.334700  188.557387  192.835489
## total_inspections_norm  -34.258810  -35.334810  -36.307769  -37.231900
## total_withOrders_norm  -316.734741 -324.562660 -331.252350 -337.883153
##
## (Intercept)               9.485013    9.504539    9.522848    9.539504
## home_typeMunicipal       -4.582260   -4.591495   -4.600004   -4.607725
## short_stayYes             2.516196    2.522096    2.527591    2.532590
## residents_councilYes     -7.382123   -7.400963   -7.417903   -7.433518
## family_councilYes         1.085408    1.086297    1.086407    1.086605
## accreditationYes          2.997147    3.009037    3.020472    3.030734
## X2y_inspections_norm    -62.022193  -63.347109  -64.653989  -65.806920
## X2y_withOrders_norm      37.894107   38.800887   39.648098   40.389208
## X5y_inspections_norm    111.803666  113.706456  115.608719  117.272809
## X5y_withOrders_norm     196.758419  199.880947  203.045177  205.935852
## total_inspections_norm  -38.024891  -38.723006  -39.427383  -40.037918
## total_withOrders_norm  -343.908021 -348.858668 -353.792770 -358.255933
##
## (Intercept)               9.554325    9.568232    9.580839    9.592796
## home_typeMunicipal       -4.614730   -4.621174   -4.627005   -4.632368
## short_stayYes             2.537083    2.541264    2.545042    2.548598
## residents_councilYes     -7.447689   -7.460505   -7.472379   -7.483220
## family_councilYes         1.087185    1.087190    1.087359    1.086943
## accreditationYes          3.039829    3.048530    3.056249    3.063670
## X2y_inspections_norm    -66.839293  -67.838148  -68.697290  -69.528178
## X2y_withOrders_norm      41.094613   41.736373   42.284649   42.764213
## X5y_inspections_norm    118.741809  120.187729  121.426069  122.628695
## X5y_withOrders_norm     208.362862  210.818824  213.009688  215.339246
## total_inspections_norm  -40.563657  -41.092095  -41.546848  -41.986399
## total_withOrders_norm  -362.104486 -365.914316 -369.279250 -372.731106
##
## (Intercept)               9.602896    9.611946    9.620329    9.628256
## home_typeMunicipal       -4.637124   -4.641523   -4.645588   -4.649323
## short_stayYes             2.551646    2.554337    2.556900    2.559309
## residents_councilYes     -7.493340   -7.502905   -7.510542   -7.517582
```

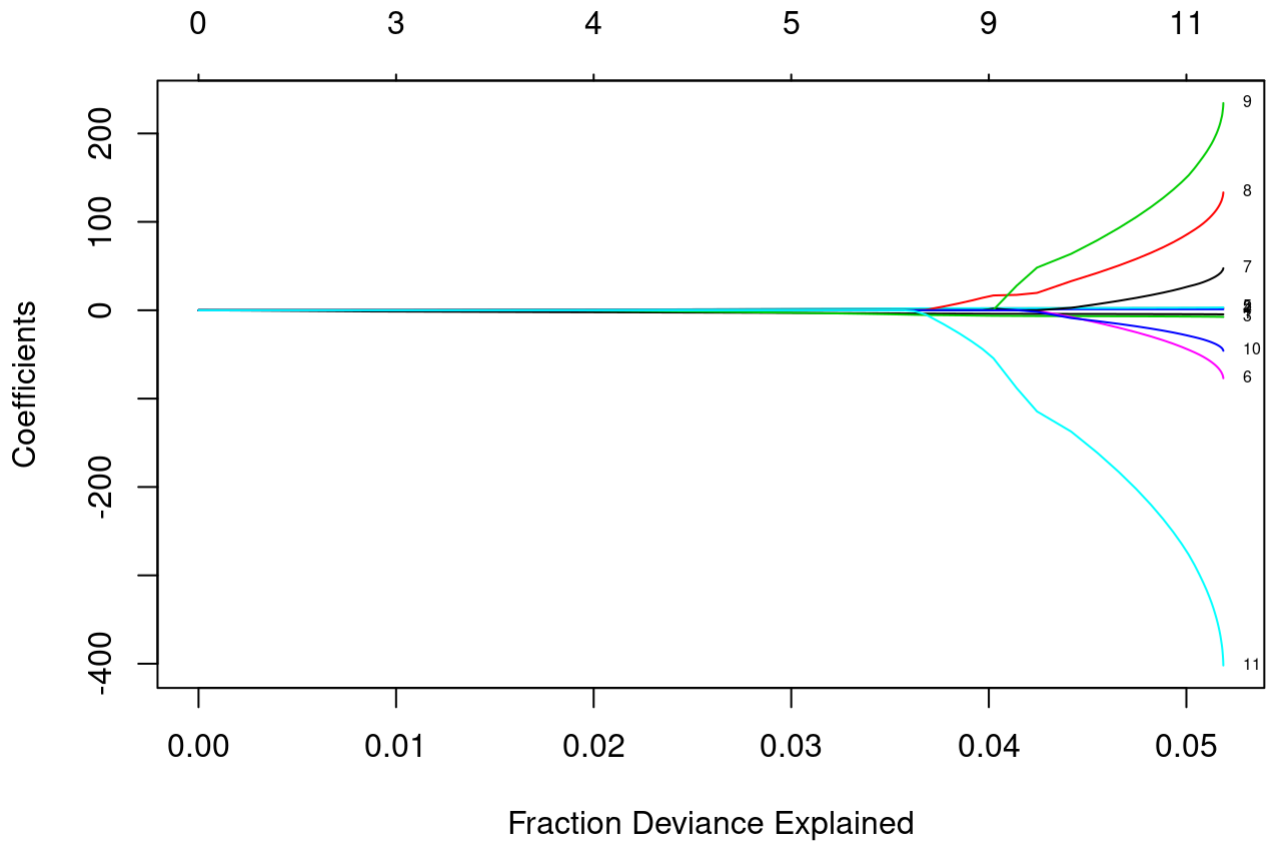
```
## family_councilYes         1.087625    1.089100    1.089393    1.089256
## accreditationYes          3.069571    3.074400    3.079874    3.085101
## X2y_inspections_norm    -70.151815  -70.709678  -71.391649  -72.021844
## X2y_withOrders_norm      43.187374   43.641062   44.142597   44.567454
## X5y_inspections_norm    123.499576  124.220909  125.202208  126.143047
## X5y_withOrders_norm     216.944788  217.955977  219.248092  220.620603
## total_inspections_norm  -42.296846  -42.510596  -42.859859  -43.215567
## total_withOrders_norm  -375.216592 -377.016827 -379.226005 -381.446458
##
## (Intercept)               9.636246    9.642971    9.649053    9.654646
## home_typeMunicipal       -4.652735   -4.655705   -4.658448   -4.660973
## short_stayYes             2.561693    2.563641    2.565456    2.567144
## residents_councilYes     -7.523666   -7.530386   -7.536254   -7.541487
## family_councilYes         1.087642    1.087763    1.087812    1.087739
## accreditationYes          3.090828    3.094579    3.098156    3.101549
## X2y_inspections_norm    -72.651346  -72.989686  -73.364877  -73.743418
## X2y_withOrders_norm      44.841293   45.010770   45.228807   45.452432
## X5y_inspections_norm    127.159705  127.660882  128.183762  128.704251
## X5y_withOrders_norm     222.664360  223.867711  225.008568  226.112138
## total_inspections_norm  -43.653837  -43.860722  -44.043959  -44.216322
## total_withOrders_norm  -384.297284 -385.977036 -387.641702 -389.269181
##
## (Intercept)               9.659357    9.664028    9.667904    9.671541
## home_typeMunicipal       -4.663207   -4.665334   -4.667217   -4.668954
## short_stayYes             2.568570    2.569887    2.571070    2.572172
## residents_councilYes     -7.546417   -7.551314   -7.555168   -7.558622
## family_councilYes         1.088212    1.088824    1.089208    1.089390
## accreditationYes          3.104186    3.106493    3.108808    3.111066
## X2y_inspections_norm    -74.005078  -74.272479  -74.539509  -74.803507
## X2y_withOrders_norm      45.633209   45.835212   46.035694   46.223618
## X5y_inspections_norm    129.061991  129.395766  129.756776  130.130866
## X5y_withOrders_norm     226.825075  227.379824  227.938886  228.507104
## total_inspections_norm  -44.342577  -44.430185  -44.548556  -44.680910
## total_withOrders_norm  -390.362347 -391.294821 -392.224112 -393.152698
##
## (Intercept)               9.674945    9.678124    9.681087    9.683847
## home_typeMunicipal       -4.670554   -4.672026   -4.673377   -4.674614
## short_stayYes             2.573200    2.574161    2.575057    2.575894
## residents_councilYes     -7.561728   -7.564532   -7.567072   -7.569383
## family_councilYes         1.089415    1.089321    1.089136    1.088883
## accreditationYes          3.113241    3.115317    3.117283    3.119133
## X2y_inspections_norm    -75.061637  -75.311270  -75.550258  -75.776994
## X2y_withOrders_norm      46.398524   46.560132   46.708200   46.842640
## X5y_inspections_norm    130.505380  130.871016  131.221104  131.551031
## X5y_withOrders_norm     229.083859  229.667416  230.255464  230.845341
## total_inspections_norm  -44.817294  -44.951083  -45.077854  -45.194736
## total_withOrders_norm  -394.077927 -394.996287 -395.903938 -396.797016
##
## (Intercept)               9.685677    9.687829    9.689844    9.691713
## home_typeMunicipal       -4.675629   -4.676611   -4.677515   -4.678347
## short_stayYes             2.576557    2.577191    2.577781    2.578331
## residents_councilYes     -7.571256   -7.573364   -7.575255   -7.576944
## family_councilYes         1.088999    1.089029    1.089001    1.088924
## accreditationYes          3.120457    3.121733    3.122952    3.124114
```

```
## X2y_inspections_norm    -75.887863  -76.008548  -76.134166  -76.261390
## X2y_withOrders_norm      46.909222   46.977705   47.049060   47.120979
## X5y_inspections_norm    131.736634  131.927347  132.118627  132.307671
## X5y_withOrders_norm     231.215173  231.581773  231.944800  232.304680
## total_inspections_norm  -45.288232  -45.372902  -45.451282  -45.524187
## total_withOrders_norm  -397.329128 -397.863979 -398.397932 -398.928653
##
## (Intercept)               9.693448    9.695061    9.696561    9.697958
## home_typeMunicipal       -4.679113   -4.679818   -4.680465   -4.681060
## short_stayYes             2.578844    2.579324    2.579772    2.580191
## residents_councilYes     -7.578458   -7.579820   -7.581049   -7.582163
## family_councilYes         1.088807    1.088654    1.088471    1.088265
## accreditationYes          3.125218    3.126264    3.127252    3.128184
## X2y_inspections_norm    -76.387889  -76.511989  -76.632484  -76.748506
## X2y_withOrders_norm      47.191514   47.259277   47.323331   47.383079
## X5y_inspections_norm    132.492212  132.670405  132.840796  133.002278
## X5y_withOrders_norm     232.661735  233.016046  233.367476  233.715717
## total_inspections_norm  -45.591851  -45.654262  -45.711317  -45.762903
## total_withOrders_norm  -399.454230 -399.973044 -400.483718 -400.985077
##
## (Intercept)               9.699259    9.700471
## home_typeMunicipal       -4.681605   -4.682105
## short_stayYes             2.580583    2.580949
## residents_councilYes     -7.583175   -7.584098
## family_councilYes         1.088039    1.087799
## accreditationYes          3.129059    3.129879
## X2y_inspections_norm    -76.859443  -76.964882
## X2y_withOrders_norm      47.438177   47.488461
## X5y_inspections_norm    133.154055  133.295596
## X5y_withOrders_norm     234.060345  234.400865
## total_inspections_norm  -45.808943  -45.849414
## total_withOrders_norm  -401.476118 -401.955991
```

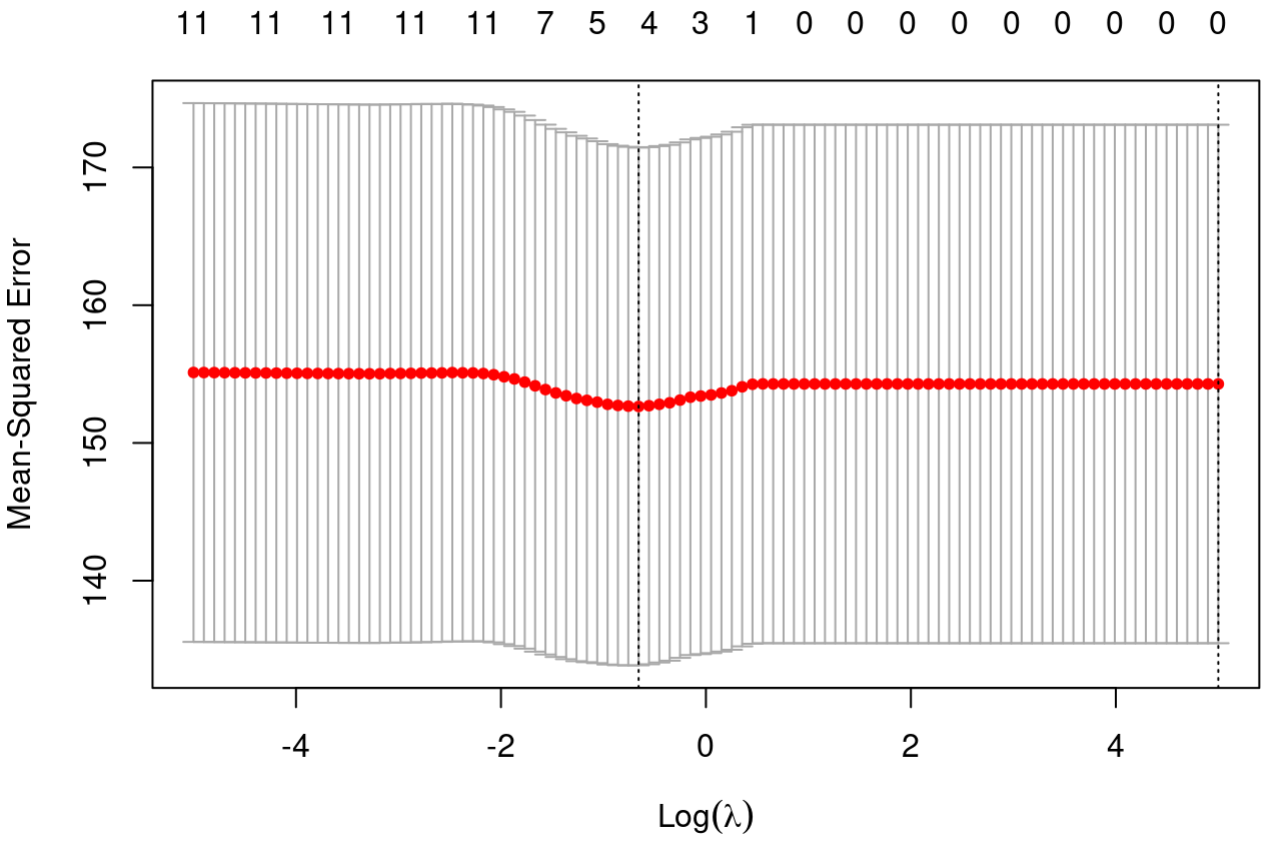
```
# Plot variable coefficients vs. shrinkage parameter lambda
plot(glmmod, xvar = 'lambda', label = TRUE)
```




```
plot(glmmod, xvar = 'dev', label = TRUE)
```




```
# LASSO - CV
grid = exp(seq(-5, 5, length=100))
cv.glmmod <- cv.glmnet(x, y, alpha=1, lambda = grid)
# cv.glmmod <- cv.glmnet(x, y, alpha=1)
plot(cv.glmmod)
```




```
coef(cv.glmmod)
```

```
## 12 x 1 sparse Matrix of class "dgCMatrix"
##                                1
## (Intercept)            5.504478
## home_typeMunicipal     .
## short_stayYes          .
## residents_councilYes   .
## family_councilYes      .
## accreditationYes       .
## X2y_inspections_norm   .
## X2y_withOrders_norm    .
## X5y_inspections_norm   .
## X5y_withOrders_norm    .
## total_inspections_norm .
## total_withOrders_norm  .
```

```
coef(cv.glmmod, s = "lambda.min")
```

```
## 12 x 1 sparse Matrix of class "dgCMatrix"
##                                1
## (Intercept)             6.951989
## home_typeMunicipal     -2.962268
## short_stayYes           1.298334
## residents_councilYes   -2.703216
## family_councilYes       .
## accreditationYes        1.473415
## X2y_inspections_norm    .
## X2y_withOrders_norm     .
## X5y_inspections_norm    .
## X5y_withOrders_norm     .
## total_inspections_norm  .
## total_withOrders_norm   .
```

As lambda decreases, the order that predictors are added to the model:

```
1. home_typeMunicipal
2. short_stayYes
3. accreditationYes
4. residents_councilYes
5. family_councilYes
```

Poisson regression with offset for the number of beds in each home

```
# fit_poi <- glm(Total.Confirmed.Cases/BEDS_TOTAL~ ., family = poisson, data = data_case
s, weight = BEDS_TOTAL)
# summary(fit_poi)

fit_poi <- glm(cum_resident_deaths~
    home_type
    + short_stay
    + residents_council
    + family_council
    + accreditation
    # + X2y_inspections_norm
    # + X2y_withOrders_norm
    # + X5y_inspections_norm
    # + X5y_withOrders_norm
    # + total_inspections_norm
    # + total_withOrders_norm
    , family = poisson, data = data, offset = log(number_beds))
summary(fit_poi)
```

```
##
## Call:
## glm(formula = cum_resident_deaths ~ home_type + short_stay +
##     residents_council + family_council + accreditation, family = poisson,
##     data = data, offset = log(number_beds))
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -6.6934  -3.4038  -2.3974  -0.8559  12.2429
##
## Coefficients:
##                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)          -2.75736    0.13210 -20.874  < 2e-16 ***
## home_typeMunicipal   -1.65955    0.10603 -15.651  < 2e-16 ***
## home_typeNon-Profit  -0.42524    0.05680  -7.486 7.09e-14 ***
## short_stayYes         0.23058    0.04789   4.815 1.47e-06 ***
## residents_councilYes -0.71640    0.13410  -5.342 9.17e-08 ***
## family_councilYes     0.08309    0.08366   0.993   0.3206
## accreditationYes      0.29528    0.09844   3.000   0.0027 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 5623.9  on 334  degrees of freedom
## Residual deviance: 5152.7  on 328  degrees of freedom
## AIC: 5604.7
##
## Number of Fisher Scoring iterations: 7
```