

ltc_analysis_ON

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Import and prepare the data

```
library(skimr)

# 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)
```

Data summary

Name df
Number of rows 625
Number of columns 43

Column type frequency:

character 6
Date 5
factor 7
numeric 25

Group variables None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
cleaned_name	0		1	7	84	0	625
name	0		1	7	84	0	625
address	0		1	8	61	0	623
city	0		1	3	19	0	267
postal_code	0		1	7	7	0	600
CSDname	1		1	3	39	0	209

Variable type: Date

skim_variable	n_missing	complete_rate	min	max	median	n_unique
first_inspection_date	0		1.00	2009-09-22	2016-08-16	276
date_first_outbreak	308		0.51	2020-04-24	2020-07-31	59
date_max_cases	308		0.51	2020-04-24	2020-07-31	66
date_max_HCWcases	308		0.51	2020-04-24	2020-07-31	69

skim_variable	n_missing	complete_rate	min	max	median	n_unique
date_first_resolved	301	0.52	2020-04-24	2020-07-30	2020-05-26	81

Variable type: factor

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
outbreak	0	1	FALSE	2	1: 335, 0: 290
LHIN	0	1	FALSE	14	Ham: 86, Sou: 77, Cen: 68, Cha: 60
home_type	0	1	FALSE	3	For: 354, Non: 171, Mun: 100
short_stay	0	1	FALSE	2	No: 420, Yes: 205
residents_council	0	1	FALSE	2	Yes: 615, No: 10
family_council	0	1	FALSE	2	Yes: 517, No: 108
accreditation	0	1	FALSE	2	Yes: 520, No: 105

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
number_beds	0	1.00	125.92	74.14	9.00	67.00	120.00	160.00	543.00	
antipsychotic_percent	8	0.99	18.49	7.81	0.00	13.40	18.00	23.00	62.80	
pressure_ulcers_percent	7	0.99	2.74	1.53	0.00	1.60	2.55	3.60	11.00	
falls_percent	6	0.99	16.46	4.83	1.80	13.30	16.40	19.70	33.20	
restraints_percent	7	0.99	4.19	5.74	0.00	0.40	2.10	5.80	42.00	
depression_percent	7	0.99	23.37	10.07	1.50	15.22	23.35	31.37	48.40	
pain_percent	6	0.99	5.64	5.76	0.00	1.90	3.90	7.50	48.00	
total_inspections	0	1.00	38.65	22.69	9.00	22.00	33.00	49.00	175.00	
X5y_inspections	0	1.00	20.91	12.51	5.00	12.00	18.00	25.00	92.00	
X2y_inspections	0	1.00	10.33	6.16	1.00	6.00	9.00	13.00	50.00	
total_complaints	0	1.00	15.05	12.00	0.00	7.00	12.00	21.00	94.00	
X5y_complaints	0	1.00	7.01	6.23	0.00	3.00	5.00	9.00	47.00	
X2y_complaints	0	1.00	3.64	3.18	0.00	1.00	3.00	5.00	22.00	
total_critical	0	1.00	13.13	9.40	0.00	7.00	11.00	16.00	64.00	
X5y_critical	0	1.00	7.10	5.02	0.00	4.00	6.00	9.00	42.00	
X2y_critical	0	1.00	4.56	2.79	0.00	3.00	4.00	6.00	28.00	
total_withOrders	0	1.00	7.06	6.33	0.00	3.00	5.00	10.00	44.00	
X5y_withOrders	0	1.00	4.59	4.53	0.00	2.00	3.00	6.00	37.00	
X2y_withOrders	0	1.00	2.05	2.43	0.00	0.00	1.00	3.00	17.00	
cum_resident_deaths	290	0.54	5.50	12.42	0.00	0.00	0.00	1.00	71.00	
max_resident_cases	308	0.51	13.37	27.28	0.00	0.00	1.00	12.00	171.00	
max_hcw_cases	308	0.51	7.84	15.48	0.00	1.00	1.00	7.00	105.00	
CSDuid	2	1.00	3527768.90	14296.08	3501005.00	3519537.50	3525005.00	3539018.00	3560042.00	
latitude	0	1.00	44.22	1.48	42.03	43.32	43.76	44.57	51.01	
longitude	0	1.00	-79.88	2.73	-94.57	-80.81	-79.65	-79.18	-74.50	

```
# 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$number_beds/5
df[444, "X5y_inspections_norm"] <- df[444, "X5y_inspections_norm"]*5/4
df$X2y_inspections_norm <- df$X2y_inspections/df$number_beds/2

# Number of complaints/beds
df$total_complaints_norm <- df$total_complaints/df$number_beds/df$years_since_first
df$X5y_complaints_norm <- df$X5y_complaints/df$number_beds/5
df[444, "X5y_complaints_norm"] <- df[444, "X5y_complaints_norm"]*5/4
df$X2y_complaints_norm <- df$X2y_complaints/df$number_beds/2

# Number of noncomplaints/beds
df$total_noncomplaints_norm <- (df$total_inspections - df$total_complaints)/df$number_beds/df$years_since_first
df$X5y_noncomplaints_norm <- (df$X5y_inspections - df$X5y_complaints)/df$number_beds/5
df[444, "X5y_noncomplaints_norm"] <- df[444, "X5y_noncomplaints_norm"]*5/4
df$X2y_noncomplaints_norm <- (df$X2y_inspections - df$X2y_complaints)/df$number_beds/2

# Number of critical/beds
df$total_critical_norm <- df$total_critical/df$number_beds/df$years_since_first
df$X5y_critical_norm <- df$X5y_critical/df$number_beds/5
df[444, "X5y_critical_norm"] <- df[444, "X5y_critical_norm"]*5/4
df$X2y_critical_norm <- df$X2y_critical/df$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$number_beds/5
df[444, "X5y_withOrders_norm"] <- df[444, "X5y_withOrders_norm"]*5/4
df$X2y_withOrders_norm <- df$X2y_withOrders/df$number_beds/2

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

```

# Generate 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')

qual = c(
  "antipsychotic_percent",
  "pressure_ulcers_percent",
  "falls_percent",
  "restraints_percent",
  "depression_percent",
  "pain_percent"
)

complaints = c("total_complaints_norm"
  , "X5y_complaints_norm"
  , "X2y_complaints_norm"
)

noncomplaints = c("total_noncomplaints_norm"
  , "X5y_noncomplaints_norm"
  , "X2y_noncomplaints_norm"
)

critical = c("total_critical_norm"
  , "X5y_critical_norm"
  , "X2y_critical_norm"
)

withOrders = c("total_withOrders_norm"
  , "X5y_withOrders_norm"
  , "X2y_withOrders_norm"
)

all_inspections = c(complaints, noncomplaints, critical, withOrders)
all_inspections_general = c(complaints, noncomplaints)
all_inspections_specific = c(complaints, critical, withOrders)

```

Analysis with all 625 homes (exclude Quality data)

```

data <- subset(df, select = c('outbreak', profile, all_inspections))
skim(data)

```

Data summary

Name	data
Number of rows	625
Number of columns	19

Column type frequency:

factor 6
 numeric 13

Group variables None

Variable type: factor

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
outbreak	0	1	FALSE	2	1: 335, 0: 290
home_type	0	1	FALSE	3	For: 354, Non: 171, Mun: 100
short_stay	0	1	FALSE	2	No: 420, Yes: 205
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accreditation	0	1	FALSE	2	Yes: 520, No: 105

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
number_beds	0	1	125.92	74.14	9.00	67.00	120.00	160.00	543.00	
total_complaints_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.09	
X5y_complaints_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.01	0.09	
X2y_complaints_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.12	
total_noncomplaints_norm	0	1	0.03	0.02	0.00	0.01	0.02	0.03	0.15	
X5y_noncomplaints_norm	0	1	0.03	0.02	0.01	0.02	0.02	0.03	0.17	
X2y_noncomplaints_norm	0	1	0.03	0.03	0.00	0.02	0.03	0.04	0.25	
total_critical_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.06	
X5y_critical_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.06	
X2y_critical_norm	0	1	0.02	0.01	0.00	0.01	0.02	0.03	0.10	
total_withOrders_norm	0	1	0.01	0.01	0.00	0.00	0.01	0.01	0.09	
X5y_withOrders_norm	0	1	0.01	0.01	0.00	0.00	0.01	0.01	0.12	
X2y_withOrders_norm	0	1	0.01	0.01	0.00	0.00	0.01	0.01	0.17	

```
# View(colnames(data))
# dput(names(df))
```

Fit logistic regression

```
# fit logistic regression
fit = glm(outbreak~., family='binomial', data=data)
summary(fit)
```

```
##
## Call:
## glm(formula = outbreak ~ ., family = "binomial", data = data)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.9366  -0.9664   0.3927   0.9478   2.0707
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.207139    0.944090  -1.279   0.2010
## home_typeMunicipal    -0.630064    0.282441  -2.231   0.0257 *
## home_typeNon-Profit    -0.006521    0.238404  -0.027   0.9782
## number_beds         0.014960    0.002396   6.244 4.26e-10 ***
## short_stayYes      -0.469247    0.201476  -2.329   0.0199 *
## residents_councilYes -0.072174    0.824604  -0.088   0.9303
## family_councilYes    0.266113    0.251551   1.058   0.2901
## accreditationYes    -0.328609    0.266081  -1.235   0.2168
## total_complaints_norm 23.401394   20.052371   1.167   0.2432
## X5y_complaints_norm  -12.755270   25.586022  -0.499   0.6181
## X2y_complaints_norm    3.970606   12.673686   0.313   0.7541
## total_noncomplaints_norm -11.040279   37.670784  -0.293   0.7695
## X5y_noncomplaints_norm  -1.824911   32.014352  -0.057   0.9545
## X2y_noncomplaints_norm -11.763602   15.216590  -0.773   0.4395
## total_critical_norm    6.665255   42.616928   0.156   0.8757
## X5y_critical_norm     15.308446   44.338445   0.345   0.7299
## X2y_critical_norm     -6.694648   18.749001  -0.357   0.7210
## total_withOrders_norm   5.805866   43.384027   0.134   0.8935
## X5y_withOrders_norm    -5.766053   36.129456  -0.160   0.8732
## X2y_withOrders_norm    31.114761   16.635248   1.870   0.0614 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 863.19  on 624  degrees of freedom
## Residual deviance: 715.84  on 605  degrees of freedom
## AIC: 755.84
##
## Number of Fisher Scoring iterations: 4
```

LASSO

```
# https://stats.stackexchange.com/questions/72251/an-example-lasso-regression-using-glmnet-for-binary-outcome
library(glmnet)
```

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

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

```
# library(caret)
options(max.print=999999)

# model.matrix() automatically transforms any qualitative variables into dummy variables
# Trim the first column leaving only predictors
x = model.matrix(outbreak~., data = data)[-1]
y <- as.factor(data.matrix(data[,1]))

# Note alpha=1 for lasso only, and can blend with ridge penalty
# alpha=0 ridge only
glmmod <- glmnet(x, y, family = 'binomial')

# glmmod$call
# summary(glmmod)
# plot(glmmod, xvar = 'lambda', label = TRUE)
# plot(glmmod, xvar = 'dev', label = TRUE)
coef(glmmod)
```

```
## 20 x 69 sparse Matrix of class "dgCMatrix"
```

```
##      [[ suppressing 69 column names 's0', 's1', 's2' ... ]]
```

```

##
## (Intercept)          0.1442496 0.0247757097 -0.086073693 -0.189907106
## home_typeMunicipal   .          .          .          .
## home_typeNon-Profit  .          .          .          .
## number_beds          .          0.0009505196 0.001836641 0.002671562
## short_stayYes        .          .          .          .
## residents_councilYes .          .          .          .
## family_councilYes    .          .          .          .
## accreditationYes     .          .          .          .
## total_complaints_norm .          .          .          .
## X5y_complaints_norm  .          .          .          .
## X2y_complaints_norm  .          .          .          .
## total_noncomplaints_norm .        .          .          .
## X5y_noncomplaints_norm .        .          .          .
## X2y_noncomplaints_norm .        .          .          .
## total_critical_norm  .          .          .          .
## X5y_critical_norm    .          .          .          .
## X2y_critical_norm    .          .          .          .
## total_withOrders_norm .          .          .          .
## X5y_withOrders_norm  .          .          .          .
## X2y_withOrders_norm  .          .          .          .
##
## (Intercept)          -0.287770794 -0.380328588 -0.467999677 -0.551052221
## home_typeMunicipal   .          .          .          .
## home_typeNon-Profit  .          .          .          .
## number_beds          .          0.003463561 0.004217585 0.004936458 0.005621713
## short_stayYes        .          .          .          .
## residents_councilYes .          .          .          .
## family_councilYes    .          .          .          .
## accreditationYes     .          .          .          .
## total_complaints_norm .          .          .          .
## X5y_complaints_norm  .          .          .          .
## X2y_complaints_norm  .          .          .          .
## total_noncomplaints_norm .        .          .          .
## X5y_noncomplaints_norm .        .          .          .
## X2y_noncomplaints_norm .        .          .          .
## total_critical_norm  .          .          .          .
## X5y_critical_norm    .          .          .          .
## X2y_critical_norm    .          .          .          .
## total_withOrders_norm .          .          .          .
## X5y_withOrders_norm  .          .          .          .
## X2y_withOrders_norm  .          .          .          .
##
## (Intercept)          -0.629666826 -0.703978232 -0.774101544 -0.840147778
## home_typeMunicipal   .          .          .          .
## home_typeNon-Profit  .          .          .          .
## number_beds          .          0.006274158 0.006894247 0.007482318 0.008038736
## short_stayYes        .          .          .          .
## residents_councilYes .          .          .          .
## family_councilYes    .          .          .          .
## accreditationYes     .          .          .          .
## total_complaints_norm .          .          .          .
## X5y_complaints_norm  .          .          .          .
## X2y_complaints_norm  .          .          .          .
## total_noncomplaints_norm .        .          .          .
## X5y_noncomplaints_norm .        .          .          .
## X2y_noncomplaints_norm .        .          .          .
## total_critical_norm  .          .          .          .
## X5y_critical_norm    .          .          .          .
## X2y_critical_norm    .          .          .          .
## total_withOrders_norm .          .          .          .
## X5y_withOrders_norm  .          .          .          .
## X2y_withOrders_norm  .          .          .          .
##
## (Intercept)          -0.902185330 -0.960434220 -1.014978277 -1.065958799
## home_typeMunicipal   .          .          .          .
## home_typeNon-Profit  .          .          .          .
## number_beds          .          0.008563563 0.009058207 0.009522984 0.009958752
## short_stayYes        .          .          .          .
## residents_councilYes .          .          .          .
## family_councilYes    .          .          .          .
## accreditationYes     .          .          .          .
## total_complaints_norm .          .          .          .

```



```

## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm . . . .
## X5y_noncomplaints_norm . . . .
## X2y_noncomplaints_norm . . . .
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm . . . .
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm . . . .
##
## (Intercept) -1.11352454 -1.14402670 -1.16437800 -1.17818317
## home_typeMunicipal . . -0.03466132 -0.08541472
## home_typeNon-Profit . . . .
## number_beds 0.01036648 0.01070644 0.01104445 0.01143345
## short_stayYes . . . -0.03486559
## residents_councilYes . . . .
## family_councilYes . . . .
## accreditationYes . . . .
## total_complaints_norm . . . .
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm . . . .
## X5y_noncomplaints_norm . . . .
## X2y_noncomplaints_norm . . . .
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm . -0.41303422 -1.03430133 -1.60576131
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm . . . .
##
## (Intercept) -1.19554822 -1.22809435 -1.263125224 -1.29356523
## home_typeMunicipal -0.13023298 -0.16716276 -0.201203731 -0.23249730
## home_typeNon-Profit . . . .
## number_beds 0.01179858 0.01216143 0.012509750 0.01274430
## short_stayYes -0.06874783 -0.09949851 -0.128284622 -0.15597391
## residents_councilYes . . . .
## family_councilYes . . 0.002822799 0.02231627
## accreditationYes . . . .
## total_complaints_norm 0.44964699 1.70519905 2.782233312 4.02061136
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm . . -0.64223941
## X5y_noncomplaints_norm . . . .
## X2y_noncomplaints_norm . . . .
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm -2.21488779 -3.05111786 -3.852268591 -4.32836466
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm . 0.75554343 1.756157623 2.87600171
##
## (Intercept) -1.31275911 -1.33029251 -1.34456344 -1.35887926
## home_typeMunicipal -0.26072464 -0.28671921 -0.31080496 -0.33316339
## home_typeNon-Profit . . . .
## number_beds 0.01291860 0.01308002 0.01321204 0.01334065
## short_stayYes -0.18184530 -0.20573746 -0.22765361 -0.24783117
## residents_councilYes . . . .
## family_councilYes 0.03950029 0.05539985 0.07062751 0.08489994
## accreditationYes . . . .
## total_complaints_norm 5.37146890 6.63267023 7.79032728 8.83138497
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm -1.63795966 -2.57240897 -2.79386802 -2.91335012
## X5y_noncomplaints_norm . -0.02135597 -0.78293903 -1.55110474
## X2y_noncomplaints_norm . . . .
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm -4.63468721 -4.90091569 -5.01085188 -5.10441426
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .

```

## X2y_withOrders_norm	4.02782480	5.10240249	6.27305633	7.35962741
##				
## (Intercept)	-1.366746613	-1.36315535	-1.35988256	-1.35731897
## home_typeMunicipal	-0.355478928	-0.37965621	-0.40182610	-0.42176611
home_typeNon-Profit	.	.	.	.
## number_beds	0.013471946	0.01361898	0.01375519	0.01387769
## short_stayYes	-0.266207489	-0.28265556	-0.29781952	-0.31136729
residents_councilYes	.	.	.	.
## family_councilYes	0.098970308	0.11382090	0.12747395	0.13983269
## accreditationYes	-0.008952422	-0.03564919	-0.06019143	-0.08196966
## total_complaints_norm	9.810465800	10.73675135	11.60145292	12.24532050
X5y_complaints_norm	.	.	.	.
X2y_complaints_norm	.	.	.	.
## total_noncomplaints_norm	-3.071599959	-3.28335158	-3.50117649	-3.37549752
## X5y_noncomplaints_norm	-2.226534127	-2.79242844	-3.30600298	-3.80397009
## X2y_noncomplaints_norm	.	.	.	-0.46127011
total_critical_norm	.	.	.	.
X5y_critical_norm	.	.	.	.
## X2y_critical_norm	-5.190959958	-5.27468263	-5.34897839	-5.11417457
total_withOrders_norm	.	.	.	.
X5y_withOrders_norm	.	.	.	.
## X2y_withOrders_norm	8.363733803	9.29200737	10.14901017	11.30626323
##				
## (Intercept)	-1.35411923	-1.35074764	-1.34764293	-1.34486154
## home_typeMunicipal	-0.43969617	-0.45602694	-0.47096763	-0.48466261
home_typeNon-Profit	.	.	.	.
## number_beds	0.01398911	0.01409015	0.01418308	0.01426907
## short_stayYes	-0.32350689	-0.33474233	-0.34509687	-0.35461608
residents_councilYes	.	.	.	.
## family_councilYes	0.15053991	0.16032405	0.16932862	0.17760720
## accreditationYes	-0.10166340	-0.11983317	-0.13651262	-0.15180311
## total_complaints_norm	12.70675669	13.16370503	13.59217941	13.98362542
X5y_complaints_norm	.	.	.	.
X2y_complaints_norm	.	.	.	.
## total_noncomplaints_norm	-3.38951157	-3.48196149	-3.57439751	-3.66214250
## X5y_noncomplaints_norm	-3.81276790	-3.78393300	-3.76177775	-3.73227209
## X2y_noncomplaints_norm	-1.43316325	-2.31250248	-3.12506556	-3.89487702
total_critical_norm	.	.	.	.
X5y_critical_norm	.	.	.	.
## X2y_critical_norm	-4.59528719	-4.12155067	-3.67697896	-3.25082040
total_withOrders_norm	.	.	.	.
X5y_withOrders_norm	.	.	.	.
## X2y_withOrders_norm	12.72420762	14.01740217	15.21351399	16.33083224
##				
## (Intercept)	-1.34225341	-1.3398703	-1.33775363	-1.3357501
## home_typeMunicipal	-0.49717055	-0.5086105	-0.51909733	-0.5286625
home_typeNon-Profit	.	.	.	.
## number_beds	0.01434773	0.0144200	0.01448685	0.0145478
## short_stayYes	-0.36338615	-0.3714499	-0.37884477	-0.3856474
residents_councilYes	.	.	.	.
## family_councilYes	0.18521807	0.1922127	0.19863328	0.2045233
## accreditationYes	-0.16584079	-0.1787111	-0.19049209	-0.2013025
## total_complaints_norm	14.35486934	14.7000213	15.01185235	15.3079292
X5y_complaints_norm	.	.	.	.
X2y_complaints_norm	.	.	.	.
## total_noncomplaints_norm	-3.75087337	-3.8340263	-3.90882731	-3.9865605
## X5y_noncomplaints_norm	-3.71509103	-3.7037540	-3.68506050	-3.6743637
## X2y_noncomplaints_norm	-4.59353405	-5.2379558	-5.85041842	-6.4015143
total_critical_norm	.	.	.	.
X5y_critical_norm	.	.	.	.
## X2y_critical_norm	-2.85878947	-2.4930584	-2.14293965	-1.8247985
total_withOrders_norm	.	.	.	.
X5y_withOrders_norm	.	.	.	.
## X2y_withOrders_norm	17.35530979	18.3009169	19.18445132	19.9898398
##				
## (Intercept)	-1.33391919	-1.33230930	-1.33077468	-1.32937267
## home_typeMunicipal	-0.53740426	-0.54541909	-0.55272034	-0.55938793
home_typeNon-Profit	.	.	.	.
## number_beds	0.01460371	0.01465539	0.01470242	0.01474548
## short_stayYes	-0.39189132	-0.39760406	-0.40285312	-0.40766443
residents_councilYes	.	.	.	.
## family_councilYes	0.20992796	0.21488276	0.21941961	0.22357717
## accreditationYes	-0.21120431	-0.22025262	-0.22855280	-0.23614900

```

## total_complaints_norm 15.58241028 15.82760120 16.06098610 16.27710252
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm -4.05852053 -4.11949938 -4.18547184 -4.24626692
## X5y_noncomplaints_norm -3.66835803 -3.65624865 -3.64876682 -3.64536031
## X2y_noncomplaints_norm -6.90715980 -7.39010422 -7.82057654 -8.21311658
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm -1.53046431 -1.24814849 -0.99477502 -0.76227433
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm 20.73042076 21.42340626 22.05106873 22.62588551
##
## (Intercept) -1.32814952 -1.32698360 -1.32591885 -1.32463304
## home_typeMunicipal -0.56550219 -0.57106713 -0.57614513 -0.58080951
## home_typeNon-Profit . . . .
## number_beds 0.01478525 0.01482144 0.01485452 0.01488467
## short_stayYes -0.41205726 -0.41608990 -0.41978263 -0.42315114
## residents_councilYes . . . .
## family_councilYes 0.22738480 0.23086622 0.23405334 0.23696724
## accreditationYes -0.24307770 -0.24943304 -0.25524605 -0.26053939
## total_complaints_norm 16.46797243 16.65013928 16.81898852 16.96789913
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm -4.29432269 -4.34901643 -4.39970601 -4.43604399
## X5y_noncomplaints_norm -3.63760732 -3.63178989 -3.62958599 -3.62484131
## X2y_noncomplaints_norm -8.59089964 -8.92417610 -9.22568606 -9.51871034
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm -0.53792391 -0.33919257 -0.15852125 .
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm 23.16556483 23.65091579 24.09326847 24.51293335
##
## (Intercept) -1.32329374 -1.31983103 -1.31161852 -1.298883112
## home_typeMunicipal -0.58504202 -0.59000234 -0.59411998 -0.597559161
## home_typeNon-Profit . . . .
## number_beds 0.01491285 0.01492387 0.01492214 0.014913014
## short_stayYes -0.42627117 -0.42942778 -0.43242686 -0.435226544
## residents_councilYes . . -0.00220057 -0.008392714
## family_councilYes 0.23962638 0.24171171 0.24338049 0.244921751
## accreditationYes -0.26552617 -0.27068792 -0.27550051 -0.279821981
## total_complaints_norm 17.13575663 17.09066786 17.07207822 17.070764427
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm -4.51640972 -4.95110957 -5.37394629 -5.737412654
## X5y_noncomplaints_norm -3.61493175 -3.53433298 -3.49934883 -3.551271853
## X2y_noncomplaints_norm -9.66374787 -9.85405415 -9.98467677 -10.075976553
## total_critical_norm 0.04467951 0.75636170 1.33065706 1.771889383
## X5y_critical_norm . 0.48141664 1.25233777 2.157389208
## X2y_critical_norm . -0.19667938 -0.58800405 -1.005272881
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm 24.78927394 25.21928549 25.60249589 25.954942063
##
## (Intercept) -1.28760863 -1.27936621 -1.27376825 -1.26879421
## home_typeMunicipal -0.60071310 -0.60298012 -0.60490398 -0.60664903
## home_typeNon-Profit . . . .
## number_beds 0.01490603 0.01490309 0.01490650 0.01490974
## short_stayYes -0.43778696 -0.44033928 -0.44276057 -0.44501675
## residents_councilYes -0.01401303 -0.01908618 -0.02345765 -0.02727730
## family_councilYes 0.24639664 0.24794440 0.24949866 0.25090792
## accreditationYes -0.28372004 -0.28714572 -0.29034607 -0.29333671
## total_complaints_norm 17.06655386 17.47652333 18.02035806 18.53705819
## X5y_complaints_norm . -0.76112388 -1.83074698 -2.85721861
## X2y_complaints_norm . 0.21575273 0.55251137 0.87647178
## total_noncomplaints_norm -5.99521543 -6.12216879 -6.20638169 -6.29863942
## X5y_noncomplaints_norm -3.66567738 -3.80682958 -3.91736421 -4.01272471
## X2y_noncomplaints_norm -10.14296449 -10.27410168 -10.41242244 -10.53077174
## total_critical_norm 2.09887871 2.27077173 2.38106691 2.47641302
## X5y_critical_norm 3.04971192 4.16088865 5.29623058 6.39735534
## X2y_critical_norm -1.39705338 -1.78759023 -2.17887216 -2.56757566
## total_withOrders_norm . . . .

```

```

## X5y_withOrders_norm      .      .      .      .
## X2y_withOrders_norm      26.27019330  26.61489498  26.93102390  27.21569947
##
## (Intercept)              -1.26428813 -1.26016135 -1.256136e+00 -1.252395986
## home_typeMunicipal        -0.60827860 -0.60977960 -6.112083e-01 -0.612588904
## home_typeNon-Profit       .      .      -1.926324e-04 -0.000739106
## number_beds                0.01491285  0.01491574  1.491783e-02  0.014920854
## short_stayYes             -0.44706930 -0.44894080 -4.506680e-01 -0.452225166
## residents_councilYes      -0.03072493 -0.03386933 -3.675621e-02 -0.039534169
## family_councilYes         0.25219792  0.25337456  2.544496e-01  0.255495365
## accreditationYes          -0.29608353 -0.29860015 -3.009792e-01 -0.303235380
## total_complaints_norm     18.99916489  19.41754459  1.981186e+01  20.163821059
## X5y_complaints_norm       -3.77220554 -4.59887263 -5.379142e+00 -6.058038678
## X2y_complaints_norm        1.16719125  1.43047405  1.676661e+00  1.886946258
## total_noncomplaints_norm  -6.39349218 -6.48674279 -6.569798e+00 -6.620624787
## X5y_noncomplaints_norm    -4.09692247 -4.17056997 -4.242823e+00 -4.298612845
## X2y_noncomplaints_norm    -10.62931341 -10.71645999 -1.079982e+01 -10.882802301
## total_critical_norm        2.58546659  2.69494571  2.774200e+00  2.822555131
## X5y_critical_norm          7.37102373  8.24727724  9.096706e+00  9.838988210
## X2y_critical_norm         -2.92194186 -3.24503669 -3.550977e+00 -3.814660963
## total_withOrders_norm     .      .      .      .
## X5y_withOrders_norm        .      .      .      -0.065576200
## X2y_withOrders_norm       27.46786987  27.69553500  2.790998e+01  28.136860218
##
## (Intercept)              -1.249255827 -1.246600690 -1.244258064
## home_typeMunicipal        -0.613928637 -0.615210350 -0.616317700
## home_typeNon-Profit       -0.001299561 -0.001864653 -0.002330744
## number_beds                0.014925033  0.014930127  0.014934766
## short_stayYes             -0.453655145 -0.454951965 -0.456166105
## residents_councilYes      -0.042076405 -0.044379166 -0.046473773
## family_councilYes         0.256510437  0.257463794  0.258329873
## accreditationYes          -0.305321229 -0.307251737 -0.309011482
## total_complaints_norm     20.481433689  20.763760200  21.043908392
## X5y_complaints_norm       -6.664535614 -7.208490801 -7.740356309
## X2y_complaints_norm        2.072561862  2.239545933  2.398536645
## total_noncomplaints_norm  -6.654167144 -6.686504104 -6.719201787
## X5y_noncomplaints_norm    -4.329744295 -4.340072988 -4.336510174
## X2y_noncomplaints_norm    -10.967211595 -11.047357874 -11.130329597
## total_critical_norm        2.856348221  2.891480009  2.913116152
## X5y_critical_norm         10.493217107  11.065840726  11.623222475
## X2y_critical_norm         -4.046741404 -4.253509954 -4.450542913
## total_withOrders_norm     .      .      .
## X5y_withOrders_norm       -0.175457950 -0.293388713 -0.420302549
## X2y_withOrders_norm       28.366471607  28.580418100  28.791150052
##
## (Intercept)              -1.242201539 -1.240397447 -1.238749187
## home_typeMunicipal        -0.617315063 -0.618321440 -0.619185199
## home_typeNon-Profit       -0.002754765 -0.003220912 -0.003591411
## number_beds                0.014939353  0.014944430  0.014948651
## short_stayYes             -0.457283287 -0.458272245 -0.459196489
## residents_councilYes      -0.048387515 -0.050119663 -0.051689890
## family_councilYes         0.259125903  0.259871484  0.260538360
## accreditationYes          -0.310621711 -0.312117780 -0.313475647
## total_complaints_norm     21.306647663  21.521826318  21.736597045
## X5y_complaints_norm       -8.236936060 -8.654364134 -9.061009107
## X2y_complaints_norm        2.545476722  2.672884378  2.793631369
## total_noncomplaints_norm  -6.748310582 -6.778463429 -6.813384332
## X5y_noncomplaints_norm    -4.324659922 -4.308694546 -4.287204536
## X2y_noncomplaints_norm    -11.211275800 -11.278517831 -11.344963542
## total_critical_norm        2.925349550  2.953880374  2.980258882
## X5y_critical_norm         12.141306574  12.565417558  12.974529214
## X2y_critical_norm         -4.631586894 -4.787478895 -4.936075224
## total_withOrders_norm     .      .      .
## X5y_withOrders_norm       -0.548567763 -0.660933758 -0.770688690
## X2y_withOrders_norm       28.991077604  29.162584599  29.327352067
##
## (Intercept)              -1.237253246 -1.235927577 -1.234475236
## home_typeMunicipal        -0.619953118 -0.620738018 -0.621181996
## home_typeNon-Profit       -0.003917028 -0.004288306 -0.004735787
## number_beds                0.014952471  0.014956687  0.014960975
## short_stayYes             -0.460047738 -0.460796321 -0.461292240
## residents_councilYes      -0.053127454 -0.054433336 -0.056002148
## family_councilYes         0.261143994  0.261714241  0.262187117

```

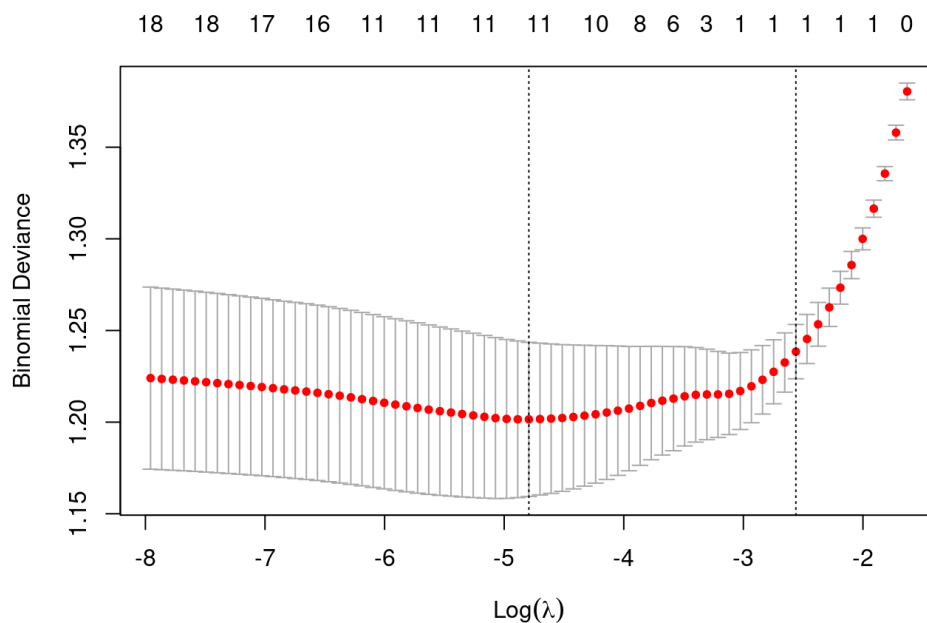
```
## accreditationYes      -0.314713577 -0.315865237 -0.316663402
## total_complaints_norm 21.938988098 22.098112023 22.114428007
## X5y_complaints_norm   -9.441435137 -9.754872270 -9.814368648
## X2y_complaints_norm    2.905410851  3.001947497  3.040546413
## total_noncomplaints_norm -6.846597624 -6.876542290 -6.879991940
## X5y_noncomplaints_norm -4.263487801 -4.241629694 -4.238341935
## X2y_noncomplaints_norm -11.408750419 -11.459890539 -11.468213515
## total_critical_norm     3.000879347  3.032043728  3.064475727
## X5y_critical_norm      13.357061939 13.667264435 13.720543739
## X2y_critical_norm      -5.073374982 -5.191574187 -5.233353440
## total_withOrders_norm   .           .           .
## X5y_withOrders_norm    -0.876043370 -0.965125468 -0.987801548
## X2y_withOrders_norm    29.482128200 29.611997572 29.651098815
```

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

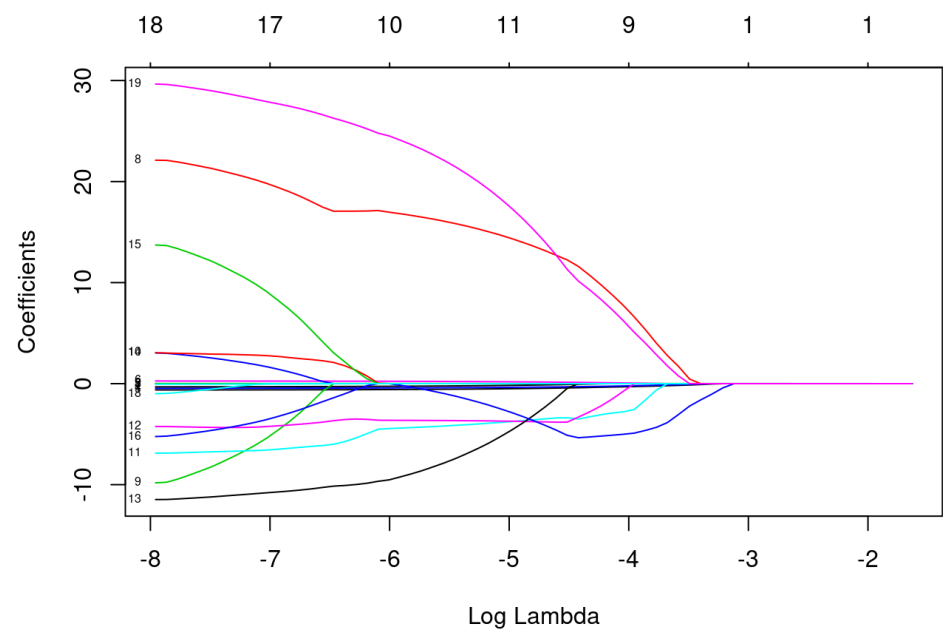
1. number_beds
2. X2y_critical_norm
3. home_typeMunicipal
4. short_stayYes
5. total_complaints_norm
6. X2y_withOrders_norm
7. family_councilYes,
8. total_noncomplaints_norm
9. X5y_noncomplaints_norm
10. accreditationYes
11. X2y_noncomplaints_norm

LASSO - CV

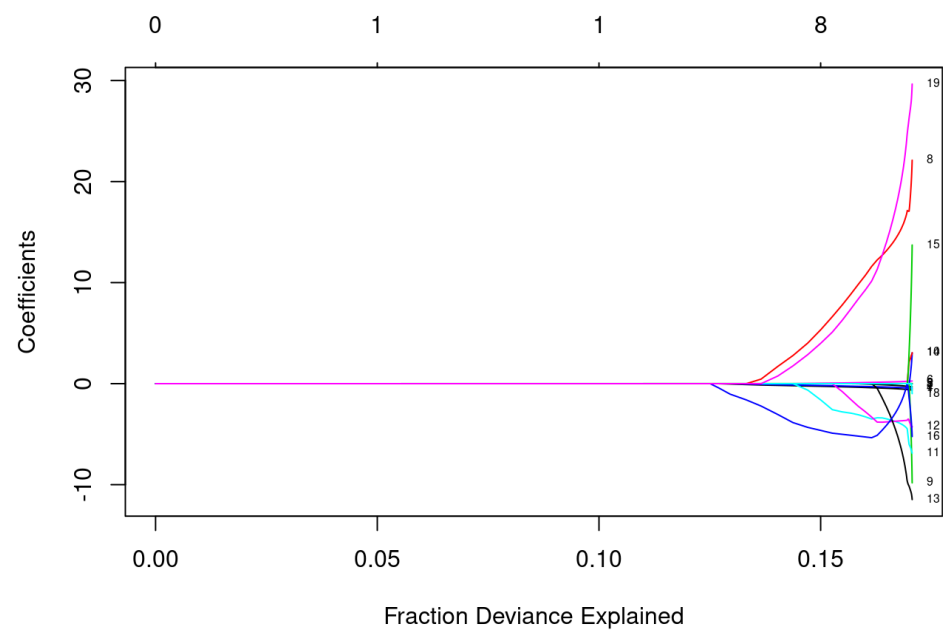
```
cv.glmmod <- cv.glmnet(x, y, alpha=1, family = 'binomial')
plot(cv.glmmod)
```



```
plot(cv.glmmod$glmnet.fit, label = TRUE, xvar = "lambda")
```



```
plot(cv.glmmod$glmnet.fit, label = TRUE, xvar = "dev")
```



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

```
## 20 x 1 sparse Matrix of class "dgCMatrix"
##                                     1
## (Intercept)                      -0.774101544
## home_typeMunicipal                .
## home_typeNon-Profit               .
## number_beds                       0.007482318
## short_stayYes                     .
## residents_councilYes              .
## family_councilYes                 .
## accreditationYes                  .
## total_complaints_norm              .
## X5y_complaints_norm                .
## X2y_complaints_norm                .
## total_noncomplaints_norm           .
## X5y_noncomplaints_norm             .
## X2y_noncomplaints_norm             .
## total_critical_norm                .
## X5y_critical_norm                  .
## X2y_critical_norm                  .
## total_withOrders_norm              .
## X5y_withOrders_norm                .
## X2y_withOrders_norm                .
```

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

```
## 20 x 1 sparse Matrix of class "dgCMatrix"
##                                     1
## (Intercept)                      -1.34764293
## home_typeMunicipal                -0.47096763
## home_typeNon-Profit               .
## number_beds                       0.01418308
## short_stayYes                     -0.34509687
## residents_councilYes              .
## family_councilYes                 0.16932862
## accreditationYes                  -0.13651262
## total_complaints_norm             13.59217941
## X5y_complaints_norm                .
## X2y_complaints_norm                .
## total_noncomplaints_norm          -3.57439751
## X5y_noncomplaints_norm             -3.76177775
## X2y_noncomplaints_norm             -3.12506556
## total_critical_norm                .
## X5y_critical_norm                  .
## X2y_critical_norm                  -3.67697896
## total_withOrders_norm              .
## X5y_withOrders_norm                .
## X2y_withOrders_norm                15.21351399
```

Fit logistic regression with selected covariates

```
data_lr <- subset(df, select = c('outbreak',
                                'number_beds',
                                'home_type',
                                'short_stay',
                                'family_council',
                                'accreditation',
                                'X2y_complaints_norm',
                                'X2y_critical_norm',
                                'X2y_withOrders_norm'
                                ))

# data_lr <- subset(df, select = c('outbreak',
#                                  'number_beds',
#                                  'home_type',
#                                  'short_stay',
#                                  'family_council',
#                                  'accreditation',
#                                  'X2y_complaints_norm',
#                                  'X2y_noncomplaints_norm'
#                                  ))

fit = glm(outbreak~., family='binomial', data=data_lr)
summary(fit)
```

```
##
## Call:
## glm(formula = outbreak ~ ., family = "binomial", data = data_lr)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -3.0527  -0.9622   0.3543   0.9719   1.9524
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.515263    0.414058  -3.660 0.000253 ***
## number_beds         0.016991    0.002015   8.433 < 2e-16 ***
## home_typeMunicipal -0.738888    0.276186  -2.675 0.007466 **
## home_typeNon-Profit -0.120040    0.226688  -0.530 0.596431
## short_stayYes     -0.461869    0.199477  -2.315 0.020591 *
## family_councilYes  0.312405    0.244956   1.275 0.202185
## accreditationYes  -0.393592    0.258131  -1.525 0.127315
## X2y_complaints_norm  8.661270    7.706889   1.124 0.261083
## X2y_critical_norm  -12.397734    7.449868  -1.664 0.096081 .
## X2y_withOrders_norm 13.791214    6.170810   2.235 0.025423 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 863.19  on 624  degrees of freedom
## Residual deviance: 721.14  on 615  degrees of freedom
## AIC: 741.14
##
## Number of Fisher Scoring iterations: 4
```

Analyses with the Quality data (615/625 homes)

```
data <- subset(df, select = c('outbreak', profile, qual, all_inspections))

# Remove 10 homes with missing quality data
data <- na.omit(data)
skim(data)
```

Data summary

```
Name          data
Number of rows 615
Number of columns 25
```


Column type frequency:

factor	6
numeric	19

Group variables: None

Variable type: factor

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
outbreak	0	1	FALSE	2	1: 334, 0: 281
home_type	0	1	FALSE	3	For: 351, Non: 164, Mun: 100
short_stay	0	1	FALSE	2	No: 413, Yes: 202
residents_council	0	1	FALSE	2	Yes: 606, No: 9
family_council	0	1	FALSE	2	Yes: 510, No: 105
accreditation	0	1	FALSE	2	Yes: 511, No: 104

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
number_beds	0	1	127.34	73.81	12.00	69.00	120.00	160.00	543.00	
antipsychotic_percent	0	1	18.47	7.74	0.00	13.45	18.00	23.00	62.80	
pressure_ulcers_percent	0	1	2.74	1.53	0.00	1.60	2.60	3.60	11.00	
falls_percent	0	1	16.49	4.83	1.80	13.35	16.40	19.70	33.20	
restraints_percent	0	1	4.21	5.75	0.00	0.40	2.20	5.80	42.00	
depression_percent	0	1	23.40	10.09	1.50	15.25	23.40	31.40	48.40	
pain_percent	0	1	5.67	5.77	0.00	1.95	3.90	7.50	48.00	
total_complaints_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.07	
X5y_complaints_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.01	0.07	
X2y_complaints_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.09	
total_noncomplaints_norm	0	1	0.02	0.02	0.00	0.01	0.02	0.03	0.15	
X5y_noncomplaints_norm	0	1	0.03	0.02	0.01	0.02	0.02	0.03	0.17	
X2y_noncomplaints_norm	0	1	0.03	0.02	0.00	0.02	0.03	0.04	0.25	
total_critical_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.06	
X5y_critical_norm	0	1	0.01	0.01	0.00	0.01	0.01	0.02	0.06	
X2y_critical_norm	0	1	0.02	0.01	0.00	0.01	0.02	0.03	0.10	
total_withOrders_norm	0	1	0.01	0.01	0.00	0.00	0.01	0.01	0.07	
X5y_withOrders_norm	0	1	0.01	0.01	0.00	0.00	0.01	0.01	0.12	
X2y_withOrders_norm	0	1	0.01	0.01	0.00	0.00	0.01	0.01	0.17	

```
# View(colnames(data))
# dput(names(df))
```

Fit logistic regression

```
# fit logistic regression
fit = glm(outbreak~., family='binomial', data=data)
summary(fit)
```

```
##
## Call:
## glm(formula = outbreak ~ ., family = "binomial", data = data)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.8085  -0.9725   0.3969   0.9242   2.3293
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -0.655248    1.108363  -0.591    0.5544
## home_typeMunicipal    -0.513095    0.294870  -1.740    0.0818 .
## home_typeNon-Profit     0.023678    0.246678   0.096    0.9235
## number_beds         0.014125    0.002509   5.630 1.8e-08 ***
## short_stayYes       -0.421036    0.205741  -2.046    0.0407 *
## residents_councilYes  -0.118293    0.895867  -0.132    0.8949
## family_councilYes     0.376488    0.257892   1.460    0.1443
## accreditationYes     -0.393547    0.272581  -1.444    0.1488
## antipsychotic_percent  0.015794    0.012897   1.225    0.2207
## pressure_ulcers_percent 0.027086    0.073104   0.371    0.7110
## falls_percent       -0.039052    0.021272  -1.836    0.0664 .
## restraints_percent   -0.027571    0.017943  -1.537    0.1244
## depression_percent    0.001435    0.010244   0.140    0.8886
## pain_percent        -0.036225    0.018439  -1.965    0.0495 *
## total_complaints_norm 15.557720   20.889469   0.745    0.4564
## X5y_complaints_norm   -1.744845   26.971234  -0.065    0.9484
## X2y_complaints_norm    4.167504   13.339179   0.312    0.7547
## total_noncomplaints_norm -24.021093   41.853699  -0.574    0.5660
## X5y_noncomplaints_norm  1.327382   34.621756   0.038    0.9694
## X2y_noncomplaints_norm -12.886702   16.128760  -0.799    0.4243
## total_critical_norm   21.462059   47.356779   0.453    0.6504
## X5y_critical_norm     11.812186   47.752049   0.247    0.8046
## X2y_critical_norm     -3.069643   19.600673  -0.157    0.8756
## total_withOrders_norm  27.770800   46.212263   0.601    0.5479
## X5y_withOrders_norm   -10.612761   38.384379  -0.276    0.7822
## X2y_withOrders_norm    30.100931   17.286311   1.741    0.0816 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 848.00  on 614  degrees of freedom
## Residual deviance: 695.97  on 589  degrees of freedom
## AIC: 747.97
##
## Number of Fisher Scoring iterations: 4
```

LASSO

```
x <- model.matrix(outbreak~., data = data)[,-1]
y <- as.factor(data.matrix(data[,1]))

glmmod <- glmnet(x, y, family = 'binomial')
# glmmod$call
# summary(glmmod)
# plot(glmmod, xvar = 'lambda', label = TRUE)
# plot(glmmod, xvar = 'dev', label = TRUE)
coef(glmmod)
```

```
## 26 x 71 sparse Matrix of class "dgCMatrix"
```

```
##      [[ suppressing 71 column names 's0', 's1', 's2' ... ]]
```

```

##
## (Intercept)          0.1727863  0.0536012270 -0.057044303 -0.160707579
## home_typeMunicipal   .          .          .          .
## home_typeNon-Profit  .          .          .          .
## number_beds          .          0.0009378785  0.001813044  0.002638037
## short_stayYes        .          .          .          .
## residents_councilYes .          .          .          .
## family_councilYes    .          .          .          .
## accreditationYes     .          .          .          .
## antipsychotic_percent .          .          .          .
## pressure_ulcers_percent .        .          .          .
## falls_percent        .          .          .          .
## restraints_percent    .          .          .          .
## depression_percent    .          .          .          .
## pain_percent          .          .          .          .
## total_complaints_norm .          .          .          .
## X5y_complaints_norm   .          .          .          .
## X2y_complaints_norm   .          .          .          .
## total_noncomplaints_norm .        .          .          .
## X5y_noncomplaints_norm .          .          .          .
## X2y_noncomplaints_norm .          .          .          .
## total_critical_norm   .          .          .          .
## X5y_critical_norm     .          .          .          .
## X2y_critical_norm     .          .          .          .
## total_withOrders_norm .          .          .          .
## X5y_withOrders_norm   .          .          .          .
## X2y_withOrders_norm   .          .          .          .
##
## (Intercept)          -0.258406398 -0.350788298 -0.438264288 -0.521099324
## home_typeMunicipal   .          .          .          .
## home_typeNon-Profit  .          .          .          .
## number_beds          .          0.003420748  0.004165896  0.004876178  0.005553064
## short_stayYes        .          .          .          .
## residents_councilYes .          .          .          .
## family_councilYes    .          .          .          .
## accreditationYes     .          .          .          .
## antipsychotic_percent .          .          .          .
## pressure_ulcers_percent .        .          .          .
## falls_percent        .          .          .          .
## restraints_percent    .          .          .          .
## depression_percent    .          .          .          .
## pain_percent          .          .          .          .
## total_complaints_norm .          .          .          .
## X5y_complaints_norm   .          .          .          .
## X2y_complaints_norm   .          .          .          .
## total_noncomplaints_norm .        .          .          .
## X5y_noncomplaints_norm .          .          .          .
## X2y_noncomplaints_norm .          .          .          .
## total_critical_norm   .          .          .          .
## X5y_critical_norm     .          .          .          .
## X2y_critical_norm     .          .          .          .
## total_withOrders_norm .          .          .          .
## X5y_withOrders_norm   .          .          .          .
## X2y_withOrders_norm   .          .          .          .
##
## (Intercept)          -0.599473757 -0.673523781 -0.743366910 -0.80911708
## home_typeMunicipal   .          .          .          .
## home_typeNon-Profit  .          .          .          .
## number_beds          .          0.006197333  0.006809436  0.007389717  0.00793855
## short_stayYes        .          .          .          .
## residents_councilYes .          .          .          .
## family_councilYes    .          .          .          .
## accreditationYes     .          .          .          .
## antipsychotic_percent .          .          .          .
## pressure_ulcers_percent .        .          .          .
## falls_percent        .          .          .          .
## restraints_percent    .          .          .          .
## depression_percent    .          .          .          .
## pain_percent          .          .          .          .
## total_complaints_norm .          .          .          .
## X5y_complaints_norm   .          .          .          .
## X2y_complaints_norm   .          .          .          .
## total_noncomplaints_norm .        .          .          .

```

```

## X5y_noncomplaints_norm . . . .
## X2y_noncomplaints_norm . . . .
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm . . . .
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm . . . .
##
## (Intercept) -0.8683042901 -0.899659374 -0.929158904 -0.956903748
## home_typeMunicipal . . . .
## home_typeNon-Profit . . . .
## number_beds 0.0084493634 0.008868722 0.009262773 0.009632980
## short_stayYes . . . .
## residents_councilYes . . . .
## family_councilYes . . . .
## accreditationYes . . . .
## antipsychotic_percent . . . .
## pressure_ulcers_percent . . . .
## falls_percent . . . .
## restraints_percent . . . .
## depression_percent . . . .
## pain_percent -0.0003058007 -0.003539001 -0.006549544 -0.009356185
## total_complaints_norm . . . .
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm . . . .
## X5y_noncomplaints_norm . . . .
## X2y_noncomplaints_norm . . . .
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm . . . .
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm . . . .
##
## (Intercept) -0.982920420 -1.00490047 -1.01170622 -1.029353387
## home_typeMunicipal . . . .
## home_typeNon-Profit . . . .
## number_beds 0.009980125 0.01029785 0.01061350 0.010933298
## short_stayYes . . . .
## residents_councilYes . . . .
## family_councilYes . . . .
## accreditationYes . . . .
## antipsychotic_percent . . . .
## pressure_ulcers_percent . . . .
## falls_percent . . . .
## restraints_percent . . . .
## depression_percent . . . .
## pain_percent -0.011975103 -0.01440927 -0.01639991 -0.018008811
## total_complaints_norm . . . .
## X5y_complaints_norm . . . .
## X2y_complaints_norm . . . .
## total_noncomplaints_norm . . . .
## X5y_noncomplaints_norm . . . .
## X2y_noncomplaints_norm . . . .
## total_critical_norm . . . .
## X5y_critical_norm . . . .
## X2y_critical_norm . . . .
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm . . . .
##
## (Intercept) -1.06499744 -1.1046098624 -1.1306263129 -1.131983171
## home_typeMunicipal -0.13221744 -0.1664735648 -0.1937856180 -0.216582998
## home_typeNon-Profit . . . .
## number_beds 0.01123926 0.0115395612 0.0118201054 0.012096012
## short_stayYes -0.04001989 -0.0699062004 -0.0976440601 -0.123474271
## residents_councilYes . . . .
## family_councilYes 0.02287230 0.0491208287 0.0738205662 0.096692834
## accreditationYes . . . .
## antipsychotic_percent . . . .
## pressure_ulcers_percent . . . .

```

## falls_percent	.	.	-0.0006444882	-0.002937657
## restraints_percent	.	-0.0003907181	-0.0019040039	-0.003414607
depression_percent	.	.	.	.
## pain_percent	-0.01937354	-0.0207629327	-0.0218937336	-0.022782468
## total_complaints_norm	2.37538262	3.3592547214	4.3535486292	5.350205756
X5y_complaints_norm	.	.	.	.
X2y_complaints_norm	.	.	.	.
total_noncomplaints_norm	.	.	.	.
X5y_noncomplaints_norm	.	.	.	.
X2y_noncomplaints_norm	.	.	.	.
total_critical_norm	.	.	.	.
X5y_critical_norm	.	.	.	.
## X2y_critical_norm	-1.94507857	-2.7403711898	-3.4165128568	-3.976537046
total_withOrders_norm	.	.	.	.
X5y_withOrders_norm	.	.	.	.
## X2y_withOrders_norm	0.14284122	1.3112180812	2.4105224292	3.445101386
##				
## (Intercept)	-1.133706007	-1.135633864	-1.1342240267	-1.134700276
## home_typeMunicipal	-0.237692168	-0.257222102	-0.2748104404	-0.291301385
home_typeNon-Profit	.	.	.	.
## number_beds	0.012354717	0.012596674	0.0127906070	0.012931133
## short_stayYes	-0.147311073	-0.169306983	-0.1899633920	-0.209400513
residents_councilYes	.	.	.	.
## family_councilYes	0.117844508	0.137393433	0.1548836564	0.171259981
## accreditationYes	.	.	.	-0.009025610
## antipsychotic_percent	.	.	0.0001800233	0.001542375
pressure_ulcers_percent	.	.	.	.
## falls_percent	-0.005047023	-0.006988192	-0.0088433253	-0.010898786
## restraints_percent	-0.004801562	-0.006076744	-0.0071905182	-0.008257466
depression_percent	.	.	.	.
## pain_percent	-0.023612755	-0.024388478	-0.0250816136	-0.025795553
## total_complaints_norm	6.274464418	7.130840706	8.0349483032	8.973031158
X5y_complaints_norm	.	.	.	.
## X2y_complaints_norm	.	.	0.0835607839	0.419154902
## total_noncomplaints_norm	.	.	-0.1412186980	-0.111598823
## X5y_noncomplaints_norm	.	.	-0.2110201651	-1.107301739
X2y_noncomplaints_norm	.	.	.	.
total_critical_norm	.	.	.	.
X5y_critical_norm	.	.	.	.
## X2y_critical_norm	-4.496521880	-4.980354686	-5.2597597036	-5.230925247
total_withOrders_norm	.	.	.	.
X5y_withOrders_norm	.	.	.	.
## X2y_withOrders_norm	4.387988657	5.250465598	6.1660002152	7.260499302
##				
## (Intercept)	-1.119293959	-1.105643430	-1.090914319	-1.074083387
## home_typeMunicipal	-0.310463134	-0.328170432	-0.343523224	-0.357069661
home_typeNon-Profit	.	.	.	.
## number_beds	0.013094889	0.013248948	0.013384681	0.013504502
## short_stayYes	-0.226581603	-0.242370200	-0.256191795	-0.268721794
residents_councilYes	.	.	.	.
## family_councilYes	0.188899315	0.205279044	0.219816550	0.232673145
## accreditationYes	-0.041615078	-0.071565765	-0.098028610	-0.122585026
## antipsychotic_percent	0.002781700	0.003921707	0.004939238	0.005852312
pressure_ulcers_percent	.	.	.	.
## falls_percent	-0.012870161	-0.014684200	-0.016401738	-0.018007018
## restraints_percent	-0.009465871	-0.010578878	-0.011683437	-0.012759659
depression_percent	.	.	.	.
## pain_percent	-0.026482836	-0.027128220	-0.027730540	-0.028306322
## total_complaints_norm	9.825607950	10.606726117	11.148872190	11.685494530
X5y_complaints_norm	.	.	.	.
## X2y_complaints_norm	0.814373384	1.183907893	1.409602168	1.551931657
## total_noncomplaints_norm	-0.279356284	-0.403796143	-0.162330710	-0.258941867
## X5y_noncomplaints_norm	-1.755944409	-2.381865331	-2.767711117	-2.704611142
## X2y_noncomplaints_norm	.	.	-0.995568972	-2.246346200
total_critical_norm	.	.	.	.
X5y_critical_norm	.	.	.	.
## X2y_critical_norm	-5.205668750	-5.181748724	-4.465902019	-3.590466104
total_withOrders_norm	.	.	.	.
X5y_withOrders_norm	.	.	.	.
## X2y_withOrders_norm	8.251053550	9.168979653	10.783846612	12.473519304
##				
## (Intercept)	-1.05843536	-1.044071403	-1.03089066	-1.018741071
## home_typeMunicipal	-0.36949823	-0.380897152	-0.39135754	-0.400959940

```

## home_typeNon-Profit      .      .      .      .
## number_beds              0.01361598 0.013719226 0.01381501 0.013904020
## short_stayYes            -0.28022400 -0.290812835 -0.30054648 -0.309474952
## residents_councilYes    .      .      .      .
## family_councilYes        0.24458107 0.255622895 0.26585006 0.275305881
## accreditationYes        -0.14519107 -0.165986344 -0.18510487 -0.202674812
## antipsychotic_percent    0.00668872 0.007457961 0.00816436 0.008811418
## pressure_ulcers_percent  .      .      .      .
## falls_percent           -0.01948907 -0.020855682 -0.02211512 -0.023275560
## restraints_percent       -0.01375741 -0.014674960 -0.01552021 -0.016301595
## depression_percent       .      .      .      .
## pain_percent             -0.02885051 -0.029359804 -0.02983635 -0.030282892
## total_complaints_norm    12.18621389 12.661004851 13.10465344 13.512870667
## X5y_complaints_norm      .      .      .      .
## X2y_complaints_norm      1.67747554 1.793859021 1.90076576 1.996519604
## total_noncomplaints_norm -0.37835067 -0.497991089 -0.61406498 -0.729322649
## X5y_noncomplaints_norm   -2.60918117 -2.528785743 -2.45433889 -2.369166439
## X2y_noncomplaints_norm   -3.43139323 -4.512701578 -5.51066307 -6.450311647
## total_critical_norm      .      .      .      .
## X5y_critical_norm        .      .      .      .
## X2y_critical_norm        -2.76318654 -2.004882431 -1.30402227 -0.646113124
## total_withOrders_norm    .      .      .      .
## X5y_withOrders_norm      .      .      .      .
## X2y_withOrders_norm      14.05038788 15.497434882 16.83241980 18.075290475
##
## (Intercept)              -1.007606215 -0.996618123 -0.988886791 -0.983076947
## home_typeMunicipal       -0.409757358 -0.417860812 -0.425558476 -0.432732416
## home_typeNon-Profit      .      .      .      .
## number_beds              0.013986091 0.014060203 0.014131989 0.014197997
## short_stayYes            -0.317688371 -0.325396862 -0.332752128 -0.339719068
## residents_councilYes    .      .      .      .
## family_councilYes        0.284041990 0.292156462 0.300335272 0.308330420
## accreditationYes        -0.218822226 -0.233834904 -0.247034197 -0.258692755
## antipsychotic_percent    0.009406348 0.009962518 0.010425323 0.010818007
## pressure_ulcers_percent  .      .      0.001566771 0.004147088
## falls_percent           -0.024343359 -0.025260487 -0.026207564 -0.027160734
## restraints_percent       -0.017018598 -0.017647925 -0.018317527 -0.018995372
## depression_percent       .      .      .      .
## pain_percent             -0.030697504 -0.031080115 -0.031460540 -0.031825980
## total_complaints_norm    13.898020843 14.266250783 14.552530730 14.799114003
## X5y_complaints_norm      .      .      .      .
## X2y_complaints_norm      2.086035414 2.262828084 2.442580540 2.610330327
## total_noncomplaints_norm -0.841155196 -0.949013285 -1.022979558 -1.069518527
## X5y_noncomplaints_norm   -2.299106555 -2.271330872 -2.273909424 -2.317330873
## X2y_noncomplaints_norm   -7.302268837 -7.741919526 -8.089927633 -8.389592735
## total_critical_norm      .      .      .      .
## X5y_critical_norm        .      .      .      .
## X2y_critical_norm        -0.047171423 .      .      .
## total_withOrders_norm    .      .      .      .
## X5y_withOrders_norm      .      .      .      .
## X2y_withOrders_norm      19.211348465 19.964933635 20.602691501 21.176137785
##
## (Intercept)              -0.977946661 -0.973186798 -0.96886945 -0.96456553
## home_typeMunicipal       -0.439347093 -0.445397500 -0.45093276 -0.45608279
## home_typeNon-Profit      .      .      .      .
## number_beds              0.014259666 0.014316049 0.01436807 0.01441512
## short_stayYes            -0.346089558 -0.351946528 -0.35729571 -0.36219664
## residents_councilYes    .      .      .      .
## family_councilYes        0.315727846 0.322517975 0.32876122 0.33448992
## accreditationYes        -0.269334227 -0.279104861 -0.28802662 -0.29622422
## antipsychotic_percent    0.011176196 0.011504696 0.01180503 0.01207884
## pressure_ulcers_percent  0.006540349 0.008737372 0.01076229 0.01261536
## falls_percent           -0.028036117 -0.028841324 -0.02957995 -0.03025894
## restraints_percent       -0.019620041 -0.020191648 -0.02071784 -0.02120351
## depression_percent       .      .      .      .
## pain_percent             -0.032165972 -0.032478069 -0.03276692 -0.03303568
## total_complaints_norm    15.010933421 15.217236596 15.39897430 15.52829065
## X5y_complaints_norm      .      .      .      0.07816719
## X2y_complaints_norm      2.766947563 2.909694670 3.04170830 3.13676082
## total_noncomplaints_norm -1.081698495 -1.109786692 -1.11691189 -1.14756818
## X5y_noncomplaints_norm   -2.366481734 -2.414272205 -2.46024768 -2.50489054
## X2y_noncomplaints_norm   -8.678243594 -8.930875873 -9.17577014 -9.38337898
## total_critical_norm      .      .      .      .

```

```

## X5y_critical_norm . . . .
## X2y_critical_norm . . . .
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm 21.712468417 22.198007840 22.65228719 23.06132007
##
## (Intercept) -0.96046749 -0.95322586 -0.94233533 -0.93313271
## home_typeMunicipal -0.46079807 -0.46518649 -0.46869732 -0.47224721
## home_typeNon-Profit . . . .
## number_beds 0.01445800 0.01448191 0.01448236 0.01448883
## short_stayYes -0.36665606 -0.37099778 -0.37520363 -0.37899506
## residents_councilYes . . . .
## family_councilYes 0.33973470 0.34412765 0.34755704 0.35084823
## accreditationYes -0.30372400 -0.31108648 -0.31806662 -0.32454577
## antipsychotic_percent 0.01233040 0.01258825 0.01286460 0.01310526
## pressure_ulcers_percent 0.01431833 0.01570531 0.01678470 0.01780010
## falls_percent -0.03088289 -0.03152021 -0.03217476 -0.03276362
## restraints_percent -0.02165312 -0.02207737 -0.02246666 -0.02283529
## depression_percent . . . .
## pain_percent -0.03328533 -0.03352771 -0.03374506 -0.03395649
## total_complaints_norm 15.61686473 15.69331976 15.88160018 15.94276262
## X5y_complaints_norm 0.19692642 0.20687562 . .
## X2y_complaints_norm 3.20766594 3.22338068 3.18971591 3.12513309
## total_noncomplaints_norm -1.15706313 -1.26851645 -1.34276289 -1.48986759
## X5y_noncomplaints_norm -2.5533869 -2.71473639 -3.03921652 -3.27966291
## X2y_noncomplaints_norm -9.58453879 -9.90824669 -10.45364956 -10.85700942
## total_critical_norm . . . .
## X5y_critical_norm . 0.80612054 2.37765087 3.66734769
## X2y_critical_norm . . . .
## total_withOrders_norm . . . .
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm 23.44625191 24.02789787 24.88768586 25.57624353
##
## (Intercept) -0.92410507 -0.91562152 -0.90052374 -8.851366e-01
## home_typeMunicipal -0.47541954 -0.47859699 -0.48145064 -4.842013e-01
## home_typeNon-Profit . . . .
## number_beds 0.01449155 0.01449970 0.01447003 1.444352e-02
## short_stayYes -0.38247001 -0.38551124 -0.38842557 -3.910230e-01
## residents_councilYes . . . -2.321198e-03
## family_councilYes 0.35381943 0.35644924 0.35813536 3.597268e-01
## accreditationYes -0.33043695 -0.33590472 -0.34103925 -3.457528e-01
## antipsychotic_percent 0.01333002 0.01350061 0.01369062 1.386752e-02
## pressure_ulcers_percent 0.01873278 0.01950292 0.02020335 2.082647e-02
## falls_percent -0.03330791 -0.03377799 -0.03421989 -3.462681e-02
## restraints_percent -0.02317217 -0.02351989 -0.02383477 -2.412566e-02
## depression_percent . . . 2.533330e-05
## pain_percent -0.03415056 -0.03432788 -0.03447317 -3.460748e-02
## total_complaints_norm 15.99638961 15.93965368 15.84194238 1.575034e+01
## X5y_complaints_norm . . . .
## X2y_complaints_norm 3.05951614 3.07308923 3.08386933 3.100320e+00
## total_noncomplaints_norm -1.58572090 -2.03366036 -2.87553040 -3.743999e+00
## X5y_noncomplaints_norm -3.53643255 -3.75948443 -4.05088781 -4.234950e+00
## X2y_noncomplaints_norm -11.25823536 -11.46184892 -11.70817461 -1.193002e+01
## total_critical_norm . 0.13601113 0.91513265 1.778088e+00
## X5y_critical_norm 4.89632782 5.95446083 6.93387128 7.697119e+00
## X2y_critical_norm . . . .
## total_withOrders_norm . 0.73652418 1.96185388 3.092302e+00
## X5y_withOrders_norm . . . .
## X2y_withOrders_norm 26.24579012 26.54989596 26.88125975 2.716133e+01
##
## (Intercept) -8.641681e-01 -8.436331e-01 -8.251098e-01
## home_typeMunicipal -4.870030e-01 -4.895838e-01 -4.919977e-01
## home_typeNon-Profit . . . .
## number_beds 1.442117e-02 1.439628e-02 1.437452e-02
## short_stayYes -3.932199e-01 -3.952356e-01 -3.970695e-01
## residents_councilYes -1.315567e-02 -2.349051e-02 -3.287101e-02
## family_councilYes 3.613924e-01 3.628208e-01 3.641363e-01
## accreditationYes -3.499528e-01 -3.538643e-01 -3.574750e-01
## antipsychotic_percent 1.402980e-02 1.418220e-02 1.432136e-02
## pressure_ulcers_percent 2.119664e-02 2.152732e-02 2.183401e-02
## falls_percent -3.502510e-02 -3.539002e-02 -3.572297e-02
## restraints_percent -2.440346e-02 -2.465863e-02 -2.489397e-02
## depression_percent 1.467182e-04 2.590161e-04 3.630929e-04

```

```

## pain_percent -3.473083e-02 -3.484221e-02 -3.494551e-02
## total_complaints_norm 1.566191e+01 1.558262e+01 1.551071e+01
## X5y_complaints_norm . . .
## X2y_complaints_norm 3.127019e+00 3.152275e+00 3.176755e+00
## total_noncomplaints_norm -4.646566e+00 -5.586487e+00 -6.481777e+00
## X5y_noncomplaints_norm -4.335776e+00 -4.395114e+00 -4.423870e+00
## X2y_noncomplaints_norm -1.212085e+01 -1.229643e+01 -1.244897e+01
## total_critical_norm 2.653728e+00 3.579505e+00 4.465411e+00
## X5y_critical_norm 8.325226e+00 8.860396e+00 9.310912e+00
## X2y_critical_norm . . .
## total_withOrders_norm 4.190663e+00 5.272745e+00 6.272937e+00
## X5y_withOrders_norm . . .
## X2y_withOrders_norm 2.736911e+01 2.755079e+01 2.770299e+01
##
## (Intercept) -8.079364e-01 -7.926565e-01 -7.789731e-01
## home_typeMunicipal -4.942197e-01 -4.962840e-01 -4.981612e-01
## home_typeNon-Profit . . .
## number_beds 1.435396e-02 1.433670e-02 1.432012e-02
## short_stayYes -3.987436e-01 -4.002678e-01 -4.017240e-01
## residents_councilYes -4.153794e-02 -4.934076e-02 -5.604500e-02
## family_councilYes 3.653266e-01 3.664443e-01 3.673982e-01
## accreditationYes -3.607997e-01 -3.638454e-01 -3.667850e-01
## antipsychotic_percent 1.444924e-02 1.456517e-02 1.467713e-02
## pressure_ulcers_percent 2.211458e-02 2.237576e-02 2.259449e-02
## falls_percent -3.602735e-02 -3.630523e-02 -3.656360e-02
## restraints_percent -2.511001e-02 -2.530838e-02 -2.549284e-02
## depression_percent 4.588531e-04 5.469279e-04 6.252728e-04
## pain_percent -3.504040e-02 -3.512844e-02 -3.521254e-02
## total_complaints_norm 1.544561e+01 1.538655e+01 1.532078e+01
## X5y_complaints_norm . . .
## X2y_complaints_norm 3.199749e+00 3.221374e+00 3.241444e+00
## total_noncomplaints_norm -7.335014e+00 -8.112261e+00 -8.862008e+00
## X5y_noncomplaints_norm -4.437366e+00 -4.443885e+00 -4.449818e+00
## X2y_noncomplaints_norm -1.258574e+01 -1.270492e+01 -1.277578e+01
## total_critical_norm 5.312101e+00 6.082647e+00 6.808429e+00
## X5y_critical_norm 9.704939e+00 1.005219e+01 1.046233e+01
## X2y_critical_norm . . -5.170951e-02
## total_withOrders_norm 7.209238e+00 8.057611e+00 8.831378e+00
## X5y_withOrders_norm . . .
## X2y_withOrders_norm 2.783552e+01 2.794952e+01 2.802997e+01
##
## (Intercept) -7.676205e-01 -7.570144e-01 -7.472837e-01
## home_typeMunicipal -4.993682e-01 -5.003092e-01 -5.011667e-01
## home_typeNon-Profit 1.509007e-03 3.297278e-03 4.938315e-03
## number_beds 1.430069e-02 1.427955e-02 1.425973e-02
## short_stayYes -4.031645e-01 -4.045431e-01 -4.058146e-01
## residents_councilYes -6.080075e-02 -6.494523e-02 -6.867559e-02
## family_councilYes 3.680886e-01 3.686247e-01 3.691138e-01
## accreditationYes -3.690585e-01 -3.710718e-01 -3.729135e-01
## antipsychotic_percent 1.478939e-02 1.489658e-02 1.499483e-02
## pressure_ulcers_percent 2.280981e-02 2.299674e-02 2.316706e-02
## falls_percent -3.677965e-02 -3.697455e-02 -3.715274e-02
## restraints_percent -2.567098e-02 -2.583709e-02 -2.598839e-02
## depression_percent 6.984511e-04 7.651608e-04 8.261476e-04
## pain_percent -3.529533e-02 -3.537119e-02 -3.544018e-02
## total_complaints_norm 1.526926e+01 1.521871e+01 1.517146e+01
## X5y_complaints_norm . . .
## X2y_complaints_norm 3.272805e+00 3.307471e+00 3.341139e+00
## total_noncomplaints_norm -9.549090e+00 -1.023069e+01 -1.085278e+01
## X5y_noncomplaints_norm -4.475077e+00 -4.527886e+00 -4.593996e+00
## X2y_noncomplaints_norm -1.278796e+01 -1.275855e+01 -1.271960e+01
## total_critical_norm 7.497810e+00 8.170495e+00 8.781496e+00
## X5y_critical_norm 1.093670e+01 1.143421e+01 1.190936e+01
## X2y_critical_norm -2.662259e-01 -5.097007e-01 -7.432776e-01
## total_withOrders_norm 9.535705e+00 1.025157e+01 1.092201e+01
## X5y_withOrders_norm . . .
## X2y_withOrders_norm 2.807352e+01 2.808131e+01 2.808020e+01
##
## (Intercept) -7.377353e-01 -7.316996e-01 -7.252815e-01
## home_typeMunicipal -5.019181e-01 -5.026034e-01 -5.032031e-01
## home_typeNon-Profit 6.492159e-03 7.731750e-03 8.988269e-03
## number_beds 1.423926e-02 1.423144e-02 1.422237e-02
## short_stayYes -4.069780e-01 -4.080308e-01 -4.091135e-01

```



```

## residents_councilYes -7.235229e-02 -7.562578e-02 -7.888300e-02
## family_councilYes 3.695272e-01 3.702451e-01 3.708920e-01
## accreditationYes -3.745665e-01 -3.758811e-01 -3.771497e-01
## antipsychotic_percent 1.508597e-02 1.515469e-02 1.521440e-02
## pressure_ulcers_percent 2.331859e-02 2.356687e-02 2.381602e-02
## falls_percent -3.731529e-02 -3.746644e-02 -3.761216e-02
## restraints_percent -2.612525e-02 -2.623865e-02 -2.634593e-02
## depression_percent 8.819269e-04 9.239962e-04 9.576244e-04
## pain_percent -3.550069e-02 -3.555746e-02 -3.561626e-02
## total_complaints_norm 1.513129e+01 1.510801e+01 1.507684e+01
## X5y_complaints_norm . . .
## X2y_complaints_norm 3.373232e+00 3.394726e+00 3.405810e+00
## total_noncomplaints_norm -1.144920e+01 -1.183039e+01 -1.229230e+01
## X5y_noncomplaints_norm -4.667310e+00 -4.661138e+00 -4.568099e+00
## X2y_noncomplaints_norm -1.268202e+01 -1.269624e+01 -1.271927e+01
## total_critical_norm 9.374455e+00 9.773102e+00 1.016601e+01
## X5y_critical_norm 1.233601e+01 1.261200e+01 1.296026e+01
## X2y_critical_norm -9.512271e-01 -1.086062e+00 -1.250911e+00
## total_withOrders_norm 1.157954e+01 1.219460e+01 1.302883e+01
## X5y_withOrders_norm . -2.883030e-01 -8.314408e-01
## X2y_withOrders_norm 2.807570e+01 2.819335e+01 2.837309e+01
##
## (Intercept) -7.184824e-01 -0.712660508 -0.708437926
## home_typeMunicipal -5.038861e-01 -0.504641319 -0.505351321
## home_typeNon-Profit 1.022561e-02 0.011337512 0.012245513
## number_beds 1.421195e-02 0.014203684 0.014199805
## short_stayYes -4.101484e-01 -0.411069931 -0.411866281
## residents_councilYes -8.227598e-02 -0.085310023 -0.087780900
## family_councilYes 3.714326e-01 0.371908136 0.372408696
## accreditationYes -3.784001e-01 -0.379616592 -0.380700842
## antipsychotic_percent 1.526467e-02 0.015309980 0.015350599
## pressure_ulcers_percent 2.407093e-02 0.024321030 0.024551641
## falls_percent -3.774444e-02 -0.037861606 -0.037967344
## restraints_percent -2.645136e-02 -0.026550947 -0.026639189
## depression_percent 9.912958e-04 0.001025381 0.001056294
## pain_percent -3.567243e-02 -0.035723420 -0.035769366
## total_complaints_norm 1.503267e+01 14.995147455 14.968856286
## X5y_complaints_norm . . .
## X2y_complaints_norm 3.422347e+00 3.440522914 3.455036983
## total_noncomplaints_norm -1.297895e+01 -13.744934204 -14.344586411
## X5y_noncomplaints_norm -4.323537e+00 -3.985367397 -3.699602930
## X2y_noncomplaints_norm -1.273088e+01 -12.734845774 -12.746173739
## total_critical_norm 1.076701e+01 11.483092069 12.061409244
## X5y_critical_norm 1.315279e+01 13.162266441 13.147478759
## X2y_critical_norm -1.412661e+00 -1.551099711 -1.659660970
## total_withOrders_norm 1.413243e+01 15.213747531 16.050024005
## X5y_withOrders_norm -1.554840e+00 -2.270889846 -2.852588313
## X2y_withOrders_norm 2.854433e+01 28.685361994 28.812097310
##
## (Intercept) -0.703484431 -0.700540391 -0.695720641
## home_typeMunicipal -0.506086457 -0.506676659 -0.507327652
## home_typeNon-Profit 0.013217294 0.013886179 0.014779009
## number_beds 0.014192458 0.014191392 0.014183056
## short_stayYes -0.412665629 -0.413283131 -0.413989751
## residents_councilYes -0.090263731 -0.092238278 -0.094492153
## family_councilYes 0.372777709 0.373233108 0.373494536
## accreditationYes -0.381808741 -0.382675575 -0.383662573
## antipsychotic_percent 0.015388388 0.015420697 0.015452608
## pressure_ulcers_percent 0.024777390 0.024965337 0.025163465
## falls_percent -0.038064586 -0.038150982 -0.038232926
## restraints_percent -0.026726491 -0.026798013 -0.026874478
## depression_percent 0.001085491 0.001112609 0.001136956
## pain_percent -0.035814653 -0.035850598 -0.035890359
## total_complaints_norm 14.931733397 14.917086365 14.880794572
## X5y_complaints_norm . . .
## X2y_complaints_norm 3.470614741 3.484025469 3.496513485
## total_noncomplaints_norm -15.121021714 -15.563580111 -16.340158040
## X5y_noncomplaints_norm -3.319444730 -3.104247943 -2.715646477
## X2y_noncomplaints_norm -12.741665345 -12.752379488 -12.745573218
## total_critical_norm 12.794120798 13.235267733 13.960972055
## X5y_critical_norm 13.089590187 13.038854488 12.963876138
## X2y_critical_norm -1.794637836 -1.862267400 -1.991271147
## total_withOrders_norm 17.077204243 17.693332997 18.697924918

```

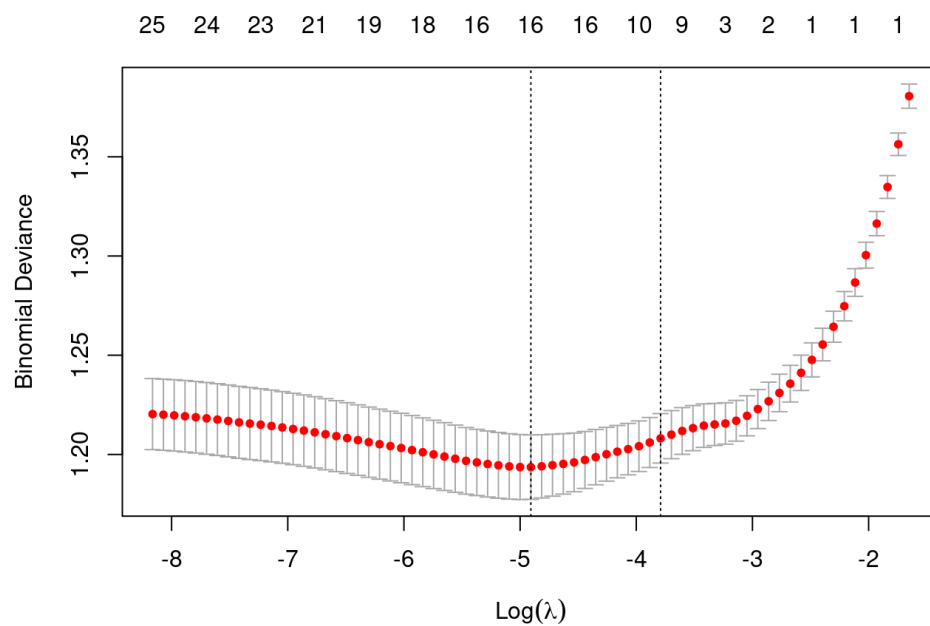
```
## X5y_withOrders_norm      -3.552386772  -3.977723805  -4.661852416
## X2y_withOrders_norm      28.932567543  29.025455211  29.134569185
##
## (Intercept)              -0.693415421
## home_typeMunicipal        -0.507832063
## home_typeNon-Profit        0.015312135
## number_beds                0.014182815
## short_stayYes              -0.414481750
## residents_councilYes       -0.096219433
## family_councilYes          0.373891863
## accreditationYes           -0.384372626
## antipsychotic_percent      0.015478234
## pressure_ulcers_percent    0.025328993
## falls_percent              -0.038302997
## restraints_percent         -0.026933400
## depression_percent         0.001160929
## pain_percent                -0.035918936
## total_complaints_norm      14.872757521
## X5y_complaints_norm        -0.013284576
## X2y_complaints_norm         3.516584939
## total_noncomplaints_norm   -16.725726446
## X5y_noncomplaints_norm     -2.518684029
## X2y_noncomplaints_norm     -12.756359425
## total_critical_norm        14.367202998
## X5y_critical_norm          12.859601458
## X2y_critical_norm          -2.033177960
## total_withOrders_norm      19.218171717
## X5y_withOrders_norm        -5.011804578
## X2y_withOrders_norm        29.204133041
```

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

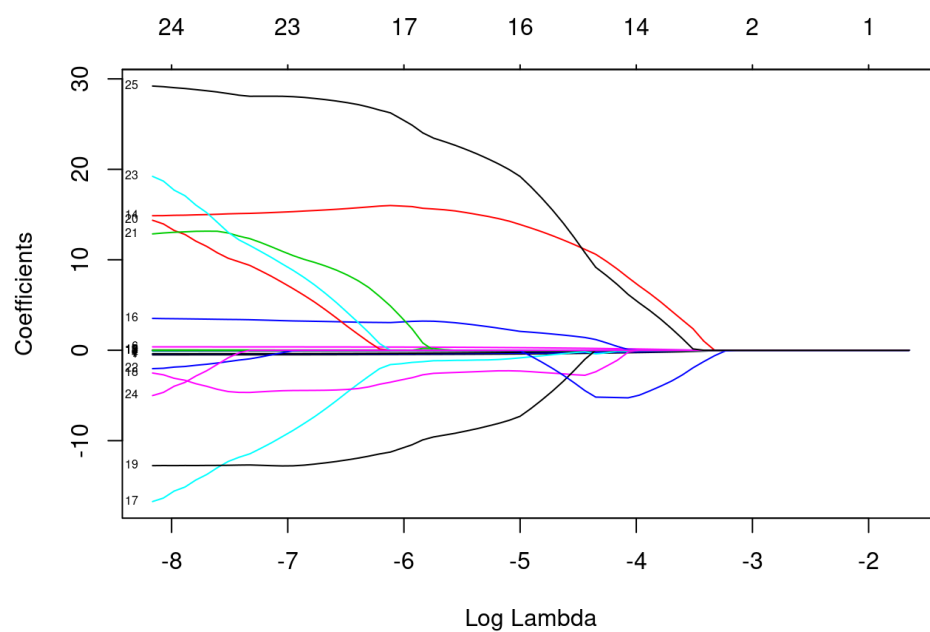
```
1. number_beds
2. pain_percent
2. X2y_critical_norm
3. home_typeMunicipal
4. short_stayYes
5. total_complaints_norm
6. X2y_withOrders_norm, family_councilYes
7. restraints_percent
8. falls_percent
9. antipsychotic_percent, X2y_complaints_norm, total_noncomplaints_norm, X5y_noncomplaints_norm
```

LASSO - CV

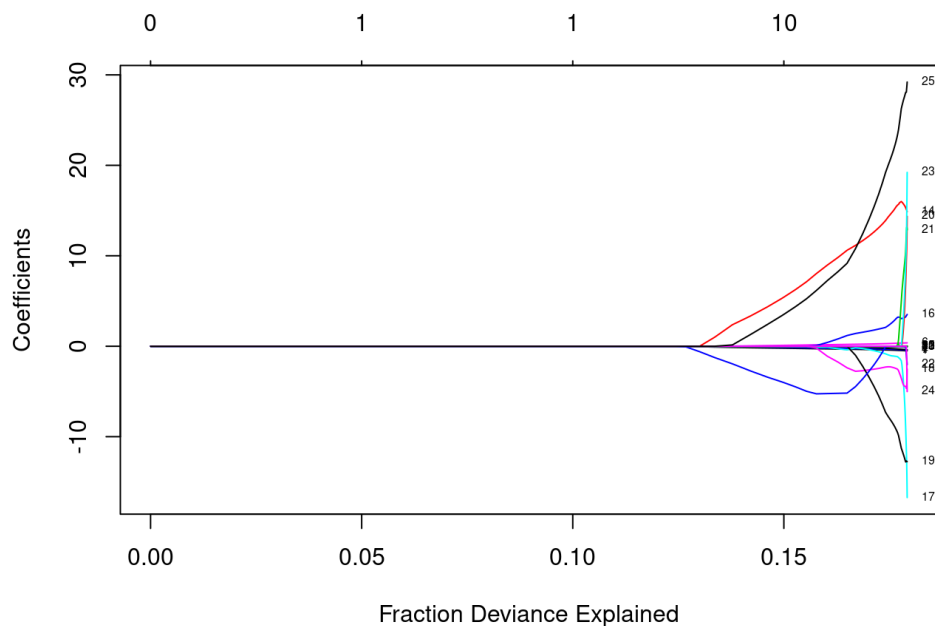
```
cv.glmmod <- cv.glmnet(x, y, alpha=1, family = 'binomial')
plot(cv.glmmod)
```



```
plot(cv.glmmod$glmnet.fit, label = TRUE, xvar = "lambda")
```



```
plot(cv.glmmod$glmnet.fit, label = TRUE, xvar = "dev")
```



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

```
## 26 x 1 sparse Matrix of class "dgCMatrix"
##                               1
## (Intercept)                 -1.131983171
## home_typeMunicipal          -0.216582998
## home_typeNon-Profit          .
## number_beds                  0.012096012
## short_stayYes                -0.123474271
## residents_councilYes         .
## family_councilYes            0.096692834
## accreditationYes             .
## antipsychotic_percent        .
## pressure_ulcers_percent      .
## falls_percent                -0.002937657
## restraints_percent           -0.003414607
## depression_percent           .
## pain_percent                 -0.022782468
## total_complaints_norm        5.350205756
## X5y_complaints_norm          .
## X2y_complaints_norm          .
## total_noncomplaints_norm     .
## X5y_noncomplaints_norm       .
## X2y_noncomplaints_norm       .
## total_critical_norm          .
## X5y_critical_norm            .
## X2y_critical_norm            -3.976537046
## total_withOrders_norm        .
## X5y_withOrders_norm          .
## X2y_withOrders_norm          3.445101386
```

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

```
## 26 x 1 sparse Matrix of class "dgCMatrix"
##                                     1
## (Intercept)                      -1.018741071
## home_typeMunicipal                -0.400959940
## home_typeNon-Profit                .
## number_beds                       0.013904020
## short_stayYes                     -0.309474952
## residents_councilYes              .
## family_councilYes                 0.275305881
## accreditationYes                  -0.202674812
## antipsychotic_percent              0.008811418
## pressure_ulcers_percent            .
## falls_percent                     -0.023275560
## restraints_percent                 -0.016301595
## depression_percent                .
## pain_percent                      -0.030282892
## total_complaints_norm              13.512870667
## X5y_complaints_norm                .
## X2y_complaints_norm                1.996519604
## total_noncomplaints_norm           -0.729322649
## X5y_noncomplaints_norm             -2.369166439
## X2y_noncomplaints_norm             -6.450311647
## total_critical_norm                .
## X5y_critical_norm                  .
## X2y_critical_norm                  -0.646113124
## total_withOrders_norm              .
## X5y_withOrders_norm                .
## X2y_withOrders_norm                18.075290475
```

Fit logistic regression with selected covariates

```
data_lr <- subset(data, select = c('outbreak',
                                   'number_beds',
                                   'pain_percent',
                                   'restraints_percent',
                                   'falls_percent',
                                   'antipsychotic_percent',
                                   'home_type',
                                   'short_stay',
                                   'family_council',
                                   'accreditation',
                                   'X2y_complaints_norm',
                                   'X2y_critical_norm',
                                   'X2y_withOrders_norm'
                                   ))

fit = glm(outbreak~., family='binomial', data=data_lr)
summary(fit)
```

```
##
## Call:
## glm(formula = outbreak ~ ., family = "binomial", data = data_lr)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.9038  -0.9752   0.3685   0.9367   2.2791
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.016702   0.546103  -1.862   0.0626 .
## number_beds      0.016111   0.002082   7.737 1.02e-14 ***
## pain_percent    -0.037893   0.018049  -2.100   0.0358 *
## restraints_percent -0.023670   0.016843  -1.405   0.1599
## falls_percent   -0.033167   0.019977  -1.660   0.0969 .
## antipsychotic_percent 0.014415   0.012337   1.168   0.2426
## home_typeMunicipal -0.600265   0.284088  -2.113   0.0346 *
## home_typeNon-Profit -0.076855   0.235332  -0.327   0.7440
## short_stayYes    -0.414443   0.203373  -2.038   0.0416 *
## family_councilYes  0.423208   0.250088   1.692   0.0906 .
## accreditationYes  -0.443252   0.264537  -1.676   0.0938 .
## X2y_complaints_norm 12.119988   8.446457   1.435   0.1513
## X2y_critical_norm  -10.411186   7.824178  -1.331   0.1833
## X2y_withOrders_norm 15.714925   6.799129   2.311   0.0208 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 848.00  on 614  degrees of freedom
## Residual deviance: 701.15  on 601  degrees of freedom
## AIC: 729.15
##
## Number of Fisher Scoring iterations: 4
```

Fit logistic regression

Backwards selection

Transforming the Predictors

Visualize the model