Lab 4: Adaptive LASSO

```
library(glmnet)
```

```
##      Matrix
```

```
## Loaded glmnet 4.1-2
```

```
library(AER)
```

```
##      car
##      carData
##      lmtest
##      zoo
##
##    'zoo'
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
##      sandwich
##      survival
```

```
?Fatalities
data(Fatalities)
F=na.omit(Fatalities)
```

We define the dependent variable as the rate of alcohol-involved vehicle fatalities:

```
F$afatal_rate=F$afatal/F$pop
```

We run OLS first:

```
OUT=lm(afatal_rate~spirits+unemp+income+beertax+baptist+mormon+drinkage+dry+youngdrivers
       +miles+breath+jail+service+pop+state+year,data=F)
summary(OUT)
```

```
##
## Call:
## lm(formula = afatal_rate ~ spirits + unemp + income + beertax +
##     baptist + mormon + drinkage + dry + youngdrivers + miles +
##     breath + jail + service + pop + state + year, data = F)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -9.351e-05 -4.947e-06 -1.620e-07  4.643e-06  4.704e-05
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   3.122e-04  1.615e-04   1.933 0.054240 .
```

```
## spirits       2.345e-05  9.799e-06   2.393 0.017413 *
## unemp        -3.052e-06  8.963e-07  -3.406 0.000761 ***
## income        8.683e-10  1.770e-09   0.491 0.624116
## beertax      -2.007e-05  1.564e-05  -1.284 0.200410
## baptist      -5.476e-06  4.728e-06  -1.158 0.247843
## mormon       -2.788e-06  3.427e-06  -0.814 0.416650
## drinkage     -4.841e-07  1.468e-06  -0.330 0.741829
## dry           2.431e-08  1.039e-06   0.023 0.981355
## youngdrivers  3.467e-05  7.376e-05   0.470 0.638719
## miles        -3.221e-10  6.963e-10  -0.463 0.644045
## breathyes    -9.715e-07  3.997e-06  -0.243 0.808149
## jailyes       2.294e-05  9.581e-06   2.395 0.017323 *
## serviceyes   -2.125e-05  1.104e-05  -1.926 0.055204 .
## pop          -6.309e-12  4.481e-12  -1.408 0.160302
## stateaz      -2.029e-04  1.238e-04  -1.639 0.102382
## statear      -5.522e-05  3.879e-05  -1.423 0.155771
## stateca      -1.011e-04  1.269e-04  -0.797 0.426253
## stateco      -2.143e-04  1.291e-04  -1.661 0.097936 .
## statect      -2.772e-04  1.392e-04  -1.992 0.047383 *
## statede      -2.747e-04  1.409e-04  -1.950 0.052265 .
## statefl      -1.076e-04  9.592e-05  -1.122 0.262935
## statega      -3.921e-05  4.339e-05  -0.904 0.367025
## stateid      -1.428e-04  1.674e-04  -0.853 0.394365
## stateil      -1.939e-04  1.155e-04  -1.679 0.094401 .
## statein      -2.017e-04  1.268e-04  -1.591 0.112902
## stateia      -2.172e-04  1.384e-04  -1.569 0.117835
## stateks      -1.907e-04  1.261e-04  -1.512 0.131748
## stateky      -8.301e-05  3.755e-05  -2.210 0.027924 *
## statela      -1.067e-04  6.991e-05  -1.526 0.128091
## stateme      -2.711e-04  1.446e-04  -1.875 0.061913 .
## statemd      -2.547e-04  1.227e-04  -2.075 0.038943 *
## statema      -2.710e-04  1.347e-04  -2.011 0.045288 *
## statemi      -1.909e-04  1.271e-04  -1.502 0.134294
## statemn      -2.606e-04  1.377e-04  -1.892 0.059519 .
## statems       4.114e-05  1.439e-05   2.859 0.004581 **
## statemo      -1.298e-04  7.056e-05  -1.839 0.066977 .
## statemt      -2.087e-04  1.391e-04  -1.501 0.134636
## statene      -2.529e-04  1.400e-04  -1.806 0.072042 .
## statenv      -2.768e-04  1.379e-04  -2.007 0.045767 *
## statenh      -3.138e-04  1.464e-04  -2.143 0.033019 *
## statenj      -2.629e-04  1.313e-04  -2.002 0.046280 *
## statenm      -1.388e-04  1.002e-04  -1.385 0.167151
## stateny      -1.931e-04  1.260e-04  -1.533 0.126511
## statenc      -7.026e-05  3.779e-05  -1.859 0.064099 .
## statend      -2.408e-04  1.416e-04  -1.701 0.090135 .
## stateoh      -1.655e-04  1.199e-04  -1.380 0.168872
## stateok      -6.448e-05  3.159e-05  -2.041 0.042234 *
## stateor      -2.232e-04  1.355e-04  -1.647 0.100728
## statepa      -1.820e-04  1.266e-04  -1.438 0.151729
## stateri      -2.919e-04  1.428e-04  -2.043 0.041998 *
## statesc      -3.266e-05  4.028e-05  -0.811 0.418190
## statesd      -2.466e-04  1.425e-04  -1.731 0.084666 .
## statetn      -7.824e-05  3.428e-05  -2.283 0.023230 *
## statetx      -1.314e-05  6.181e-05  -0.213 0.831832
```

```
## stateut      -6.135e-05  2.699e-04  -0.227 0.820331
## statevt      -2.590e-04  1.465e-04  -1.768 0.078196 .
## stateva      -1.607e-04  8.084e-05  -1.988 0.047854 *
## statewa      -2.413e-04  1.317e-04  -1.832 0.068111 .
## statewv      -2.032e-04  1.351e-04  -1.504 0.133680
## statewi      -2.403e-04  1.344e-04  -1.788 0.074862 .
## statewy      -1.981e-04  1.360e-04  -1.456 0.146525
## year1983     -6.286e-06  2.670e-06  -2.354 0.019307 *
## year1984     -1.184e-05  3.541e-06  -3.343 0.000946 ***
## year1985     -1.530e-05  4.095e-06  -3.735 0.000229 ***
## year1986     -9.908e-06  5.198e-06  -1.906 0.057697 .
## year1987     -1.427e-05  6.107e-06  -2.337 0.020156 *
## year1988     -1.592e-05  7.195e-06  -2.213 0.027753 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.233e-05 on 267 degrees of freedom
## Multiple R-squared:   0.82,  Adjusted R-squared:  0.7748
## F-statistic: 18.16 on 67 and 267 DF,  p-value: < 2.2e-16
```

OLS weights for adaptive Lasso:

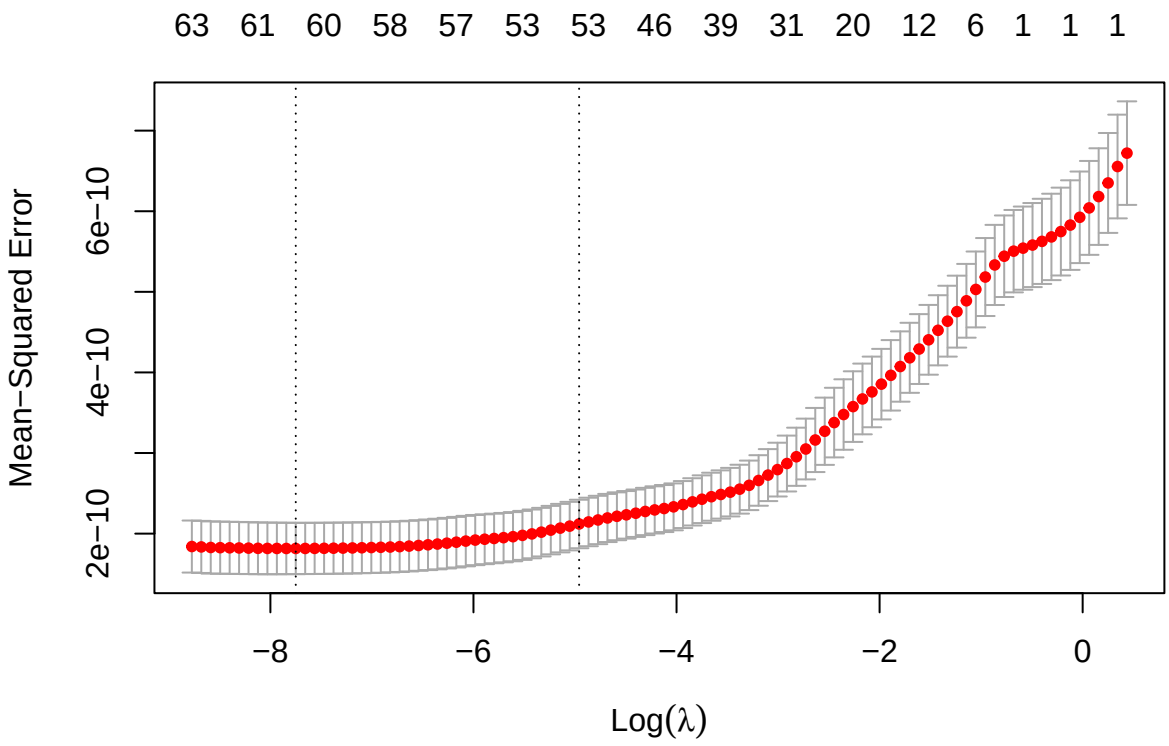
```
w=coef(OUT)[-1] # not penalizing the intercept
w=1/abs(w)
```

Model matrix for glmnet():

```
y=F$afatal_rate
x=model.matrix(afatal_rate~spirits+unemp+income+beertax+baptist
               +mormon+drinkage+dry+youngdrivers+miles+breath+jail
               +service+pop+state+year,F)[,-1] # drop the intercept
```

- Cross-validation with adaptive weights:

```
set.seed(1)
CV=cv.glmnet(x,y,alpha=1,family="gaussian",penalty.factor=w,standardize=FALSE)
plot(CV)
```



Selected coefficients:

```
coef(CV,s=CV$lambda.1se)
```

```
## 68 x 1 sparse Matrix of class "dgCMatrix"
##                         s1
## (Intercept)   3.549296e-05
## spirits       1.420274e-05
## unemp         .
## income        .
## beertax      -7.702776e-06
## baptist       1.457252e-06
## mormon       -7.128889e-08
## drinkage      .
## dry           .
## youngdrivers  .
## miles         .
## breathyes     .
## jailyes       3.450831e-06
## serviceyes    .
## pop           1.473141e-13
## stateaz       5.401432e-08
## statear       1.313261e-05
## stateca      -1.586926e-05
## stateco      -7.562811e-06
## statect      -1.710927e-05
## statede      -6.382943e-06
## statefl      -1.016402e-06
## stategа      -7.613257e-07
## stateid       2.955477e-05
## stateil      -2.290723e-05
```

```
## statein       1.477182e-06
## stateia       1.522080e-05
## stateks       2.874835e-05
## stateky      -1.891199e-05
## statela       1.125877e-06
## stateme       .
## statemd      -2.887774e-05
## statema      -2.849104e-05
## statemi      -3.065681e-06
## statemn      -2.014477e-05
## statems       4.887078e-05
## statemo      -5.582576e-06
## statemt       4.626501e-05
## statene      -5.377704e-06
## statenv      -2.593721e-05
## statenh      -2.834955e-05
## statenj      -3.565748e-05
## statenm       3.238970e-05
## stateny      -3.708815e-05
## statenc      -1.039728e-05
## statend       1.544119e-05
## stateoh       1.457980e-05
## stateok      -1.881575e-05
## stateor       .
## statepa      -3.672661e-06
## stateri      -2.620775e-05
## statesc       1.289321e-05
## statesd       5.303505e-06
## statetn      -1.049711e-05
## statetx       5.892895e-06
## stateut       .
## statevt       3.534955e-06
## stateva      -2.228402e-05
## statewa      -7.738103e-06
## statewv       2.349148e-05
## statewi      -7.586342e-06
## statewy       4.174169e-05
## year1983      .
## year1984      .
## year1985     -3.006877e-06
## year1986      .
## year1987     -1.569983e-06
## year1988     -1.226260e-06
```