HW5

William Florez

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### Q1

library('caret')

## Loading required package: lattice

## Loading required package: ggplot2

library('glmnet')

## Loading required package: Matrix

## Loading required package: foreach

## Loaded glmnet 2.0-10

library('parallel')  
library("MASS")  
set.seed(1)  
#setwd("C:/Users/ce02144/Documents/HW4")  
setwd("~/Dropbox/WILL/DataScience/GT Analytics/Introduction\_to\_Analytics\_Modeling/HW4")  
  
#Reading data  
uscrime = read.table("uscrime.txt", header = TRUE)  
  
#step seleccion  
crime.scale = data.frame(scale(uscrime))  
model.lm = lm(Crime ~ ., data = crime.scale)  
model.step = step(model.lm, direction = 'both')

## Start: AIC=-45.39  
## Crime ~ M + So + Ed + Po1 + Po2 + LF + M.F + Pop + NW + U1 +   
## U2 + Wealth + Ineq + Prob + Time  
##   
## Df Sum of Sq RSS AIC  
## - So 1 0.00019 9.0582 -47.384  
## - LF 1 0.05961 9.1176 -47.077  
## - Time 1 0.06888 9.1269 -47.029  
## - Pop 1 0.09441 9.1524 -46.898  
## - NW 1 0.12298 9.1810 -46.752  
## - M.F 1 0.21371 9.2717 -46.289  
## - Wealth 1 0.25145 9.3095 -46.099  
## - Po2 1 0.25350 9.3115 -46.088  
## <none> 9.0580 -45.385  
## - U1 1 0.55970 9.6177 -44.567  
## - Po1 1 0.96471 10.0227 -42.629  
## - U2 1 1.21360 10.2716 -41.476  
## - M 1 1.29538 10.3534 -41.103  
## - Prob 1 1.33394 10.3920 -40.928  
## - Ed 1 2.68821 11.7462 -35.171  
## - Ineq 1 2.82803 11.8860 -34.615  
##   
## Step: AIC=-47.38  
## Crime ~ M + Ed + Po1 + Po2 + LF + M.F + Pop + NW + U1 + U2 +   
## Wealth + Ineq + Prob + Time  
##   
## Df Sum of Sq RSS AIC  
## - Time 1 0.0691 9.1273 -49.027  
## - LF 1 0.0727 9.1309 -49.009  
## - Pop 1 0.0944 9.1526 -48.897  
## - NW 1 0.1446 9.2028 -48.640  
## - M.F 1 0.2169 9.2751 -48.272  
## - Po2 1 0.2537 9.3119 -48.086  
## - Wealth 1 0.2622 9.3204 -48.043  
## <none> 9.0582 -47.384  
## - U1 1 0.6446 9.7028 -46.154  
## + So 1 0.0002 9.0580 -45.385  
## - Po1 1 0.9647 10.0229 -44.628  
## - U2 1 1.2692 10.3274 -43.221  
## - M 1 1.3042 10.3624 -43.062  
## - Prob 1 1.3669 10.4251 -42.779  
## - Ed 1 2.6950 11.7532 -37.143  
## - Ineq 1 3.2679 12.3261 -34.906  
##   
## Step: AIC=-49.03  
## Crime ~ M + Ed + Po1 + Po2 + LF + M.F + Pop + NW + U1 + U2 +   
## Wealth + Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## - LF 1 0.0704 9.1977 -50.666  
## - NW 1 0.1035 9.2308 -50.497  
## - Pop 1 0.1460 9.2734 -50.281  
## - Po2 1 0.1934 9.3207 -50.042  
## - Wealth 1 0.2411 9.3685 -49.802  
## - M.F 1 0.2793 9.4067 -49.610  
## <none> 9.1273 -49.027  
## - U1 1 0.6112 9.7385 -47.981  
## + Time 1 0.0691 9.0582 -47.384  
## + So 1 0.0004 9.1269 -47.029  
## - Po1 1 0.8967 10.0241 -46.623  
## - U2 1 1.2310 10.3584 -45.081  
## - M 1 1.2442 10.3715 -45.021  
## - Prob 1 1.5877 10.7150 -43.490  
## - Ed 1 2.7372 11.8645 -38.700  
## - Ineq 1 3.3620 12.4893 -36.288  
##   
## Step: AIC=-50.67  
## Crime ~ M + Ed + Po1 + Po2 + M.F + Pop + NW + U1 + U2 + Wealth +   
## Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## - NW 1 0.0780 9.2758 -52.269  
## - Po2 1 0.1432 9.3409 -51.940  
## - Pop 1 0.1859 9.3836 -51.726  
## - M.F 1 0.2089 9.4067 -51.610  
## - Wealth 1 0.2342 9.4320 -51.484  
## <none> 9.1977 -50.666  
## - U1 1 0.5412 9.7389 -49.979  
## + LF 1 0.0704 9.1273 -49.027  
## + Time 1 0.0668 9.1309 -49.009  
## + So 1 0.0204 9.1774 -48.770  
## - Po1 1 0.8283 10.0260 -48.613  
## - U2 1 1.2752 10.4729 -46.564  
## - M 1 1.4555 10.6532 -45.761  
## - Prob 1 1.5173 10.7151 -45.489  
## - Ed 1 2.7627 11.9604 -40.322  
## - Ineq 1 3.3489 12.5466 -38.073  
##   
## Step: AIC=-52.27  
## Crime ~ M + Ed + Po1 + Po2 + M.F + Pop + U1 + U2 + Wealth + Ineq +   
## Prob  
##   
## Df Sum of Sq RSS AIC  
## - Po2 1 0.1117 9.3875 -53.706  
## - Pop 1 0.1724 9.4482 -53.403  
## - M.F 1 0.1791 9.4549 -53.370  
## - Wealth 1 0.2109 9.4867 -53.212  
## <none> 9.2758 -52.269  
## - U1 1 0.5608 9.8365 -51.510  
## + NW 1 0.0780 9.1977 -50.666  
## + So 1 0.0482 9.2276 -50.514  
## + LF 1 0.0450 9.2308 -50.497  
## + Time 1 0.0303 9.2455 -50.423  
## - Po1 1 0.7912 10.0670 -50.422  
## - U2 1 1.3467 10.6225 -47.897  
## - Prob 1 1.4491 10.7249 -47.446  
## - M 1 2.0671 11.3429 -44.813  
## - Ed 1 2.6925 11.9683 -42.291  
## - Ineq 1 3.9425 13.2183 -37.622  
##   
## Step: AIC=-53.71  
## Crime ~ M + Ed + Po1 + M.F + Pop + U1 + U2 + Wealth + Ineq +   
## Prob  
##   
## Df Sum of Sq RSS AIC  
## - Pop 1 0.1494 9.5369 -54.964  
## - Wealth 1 0.2149 9.6024 -54.643  
## - M.F 1 0.2461 9.6335 -54.490  
## <none> 9.3875 -53.706  
## - U1 1 0.5774 9.9649 -52.901  
## + Po2 1 0.1117 9.2758 -52.269  
## + NW 1 0.0465 9.3409 -51.940  
## + So 1 0.0254 9.3620 -51.834  
## + LF 1 0.0133 9.3742 -51.773  
## + Time 1 0.0038 9.3836 -51.725  
## - U2 1 1.3759 10.7634 -49.278  
## - Prob 1 1.4614 10.8489 -48.906  
## - M 1 2.0523 11.4398 -46.413  
## - Ed 1 2.6039 11.9914 -44.200  
## - Ineq 1 4.0688 13.4562 -38.783  
## - Po1 1 7.0208 16.4082 -29.461  
##   
## Step: AIC=-54.96  
## Crime ~ M + Ed + Po1 + M.F + U1 + U2 + Wealth + Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## - Wealth 1 0.1771 9.7140 -56.099  
## <none> 9.5369 -54.964  
## - M.F 1 0.5648 10.1017 -54.260  
## - U1 1 0.6649 10.2018 -53.797  
## + Pop 1 0.1494 9.3875 -53.706  
## + Po2 1 0.0886 9.4482 -53.403  
## + NW 1 0.0396 9.4972 -53.160  
## + So 1 0.0383 9.4986 -53.153  
## + LF 1 0.0346 9.5023 -53.135  
## + Time 1 0.0262 9.5107 -53.093  
## - Prob 1 1.3275 10.8643 -50.839  
## - U2 1 1.3964 10.9333 -50.542  
## - M 1 2.1454 11.6823 -47.427  
## - Ed 1 2.5856 12.1225 -45.689  
## - Ineq 1 3.9762 13.5130 -40.585  
## - Po1 1 7.5360 17.0729 -29.595  
##   
## Step: AIC=-56.1  
## Crime ~ M + Ed + Po1 + M.F + U1 + U2 + Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## <none> 9.7140 -56.099  
## + Wealth 1 0.1771 9.5369 -54.964  
## - M.F 1 0.6896 10.4036 -54.876  
## + Pop 1 0.1116 9.6024 -54.643  
## + Po2 1 0.0946 9.6194 -54.559  
## + So 1 0.0624 9.6516 -54.402  
## + LF 1 0.0292 9.6847 -54.241  
## + NW 1 0.0254 9.6886 -54.222  
## + Time 1 0.0153 9.6986 -54.174  
## - U1 1 0.8493 10.5633 -54.160  
## - Prob 1 1.6578 11.3717 -50.694  
## - U2 1 1.7077 11.4216 -50.488  
## - M 1 1.9841 11.6981 -49.364  
## - Ed 1 2.9802 12.6941 -45.523  
## - Ineq 1 4.9353 14.6492 -38.791  
## - Po1 1 11.1778 20.8918 -22.107

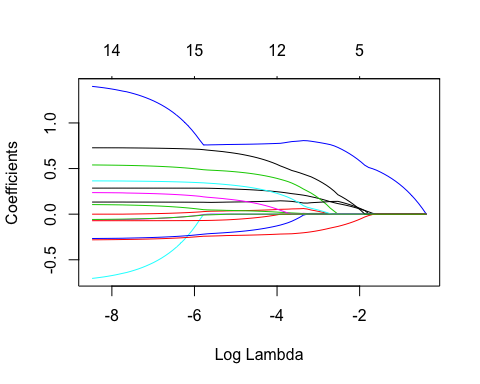
#testing ANOVA  
model.step.aic = stepAIC(model.lm, direction="both")

## Start: AIC=-45.39  
## Crime ~ M + So + Ed + Po1 + Po2 + LF + M.F + Pop + NW + U1 +   
## U2 + Wealth + Ineq + Prob + Time  
##   
## Df Sum of Sq RSS AIC  
## - So 1 0.00019 9.0582 -47.384  
## - LF 1 0.05961 9.1176 -47.077  
## - Time 1 0.06888 9.1269 -47.029  
## - Pop 1 0.09441 9.1524 -46.898  
## - NW 1 0.12298 9.1810 -46.752  
## - M.F 1 0.21371 9.2717 -46.289  
## - Wealth 1 0.25145 9.3095 -46.099  
## - Po2 1 0.25350 9.3115 -46.088  
## <none> 9.0580 -45.385  
## - U1 1 0.55970 9.6177 -44.567  
## - Po1 1 0.96471 10.0227 -42.629  
## - U2 1 1.21360 10.2716 -41.476  
## - M 1 1.29538 10.3534 -41.103  
## - Prob 1 1.33394 10.3920 -40.928  
## - Ed 1 2.68821 11.7462 -35.171  
## - Ineq 1 2.82803 11.8860 -34.615  
##   
## Step: AIC=-47.38  
## Crime ~ M + Ed + Po1 + Po2 + LF + M.F + Pop + NW + U1 + U2 +   
## Wealth + Ineq + Prob + Time  
##   
## Df Sum of Sq RSS AIC  
## - Time 1 0.0691 9.1273 -49.027  
## - LF 1 0.0727 9.1309 -49.009  
## - Pop 1 0.0944 9.1526 -48.897  
## - NW 1 0.1446 9.2028 -48.640  
## - M.F 1 0.2169 9.2751 -48.272  
## - Po2 1 0.2537 9.3119 -48.086  
## - Wealth 1 0.2622 9.3204 -48.043  
## <none> 9.0582 -47.384  
## - U1 1 0.6446 9.7028 -46.154  
## + So 1 0.0002 9.0580 -45.385  
## - Po1 1 0.9647 10.0229 -44.628  
## - U2 1 1.2692 10.3274 -43.221  
## - M 1 1.3042 10.3624 -43.062  
## - Prob 1 1.3669 10.4251 -42.779  
## - Ed 1 2.6950 11.7532 -37.143  
## - Ineq 1 3.2679 12.3261 -34.906  
##   
## Step: AIC=-49.03  
## Crime ~ M + Ed + Po1 + Po2 + LF + M.F + Pop + NW + U1 + U2 +   
## Wealth + Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## - LF 1 0.0704 9.1977 -50.666  
## - NW 1 0.1035 9.2308 -50.497  
## - Pop 1 0.1460 9.2734 -50.281  
## - Po2 1 0.1934 9.3207 -50.042  
## - Wealth 1 0.2411 9.3685 -49.802  
## - M.F 1 0.2793 9.4067 -49.610  
## <none> 9.1273 -49.027  
## - U1 1 0.6112 9.7385 -47.981  
## + Time 1 0.0691 9.0582 -47.384  
## + So 1 0.0004 9.1269 -47.029  
## - Po1 1 0.8967 10.0241 -46.623  
## - U2 1 1.2310 10.3584 -45.081  
## - M 1 1.2442 10.3715 -45.021  
## - Prob 1 1.5877 10.7150 -43.490  
## - Ed 1 2.7372 11.8645 -38.700  
## - Ineq 1 3.3620 12.4893 -36.288  
##   
## Step: AIC=-50.67  
## Crime ~ M + Ed + Po1 + Po2 + M.F + Pop + NW + U1 + U2 + Wealth +   
## Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## - NW 1 0.0780 9.2758 -52.269  
## - Po2 1 0.1432 9.3409 -51.940  
## - Pop 1 0.1859 9.3836 -51.726  
## - M.F 1 0.2089 9.4067 -51.610  
## - Wealth 1 0.2342 9.4320 -51.484  
## <none> 9.1977 -50.666  
## - U1 1 0.5412 9.7389 -49.979  
## + LF 1 0.0704 9.1273 -49.027  
## + Time 1 0.0668 9.1309 -49.009  
## + So 1 0.0204 9.1774 -48.770  
## - Po1 1 0.8283 10.0260 -48.613  
## - U2 1 1.2752 10.4729 -46.564  
## - M 1 1.4555 10.6532 -45.761  
## - Prob 1 1.5173 10.7151 -45.489  
## - Ed 1 2.7627 11.9604 -40.322  
## - Ineq 1 3.3489 12.5466 -38.073  
##   
## Step: AIC=-52.27  
## Crime ~ M + Ed + Po1 + Po2 + M.F + Pop + U1 + U2 + Wealth + Ineq +   
## Prob  
##   
## Df Sum of Sq RSS AIC  
## - Po2 1 0.1117 9.3875 -53.706  
## - Pop 1 0.1724 9.4482 -53.403  
## - M.F 1 0.1791 9.4549 -53.370  
## - Wealth 1 0.2109 9.4867 -53.212  
## <none> 9.2758 -52.269  
## - U1 1 0.5608 9.8365 -51.510  
## + NW 1 0.0780 9.1977 -50.666  
## + So 1 0.0482 9.2276 -50.514  
## + LF 1 0.0450 9.2308 -50.497  
## + Time 1 0.0303 9.2455 -50.423  
## - Po1 1 0.7912 10.0670 -50.422  
## - U2 1 1.3467 10.6225 -47.897  
## - Prob 1 1.4491 10.7249 -47.446  
## - M 1 2.0671 11.3429 -44.813  
## - Ed 1 2.6925 11.9683 -42.291  
## - Ineq 1 3.9425 13.2183 -37.622  
##   
## Step: AIC=-53.71  
## Crime ~ M + Ed + Po1 + M.F + Pop + U1 + U2 + Wealth + Ineq +   
## Prob  
##   
## Df Sum of Sq RSS AIC  
## - Pop 1 0.1494 9.5369 -54.964  
## - Wealth 1 0.2149 9.6024 -54.643  
## - M.F 1 0.2461 9.6335 -54.490  
## <none> 9.3875 -53.706  
## - U1 1 0.5774 9.9649 -52.901  
## + Po2 1 0.1117 9.2758 -52.269  
## + NW 1 0.0465 9.3409 -51.940  
## + So 1 0.0254 9.3620 -51.834  
## + LF 1 0.0133 9.3742 -51.773  
## + Time 1 0.0038 9.3836 -51.725  
## - U2 1 1.3759 10.7634 -49.278  
## - Prob 1 1.4614 10.8489 -48.906  
## - M 1 2.0523 11.4398 -46.413  
## - Ed 1 2.6039 11.9914 -44.200  
## - Ineq 1 4.0688 13.4562 -38.783  
## - Po1 1 7.0208 16.4082 -29.461  
##   
## Step: AIC=-54.96  
## Crime ~ M + Ed + Po1 + M.F + U1 + U2 + Wealth + Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## - Wealth 1 0.1771 9.7140 -56.099  
## <none> 9.5369 -54.964  
## - M.F 1 0.5648 10.1017 -54.260  
## - U1 1 0.6649 10.2018 -53.797  
## + Pop 1 0.1494 9.3875 -53.706  
## + Po2 1 0.0886 9.4482 -53.403  
## + NW 1 0.0396 9.4972 -53.160  
## + So 1 0.0383 9.4986 -53.153  
## + LF 1 0.0346 9.5023 -53.135  
## + Time 1 0.0262 9.5107 -53.093  
## - Prob 1 1.3275 10.8643 -50.839  
## - U2 1 1.3964 10.9333 -50.542  
## - M 1 2.1454 11.6823 -47.427  
## - Ed 1 2.5856 12.1225 -45.689  
## - Ineq 1 3.9762 13.5130 -40.585  
## - Po1 1 7.5360 17.0729 -29.595  
##   
## Step: AIC=-56.1  
## Crime ~ M + Ed + Po1 + M.F + U1 + U2 + Ineq + Prob  
##   
## Df Sum of Sq RSS AIC  
## <none> 9.7140 -56.099  
## + Wealth 1 0.1771 9.5369 -54.964  
## - M.F 1 0.6896 10.4036 -54.876  
## + Pop 1 0.1116 9.6024 -54.643  
## + Po2 1 0.0946 9.6194 -54.559  
## + So 1 0.0624 9.6516 -54.402  
## + LF 1 0.0292 9.6847 -54.241  
## + NW 1 0.0254 9.6886 -54.222  
## + Time 1 0.0153 9.6986 -54.174  
## - U1 1 0.8493 10.5633 -54.160  
## - Prob 1 1.6578 11.3717 -50.694  
## - U2 1 1.7077 11.4216 -50.488  
## - M 1 1.9841 11.6981 -49.364  
## - Ed 1 2.9802 12.6941 -45.523  
## - Ineq 1 4.9353 14.6492 -38.791  
## - Po1 1 11.1778 20.8918 -22.107

model.step.aic$anova

## Stepwise Model Path   
## Analysis of Deviance Table  
##   
## Initial Model:  
## Crime ~ M + So + Ed + Po1 + Po2 + LF + M.F + Pop + NW + U1 +   
## U2 + Wealth + Ineq + Prob + Time  
##   
## Final Model:  
## Crime ~ M + Ed + Po1 + M.F + U1 + U2 + Ineq + Prob  
##   
##   
## Step Df Deviance Resid. Df Resid. Dev AIC  
## 1 31 9.058009 -45.38542  
## 2 - So 1 0.0001910216 32 9.058200 -47.38443  
## 3 - Time 1 0.0691288785 33 9.127329 -49.02710  
## 4 - LF 1 0.0704156967 34 9.197745 -50.66590  
## 5 - NW 1 0.0780466621 35 9.275791 -52.26876  
## 6 - Po2 1 0.1116843137 36 9.387476 -53.70625  
## 7 - Pop 1 0.1493820171 37 9.536858 -54.96423  
## 8 - Wealth 1 0.1771111995 38 9.713969 -56.09938

x = as.matrix(crime.scale[-16])  
y = as.matrix(crime.scale[16])  
  
  
  
# Lasso, ridge, elastic net cross validation  
  
model.lasso = glmnet(x = x, y = y,   
 family = 'gaussian', alpha = 1)  
  
  
#Results  
#Numbers of coefficients upper, lambda x, mse y  
plot(model.lasso, xvar = "lambda")



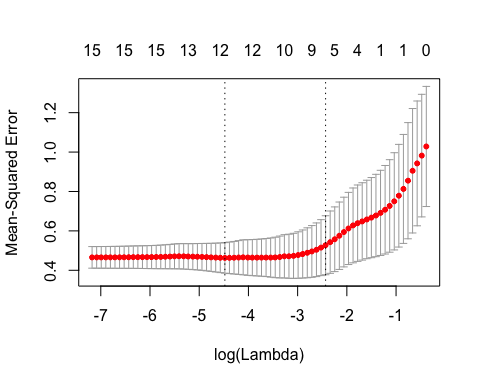
coef(model.lasso, s = model.lasso$lambda.min)

## 16 x 88 sparse Matrix of class "dgCMatrix"

## [[ suppressing 88 column names 's0', 's1', 's2' ... ]]

##   
## (Intercept) -1.465841e-16 -1.460278e-16 -1.455209e-16 -1.450591e-16  
## M . . . .   
## So . . . .   
## Ed . . . .   
## Po1 . 6.108488e-02 1.167432e-01 1.674569e-01  
## Po2 . . . .   
## LF . . . .   
## M.F . . . .   
## Pop . . . .   
## NW . . . .   
## U1 . . . .   
## U2 . . . .   
## Wealth . . . .   
## Ineq . . . .   
## Prob . . . .   
## Time . . . .   
##   
## (Intercept) -1.446382e-16 -1.442548e-16 -1.439054e-16 -1.435870e-16  
## M . . . .   
## So . . . .   
## Ed . . . .   
## Po1 2.136654e-01 2.557688e-01 2.941319e-01 3.290869e-01  
## Po2 . . . .   
## LF . . . .   
## M.F . . . .   
## Pop . . . .   
## NW . . . .   
## U1 . . . .   
## U2 . . . .   
## Wealth . . . .   
## Ineq . . . .   
## Prob . . . .   
## Time . . . .   
##   
## (Intercept) -1.432970e-16 -1.430327e-16 -1.427919e-16 -1.425724e-16  
## M . . . .   
## So . . . .   
## Ed . . . .   
## Po1 3.609366e-01 3.899569e-01 4.163991e-01 4.404922e-01  
## Po2 . . . .   
## LF . . . .   
## M.F . . . .   
## Pop . . . .   
## NW . . . .   
## U1 . . . .   
## U2 . . . .   
## Wealth . . . .   
## Ineq . . . .   
## Prob . . . .   
## Time . . . .   
##   
## (Intercept) -1.423725e-16 -1.421903e-16 -1.487712e-16 -1.617987e-16  
## M . . . 5.369483e-03  
## So . . . .   
## Ed . . . .   
## Po1 4.624450e-01 4.824475e-01 4.983904e-01 5.117919e-01  
## Po2 . . . .   
## LF . . . .   
## M.F . . 9.947910e-03 2.567674e-02  
## Pop . . . .   
## NW . . . .   
## U1 . . . .   
## U2 . . . .   
## Wealth . . . .   
## Ineq . . . .   
## Prob . . -4.123119e-03 -1.552643e-02  
## Time . . . .   
##   
## (Intercept) -1.886374e-16 -2.222194e-16 -2.528547e-16 -2.807552e-16  
## M 3.870868e-02 5.309193e-02 6.604337e-02 7.798625e-02  
## So . . . .   
## Ed . . . .   
## Po1 5.362635e-01 5.723862e-01 6.054400e-01 6.354735e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 4.018237e-02 5.875653e-02 7.573368e-02 9.116445e-02  
## Pop . . . .   
## NW . . . .   
## U1 . . . .   
## U2 . . . .   
## Wealth . . . .   
## Ineq . 3.943430e-02 7.558726e-02 1.083589e-01  
## Prob -3.037812e-02 -4.966918e-02 -6.722508e-02 -8.323537e-02  
## Time . . . .   
##   
## (Intercept) -3.061654e-16 -3.293185e-16 -3.504148e-16 -3.694731e-16  
## M 8.879298e-02 9.864001e-02 1.076123e-01 1.157874e-01  
## So . . . .   
## Ed . . . 1.884051e-04  
## Po1 6.628522e-01 6.877991e-01 7.105297e-01 7.311501e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 1.052353e-01 1.180562e-01 1.297381e-01 1.403030e-01  
## Pop . . . .   
## NW . . . .   
## U1 . . . .   
## U2 . . . .   
## Wealth . . . .   
## Ineq 1.382753e-01 1.655342e-01 1.903715e-01 2.130764e-01  
## Prob -9.781545e-02 -1.111003e-01 -1.232049e-01 -1.342423e-01  
## Time . . . .   
##   
## (Intercept) -3.647061e-16 -3.583455e-16 -3.464805e-16 -3.360968e-16  
## M 1.257430e-01 1.364218e-01 1.494782e-01 1.614566e-01  
## So . 7.360847e-04 1.080558e-02 2.082223e-02  
## Ed 3.324326e-02 6.651345e-02 1.067465e-01 1.425311e-01  
## Po1 7.488734e-01 7.622047e-01 7.709699e-01 7.789440e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 1.397168e-01 1.385868e-01 1.353634e-01 1.326629e-01  
## Pop . . . .   
## NW 2.127491e-03 6.923580e-03 7.823401e-03 8.163900e-03  
## U1 . . . .   
## U2 . 4.909071e-03 1.919877e-02 3.204789e-02  
## Wealth . . . .   
## Ineq 2.532281e-01 2.870115e-01 3.168773e-01 3.431307e-01  
## Prob -1.433736e-01 -1.524170e-01 -1.621758e-01 -1.712377e-01  
## Time . . . .   
##   
## (Intercept) -3.266856e-16 -3.181104e-16 -3.094884e-16 -2.982973e-16  
## M 1.723602e-01 1.822966e-01 1.913769e-01 2.007211e-01  
## So 2.985787e-02 3.809355e-02 4.579905e-02 5.617018e-02  
## Ed 1.751316e-01 2.048353e-01 2.316164e-01 2.538630e-01  
## Po1 7.863357e-01 7.930698e-01 7.994261e-01 8.046182e-01  
## Po2 . . . .   
## LF . . 1.238633e-03 7.469092e-03  
## M.F 1.301819e-01 1.279215e-01 1.253784e-01 1.214060e-01  
## Pop . . . .   
## NW 8.380552e-03 8.577376e-03 8.439516e-03 6.861683e-03  
## U1 . . . .   
## U2 4.374018e-02 5.439408e-02 6.453463e-02 7.576208e-02  
## Wealth . . . .   
## Ineq 3.672462e-01 3.892159e-01 4.093795e-01 4.243990e-01  
## Prob -1.794371e-01 -1.869089e-01 -1.934599e-01 -1.992222e-01  
## Time . . . .   
##   
## (Intercept) -2.943771e-16 -2.983091e-16 -3.016557e-16 -3.046715e-16  
## M 2.083090e-01 2.143137e-01 2.197813e-01 2.247676e-01  
## So 6.143352e-02 5.938496e-02 5.830696e-02 5.738635e-02  
## Ed 2.758070e-01 3.000769e-01 3.213600e-01 3.407168e-01  
## Po1 8.063720e-01 8.020148e-01 7.986546e-01 7.955957e-01  
## Po2 . . . .   
## LF 9.414414e-03 5.762247e-03 2.887387e-03 3.021195e-04  
## M.F 1.221930e-01 1.288092e-01 1.345463e-01 1.397577e-01  
## Pop . . . .   
## NW 6.355609e-03 9.368004e-03 1.148901e-02 1.340837e-02  
## U1 -1.076307e-02 -3.577858e-02 -5.754773e-02 -7.733692e-02  
## U2 9.343705e-02 1.207421e-01 1.447435e-01 1.665824e-01  
## Wealth . . . .   
## Ineq 4.393192e-01 4.538892e-01 4.669237e-01 4.787490e-01  
## Prob -2.039764e-01 -2.079189e-01 -2.115324e-01 -2.148360e-01  
## Time . . . .   
##   
## (Intercept) -3.074901e-16 -3.103874e-16 -3.129545e-16 -3.133367e-16  
## M 2.309848e-01 2.368530e-01 2.420757e-01 2.465627e-01  
## So 5.507658e-02 5.397527e-02 5.295032e-02 5.042014e-02  
## Ed 3.569551e-01 3.701484e-01 3.820119e-01 3.933085e-01  
## Po1 7.892436e-01 7.825085e-01 7.767127e-01 7.750817e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 1.425856e-01 1.447811e-01 1.464657e-01 1.445178e-01  
## Pop . . -9.083221e-04 -8.622515e-03  
## NW 1.598125e-02 1.822232e-02 2.022464e-02 2.306971e-02  
## U1 -9.390151e-02 -1.073457e-01 -1.195053e-01 -1.296086e-01  
## U2 1.858803e-01 2.017781e-01 2.162493e-01 2.295687e-01  
## Wealth 1.242575e-02 2.782691e-02 4.244624e-02 5.781035e-02  
## Ineq 4.961557e-01 5.130815e-01 5.291168e-01 5.479412e-01  
## Prob -2.160509e-01 -2.170651e-01 -2.181077e-01 -2.200107e-01  
## Time . . . .   
##   
## (Intercept) -3.138094e-16 -3.142308e-16 -3.146152e-16 -3.149655e-16  
## M 2.505483e-01 2.541835e-01 2.574941e-01 2.605084e-01  
## So 4.850116e-02 4.674977e-02 4.515873e-02 4.371560e-02  
## Ed 4.033644e-01 4.125514e-01 4.209180e-01 4.285369e-01  
## Po1 7.735709e-01 7.721855e-01 7.709252e-01 7.697799e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 1.429518e-01 1.415339e-01 1.402431e-01 1.390686e-01  
## Pop -1.546299e-02 -2.168851e-02 -2.736017e-02 -3.252669e-02  
## NW 2.542826e-02 2.758818e-02 2.955422e-02 3.134311e-02  
## U1 -1.387641e-01 -1.471333e-01 -1.547556e-01 -1.616968e-01  
## U2 2.415699e-01 2.525356e-01 2.625229e-01 2.716181e-01  
## Wealth 7.160073e-02 8.411750e-02 9.551875e-02 1.058998e-01  
## Ineq 5.647348e-01 5.800000e-01 5.939043e-01 6.065654e-01  
## Prob -2.217979e-01 -2.234308e-01 -2.249200e-01 -2.262789e-01  
## Time . . . .   
##   
## (Intercept) -3.152844e-16 -3.155748e-16 -3.158388e-16 -3.160786e-16  
## M 2.632526e-01 2.657502e-01 2.680230e-01 2.700905e-01  
## So 4.240729e-02 4.122200e-02 4.014910e-02 3.917902e-02  
## Ed 4.354745e-01 4.417910e-01 4.475416e-01 4.527764e-01  
## Po1 7.687395e-01 7.677946e-01 7.669372e-01 7.661597e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 1.380001e-01 1.370285e-01 1.361453e-01 1.353429e-01  
## Pop -3.723288e-02 -4.151960e-02 -4.542407e-02 -4.898014e-02  
## NW 3.297085e-02 3.445197e-02 3.579975e-02 3.702627e-02  
## U1 -1.680174e-01 -1.737725e-01 -1.790121e-01 -1.837816e-01  
## U2 2.799004e-01 2.874420e-01 2.943082e-01 3.005588e-01  
## Wealth 1.153505e-01 1.239529e-01 1.317809e-01 1.389017e-01  
## Ineq 6.180932e-01 6.285875e-01 6.381394e-01 6.468310e-01  
## Prob -2.275193e-01 -2.286519e-01 -2.296865e-01 -2.306323e-01  
## Time . . . .   
##   
## (Intercept) -3.164261e-16 -3.166270e-16 -3.168075e-16 -3.169715e-16  
## M 2.719011e-01 2.736089e-01 2.751650e-01 2.765794e-01  
## So 3.830128e-02 3.752564e-02 3.681096e-02 3.616710e-02  
## Ed 4.573892e-01 4.617094e-01 4.656575e-01 4.692482e-01  
## Po1 7.656205e-01 7.650043e-01 7.644342e-01 7.639208e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 1.345736e-01 1.339095e-01 1.333085e-01 1.327626e-01  
## Pop -5.233185e-02 -5.528182e-02 -5.796845e-02 -6.041533e-02  
## NW 3.796430e-02 3.896378e-02 3.988365e-02 4.071987e-02  
## U1 -1.880392e-01 -1.919650e-01 -1.955583e-01 -1.988246e-01  
## U2 3.061123e-01 3.112647e-01 3.159763e-01 3.202606e-01  
## Wealth 1.456921e-01 1.515767e-01 1.569261e-01 1.617894e-01  
## Ineq 6.551871e-01 6.623830e-01 6.689315e-01 6.748882e-01  
## Prob -2.314593e-01 -2.322522e-01 -2.329755e-01 -2.336374e-01  
## Time . . . .   
##   
## (Intercept) -3.171155e-16 -3.175001e-16 -3.177270e-16 -3.179885e-16  
## M 2.780147e-01 2.796905e-01 2.809979e-01 2.823311e-01  
## So 3.553718e-02 3.431198e-02 3.381973e-02 3.296149e-02  
## Ed 4.724557e-01 4.752143e-01 4.775428e-01 4.798922e-01  
## Po1 7.635040e-01 7.622323e-01 7.616035e-01 7.606867e-01  
## Po2 . . . .   
## LF . . . .   
## M.F 1.320827e-01 1.311250e-01 1.304618e-01 1.297632e-01  
## Pop -6.252660e-02 -6.411680e-02 -6.551911e-02 -6.684162e-02  
## NW 4.151610e-02 4.295821e-02 4.393970e-02 4.501316e-02  
## U1 -2.018168e-01 -2.049728e-01 -2.075236e-01 -2.101810e-01  
## U2 3.242001e-01 3.282070e-01 3.314973e-01 3.348574e-01  
## Wealth 1.662041e-01 1.713263e-01 1.748378e-01 1.786966e-01  
## Ineq 6.803189e-01 6.858792e-01 6.900246e-01 6.943435e-01  
## Prob -2.344990e-01 -2.361113e-01 -2.375701e-01 -2.388128e-01  
## Time -6.845437e-04 -2.665347e-03 -4.253191e-03 -5.767509e-03  
##   
## (Intercept) -3.183098e-16 -3.204461e-16 -3.220302e-16 -3.092099e-16  
## M 2.834650e-01 2.842335e-01 2.848985e-01 2.849671e-01  
## So 3.230554e-02 3.075310e-02 2.797934e-02 2.457911e-02  
## Ed 4.818075e-01 4.841922e-01 4.873763e-01 4.917930e-01  
## Po1 7.600610e-01 7.588239e-01 7.595837e-01 8.131146e-01  
## Po2 . . -3.320027e-03 -6.238935e-02  
## LF -3.670299e-05 -2.174018e-03 -5.012740e-03 -1.052120e-02  
## M.F 1.291136e-01 1.297524e-01 1.305851e-01 1.307988e-01  
## Pop -6.808607e-02 -6.890612e-02 -6.947080e-02 -6.987925e-02  
## NW 4.583804e-02 4.720623e-02 4.938949e-02 5.442931e-02  
## U1 -2.123677e-01 -2.154383e-01 -2.193124e-01 -2.236148e-01  
## U2 3.376290e-01 3.402012e-01 3.432623e-01 3.450458e-01  
## Wealth 1.822399e-01 1.855857e-01 1.899468e-01 1.960539e-01  
## Ineq 6.983460e-01 7.022820e-01 7.068486e-01 7.105986e-01  
## Prob -2.399513e-01 -2.411287e-01 -2.420455e-01 -2.452590e-01  
## Time -7.122194e-03 -8.331078e-03 -9.616500e-03 -1.387851e-02  
##   
## (Intercept) -2.948081e-16 -2.816649e-16 -2.696963e-16 -2.588104e-16  
## M 2.850174e-01 2.850629e-01 2.851044e-01 2.851425e-01  
## So 2.203148e-02 1.970874e-02 1.759287e-02 1.566635e-02  
## Ed 4.963750e-01 5.005533e-01 5.043592e-01 5.078240e-01  
## Po1 8.697180e-01 9.213688e-01 9.684053e-01 1.011193e+00  
## Po2 -1.241773e-01 -1.805567e-01 -2.319001e-01 -2.786073e-01  
## LF -1.559049e-02 -2.021373e-02 -2.442477e-02 -2.825770e-02  
## M.F 1.309785e-01 1.311417e-01 1.312905e-01 1.314266e-01  
## Pop -7.008828e-02 -7.027856e-02 -7.045199e-02 -7.061020e-02  
## NW 5.933925e-02 6.381805e-02 6.789723e-02 7.160930e-02  
## U1 -2.278044e-01 -2.316239e-01 -2.351033e-01 -2.382717e-01  
## U2 3.469555e-01 3.486953e-01 3.502805e-01 3.517252e-01  
## Wealth 1.998966e-01 2.033993e-01 2.065904e-01 2.094966e-01  
## Ineq 7.123039e-01 7.138558e-01 7.152704e-01 7.165612e-01  
## Prob -2.486984e-01 -2.518358e-01 -2.546933e-01 -2.572936e-01  
## Time -1.814620e-02 -2.203920e-02 -2.558484e-02 -2.881136e-02  
##   
## (Intercept) -2.489188e-16 -2.398597e-16 -2.316000e-16 -2.240879e-16  
## M 2.851777e-01 2.852090e-01 2.852375e-01 2.852636e-01  
## So 1.391290e-02 1.231186e-02 1.085256e-02 9.523711e-03  
## Ed 5.109766e-01 5.138564e-01 5.164813e-01 5.188708e-01  
## Po1 1.050079e+00 1.085680e+00 1.118139e+00 1.147664e+00  
## Po2 -3.210597e-01 -3.599200e-01 -3.953498e-01 -4.275786e-01  
## LF -3.174448e-02 -3.493114e-02 -3.783594e-02 -4.047990e-02  
## M.F 1.315512e-01 1.316637e-01 1.317661e-01 1.318597e-01  
## Pop -7.075462e-02 -7.088580e-02 -7.100528e-02 -7.111428e-02  
## NW 7.498496e-02 7.807203e-02 8.088625e-02 8.344716e-02  
## U1 -2.411558e-01 -2.437884e-01 -2.461876e-01 -2.483724e-01  
## U2 3.530420e-01 3.542410e-01 3.553334e-01 3.563290e-01  
## Wealth 2.121429e-01 2.145575e-01 2.167582e-01 2.187627e-01  
## Ineq 7.177399e-01 7.188097e-01 7.197842e-01 7.206736e-01  
## Prob -2.596583e-01 -2.618208e-01 -2.637921e-01 -2.655859e-01  
## Time -3.174542e-02 -3.442873e-02 -3.687487e-02 -3.910076e-02  
##   
## (Intercept) -2.172688e-16 -2.110100e-16 -2.053768e-16 -2.001477e-16  
## M 2.852878e-01 2.853092e-01 2.853299e-01 2.853472e-01  
## So 8.314490e-03 7.209321e-03 6.206800e-03 5.286810e-03  
## Ed 5.210441e-01 5.230317e-01 5.248321e-01 5.264877e-01  
## Po1 1.174472e+00 1.199065e+00 1.221220e+00 1.241758e+00  
## Po2 -4.568454e-01 -4.836887e-01 -5.078787e-01 -5.302919e-01  
## LF -4.288382e-02 -4.508369e-02 -4.707399e-02 -4.890722e-02  
## M.F 1.319456e-01 1.320229e-01 1.320951e-01 1.321586e-01  
## Pop -7.121383e-02 -7.130410e-02 -7.138694e-02 -7.146151e-02  
## NW 8.577449e-02 8.790626e-02 8.983206e-02 9.161007e-02  
## U1 -2.503607e-01 -2.521771e-01 -2.538257e-01 -2.553373e-01  
## U2 3.572366e-01 3.580631e-01 3.588175e-01 3.595036e-01  
## Wealth 2.205876e-01 2.222536e-01 2.237668e-01 2.251516e-01  
## Ineq 7.214866e-01 7.222232e-01 7.229009e-01 7.235091e-01  
## Prob -2.672159e-01 -2.687090e-01 -2.700575e-01 -2.713027e-01  
## Time -4.112347e-02 -4.297625e-02 -4.464965e-02 -4.619491e-02  
##   
## (Intercept) -1.954954e-16 -1.911923e-16 -1.872435e-16 -1.836398e-16  
## M 2.853649e-01 2.853800e-01 2.853933e-01 2.854054e-01  
## So 4.455855e-03 3.694865e-03 2.999679e-03 2.366176e-03  
## Ed 5.279795e-01 5.293486e-01 5.306007e-01 5.317427e-01  
## Po1 1.260060e+00 1.276970e+00 1.292478e+00 1.306629e+00  
## Po2 -5.502790e-01 -5.687373e-01 -5.856628e-01 -6.011057e-01  
## LF -5.055463e-02 -5.206854e-02 -5.345359e-02 -5.471652e-02  
## M.F 1.322193e-01 1.322731e-01 1.323214e-01 1.323654e-01  
## Pop -7.153032e-02 -7.159242e-02 -7.164868e-02 -7.169979e-02  
## NW 9.320336e-02 9.467029e-02 9.601365e-02 9.723896e-02  
## U1 -2.567045e-01 -2.579562e-01 -2.590997e-01 -2.601422e-01  
## U2 3.601314e-01 3.607022e-01 3.612223e-01 3.616963e-01  
## Wealth 2.264050e-01 2.275506e-01 2.285955e-01 2.295468e-01  
## Ineq 7.240733e-01 7.245807e-01 7.250399e-01 7.254568e-01  
## Prob -2.724182e-01 -2.734455e-01 -2.743864e-01 -2.752447e-01  
## Time -4.757897e-02 -4.885363e-02 -5.002094e-02 -5.108570e-02  
##   
## (Intercept) -1.804446e-16 -1.774602e-16 -1.747758e-16 -1.731350e-16  
## M 2.854180e-01 2.854281e-01 2.854380e-01 2.855739e-01  
## So 1.795995e-03 1.271454e-03 7.970977e-04 9.134709e-06  
## Ed 5.327702e-01 5.337165e-01 5.345738e-01 5.353907e-01  
## Po1 1.319196e+00 1.330915e+00 1.341462e+00 1.348861e+00  
## Po2 -6.148298e-01 -6.276202e-01 -6.391342e-01 -6.481716e-01  
## LF -5.584826e-02 -5.689471e-02 -5.784010e-02 -5.889040e-02  
## M.F 1.324078e-01 1.324443e-01 1.324785e-01 1.327824e-01  
## Pop -7.174687e-02 -7.178942e-02 -7.182822e-02 -7.166464e-02  
## NW 9.833369e-02 9.934853e-02 1.002643e-01 1.013957e-01  
## U1 -2.610840e-01 -2.619480e-01 -2.627321e-01 -2.638455e-01  
## U2 3.621308e-01 3.625239e-01 3.628835e-01 3.635015e-01  
## Wealth 2.304039e-01 2.311926e-01 2.319051e-01 2.334486e-01  
## Ineq 7.258424e-01 7.261887e-01 7.265048e-01 7.270515e-01  
## Prob -2.760117e-01 -2.767230e-01 -2.773652e-01 -2.778658e-01  
## Time -5.203669e-02 -5.291889e-02 -5.371492e-02 -5.445790e-02  
##   
## (Intercept) -1.707058e-16 -1.684404e-16 -1.664492e-16 -1.645955e-16  
## M 2.855666e-01 2.855471e-01 2.855308e-01 2.855150e-01  
## So . . . .   
## Ed 5.361002e-01 5.367345e-01 5.373031e-01 5.378264e-01  
## Po1 1.357566e+00 1.365716e+00 1.372886e+00 1.379558e+00  
## Po2 -6.576675e-01 -6.664877e-01 -6.742569e-01 -6.814805e-01  
## LF -5.953043e-02 -6.011408e-02 -6.063445e-02 -6.111482e-02  
## M.F 1.327475e-01 1.327229e-01 1.327054e-01 1.326871e-01  
## Pop -7.170476e-02 -7.173601e-02 -7.176329e-02 -7.178871e-02  
## NW 1.020210e-01 1.025834e-01 1.030820e-01 1.035436e-01  
## U1 -2.643453e-01 -2.647937e-01 -2.652008e-01 -2.655730e-01  
## U2 3.637193e-01 3.639081e-01 3.640851e-01 3.642442e-01  
## Wealth 2.340725e-01 2.345001e-01 2.348841e-01 2.352350e-01  
## Ineq 7.272184e-01 7.272832e-01 7.273472e-01 7.274019e-01  
## Prob -2.784360e-01 -2.789692e-01 -2.794429e-01 -2.798812e-01  
## Time -5.508981e-02 -5.567007e-02 -5.618447e-02 -5.666082e-02  
##   
## (Intercept) -1.628821e-16 -1.614254e-16 -1.599722e-16 -1.588429e-16  
## M 2.854997e-01 2.854881e-01 2.854751e-01 2.854717e-01  
## So . . . -1.272354e-04  
## Ed 5.383064e-01 5.387287e-01 5.391318e-01 5.394732e-01  
## Po1 1.385723e+00 1.390974e+00 1.396199e+00 1.400532e+00  
## Po2 -6.881507e-01 -6.938468e-01 -6.994970e-01 -7.042016e-01  
## LF -6.155628e-02 -6.194199e-02 -6.231340e-02 -6.267794e-02  
## M.F 1.326692e-01 1.326590e-01 1.326421e-01 1.326530e-01  
## Pop -7.181216e-02 -7.183203e-02 -7.185201e-02 -7.186545e-02  
## NW 1.039684e-01 1.043361e-01 1.046948e-01 1.050429e-01  
## U1 -2.659129e-01 -2.662179e-01 -2.665016e-01 -2.667971e-01  
## U2 3.643876e-01 3.645229e-01 3.646409e-01 3.647735e-01  
## Wealth 2.355529e-01 2.358389e-01 2.361070e-01 2.363407e-01  
## Ineq 7.274482e-01 7.274996e-01 7.275368e-01 7.276124e-01  
## Prob -2.802845e-01 -2.806348e-01 -2.809747e-01 -2.812518e-01  
## Time -5.709938e-02 -5.747880e-02 -5.784903e-02 -5.817274e-02

# Lasso cross validation  
  
model.lasso.cv = cv.glmnet(x = x, y = y,   
 family = 'gaussian', alpha = 1, nfolds = 5)  
  
  
#Results  
#suggest between 5 to 12 coerfficients  
plot(model.lasso.cv, xvar="lambda")



model.lasso.cv$lambda.min

## [1] 0.01134726

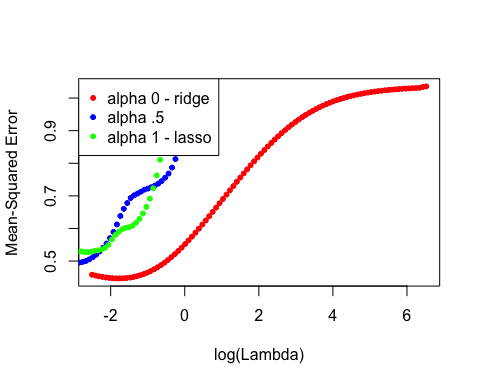
model.lasso.cv$lambda.1se

## [1] 0.08785769

coef(model.lasso.cv, s = model.lasso.cv$lambda.min) #best coefficients

## 16 x 1 sparse Matrix of class "dgCMatrix"  
## 1  
## (Intercept) -3.152844e-16  
## M 2.632526e-01  
## So 4.240729e-02  
## Ed 4.354745e-01  
## Po1 7.687395e-01  
## Po2 .   
## LF .   
## M.F 1.380001e-01  
## Pop -3.723288e-02  
## NW 3.297085e-02  
## U1 -1.680174e-01  
## U2 2.799004e-01  
## Wealth 1.153505e-01  
## Ineq 6.180932e-01  
## Prob -2.275193e-01  
## Time .

#alpha comparation  
  
  
# alpha comparison plots lasso, ridge, elastic net  
cv.alpha.0 = cv.glmnet(x = x, y = y,   
 family = 'gaussian', alpha = 0, nfolds = 5)  
cv.alpha.05 = cv.glmnet(x = x, y = y,   
 family = 'gaussian', alpha = 0.5, nfolds = 5)  
cv.alpha.1 = cv.glmnet(x = x, y = y,   
 family = 'gaussian', alpha = 1, nfolds = 5)  
  
# Elastic Net  
plot( log(cv.alpha.0$lambda), cv.alpha.0$cvm, pch = 20, col = "red", xlab = "log(Lambda)", ylab = cv.alpha.0$name)  
points(log(cv.alpha.05$lambda), cv.alpha.05$cvm, pch = 20, col = "blue")  
points(log(cv.alpha.1$lambda), cv.alpha.1$cvm, pch = 20, col="green")  
legend("topleft", legend = c("alpha 0 - ridge","alpha .5", "alpha 1 - lasso"), pch = 20, col = c("red", "blue", "green"))



### Q2

To determine if which type of music to listen when a person drive to home after work reduce stress. I suggest to evaluate if the driver start drives agressive, temperature, if taking longer than usual to arrive some destination (with gps historial data), car smell. We could evaluate to start playlist to calm down and manipulate car temperature and car smell.

### Q3

library('FrF2')

## Loading required package: DoE.base

## Loading required package: grid

## Loading required package: conf.design

##   
## Attaching package: 'DoE.base'

## The following objects are masked from 'package:stats':  
##   
## aov, lm

## The following object is masked from 'package:graphics':  
##   
## plot.design

## The following object is masked from 'package:base':  
##   
## lengths

features <- c('Feature 1','Feature 2','Feature 3','Feature 4','Feature 5', 'Feature 6','Feature 7','Feature 8','Feature 9','Feature 10')  
  
experiment <- FrF2(nruns = 16, factor.names = features)  
data.frame(experiment)

## Feature.1 Feature.2 Feature.3 Feature.4 Feature.5 Feature.6 Feature.7  
## 1 1 1 1 1 1 1 1  
## 2 -1 -1 -1 1 1 1 1  
## 3 1 -1 -1 1 -1 -1 1  
## 4 1 -1 1 -1 -1 1 -1  
## 5 1 -1 -1 -1 -1 -1 1  
## 6 -1 1 -1 1 -1 1 -1  
## 7 -1 1 -1 -1 -1 1 -1  
## 8 -1 -1 1 1 1 -1 -1  
## 9 -1 -1 -1 -1 1 1 1  
## 10 -1 1 1 1 -1 -1 1  
## 11 1 1 -1 1 1 -1 -1  
## 12 1 1 -1 -1 1 -1 -1  
## 13 -1 1 1 -1 -1 -1 1  
## 14 1 1 1 -1 1 1 1  
## 15 -1 -1 1 -1 1 -1 -1  
## 16 1 -1 1 1 -1 1 -1  
## Feature.8 Feature.9 Feature.10  
## 1 1 1 1  
## 2 -1 1 -1  
## 3 1 1 1  
## 4 -1 1 1  
## 5 -1 -1 -1  
## 6 -1 -1 1  
## 7 1 1 -1  
## 8 -1 -1 1  
## 9 1 -1 1  
## 10 -1 1 -1  
## 11 1 -1 -1  
## 12 -1 1 1  
## 13 1 -1 1  
## 14 -1 -1 -1  
## 15 1 1 -1  
## 16 1 -1 -1

### Q4

1. Binomial: The number of successful sales calls
2. Geometric: Expected number of trade win before a bad trade with a robot system
3. Poisson: The daily number of emergency calls in Dallas
4. Exponential: The length of time between arrivals at a service station
5. Weibull