Hw8

```r
crime <- read.delim("http://www.statsci.org/data/general/uscrime.txt")

intercept <- lm(Crime ~ 1, data = crime) #intercept model
stepwise <- lm(Crime ~., data = crime) #model with all predictors


#performing stepwise regression below
forward <- step(intercept, direction = 'forward', scope=formula(stepwise), trace = 0)
```

```r
forward$anova #Viewing results of forward stepwise regression
```

```
##     Step Df  Deviance Resid. Df Resid. Dev      AIC
## 1          NA        NA        46    6880928 561.0235
## 2  + Po1 -1 3253301.8        45    3627626 532.9352
## 3 + Ineq -1  739818.6        44    2887807 524.2154
## 4   + Ed -1  587049.8        43    2300757 515.5343
## 5    + M -1  239404.6        42    2061353 512.3701
## 6 + Prob -1  258062.5        41    1803290 508.0839
## 7   + U2 -1  192233.4        40    1611057 504.7859
```

```r
forward$coefficients #Looking at coefficients of final model
```

```
## (Intercept)         Po1        Ineq          Ed           M        Prob
## -5040.50498   115.02419    67.65322   196.47120   105.01957 -3801.83628
##          U2
##    89.36604
```

Including in the variables above in our model that had significant reduction in AIC compared to intercept only model.

```r
backward <- step(stepwise, direction = "backward", scope=formula(stepwise), trace = 0)

backward$anova
```

```
##       Step Df    Deviance Resid. Df Resid. Dev      AIC
## 1           NA          NA        31    1354946 514.6488
## 2     - So  1    28.57405        32    1354974 512.6498
## 3   - Time  1 10340.66984        33    1365315 511.0072
## 4     - LF  1 10533.15902        34    1375848 509.3684
## 5     - NW  1 11674.63991        35    1387523 507.7655
## 6    - Po2  1 16706.34095        36    1404229 506.3280
## 7    - Pop  1 22345.36638        37    1426575 505.0700
## 8 - Wealth  1 26493.24677        38    1453068 503.9349
```

```r
backward$coefficients #showing coefficients of backward stepwise regression
```

```
## (Intercept)           M          Ed         Po1         M.F          U1
## -6426.10102    93.32155   180.12011   102.65316    22.33975 -6086.63315
##          U2        Ineq        Prob
##   187.34512    61.33494 -3796.03183
```

```r
#Doing both direction stepwise function
both <- step(intercept, direction = 'both', scope = formula(stepwise), trace=0)

both$anova
```

```
##     Step Df  Deviance Resid. Df Resid. Dev      AIC
## 1        NA        NA        46    6880928 561.0235
## 2  + Po1 -1 3253301.8        45    3627626 532.9352
## 3 + Ineq -1  739818.6        44    2887807 524.2154
## 4   + Ed -1  587049.8        43    2300757 515.5343
## 5    + M -1  239404.6        42    2061353 512.3701
## 6 + Prob -1  258062.5        41    1803290 508.0839
## 7   + U2 -1  192233.4        40    1611057 504.7859
```

```r
both$coefficients
```

```
## (Intercept)         Po1        Ineq          Ed           M        Prob
## -5040.50498   115.02419    67.65322   196.47120   105.01957 -3801.83628
##          U2
##    89.36604
```

This is final model coeffcients for Step wise regression. Using coefficients with reduction in AIC and low AIC. The coefficients above are the most significant predictors according to the stepwise regression model.

Now we will do Lasso Regression on the dataset.

```r
y <- crime %>%
      select(Crime) %>%
      as.matrix()
      # Response variable


#Defining matrix of predictor variables
x <- data.matrix(crime[,c('M','So','Ed', 'Po1', 'Po2', 'LF', 'M.F', 'Pop', 'NW','U1', 'U2', 'Wealth', '

y <- scale(y,scale = TRUE)
x <- scale(x,scale = TRUE)

cv_model <- cv.glmnet(x,y, alpha = 1)

lambda1 <- cv_model$lambda.min
lambda1
```

```
## [1] 0.0124536
```

This is the lambda value that minimizes the MSE.

```
lasso <- glmnet(x, y, alpha = 1, lambda = lambda1)
coef(lasso)
```

```
## 16 x 1 sparse Matrix of class "dgCMatrix"
##                        s0
## (Intercept) -3.153700e-16
## M            2.600107e-01
## So           4.375585e-02
## Ed           4.268717e-01
## Po1          7.690342e-01
## Po2          .
## LF           .
## M.F          1.388609e-01
## Pop         -3.277107e-02
## NW           3.193554e-02
## U1          -1.602861e-01
## U2           2.699039e-01
## Wealth       1.088639e-01
## Ineq         6.074496e-01
## Prob        -2.263322e-01
## Time         .
```

Looking at the coefficients above, you can see that some of the variables don't have coeff values since lasso reg shrunk those values to zero. This is because Lasso didn't think these variables were important enough.

Now doing Elastic Net regression below.

```
traincontrol <- trainControl(method = "repeatedcv", number = 5, repeats = 5, search = "random", verbosel

invisible(elastic <- train(Crime ~., data = cbind(y,x), method = "glmnet", preProcess = c("center", "sca
```

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## + Fold1.Rep1: alpha=0.15605, lambda=0.398372
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```

```
## Warning in nominalTrainWorkflow(x = x, y = y, wts = weights, info = trainInfo, :
## There were missing values in resampled performance measures.
```

```
## Aggregating results
## Selecting tuning parameters
## Fitting alpha = 0.118, lambda = 0.0831 on full training set
```

```
elastic
```

```
## glmnet
```

```
##
## 47 samples
## 15 predictors
##
## Pre-processing: centered (15), scaled (15)
## Resampling: Cross-Validated (5 fold, repeated 5 times)
## Summary of sample sizes: 37, 38, 38, 37, 38, 37, ...
## Resampling results across tuning parameters:
##
##   alpha       lambda       RMSE       Rsquared   MAE
##   0.05946093  0.001203437  0.7435215  0.5015924  0.5845416
##   0.09134797  4.797303665  0.9431639  0.4833492  0.7227831
##   0.11809201  0.083065279  0.6971050  0.5149562  0.5712103
##   0.12381883  0.244664216  0.7302252  0.4873365  0.5878876
##   0.14076318  0.017993898  0.7087425  0.5206701  0.5726574
##   0.15201310  2.115407332  0.8898718  0.4606912  0.6822672
##   0.15605003  0.398372258  0.7721924  0.4596281  0.6120125
##   0.17557005  0.029738924  0.7014909  0.5208052  0.5700595
##   0.26330051  0.198213618  0.7464897  0.4734427  0.5986102
##   0.39539398  0.093520937  0.7262130  0.4813335  0.5876340
##   0.41314853  2.450918753  0.9816553        NaN  0.7582951
##   0.45543429  0.259950020  0.7977067  0.4416801  0.6306483
##   0.54813593  1.497670277  0.9815152  0.1604286  0.7581487
##   0.64264370  0.942627734  0.9559041  0.4165017  0.7349939
##   0.71521449  0.028772025  0.7135306  0.4929724  0.5779849
##   0.73483231  0.001937112  0.7386699  0.5024584  0.5820411
##   0.74610159  0.005242536  0.7220968  0.5122142  0.5753759
##   0.79847490  0.223218297  0.8087688  0.4378922  0.6394341
##   0.83315084  7.311530621  0.9816553        NaN  0.7582951
##   0.86816845  0.793431990  0.9742780  0.2948805  0.7510761
##   0.86951064  0.004494777  0.7242968  0.5105405  0.5757675
##   0.89122856  1.278851252  0.9816553        NaN  0.7582951
##   0.96599411  4.376947657  0.9816553        NaN  0.7582951
##   0.96839394  0.073855204  0.7441068  0.4747827  0.5945904
##   0.98832488  0.012198480  0.7104151  0.5099044  0.5695970
##
## RMSE was used to select the optimal model using the smallest value.
## The final values used for the model were alpha = 0.118092 and lambda
##  = 0.08306528.
```

You can see different alpha values are used between 0 and 1 which indicates we are using the Elastic net regression. With the different alpha values we also got different R2 values so we see how accurate each Elastic net regression model fits the data. It seems it the model doesn't fit too well as the highest R2 value is 55%.