week5_hw.R

yangz

2022-09-29

```
# import the data
df <- read.delim("D:/GEORGIA INSTITUTE OF TECHNOLOGY/ISYE_6501/week5/hw5-SP22-1/data 8.2/uscrime.txt")
# set seed
set.seed(9876)
# check the head
head(df)
```

```
##      M So   Ed  Po1  Po2    LF   M.F Pop   NW    U1  U2 Wealth Ineq     Prob    Time Crime
## 1 15.1  1  9.1  5.8  5.6 0.510  95.0  33 30.1 0.108 4.1   3940 26.1 0.084602 26.2011   791
## 2 14.3  0 11.3 10.3  9.5 0.583 101.2  13 10.2 0.096 3.6   5570 19.4 0.029599 25.2999  1635
## 3 14.2  1  8.9  4.5  4.4 0.533  96.9  18 21.9 0.094 3.3   3180 25.0 0.083401 24.3006   578
## 4 13.6  0 12.1 14.9 14.1 0.577  99.4 157  8.0 0.102 3.9   6730 16.7 0.015801 29.9012  1969
## 5 14.1  0 12.1 10.9 10.1 0.591  98.5  18  3.0 0.091 2.0   5780 17.4 0.041399 21.2998  1234
## 6 12.1  0 11.0 11.8 11.5 0.547  96.4  25  4.4 0.084 2.9   6890 12.6 0.034201 20.9995   682
```

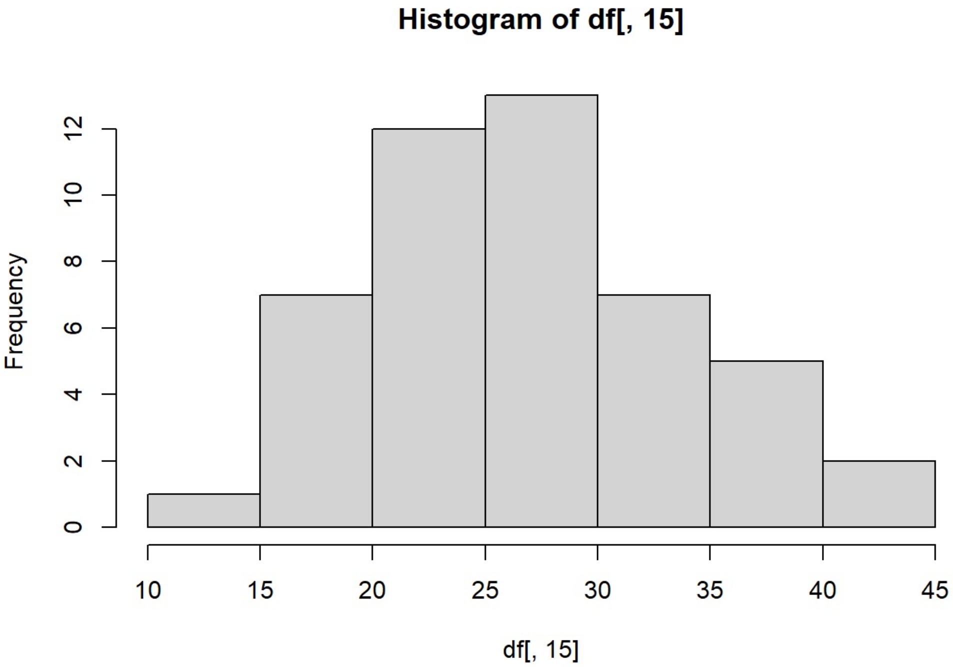
```
# check the summary
summary(df)
```

```
##        M               So               Ed             Po1             Po2              LF              M.F       
Pop              NW        
##  Min.   :11.90   Min.   :0.0000   Min.   : 8.70   Min.   : 4.50   Min.   : 4.100   Min.   :0.4800   Min.   : 9
3.40   Min.   :  3.00   Min.   : 0.20  
##  1st Qu.:13.00   1st Qu.:0.0000   1st Qu.: 9.75   1st Qu.: 6.25   1st Qu.: 5.850   1st Qu.:0.5305   1st Qu.: 9
6.45   1st Qu.: 10.00   1st Qu.: 2.40  
##  Median :13.60   Median :0.0000   Median :10.80   Median : 7.80   Median : 7.300   Median :0.5600   Median : 9
7.70   Median : 25.00   Median : 7.60  
##  Mean   :13.86   Mean   :0.3404   Mean   :10.56   Mean   : 8.50   Mean   : 8.023   Mean   :0.5612   Mean   : 9
8.30   Mean   : 36.62   Mean   :10.11  
##  3rd Qu.:14.60   3rd Qu.:1.0000   3rd Qu.:11.45   3rd Qu.:10.45   3rd Qu.: 9.700   3rd Qu.:0.5930   3rd Qu.: 9
9.20   3rd Qu.: 41.50   3rd Qu.:13.25  
##  Max.   :17.70   Max.   :1.0000   Max.   :12.20   Max.   :16.60   Max.   :15.700   Max.   :0.6410   Max.   :10
7.10   Max.   :168.00   Max.   :42.30  
##        U1                U2            Wealth          Ineq             Prob              Time           Crime       
##  Min.   :0.07000   Min.   :2.000   Min.   :2880   Min.   :12.60   Min.   :0.00690   Min.   :12.20   Min.   : 3
42.0  
##  1st Qu.:0.08050   1st Qu.:2.750   1st Qu.:4595   1st Qu.:16.55   1st Qu.:0.03270   1st Qu.:21.60   1st Qu.: 6
58.5  
##  Median :0.09200   Median :3.400   Median :5370   Median :17.60   Median :0.04210   Median :25.80   Median : 8
31.0  
##  Mean   :0.09547   Mean   :3.398   Mean   :5254   Mean   :19.40   Mean   :0.04709   Mean   :26.60   Mean   : 9
05.1  
##  3rd Qu.:0.10400   3rd Qu.:3.850   3rd Qu.:5915   3rd Qu.:22.75   3rd Qu.:0.05445   3rd Qu.:30.45   3rd Qu.:10
57.5  
##  Max.   :0.14200   Max.   :5.800   Max.   :6890   Max.   :27.60   Max.   :0.11980   Max.   :44.00   Max.   :19
93.0  
```

```
# 
dim(df)
```

```
## [1] 47 16
```

```
# 
hist(df[,15])
```



```
# calculate the sum of squares total
SST <- sum((df$Crime - mean(df$Crime))^2)
# build up general linear model
glm_model <- glm(Crime ~ . , data=df, family="gaussian")
# check the factors used and coefficients
summary(glm_model)
```

```
##
## Call:
## glm(formula = Crime ~ ., family = "gaussian", data = df)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -395.74   -98.09    -6.69   112.99   512.67
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -5.984e+03  1.628e+03  -3.675 0.000893 ***
## M            8.783e+01  4.171e+01   2.106 0.043443 *
## So          -3.803e+00  1.488e+02  -0.026 0.979765
## Ed           1.883e+02  6.209e+01   3.033 0.004861 **
## Po1          1.928e+02  1.061e+02   1.817 0.078892 .
## Po2         -1.094e+02  1.175e+02  -0.931 0.358830
## LF          -6.638e+02  1.470e+03  -0.452 0.654654
## M.F          1.741e+01  2.035e+01   0.855 0.398995
## Pop         -7.330e-01  1.290e+00  -0.568 0.573845
## NW           4.204e+00  6.481e+00   0.649 0.521279
## U1          -5.827e+03  4.210e+03  -1.384 0.176238
## U2           1.678e+02  8.234e+01   2.038 0.050161 .
## Wealth       9.617e-02  1.037e-01   0.928 0.360754
## Ineq         7.067e+01  2.272e+01   3.111 0.003983 **
## Prob        -4.855e+03  2.272e+03  -2.137 0.040627 *
## Time        -3.479e+00  7.165e+00  -0.486 0.630708
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 43707.93)
##
##     Null deviance: 6880928  on 46  degrees of freedom
## Residual deviance: 1354946  on 31  degrees of freedom
## AIC: 650.03
##
## Number of Fisher Scoring iterations: 2
```

```
# assign values to variable we need to predict
M <- 14.0
So <- 0
Ed <- 10.0
Po1 <- 12.0
Po2 <- 15.5
LF <- 0.640
M.F <- 94.0
Pop <- 150
NW <- 1.1
U1 <- 0.120
U2 <- 3.6
Wealth <- 3200
Ineq <- 20.1
Prob <- 0.04
Time <- 39.0
# fit the variable in glm
glm_model_revised <- glm(Crime ~ M + Ed + Po1 + U2 + Ineq + Prob , data=df, family="gaussian")
# check the factors
summary(glm_model_revised)
```

```
##
## Call:
## glm(formula = Crime ~ M + Ed + Po1 + U2 + Ineq + Prob, family = "gaussian",
##     data = df)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -470.68   -78.41   -19.68   133.12   556.23
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -5040.50     899.84  -5.602 1.72e-06 ***
## M             105.02      33.30   3.154  0.00305 **
## Ed            196.47      44.75   4.390 8.07e-05 ***
## Po1           115.02      13.75   8.363 2.56e-10 ***
## U2             89.37      40.91   2.185  0.03483 *
## Ineq           67.65      13.94   4.855 1.88e-05 ***
## Prob        -3801.84    1528.10  -2.488  0.01711 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 40276.42)
##
##     Null deviance: 6880928  on 46  degrees of freedom
## Residual deviance: 1611057  on 40  degrees of freedom
## AIC: 640.17
##
## Number of Fisher Scoring iterations: 2
```

```
# used cross validation with k=9
glm_cv <- cv.glm(df,glm_model,K=9)
glmr_cv <- cv.glm(df,glm_model_revised,K=9)
# calculate the cross-validated prediction error
glm_cv$delta
```

```
## [1] 79190.22 75568.42
```

```
# calculate R square
1 - glm_cv$delta[1]*nrow(df)/SST
```

```
## [1] 0.4590932
```

```
1 - glmr_cv$delta[1]*nrow(df)/SST
```

```
## [1] 0.6544089
```

```
# calculate adjusted R square
1 - glm_cv$delta[2]*nrow(df)/SST
```

```
## [1] 0.4838319
```

```
1 - glmr_cv$delta[2]*nrow(df)/SST
```

```
## [1] 0.6617965
```

```
# predict using glm
test_data <-data.frame(M = 14.0,So = 0, Ed = 10.0, Po1 = 12.0, Po2 = 15.5,LF = 0.640, M.F = 94.0, Pop = 150, NW = 1.1, U1 = 0.120, U2 = 3.6, Wealth = 3200, Ineq = 20.1, Prob = 0.040,Time = 39.0)
pred_model <- predict(glm_model, test_data)
pred_model
```

```
##        1
## 155.4349
```

```
pred_revised_model <- predict(glm_model_revised, test_data)
pred_revised_model
```

```
##        1
## 1304.245
```