Final Project For Churn Prediction

Kedar

July 9, 2018

library(readr)  
Churn<-read.csv("E:\\Kedar Business\\Acadgild\\KYD\\Project\\Churn.csv")

View(Churn)   
nrow(Churn)

## [1] 3333

head(Churn)

## Account.Length VMail.Message Day.Mins Eve.Mins Night.Mins Intl.Mins  
## 1 128 25 265.1 197.4 244.7 10.0  
## 2 107 26 161.6 195.5 254.4 13.7  
## 3 137 0 243.4 121.2 162.6 12.2  
## 4 84 0 299.4 61.9 196.9 6.6  
## 5 75 0 166.7 148.3 186.9 10.1  
## 6 118 0 223.4 220.6 203.9 6.3  
## CustServ.Calls Churn Int.l.Plan VMail.Plan Day.Calls Day.Charge  
## 1 1 0 0 1 110 45.07  
## 2 1 0 0 1 123 27.47  
## 3 0 0 0 0 114 41.38  
## 4 2 0 1 0 71 50.90  
## 5 3 0 1 0 113 28.34  
## 6 0 0 1 0 98 37.98  
## Eve.Calls Eve.Charge Night.Calls Night.Charge Intl.Calls Intl.Charge  
## 1 99 16.78 91 11.01 3 2.70  
## 2 103 16.62 103 11.45 3 3.70  
## 3 110 10.30 104 7.32 5 3.29  
## 4 88 5.26 89 8.86 7 1.78  
## 5 122 12.61 121 8.41 3 2.73  
## 6 101 18.75 118 9.18 6 1.70  
## State Area.Code Phone  
## 1 KS 415 382-4657  
## 2 OH 415 371-7191  
## 3 NJ 415 358-1921  
## 4 OH 408 375-9999  
## 5 OK 415 330-6626  
## 6 AL 510 391-8027

str(Churn)

## 'data.frame': 3333 obs. of 21 variables:  
## $ Account.Length: int 128 107 137 84 75 118 121 147 117 141 ...  
## $ VMail.Message : int 25 26 0 0 0 0 24 0 0 37 ...  
## $ Day.Mins : num 265 162 243 299 167 ...  
## $ Eve.Mins : num 197.4 195.5 121.2 61.9 148.3 ...  
## $ Night.Mins : num 245 254 163 197 187 ...  
## $ Intl.Mins : num 10 13.7 12.2 6.6 10.1 6.3 7.5 7.1 8.7 11.2 ...  
## $ CustServ.Calls: int 1 1 0 2 3 0 3 0 1 0 ...  
## $ Churn : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Int.l.Plan : int 0 0 0 1 1 1 0 1 0 1 ...  
## $ VMail.Plan : int 1 1 0 0 0 0 1 0 0 1 ...  
## $ Day.Calls : int 110 123 114 71 113 98 88 79 97 84 ...  
## $ Day.Charge : num 45.1 27.5 41.4 50.9 28.3 ...  
## $ Eve.Calls : int 99 103 110 88 122 101 108 94 80 111 ...  
## $ Eve.Charge : num 16.78 16.62 10.3 5.26 12.61 ...  
## $ Night.Calls : int 91 103 104 89 121 118 118 96 90 97 ...  
## $ Night.Charge : num 11.01 11.45 7.32 8.86 8.41 ...  
## $ Intl.Calls : int 3 3 5 7 3 6 7 6 4 5 ...  
## $ Intl.Charge : num 2.7 3.7 3.29 1.78 2.73 1.7 2.03 1.92 2.35 3.02 ...  
## $ State : Factor w/ 51 levels "AK","AL","AR",..: 17 36 32 36 37 2 20 25 19 50 ...  
## $ Area.Code : int 415 415 415 408 415 510 510 415 408 415 ...  
## $ Phone : Factor w/ 3333 levels "327-1058","327-1319",..: 1927 1576 1118 1708 111 2254 1048 81 292 118 ...

names(Churn)

## [1] "Account.Length" "VMail.Message" "Day.Mins" "Eve.Mins"   
## [5] "Night.Mins" "Intl.Mins" "CustServ.Calls" "Churn"   
## [9] "Int.l.Plan" "VMail.Plan" "Day.Calls" "Day.Charge"   
## [13] "Eve.Calls" "Eve.Charge" "Night.Calls" "Night.Charge"   
## [17] "Intl.Calls" "Intl.Charge" "State" "Area.Code"   
## [21] "Phone"

table(Churn$Churn)

##   
## 0 1   
## 2850 483

class(Churn)

## [1] "data.frame"

summary(Churn)

## Account.Length VMail.Message Day.Mins Eve.Mins   
## Min. : 1.0 Min. : 0.000 Min. : 0.0 Min. : 0.0   
## 1st Qu.: 74.0 1st Qu.: 0.000 1st Qu.:143.7 1st Qu.:166.6   
## Median :101.0 Median : 0.000 Median :179.4 Median :201.4   
## Mean :101.1 Mean : 8.099 Mean :179.8 Mean :201.0   
## 3rd Qu.:127.0 3rd Qu.:20.000 3rd Qu.:216.4 3rd Qu.:235.3   
## Max. :243.0 Max. :51.000 Max. :350.8 Max. :363.7   
##   
## Night.Mins Intl.Mins CustServ.Calls Churn   
## Min. : 23.2 Min. : 0.00 Min. :0.000 Min. :0.0000   
## 1st Qu.:167.0 1st Qu.: 8.50 1st Qu.:1.000 1st Qu.:0.0000   
## Median :201.2 Median :10.30 Median :1.000 Median :0.0000   
## Mean :200.9 Mean :10.24 Mean :1.563 Mean :0.1449   
## 3rd Qu.:235.3 3rd Qu.:12.10 3rd Qu.:2.000 3rd Qu.:0.0000   
## Max. :395.0 Max. :20.00 Max. :9.000 Max. :1.0000   
##   
## Int.l.Plan VMail.Plan Day.Calls Day.Charge   
## Min. :0.00000 Min. :0.0000 Min. : 0.0 Min. : 0.00   
## 1st Qu.:0.00000 1st Qu.:0.0000 1st Qu.: 87.0 1st Qu.:24.43   
## Median :0.00000 Median :0.0000 Median :101.0 Median :30.50   
## Mean :0.09691 Mean :0.2766 Mean :100.4 Mean :30.56   
## 3rd Qu.:0.00000 3rd Qu.:1.0000 3rd Qu.:114.0 3rd Qu.:36.79   
## Max. :1.00000 Max. :1.0000 Max. :165.0 Max. :59.64   
##   
## Eve.Calls Eve.Charge Night.Calls Night.Charge   
## Min. : 0.0 Min. : 0.00 Min. : 33.0 Min. : 1.040   
## 1st Qu.: 87.0 1st Qu.:14.16 1st Qu.: 87.0 1st Qu.: 7.520   
## Median :100.0 Median :17.12 Median :100.0 Median : 9.050   
## Mean :100.1 Mean :17.08 Mean :100.1 Mean : 9.039   
## 3rd Qu.:114.0 3rd Qu.:20.00 3rd Qu.:113.0 3rd Qu.:10.590   
## Max. :170.0 Max. :30.91 Max. :175.0 Max. :17.770   
##   
## Intl.Calls Intl.Charge State Area.Code   
## Min. : 0.000 Min. :0.000 WV : 106 Min. :408.0   
## 1st Qu.: 3.000 1st Qu.:2.300 MN : 84 1st Qu.:408.0   
## Median : 4.000 Median :2.780 NY : 83 Median :415.0   
## Mean : 4.479 Mean :2.765 AL : 80 Mean :437.2   
## 3rd Qu.: 6.000 3rd Qu.:3.270 OH : 78 3rd Qu.:510.0   
## Max. :20.000 Max. :5.400 OR : 78 Max. :510.0   
## (Other):2824   
## Phone   
## 327-1058: 1   
## 327-1319: 1   
## 327-3053: 1   
## 327-3587: 1   
## 327-3850: 1   
## 327-3954: 1   
## (Other) :3327

library(plyr)

## Warning: package 'plyr' was built under R version 3.5.1

library(corrplot)

## Warning: package 'corrplot' was built under R version 3.5.1

## corrplot 0.84 loaded

library(ggplot2)

## Warning: package 'ggplot2' was built under R version 3.5.1

library(gridExtra)

## Warning: package 'gridExtra' was built under R version 3.5.1

library(ggthemes)

## Warning: package 'ggthemes' was built under R version 3.5.1

library(caret)

## Warning: package 'caret' was built under R version 3.5.1

## Loading required package: lattice

library(MASS)

## Warning: package 'MASS' was built under R version 3.5.1

library(randomForest)

## Warning: package 'randomForest' was built under R version 3.5.1

## randomForest 4.6-14

## Type rfNews() to see new features/changes/bug fixes.

##   
## Attaching package: 'randomForest'

## The following object is masked from 'package:gridExtra':  
##   
## combine

## The following object is masked from 'package:ggplot2':  
##   
## margin

library(party)

## Warning: package 'party' was built under R version 3.5.1

## Loading required package: grid

## Loading required package: mvtnorm

## Loading required package: modeltools

## Loading required package: stats4

##   
## Attaching package: 'modeltools'

## The following object is masked from 'package:plyr':  
##   
## empty

## Loading required package: strucchange

## Warning: package 'strucchange' was built under R version 3.5.1

## Loading required package: zoo

## Warning: package 'zoo' was built under R version 3.5.1

##   
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':  
##   
## as.Date, as.Date.numeric

## Loading required package: sandwich

## Warning: package 'sandwich' was built under R version 3.5.1

#################### Logistic Regression################  
str(Churn)

## 'data.frame': 3333 obs. of 21 variables:  
## $ Account.Length: int 128 107 137 84 75 118 121 147 117 141 ...  
## $ VMail.Message : int 25 26 0 0 0 0 24 0 0 37 ...  
## $ Day.Mins : num 265 162 243 299 167 ...  
## $ Eve.Mins : num 197.4 195.5 121.2 61.9 148.3 ...  
## $ Night.Mins : num 245 254 163 197 187 ...  
## $ Intl.Mins : num 10 13.7 12.2 6.6 10.1 6.3 7.5 7.1 8.7 11.2 ...  
## $ CustServ.Calls: int 1 1 0 2 3 0 3 0 1 0 ...  
## $ Churn : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Int.l.Plan : int 0 0 0 1 1 1 0 1 0 1 ...  
## $ VMail.Plan : int 1 1 0 0 0 0 1 0 0 1 ...  
## $ Day.Calls : int 110 123 114 71 113 98 88 79 97 84 ...  
## $ Day.Charge : num 45.1 27.5 41.4 50.9 28.3 ...  
## $ Eve.Calls : int 99 103 110 88 122 101 108 94 80 111 ...  
## $ Eve.Charge : num 16.78 16.62 10.3 5.26 12.61 ...  
## $ Night.Calls : int 91 103 104 89 121 118 118 96 90 97 ...  
## $ Night.Charge : num 11.01 11.45 7.32 8.86 8.41 ...  
## $ Intl.Calls : int 3 3 5 7 3 6 7 6 4 5 ...  
## $ Intl.Charge : num 2.7 3.7 3.29 1.78 2.73 1.7 2.03 1.92 2.35 3.02 ...  
## $ State : Factor w/ 51 levels "AK","AL","AR",..: 17 36 32 36 37 2 20 25 19 50 ...  
## $ Area.Code : int 415 415 415 408 415 510 510 415 408 415 ...  
## $ Phone : Factor w/ 3333 levels "327-1058","327-1319",..: 1927 1576 1118 1708 111 2254 1048 81 292 118 ...

intrain<-createDataPartition(Churn$Churn, p=0.7, list = FALSE) ## Split the data into trainig and testing##  
set.seed(1)  
training<-Churn[intrain,-c(21)]  
testing<-Churn[-intrain,-c(21)]  
  
##### Confrim the splitting is correct####  
  
dim(training)

## [1] 2334 20

dim(testing)

## [1] 999 20

#### Fitting the logistic regression model ######  
  
LogModel<-glm(Churn~.,family = binomial(link = "logit"), data = training)  
print(summary(LogModel))

##   
## Call:  
## glm(formula = Churn ~ ., family = binomial(link = "logit"), data = training)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -1.9756 -0.5030 -0.3006 -0.1503 3.1312   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.107e+01 1.572e+00 -7.042 1.9e-12 \*\*\*  
## Account.Length 7.240e-04 1.706e-03 0.424 0.671242   
## VMail.Message 5.825e-02 2.296e-02 2.537 0.011196 \*   
## Day.Mins 2.808e+00 4.029e+00 0.697 0.485840   
## Eve.Mins 6.275e-01 2.021e+00 0.311 0.756136   
## Night.Mins -9.395e-01 1.079e+00 -0.871 0.383961   
## Intl.Mins -9.617e+00 6.580e+00 -1.461 0.143882   
## CustServ.Calls 5.604e-01 4.902e-02 11.434 < 2e-16 \*\*\*  
## Int.l.Plan 2.155e+00 1.847e-01 11.669 < 2e-16 \*\*\*  
## VMail.Plan -2.893e+00 7.444e-01 -3.887 0.000102 \*\*\*  
## Day.Calls 6.284e-03 3.403e-03 1.847 0.064819 .   
## Day.Charge -1.644e+01 2.370e+01 -0.694 0.487840   
## Eve.Calls -1.109e-03 3.530e-03 -0.314 0.753375   
## Eve.Charge -7.289e+00 2.377e+01 -0.307 0.759110   
## Night.Calls -1.271e-04 3.489e-03 -0.036 0.970946   
## Night.Charge 2.101e+01 2.398e+01 0.876 0.380989   
## Intl.Calls -9.770e-02 3.142e-02 -3.109 0.001875 \*\*   
## Intl.Charge 3.593e+01 2.437e+01 1.474 0.140385   
## StateAL 1.246e+00 1.179e+00 1.057 0.290382   
## StateAR 2.000e+00 1.157e+00 1.728 0.083936 .   
## StateAZ 1.148e+00 1.311e+00 0.876 0.380898   
## StateCA 1.856e+00 1.238e+00 1.499 0.133812   
## StateCO 1.491e+00 1.194e+00 1.249 0.211488   
## StateCT 1.894e+00 1.139e+00 1.662 0.096535 .   
## StateDC 1.932e+00 1.205e+00 1.603 0.108860   
## StateDE 1.759e+00 1.176e+00 1.496 0.134713   
## StateFL 1.871e+00 1.164e+00 1.607 0.108096   
## StateGA 1.756e+00 1.188e+00 1.478 0.139416   
## StateHI -4.104e-02 1.493e+00 -0.027 0.978070   
## StateIA 1.825e+00 1.264e+00 1.444 0.148718   
## StateID 2.024e+00 1.152e+00 1.757 0.078850 .   
## StateIL 5.835e-01 1.262e+00 0.463 0.643701   
## StateIN 1.177e+00 1.195e+00 0.985 0.324663   
## StateKS 2.141e+00 1.154e+00 1.856 0.063464 .   
## StateKY 1.344e+00 1.189e+00 1.130 0.258288   
## StateLA 1.757e+00 1.241e+00 1.416 0.156872   
## StateMA 1.657e+00 1.163e+00 1.425 0.154124   
## StateMD 1.682e+00 1.150e+00 1.462 0.143722   
## StateME 2.371e+00 1.148e+00 2.065 0.038903 \*   
## StateMI 2.489e+00 1.130e+00 2.203 0.027605 \*   
## StateMN 2.243e+00 1.131e+00 1.983 0.047345 \*   
## StateMO 1.633e+00 1.171e+00 1.394 0.163238   
## StateMS 2.212e+00 1.148e+00 1.927 0.054003 .   
## StateMT 2.986e+00 1.142e+00 2.615 0.008925 \*\*   
## StateNC 1.684e+00 1.174e+00 1.434 0.151530   
## StateND 1.009e+00 1.222e+00 0.826 0.408823   
## StateNE 1.440e+00 1.185e+00 1.215 0.224416   
## StateNH 1.764e+00 1.198e+00 1.473 0.140847   
## StateNJ 2.447e+00 1.133e+00 2.159 0.030819 \*   
## StateNM 1.435e+00 1.182e+00 1.214 0.224842   
## StateNV 2.170e+00 1.142e+00 1.901 0.057356 .   
## StateNY 2.225e+00 1.127e+00 1.975 0.048316 \*   
## StateOH 1.480e+00 1.168e+00 1.267 0.204986   
## StateOK 2.254e+00 1.159e+00 1.945 0.051817 .   
## StateOR 1.848e+00 1.144e+00 1.616 0.106072   
## StatePA 2.738e+00 1.178e+00 2.325 0.020065 \*   
## StateRI 1.028e+00 1.201e+00 0.855 0.392312   
## StateSC 2.569e+00 1.155e+00 2.224 0.026140 \*   
## StateSD 1.838e+00 1.161e+00 1.584 0.113213   
## StateTN 1.124e+00 1.248e+00 0.901 0.367618   
## StateTX 2.763e+00 1.134e+00 2.436 0.014867 \*   
## StateUT 2.001e+00 1.155e+00 1.732 0.083231 .   
## StateVA 1.813e-01 1.303e+00 0.139 0.889366   
## StateVT 1.016e+00 1.194e+00 0.851 0.394685   
## StateWA 2.339e+00 1.164e+00 2.010 0.044482 \*   
## StateWI 6.987e-01 1.219e+00 0.573 0.566424   
## StateWV 1.526e+00 1.152e+00 1.325 0.185166   
## StateWY 1.139e+00 1.168e+00 0.975 0.329366   
## Area.Code 8.586e-05 1.590e-03 0.054 0.956938   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 1962.4 on 2333 degrees of freedom  
## Residual deviance: 1446.9 on 2265 degrees of freedom  
## AIC: 1584.9  
##   
## Number of Fisher Scoring iterations: 6

### The top three most relevant features include CustServ.Calls, Int.l.Plan, VMail.Plan   
  
anova(LogModel, test="Chisq")

## Analysis of Deviance Table  
##   
## Model: binomial, link: logit  
##   
## Response: Churn  
##   
## Terms added sequentially (first to last)  
##   
##   
## Df Deviance Resid. Df Resid. Dev Pr(>Chi)   
## NULL 2333 1962.4   
## Account.Length 1 0.534 2332 1961.9 0.4651195   
## VMail.Message 1 26.148 2331 1935.7 3.162e-07 \*\*\*  
## Day.Mins 1 93.724 2330 1842.0 < 2.2e-16 \*\*\*  
## Eve.Mins 1 22.964 2329 1819.0 1.650e-06 \*\*\*  
## Night.Mins 1 8.517 2328 1810.5 0.0035177 \*\*   
## Intl.Mins 1 15.213 2327 1795.3 9.603e-05 \*\*\*  
## CustServ.Calls 1 115.131 2326 1680.2 < 2.2e-16 \*\*\*  
## Int.l.Plan 1 123.441 2325 1556.8 < 2.2e-16 \*\*\*  
## VMail.Plan 1 15.398 2324 1541.3 8.708e-05 \*\*\*  
## Day.Calls 1 3.336 2323 1538.0 0.0677885 .   
## Day.Charge 1 0.426 2322 1537.6 0.5138926   
## Eve.Calls 1 0.009 2321 1537.6 0.9264550   
## Eve.Charge 1 0.025 2320 1537.5 0.8732376   
## Night.Calls 1 0.006 2319 1537.5 0.9369764   
## Night.Charge 1 0.711 2318 1536.8 0.3990932   
## Intl.Calls 1 11.677 2317 1525.2 0.0006327 \*\*\*  
## Intl.Charge 1 2.685 2316 1522.5 0.1012807   
## State 50 75.600 2266 1446.9 0.0111776 \*   
## Area.Code 1 0.003 2265 1446.9 0.9569500   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

##Assessing the predictive ability of the Logistic Regression model##  
  
fitted.results<-predict(LogModel,newdata=testing, type='response')  
fitted.results<-ifelse(fitted.results>0.5,1,0)  
misClassificationError<-mean(fitted.results !=testing$Churn)  
print(paste('Logistic Regression Accuracy', 1-misClassificationError))

## [1] "Logistic Regression Accuracy 0.864864864864865"

#########"Logistic Regression Accuracy 0.865865865865866"#############  
  
  
###########Logistic Regression Confusion Matrix#################  
  
print("Confusion Matrix for Logistic Regression");

## [1] "Confusion Matrix for Logistic Regression"

cfmatrix=table(testing$Churn, fitted.results >0.5)  
cfmatrix

##   
## FALSE TRUE  
## 0 831 32  
## 1 103 33

Accuracy\_model<-((cfmatrix[1]+cfmatrix[2,2])/  
 (cfmatrix[1,1]+cfmatrix[1,2]+cfmatrix[2,1]+cfmatrix[2,2]))  
Accuracy\_model

## [1] 0.8648649

library(ROCR)

## Warning: package 'ROCR' was built under R version 3.5.1

## Loading required package: gplots

##   
## Attaching package: 'gplots'

## The following object is masked from 'package:stats':  
##   
## lowess

pred <- predict(LogModel,testing,type="response")  
pr <- prediction(pred, testing$Churn)  
auc <- performance(pr, measure = "auc")  
auc <- auc@y.values[[1]]  
auc

## [1] 0.7988464

#### ODDS Ratio ###  
  
library(MASS)  
exp(cbind(OR=coef(LogModel), confint(LogModel)))

## Waiting for profiling to be done...

## OR 2.5 % 97.5 %  
## (Intercept) 1.561669e-05 4.485405e-07 2.781292e-04  
## Account.Length 1.000724e+00 9.973818e-01 1.004078e+00  
## VMail.Message 1.059978e+00 1.013902e+00 1.109543e+00  
## Day.Mins 1.658057e+01 6.147677e-03 4.500632e+04  
## Eve.Mins 1.872922e+00 3.562260e-02 9.864206e+01  
## Night.Mins 3.908339e-01 4.703608e-02 3.242122e+00  
## Intl.Mins 6.657504e-05 1.615676e-10 2.627329e+01  
## CustServ.Calls 1.751450e+00 1.592319e+00 1.929996e+00  
## Int.l.Plan 8.631929e+00 6.021856e+00 1.243207e+01  
## VMail.Plan 5.538597e-02 1.222674e-02 2.270946e-01  
## Day.Calls 1.006304e+00 9.996327e-01 1.013067e+00  
## Day.Charge 7.223777e-08 4.579596e-28 1.097786e+13  
## Eve.Calls 9.988917e-01 9.920051e-01 1.005836e+00  
## Eve.Charge 6.827303e-04 3.810614e-24 1.199370e+17  
## Night.Calls 9.998729e-01 9.930516e-01 1.006735e+00  
## Night.Charge 1.329587e+09 5.071144e-12 3.620161e+29  
## Intl.Calls 9.069168e-01 8.517762e-01 9.634765e-01  
## Intl.Charge 4.028311e+15 7.571866e-06 2.518449e+36  
## StateAL 3.478015e+00 4.636758e-01 7.301583e+01  
## StateAR 7.389838e+00 1.057841e+00 1.519212e+02  
## StateAZ 3.153305e+00 2.578693e-01 7.520568e+01  
## StateCA 6.397803e+00 7.187041e-01 1.430368e+02  
## StateCO 4.442719e+00 5.719705e-01 9.478400e+01  
## StateCT 6.643883e+00 9.977619e-01 1.340428e+02  
## StateDC 6.905662e+00 8.369079e-01 1.487082e+02  
## StateDE 5.808655e+00 7.802170e-01 1.216176e+02  
## StateFL 6.491801e+00 9.064824e-01 1.343175e+02  
## StateGA 5.786374e+00 7.549248e-01 1.226626e+02  
## StateHI 9.597916e-01 3.423025e-02 2.699776e+01  
## StateIA 6.204131e+00 6.266834e-01 1.420228e+02  
## StateID 7.569452e+00 1.096238e+00 1.546416e+02  
## StateIL 1.792330e+00 1.820570e-01 4.090120e+01  
## StateIN 3.245115e+00 4.106111e-01 6.924119e+01  
## StateKS 8.506914e+00 1.228970e+00 1.741691e+02  
## StateKY 3.833042e+00 4.942876e-01 8.123354e+01  
## StateLA 5.794139e+00 6.182077e-01 1.292714e+02  
## StateMA 5.242753e+00 7.340038e-01 1.082620e+02  
## StateMD 5.375255e+00 7.819109e-01 1.096487e+02  
## StateME 1.070276e+01 1.576099e+00 2.179506e+02  
## StateMI 1.204386e+01 1.870315e+00 2.407199e+02  
## StateMN 9.424054e+00 1.454706e+00 1.886038e+02  
## StateMO 5.120407e+00 6.969731e-01 1.066657e+02  
## StateMS 9.132168e+00 1.344902e+00 1.859646e+02  
## StateMT 1.979765e+01 2.972533e+00 4.007906e+02  
## StateNC 5.385439e+00 7.325382e-01 1.125671e+02  
## StateND 2.742847e+00 3.192444e-01 6.015011e+01  
## StateNE 4.221251e+00 5.483423e-01 8.914816e+01  
## StateNH 5.832923e+00 7.367783e-01 1.248618e+02  
## StateNJ 1.155035e+01 1.776396e+00 2.316683e+02  
## StateNM 4.200586e+00 5.488247e-01 8.839524e+01  
## StateNV 8.760087e+00 1.310242e+00 1.772374e+02  
## StateNY 9.253057e+00 1.446265e+00 1.843370e+02  
## StateOH 4.393736e+00 6.060065e-01 9.121656e+01  
## StateOK 9.523003e+00 1.350031e+00 1.960037e+02  
## StateOR 6.349326e+00 9.415871e-01 1.286575e+02  
## StatePA 1.545962e+01 2.092014e+00 3.246847e+02  
## StateRI 2.794278e+00 3.514126e-01 6.008822e+01  
## StateSC 1.305866e+01 1.889282e+00 2.681041e+02  
## StateSD 6.286572e+00 8.855928e-01 1.295750e+02  
## StateTN 3.078541e+00 3.233981e-01 6.924738e+01  
## StateTX 1.584284e+01 2.431352e+00 3.182471e+02  
## StateUT 7.396595e+00 1.060157e+00 1.516299e+02  
## StateVA 1.198766e+00 9.930426e-02 2.832134e+01  
## StateVT 2.763409e+00 3.518668e-01 5.891179e+01  
## StateWA 1.036736e+01 1.456448e+00 2.145557e+02  
## StateWI 2.011173e+00 2.351332e-01 4.393887e+01  
## StateWV 4.601558e+00 6.624613e-01 9.396494e+01  
## StateWY 3.123146e+00 4.310605e-01 6.481961e+01  
## Area.Code 1.000086e+00 9.969399e-01 1.003179e+00

## R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

summary(cars)

## speed dist   
## Min. : 4.0 Min. : 2.00   
## 1st Qu.:12.0 1st Qu.: 26.00   
## Median :15.0 Median : 36.00   
## Mean :15.4 Mean : 42.98   
## 3rd Qu.:19.0 3rd Qu.: 56.00   
## Max. :25.0 Max. :120.00

## Including Plots

You can also embed plots, for example:



Note that the echo = FALSE parameter was added to the code chunk to prevent printing of the R code that generated the plot.