

Churn Decision tree, Pruning tree. & Kernel Classifications

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```
setwd("C:/Users/tsraj/Desktop/Acadgild project")
library(readr)
Churn <- read.csv("C:/Users/tsraj/Desktop/Acadgild project/Churn.csv")
View(Churn)
# enable multi-core processing
library(doParallel)

## Loading required package: foreach

## Loading required package: iterators

## Loading required package: parallel

registerDoParallel()
set.seed(12345)
churnTrain<-Churn[1:2500,]
churnTest<-Churn[2501:3033,]
library(C50)
head(churnTrain)
```

	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
```

```
head(churnTest)
```

```
##      Account.Length VMail.Message Day.Mins Eve.Mins Night.Mins Intl.Mins
## 2501             121              41   215.5   241.8    147.0      9.6
## 2502             101              0   124.8   257.2    193.2     13.4
## 2503             115              0   178.7   271.0    245.9     16.4
## 2504             168              0   183.2   179.2    292.8      9.9
## 2505              90              0   167.5   139.1    138.4     13.0
## 2506              70              0   147.1   200.0    234.9     12.5
##      CustServ.Calls Churn Int.l.Plan VMail.Plan Day.Calls Day.Charge
## 2501              1     0           0           1      95      36.64
## 2502              0     0           0           0      66      21.22
## 2503              2     0           0           0     114      30.38
## 2504              2     0           0           0     131      31.14
## 2505              1     0           0           0      96      28.48
## 2506              3     0           0           0     105      25.01
##      Eve.Calls Eve.Charge Night.Calls Night.Charge Intl.Calls Intl.Charge
## 2501          92      20.55         108         6.61          3         2.59
## 2502          85      21.86         115         8.69          4         3.62
## 2503          96      23.04          94        11.07          5         4.43
## 2504          73      15.23         100        13.18          5         2.67
## 2505         104      11.82          87         6.23          1         3.51
## 2506         135      17.00          65        10.57          9         3.38
##      State Area.Code   Phone
## 2501     UT      415 337-2348
## 2502     IL      415 342-8702
## 2503     DC      408 393-5802
## 2504     IN      415 384-2219
## 2505     NM      415 347-6164
## 2506     MS      510 376-9940
```

```
library(tree)
```

```
data<-Churn
```

```
View(data)
```

```
names(data)
```

```
## [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"
```

```
nrow(data)
```

```

## [1] 3333

ncol(data)

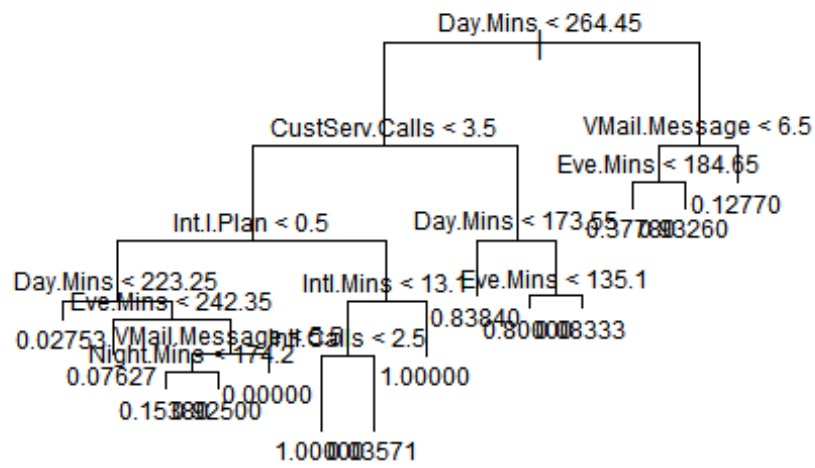
## [1] 21

str(data)

## '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 15
76 1118 1708 111 2254 1048 81 292 118 ...

select_rows<-sample(1:nrow(data), round(0.2*nrow(data)))
datatest<-data[select_rows,]
datatrain<-data[-select_rows,]
#modelRegtree<-tree(Mark~Motivation+Gender+Age,data=stutrain)
modelRegtree<-tree(Churn~Account.Length+ VMail.Message+Day.Mins+Eve.Mins+Nigh
t.Mins+Intl.Mins+CustServ.Calls+Int.l.Plan+VMail.Plan+Day.Calls+Day.Charge+Ev
e.Calls+Eve.Charge+Night.Calls+Night.Charge+Intl.Calls+Intl.Charge,data =data
train)
plot(modelRegtree)
text(modelRegtree,pretty = 0, cex=0.75)

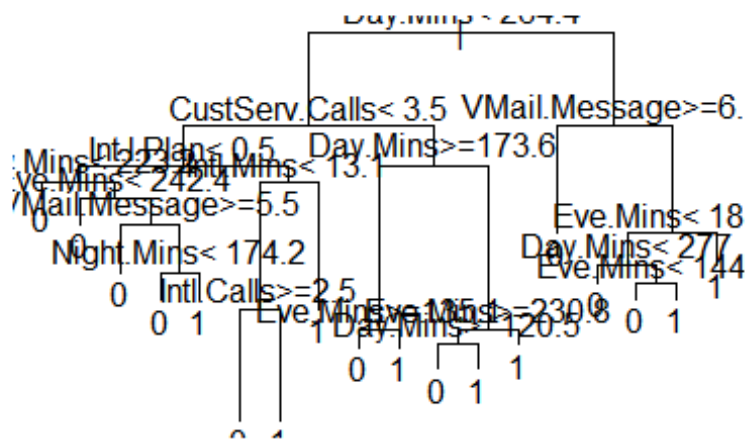
```



```

library(rpart)
churn_data<-as.data.frame(data)
tree<-rpart(Churn~Account.Length+ VMail.Message+Day.Mins+Eve.Mins+Night.Mins+
Intl.Mins+CustServ.Calls+Intl.Plan+VMail.Plan+Day.Calls+Day.Charge+Eve.Calls
+Eve.Charge+Night.Calls+Night.Charge+Intl.Calls+Intl.Charge,data =datatrain,m
ethod="class")
plot(tree)
text(tree, pretty=0)

```



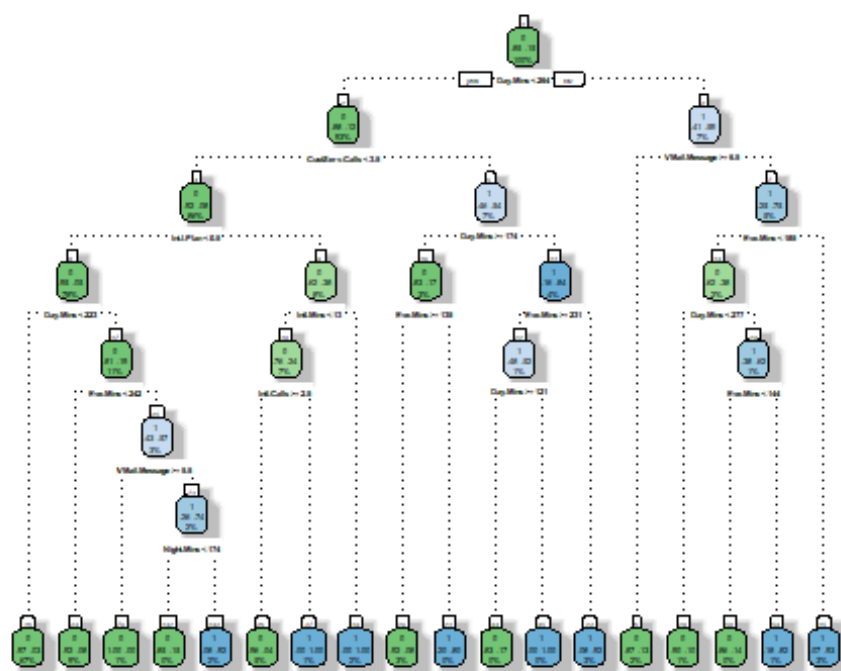
```
library(rattle)
```

```
## Rattle: A free graphical interface for data science with R.  
## Version 5.2.0 Copyright (c) 2006-2018 Togaware Pty Ltd.  
## Type 'rattle()' to shake, rattle, and roll your data.
```

rattle()

```
## Loading required package: RGtk2
```

```
library(rpart.plot)
library(RColorBrewer)
fancyRpartPlot(tree)
```



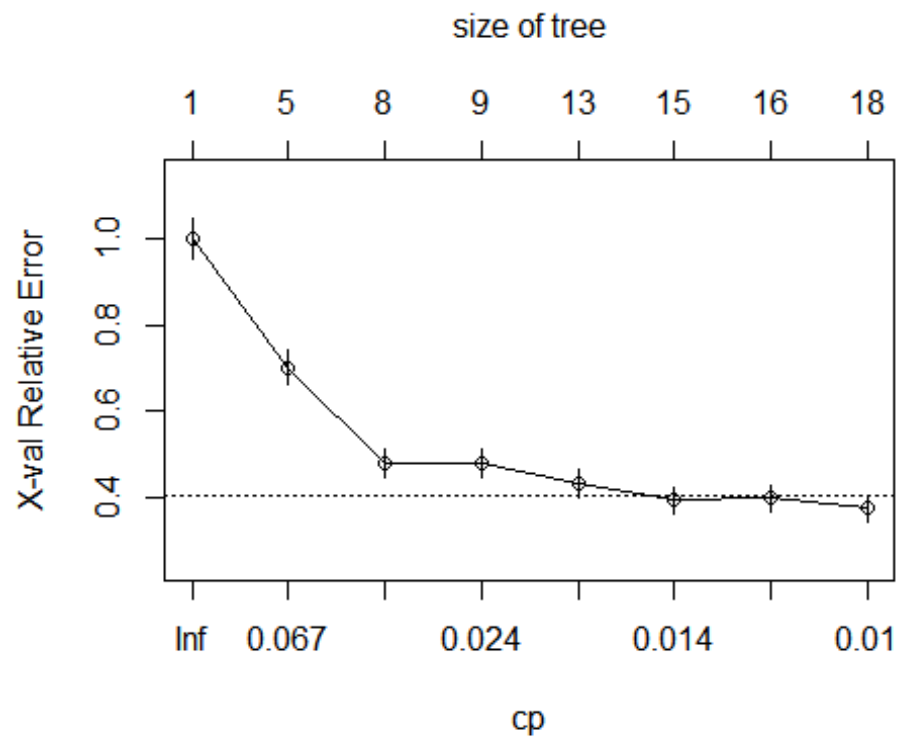
Rattle 2018-Oct-16 15:25:00 tsraj

```
printcp(tree)
```

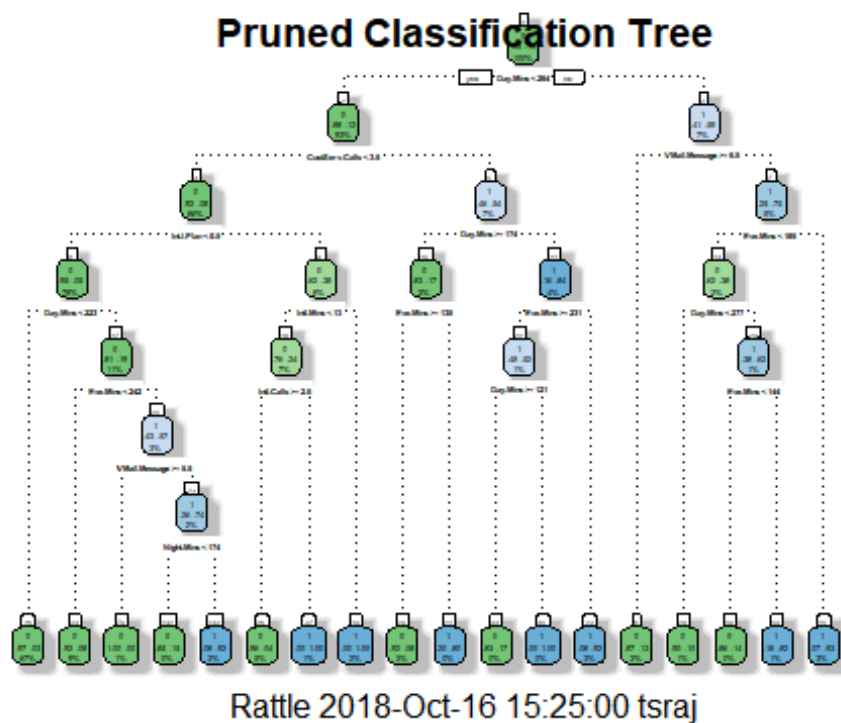
```
##
## Classification tree:
## rpart(formula = Churn ~ Account.Length + VMail.Message + Day.Mins +
##   Eve.Mins + Night.Mins + Intl.Mins + CustServ.Calls + Int.l.Plan +
##   VMail.Plan + Day.Calls + Day.Charge + Eve.Calls + Eve.Charge +
##   Night.Calls + Night.Charge + Intl.Calls + Intl.Charge, data = datatrai
n,
##   method = "class")
##
## Variables actually used in tree construction:
## [1] CustServ.Calls Day.Mins      Eve.Mins      Int.l.Plan
## [5] Intl.Calls      Intl.Mins      Night.Mins    VMail.Message
##
## Root node error: 393/2666 = 0.14741
##
## n= 2666
##
##      CP nsplit rel error  xerror    xstd
## 1 0.084606    0  1.00000 1.00000 0.046577
## 2 0.053435    4  0.66158 0.70229 0.040025
## 3 0.027990    7  0.46056 0.48092 0.033719
## 4 0.021204    8  0.43257 0.48092 0.033719
## 5 0.015267   12  0.34606 0.43511 0.032189
## 6 0.012723   14  0.31552 0.39440 0.030744
```

```
## 7 0.010178    15    0.30280 0.39949 0.030930
## 8 0.010000    17    0.28244 0.37659 0.030084
```

```
plotcp(tree)
```



```
pmtree<- prune(tree, cp= tree$cptable[which.min(tree$cptable[, "xerror"]), "CP"]
)
fancyRpartPlot(pmtree, uniform=TRUE, main="Pruned Classification Tree")
```



```

pred<-predict(modelRegtree, newdata = datatest)
head(pred,nrow = 5)

##          2403          2919          2535          2951          1520          554
## 0.83838384 0.08333333 0.02752809 0.02752809 0.02752809 0.03571429

head(pred,n = 5)

##          2403          2919          2535          2951          1520
## 0.83838384 0.08333333 0.02752809 0.02752809 0.02752809

ME<-sum(datatest$Mark-pred)/nrow(datatest)
ME

## [1] 0

RSS<-sum(datatest$Mark-pred)^2
RSS

## [1] 0

RMSE<-sqrt(RSS/nrow(datatest))
RMSE

## [1] 0

MAPE<-sum(abs(datatest$Mark-pred)/datatest$Mark)*100
MAPE

```



```
## [1] 0

names(churnTrain)

## [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"

library(rpart)
fit1 <- rpart(Churn~.,data=churnTrain[, -1])
fit1

## n= 2500
##
## node), split, n, deviance, yval
## * denotes terminal node
##
## 1) root 2500 298.8364 0.1388
## 2) Phone=327-1319,327-3053,327-3850,327-3954,327-4795,327-5525,327-5817,
327-6179,327-6194,327-6764,327-8732,327-9289,327-9341,328-1206,328-1222,328-1
373,328-1522,328-1768,328-2110,328-2236,328-2478,328-2647,328-2982,328-3266,3
28-3402,328-4231,328-5050,328-6289,328-6770,328-7209,328-8147,328-9006,328-93
15,328-9869,329-1955,329-2045,329-2204,329-2388,329-2789,329-2918,329-3222,32
9-3458,329-4391,329-5114,329-5377,329-6144,329-6191,329-6192,329-6562,329-710
2,329-8056,329-8115,329-9001,329-9046,329-9364,329-9847,330-1175,330-1835,330
-2693,330-2849,330-2881,330-3008,330-3429,330-3589,330-4419,330-4914,330-5168
,330-5255,330-5462,330-6165,330-6208,330-6436,330-6626,330-6630,330-7483,330-
7486,330-8142,330-8173,330-8351,330-9833,331-2144,331-3174,331-3202,331-3698,
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31-9861,332-1060,332-1109,332-1494,332-1502,332-2126,332-2137,332-2258,332-24
62,332-2965,332-3381,332-3544,332-3642,332-4289,332-4291,332-5582,332-5596,33
2-5964,332-6633,332-6934,332-6958,332-7607,332-8103,332-8160,332-8764,332-911
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82,334-9806,335-1838,335-2261,335-2274,335-2331,335-3110,335-3133,335-3320,33
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886,416-8701,417-3999,417-4810,417-4826,418-5300,418-6455,418-6651,418-6737,4
18-7055,418-9036,419-1674,419-1714,419-1863,419-5171,419-8987,420-6465,420-78
23,420-8435,420-8897,420-9838,420-9971,421-8537,422-5350 347 0.0000 1.0000
*

summary(fit1)

```
## Call:
## rpart(formula = Churn ~ ., data = churnTrain[, -1])
##   n= 2500
##
##      CP nsplit rel error   xerror      xstd
## 1 1.00      0         1 1.000371 0.04180395
## 2 0.01      1         0 1.187941 0.05840154
##
## Variable importance
##           Phone      Day.Charge      Day.Mins CustServ.Calls
##              84              6              6              5
##
## Node number 1: 2500 observations,      complexity param=1
##   mean=0.1388, MSE=0.1195346
##   left son=2 (2153 obs) right son=3 (347 obs)
##   Primary splits:
##           Phone      splits as -LLRLLLLL-LLL-RLLL-LLLLLLLLLLLLLLLL-RLLL-RL-
## ---RL-L-L-LLLLRLLLLL-LL-LLLLRLRL---LLRL-R-LL-L--LLLLLL-LLRLLL-LLLLL-LLRLLL
## -RLRLLLLL-LLLLLLLLLLLLLLLL-LLLLLLLL-LLL-L-RLLL-L--LLRRL-RLRRLLL-LLLLLLLLL--LLLL
## --LLLLLLLL-RRLLLLL---LLRLL-LLLL--LLLL--LLRLL-LLLLL--LLLLLLRLLLLL-LRLLLLRL-LR
## L-RLRRLLRLLLLLLLLLRRLLLLR--L-LLLLLLLLL-LLL-L--LLLRLL-L-LLLLLLLLLLLLLLLL-LR---LL
## -LLL---L-LL--LL--LLLLLRLL-LR-L-LLLLR--LLLLLLLLRL--RLLL--LLLLLLL--LLLL-LL-RLL
## L-RL-LLL--RRLLLRLLLLLLLL-LLLLLL-LLLR-LLLLL-LRL-L-RL-L-LLRLLL-LLLLLLL-LLRL-LL
## ---L-RLL-RLLLL-L-LL-LL-RLL--LLLL-LRLL-LL-L-LLRLLLLL-L-LLLLL-LLL-LLLRL--RLL-R
## RLL-LLLLL--LL--RLRLLLLL-L--L---L--RL-LLL-LLLLL-LL-LL-LLL-L-L-LL-LLLLLL-LL-LL-
## LLRL-LLLRLLLLLL-L--RLLLL-LLLRLLLLL-LL--LLL-L-RL-LL-LL-L--L--LL-LLLL-LLLL---L
## LLLLLLLLL--R--LL-R-L--LRRLR-LL-L-RL-L-L-LLLL-LLLLL-RL-LLL-LLLLLLL-LL-LLL-LLLL
## L-L-LLLLL-L-LLRL-LRLLLLLLLLLLLLL-LLLL-L--RLLL-LLLRLRRLLL-LLLLLLLL-L--L-RLL
## L-R-RL-L--LR-LLL-LRLLLRLLLLRL-LLLLLLL-L-L-LL-LLL-LRL-LL-L-RLLLLLLLL-LLLRL--
## LRL--LL-L--L-LLL-R---LLLLL-L--LL-L-LLLLLR--LLRLLLLL-R-LLRLLLLLLLLL-L-
## LLLLLLLLLL-LLLLL-LLL-LLLRLLL--L-R-LLLLL-L-LLLLLLLLL-LR-L-R-LL-LL-RLLL-LLLLL
## -R-LLLL--LRL-LLLL-LLLLR--LLL-L-L-LRL-LLLRLLL-LL--LLLLL-L-LLLR-LRL-LLL-LL-RL
```

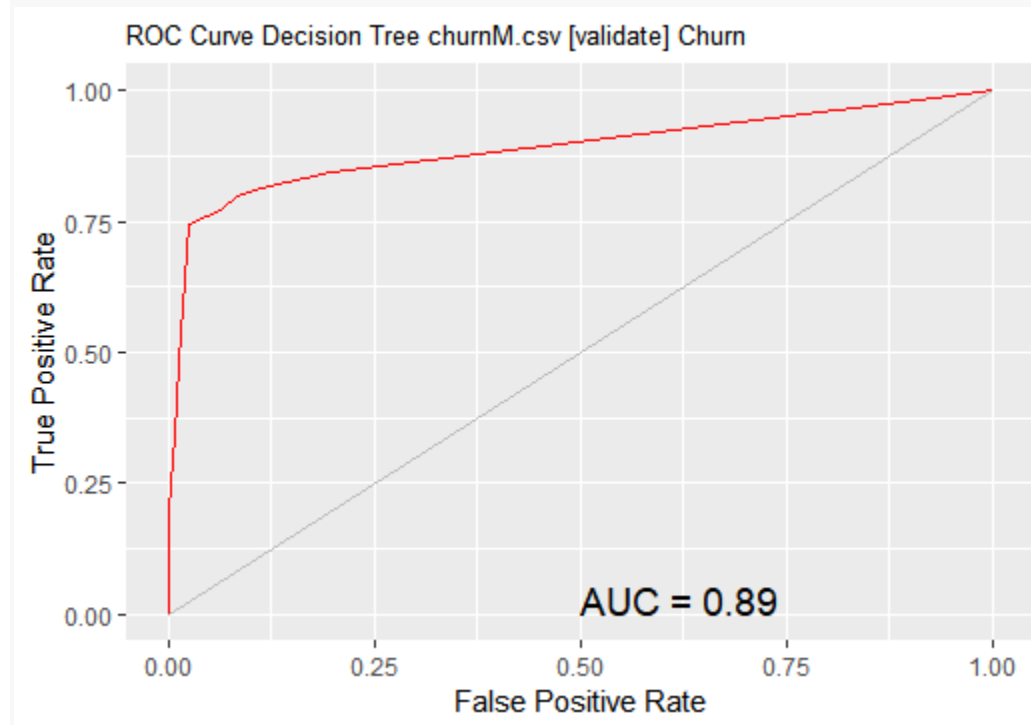
```

LLLLLLLLLLLLLLLLLLLL-LLLLLL-RLLLLLLLLLLRL-LLLLL--LLLLLLLL-LL-LL-L-LL-R-L-LLLLLL-LL
---LLRLRL-LL-LLL-LL--LL-LLL-LLLLLLLLL--LLLLLLLL-LLLLLRL--R--LLRR--LLRLLLLR--RL
---L-LL-LLR-L-R-LL-L--L-RLRLRLRLLLLLLLLLLLLLRLRLRLRL--RL---LLL-LLLLLLRLL--R
LL-LL---L-LL-R-RL-LLLLRLLLLLLL-LL-RL-LL-LLRRLL-LLLLL-LLLL---L-LL-LL-LLRL-LLL
-L-RL-LLR---LL--LLRLLL-LLLL-LLRLLLR--LL--LR-LL--R--LR-L-R--L-LL--LRLLLLLL-R
L--LLLLRL-LL-LLRL-LRL-L-L-LLRRLLLLLLLL-RL-LLLLLLLLL-L-L--RL-RL-LLL-RLLL-LRL
LL-LLRRLRLRR-RRLLLLRLRL-LLLRR-LLLL-LLLLLLLL-LLLLL-LL-L-LL--LLLL--LLL-L-L-LLR
LLR---LRRL--RL-RL--LLL-LLLLLL-LLLL--L-L---LRRL-LL--LLLLRL--L-LLL-L--LLL
L-LRRL-LL-LLLLLLLL-LLLRL-R-LLRLRLRLRL-L--LRL-LR-LLLLLLLL-LLLLLRRRL--LLLL
L-LLLL--R-LLLLLL---LLLLL---LL-LLL-R-LRL-L-LL-LL--LL-LLLLRL-LLL-RLLL--LLLR
RL-LLLLL-LLL-L-LLL-RLLLRL-LLL-RLLLRL-LLL-LLLLRL--L--LL-LLLLLLLL--L-L-L
R-LLLLRLRLRL-LLLLLRL-LLL--R-LLL-L--L-LLLLLL-L--LLLL-LL-LR--RL-LL-LLRRRL
-LLLL-RLLLRLRL-LLLRL--L--LL-L-R-LLLLLLLLLLLL--LLLL-LLLL-L--LLLL-LRL
LLL-LLL-R--LLL--LLLLRLRLRL-RLL-R-LL---LL--LL-L-LLLLLLLL---LLLLRL-LLL
-L-LLL-LLL-LLLLLLLL-LLLLLLLL-LLLLRL-L-LLRLRLRL-L-LLLLLLLL--LLLLRL
--L-LLLLRLRL-RL-L-LLL--LLL-LLLLRLLLLLLLLLRL--LRLL-RLL-LLLLLLLL--LRLL-L-L
LL-LLLLL-LLLLRL-L--LLL-LLLLLLL-R-L-LLLLRL-LL--R-LL--LLL-RL-LLLL--LLLLLL
LRL--RRR-LLLL--LL-RLLL-RLL-LLRLRL-RL--LLLLLLLL--L-L-LR-LRL--LLRRLLLL
LL-LLLLLLLL-L-LL-LLL-R--RLLL-LR--LRLL--LR-LLL-LLLRL-L--R-LLRL-LL--LL-LL--LL
LRL--LLL--LLL--RRLLRL-LLL-RL--LLL-L-LLL--LLLLLL-LRL--L-L-R-LLR-LL
-LRR-LLR-RR-LRL--LL-LLLLRLLLLLLLLL-LLL-LLRL-L-RL--LLL-LL-LL-LLL-L-LL--LL-LL
--L-L-RLRL-L--LL-LLR-LLL-LLLLLLLL--LLL-LLLLLLLLRLRL--LLL-RLLL-LL
LLL-L-----LLRL-RLL-L-LLLR-LL-L-LR--L-LLLLLLL-L--L-LLRL-RLLL--LLLR-LLL
-LLRLLL-LLLRL-L-LLLLRL-LLL-RRL-LLLL--LL-LLLLLLLLRL-R-LLR-LLRL-LLRLR
LR-LR-L-LLL-LL-LLLLL-RL-LRLLLLLLLLLLLL-LL--LLRLLL-LLL--LLL--RL--LRRL-LL
LLLRLRLRLLLLLLL-LLLRLLLL-LL-LL-LLL-LLL-RLLL-RRL-L-LL-LLLL-LLLL---LLL
-L-LLLLRLRLRLRLR-LL-L-LL-RLRRR-LLLL-LLR-LLLLRL-L-LLLL--LL--LLL-L-LRL
-L-RLRRLLRLRL-L-LLL-L--LLL-LR-LLLL--LLLRLLLL-LL, improve=1.0000000
, (0 missing)
##      Day.Mins      < 264.55 to the left,  improve=0.09769634, (0 missing
)
##      Day.Charge     < 44.975 to the left,  improve=0.09769634, (0 missing
)
##      CustServ.Calls < 3.5      to the left,  improve=0.09755406, (0 missing
)
##      Int.l.Plan     < 0.5      to the left,  improve=0.06796193, (0 missing
)
##      Surrogate splits:
##      Day.Mins      < 284.15 to the left,  agree=0.870, adj=0.066, (0 spl
it)
##      Day.Charge     < 48.305 to the left,  agree=0.870, adj=0.066, (0 spl
it)
##      CustServ.Calls < 4.5      to the left,  agree=0.869, adj=0.058, (0 spl
it)
##      Eve.Mins       < 335.85 to the left,  agree=0.862, adj=0.003, (0 spl
it)
##      Eve.Charge     < 28.545 to the left,  agree=0.862, adj=0.003, (0 spl
it)
##
## Node number 2: 2153 observations

```

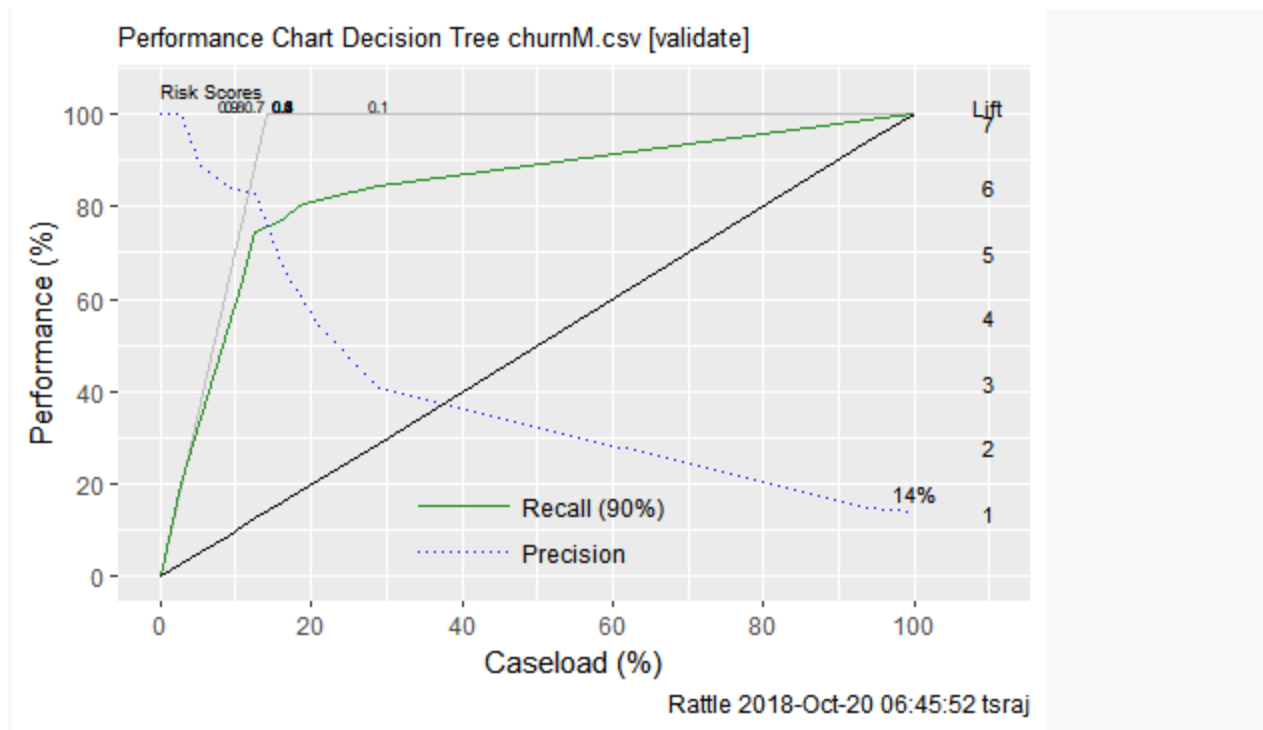


```
## mean=0, MSE=0
##
## Node number 3: 347 observations
## mean=1, MSE=0
```



The area under the Risk and Recall curves for Decision Tree model

Area under the Recall (green) curve: 90% (0.898)



Error matrix for the Decision Tree model on churnM.csv [validate] (counts):

		Predicted		
		0	1	Error
Actual	0	418	11	2.6
	1	18	52	25.7

Error matrix for the Decision Tree model on churnM.csv [validate] (proportions):

		Predicted		
		0	1	Error
Actual	0	83.8	2.2	2.6
	1	3.6	10.4	25.7

Overall error: 5.8%, Averaged class error: 14.15%

Rattle timestamp: 2018-10-20 06:41:37 tsraj

#Kernlab Classification

```
require(kernlab)
```

```
## Loading required package: kernlab
```

```
installed.packages("kernlab")
```

```
##      Package LibPath Version Priority Depends Imports LinkingTo Suggests
##      Enhances License License_is_FOSS License_restricts_use OS_type Archs
##      MD5sum NeedsCompilation Built
```

```
library(kernlab)
```

```
churn_classifier<-ksvm(Churn ~., data =datatrain , kernel='vanilladot')
```

```
## Setting default kernel parameters
```

```
churn_classifier
```

```
## Support Vector Machine object of class "ksvm"
```

```
##
```

```
## SV type: eps-svr (regression)
```

```
## parameter : epsilon = 0.1 cost C = 1
```

```
##
```

```
## Linear (vanilla) kernel function.
```

```
##
```

```
## Number of Support Vectors : 2203
```

```
##
```

```
## Objective Function Value : -718.7691
```

```
## Training error : 0.221987
```

```
churn_predictions<-predict(churn_classifier,datatest)
```

```
head(churn_predictions)
```

```
##           [,1]
```

```
## 2403  0.17884755
```

```
## 2919  0.22759370
```

```
## 2535  0.08201885
```

```
## 2951 -0.01274966
```

```
## 1520  0.14549398
```

```
## 554   0.21449679
```

```
table(churn_predictions, datatest$Churn)
```

```
##
```

```
## churn_predictions      0 1
```

```
## -0.246864954149444    1 0
```

##	-0.199376134699389	1 0
##	-0.169327799847542	1 0
##	-0.167466134077193	1 0
##	-0.153902400184883	1 0
##	-0.129407777518702	1 0
##	-0.119184901940138	1 0
##	-0.108528032074328	1 0
##	-0.0986546483714096	1 0
##	-0.0978416954500534	1 0
##	-0.0959979081211554	1 0
##	-0.0953575595732112	1 0
##	-0.092792110536179	1 0
##	-0.0885310736611716	1 0
##	-0.0846768157831452	1 0
##	-0.0815618723621662	1 0
##	-0.0809232395464094	1 0
##	-0.0807271032893598	1 0
##	-0.0801305846795515	1 0
##	-0.0793766990903454	1 0
##	-0.0766755154776203	1 0
##	-0.0747586808437682	1 0
##	-0.0727274215576317	0 1
##	-0.0709561111655188	1 0
##	-0.0703283845416149	1 0
##	-0.0695000702156509	1 0
##	-0.0656235089571222	1 0
##	-0.0642209534347146	1 0
##	-0.06097837436165	1 0
##	-0.0607365290186764	1 0
##	-0.0590208815558827	1 0
##	-0.0585917262607419	1 0
##	-0.0580494290470151	1 0
##	-0.0542350152938703	1 0
##	-0.0538633654592075	1 0
##	-0.0513850499725406	1 0
##	-0.0506137046752094	1 0
##	-0.0502048065785007	1 0
##	-0.0488587771900107	1 0
##	-0.0487443993104588	1 0
##	-0.0486287061741893	1 0
##	-0.0478585795397038	1 0
##	-0.0475623528782321	1 0
##	-0.0468148450816511	1 0
##	-0.0450317294011737	1 0
##	-0.043477897838293	1 0
##	-0.0417286152768088	1 0
##	-0.0417022546337522	1 0
##	-0.0414912835944619	1 0
##	-0.0401541332083682	1 0
##	-0.0399947126230921	0 1

##	-0.0391761700860333	1 0
##	-0.0382630098379608	1 0
##	-0.037425799161757	1 0
##	-0.0369095021803348	1 0
##	-0.0366210845211981	1 0
##	-0.0364036684152444	1 0
##	-0.0358084767302908	1 0
##	-0.0355072900549292	1 0
##	-0.034722971492802	1 0
##	-0.0342046721611682	1 0
##	-0.0339384069847862	1 0
##	-0.033684548870159	1 0
##	-0.0335615474565367	1 0
##	-0.0290539244068106	1 0
##	-0.028780832993049	1 0
##	-0.0279722306987139	1 0
##	-0.0278959475993048	1 0
##	-0.0274254719251915	1 0
##	-0.0261689884540718	1 0
##	-0.02507972450408	1 0
##	-0.0245117028132695	1 0
##	-0.0243769918466528	1 0
##	-0.0230370319290666	1 0
##	-0.022676255297833	1 0
##	-0.0223047333150429	1 0
##	-0.0218405712205973	1 0
##	-0.0212428633206152	1 0
##	-0.0205227224256447	1 0
##	-0.0203253100228142	1 0
##	-0.019600045375044	1 0
##	-0.0187688064650692	0 1
##	-0.0180621928981769	1 0
##	-0.018056520002233	1 0
##	-0.0174541147741836	1 0
##	-0.0160931550477125	1 0
##	-0.0156098517474016	1 0
##	-0.0153673880536793	1 0
##	-0.015365473100468	1 0
##	-0.0152504594841301	1 0
##	-0.0127496557004724	0 1
##	-0.0111055098235918	1 0
##	-0.0106615318484521	1 0
##	-0.0106166521040775	1 0
##	-0.0100556685335028	1 0
##	-0.00993408683304367	1 0
##	-0.00882737026536493	1 0
##	-0.00791777370717872	1 0
##	-0.00753439242064932	1 0
##	-0.00708538792277791	1 0
##	-0.00682479685585138	1 0

##	-0.00646976309265887	1	0
##	-0.00599213678537863	1	0
##	-0.00561219054438442	1	0
##	-0.00503233723459268	1	0
##	-0.00416545332370491	1	0
##	-0.00372211735593342	1	0
##	-0.00249280479471359	1	0
##	-0.00246630504933959	1	0
##	-0.00151520960614354	1	0
##	-0.00116518165529961	1	0
##	-0.000780183335145651	1	0
##	-0.0006246795837834	1	0
##	-0.000598778145924683	1	0
##	0.00127237458879101	1	0
##	0.00191505478645401	1	0
##	0.00217995683056516	1	0
##	0.0023658466081056	1	0
##	0.00355908927022663	1	0
##	0.00364949322709116	1	0
##	0.00408838747191564	1	0
##	0.00438502375939442	1	0
##	0.00444140773401605	1	0
##	0.00459437161635778	1	0
##	0.00465871084763886	1	0
##	0.00502312081580092	1	0
##	0.00507630547021598	1	0
##	0.00555632726157795	1	0
##	0.0060138841554897	1	0
##	0.00633208403081267	1	0
##	0.00650214264932372	1	0
##	0.0066021890729053	1	0
##	0.00738936550882535	1	0
##	0.00773335720595239	1	0
##	0.0081460339598938	1	0
##	0.00818900746890358	1	0
##	0.00827761514850167	1	0
##	0.00836626086180711	1	0
##	0.00853049895905716	1	0
##	0.00874116348659615	1	0
##	0.00887432145988737	1	0
##	0.00899449567435209	1	0
##	0.00964165891379809	1	0
##	0.0100325703354689	1	0
##	0.0101237675644473	1	0
##	0.0104225181760711	1	0
##	0.0118566089602637	1	0
##	0.0127305820395746	1	0
##	0.0128166010960021	1	0
##	0.0136177392884975	1	0
##	0.0139586132689534	1	0

##	0.0140793132702468	1 0
##	0.014143970751718	1 0
##	0.0142118320453435	1 0
##	0.0144811929920946	1 0
##	0.0146750468376201	1 0
##	0.0151035431044428	1 0
##	0.0159605952746779	1 0
##	0.0160103474905006	1 0
##	0.016226227697181	1 0
##	0.016298237401229	1 0
##	0.0166762755815308	1 0
##	0.0170744660531613	1 0
##	0.0176216861604115	1 0
##	0.0186174561906485	1 0
##	0.0187833365782249	1 0
##	0.0197294953228044	1 0
##	0.0198482076387078	1 0
##	0.0207955716815643	1 0
##	0.0213250324717461	1 0
##	0.0218985288706775	1 0
##	0.0219170906075291	1 0
##	0.0222923930489458	1 0
##	0.0232370274541173	1 0
##	0.0233356786283977	1 0
##	0.0239367751164274	1 0
##	0.0242669797793636	1 0
##	0.0254498994841524	1 0
##	0.0259903028301818	1 0
##	0.02678077807428	1 0
##	0.0268935413402124	1 0
##	0.0270934682303431	1 0
##	0.0277529815011734	1 0
##	0.0277982351039073	1 0
##	0.027819876441624	1 0
##	0.0282309369358254	1 0
##	0.0285604110820946	1 0
##	0.0294933806085941	1 0
##	0.0307051142236587	1 0
##	0.0310000980882438	1 0
##	0.0310134428657024	1 0
##	0.0314291825931667	1 0
##	0.031547424720863	1 0
##	0.0316143728807616	1 0
##	0.0316543739750678	1 0
##	0.0325078005799365	1 0
##	0.0330122104030664	1 0
##	0.0330301451890555	1 0
##	0.0331131562591883	1 0
##	0.0332103347997349	1 0
##	0.0340760090362318	1 0

##	0.0341840197481547	1 0
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## 0.406277610829766 0 1
## 0.414658347176808 0 1
## 0.416040655732383 0 1
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## 0.476221336505797 0 1
## 0.488694695208939 1 0
## 0.57464617741042 0 1
## 0.585560042556624 0 1
```

```
agreement<-churn_predictions == datatest$Churn
table(agreement)
```

```
## agreement
## FALSE
## 667
```

```
prop.table(table(agreement))
```

```
## agreement
## FALSE
## 1
```

```
agreement
```

```
## [,1]
## 2403 FALSE
## 2919 FALSE
## 2535 FALSE
## 2951 FALSE
## 1520 FALSE
## 554 FALSE
## 1082 FALSE
## 1694 FALSE
## 2420 FALSE
## 3290 FALSE
## 115 FALSE
## 507 FALSE
## 2444 FALSE
## 4 FALSE
## 1299 FALSE
## 1535 FALSE
## 1288 FALSE
## 1335 FALSE
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594 FALSE
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1504 FALSE
1083 FALSE
3197 FALSE
2342 FALSE
2133 FALSE
1290 FALSE
2311 FALSE
1799 FALSE
749 FALSE
1601 FALSE
2620 FALSE
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2251 FALSE
1221 FALSE
1193 FALSE
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2981 FALSE
2035 FALSE
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2544 FALSE
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198 FALSE
143 FALSE
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3167 FALSE
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1637 FALSE
2392 FALSE
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1427 FALSE
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2475 FALSE
3203 FALSE
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3100 FALSE
489 FALSE

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1217 FALSE
1095 FALSE
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2017 FALSE
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2351 FALSE
1888 FALSE
2701 FALSE
2581 FALSE
1206 FALSE
1560 FALSE
3147 FALSE
552 FALSE

2641 FALSE
1253 FALSE
3066 FALSE
596 FALSE
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975 FALSE
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2371 FALSE
2224 FALSE
2906 FALSE
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KSVM Classification

```
set.seed(12345)
churn_classifier_rbf<-ksvm(Churn ~., data = datatrain, kernel='rbfdot')
churn_predictions_rbf<-predict(churn_classifier_rbf,datatest)
agreement_rbf<-churn_predictions_rbf == datatest$Churn
table(agreement_rbf)
```

```
## agreement_rbf
## FALSE
##      667
```

```
prop.table(table(agreement_rbf))
```

```
## agreement_rbf
## FALSE
##      1
```

