jiahua-zou / **lending-club-loan-project** Private

Branch: master ▾ lending-club-loan-project / **logit_svm_rf.ipynb** Find file Copy path

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1522 lines (1521 sloc) 681 KB

In [1]:

```
library(dplyr)
library(tidyr)
library(ISLR)
library(MASS)
library(ggplot2)
library(e1071)
```

```
Attaching package: ‘dplyr’

The following objects are masked from ‘package:stats’:

    filter, lag

The following objects are masked from ‘package:base’:

    intersect, setdiff, setequal, union


Attaching package: ‘MASS’

The following object is masked from ‘package:dplyr’:

    select
```

In [2]:

```
df <- read.csv('cleaned_loan_data.csv')
head(df$loan_rate, 20)
```

```
 1. 2
 2. 2
 3. 2
 4. 1
 5. 2
 6. 2
 7. 2
 8. 2
 9. 2
10. 1
11. 2
12. 1
13. 2
14. 2
15. 1
16. 0
17. 0
18. 1
19. 2
20. 1
```

In [3]:

```
df2 <- df %>% filter(loan_rate != 2) %>% dplyr::select(-c(policy_code, id, X, member_id, term,
out_prncp_inv)) %>% select_if(is.numeric)
```

```
df2$loan_rate <- as.factor(df2$loan_rate)
head(df2$loan_rate)
```

1. 1
2. 1
3. 1
4. 1
5. 0
6. 0

In [4]:

```
useful_var = c("loan_amnt", "funded_amnt", "funded_amnt_inv",
               "int_rate", "installment", "dti", "delinq_2yrs", "inq_last_6mths",
               "open_acc", "pub_rec", "revol_bal", "revol_util", "total_acc",
               "total_rec_int", "total_rec_late_fee", "collections_12_mths_ex_med",
               "acc_now_delinq", "tot_coll_amt", "tot_cur_bal", "total_rev_hi_lim", "loan_rate")
```

In [5]:

```
df3 <- df2[, useful_var]
colnames(df2)
```

1. 'loan_amnt'
2. 'funded_amnt'
3. 'funded_amnt_inv'
4. 'int_rate'
5. 'installment'
6. 'annual_inc'
7. 'dti'
8. 'delinq_2yrs'
9. 'inq_last_6mths'
10. 'open_acc'
11. 'pub_rec'
12. 'revol_bal'
13. 'revol_util'
14. 'total_acc'
15. 'out_prncp'
16. 'total_pymnt'
17. 'total_pymnt_inv'
18. 'total_rec_prncp'
19. 'total_rec_int'
20. 'total_rec_late_fee'
21. 'recoveries'
22. 'collection_recovery_fee'
23. 'last_pymnt_amnt'
24. 'collections_12_mths_ex_med'
25. 'acc_now_delinq'
26. 'tot_coll_amt'
27. 'tot_cur_bal'
28. 'total_rev_hi_lim'
29. 'loan_rate'

In [6]:

```
set.seed(1)
train=sample(nrow(df3), round(0.75 * nrow(df3)))
trainset=df3[train,]
testset=df3[-train,]
```

In [7]:

```
glm.fit2 = glm(loan_rate~., data = trainset, family = binomial)
summary(glm.fit2)
```

```
Call:
glm(formula = loan_rate ~ ., family = binomial, data = trainset)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-4.0322  -0.9056   0.5950   0.7818   4.7886

Coefficients:
```

```
Coefficients:
                             Estimate Std. Error z value Pr(>|z|)    
(Intercept)                 3.367e+00  3.678e-02  91.537  < 2e-16 ***
loan_amnt                  -3.203e-04  3.972e-04  -0.806  0.42004    
funded_amnt                 1.454e-03  4.605e-04   3.157  0.00159 ** 
funded_amnt_inv            -1.215e-03  2.312e-04  -5.256 1.47e-07 ***
int_rate                   -1.078e-01  1.663e-03 -64.820  < 2e-16 ***
installment                 1.778e-03  8.138e-05  21.850  < 2e-16 ***
dti                        -3.396e-02  8.251e-04 -41.159  < 2e-16 ***
delinq_2yrs                -1.020e-01  7.090e-03 -14.380  < 2e-16 ***
inq_last_6mths             -2.677e-02  5.954e-03  -4.496 6.92e-06 ***
open_acc                   -3.197e-02  1.756e-03 -18.207  < 2e-16 ***
pub_rec                    -5.060e-02  1.222e-02  -4.141 3.46e-05 ***
revol_bal                  -6.037e-06  9.567e-07  -6.310 2.79e-10 ***
revol_util                 -2.765e-03  3.755e-04  -7.364 1.78e-13 ***
total_acc                   1.863e-02  7.478e-04  24.914  < 2e-16 ***
total_rec_int               8.251e-05  3.943e-06  20.927  < 2e-16 ***
total_rec_late_fee         -8.738e-02  1.705e-03 -51.263  < 2e-16 ***
collections_12_mths_ex_med -3.251e-01  5.238e-02  -6.207 5.41e-10 ***
acc_now_delinq             -1.620e-01  7.993e-02  -2.027  0.04267 *  
tot_coll_amt                5.572e-08  4.133e-07   0.135  0.89276    
tot_cur_bal                 1.366e-06  5.506e-08  24.816  < 2e-16 ***
total_rev_hi_lim            6.846e-06  6.705e-07  10.210  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 183474  on 157733  degrees of freedom
Residual deviance: 164416  on 157713  degrees of freedom
AIC: 164458

Number of Fisher Scoring iterations: 5
```

In [8]:

```
glm.probs=predict(glm.fit2, testset, type="response")
glm.pred=rep(0, nrow(testset))
glm.pred[glm.probs>0.5]=1
table(glm.pred, testset$loan_rate)
1-mean(glm.pred==testset$loan_rate)
```

```
glm.pred     0     1
       0  2494  1510
       1 11557 37017
```

0.248525999467458

In [8]:

```
colnames(testset)
```

1. 'loan_amnt'
2. 'funded_amnt'
3. 'funded_amnt_inv'
4. 'int_rate'
5. 'installment'
6. 'dti'
7. 'delinq_2yrs'
8. 'inq_last_6mths'
9. 'open_acc'
10. 'pub_rec'
11. 'revol_bal'
12. 'revol_util'
13. 'total_acc'
14. 'total_rec_int'
15. 'total_rec_late_fee'
16. 'collections_12_mths_ex_med'
17. 'acc_now_delinq'
18. 'tot_coll_amt'
19. 'tot_cur_bal'
20. 'total_rev_hi_lim'

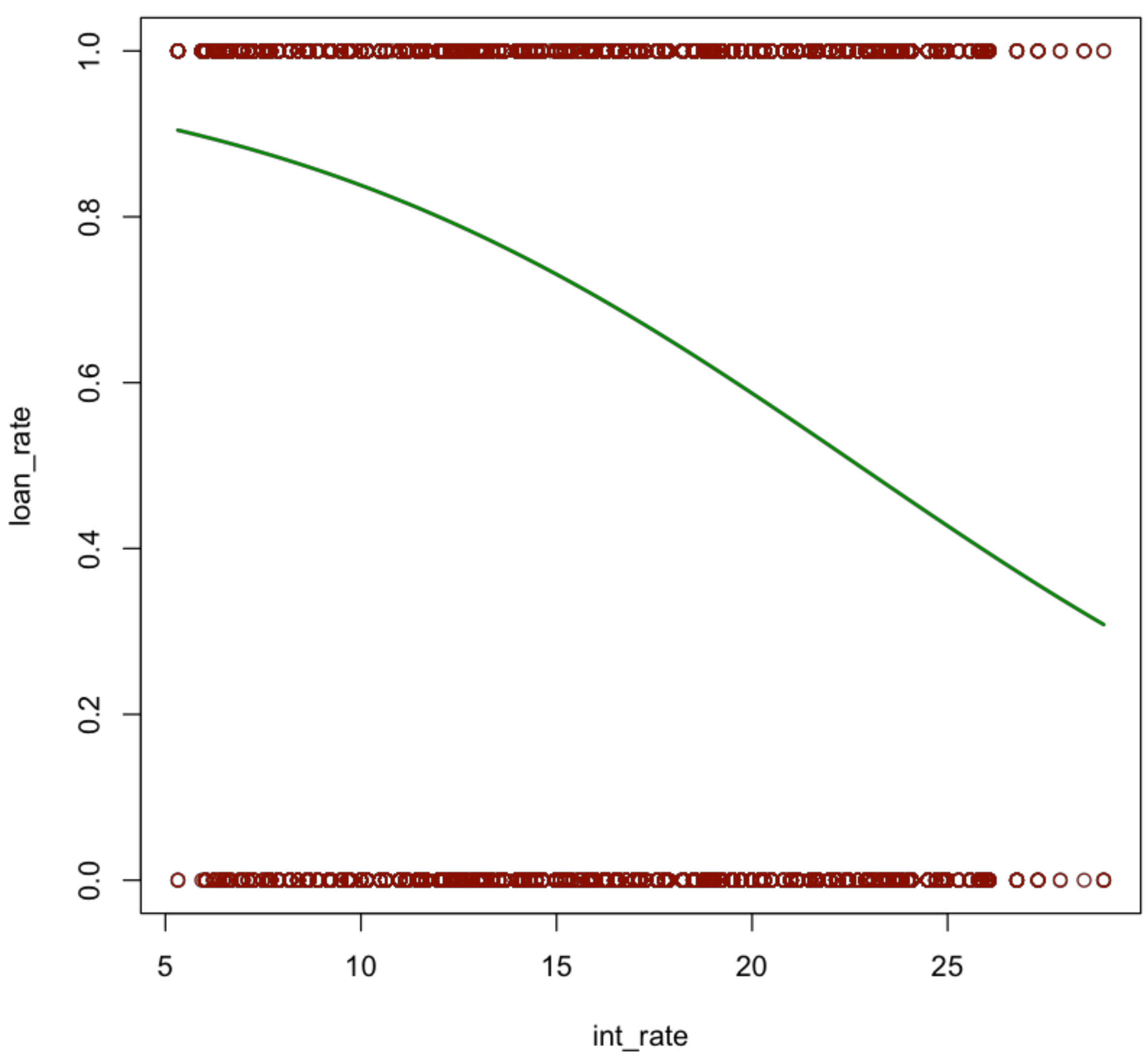
21. 'loan_rate'

In [9]:

```
testset$loan_rate <- as.numeric(as.character(testset$loan_rate))
```

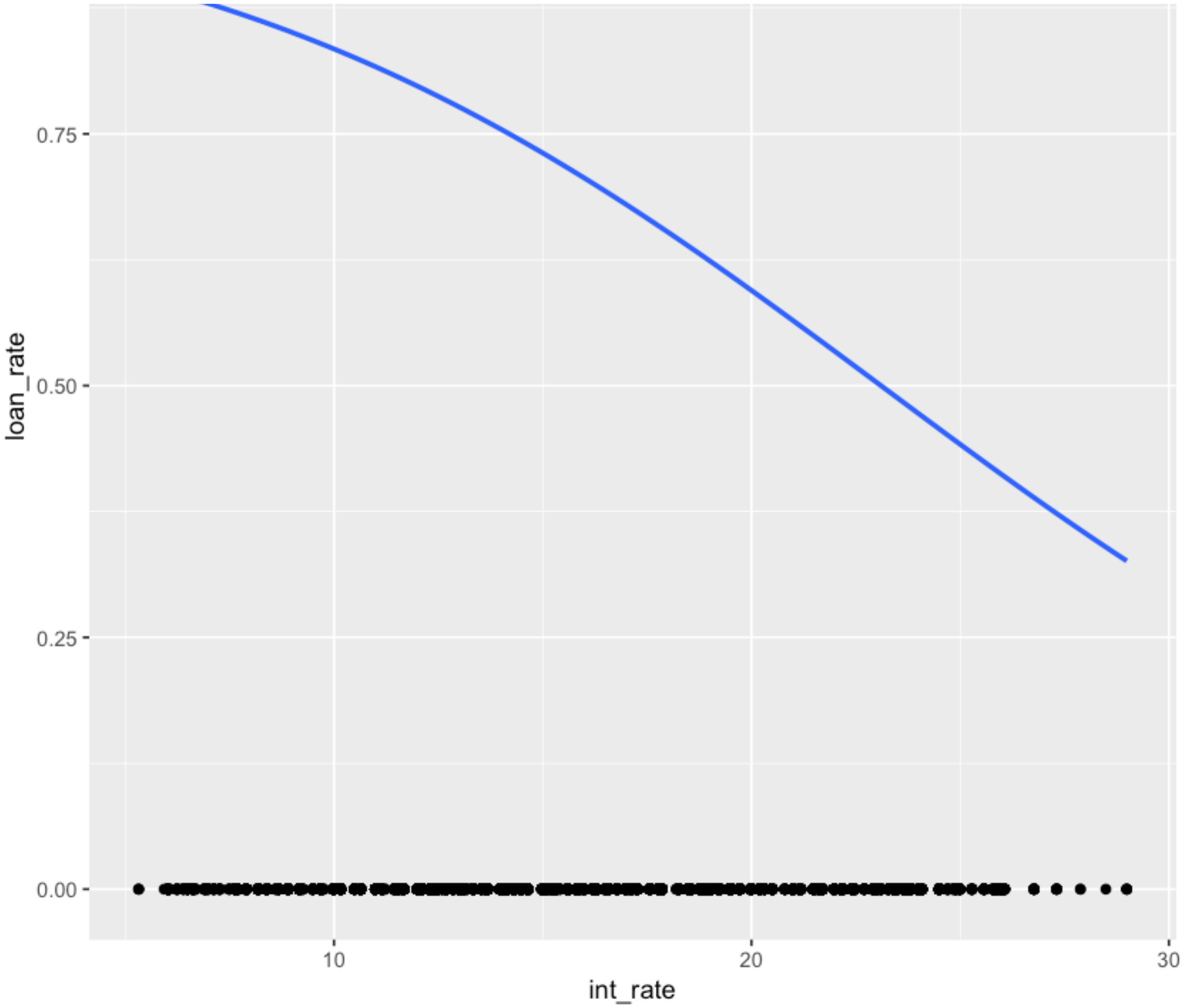
In [16]:

```
fit = glm(loan_rate ~ int_rate, data=trainset, family=binomial)
newdat <- data.frame(int_rate=seq(min(testset$int_rate), max(testset$int_rate),len=100))
newdat$loan_rate = predict(fit, newdata=newdat, type="response")
plot(loan_rate~int_rate, data=testset, col="red4")
lines(loan_rate~int_rate, newdat, col="green4", lwd=2)
```

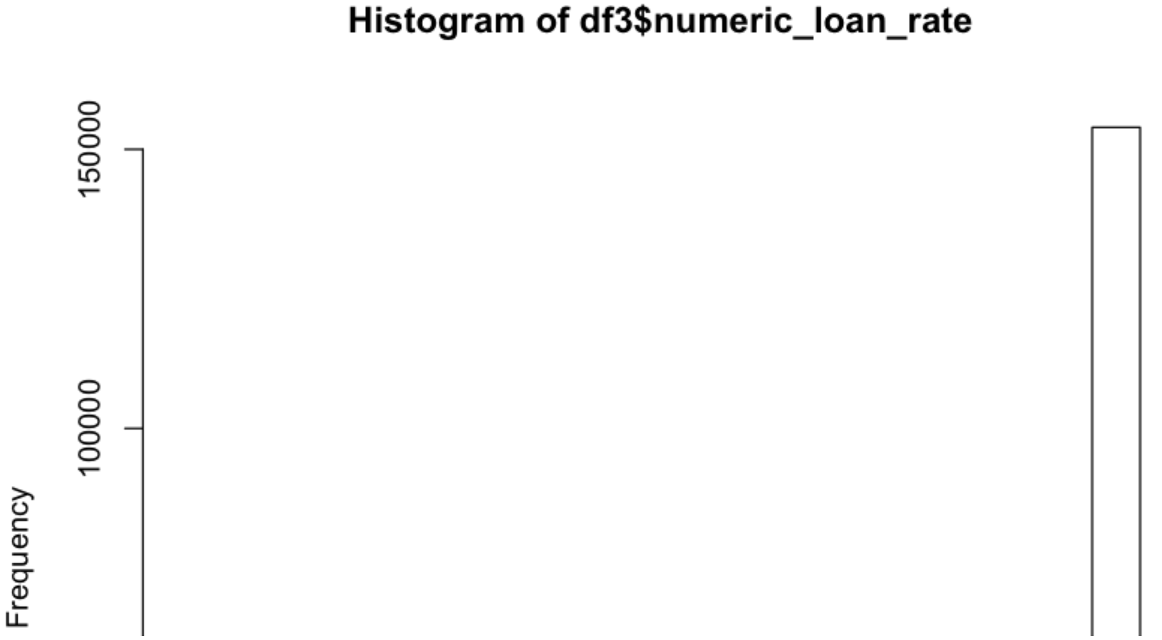


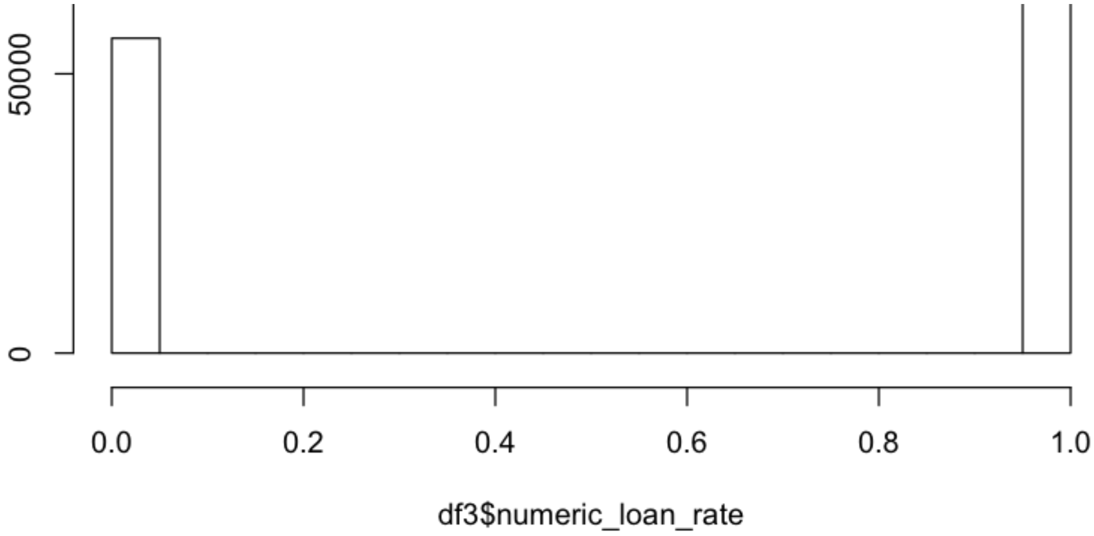
In [42]:

```
ggplot(testset, aes(x=int_rate, y=loan_rate)) + geom_point() +
    geom_smooth(method = "glm", method.args = list(family = "binomial"), se = FALSE)
```



In [68]:
```
hist(df3$numeric_loan_rate)
```





In [17]:
```
temp <- sample(nrow(df3), 30000)
df4 <- df3[temp, ]
```

In [18]:
```
train = sample(nrow(df4), round(0.8*nrow(df4)))
length(train)
```

```
24000
```

In [19]:
```
#set.seed(1)
#tune.out=tune(svm, loan_rate~., data=df4[train,], kernel = "sigmoid",
              #ranges=list(cost=c(0.1, 1, 10, 100, 1000)))
#summary(tune.out)
```

In [30]:
```
svmfit=svm(loan_rate~., data=df4[train,], kernel = "radial", cost = 0.1)
y_pred2 = predict(svmfit, newdata=df4[-train,])
```

In [31]:
```
true=df4[-train, "loan_rate"]
table(true, y_pred2)
1-(sum(true == y_pred2)/nrow(df4[-train,]))
```

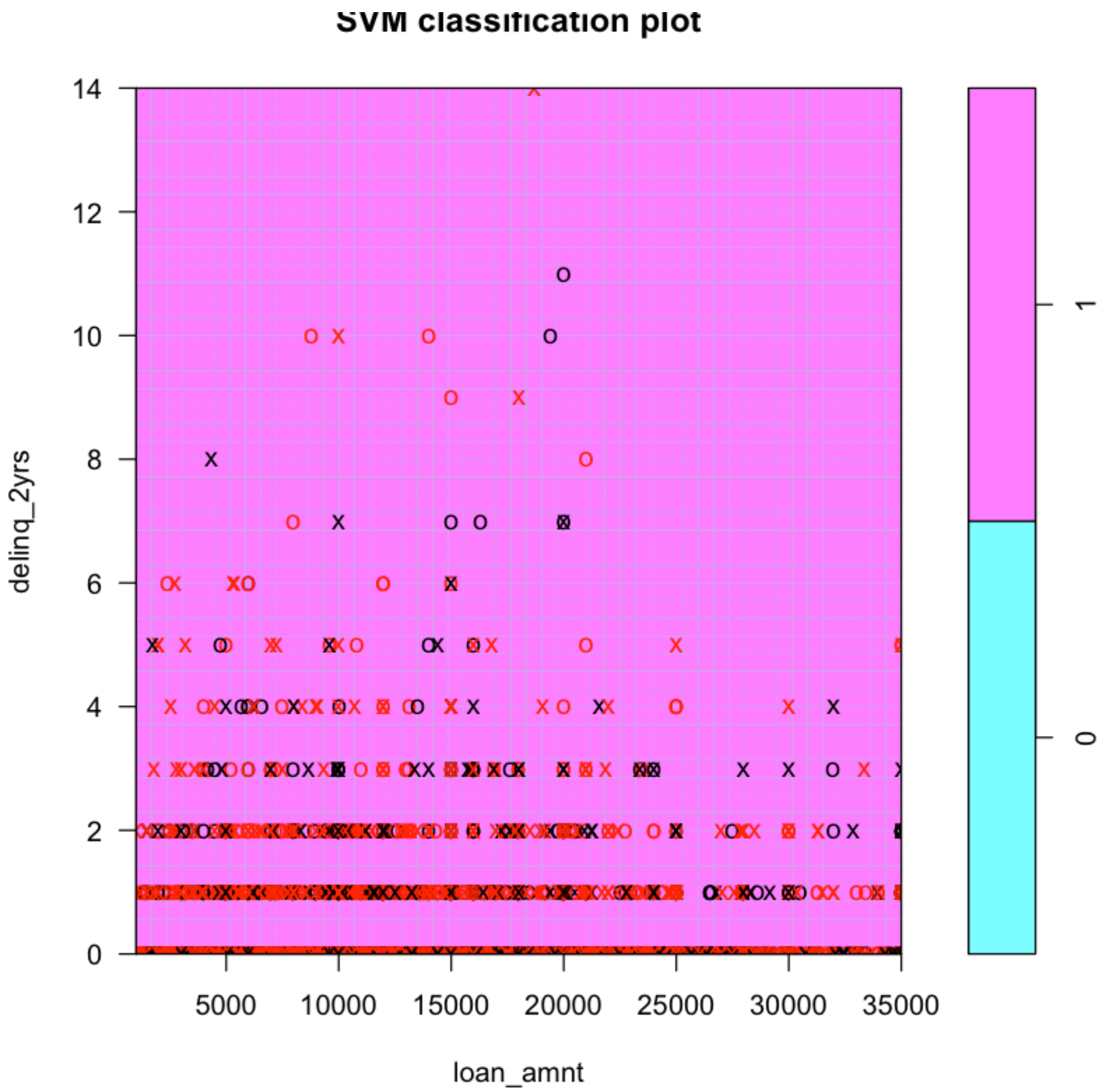
```
    y_pred2
true    0    1
   0   91 1504
   1   44 4361
```

```
0.258
```

In [32]:
```
temp <- df4[-train,]
head(temp)
```

	loan_amnt	funded_amnt	funded_amnt_inv	int_rate	installment	dti	delinq_2yrs	inq_last_6mths	open_acc	pub
63706	8400	8400	8400	6.03	255.66	15.29	0	3	12	0
77293	8000	8000	8000	21.00	301.41	14.88	0	2	13	0
2773	10000	10000	10000	16.24	352.76	14.22	2	5	8	0
38063	14825	14825	14825	6.03	451.21	20.53	0	1	15	0
57878	28000	28000	28000	22.47	780.84	16.97	0	1	13	0
138046	10000	10000	10000	9.17	318.79	22.46	2	0	8	0

In [44]:
```
plot(svmfit, temp, delinq_2yrs~loan_amnt)
```



```
In [45]: true2=df2[-train, "loan_rate"]
         pred2=predict(svmfit, newdata=df2[-train,])
         table(true2, pred2)
```

```
     pred2
true2      0      1
    0   3815  46669
    1    932 134896
```

```
In [46]: 1-(sum(true2 == pred2)/nrow(df2[-train,]))
```

```
0.255490789643179
```

```
In [52]: svmfit3 = svm(loan_rate~., data=df4[train,], kernel = "sigmoid", cost = 0.1)
         y_pred3 = predict(svmfit3, newdata=df4[-train,])
         true3=df2[-train, "loan_rate"]
         pred3=predict(svmfit3, newdata=df2[-train,])
         table(true3, pred3)
         1-(sum(true3 == pred3)/nrow(df2[-train,]))
```

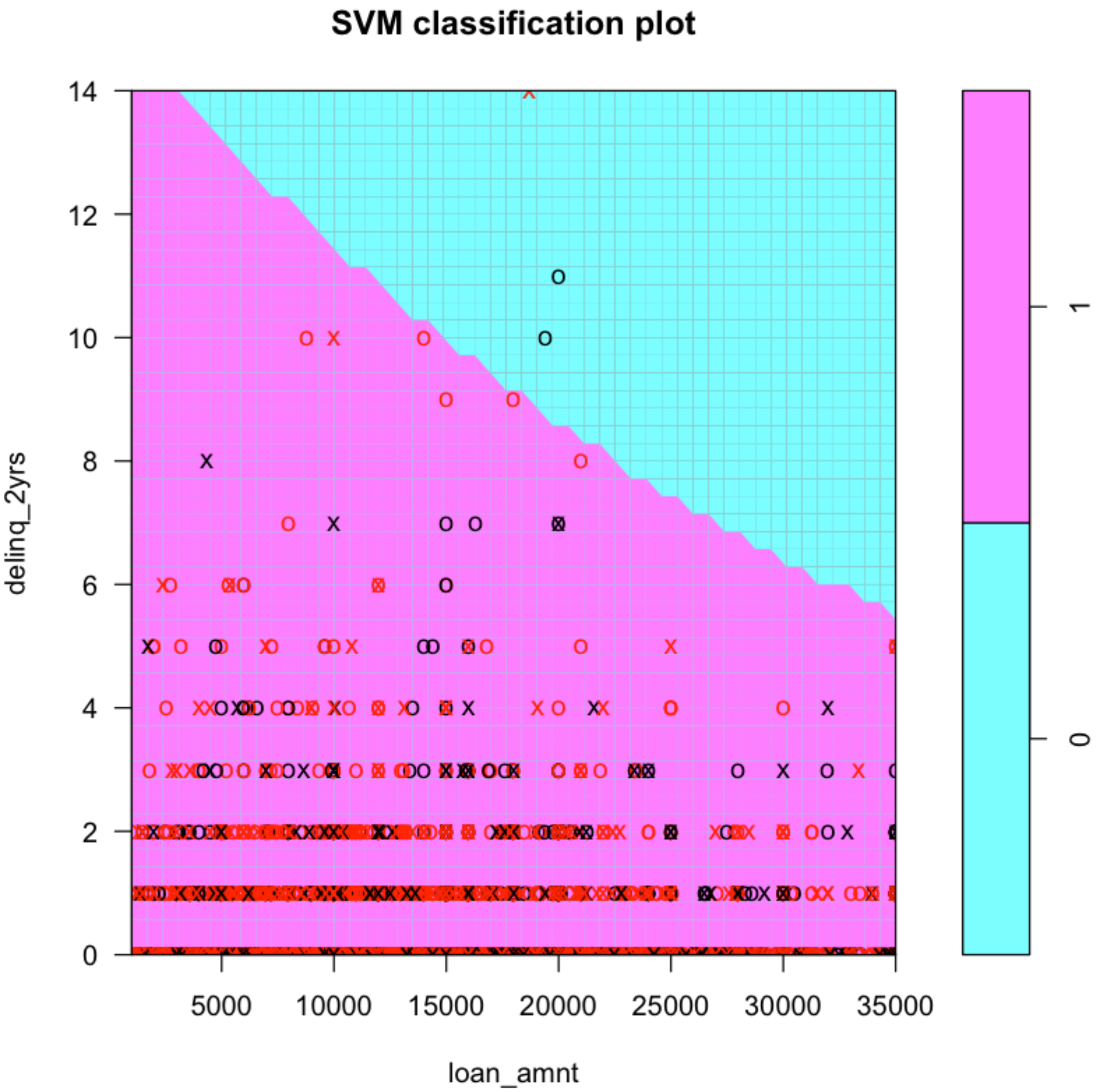
```
     pred3
true3      0      1
    0  15881  34603
    1  25384 110444
```

```
0.321970672849843
```

In [54]:
```
1-((15881 + 110444)/(15881+34603+25384+110444))
```

```
0.321970672849843
```

In [49]:
```
plot(svmfit3, temp, delinq_2yrs~loan_amnt)
```



In [48]:
```
colnames(df4)
```

1. 'loan_amnt'
2. 'funded_amnt'
3. 'funded_amnt_inv'
4. 'int_rate'
5. 'installment'
6. 'dti'
7. 'delinq_2yrs'
8. 'inq_last_6mths'
9. 'open_acc'

10. 'pub_rec'
11. 'revol_bal'
12. 'revol_util'
13. 'total_acc'
14. 'total_rec_int'
15. 'total_rec_late_fee'
16. 'collections_12_mths_ex_med'
17. 'acc_now_delinq'
18. 'tot_coll_amt'
19. 'tot_cur_bal'
20. 'total_rev_hi_lim'
21. 'loan_rate'

In [34]:

```
train2 = sample(nrow(df3), round(0.8 * nrow(df3)))
length(train2)
```

168250

In [38]:

```
trainset2 <- df3[train2,]
dim(trainset2)
```

1. 168250
2. 21

In [41]:

```
testset2 <- df3[-train2, ]
dim(testset2)
```

1. 42062
2. 21

In [39]:

```
library(randomForest)
rf_model <- randomForest(loan_rate~.,data = trainset2, keep.forest=TRUE)
```

In [40]:

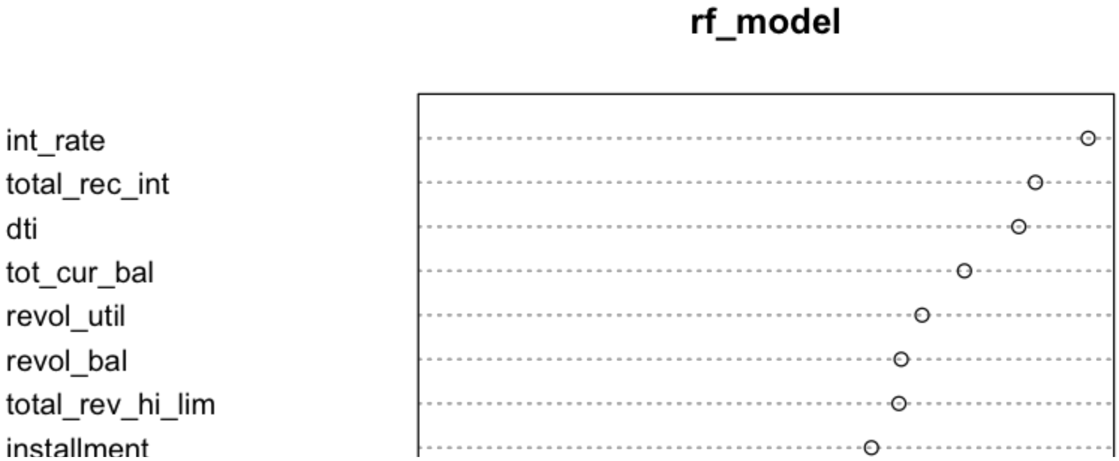
```
rf_model
```

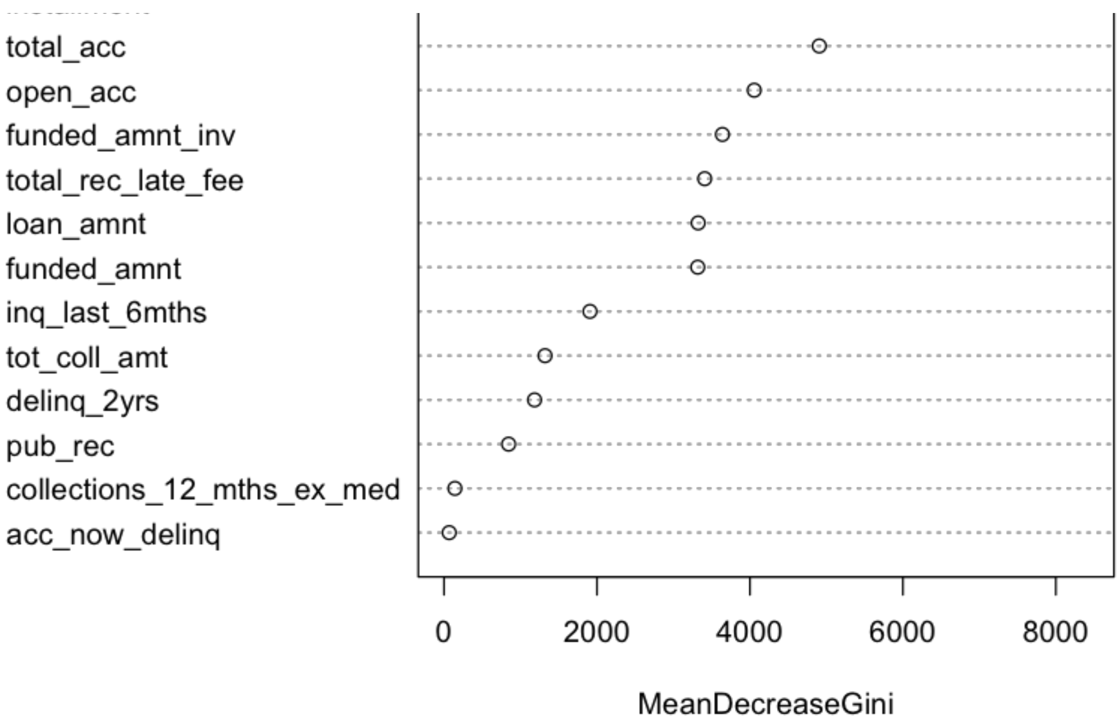
```
Call:
 randomForest(formula = loan_rate ~ ., data = trainset2, keep.forest = TRUE)
               Type of random forest: classification
                     Number of trees: 500
No. of variables tried at each split: 4

        OOB estimate of  error rate: 24.03%
Confusion matrix:
     0      1 class.error
0 9856  35278  0.78162804
1 5157 117959  0.04188733
```

In [30]:

```
varImpPlot(rf_model)
```





```
In [31]: importance(rf_model)
```

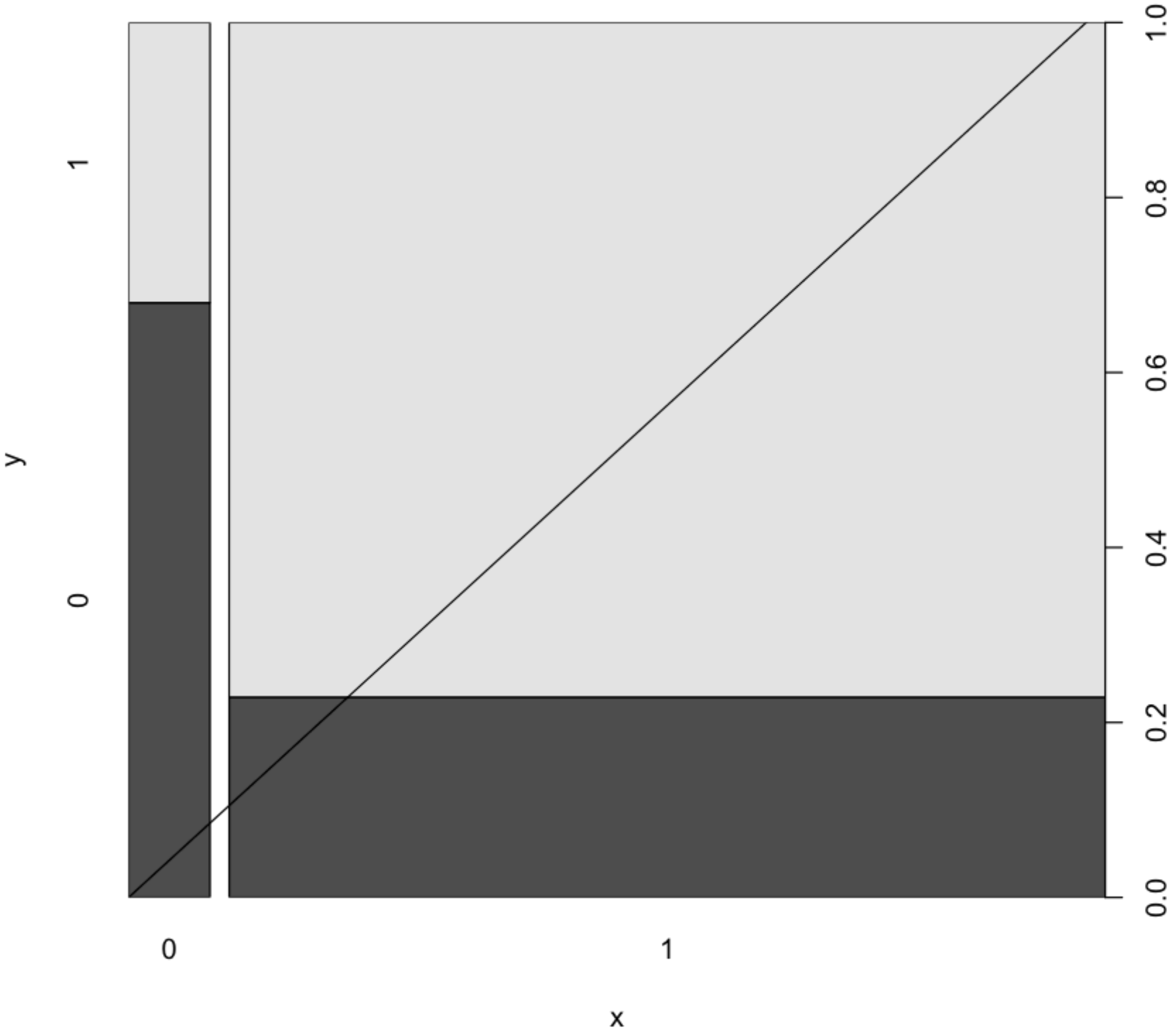
	MeanDecreaseGini
loan_amnt	3323.0490
funded_amnt	3317.6038
funded_amnt_inv	3640.2764
int_rate	8423.2912
installment	5588.9964
dti	7516.2359
delinq_2yrs	1183.2540
inq_last_6mths	1908.2250
open_acc	4056.0094
pub_rec	844.6215
revol_bal	5978.1019
revol_util	6251.2847
total_acc	4906.5944
total_rec_int	7733.7014
total_rec_late_fee	3408.2718
collections_12_mths_ex_med	142.0265
acc_now_delinq	67.7321
tot_coll_amt	1320.5947
tot_cur_bal	6805.3234
total_rev_hi_lim	5948.2921

```
In [43]: yhat_rf <- predict(rf_model, newdata = testset2)
         plot(yhat_rf, testset2$loan_rate)
```

```
abline(0, 1)
```

```
Warning message in Ops.factor(yhat_rf, testset2$loan_rate):
"'-' not meaningful for factors"
```

<NA>



In [44]:

```
table(testset2$loan_rate, yhat_rf)
1-(sum(testset2$loan_rate == yhat_rf)/nrow(testset2))
```

```
   yhat_rf
        0     1
  0  2430  8812
  1  1145 29675
```

0.236721981836337