Assignment8

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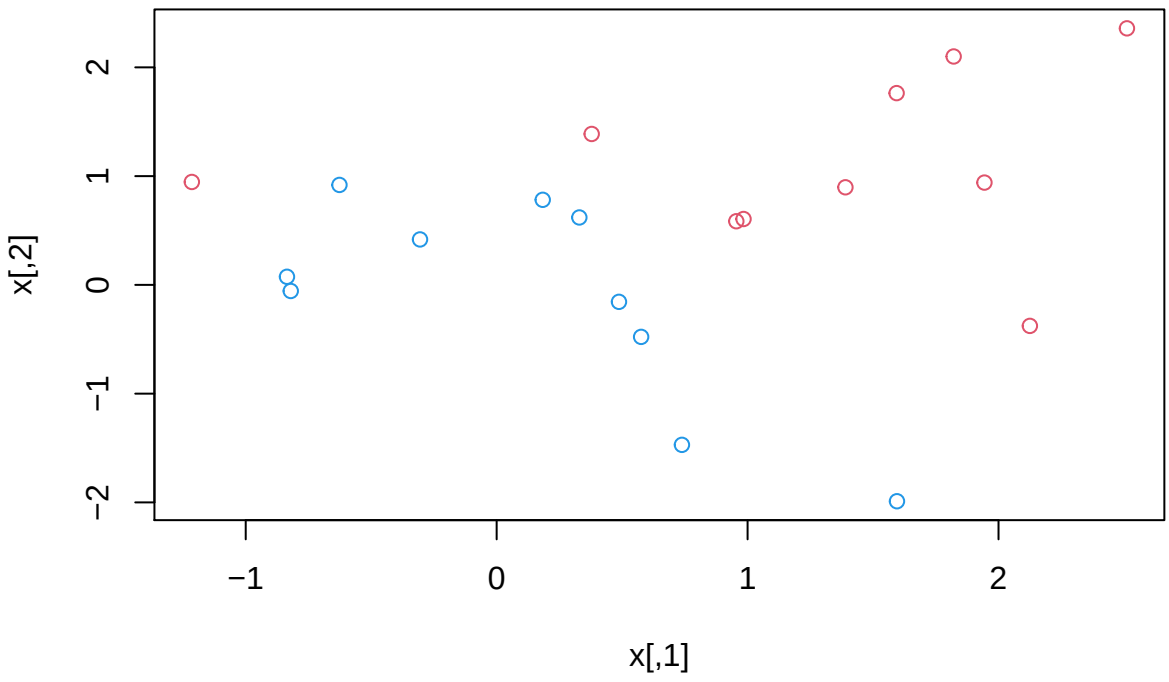
Contents

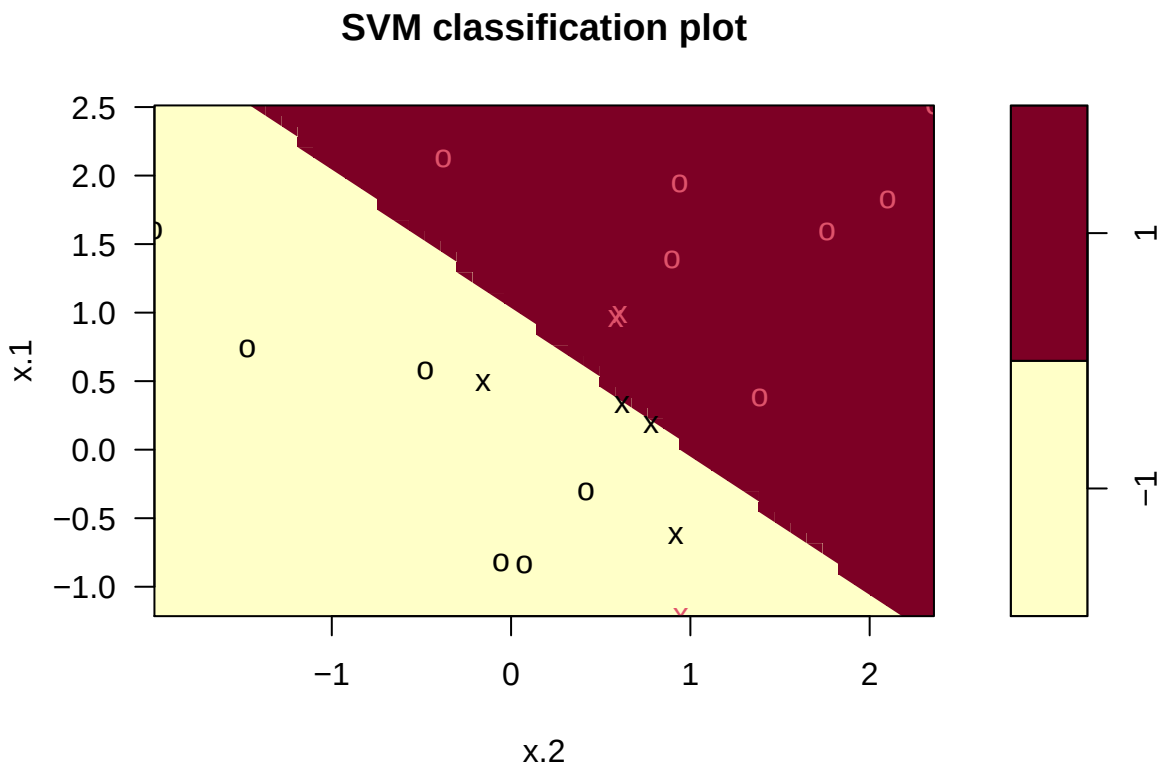
9.6.1 Support Vector Classifier

```
set.seed(1)
x=matrix(rnorm(20*2), ncol=2)
y=c(rep(-1,10), rep(1,10))
x[y==1,]=x[y==1,] + 1
plot(x, col=(3-y))
```




```
dat=data.frame(x=x, y=as.factor(y))
library(e1071)
```

```
svmfit=svm(y~., data=dat, kernel="linear", cost=10,scale=FALSE)
plot(svmfit, dat)
```



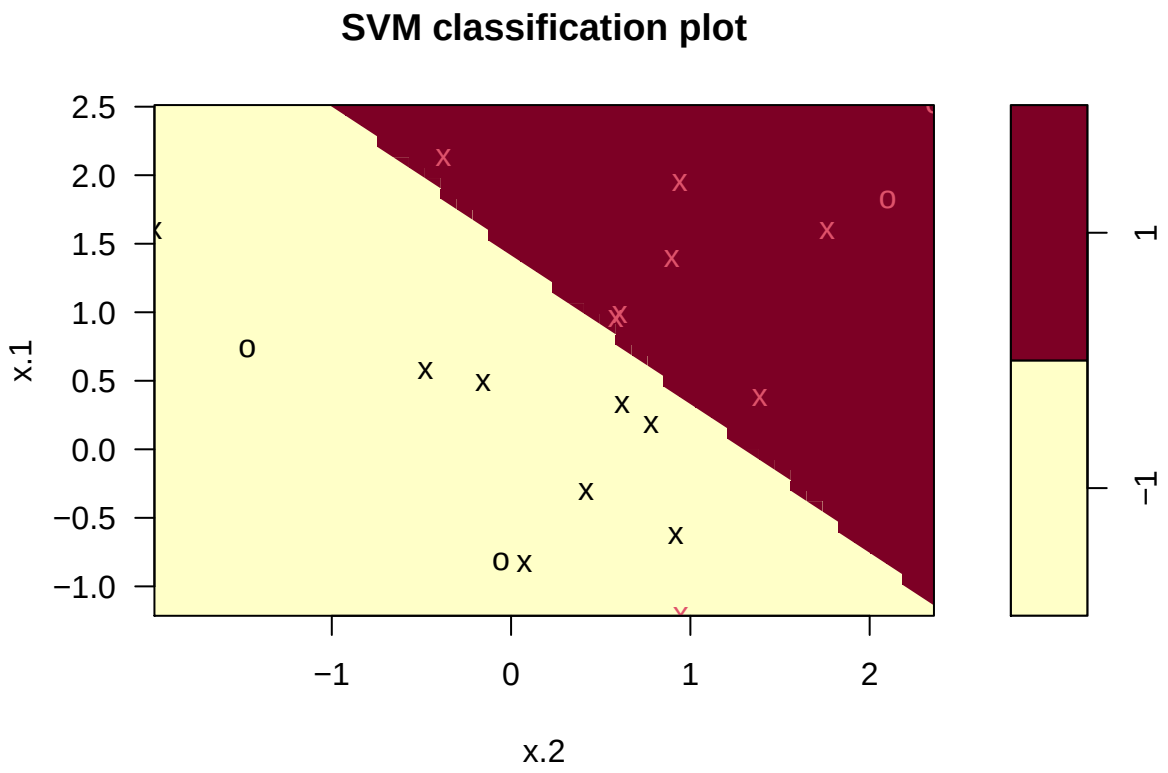

```
svmfit$index
```

```
## [1]  1  2  5  7 14 16 17
```

```
summary(svmfit)
```

```
##
## Call:
## svm(formula = y ~ ., data = dat, kernel = "linear", cost = 10, scale = FALSE)
##
##
## Parameters:
##    SVM-Type:  C-classification
##  SVM-Kernel:  linear
##        cost:  10
##
## Number of Support Vectors:  7
##
##  ( 4 3 )
##
##
## Number of Classes:  2
##
## Levels:
##  -1 1
```

```
svmfit=svm(y~., data=dat, kernel="linear", cost=0.1,scale=FALSE)
plot(svmfit, dat)
```




```
svmfit$index
```

```
##  [1]  1  2  3  4  5  7  9 10 12 13 14 15 16 17 18 20
```

```
set.seed(1)
tune.out=tune(svm,y~.,data=dat,kernel="linear",ranges=list(cost=c(0.001, 0.01, 0.1, 1,5,10,100)))
summary(tune.out)
```

```
##
## Parameter tuning of 'svm':
##
## - sampling method: 10-fold cross validation
##
## - best parameters:
##  cost
##   0.1
##
## - best performance: 0.05
##
## - Detailed performance results:
##    cost error dispersion
```

```
## 1 1e-03  0.55  0.4377975
## 2 1e-02  0.55  0.4377975
## 3 1e-01  0.05  0.1581139
## 4 1e+00  0.15  0.2415229
## 5 5e+00  0.15  0.2415229
## 6 1e+01  0.15  0.2415229
## 7 1e+02  0.15  0.2415229
```

```
bestmod=tune.out$best.model
summary(bestmod)
```

```
##
## Call:
## best.tune(method = svm, train.x = y ~ ., data = dat, ranges = list(cost = c(0.001,
##     0.01, 0.1, 1, 5, 10, 100)), kernel = "linear")
##
##
## Parameters:
##    SVM-Type:  C-classification
##  SVM-Kernel:  linear
##        cost:  0.1
##
## Number of Support Vectors:  16
##
##  ( 8 8 )
##
##
## Number of Classes:  2
##
## Levels:
##  -1 1
```

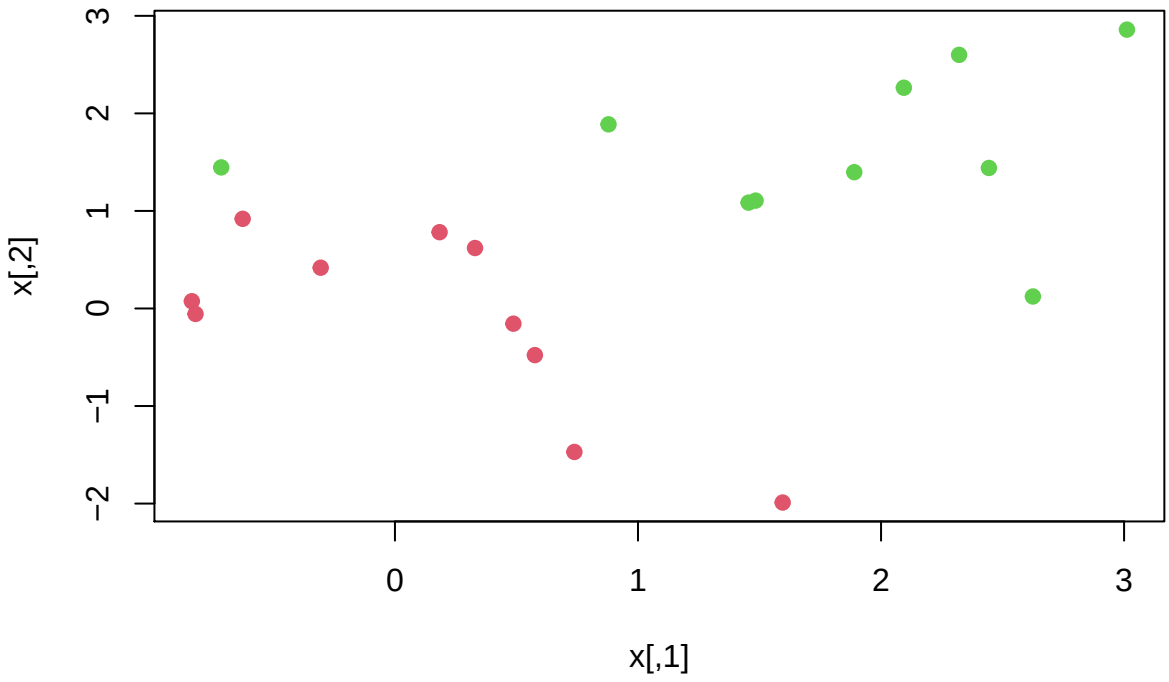
```
xtest=matrix(rnorm(20*2), ncol=2)
ytest=sample(c(-1,1), 20, rep=TRUE)
xtest[ytest==1,]=xtest[ytest==1,] + 1
testdat=data.frame(x=xtest, y=as.factor(ytest))
ypred=predict(bestmod,testdat)
table(predict=ypred, truth=testdat$y)
```

```
##        truth
## predict -1 1
##      -1  9 1
##      1   2 8
```

```
svmfit=svm(y~., data=dat, kernel="linear", cost=.01,scale=FALSE)
ypred=predict(svmfit,testdat)
table(predict=ypred, truth=testdat$y)
```

```
##        truth
## predict -1  1
##      -1 11  6
##      1   0  3
```

```r
x[y==1,]=x[y==1,]+0.5
plot(x, col=(y+5)/2, pch=19)
```

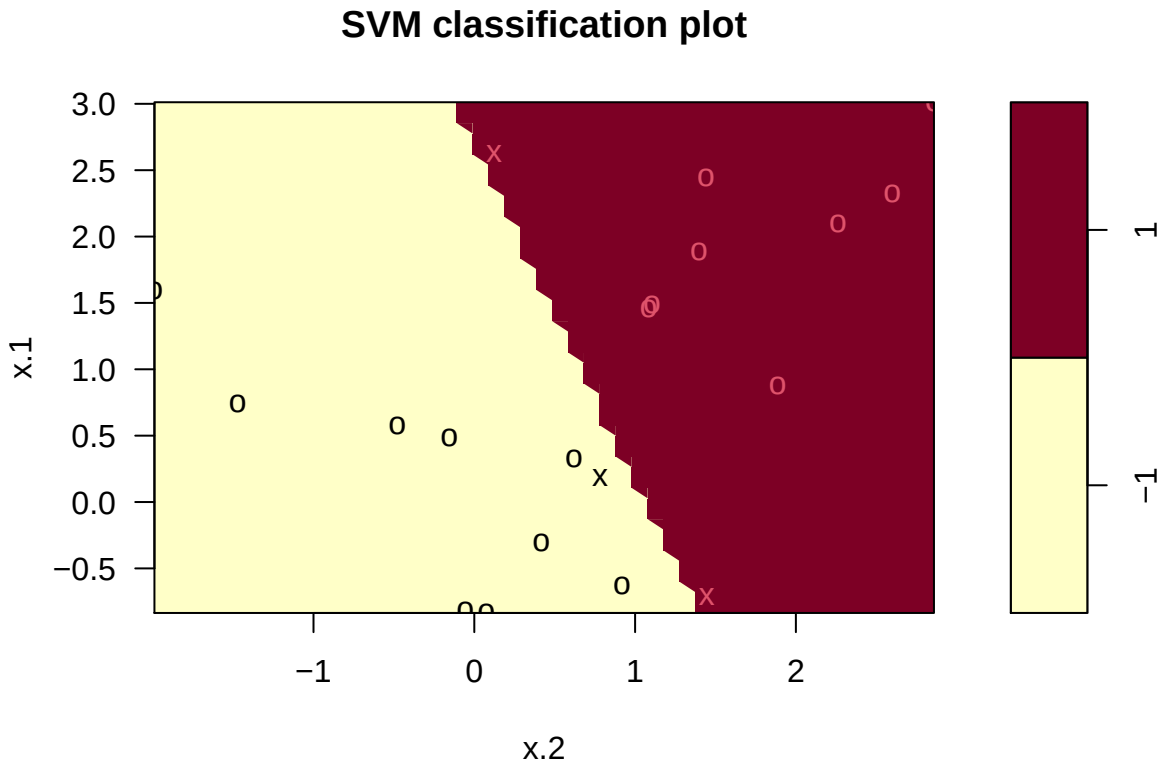



```r
dat=data.frame(x=x,y=as.factor(y))
svmfit=svm(y~., data=dat, kernel="linear", cost=1e5)
summary(svmfit)
```

```
##
## Call:
## svm(formula = y ~ ., data = dat, kernel = "linear", cost = 1e+05)
##
##
## Parameters:
##    SVM-Type:  C-classification
##  SVM-Kernel:  linear
##        cost:  1e+05
##
## Number of Support Vectors:  3
##
##  ( 1 2 )
##
##
## Number of Classes:  2
##
## Levels:
```

```
##  -1 1
```

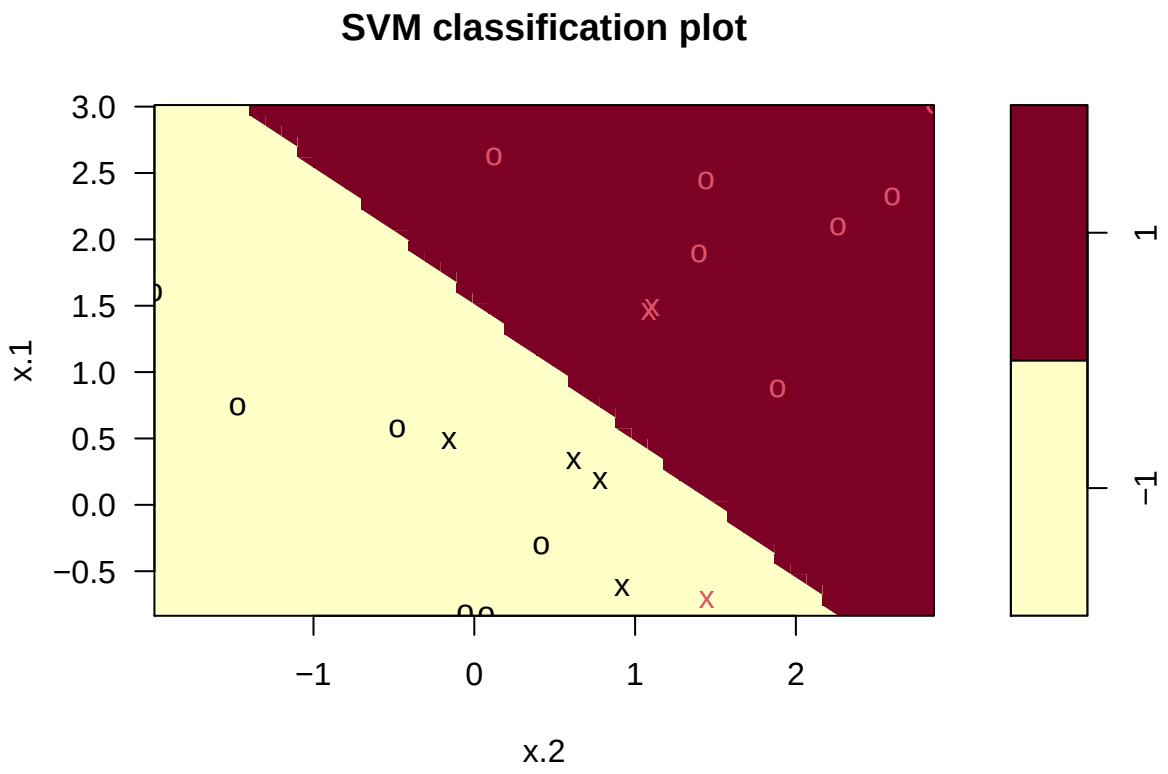
```
plot(svmfit, dat)
```




```
svmfit=svm(y~., data=dat, kernel="linear", cost=1)
summary(svmfit)
```

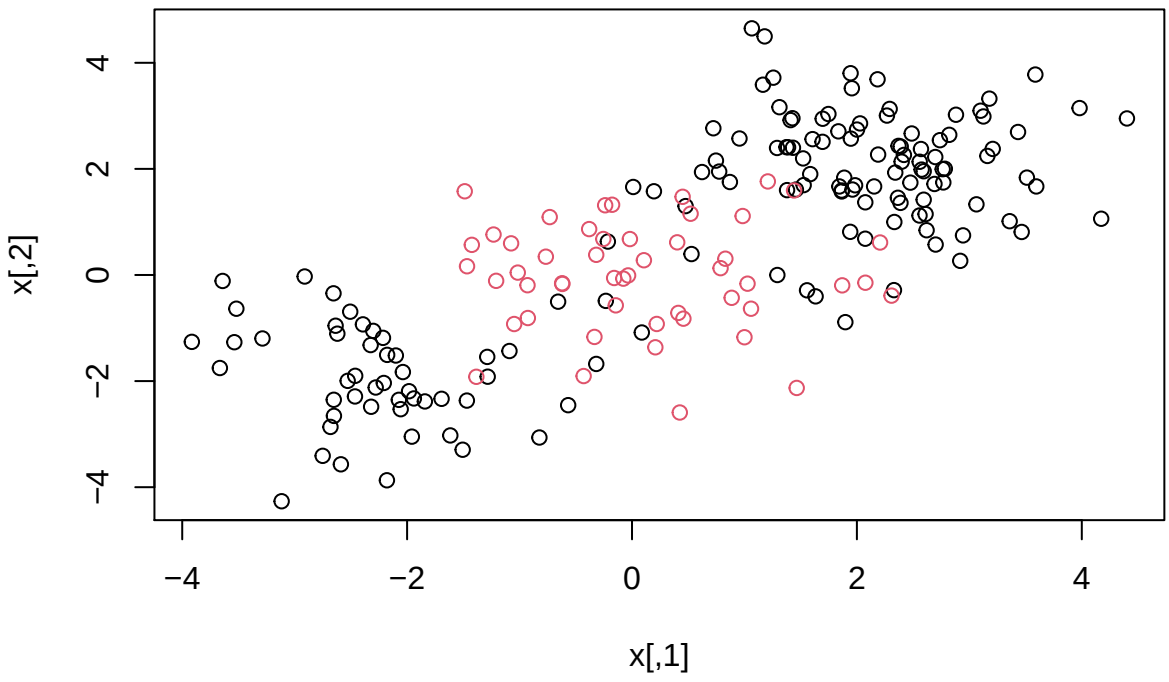
```
##
## Call:
## svm(formula = y ~ ., data = dat, kernel = "linear", cost = 1)
##
##
## Parameters:
##    SVM-Type:  C-classification
##  SVM-Kernel:  linear
##        cost:  1
##
## Number of Support Vectors:  7
##
##  ( 4 3 )
##
##
## Number of Classes:  2
##
## Levels:
##  -1 1
```

```
plot(svmfit,dat)
```

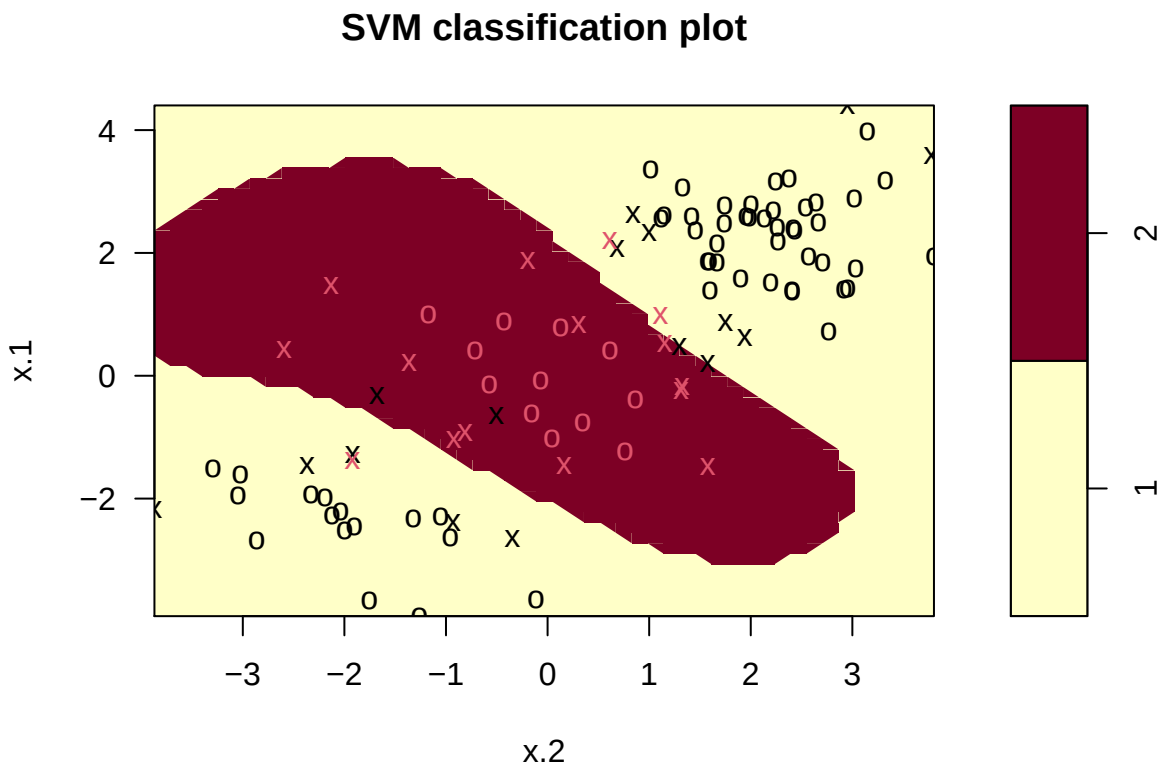


9.6.2 Support Vector Machine

```
set.seed (1)
x = matrix (rnorm (200 * 2) , ncol = 2)
x[1:100 , ] = x[1:100 , ] + 2
x[101:150 , ] = x[101:150 , ] - 2
y = c(rep (1 , 150) , rep (2 , 50))
dat = data.frame(x = x, y = as.factor (y))
plot(x, col=y)
```




```
train = sample (200 , 100)
svmfit = svm(y~.,data = dat [train , ],kernel ="radial",
gamma = 1,cost = 1)
plot(svmfit , dat[train , ])
```

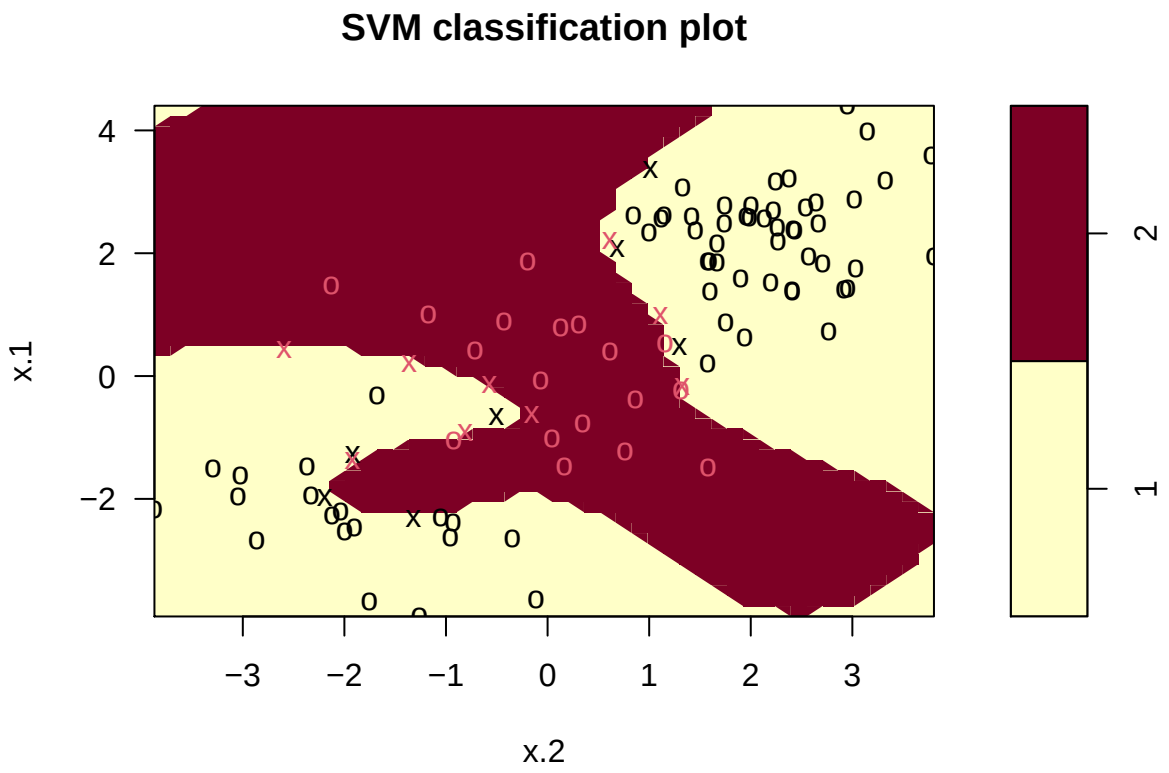



```
summary (svmfit)
```

```
##
## Call:
## svm(formula = y ~ ., data = dat[train, ], kernel = "radial", gamma = 1,
##     cost = 1)
##
##
## Parameters:
##    SVM-Type:  C-classification
##  SVM-Kernel:  radial
##        cost:  1
##
## Number of Support Vectors:  31
##
##  ( 16 15 )
##
##
## Number of Classes:  2
##
## Levels:
##  1 2
```

```
svmfit = svm(y~.,data = dat [train , ],kernel ="radial",
gamma = 1,cost = 1e5)
```

```
plot(svmfit , dat [train , ])
```




```
set.seed (1)
tune.out = tune(svm,y~.,data = dat[train , ],kernel ="radial",
ranges = list(cost = c(0.1 , 1 , 10 , 100 , 1000),
              gamma = c(0.5, 1, 2, 3, 4)))
summary (tune.out)
```

```
##
## Parameter tuning of 'svm':
##
## - sampling method: 10-fold cross validation
##
## - best parameters:
##  cost gamma
##     1   0.5
##
## - best performance: 0.07
##
## - Detailed performance results:
##    cost gamma error dispersion
## 1  1e-01   0.5  0.26 0.15776213
## 2  1e+00   0.5  0.07 0.08232726
## 3  1e+01   0.5  0.07 0.08232726
## 4  1e+02   0.5  0.14 0.15055453
```

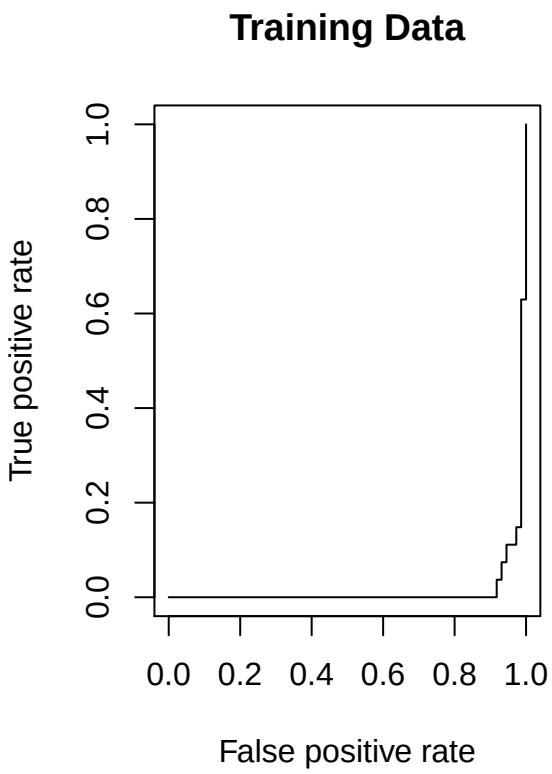
```
## 5  1e+03   0.5  0.11 0.07378648
## 6  1e-01   1.0  0.22 0.16193277
## 7  1e+00   1.0  0.07 0.08232726
## 8  1e+01   1.0  0.09 0.07378648
## 9  1e+02   1.0  0.12 0.12292726
## 10 1e+03   1.0  0.11 0.11005049
## 11 1e-01   2.0  0.27 0.15670212
## 12 1e+00   2.0  0.07 0.08232726
## 13 1e+01   2.0  0.11 0.07378648
## 14 1e+02   2.0  0.12 0.13165612
## 15 1e+03   2.0  0.16 0.13498971
## 16 1e-01   3.0  0.27 0.15670212
## 17 1e+00   3.0  0.07 0.08232726
## 18 1e+01   3.0  0.08 0.07888106
## 19 1e+02   3.0  0.13 0.14181365
## 20 1e+03   3.0  0.15 0.13540064
## 21 1e-01   4.0  0.27 0.15670212
## 22 1e+00   4.0  0.07 0.08232726
## 23 1e+01   4.0  0.09 0.07378648
## 24 1e+02   4.0  0.13 0.14181365
## 25 1e+03   4.0  0.15 0.13540064
```

```
table(true = dat[-train ,"y"],
pred = predict (tune.out$best.model , newdata = dat[-train , ]))
```

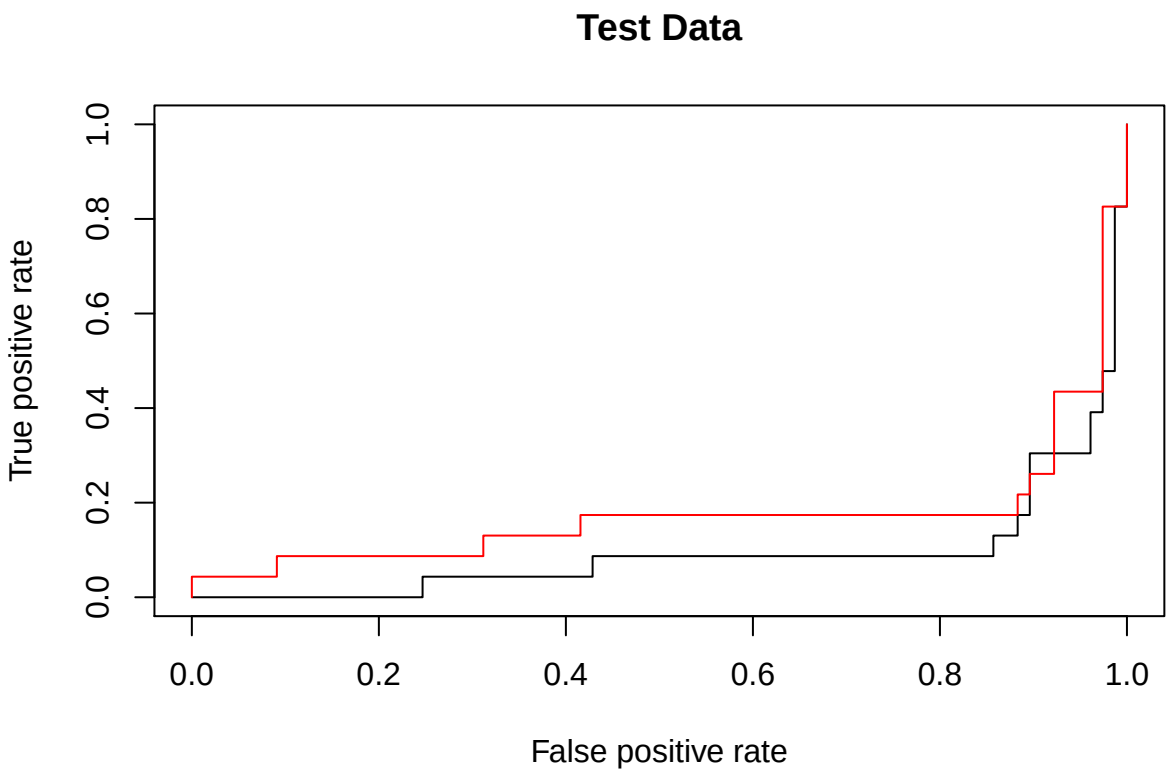
```
##     pred
## true  1  2
##    1 67 10
##    2  2 21
```

9.6.3 ROC Curves

```
library(ROCR)
rocplot = function (pred , truth , ...) {
  predob = prediction (pred , truth)
  perf = performance (predob ,"tpr","fpr")
  plot(perf , ...)
}

svmfit.opt = svm(y~.,data = dat[train , ],kernel ="radial",
gamma = 2,cost = 1,decision.values = T)

fitted =attributes (predict (svmfit.opt ,dat[train ,], decision.values =TRUE))$decision.values

par(mfrow=c(1,2))
rocplot (fitted ,dat[train ,"y"], main="Training Data")
```




```
svmfit.flex=svm(y~., data=dat[train ,], kernel ="radial",
gamma=50, cost=1, decision.values =T)
fitted=attributes (predict (svmfit.flex ,dat[train ,], decision.values=T))$decision.values
# rocplot(fitted,dat[train ,"y"],add=T,col="red")

fitted =attributes (predict (svmfit.opt ,dat[-train ,],
decision.values=T))$decision.values
rocplot (fitted ,dat[-train ,"y"], main="Test Data")
fitted=attributes (predict (svmfit.flex ,dat[- train ,],
decision.values=T))$decision.values
rocplot (fitted ,dat[-train ,"y"],add=T,col="red")
```


Test Data
True positive rate
False positive rate
0.0
0.2
0.4
0.6
0.8
1.0