

Implementation of Support Vector Machine Classification using R package - Caret for Heart Disease Recognition Dataset.

Expt No: 7 (b)

May 8, 2019

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Aim

Implementation of Support Vector Machine(SVM) using R package- Classification and Regression Training(CARET) for Heart Disease Recognition Dataset.

Description

1. Support Vector Machine:

- Support Vector Machine is a Supervised Learning Model.
- SVM can be applied for both classification and regression algorithms but predominantly used for classification problems.
- Support Vector Algorithm Working:
 - Input : Data points from the dataset (Heart Disease recognition dataset).
 - Output : Hyperplane - The line which best separates the tags.
 - Careful choice of Kernel function which decides the accuracy of the model.
- Advantages of using SVM for classification:
 - High Dimensionality.
 - Memory Efficiency.
 - Versatility.
- Disadvantages of using SVM:
 - Kernel Parameters Selection : SVM shows poor performance on higher dimensional data.
 - Non-Probabilistic : Effectiveness is less evident as the algorithm places few data points above and below the decision boundary which might lead to misclassification if the between class varients among points is less.

2. Classification hyperplane based on the data point's distribution is presented below:

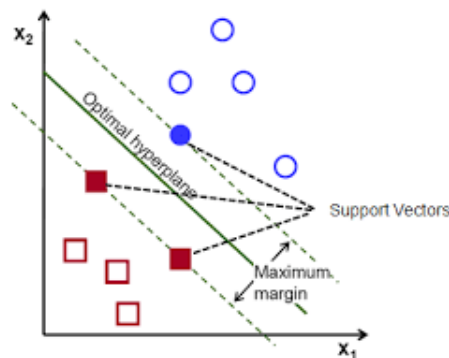


Figure 1: SVM Linear Model.

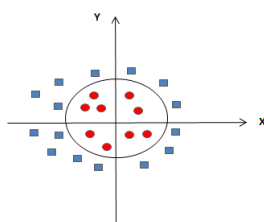


Figure 2: SVM Non Linear model by 3-D projection.

Tools and Packages

1. Tools

- RStudio.
- R Version 1.1.463

2. Support Vector Machine and Visualisation Packages

-
- ggplot2 (Visualisation)
- GGally (Visualisation)

Dataset Description - Heart Disease Databases

- This database contains 76 attributes, but all published experiments refer to using a subset of 14 of them.
- The "goal" field refers to the presence of heart disease in the patient. It is integer valued from 0 (no presence) to 4. Experiments with the Cleveland database have concentrated on simply attempting to distinguish presence (values 1,2,3,4) from absence (value 0).
- Number of instances in Heart Disease Dataset:
 - Cleveland: 303
 - Hungarian: 294
 - Switzerland: 123
 - Long Beach VA: 200
- Attribute information:

Variable name	Short description	Variable name	Short description
age	Age of patient	thalach	maximum heart rate achieved
sex	Sex, 1 for male	exang	exercise induced angina (1 yes)
cp	chest pain	oldpeak	ST depression induc. ex.
trestbps	resting blood pressure	slope	slope of peak exercise ST
chol	serum cholesterol	ca	number of major vessel
fbs	fasting blood sugar larger 120mg/dl (1 true)	thal	no explanation provided, but probably thalassemia (3 normal; 6 fixed defect; 7 reversable defect)
restecg	resting electroc. result (1 anomaly)	num	diagnosis of heart disease (angiographic disease status)

Figure 3: Heart Disease Detection Database important attributes.

Procedure

1. Split the data set as:
 - Training dataset.
 - Testing dataset.
2. Exploratory data Visualisation : To decide on the model to fit for a better precision in classification.
3. Feature Scaling and Model Fitting.
4. Calculate prediction and evaluate the SVM model/kernel accuracy.
5. Display the confusion matrix.

Support Vector Machine

- Support Vector Machine is a machine learning algorithm which:
 1. Solves classification problems.
 2. Uses flexible representation of decision boundary.
 3. Implements automatic complexity control to reduce overfitting.
 4. A single global minimum which can be found in polynomial time.
- Pseudocode :

- **Initialisation:**

- * For the specified kernel, and kernel parameters, compute the kernel of distances between the datapoints.
- * The main work here is the computation $K=XX^T$.
- * For the linear kernel, return K , for the polynomial of degree d return $\frac{1}{\sigma K^d}$.
- * For the RBF kernel, compute $K = \exp(-\frac{(x-x')^2}{2\sigma^2})$.

- **Training**

- * Assemble the constraint set as matrices to solve:

$$\min_x \frac{1}{2} x^T t_i t_j K_x + q^T x. \quad (1)$$

subject to $G_x \leq h$

$A_x = b$

- * Pass these matrices to the solver.
- * Identify the support vectors as those that are within some specified distance of the closest point and dispose of the rest of the training data.
- * Calculate b^* using equation:

$$b^* = \frac{1}{N_s} \sum_{all\ support\ vectors} (t_j - \sum_{i=1}^n \lambda_i t_i x_i^T x_j). \quad (2)$$

- **Classification**

- * For the given test data \mathbf{z} , Use the support vector to classify the data for the relevant kernel by :
 - Compute the inner product of the test data and the support vectors.
 - Perform the classification as:

$$\sum_{i=1}^n \lambda_i t_i K(x_i, z) + b^*. \quad (3)$$

returning -

The label (Hard Classification)

The value (Soft Classification)

Algorithm 1: The Support Vector Algorithm

Confusion Matrix

- A confusion matrix is a table that can be generated for a classifier on a Data Set

True Positives(TP)- These are the cases where the predicted and actual both are yes.

True Negatives(TN)- These are the cases where the predicted value is no and actual value is yes.

False Positive(FP)- These are the cases where the predicted value is yes and actual value is no.

False Negative(FN)- These are the cases where prediction is no and actual value is no.

Coding

```
# Use library TeachingDemos to save output and commands
library(TeachingDemos)

txtStart("svmOutput.txt")

# SVM Classification using Linear Kernel

# Importing SVM library caret

library(caret)

# Loading CSV file to data frame

heart_df <- read.csv("/home/subalakshmi/PCP1211DALab/PCP1211ExptSevenB/heart_tidy.csv", sep = ";")

# Showing the dataset description

# str(heart_df)

# head(heart_df)

# Split dataset for training and testing

set.seed(3033)
intrain <- createDataPartition(y = heart_df$V14, p = 0.7, list = FALSE)
training <- heart_df[intrain,]
testing <- heart_df[-intrain,]

# Printing the dimension
dim(training)
dim(testing)

# Preprocessing dataset - checking missing values
anyNA(heart_df)

# Summary Stats

summary(heart_df)

# Converting target to factor variable

training[["V14"]] = factor(training[["V14"]])

# Training SVM model

trctrl <- trainControl(method = "repeatedcv", number = 10, repeats = 3)
set.seed(3233)
```

```

svm_Linear <- train(V14 ~., data = training, method = "svmLinear",
                    trControl=trctrl,
                    preProcess = c("center", "scale"),
                    tuneLength = 10)

# Printing trained SVM model

# svm_Linear

# Predicting the model

test_pred <- predict(svm_Linear, newdata = testing)

# Printing the prediction

#str(test_pred)

# Confusion Matrix

confusionMatrix(factor(test_pred, levels = 1:148),
                 factor(testing$V14, levels = 1:148))
# Parameter Tuning

grid <- expand.grid(C = c(0,0.01, 0.05, 0.1, 0.25, 0.5, 0.75, 1, 1.25, 1.5, 1.75, 2,5))
set.seed(3233)
svm_Linear_Grid <- train(V14 ~., data = training, method = "svmLinear",
                        trControl=trctrl,
                        preProcess = c("center", "scale"),
                        tuneGrid = grid,
                        tuneLength = 10)
plot(svm_Linear_Grid, main = "SVM Linear Grid")
#Prediction – with tuning exprementation

test_pred_grid <- predict(svm_Linear_Grid, newdata = testing)
#test_pred_grid

#Confusion matrix

confusionMatrix(factor(test_pred_grid, levels = 1:148),
                 factor(testing$V14, levels = 1:148))

# SVM Classification for Non Linear Kernal – RBF
set.seed(3233)
svm_Radial <- train(V14 ~., data = training, method = "svmRadial",
                    trControl=trctrl,
                    preProcess = c("center", "scale"),
                    tuneLength = 10)

# Visualisation SVM –RBF Kernal
plot(svm_Radial, main= "SVM with RBF Kernal")

# Prediction of RBF trained model
test_pred_Radial <- predict(svm_Radial, newdata = testing)
confusionMatrix(factor(test_pred_Radial, levels = 1:148),
                 factor(testing$V14, levels = 1:148))

# Tuning parameters of SVM – RBF

```

```

grid_radial <- expand.grid(sigma = c(0,0.01, 0.02, 0.025, 0.03, 0.04,
                                     0.05, 0.06, 0.07,0.08, 0.09, 0.1, 0.25, 0.5, 0.75,0.9
                                     C = c(0,0.01, 0.05, 0.1, 0.25, 0.5, 0.75,
                                           1, 1.5, 2,5))

set.seed(3233)
svm_Radial_Grid <- train(V14 ~., data = training, method = "svmRadial",
                        trControl=trctrl,
                        preProcess = c("center", "scale"),
                        tuneGrid = grid_radial,
                        tuneLength = 10)

#svm_Radial_Grid

# Visualisation
plot(svm_Radial_Grid, main="SVM RBF after tuning")
# Prediction with tuning
test_pred_Radial_Grid <- predict(svm_Radial_Grid, newdata = testing)

# Confusion Matrix
confusionMatrix(
  factor(test_pred_Radial_Grid, levels = 1:148),
  factor(testing$V14, levels = 1:148) )

txtStop()

```

Output

```

> library(caret)
> heart_df <- read.csv("/home/subalakshmi/PCP1211DALab/PCP1211ExptSevenB/heart_tidy.csv",
+ sep = ",", header = FALSE)
> str(heart_df)
'data.frame': 300 obs. of  14 variables:
 $ V1 : int  63 67 67 37 41 56 62 57 63 53 ...
 $ V2 : int  1 1 1 1 0 1 0 0 1 1 ...
 $ V3 : int  1 4 4 3 2 2 4 4 4 4 ...
 $ V4 : int  145 160 120 130 130 120 140 120 130 140 ...
 $ V5 : int  233 286 229 250 204 236 268 354 254 203 ...
 $ V6 : int  1 0 0 0 0 0 0 0 0 1 ...
 $ V7 : int  2 2 2 0 2 0 2 0 2 2 ...
 $ V8 : int  150 108 129 187 172 178 160 163 147 155 ...
 $ V9 : int  0 1 1 0 0 0 0 1 0 1 ...
 $ V10: num  2.3 1.5 2.6 3.5 1.4 0.8 3.6 0.6 1.4 3.1 ...
 $ V11: int  3 2 2 3 1 1 3 1 2 3 ...
 $ V12: int  0 3 2 0 0 0 2 0 1 0 ...
 $ V13: int  6 3 7 3 3 3 3 7 7 ...
 $ V14: int  0 1 1 0 0 0 1 0 1 1 ...
> head(heart_df)
  V1 V2 V3  V4  V5 V6 V7  V8 V9 V10 V11 V12 V13 V14
1 63  1  1 145 233  1  2 150  0 2.3  3  0  6  0
2 67  1  4 160 286  0  2 108  1 1.5  2  3  3  1
3 67  1  4 120 229  0  2 129  1 2.6  2  2  7  1
4 37  1  3 130 250  0  0 187  0 3.5  3  0  3  0
5 41  0  2 130 204  0  2 172  0 1.4  1  0  3  0
6 56  1  2 120 236  0  0 178  0 0.8  1  0  3  0
> set.seed(3033)
> intrain <- createDataPartition(y = heart_df$V14, p = 0.7, list = FALSE)
> training <- heart_df[intrain, ]
> testing <- heart_df[-intrain, ]

```

```

> dim(training)
[1] 210 14
> dim(testing)
[1] 90 14
> anyNA(heart_df)
[1] FALSE
> summary(heart_df)
      V1      V2      V3      V4      V5
Min.   :29.00  Min.   :0.00  Min.   :1.000  Min.   : 94.0  Min.   :126.0
1st Qu.:48.00  1st Qu.:0.00  1st Qu.:3.000  1st Qu.:120.0  1st Qu.:211.0
Median :56.00  Median :1.00  Median :3.000  Median :130.0  Median :241.5
Mean   :54.48  Mean   :0.68  Mean   :3.153  Mean   :131.6  Mean   :246.9
3rd Qu.:61.00  3rd Qu.:1.00  3rd Qu.:4.000  3rd Qu.:140.0  3rd Qu.:275.2
Max.   :77.00  Max.   :1.00  Max.   :4.000  Max.   :200.0  Max.   :564.0
      V6      V7      V8      V9     V10
Min.   :0.0000  Min.   :0.0000  Min.   : 71.0  Min.   :0.0000  Min.   :0.00
1st Qu.:0.0000  1st Qu.:0.0000  1st Qu.:133.8  1st Qu.:0.0000  1st Qu.:0.00
Median :0.0000  Median :0.5000  Median :153.0  Median :0.0000  Median :0.80
Mean   :0.1467  Mean   :0.9867  Mean   :149.7  Mean   :0.3267  Mean   :1.05
3rd Qu.:0.0000  3rd Qu.:2.0000  3rd Qu.:166.0  3rd Qu.:1.0000  3rd Qu.:1.60
Max.   :1.0000  Max.   :2.0000  Max.   :202.0  Max.   :1.0000  Max.   :6.20
      V11     V12     V13     V14
Min.   :1.000  Min.   :0.00  Min.   :3.000  Min.   :0.00
1st Qu.:1.000  1st Qu.:0.00  1st Qu.:3.000  1st Qu.:0.00
Median :2.000  Median :0.00  Median :3.000  Median :0.00
Mean   :1.603  Mean   :0.67  Mean   :4.727  Mean   :0.46
3rd Qu.:2.000  3rd Qu.:1.00  3rd Qu.:7.000  3rd Qu.:1.00
Max.   :3.000  Max.   :3.00  Max.   :7.000  Max.   :1.00
> training[["V14"]] = factor(training[["V14"]])
> trctrl <- trainControl(method = "repeatedcv", number = 10, repeats = 3)
> set.seed(3233)
> svm_Linear <- train(V14 ~ ., data = training, method = "svmLinear",
+ trControl = trctrl, preProcess = c("center", "scale"), tuneLength = 10)
> svm_Linear
Support Vector Machines with Linear Kernel

210 samples
13 predictor
2 classes: '0', '1'

Pre-processing: centered (13), scaled (13)
Resampling: Cross-Validated (10 fold, repeated 3 times)
Summary of sample sizes: 189, 189, 189, 189, 189, 189, 189, ...
Resampling results:

Accuracy   Kappa
0.7920635  0.581696

Tuning parameter 'C' was held constant at a value of 1
> test_pred <- predict(svm_Linear, newdata = testing)
> str(test_pred)
Factor w/ 2 levels "0","1": 1 2 2 2 1 1 2 1 1 2 ...
> confusionMatrix(factor(test_pred, levels = 1:148), factor(testing$V14,
+ levels = 1:148))
Confusion Matrix and Statistics

      Reference
Prediction 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

```


Accuracy : 1
 95% CI : (0.8942, 1)
 No Information Rate : 1
 P-Value [Acc > NIR] : 1

Kappa : NaN

Mcnemar's Test P-Value : NA

Statistics by Class:

	Class: 1	Class: 2	Class: 3	Class: 4	Class: 5	Class: 6
Sensitivity	1	NA	NA	NA	NA	NA
Specificity	NA	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	1	0	0	0	0	0
Detection Rate	1	0	0	0	0	0

	Class: 7	Class: 8	Class: 9	Class: 10	Class: 11	Class: 12
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 13	Class: 14	Class: 15	Class: 16	Class: 17	Class: 18
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 19	Class: 20	Class: 21	Class: 22	Class: 23	Class: 24
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 25	Class: 26	Class: 27	Class: 28	Class: 29	Class: 30
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 31	Class: 32	Class: 33	Class: 34	Class: 35	Class: 36
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 37	Class: 38	Class: 39	Class: 40	Class: 41	Class: 42
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA

Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 43	Class: 44	Class: 45	Class: 46	Class: 47	Class: 48
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 49	Class: 50	Class: 51	Class: 52	Class: 53	Class: 54
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 55	Class: 56	Class: 57	Class: 58	Class: 59	Class: 60
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 61	Class: 62	Class: 63	Class: 64	Class: 65	Class: 66
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 67	Class: 68	Class: 69	Class: 70	Class: 71	Class: 72
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 73	Class: 74	Class: 75	Class: 76	Class: 77	Class: 78
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 79	Class: 80	Class: 81	Class: 82	Class: 83	Class: 84
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 85	Class: 86	Class: 87	Class: 88	Class: 89	Class: 90
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 91	Class: 92	Class: 93	Class: 94	Class: 95	Class: 96
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 97	Class: 98	Class: 99	Class: 100	Class: 101	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 102	Class: 103	Class: 104	Class: 105	Class: 106	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 107	Class: 108	Class: 109	Class: 110	Class: 111	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 112	Class: 113	Class: 114	Class: 115	Class: 116	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 117	Class: 118	Class: 119	Class: 120	Class: 121	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 122	Class: 123	Class: 124	Class: 125	Class: 126	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 127	Class: 128	Class: 129	Class: 130	Class: 131	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 132	Class: 133	Class: 134	Class: 135	Class: 136	
Sensitivity	NA	NA	NA	NA	NA	

```

Specificity          1          1          1          1          1
Pos Pred Value       NA         NA         NA         NA         NA
Neg Pred Value       NA         NA         NA         NA         NA
Prevalence           0          0          0          0          0
Detection Rate       0          0          0          0          0
Class: 137 Class: 138 Class: 139 Class: 140 Class: 141
Sensitivity          NA         NA         NA         NA         NA
Specificity          1          1          1          1          1
Pos Pred Value       NA         NA         NA         NA         NA
Neg Pred Value       NA         NA         NA         NA         NA
Prevalence           0          0          0          0          0
Detection Rate       0          0          0          0          0
Class: 142 Class: 143 Class: 144 Class: 145 Class: 146
Sensitivity          NA         NA         NA         NA         NA
Specificity          1          1          1          1          1
Pos Pred Value       NA         NA         NA         NA         NA
Neg Pred Value       NA         NA         NA         NA         NA
Prevalence           0          0          0          0          0
Detection Rate       0          0          0          0          0
Class: 147 Class: 148
Sensitivity          NA         NA
Specificity          1          1
Pos Pred Value       NA         NA
Neg Pred Value       NA         NA
Prevalence           0          0
Detection Rate       0          0
[ reached getOption("max.print") -- omitted 2 rows ]
> grid <- expand.grid(C = c(0, 0.01, 0.05, 0.1, 0.25, 0.5, 0.75,
+ 1, 1.25, 1.5, 1.75, 2, 5))
> set.seed(3233)
> svm_Linear_Grid <- train(V14 ~ ., data = training, method = "svmLinear",
+ trControl = trctrl, preProcess = c("center", "scale"), tuneGrid = grid,
+ tuneLength = 10)
> plot(svm_Linear_Grid)
> test_pred_grid <- predict(svm_Linear_Grid, newdata = testing)
> test_pred_grid
[1] 0 1 1 1 0 0 1 0 0 1 0 1 0 1 1 1 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 1 0 0 0 1 1 1 1
[40] 1 0 0 1 0 0 1 0 1 1 1 1 0 1 1 1 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 1 1 0 1 1 0 0
[79] 0 1 0 1 1 0 1 0 0 0 1 0
Levels: 0 1
> confusionMatrix(factor(test_pred_grid, levels = 1:148), factor(testing$V14,
+ levels = 1:148))
Confusion Matrix and Statistics

```

```

      Reference
Prediction  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1      32  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
3       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
4       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
5       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
6       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
      Reference
Prediction 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
1       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
3       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
4       0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0

```

5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Reference

Prediction	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Reference

Prediction	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Reference

Prediction	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Reference

Prediction	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Reference

Prediction	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[reached getopt("max.print") -- omitted 142 rows]

Overall Statistics

Accuracy : 1
95% CI : (0.8911, 1)
No Information Rate : 1
P-Value [Acc > NIR] : 1

Kappa : NaN

Mcnemar's Test P-Value : NA

Statistics by Class:

Class: 1 Class: 2 Class: 3 Class: 4 Class: 5 Class: 6

Sensitivity	1	NA	NA	NA	NA	NA
Specificity	NA	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	1	0	0	0	0	0
Detection Rate	1	0	0	0	0	0
Class: 7 Class: 8 Class: 9 Class: 10 Class: 11 Class: 12						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
Class: 13 Class: 14 Class: 15 Class: 16 Class: 17 Class: 18						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
Class: 19 Class: 20 Class: 21 Class: 22 Class: 23 Class: 24						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
Class: 25 Class: 26 Class: 27 Class: 28 Class: 29 Class: 30						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
Class: 31 Class: 32 Class: 33 Class: 34 Class: 35 Class: 36						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
Class: 37 Class: 38 Class: 39 Class: 40 Class: 41 Class: 42						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
Class: 43 Class: 44 Class: 45 Class: 46 Class: 47 Class: 48						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
Class: 49 Class: 50 Class: 51 Class: 52 Class: 53 Class: 54						
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1

Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 55	Class: 56	Class: 57	Class: 58	Class: 59	Class: 60
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 61	Class: 62	Class: 63	Class: 64	Class: 65	Class: 66
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 67	Class: 68	Class: 69	Class: 70	Class: 71	Class: 72
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 73	Class: 74	Class: 75	Class: 76	Class: 77	Class: 78
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 79	Class: 80	Class: 81	Class: 82	Class: 83	Class: 84
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 85	Class: 86	Class: 87	Class: 88	Class: 89	Class: 90
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 91	Class: 92	Class: 93	Class: 94	Class: 95	Class: 96
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 97	Class: 98	Class: 99	Class: 100	Class: 101	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	

Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 102	Class: 103	Class: 104	Class: 105	Class: 106
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 107	Class: 108	Class: 109	Class: 110	Class: 111
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 112	Class: 113	Class: 114	Class: 115	Class: 116
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 117	Class: 118	Class: 119	Class: 120	Class: 121
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 122	Class: 123	Class: 124	Class: 125	Class: 126
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 127	Class: 128	Class: 129	Class: 130	Class: 131
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 132	Class: 133	Class: 134	Class: 135	Class: 136
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 137	Class: 138	Class: 139	Class: 140	Class: 141
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0

```

Class: 142 Class: 143 Class: 144 Class: 145 Class: 146
Sensitivity      NA      NA      NA      NA      NA
Specificity      1       1       1       1       1
Pos Pred Value   NA      NA      NA      NA      NA
Neg Pred Value   NA      NA      NA      NA      NA
Prevalence       0       0       0       0       0
Detection Rate   0       0       0       0       0
Class: 147 Class: 148
Sensitivity      NA      NA
Specificity      1       1
Pos Pred Value   NA      NA
Neg Pred Value   NA      NA
Prevalence       0       0
Detection Rate   0       0
[ reached getOption("max.print") -- omitted 2 rows ]
> set.seed(3233)
> svm_Radial <- train(V14 ~ ., data = training, method = "svmRadial",
+ trControl = trctrl, preProcess = c("center", "scale"), tuneLength = 10)
> plot(svm_Radial)
> test_pred_Radial <- predict(svm_Radial, newdata = testing)
> confusionMatrix(factor(test_pred_Radial, levels = 1:148), factor(testing$V14,
+ levels = 1:148))
Confusion Matrix and Statistics

```

	Reference																							
Prediction	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Reference																							
Prediction	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Reference																							
Prediction	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Reference																							
Prediction	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Reference													
Prediction	97	98	99	100	101	102	103	104	105	106	107	108	109	110

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

Reference

Prediction	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Reference

Prediction	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[reached getOption("max.print") -- omitted 142 rows]

Overall Statistics

Accuracy : 1
95% CI : (0.8911, 1)
No Information Rate : 1
P-Value [Acc > NIR] : 1

Kappa : NaN

Mcnemar's Test P-Value : NA

Statistics by Class:

	Class: 1	Class: 2	Class: 3	Class: 4	Class: 5	Class: 6
Sensitivity	1	NA	NA	NA	NA	NA
Specificity	NA	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	1	0	0	0	0	0
Detection Rate	1	0	0	0	0	0
	Class: 7	Class: 8	Class: 9	Class: 10	Class: 11	Class: 12
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 13	Class: 14	Class: 15	Class: 16	Class: 17	Class: 18
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 19	Class: 20	Class: 21	Class: 22	Class: 23	Class: 24
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 25	Class: 26	Class: 27	Class: 28	Class: 29	Class: 30
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 31	Class: 32	Class: 33	Class: 34	Class: 35	Class: 36
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 37	Class: 38	Class: 39	Class: 40	Class: 41	Class: 42
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 43	Class: 44	Class: 45	Class: 46	Class: 47	Class: 48
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 49	Class: 50	Class: 51	Class: 52	Class: 53	Class: 54
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 55	Class: 56	Class: 57	Class: 58	Class: 59	Class: 60
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 61	Class: 62	Class: 63	Class: 64	Class: 65	Class: 66
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 67	Class: 68	Class: 69	Class: 70	Class: 71	Class: 72
Sensitivity	NA	NA	NA	NA	NA	NA

Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 73	Class: 74	Class: 75	Class: 76	Class: 77	Class: 78
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 79	Class: 80	Class: 81	Class: 82	Class: 83	Class: 84
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 85	Class: 86	Class: 87	Class: 88	Class: 89	Class: 90
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 91	Class: 92	Class: 93	Class: 94	Class: 95	Class: 96
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 97	Class: 98	Class: 99	Class: 100	Class: 101	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 102	Class: 103	Class: 104	Class: 105	Class: 106	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 107	Class: 108	Class: 109	Class: 110	Class: 111	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 112	Class: 113	Class: 114	Class: 115	Class: 116	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	

Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 117	Class: 118	Class: 119	Class: 120	Class: 121
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 122	Class: 123	Class: 124	Class: 125	Class: 126
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 127	Class: 128	Class: 129	Class: 130	Class: 131
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 132	Class: 133	Class: 134	Class: 135	Class: 136
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 137	Class: 138	Class: 139	Class: 140	Class: 141
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 142	Class: 143	Class: 144	Class: 145	Class: 146
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
	Class: 147	Class: 148			
Sensitivity	NA	NA			
Specificity	1	1			
Pos Pred Value	NA	NA			
Neg Pred Value	NA	NA			
Prevalence	0	0			
Detection Rate	0	0			

[reached getOption("max.print") -- omitted 2 rows]

```
> grid_radial <- expand.grid(sigma = c(0, 0.01, 0.02, 0.025, 0.03,
+ 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.25, 0.5, 0.75,
+ 0.9), C = c(0, 0.01, 0.05, 0.1, 0.25, 0.5, 0.75, 1, 1.5,
+ 2, 5))
> set.seed(3233)
```

```
> svm_Radial_Grid <- train(V14 ~ ., data = training, method = "svmRadial",
+ trControl = trctrl, preProcess = c("center", "scale"), tuneGrid = grid_radial,
+ tuneLength = 10)
> svm_Radial_Grid
```

Support Vector Machines with Radial Basis Function Kernel

```
210 samples
13 predictor
2 classes: '0', '1'
```

Pre-processing: centered (13), scaled (13)

Resampling: Cross-Validated (10 fold, repeated 3 times)

Summary of sample sizes: 189, 189, 189, 189, 189, 189, ...

Resampling results across tuning parameters:

sigma	C	Accuracy	Kappa
0.000	0.00	NaN	NaN
0.000	0.01	0.5238095	0.000000000
0.000	0.05	0.5238095	0.000000000
0.000	0.10	0.5238095	0.000000000
0.000	0.25	0.5238095	0.000000000
0.000	0.50	0.5238095	0.000000000
0.000	0.75	0.5238095	0.000000000
0.000	1.00	0.5238095	0.000000000
0.000	1.50	0.5238095	0.000000000
0.000	2.00	0.5238095	0.000000000
0.000	5.00	0.5238095	0.000000000
0.010	0.00	NaN	NaN
0.010	0.01	0.5238095	0.000000000
0.010	0.05	0.5238095	0.000000000
0.010	0.10	0.7904762	0.572773277
0.010	0.25	0.8111111	0.617503180
0.010	0.50	0.8190476	0.634519523
0.010	0.75	0.8174603	0.631528851
0.010	1.00	0.8174603	0.631352905
0.010	1.50	0.8190476	0.634666550
0.010	2.00	0.8190476	0.634666550
0.010	5.00	0.8111111	0.619121228
0.020	0.00	NaN	NaN
0.020	0.01	0.5238095	0.000000000
0.020	0.05	0.6952381	0.370309451
0.020	0.10	0.8174603	0.630021936
0.020	0.25	0.8222222	0.641206267
0.020	0.50	0.8142857	0.625078184
0.020	0.75	0.8174603	0.631528851
0.020	1.00	0.8190476	0.634722788
0.020	1.50	0.8111111	0.618915958
0.020	2.00	0.8095238	0.615630414
0.020	5.00	0.7904762	0.578177897
0.025	0.00	NaN	NaN
0.025	0.01	0.5238095	0.000000000
0.025	0.05	0.7571429	0.501717569
0.025	0.10	0.8158730	0.627180600
0.025	0.25	0.8158730	0.628156814
0.025	0.50	0.8142857	0.625105376
0.025	0.75	0.8158730	0.628419020
0.025	1.00	0.8142857	0.625368228
0.025	1.50	0.8095238	0.615630414

0.025	2.00	0.8079365	0.612375952
0.025	5.00	0.7825397	0.562431414
0.030	0.00	NaN	NaN
0.030	0.01	0.5238095	0.000000000
0.030	0.05	0.7666667	0.522491751
0.030	0.10	0.8158730	0.627327897
0.030	0.25	0.8158730	0.628215207
0.030	0.50	0.8126984	0.621968353
0.030	0.75	0.8142857	0.625280394
0.030	1.00	0.8111111	0.618944058
0.030	1.50	0.8095238	0.615630414
0.030	2.00	0.8000000	0.596829329
0.030	5.00	0.7746032	0.546420219
0.040	0.00	NaN	NaN
0.040	0.01	0.5238095	0.000000000
0.040	0.05	0.7777778	0.546099884
0.040	0.10	0.8142857	0.624457829
0.040	0.25	0.8158730	0.628098443
0.040	0.50	0.8111111	0.619061556
0.040	0.75	0.8095238	0.615862243
0.040	1.00	0.8079365	0.612522040
0.040	1.50	0.7968254	0.590465952
0.040	2.00	0.7888889	0.574894377
0.040	5.00	0.7682540	0.533689992
0.050	0.00	NaN	NaN
0.050	0.01	0.5238095	0.000000000
0.050	0.05	0.7746032	0.539466957
0.050	0.10	0.8142857	0.624780963
0.050	0.25	0.8158730	0.628098443
0.050	0.50	0.8126984	0.622345065
0.050	0.75	0.8063492	0.609411690
0.050	1.00	0.8063492	0.609383154
0.050	1.50	0.7888889	0.574836119
0.050	2.00	0.7761905	0.549556877
0.050	5.00	0.7650794	0.527295716
0.060	0.00	NaN	NaN
0.060	0.01	0.5238095	0.000000000
0.060	0.05	0.7587302	0.506304402
0.060	0.10	0.8111111	0.618300573
0.060	0.25	0.8126984	0.621881063
0.060	0.50	0.8079365	0.612610195
0.060	0.75	0.8015873	0.599880768
0.060	1.00	0.7952381	0.587007531
0.060	1.50	0.7793651	0.555802949
0.060	2.00	0.7793651	0.556185239
0.060	5.00	0.7603175	0.518483308
0.070	0.00	NaN	NaN
0.070	0.01	0.5238095	0.000000000
0.070	0.05	0.7365079	0.458840485
0.070	0.10	0.8111111	0.618330431
0.070	0.25	0.8063492	0.609094732
0.070	0.50	0.8063492	0.609443172
0.070	0.75	0.7952381	0.587095518
0.070	1.00	0.7904762	0.577855206
0.070	1.50	0.7761905	0.549499422
0.070	2.00	0.7761905	0.549790799
0.070	5.00	0.7571429	0.512342204
0.080	0.00	NaN	NaN

0.080	0.01	0.5238095	0.000000000
0.080	0.05	0.7015873	0.384579214
0.080	0.10	0.8063492	0.608623691
0.080	0.25	0.8079365	0.612787335
0.080	0.50	0.8015873	0.599970753
0.080	0.75	0.7952381	0.587185098
0.080	1.00	0.7841270	0.565155380
0.080	1.50	0.7793651	0.556038205
0.080	2.00	0.7714286	0.540317989
0.080	5.00	0.7571429	0.512520301
0.090	0.00	NaN	NaN
0.090	0.01	0.5238095	0.000000000
0.090	0.05	0.6571429	0.289294589
0.090	0.10	0.8063492	0.608476664
0.090	0.25	0.8079365	0.613251126
0.090	0.50	0.8000000	0.596745743
0.090	0.75	0.7936508	0.584014883
0.090	1.00	0.7809524	0.558792544
0.090	1.50	0.7761905	0.549791599
0.090	2.00	0.7698413	0.537236447
0.090	5.00	0.7619048	0.522375325
0.100	0.00	NaN	NaN
0.100	0.01	0.5238095	0.000000000
0.100	0.05	0.6142857	0.197118299
0.100	0.10	0.8095238	0.614631322
0.100	0.25	0.8111111	0.619993590
0.100	0.50	0.8000000	0.597123554
0.100	0.75	0.7920635	0.580877185
0.100	1.00	0.7809524	0.559381191
0.100	1.50	0.7746032	0.546822855
0.100	2.00	0.7682540	0.534499910
0.100	5.00	0.7587302	0.516073614
0.250	0.00	NaN	NaN
0.250	0.01	0.5238095	0.000000000
0.250	0.05	0.5238095	0.000000000
0.250	0.10	0.5253968	0.003475513
0.250	0.25	0.7253968	0.439136882
0.250	0.50	0.7476190	0.496851555
0.250	0.75	0.7380952	0.477159921
0.250	1.00	0.7460317	0.491597676
0.250	1.50	0.7301587	0.460075036
0.250	2.00	0.7285714	0.456789050
0.250	5.00	0.7253968	0.450540095
0.500	0.00	NaN	NaN
0.500	0.01	0.5238095	0.000000000
0.500	0.05	0.5238095	0.000000000
0.500	0.10	0.5238095	0.000000000
0.500	0.25	0.5238095	0.000000000
0.500	0.50	0.5682540	0.098762428
0.500	0.75	0.6126984	0.204503243
0.500	1.00	0.6888889	0.379763899
0.500	1.50	0.6841270	0.371094398
0.500	2.00	0.6904762	0.384000578
0.500	5.00	0.6888889	0.380945645
0.750	0.00	NaN	NaN
0.750	0.01	0.5238095	0.000000000
0.750	0.05	0.5238095	0.000000000
0.750	0.10	0.5238095	0.000000000

0.750	0.25	0.5238095	0.000000000
0.750	0.50	0.5301587	0.013902054
0.750	0.75	0.5571429	0.074827171
0.750	1.00	0.5809524	0.138239103
0.750	1.50	0.5968254	0.174064271
0.750	2.00	0.5984127	0.177738543
0.750	5.00	0.5984127	0.177738543
0.900	0.00	NaN	NaN
0.900	0.01	0.5238095	0.000000000
0.900	0.05	0.5238095	0.000000000
0.900	0.10	0.5238095	0.000000000
0.900	0.25	0.5238095	0.000000000
0.900	0.50	0.5238095	0.000000000
0.900	0.75	0.5492063	0.055825807
0.900	1.00	0.5444444	0.055132187
0.900	1.50	0.5555556	0.081488190
0.900	2.00	0.5555556	0.081488190
0.900	5.00	0.5555556	0.081488190

Accuracy was used to select the optimal model using the largest value.
The final values used for the model were sigma = 0.02 and C = 0.25.

```
> plot(svm_Radial_Grid)
> test_pred_Radial_Grid <- predict(svm_Radial_Grid, newdata = testing)
> confusionMatrix(factor(test_pred_Radial_Grid, levels = 1:148),
+ factor(testing$V14, levels = 1:148))
```

Confusion Matrix and Statistics

	Reference																							
Prediction	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Reference																							
Prediction	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Reference																							
Prediction	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Reference																							
Prediction	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

```

        6    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      Reference
Prediction 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114
1         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
3         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
4         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
5         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
6         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      Reference
Prediction 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132
1         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
3         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
4         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
5         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
6         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
      Reference
Prediction 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148
1         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
3         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
4         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
5         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
6         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
[ reached getOption("max.print") -- omitted 142 rows ]

```

Overall Statistics

```

      Accuracy : 1
      95% CI   : (0.8911, 1)
No Information Rate : 1
P-Value [Acc > NIR] : 1

```

Kappa : NaN

Mcnemar's Test P-Value : NA

Statistics by Class:

	Class: 1	Class: 2	Class: 3	Class: 4	Class: 5	Class: 6
Sensitivity	1	NA	NA	NA	NA	NA
Specificity	NA	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	1	0	0	0	0	0
Detection Rate	1	0	0	0	0	0

	Class: 7	Class: 8	Class: 9	Class: 10	Class: 11	Class: 12
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0

	Class: 13	Class: 14	Class: 15	Class: 16	Class: 17	Class: 18
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA

Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 19	Class: 20	Class: 21	Class: 22	Class: 23	Class: 24
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 25	Class: 26	Class: 27	Class: 28	Class: 29	Class: 30
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 31	Class: 32	Class: 33	Class: 34	Class: 35	Class: 36
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 37	Class: 38	Class: 39	Class: 40	Class: 41	Class: 42
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 43	Class: 44	Class: 45	Class: 46	Class: 47	Class: 48
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 49	Class: 50	Class: 51	Class: 52	Class: 53	Class: 54
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 55	Class: 56	Class: 57	Class: 58	Class: 59	Class: 60
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 61	Class: 62	Class: 63	Class: 64	Class: 65	Class: 66
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0

Detection Rate	0	0	0	0	0	0
	Class: 67	Class: 68	Class: 69	Class: 70	Class: 71	Class: 72
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 73	Class: 74	Class: 75	Class: 76	Class: 77	Class: 78
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 79	Class: 80	Class: 81	Class: 82	Class: 83	Class: 84
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 85	Class: 86	Class: 87	Class: 88	Class: 89	Class: 90
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 91	Class: 92	Class: 93	Class: 94	Class: 95	Class: 96
Sensitivity	NA	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0	0
Detection Rate	0	0	0	0	0	0
	Class: 97	Class: 98	Class: 99	Class: 100	Class: 101	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 102	Class: 103	Class: 104	Class: 105	Class: 106	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 107	Class: 108	Class: 109	Class: 110	Class: 111	
Sensitivity	NA	NA	NA	NA	NA	
Specificity	1	1	1	1	1	
Pos Pred Value	NA	NA	NA	NA	NA	
Neg Pred Value	NA	NA	NA	NA	NA	
Prevalence	0	0	0	0	0	
Detection Rate	0	0	0	0	0	
	Class: 112	Class: 113	Class: 114	Class: 115	Class: 116	

Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
Class: 117 Class: 118 Class: 119 Class: 120 Class: 121					
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
Class: 122 Class: 123 Class: 124 Class: 125 Class: 126					
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
Class: 127 Class: 128 Class: 129 Class: 130 Class: 131					
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
Class: 132 Class: 133 Class: 134 Class: 135 Class: 136					
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
Class: 137 Class: 138 Class: 139 Class: 140 Class: 141					
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
Class: 142 Class: 143 Class: 144 Class: 145 Class: 146					
Sensitivity	NA	NA	NA	NA	NA
Specificity	1	1	1	1	1
Pos Pred Value	NA	NA	NA	NA	NA
Neg Pred Value	NA	NA	NA	NA	NA
Prevalence	0	0	0	0	0
Detection Rate	0	0	0	0	0
Class: 147 Class: 148					
Sensitivity	NA	NA			
Specificity	1	1			
Pos Pred Value	NA	NA			
Neg Pred Value	NA	NA			
Prevalence	0	0			
Detection Rate	0	0			

[reached getOption("max.print") -- omitted 2 rows]

Result

Thus the implementation of Support Vector machine is executed successfully using R program.