

Homework: *R* for Classification, RBF SVM

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The aim of this homework is to revise classification using a dataset you are familiar with (*newhousing.txt*). This file can be found on the course directory. This file has thirteen explanatory variables. The last column is the class membership ('pricelevel'). There are two classes: 'below' and 'above'.

Step 1. Read the *newhousing.txt* file into a data frame and get the dimension of the dataset.

Answer:

```
mynewhousing <- read.table(file.choose(),header=T,stringsAsFactors=TRUE)
dim(mynewhousing)
```

Note: It is important to get familiar with the data you will be working with. It is important to know which are the explanatory variables (columns 1 to 13), and the class membership (column 14).

Step 2. Get a summary report for all the explanatory variables and the class split, i.e., the number of observations in each class. Recall that the class membership is given by the last column.

Answer:

```
summary(mynewhousing)
priceleveltable <- table(mynewhousing$pricelevel)
aboveinmynewhousing <- priceleveltable[1]/nrow(mynewhousing)
belowinmynewhousing <- priceleveltable[2]/nrow(mynewhousing)
```

Step 3. Reshuffle the dataset and take a subsample of 400 observations. Call this the *minihousing*. Call the remaining dataset the *testhousing*.

Answer:

```
set.seed(1)
reshuffle <- mynewhousing[sample(nrow(mynewhousing)),]
minihousing <- reshuffle[1:400,]
testhousing <- reshuffle[401: nrow(reshuffle),]
```

Note:

It is not asked in the question, but if you want the class split in the *minihousing* and the *testhousing* you can use these couple of lines. Please note that you will be able to check that the class split in the *minihousing*, in the *testhousing* and in the whole dataset is similar.

```
priceleveltable <- table(minihousing$pricelevel)
aboveinminihousing <- priceleveltable[1]/nrow(minihousing)
belowinminihousing <- priceleveltable[2]/nrow(minihousing)
priceleveltable <- table(testhousing$pricelevel)
aboveintesthousing <- priceleveltable[1]/nrow(testhousing)
belowintesthousing <- priceleveltable[2]/nrow(testhousing)
```

Step 4. Using the *minihousing* sample tune the Support Vector Machine with the RBF kernel, for values of the tradeoff parameter equal to 2^k , $k=-12, \dots, 12$ and the gamma parameter equal to 2^l , $l=-12, \dots, 12$. Report the best value found for the parameters.

Answer:

```
set.seed(1000)
```

```
tunedmodelRBF <- tune.svm(pricelevel~.,data = minihousing,cost=2^(-12:12),gamma=2^(-12:12))
bestgamma <- tunedmodelRBF$best.parameters[[1]]
bestcost <- tunedmodelRBF$best.parameters[[2]]
```

Note1:

It is important that you understand that we have taken a wider range of values of the parameters (cost and gamma) in the model. By taking a wider range, you are doing a more thorough parameter tuning, and therefore, a better training of your final SVM model with the RBF kernel.

Note2:

It is not been asked in the question, but it would be good if you got a summary of the tuning process that you have just performed. For that, you can call, as usual, the summary function. Please see the output of the summary function below. In particular, it reports

- the best value of cost found in the chosen grid: 1
- the best value of gamma found in the chosen grid: 0.25
- the corresponding best 10-fold cross validation error: 0.145

```
summary(tunedmodelRBF)
```

Parameter tuning of 'svm':

- sampling method: 10-fold cross validation

- best parameters:

```
gamma cost
0.25  1
```

- best performance: 0.145

- Detailed performance results:

	gamma	cost	error	dispersion
1	2.441406e-04	2.441406e-04	0.4450	0.06324555
2	4.882812e-04	2.441406e-04	0.4450	0.06324555
3	9.765625e-04	2.441406e-04	0.4450	0.06324555
4	1.953125e-03	2.441406e-04	0.4450	0.06324555
5	3.906250e-03	2.441406e-04	0.4450	0.06324555
6	7.812500e-03	2.441406e-04	0.4450	0.06324555
7	1.562500e-02	2.441406e-04	0.4450	0.06324555
8	3.125000e-02	2.441406e-04	0.4450	0.06324555
9	6.250000e-02	2.441406e-04	0.4450	0.06324555
10	1.250000e-01	2.441406e-04	0.4450	0.06324555
11	2.500000e-01	2.441406e-04	0.4450	0.06324555
12	5.000000e-01	2.441406e-04	0.4450	0.06324555
13	1.000000e+00	2.441406e-04	0.4450	0.06324555
14	2.000000e+00	2.441406e-04	0.4450	0.06324555
15	4.000000e+00	2.441406e-04	0.4450	0.06324555
16	8.000000e+00	2.441406e-04	0.4450	0.06324555
17	1.600000e+01	2.441406e-04	0.4450	0.06324555
18	3.200000e+01	2.441406e-04	0.4450	0.06324555
19	6.400000e+01	2.441406e-04	0.4450	0.06324555

20 1.280000e+02 2.441406e-04 0.4450 0.06324555
21 2.560000e+02 2.441406e-04 0.4450 0.06324555
22 5.120000e+02 2.441406e-04 0.4450 0.06324555
23 1.024000e+03 2.441406e-04 0.4450 0.06324555
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34 6.250000e-02 4.882812e-04 0.4450 0.06324555
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36 2.500000e-01 4.882812e-04 0.4450 0.06324555
37 5.000000e-01 4.882812e-04 0.4450 0.06324555
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180 3.906250e-03 3.125000e-02 0.4450 0.06324555
181 7.812500e-03 3.125000e-02 0.4450 0.06324555
182 1.562500e-02 3.125000e-02 0.3250 0.07637626
183 3.125000e-02 3.125000e-02 0.2550 0.05868939
184 6.250000e-02 3.125000e-02 0.2350 0.05296750
185 1.250000e-01 3.125000e-02 0.2900 0.07923243
186 2.500000e-01 3.125000e-02 0.4450 0.06324555
187 5.000000e-01 3.125000e-02 0.4450 0.06324555
188 1.000000e+00 3.125000e-02 0.4450 0.06324555
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206 7.812500e-03 6.250000e-02 0.3025 0.05945353
207 1.562500e-02 6.250000e-02 0.2425 0.06129392
208 3.125000e-02 6.250000e-02 0.2350 0.06687468
209 6.250000e-02 6.250000e-02 0.2225 0.07587453
210 1.250000e-01 6.250000e-02 0.2050 0.07888106
211 2.500000e-01 6.250000e-02 0.2600 0.08266398
212 5.000000e-01 6.250000e-02 0.3950 0.07975657
213 1.000000e+00 6.250000e-02 0.4450 0.06324555
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229 1.953125e-03 1.250000e-01 0.4525 0.04923018
230 3.906250e-03 1.250000e-01 0.2975 0.06286007
231 7.812500e-03 1.250000e-01 0.2450 0.05627314
232 1.562500e-02 1.250000e-01 0.2350 0.06892024
233 3.125000e-02 1.250000e-01 0.2175 0.07269609
234 6.250000e-02 1.250000e-01 0.2075 0.08169217
235 1.250000e-01 1.250000e-01 0.1925 0.08420379
236 2.500000e-01 1.250000e-01 0.2000 0.06666667
237 5.000000e-01 1.250000e-01 0.2675 0.08502451
238 1.000000e+00 1.250000e-01 0.3875 0.08100926
239 2.000000e+00 1.250000e-01 0.4450 0.06324555
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254 1.953125e-03 2.500000e-01 0.2950 0.05749396
255 3.906250e-03 2.500000e-01 0.2450 0.05109903
256 7.812500e-03 2.500000e-01 0.2300 0.06324555
257 1.562500e-02 2.500000e-01 0.2150 0.07283924
258 3.125000e-02 2.500000e-01 0.2125 0.07927624
259 6.250000e-02 2.500000e-01 0.1975 0.07678433
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573 1.024000e+03 1.024000e+03 0.4450 0.06324555
574 2.048000e+03 1.024000e+03 0.4450 0.06324555
575 4.096000e+03 1.024000e+03 0.4450 0.06324555
576 2.441406e-04 2.048000e+03 0.2000 0.07817360
577 4.882812e-04 2.048000e+03 0.1900 0.07564537
578 9.765625e-04 2.048000e+03 0.1700 0.07434903
579 1.953125e-03 2.048000e+03 0.1750 0.07264832
580 3.906250e-03 2.048000e+03 0.1650 0.06582806

581 7.812500e-03 2.048000e+03 0.1500 0.07728015
582 1.562500e-02 2.048000e+03 0.1625 0.09147708
583 3.125000e-02 2.048000e+03 0.1725 0.08203150
584 6.250000e-02 2.048000e+03 0.1850 0.05916080
585 1.250000e-01 2.048000e+03 0.2000 0.05773503
586 2.500000e-01 2.048000e+03 0.2050 0.09339284
587 5.000000e-01 2.048000e+03 0.2000 0.07817360
588 1.000000e+00 2.048000e+03 0.2025 0.07857233
589 2.000000e+00 2.048000e+03 0.2100 0.08913161
590 4.000000e+00 2.048000e+03 0.2500 0.08164966
591 8.000000e+00 2.048000e+03 0.3150 0.07564537
592 1.600000e+01 2.048000e+03 0.3825 0.06671873
593 3.200000e+01 2.048000e+03 0.4150 0.06032320
594 6.400000e+01 2.048000e+03 0.4300 0.06749486
595 1.280000e+02 2.048000e+03 0.4350 0.06476453
596 2.560000e+02 2.048000e+03 0.4450 0.06324555
597 5.120000e+02 2.048000e+03 0.4450 0.06324555
598 1.024000e+03 2.048000e+03 0.4450 0.06324555
599 2.048000e+03 2.048000e+03 0.4450 0.06324555
600 4.096000e+03 2.048000e+03 0.4450 0.06324555
601 2.441406e-04 4.096000e+03 0.1950 0.07527727
602 4.882812e-04 4.096000e+03 0.1725 0.07678433
603 9.765625e-04 4.096000e+03 0.1675 0.07364517
604 1.953125e-03 4.096000e+03 0.1775 0.06061032
605 3.906250e-03 4.096000e+03 0.1575 0.07997395
606 7.812500e-03 4.096000e+03 0.1575 0.07732507
607 1.562500e-02 4.096000e+03 0.1750 0.10206207
608 3.125000e-02 4.096000e+03 0.1875 0.06481812
609 6.250000e-02 4.096000e+03 0.1950 0.06851602
610 1.250000e-01 4.096000e+03 0.2025 0.05945353
611 2.500000e-01 4.096000e+03 0.2050 0.09339284
612 5.000000e-01 4.096000e+03 0.2000 0.07817360
613 1.000000e+00 4.096000e+03 0.2025 0.07857233
614 2.000000e+00 4.096000e+03 0.2100 0.08913161
615 4.000000e+00 4.096000e+03 0.2500 0.08164966
616 8.000000e+00 4.096000e+03 0.3150 0.07564537
617 1.600000e+01 4.096000e+03 0.3825 0.06671873
618 3.200000e+01 4.096000e+03 0.4150 0.06032320
619 6.400000e+01 4.096000e+03 0.4300 0.06749486
620 1.280000e+02 4.096000e+03 0.4350 0.06476453
621 2.560000e+02 4.096000e+03 0.4450 0.06324555
622 5.120000e+02 4.096000e+03 0.4450 0.06324555
623 1.024000e+03 4.096000e+03 0.4450 0.06324555
624 2.048000e+03 4.096000e+03 0.4450 0.06324555
625 4.096000e+03 4.096000e+03 0.4450 0.06324555

Step 5. Use the best value of the parameters found in the previous step to build a model in *minihousing*. Test the model in *testhousing* and report the classification accuracy.

Answer:

```
set.seed(100000)
```

```
finalmodelRBF <- svm(pricelevel~.,data=minihousing,cost=bestcost,gamma=bestgamma)
```

```
myprediction <- predict(finalmodelRBF, testhousing[,-14])
classificationtable <- table(myprediction,testhousing[,14])
acctestfinalmodelRBF <- sum(diag(classificationtable))/sum(classificationtable)
```

Note:

acctestfinalmodelRBF is roughly 77.5%.