

```
1
2 R version 3.5.1 (2018-07-02) -- "Feather Spray"
3 Copyright (C) 2018 The R Foundation for Statistical Computing
4 Platform: x86_64-w64-mingw32/x64 (64-bit)
5
6 R is free software and comes with ABSOLUTELY NO WARRANTY.
7 You are welcome to redistribute it under certain conditions.
8 Type 'license()' or 'licence()' for distribution details.
9
10 Natural language support but running in an English locale
11
12 R is a collaborative project with many contributors.
13 Type 'contributors()' for more information and
14 'citation()' on how to cite R or R packages in publications.
15
16 Type 'demo()' for some demos, 'help()' for on-line help, or
17 'help.start()' for an HTML browser interface to help.
18 Type 'q()' to quit R.
19
20 Microsoft R Open 3.5.1
21 The enhanced R distribution from Microsoft
22 Microsoft packages Copyright (C) 2018 Microsoft Corporation
23
24 Using the Intel MKL for parallel mathematical computing (using 4
25 cores).
26
27 Default CRAN mirror snapshot taken on 2018-08-01.
28 See: https://mran.microsoft.com/.
29
30 [Previously saved workspace restored]
31
```

```
32 > ###
33 > #
34 > # Comparison of Classification Modeling Strategies
35 > #
36 > ###
37 > #
38 > # avoid exponential notation
39 > options(scipen=10)
40 >
41 > ###
42 > #
43 > # external packages
44 > #
45 > require(partykit)      # for ctree()
46 Loading required package: partykit
47 Loading required package: grid
48 Loading required package: libcoin
49 Loading required package: mvtnorm
50 >
51 > # working data
52 > data(iris)
53 > set.seed(2019)
54 > td      <- sample(iris)
55 > td$Species <- as.character(ts$Species)
56 Error in ts$Species : object of type 'closure' is not subsettable
57 >
58 > # constants
59 > classes      <- c("setosa", "versicolor", "virginica") # outcome
60 categories
61 > numClasses    <- length(classes)
62 > byRows        <- 1
```

```

63 > byCols          <- 2
64 > seed            <- 1      # not a great choice
65 >
66 > # flags
67 > debug           <- F
68 > plots           <- F
69 > verbose         <- F
70 >
71 > #
72 > #
73 > # fit classification models
74 > #
75 > # multiple logit:  each v. other (current)
76 > # multiple tree:  each v. other
77 > # single tree:    multinomial (factor)
78 > #
79 > #
80 > ###
81 > #
82 > # setup: multiple logit
83 > #
84 > fitted.logit    <- matrix(rep(NA,nrow(td)*numClasses), nrow=nrow(td) )
85 >
86 > # fit: get predictions from individual models
87 > for ( i in 1:numClasses ) {
88 +   d                      <- classes[i]
89 +   td$y                    <- rep(0, nrow(td))  # initialize
90 +   td$y[td$Species == d] <- 1                    # indicator for -
91 each- class
92 +   m                      <- glm(y ~ .-Species, data=td,
93 family=binomial())

```

```

94 + fitted.logit[,i] <- m$fitted.values
95 + }
96 Warning messages:
97 1: glm.fit: algorithm did not converge
98 2: glm.fit: fitted probabilities numerically 0 or 1 occurred
99 3: glm.fit: fitted probabilities numerically 0 or 1 occurred
100 >
101 > if (debug) summary(m) # model for last category (digit: 9)
102 >
103 > # classify
104 > index <- apply(fitted.logit, byRows, which.max) # location
105 > class.logit <- classes[index]
106 > scale.logit <- apply(fitted.logit, byRows, sum)
107 > p.logit <- apply(fitted.logit, byRows, max)/scale.logit
108 > risk.logit <- 1-p.logit # Bayes Risk
109 > if (debug) summary(scale.logit)
110 >
111 > (hits.logit <- table(class.logit, td$Species) )
112
113 class.logit setosa versicolor virginica
114 setosa 50 0 0
115 versicolor 0 48 1
116 virginica 0 2 49
117 > (pc.logit <- sum(diag(hits.logit))/sum(hits.logit)) # percent
118 correct
119 [1] 0.98
120 >
121 > # other
122 > summary(risk.logit)
123 Min. 1st Qu. Median Mean 3rd Qu. Max.
124 0.000000 0.001667 0.078640 0.126374 0.223628 0.493286

```

```

125 >
126 > fitted.logit
127           [,1]           [,2]           [,3]
128 [1,] 1.000000e+00 0.084913218 2.220446e-16
129 [2,] 1.000000e+00 0.282917869 2.220446e-16
130 [3,] 1.000000e+00 0.171982672 2.220446e-16
131 [4,] 1.000000e+00 0.268014581 2.220446e-16
132 [5,] 1.000000e+00 0.067075197 2.220446e-16
133 [6,] 1.000000e+00 0.023403244 2.220446e-16
134 [7,] 1.000000e+00 0.095100612 2.220446e-16
135 [8,] 1.000000e+00 0.125446695 2.220446e-16
136 [9,] 1.000000e+00 0.371053818 2.220446e-16
137 [10,] 1.000000e+00 0.309920322 2.220446e-16
138 [11,] 1.000000e+00 0.053204234 2.220446e-16
139 [12,] 1.000000e+00 0.146615506 2.220446e-16
140 [13,] 1.000000e+00 0.348040480 2.220446e-16
141 [14,] 1.000000e+00 0.289239940 2.220446e-16
142 [15,] 1.000000e+00 0.014626994 2.220446e-16
143 [16,] 1.000000e+00 0.004211069 2.220446e-16
144 [17,] 1.000000e+00 0.013971627 2.220446e-16
145 [18,] 1.000000e+00 0.065667789 2.220446e-16
146 [19,] 1.000000e+00 0.037423490 2.220446e-16
147 [20,] 1.000000e+00 0.033477545 2.220446e-16
148 [21,] 1.000000e+00 0.144643488 2.220446e-16
149 [22,] 1.000000e+00 0.033536563 2.220446e-16
150 [23,] 1.000000e+00 0.044795194 2.220446e-16
151 [24,] 1.000000e+00 0.094705717 2.220446e-16
152 [25,] 1.000000e+00 0.203055831 2.220446e-16
153 [26,] 1.000000e+00 0.333623714 2.220446e-16
154 [27,] 1.000000e+00 0.085791654 2.220446e-16

```

|     |       |              |             |              |
|-----|-------|--------------|-------------|--------------|
| 155 | [28,] | 1.000000e+00 | 0.093590656 | 2.220446e-16 |
| 156 | [29,] | 1.000000e+00 | 0.106951255 | 2.220446e-16 |
| 157 | [30,] | 1.000000e+00 | 0.235493474 | 2.220446e-16 |
| 158 | [31,] | 1.000000e+00 | 0.284463794 | 2.220446e-16 |
| 159 | [32,] | 1.000000e+00 | 0.069419306 | 2.220446e-16 |
| 160 | [33,] | 1.000000e+00 | 0.024827392 | 2.220446e-16 |
| 161 | [34,] | 1.000000e+00 | 0.011737848 | 2.220446e-16 |
| 162 | [35,] | 1.000000e+00 | 0.253822895 | 2.220446e-16 |
| 163 | [36,] | 1.000000e+00 | 0.144722026 | 2.220446e-16 |
| 164 | [37,] | 1.000000e+00 | 0.068695913 | 2.220446e-16 |
| 165 | [38,] | 1.000000e+00 | 0.088657334 | 2.220446e-16 |
| 166 | [39,] | 1.000000e+00 | 0.281159026 | 2.220446e-16 |
| 167 | [40,] | 1.000000e+00 | 0.122779536 | 2.220446e-16 |
| 168 | [41,] | 1.000000e+00 | 0.059409586 | 2.220446e-16 |
| 169 | [42,] | 1.000000e+00 | 0.671837566 | 2.220446e-16 |
| 170 | [43,] | 1.000000e+00 | 0.182719028 | 2.220446e-16 |
| 171 | [44,] | 1.000000e+00 | 0.039110729 | 2.220446e-16 |
| 172 | [45,] | 1.000000e+00 | 0.042484334 | 2.220446e-16 |
| 173 | [46,] | 1.000000e+00 | 0.234453540 | 2.220446e-16 |
| 174 | [47,] | 1.000000e+00 | 0.049565186 | 2.220446e-16 |
| 175 | [48,] | 1.000000e+00 | 0.195330231 | 2.220446e-16 |
| 176 | [49,] | 1.000000e+00 | 0.054453818 | 2.220446e-16 |
| 177 | [50,] | 1.000000e+00 | 0.142639277 | 2.220446e-16 |
| 178 | [51,] | 2.220446e-16 | 0.268236915 | 1.171672e-05 |
| 179 | [52,] | 2.220446e-16 | 0.198302894 | 4.856237e-05 |
| 180 | [53,] | 2.220446e-16 | 0.328605388 | 1.198626e-03 |
| 181 | [54,] | 2.220446e-16 | 0.775502078 | 4.220049e-05 |
| 182 | [55,] | 2.220446e-16 | 0.457234907 | 1.408470e-03 |
| 183 | [56,] | 2.220446e-16 | 0.610427722 | 1.018578e-04 |
| 184 | [57,] | 2.220446e-16 | 0.158802911 | 1.305727e-03 |

|     |       |              |             |              |
|-----|-------|--------------|-------------|--------------|
| 185 | [58,] | 4.617163e-13 | 0.735197378 | 5.351876e-10 |
| 186 | [59,] | 2.220446e-16 | 0.519988582 | 1.458241e-05 |
| 187 | [60,] | 2.220446e-16 | 0.446561196 | 1.481064e-05 |
| 188 | [61,] | 2.220446e-16 | 0.915132256 | 3.990780e-08 |
| 189 | [62,] | 2.220446e-16 | 0.248050604 | 3.744346e-05 |
| 190 | [63,] | 2.220446e-16 | 0.902922390 | 9.947107e-08 |
| 191 | [64,] | 2.220446e-16 | 0.514047617 | 7.988665e-04 |
| 192 | [65,] | 3.232718e-13 | 0.271250038 | 1.378280e-08 |
| 193 | [66,] | 2.220446e-16 | 0.260298942 | 2.828836e-06 |
| 194 | [67,] | 2.220446e-16 | 0.344944541 | 1.326003e-03 |
| 195 | [68,] | 2.220446e-16 | 0.733465616 | 1.481153e-08 |
| 196 | [69,] | 2.220446e-16 | 0.809798929 | 5.959820e-02 |
| 197 | [70,] | 2.220446e-16 | 0.746512788 | 8.712675e-08 |
| 198 | [71,] | 2.220446e-16 | 0.152688686 | 4.048381e-01 |
| 199 | [72,] | 2.220446e-16 | 0.424127086 | 3.405812e-07 |
| 200 | [73,] | 2.220446e-16 | 0.752251283 | 2.248338e-01 |
| 201 | [74,] | 2.220446e-16 | 0.709205985 | 4.023809e-05 |
| 202 | [75,] | 2.220446e-16 | 0.434128932 | 1.410660e-06 |
| 203 | [76,] | 2.220446e-16 | 0.322955404 | 7.060188e-06 |
| 204 | [77,] | 2.220446e-16 | 0.573336389 | 7.124099e-04 |
| 205 | [78,] | 2.220446e-16 | 0.307874353 | 2.760617e-01 |
| 206 | [79,] | 2.220446e-16 | 0.387028022 | 9.651525e-04 |
| 207 | [80,] | 4.855499e-10 | 0.629082784 | 1.290424e-10 |
| 208 | [81,] | 2.220446e-16 | 0.777806218 | 8.469327e-08 |
| 209 | [82,] | 1.733438e-13 | 0.802088276 | 5.298820e-09 |
| 210 | [83,] | 2.220446e-16 | 0.548318744 | 8.707382e-08 |
| 211 | [84,] | 2.220446e-16 | 0.647905008 | 8.676299e-01 |
| 212 | [85,] | 2.220446e-16 | 0.356115348 | 2.169221e-03 |
| 213 | [86,] | 2.220446e-16 | 0.105652352 | 2.129823e-04 |
| 214 | [87,] | 2.220446e-16 | 0.283298814 | 2.979719e-04 |

|     |        |              |             |              |
|-----|--------|--------------|-------------|--------------|
| 215 | [88,]  | 2.220446e-16 | 0.827614779 | 2.551360e-04 |
| 216 | [89,]  | 2.220446e-16 | 0.351802660 | 7.884147e-07 |
| 217 | [90,]  | 2.220446e-16 | 0.663812478 | 1.109268e-05 |
| 218 | [91,]  | 2.220446e-16 | 0.769229473 | 3.969831e-05 |
| 219 | [92,]  | 2.220446e-16 | 0.412215071 | 1.596216e-04 |
| 220 | [93,]  | 2.220446e-16 | 0.646776813 | 4.360614e-07 |
| 221 | [94,]  | 6.831499e-13 | 0.781815103 | 8.158121e-10 |
| 222 | [95,]  | 2.220446e-16 | 0.588849176 | 1.502115e-05 |
| 223 | [96,]  | 2.220446e-16 | 0.443625290 | 2.541253e-07 |
| 224 | [97,]  | 2.220446e-16 | 0.444075149 | 3.085679e-06 |
| 225 | [98,]  | 2.220446e-16 | 0.446220505 | 2.309662e-06 |
| 226 | [99,]  | 5.071636e-10 | 0.505124507 | 6.163826e-11 |
| 227 | [100,] | 2.220446e-16 | 0.480922554 | 2.344150e-06 |
| 228 | [101,] | 2.220446e-16 | 0.078715028 | 1.000000e+00 |
| 229 | [102,] | 2.220446e-16 | 0.456463346 | 9.996139e-01 |
| 230 | [103,] | 2.220446e-16 | 0.302108585 | 9.999990e-01 |
| 231 | [104,] | 2.220446e-16 | 0.519508925 | 9.997188e-01 |
| 232 | [105,] | 2.220446e-16 | 0.249878252 | 9.999999e-01 |
| 233 | [106,] | 2.220446e-16 | 0.489900110 | 1.000000e+00 |
| 234 | [107,] | 2.220446e-16 | 0.592190618 | 8.908123e-01 |
| 235 | [108,] | 2.220446e-16 | 0.679672890 | 9.999955e-01 |
| 236 | [109,] | 2.220446e-16 | 0.795969041 | 9.999921e-01 |
| 237 | [110,] | 2.220446e-16 | 0.032661153 | 1.000000e+00 |
| 238 | [111,] | 2.220446e-16 | 0.116865184 | 9.902584e-01 |
| 239 | [112,] | 2.220446e-16 | 0.485235768 | 9.997429e-01 |
| 240 | [113,] | 2.220446e-16 | 0.216000555 | 9.999800e-01 |
| 241 | [114,] | 2.220446e-16 | 0.500015457 | 9.999673e-01 |
| 242 | [115,] | 2.220446e-16 | 0.136647611 | 9.999999e-01 |
| 243 | [116,] | 2.220446e-16 | 0.071180487 | 9.999952e-01 |
| 244 | [117,] | 2.220446e-16 | 0.405640478 | 9.976994e-01 |



|     |        |              |             |              |
|-----|--------|--------------|-------------|--------------|
| 245 | [118,] | 2.220446e-16 | 0.079536211 | 9.999999e-01 |
| 246 | [119,] | 2.220446e-16 | 0.709325560 | 1.000000e+00 |
| 247 | [120,] | 2.220446e-16 | 0.896097587 | 9.204923e-01 |
| 248 | [121,] | 2.220446e-16 | 0.102853203 | 9.999996e-01 |
| 249 | [122,] | 2.220446e-16 | 0.279742901 | 9.995130e-01 |
| 250 | [123,] | 2.220446e-16 | 0.711682917 | 1.000000e+00 |
| 251 | [124,] | 2.220446e-16 | 0.429923968 | 9.484339e-01 |
| 252 | [125,] | 2.220446e-16 | 0.136952754 | 9.999824e-01 |
| 253 | [126,] | 2.220446e-16 | 0.387873714 | 9.995586e-01 |
| 254 | [127,] | 2.220446e-16 | 0.338799903 | 8.245440e-01 |
| 255 | [128,] | 2.220446e-16 | 0.255011441 | 8.022990e-01 |
| 256 | [129,] | 2.220446e-16 | 0.377468596 | 9.999992e-01 |
| 257 | [130,] | 2.220446e-16 | 0.597725020 | 9.712013e-01 |
| 258 | [131,] | 2.220446e-16 | 0.614632483 | 9.999969e-01 |
| 259 | [132,] | 2.220446e-16 | 0.088172089 | 9.999189e-01 |
| 260 | [133,] | 2.220446e-16 | 0.314720662 | 9.999999e-01 |
| 261 | [134,] | 2.220446e-16 | 0.630511939 | 2.048741e-01 |
| 262 | [135,] | 2.220446e-16 | 0.888692503 | 9.664047e-01 |
| 263 | [136,] | 2.220446e-16 | 0.217987813 | 1.000000e+00 |
| 264 | [137,] | 2.220446e-16 | 0.048006808 | 9.999999e-01 |
| 265 | [138,] | 2.220446e-16 | 0.345893720 | 9.964973e-01 |
| 266 | [139,] | 2.220446e-16 | 0.235251995 | 6.691425e-01 |
| 267 | [140,] | 2.220446e-16 | 0.151268800 | 9.998717e-01 |
| 268 | [141,] | 2.220446e-16 | 0.095661544 | 1.000000e+00 |
| 269 | [142,] | 2.220446e-16 | 0.064498190 | 9.999440e-01 |
| 270 | [143,] | 2.220446e-16 | 0.456463346 | 9.996139e-01 |
| 271 | [144,] | 2.220446e-16 | 0.132543737 | 1.000000e+00 |
| 272 | [145,] | 2.220446e-16 | 0.049634005 | 1.000000e+00 |
| 273 | [146,] | 2.220446e-16 | 0.098468930 | 9.999932e-01 |
| 274 | [147,] | 2.220446e-16 | 0.532624132 | 9.991067e-01 |

```

275 [148,] 2.220446e-16 0.208865263 9.989939e-01
276 [149,] 2.220446e-16 0.049851313 9.999956e-01
277 [150,] 2.220446e-16 0.318589723 9.776789e-01
278 >
279 > report.logit <- data.frame(n=1:nrow(td),
280 +                             classif=class.logit,
281 +                             scale=scale.logit,
282 +                             prob=p.logit,
283 +                             risk=risk.logit)
284 > report.logit
285      n  classif  scale  prob  risk
286 1    1    setosa 1.0849132 0.9217327 0.0782672906850689
287 2    2    setosa 1.2829179 0.7794731 0.2205268753069148
288 3    3    setosa 1.1719827 0.8532549 0.1467450641232388
289 4    4    setosa 1.2680146 0.7886345 0.2113655355830745
290 5    5    setosa 1.0670752 0.9371411 0.0628589222436521
291 6    6    setosa 1.0234032 0.9771319 0.0228680576027908
292 7    7    setosa 1.0951006 0.9131581 0.0868418946818581
293 8    8    setosa 1.1254467 0.8885361 0.1114639152446062
294 9    9    setosa 1.3710538 0.7293660 0.2706340282819352
295 10   10    setosa 1.3099203 0.7634052 0.2365947885932125
296 11   11    setosa 1.0532042 0.9494835 0.0505165399338726
297 12   12    setosa 1.1466155 0.8721319 0.1278680648882334
298 13   13    setosa 1.3480405 0.7418175 0.2581825137300051
299 14   14    setosa 1.2892399 0.7756508 0.2243491926397643
300 15   15    setosa 1.0146270 0.9855839 0.0144161292670995
301 16   16    setosa 1.0042111 0.9958066 0.0041934098103541
302 17   17    setosa 1.0139716 0.9862209 0.0137791104727737
303 18   18    setosa 1.0656678 0.9383787 0.0616212576859515
304 19   19    setosa 1.0374235 0.9639265 0.0360734936300182

```

|     |    |    |        |           |           |                    |
|-----|----|----|--------|-----------|-----------|--------------------|
| 305 | 20 | 20 | setosa | 1.0334775 | 0.9676069 | 0.0323931033216901 |
| 306 | 21 | 21 | setosa | 1.1446435 | 0.8736345 | 0.1263655364055218 |
| 307 | 22 | 22 | setosa | 1.0335366 | 0.9675516 | 0.0324483563427730 |
| 308 | 23 | 23 | setosa | 1.0447952 | 0.9571254 | 0.0428746174011639 |
| 309 | 24 | 24 | setosa | 1.0947057 | 0.9134875 | 0.0865124900576867 |
| 310 | 25 | 25 | setosa | 1.2030558 | 0.8312166 | 0.1687833813909165 |
| 311 | 26 | 26 | setosa | 1.3336237 | 0.7498367 | 0.2501633036950313 |
| 312 | 27 | 27 | setosa | 1.0857917 | 0.9209870 | 0.0790129978988516 |
| 313 | 28 | 28 | setosa | 1.0935907 | 0.9144189 | 0.0855810676031672 |
| 314 | 29 | 29 | setosa | 1.1069513 | 0.9033821 | 0.0966178544161264 |
| 315 | 30 | 30 | setosa | 1.2354935 | 0.8093932 | 0.1906068136538442 |
| 316 | 31 | 31 | setosa | 1.2844638 | 0.7785350 | 0.2214650151970438 |
| 317 | 32 | 32 | setosa | 1.0694193 | 0.9350869 | 0.0649130844293541 |
| 318 | 33 | 33 | setosa | 1.0248274 | 0.9757741 | 0.0242259252881312 |
| 319 | 34 | 34 | setosa | 1.0117378 | 0.9883983 | 0.0116016696542289 |
| 320 | 35 | 35 | setosa | 1.2538229 | 0.7975608 | 0.2024391926624796 |
| 321 | 36 | 36 | setosa | 1.1447220 | 0.8735745 | 0.1264254747729902 |
| 322 | 37 | 37 | setosa | 1.0686959 | 0.9357199 | 0.0642801304581879 |
| 323 | 38 | 38 | setosa | 1.0886573 | 0.9185627 | 0.0814373185972520 |
| 324 | 39 | 39 | setosa | 1.2811590 | 0.7805432 | 0.2194567731805617 |
| 325 | 40 | 40 | setosa | 1.1227795 | 0.8906468 | 0.1093532005369025 |
| 326 | 41 | 41 | setosa | 1.0594096 | 0.9439220 | 0.0560780144464996 |
| 327 | 42 | 42 | setosa | 1.6718376 | 0.5981442 | 0.4018557664228516 |
| 328 | 43 | 43 | setosa | 1.1827190 | 0.8455094 | 0.1544906468073791 |
| 329 | 44 | 44 | setosa | 1.0391107 | 0.9623613 | 0.0376386534376875 |
| 330 | 45 | 45 | setosa | 1.0424843 | 0.9592470 | 0.0407529711946575 |
| 331 | 46 | 46 | setosa | 1.2344535 | 0.8100750 | 0.1899249604260088 |
| 332 | 47 | 47 | setosa | 1.0495652 | 0.9527755 | 0.0472244946707981 |
| 333 | 48 | 48 | setosa | 1.1953302 | 0.8365889 | 0.1634111026682231 |
| 334 | 49 | 49 | setosa | 1.0544538 | 0.9483583 | 0.0516417288895967 |

|     |    |    |            |           |           |                    |
|-----|----|----|------------|-----------|-----------|--------------------|
| 335 | 50 | 50 | setosa     | 1.1426393 | 0.8751668 | 0.1248331643763416 |
| 336 | 51 | 51 | versicolor | 0.2682486 | 0.9999563 | 0.0000436785913812 |
| 337 | 52 | 52 | versicolor | 0.1983515 | 0.9997552 | 0.0002448299292033 |
| 338 | 53 | 53 | versicolor | 0.3298040 | 0.9963656 | 0.0036343574019819 |
| 339 | 54 | 54 | versicolor | 0.7755443 | 0.9999456 | 0.0000544140345583 |
| 340 | 55 | 55 | versicolor | 0.4586434 | 0.9969291 | 0.0030709484686394 |
| 341 | 56 | 56 | versicolor | 0.6105296 | 0.9998332 | 0.0001668350854757 |
| 342 | 57 | 57 | versicolor | 0.1601086 | 0.9918447 | 0.0081552546513948 |
| 343 | 58 | 58 | versicolor | 0.7351974 | 1.0000000 | 0.0000000007285789 |
| 344 | 59 | 59 | versicolor | 0.5200032 | 0.9999720 | 0.0000280429307471 |
| 345 | 60 | 60 | versicolor | 0.4465760 | 0.9999668 | 0.0000331648768604 |
| 346 | 61 | 61 | versicolor | 0.9151323 | 1.0000000 | 0.0000000436087819 |
| 347 | 62 | 62 | versicolor | 0.2480880 | 0.9998491 | 0.0001509281132401 |
| 348 | 63 | 63 | versicolor | 0.9029225 | 0.9999999 | 0.0000001101656778 |
| 349 | 64 | 64 | versicolor | 0.5148465 | 0.9984483 | 0.0015516596944093 |
| 350 | 65 | 65 | versicolor | 0.2712501 | 0.9999999 | 0.0000000508133301 |
| 351 | 66 | 66 | versicolor | 0.2603018 | 0.9999891 | 0.0000108675235119 |
| 352 | 67 | 67 | versicolor | 0.3462705 | 0.9961706 | 0.0038293836551286 |
| 353 | 68 | 68 | versicolor | 0.7334656 | 1.0000000 | 0.0000000201938987 |
| 354 | 69 | 69 | versicolor | 0.8693971 | 0.9314488 | 0.0685511767796577 |
| 355 | 70 | 70 | versicolor | 0.7465129 | 0.9999999 | 0.0000001167116547 |
| 356 | 71 | 71 | virginica  | 0.5575268 | 0.7261321 | 0.2738678968872442 |
| 357 | 72 | 72 | versicolor | 0.4241274 | 0.9999992 | 0.0000008030160962 |
| 358 | 73 | 73 | versicolor | 0.9770851 | 0.7698933 | 0.2301066758605721 |
| 359 | 74 | 74 | versicolor | 0.7092462 | 0.9999433 | 0.0000567336038194 |
| 360 | 75 | 75 | versicolor | 0.4341303 | 0.9999968 | 0.0000032493933632 |
| 361 | 76 | 76 | versicolor | 0.3229625 | 0.9999781 | 0.0000218607075074 |
| 362 | 77 | 77 | versicolor | 0.5740488 | 0.9987590 | 0.0012410267836660 |
| 363 | 78 | 78 | versicolor | 0.5839361 | 0.5272398 | 0.4727601734692531 |
| 364 | 79 | 79 | versicolor | 0.3879932 | 0.9975124 | 0.0024875502516762 |

|     |     |     |            |           |           |                    |
|-----|-----|-----|------------|-----------|-----------|--------------------|
| 365 | 80  | 80  | versicolor | 0.6290828 | 1.0000000 | 0.0000000009769656 |
| 366 | 81  | 81  | versicolor | 0.7778063 | 0.9999999 | 0.0000001088873597 |
| 367 | 82  | 82  | versicolor | 0.8020883 | 1.0000000 | 0.0000000066064959 |
| 368 | 83  | 83  | versicolor | 0.5483188 | 0.9999998 | 0.0000001588014353 |
| 369 | 84  | 84  | virginica  | 1.5155349 | 0.5724909 | 0.4275091310684835 |
| 370 | 85  | 85  | versicolor | 0.3582846 | 0.9939455 | 0.0060544651338259 |
| 371 | 86  | 86  | versicolor | 0.1058653 | 0.9979882 | 0.0020118226055311 |
| 372 | 87  | 87  | versicolor | 0.2835968 | 0.9989493 | 0.0010506886121168 |
| 373 | 88  | 88  | versicolor | 0.8278699 | 0.9996918 | 0.0003081837175790 |
| 374 | 89  | 89  | versicolor | 0.3518034 | 0.9999978 | 0.0000022410657894 |
| 375 | 90  | 90  | versicolor | 0.6638236 | 0.9999833 | 0.0000167102864457 |
| 376 | 91  | 91  | versicolor | 0.7692692 | 0.9999484 | 0.0000516052299030 |
| 377 | 92  | 92  | versicolor | 0.4123747 | 0.9996129 | 0.0003870791223541 |
| 378 | 93  | 93  | versicolor | 0.6467772 | 0.9999993 | 0.0000006742064892 |
| 379 | 94  | 94  | versicolor | 0.7818151 | 1.0000000 | 0.0000000010443586 |
| 380 | 95  | 95  | versicolor | 0.5888642 | 0.9999745 | 0.0000255086849659 |
| 381 | 96  | 96  | versicolor | 0.4436255 | 0.9999994 | 0.0000005728374362 |
| 382 | 97  | 97  | versicolor | 0.4440782 | 0.9999931 | 0.0000069485036578 |
| 383 | 98  | 98  | versicolor | 0.4462228 | 0.9999948 | 0.0000051760274826 |
| 384 | 99  | 99  | versicolor | 0.5051245 | 1.0000000 | 0.0000000011260628 |
| 385 | 100 | 100 | versicolor | 0.4809249 | 0.9999951 | 0.0000048742531449 |
| 386 | 101 | 101 | virginica  | 1.0787150 | 0.9270289 | 0.0729711053578299 |
| 387 | 102 | 102 | virginica  | 1.4560773 | 0.6865116 | 0.3134884121323774 |
| 388 | 103 | 103 | virginica  | 1.3021076 | 0.7679849 | 0.2320150656080732 |
| 389 | 104 | 104 | virginica  | 1.5192278 | 0.6580441 | 0.3419559155974093 |
| 390 | 105 | 105 | virginica  | 1.2498782 | 0.8000779 | 0.1999220880741406 |
| 391 | 106 | 106 | virginica  | 1.4899001 | 0.6711859 | 0.3288140650253462 |
| 392 | 107 | 107 | virginica  | 1.4830029 | 0.6006814 | 0.3993185720593083 |
| 393 | 108 | 108 | virginica  | 1.6796684 | 0.5953529 | 0.4046470681765758 |
| 394 | 109 | 109 | virginica  | 1.7959611 | 0.5568005 | 0.4431994788553557 |

|     |     |     |            |           |           |                    |
|-----|-----|-----|------------|-----------|-----------|--------------------|
| 395 | 110 | 110 | virginica  | 1.0326611 | 0.9683719 | 0.0316281418042430 |
| 396 | 111 | 111 | virginica  | 1.1071236 | 0.8944425 | 0.1055574837422685 |
| 397 | 112 | 112 | virginica  | 1.4849787 | 0.6732372 | 0.3267627864965190 |
| 398 | 113 | 113 | virginica  | 1.2159805 | 0.8223651 | 0.1776348797088366 |
| 399 | 114 | 114 | virginica  | 1.4999827 | 0.6666525 | 0.3333474747987981 |
| 400 | 115 | 115 | virginica  | 1.1366475 | 0.8797801 | 0.1202198638839989 |
| 401 | 116 | 116 | virginica  | 1.0711757 | 0.9335492 | 0.0664508076073811 |
| 402 | 117 | 117 | virginica  | 1.4033398 | 0.7109464 | 0.2890536306749524 |
| 403 | 118 | 118 | virginica  | 1.0795361 | 0.9263237 | 0.0736762839718532 |
| 404 | 119 | 119 | virginica  | 1.7093256 | 0.5850261 | 0.4149739385177699 |
| 405 | 120 | 120 | virginica  | 1.8165899 | 0.5067144 | 0.4932855765394175 |
| 406 | 121 | 121 | virginica  | 1.1028528 | 0.9067390 | 0.0932610418545824 |
| 407 | 122 | 122 | virginica  | 1.2792559 | 0.7813237 | 0.2186762652195482 |
| 408 | 123 | 123 | virginica  | 1.7116829 | 0.5842204 | 0.4157796468270697 |
| 409 | 124 | 124 | virginica  | 1.3783579 | 0.6880897 | 0.3119102646523909 |
| 410 | 125 | 125 | virginica  | 1.1369351 | 0.8795422 | 0.1204578429548866 |
| 411 | 126 | 126 | virginica  | 1.3874323 | 0.7204377 | 0.2795622591871946 |
| 412 | 127 | 127 | virginica  | 1.1633439 | 0.7087706 | 0.2912293526820112 |
| 413 | 128 | 128 | virginica  | 1.0573104 | 0.7588112 | 0.2411888025962501 |
| 414 | 129 | 129 | virginica  | 1.3774678 | 0.7259692 | 0.2740307885033122 |
| 415 | 130 | 130 | virginica  | 1.5689263 | 0.6190229 | 0.3809771190727831 |
| 416 | 131 | 131 | virginica  | 1.6146294 | 0.6193352 | 0.3806647512508343 |
| 417 | 132 | 132 | virginica  | 1.0880910 | 0.9189663 | 0.0810337452108374 |
| 418 | 133 | 133 | virginica  | 1.3147205 | 0.7606178 | 0.2393821747314500 |
| 419 | 134 | 134 | versicolor | 0.8353860 | 0.7547552 | 0.2452447859041381 |
| 420 | 135 | 135 | virginica  | 1.8550972 | 0.5209456 | 0.4790544241639280 |
| 421 | 136 | 136 | virginica  | 1.2179878 | 0.8210263 | 0.1789737253734668 |
| 422 | 137 | 137 | virginica  | 1.0480067 | 0.9541923 | 0.0458077308997861 |
| 423 | 138 | 138 | virginica  | 1.3423910 | 0.7423301 | 0.2576698771646598 |
| 424 | 139 | 139 | virginica  | 0.9043945 | 0.7398790 | 0.2601210047097785 |

```

425 140 140 virginica 1.1511405 0.8685922 0.1314077646828795
426 141 141 virginica 1.0956615 0.9126906 0.0873093963559063
427 142 142 virginica 1.0644422 0.9394066 0.0605934196133857
428 143 143 virginica 1.4560773 0.6865116 0.3134884121323774
429 144 144 virginica 1.1325437 0.8829681 0.1170318975423522
430 145 145 virginica 1.0496340 0.9527130 0.0472869638263160
431 146 146 virginica 1.0984621 0.9103575 0.0896425380101438
432 147 147 virginica 1.5317308 0.6522730 0.3477269807934017
433 148 148 virginica 1.2078592 0.8270781 0.1729218660393295
434 149 149 virginica 1.0498469 0.9525156 0.0474843624932125
435 150 150 virginica 1.2962686 0.7542255 0.2457744706266044
436 >
437 > ###
438 > #
439 > # multiple tree: each v. other
440 > #
441 > ###
442 > #
443 > # setup
444 > #
445 > fitted.treel0 <- matrix(rep(NA,nrow(td)*numClasses), nrow=nrow(td) )
446 >
447 > # fit: get predictions from individual models
448 > for ( i in 1:numClasses ) {
449 +     d <- classes[i]
450 +     td$y <- rep(0, nrow(td)) # initialize
451 +     td$y[td$Species == d] <- 1 # indicator for -
452 each- class
453 +     m <- ctree(y ~ .-Species, data=td)
454 +     fitted.treel0[,i] <- predict(m)
455 + }

```

```

456 >
457 > # quick look
458 > if (plots) plot(m)
459 >
460 > # classify
461 > index      <- apply(fitted.tree10, byRows, which.max) # location
462 > class.tree10 <- classes[index]
463 > scale.tree10 <- apply(fitted.tree10, byRows, sum)
464 > p.tree10    <- apply(fitted.tree10, byRows, max)/scale.tree10
465 > risk.tree10  <- 1-p.tree10                                # Bayes
466 Risk
467 > if (debug) summary(scale.tree10)
468 >
469 > (hits.tree10 <- table(class.tree10, td$Species) )
470
471 class.tree10 setosa versicolor virginica
472   setosa      50          0          0
473 versicolor    0         47          3
474 virginica     0          3         47
475 > (pc.tree10   <- sum(diag(hits.tree10))/sum(hits.tree10)) # percent
476 correct
477 [1] 0.96
478 >
479 > # other
480 > summary(risk.tree10)
481   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
482 0.00000 0.01181 0.03609 0.10016 0.21495 0.46871
483 >
484 > fitted.tree10
485      [,1]      [,2]      [,3]
486 [1,]     1 0.02702703 0.01041667

```



|     |       |   |            |            |
|-----|-------|---|------------|------------|
| 487 | [2,]  | 1 | 0.26785714 | 0.01041667 |
| 488 | [3,]  | 1 | 0.26785714 | 0.01041667 |
| 489 | [4,]  | 1 | 0.26785714 | 0.01041667 |
| 490 | [5,]  | 1 | 0.02702703 | 0.01041667 |
| 491 | [6,]  | 1 | 0.02702703 | 0.01041667 |
| 492 | [7,]  | 1 | 0.02702703 | 0.01041667 |
| 493 | [8,]  | 1 | 0.02702703 | 0.01041667 |
| 494 | [9,]  | 1 | 0.87179487 | 0.01041667 |
| 495 | [10,] | 1 | 0.26785714 | 0.01041667 |
| 496 | [11,] | 1 | 0.02702703 | 0.01041667 |
| 497 | [12,] | 1 | 0.02702703 | 0.01041667 |
| 498 | [13,] | 1 | 0.26785714 | 0.01041667 |
| 499 | [14,] | 1 | 0.26785714 | 0.01041667 |
| 500 | [15,] | 1 | 0.02702703 | 0.01041667 |
| 501 | [16,] | 1 | 0.02702703 | 0.01041667 |
| 502 | [17,] | 1 | 0.02702703 | 0.01041667 |
| 503 | [18,] | 1 | 0.02702703 | 0.01041667 |
| 504 | [19,] | 1 | 0.02702703 | 0.01041667 |
| 505 | [20,] | 1 | 0.02702703 | 0.01041667 |
| 506 | [21,] | 1 | 0.02702703 | 0.01041667 |
| 507 | [22,] | 1 | 0.02702703 | 0.01041667 |
| 508 | [23,] | 1 | 0.02702703 | 0.01041667 |
| 509 | [24,] | 1 | 0.26785714 | 0.01041667 |
| 510 | [25,] | 1 | 0.02702703 | 0.01041667 |
| 511 | [26,] | 1 | 0.26785714 | 0.01041667 |
| 512 | [27,] | 1 | 0.02702703 | 0.01041667 |
| 513 | [28,] | 1 | 0.02702703 | 0.01041667 |
| 514 | [29,] | 1 | 0.02702703 | 0.01041667 |
| 515 | [30,] | 1 | 0.26785714 | 0.01041667 |
| 516 | [31,] | 1 | 0.26785714 | 0.01041667 |

|     |       |   |            |            |
|-----|-------|---|------------|------------|
| 517 | [32,] | 1 | 0.02702703 | 0.01041667 |
| 518 | [33,] | 1 | 0.02702703 | 0.01041667 |
| 519 | [34,] | 1 | 0.02702703 | 0.01041667 |
| 520 | [35,] | 1 | 0.26785714 | 0.01041667 |
| 521 | [36,] | 1 | 0.26785714 | 0.01041667 |
| 522 | [37,] | 1 | 0.02702703 | 0.01041667 |
| 523 | [38,] | 1 | 0.02702703 | 0.01041667 |
| 524 | [39,] | 1 | 0.26785714 | 0.01041667 |
| 525 | [40,] | 1 | 0.02702703 | 0.01041667 |
| 526 | [41,] | 1 | 0.02702703 | 0.01041667 |
| 527 | [42,] | 1 | 0.87179487 | 0.01041667 |
| 528 | [43,] | 1 | 0.26785714 | 0.01041667 |
| 529 | [44,] | 1 | 0.02702703 | 0.01041667 |
| 530 | [45,] | 1 | 0.02702703 | 0.01041667 |
| 531 | [46,] | 1 | 0.26785714 | 0.01041667 |
| 532 | [47,] | 1 | 0.02702703 | 0.01041667 |
| 533 | [48,] | 1 | 0.26785714 | 0.01041667 |
| 534 | [49,] | 1 | 0.02702703 | 0.01041667 |
| 535 | [50,] | 1 | 0.26785714 | 0.01041667 |
| 536 | [51,] | 0 | 0.26785714 | 0.01041667 |
| 537 | [52,] | 0 | 0.26785714 | 0.01041667 |
| 538 | [53,] | 0 | 0.26785714 | 0.50000000 |
| 539 | [54,] | 0 | 0.87179487 | 0.01041667 |
| 540 | [55,] | 0 | 0.87179487 | 0.01041667 |
| 541 | [56,] | 0 | 0.87179487 | 0.01041667 |
| 542 | [57,] | 0 | 0.26785714 | 0.01041667 |
| 543 | [58,] | 0 | 0.87179487 | 0.01041667 |
| 544 | [59,] | 0 | 0.87179487 | 0.01041667 |
| 545 | [60,] | 0 | 0.87179487 | 0.01041667 |
| 546 | [61,] | 0 | 0.87179487 | 0.01041667 |

|     |       |   |            |            |
|-----|-------|---|------------|------------|
| 547 | [62,] | 0 | 0.26785714 | 0.01041667 |
| 548 | [63,] | 0 | 0.87179487 | 0.01041667 |
| 549 | [64,] | 0 | 0.87179487 | 0.01041667 |
| 550 | [65,] | 0 | 0.87179487 | 0.01041667 |
| 551 | [66,] | 0 | 0.26785714 | 0.01041667 |
| 552 | [67,] | 0 | 0.26785714 | 0.01041667 |
| 553 | [68,] | 0 | 0.87179487 | 0.01041667 |
| 554 | [69,] | 0 | 0.87179487 | 0.01041667 |
| 555 | [70,] | 0 | 0.87179487 | 0.01041667 |
| 556 | [71,] | 0 | 0.26785714 | 0.97826087 |
| 557 | [72,] | 0 | 0.87179487 | 0.01041667 |
| 558 | [73,] | 0 | 0.87179487 | 0.50000000 |
| 559 | [74,] | 0 | 0.87179487 | 0.01041667 |
| 560 | [75,] | 0 | 0.87179487 | 0.01041667 |
| 561 | [76,] | 0 | 0.26785714 | 0.01041667 |
| 562 | [77,] | 0 | 0.87179487 | 0.01041667 |
| 563 | [78,] | 0 | 0.26785714 | 0.50000000 |
| 564 | [79,] | 0 | 0.87179487 | 0.01041667 |
| 565 | [80,] | 0 | 0.87179487 | 0.01041667 |
| 566 | [81,] | 0 | 0.87179487 | 0.01041667 |
| 567 | [82,] | 0 | 0.87179487 | 0.01041667 |
| 568 | [83,] | 0 | 0.87179487 | 0.01041667 |
| 569 | [84,] | 0 | 0.87179487 | 0.50000000 |
| 570 | [85,] | 0 | 0.26785714 | 0.01041667 |
| 571 | [86,] | 0 | 0.02702703 | 0.01041667 |
| 572 | [87,] | 0 | 0.26785714 | 0.01041667 |
| 573 | [88,] | 0 | 0.87179487 | 0.01041667 |
| 574 | [89,] | 0 | 0.26785714 | 0.01041667 |
| 575 | [90,] | 0 | 0.87179487 | 0.01041667 |
| 576 | [91,] | 0 | 0.87179487 | 0.01041667 |

|     |        |   |            |            |
|-----|--------|---|------------|------------|
| 577 | [92,]  | 0 | 0.26785714 | 0.01041667 |
| 578 | [93,]  | 0 | 0.87179487 | 0.01041667 |
| 579 | [94,]  | 0 | 0.87179487 | 0.01041667 |
| 580 | [95,]  | 0 | 0.87179487 | 0.01041667 |
| 581 | [96,]  | 0 | 0.26785714 | 0.01041667 |
| 582 | [97,]  | 0 | 0.87179487 | 0.01041667 |
| 583 | [98,]  | 0 | 0.87179487 | 0.01041667 |
| 584 | [99,]  | 0 | 0.87179487 | 0.01041667 |
| 585 | [100,] | 0 | 0.87179487 | 0.01041667 |
| 586 | [101,] | 0 | 0.26785714 | 0.97826087 |
| 587 | [102,] | 0 | 0.00000000 | 0.97826087 |
| 588 | [103,] | 0 | 0.26785714 | 0.97826087 |
| 589 | [104,] | 0 | 0.00000000 | 0.97826087 |
| 590 | [105,] | 0 | 0.26785714 | 0.97826087 |
| 591 | [106,] | 0 | 0.26785714 | 0.97826087 |
| 592 | [107,] | 0 | 0.00000000 | 0.01041667 |
| 593 | [108,] | 0 | 0.00000000 | 0.97826087 |
| 594 | [109,] | 0 | 0.00000000 | 0.97826087 |
| 595 | [110,] | 0 | 0.02702703 | 0.97826087 |
| 596 | [111,] | 0 | 0.26785714 | 0.97826087 |
| 597 | [112,] | 0 | 0.00000000 | 0.97826087 |
| 598 | [113,] | 0 | 0.26785714 | 0.97826087 |
| 599 | [114,] | 0 | 0.00000000 | 0.97826087 |
| 600 | [115,] | 0 | 0.00000000 | 0.97826087 |
| 601 | [116,] | 0 | 0.26785714 | 0.97826087 |
| 602 | [117,] | 0 | 0.26785714 | 0.97826087 |
| 603 | [118,] | 0 | 0.02702703 | 0.97826087 |
| 604 | [119,] | 0 | 0.00000000 | 0.97826087 |
| 605 | [120,] | 0 | 0.87179487 | 0.50000000 |
| 606 | [121,] | 0 | 0.26785714 | 0.97826087 |

|     |        |   |            |            |
|-----|--------|---|------------|------------|
| 607 | [122,] | 0 | 0.00000000 | 0.97826087 |
| 608 | [123,] | 0 | 0.00000000 | 0.97826087 |
| 609 | [124,] | 0 | 0.00000000 | 0.97826087 |
| 610 | [125,] | 0 | 0.26785714 | 0.97826087 |
| 611 | [126,] | 0 | 0.26785714 | 0.97826087 |
| 612 | [127,] | 0 | 0.00000000 | 0.97826087 |
| 613 | [128,] | 0 | 0.26785714 | 0.97826087 |
| 614 | [129,] | 0 | 0.00000000 | 0.97826087 |
| 615 | [130,] | 0 | 0.26785714 | 0.50000000 |
| 616 | [131,] | 0 | 0.00000000 | 0.97826087 |
| 617 | [132,] | 0 | 0.02702703 | 0.97826087 |
| 618 | [133,] | 0 | 0.00000000 | 0.97826087 |
| 619 | [134,] | 0 | 0.87179487 | 0.50000000 |
| 620 | [135,] | 0 | 0.87179487 | 0.50000000 |
| 621 | [136,] | 0 | 0.26785714 | 0.97826087 |
| 622 | [137,] | 0 | 0.02702703 | 0.97826087 |
| 623 | [138,] | 0 | 0.26785714 | 0.97826087 |
| 624 | [139,] | 0 | 0.26785714 | 0.97826087 |
| 625 | [140,] | 0 | 0.26785714 | 0.97826087 |
| 626 | [141,] | 0 | 0.26785714 | 0.97826087 |
| 627 | [142,] | 0 | 0.26785714 | 0.97826087 |
| 628 | [143,] | 0 | 0.00000000 | 0.97826087 |
| 629 | [144,] | 0 | 0.26785714 | 0.97826087 |
| 630 | [145,] | 0 | 0.26785714 | 0.97826087 |
| 631 | [146,] | 0 | 0.26785714 | 0.97826087 |
| 632 | [147,] | 0 | 0.00000000 | 0.97826087 |
| 633 | [148,] | 0 | 0.26785714 | 0.97826087 |
| 634 | [149,] | 0 | 0.02702703 | 0.97826087 |
| 635 | [150,] | 0 | 0.26785714 | 0.97826087 |
| 636 | >      |   |            |            |

```

637 > report.tree10 <- data.frame(n=1:nrow(td),
638 +                               classif=class.tree10,
639 +                               scale=scale.tree10,
640 +                               prob=p.tree10,
641 +                               risk=risk.tree10)
642 > report.tree10

```

|     | n  | classif | scale  | prob       | risk      |            |
|-----|----|---------|--------|------------|-----------|------------|
| 644 | 1  | 1       | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 645 | 2  | 2       | setosa | 1.27827381 | 0.7823050 | 0.21769499 |
| 646 | 3  | 3       | setosa | 1.27827381 | 0.7823050 | 0.21769499 |
| 647 | 4  | 4       | setosa | 1.27827381 | 0.7823050 | 0.21769499 |
| 648 | 5  | 5       | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 649 | 6  | 6       | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 650 | 7  | 7       | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 651 | 8  | 8       | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 652 | 9  | 9       | setosa | 1.88221154 | 0.5312899 | 0.46871009 |
| 653 | 10 | 10      | setosa | 1.27827381 | 0.7823050 | 0.21769499 |
| 654 | 11 | 11      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 655 | 12 | 12      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 656 | 13 | 13      | setosa | 1.27827381 | 0.7823050 | 0.21769499 |
| 657 | 14 | 14      | setosa | 1.27827381 | 0.7823050 | 0.21769499 |
| 658 | 15 | 15      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 659 | 16 | 16      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 660 | 17 | 17      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 661 | 18 | 18      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 662 | 19 | 19      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 663 | 20 | 20      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 664 | 21 | 21      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 665 | 22 | 22      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |
| 666 | 23 | 23      | setosa | 1.03744369 | 0.9639077 | 0.03609227 |

|     |    |    |            |            |           |            |
|-----|----|----|------------|------------|-----------|------------|
| 667 | 24 | 24 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 668 | 25 | 25 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 669 | 26 | 26 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 670 | 27 | 27 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 671 | 28 | 28 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 672 | 29 | 29 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 673 | 30 | 30 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 674 | 31 | 31 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 675 | 32 | 32 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 676 | 33 | 33 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 677 | 34 | 34 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 678 | 35 | 35 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 679 | 36 | 36 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 680 | 37 | 37 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 681 | 38 | 38 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 682 | 39 | 39 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 683 | 40 | 40 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 684 | 41 | 41 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 685 | 42 | 42 | setosa     | 1.88221154 | 0.5312899 | 0.46871009 |
| 686 | 43 | 43 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 687 | 44 | 44 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 688 | 45 | 45 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 689 | 46 | 46 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 690 | 47 | 47 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 691 | 48 | 48 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 692 | 49 | 49 | setosa     | 1.03744369 | 0.9639077 | 0.03609227 |
| 693 | 50 | 50 | setosa     | 1.27827381 | 0.7823050 | 0.21769499 |
| 694 | 51 | 51 | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 695 | 52 | 52 | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 696 | 53 | 53 | virginica  | 0.76785714 | 0.6511628 | 0.34883721 |

|     |    |    |            |            |           |            |
|-----|----|----|------------|------------|-----------|------------|
| 697 | 54 | 54 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 698 | 55 | 55 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 699 | 56 | 56 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 700 | 57 | 57 | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 701 | 58 | 58 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 702 | 59 | 59 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 703 | 60 | 60 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 704 | 61 | 61 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 705 | 62 | 62 | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 706 | 63 | 63 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 707 | 64 | 64 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 708 | 65 | 65 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 709 | 66 | 66 | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 710 | 67 | 67 | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 711 | 68 | 68 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 712 | 69 | 69 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 713 | 70 | 70 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 714 | 71 | 71 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 715 | 72 | 72 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 716 | 73 | 73 | versicolor | 1.37179487 | 0.6355140 | 0.36448598 |
| 717 | 74 | 74 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 718 | 75 | 75 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 719 | 76 | 76 | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 720 | 77 | 77 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 721 | 78 | 78 | virginica  | 0.76785714 | 0.6511628 | 0.34883721 |
| 722 | 79 | 79 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 723 | 80 | 80 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 724 | 81 | 81 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 725 | 82 | 82 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 726 | 83 | 83 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |



|     |     |     |            |            |           |            |
|-----|-----|-----|------------|------------|-----------|------------|
| 727 | 84  | 84  | versicolor | 1.37179487 | 0.6355140 | 0.36448598 |
| 728 | 85  | 85  | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 729 | 86  | 86  | versicolor | 0.03744369 | 0.7218045 | 0.27819549 |
| 730 | 87  | 87  | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 731 | 88  | 88  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 732 | 89  | 89  | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 733 | 90  | 90  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 734 | 91  | 91  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 735 | 92  | 92  | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 736 | 93  | 93  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 737 | 94  | 94  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 738 | 95  | 95  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 739 | 96  | 96  | versicolor | 0.27827381 | 0.9625668 | 0.03743316 |
| 740 | 97  | 97  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 741 | 98  | 98  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 742 | 99  | 99  | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 743 | 100 | 100 | versicolor | 0.88221154 | 0.9881926 | 0.01180745 |
| 744 | 101 | 101 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 745 | 102 | 102 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 746 | 103 | 103 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 747 | 104 | 104 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 748 | 105 | 105 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 749 | 106 | 106 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 750 | 107 | 107 | virginica  | 0.01041667 | 1.0000000 | 0.00000000 |
| 751 | 108 | 108 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 752 | 109 | 109 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 753 | 110 | 110 | virginica  | 1.00528790 | 0.9731151 | 0.02688486 |
| 754 | 111 | 111 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 755 | 112 | 112 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 756 | 113 | 113 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |

|     |     |     |            |            |           |            |
|-----|-----|-----|------------|------------|-----------|------------|
| 757 | 114 | 114 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 758 | 115 | 115 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 759 | 116 | 116 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 760 | 117 | 117 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 761 | 118 | 118 | virginica  | 1.00528790 | 0.9731151 | 0.02688486 |
| 762 | 119 | 119 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 763 | 120 | 120 | versicolor | 1.37179487 | 0.6355140 | 0.36448598 |
| 764 | 121 | 121 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 765 | 122 | 122 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 766 | 123 | 123 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 767 | 124 | 124 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 768 | 125 | 125 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 769 | 126 | 126 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 770 | 127 | 127 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 771 | 128 | 128 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 772 | 129 | 129 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 773 | 130 | 130 | virginica  | 0.76785714 | 0.6511628 | 0.34883721 |
| 774 | 131 | 131 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 775 | 132 | 132 | virginica  | 1.00528790 | 0.9731151 | 0.02688486 |
| 776 | 133 | 133 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |
| 777 | 134 | 134 | versicolor | 1.37179487 | 0.6355140 | 0.36448598 |
| 778 | 135 | 135 | versicolor | 1.37179487 | 0.6355140 | 0.36448598 |
| 779 | 136 | 136 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 780 | 137 | 137 | virginica  | 1.00528790 | 0.9731151 | 0.02688486 |
| 781 | 138 | 138 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 782 | 139 | 139 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 783 | 140 | 140 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 784 | 141 | 141 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 785 | 142 | 142 | virginica  | 1.24611801 | 0.7850467 | 0.21495327 |
| 786 | 143 | 143 | virginica  | 0.97826087 | 1.0000000 | 0.00000000 |

```

787 144 144 virginica 1.24611801 0.7850467 0.21495327
788 145 145 virginica 1.24611801 0.7850467 0.21495327
789 146 146 virginica 1.24611801 0.7850467 0.21495327
790 147 147 virginica 0.97826087 1.00000000 0.00000000
791 148 148 virginica 1.24611801 0.7850467 0.21495327
792 149 149 virginica 1.00528790 0.9731151 0.02688486
793 150 150 virginica 1.24611801 0.7850467 0.21495327
794 >
795 > ###
796 > #
797 > # single tree: multinomial
798 > #
799 > ###
800 > #
801 > # setup
802 > #
803 > td$y          <- as.factor(td$Species) # triggers classification
804 >
805 > m              <- ctree(y~.-Species,data=td)
806 >
807 > fitted.tree1   <- predict(m)
808 > (pred.tree1    <- predict(m,type="prob") ) # individual class
809 probabilities
810      setosa versicolor virginica
811 2          1 0.00000000 0.00000000
812 2          1 0.00000000 0.00000000
813 2          1 0.00000000 0.00000000
814 2          1 0.00000000 0.00000000
815 2          1 0.00000000 0.00000000
816 2          1 0.00000000 0.00000000
817 2          1 0.00000000 0.00000000

```

|     |   |   |            |            |
|-----|---|---|------------|------------|
| 818 | 2 | 1 | 0.00000000 | 0.00000000 |
| 819 | 2 | 1 | 0.00000000 | 0.00000000 |
| 820 | 2 | 1 | 0.00000000 | 0.00000000 |
| 821 | 2 | 1 | 0.00000000 | 0.00000000 |
| 822 | 2 | 1 | 0.00000000 | 0.00000000 |
| 823 | 2 | 1 | 0.00000000 | 0.00000000 |
| 824 | 2 | 1 | 0.00000000 | 0.00000000 |
| 825 | 2 | 1 | 0.00000000 | 0.00000000 |
| 826 | 2 | 1 | 0.00000000 | 0.00000000 |
| 827 | 2 | 1 | 0.00000000 | 0.00000000 |
| 828 | 2 | 1 | 0.00000000 | 0.00000000 |
| 829 | 2 | 1 | 0.00000000 | 0.00000000 |
| 830 | 2 | 1 | 0.00000000 | 0.00000000 |
| 831 | 2 | 1 | 0.00000000 | 0.00000000 |
| 832 | 2 | 1 | 0.00000000 | 0.00000000 |
| 833 | 2 | 1 | 0.00000000 | 0.00000000 |
| 834 | 2 | 1 | 0.00000000 | 0.00000000 |
| 835 | 2 | 1 | 0.00000000 | 0.00000000 |
| 836 | 2 | 1 | 0.00000000 | 0.00000000 |
| 837 | 2 | 1 | 0.00000000 | 0.00000000 |
| 838 | 2 | 1 | 0.00000000 | 0.00000000 |
| 839 | 2 | 1 | 0.00000000 | 0.00000000 |
| 840 | 2 | 1 | 0.00000000 | 0.00000000 |
| 841 | 2 | 1 | 0.00000000 | 0.00000000 |
| 842 | 2 | 1 | 0.00000000 | 0.00000000 |
| 843 | 2 | 1 | 0.00000000 | 0.00000000 |
| 844 | 2 | 1 | 0.00000000 | 0.00000000 |
| 845 | 2 | 1 | 0.00000000 | 0.00000000 |
| 846 | 2 | 1 | 0.00000000 | 0.00000000 |
| 847 | 2 | 1 | 0.00000000 | 0.00000000 |

|     |   |   |            |            |
|-----|---|---|------------|------------|
| 848 | 2 | 1 | 0.00000000 | 0.00000000 |
| 849 | 2 | 1 | 0.00000000 | 0.00000000 |
| 850 | 2 | 1 | 0.00000000 | 0.00000000 |
| 851 | 2 | 1 | 0.00000000 | 0.00000000 |
| 852 | 2 | 1 | 0.00000000 | 0.00000000 |
| 853 | 2 | 1 | 0.00000000 | 0.00000000 |
| 854 | 2 | 1 | 0.00000000 | 0.00000000 |
| 855 | 2 | 1 | 0.00000000 | 0.00000000 |
| 856 | 2 | 1 | 0.00000000 | 0.00000000 |
| 857 | 2 | 1 | 0.00000000 | 0.00000000 |
| 858 | 2 | 1 | 0.00000000 | 0.00000000 |
| 859 | 2 | 1 | 0.00000000 | 0.00000000 |
| 860 | 2 | 1 | 0.00000000 | 0.00000000 |
| 861 | 5 | 0 | 0.97826087 | 0.02173913 |
| 862 | 5 | 0 | 0.97826087 | 0.02173913 |
| 863 | 6 | 0 | 0.50000000 | 0.50000000 |
| 864 | 5 | 0 | 0.97826087 | 0.02173913 |
| 865 | 5 | 0 | 0.97826087 | 0.02173913 |
| 866 | 5 | 0 | 0.97826087 | 0.02173913 |
| 867 | 5 | 0 | 0.97826087 | 0.02173913 |
| 868 | 5 | 0 | 0.97826087 | 0.02173913 |
| 869 | 5 | 0 | 0.97826087 | 0.02173913 |
| 870 | 5 | 0 | 0.97826087 | 0.02173913 |
| 871 | 5 | 0 | 0.97826087 | 0.02173913 |
| 872 | 5 | 0 | 0.97826087 | 0.02173913 |
| 873 | 5 | 0 | 0.97826087 | 0.02173913 |
| 874 | 5 | 0 | 0.97826087 | 0.02173913 |
| 875 | 5 | 0 | 0.97826087 | 0.02173913 |
| 876 | 5 | 0 | 0.97826087 | 0.02173913 |
| 877 | 5 | 0 | 0.97826087 | 0.02173913 |

|     |   |   |            |            |
|-----|---|---|------------|------------|
| 878 | 5 | 0 | 0.97826087 | 0.02173913 |
| 879 | 5 | 0 | 0.97826087 | 0.02173913 |
| 880 | 5 | 0 | 0.97826087 | 0.02173913 |
| 881 | 7 | 0 | 0.02173913 | 0.97826087 |
| 882 | 5 | 0 | 0.97826087 | 0.02173913 |
| 883 | 6 | 0 | 0.50000000 | 0.50000000 |
| 884 | 5 | 0 | 0.97826087 | 0.02173913 |
| 885 | 5 | 0 | 0.97826087 | 0.02173913 |
| 886 | 5 | 0 | 0.97826087 | 0.02173913 |
| 887 | 5 | 0 | 0.97826087 | 0.02173913 |
| 888 | 6 | 0 | 0.50000000 | 0.50000000 |
| 889 | 5 | 0 | 0.97826087 | 0.02173913 |
| 890 | 5 | 0 | 0.97826087 | 0.02173913 |
| 891 | 5 | 0 | 0.97826087 | 0.02173913 |
| 892 | 5 | 0 | 0.97826087 | 0.02173913 |
| 893 | 5 | 0 | 0.97826087 | 0.02173913 |
| 894 | 6 | 0 | 0.50000000 | 0.50000000 |
| 895 | 5 | 0 | 0.97826087 | 0.02173913 |
| 896 | 5 | 0 | 0.97826087 | 0.02173913 |
| 897 | 5 | 0 | 0.97826087 | 0.02173913 |
| 898 | 5 | 0 | 0.97826087 | 0.02173913 |
| 899 | 5 | 0 | 0.97826087 | 0.02173913 |
| 900 | 5 | 0 | 0.97826087 | 0.02173913 |
| 901 | 5 | 0 | 0.97826087 | 0.02173913 |
| 902 | 5 | 0 | 0.97826087 | 0.02173913 |
| 903 | 5 | 0 | 0.97826087 | 0.02173913 |
| 904 | 5 | 0 | 0.97826087 | 0.02173913 |
| 905 | 5 | 0 | 0.97826087 | 0.02173913 |
| 906 | 5 | 0 | 0.97826087 | 0.02173913 |
| 907 | 5 | 0 | 0.97826087 | 0.02173913 |

|     |   |   |            |            |
|-----|---|---|------------|------------|
| 908 | 5 | 0 | 0.97826087 | 0.02173913 |
| 909 | 5 | 0 | 0.97826087 | 0.02173913 |
| 910 | 5 | 0 | 0.97826087 | 0.02173913 |
| 911 | 7 | 0 | 0.02173913 | 0.97826087 |
| 912 | 7 | 0 | 0.02173913 | 0.97826087 |
| 913 | 7 | 0 | 0.02173913 | 0.97826087 |
| 914 | 7 | 0 | 0.02173913 | 0.97826087 |
| 915 | 7 | 0 | 0.02173913 | 0.97826087 |
| 916 | 7 | 0 | 0.02173913 | 0.97826087 |
| 917 | 5 | 0 | 0.97826087 | 0.02173913 |
| 918 | 7 | 0 | 0.02173913 | 0.97826087 |
| 919 | 7 | 0 | 0.02173913 | 0.97826087 |
| 920 | 7 | 0 | 0.02173913 | 0.97826087 |
| 921 | 7 | 0 | 0.02173913 | 0.97826087 |
| 922 | 7 | 0 | 0.02173913 | 0.97826087 |
| 923 | 7 | 0 | 0.02173913 | 0.97826087 |
| 924 | 7 | 0 | 0.02173913 | 0.97826087 |
| 925 | 7 | 0 | 0.02173913 | 0.97826087 |
| 926 | 7 | 0 | 0.02173913 | 0.97826087 |
| 927 | 7 | 0 | 0.02173913 | 0.97826087 |
| 928 | 7 | 0 | 0.02173913 | 0.97826087 |
| 929 | 7 | 0 | 0.02173913 | 0.97826087 |
| 930 | 6 | 0 | 0.50000000 | 0.50000000 |
| 931 | 7 | 0 | 0.02173913 | 0.97826087 |
| 932 | 7 | 0 | 0.02173913 | 0.97826087 |
| 933 | 7 | 0 | 0.02173913 | 0.97826087 |
| 934 | 7 | 0 | 0.02173913 | 0.97826087 |
| 935 | 7 | 0 | 0.02173913 | 0.97826087 |
| 936 | 7 | 0 | 0.02173913 | 0.97826087 |
| 937 | 7 | 0 | 0.02173913 | 0.97826087 |

```

938 7      0 0.02173913 0.97826087
939 7      0 0.02173913 0.97826087
940 6      0 0.50000000 0.50000000
941 7      0 0.02173913 0.97826087
942 7      0 0.02173913 0.97826087
943 7      0 0.02173913 0.97826087
944 6      0 0.50000000 0.50000000
945 6      0 0.50000000 0.50000000
946 7      0 0.02173913 0.97826087
947 7      0 0.02173913 0.97826087
948 7      0 0.02173913 0.97826087
949 7      0 0.02173913 0.97826087
950 7      0 0.02173913 0.97826087
951 7      0 0.02173913 0.97826087
952 7      0 0.02173913 0.97826087
953 7      0 0.02173913 0.97826087
954 7      0 0.02173913 0.97826087
955 7      0 0.02173913 0.97826087
956 7      0 0.02173913 0.97826087
957 7      0 0.02173913 0.97826087
958 7      0 0.02173913 0.97826087
959 7      0 0.02173913 0.97826087
960 7      0 0.02173913 0.97826087
961 > scale.tree1    <- apply(pred.tree1, byRows, sum)
962 > prob.tree1     <- apply(pred.tree1, byRows, max)/scale.tree1
963 > risk.tree1     <- 1-prob.tree1
964 >
965 > (hits.tree1    <- table(fitted.tree1, td$Species) )
966
967 fitted.tree1 setosa versicolor virginica

```



```

968     setosa           50           0           0
969     versicolor       0           49           5
970     virginica        0           1          45
971 > (pc.tree1         <- sum(diag(hits.tree1))/sum(hits.tree1)) # percent
972 correct
973 [1] 0.96
974 >
975 > # other
976 > summary(risk.tree1)
977      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
978 0.00000 0.00000 0.02174 0.04000 0.02174 0.50000
979 >
980 > #fitted.tree1
981 >
982 > report.tree1 <- data.frame(n=1:nrow(td),
983 +                             classif=fitted.tree1,
984 +                             scale=scale.tree1,
985 +                             prob=prob.tree1,
986 +                             risk=risk.tree1)
987 >
988 > report.tree1
989      n  classif scale      prob      risk
990 1    1    setosa    1 1.0000000 0.0000000
991 2    2    setosa    1 1.0000000 0.0000000
992 3    3    setosa    1 1.0000000 0.0000000
993 4    4    setosa    1 1.0000000 0.0000000
994 5    5    setosa    1 1.0000000 0.0000000
995 6    6    setosa    1 1.0000000 0.0000000
996 7    7    setosa    1 1.0000000 0.0000000
997 8    8    setosa    1 1.0000000 0.0000000
998 9    9    setosa    1 1.0000000 0.0000000

```

|      |    |    |        |   |           |            |
|------|----|----|--------|---|-----------|------------|
| 999  | 10 | 10 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1000 | 11 | 11 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1001 | 12 | 12 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1002 | 13 | 13 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1003 | 14 | 14 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1004 | 15 | 15 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1005 | 16 | 16 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1006 | 17 | 17 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1007 | 18 | 18 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1008 | 19 | 19 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1009 | 20 | 20 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1010 | 21 | 21 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1011 | 22 | 22 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1012 | 23 | 23 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1013 | 24 | 24 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1014 | 25 | 25 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1015 | 26 | 26 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1016 | 27 | 27 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1017 | 28 | 28 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1018 | 29 | 29 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1019 | 30 | 30 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1020 | 31 | 31 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1021 | 32 | 32 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1022 | 33 | 33 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1023 | 34 | 34 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1024 | 35 | 35 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1025 | 36 | 36 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1026 | 37 | 37 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1027 | 38 | 38 | setosa | 1 | 1.0000000 | 0.00000000 |
| 1028 | 39 | 39 | setosa | 1 | 1.0000000 | 0.00000000 |

|      |    |    |            |   |           |            |
|------|----|----|------------|---|-----------|------------|
| 1029 | 40 | 40 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1030 | 41 | 41 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1031 | 42 | 42 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1032 | 43 | 43 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1033 | 44 | 44 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1034 | 45 | 45 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1035 | 46 | 46 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1036 | 47 | 47 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1037 | 48 | 48 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1038 | 49 | 49 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1039 | 50 | 50 | setosa     | 1 | 1.0000000 | 0.00000000 |
| 1040 | 51 | 51 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1041 | 52 | 52 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1042 | 53 | 53 | versicolor | 1 | 0.5000000 | 0.50000000 |
| 1043 | 54 | 54 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1044 | 55 | 55 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1045 | 56 | 56 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1046 | 57 | 57 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1047 | 58 | 58 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1048 | 59 | 59 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1049 | 60 | 60 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1050 | 61 | 61 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1051 | 62 | 62 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1052 | 63 | 63 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1053 | 64 | 64 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1054 | 65 | 65 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1055 | 66 | 66 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1056 | 67 | 67 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1057 | 68 | 68 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1058 | 69 | 69 | versicolor | 1 | 0.9782609 | 0.02173913 |

|      |    |               |   |           |            |
|------|----|---------------|---|-----------|------------|
| 1059 | 70 | 70 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1060 | 71 | 71 virginica  | 1 | 0.9782609 | 0.02173913 |
| 1061 | 72 | 72 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1062 | 73 | 73 versicolor | 1 | 0.5000000 | 0.50000000 |
| 1063 | 74 | 74 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1064 | 75 | 75 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1065 | 76 | 76 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1066 | 77 | 77 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1067 | 78 | 78 versicolor | 1 | 0.5000000 | 0.50000000 |
| 1068 | 79 | 79 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1069 | 80 | 80 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1070 | 81 | 81 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1071 | 82 | 82 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1072 | 83 | 83 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1073 | 84 | 84 versicolor | 1 | 0.5000000 | 0.50000000 |
| 1074 | 85 | 85 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1075 | 86 | 86 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1076 | 87 | 87 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1077 | 88 | 88 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1078 | 89 | 89 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1079 | 90 | 90 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1080 | 91 | 91 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1081 | 92 | 92 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1082 | 93 | 93 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1083 | 94 | 94 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1084 | 95 | 95 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1085 | 96 | 96 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1086 | 97 | 97 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1087 | 98 | 98 versicolor | 1 | 0.9782609 | 0.02173913 |
| 1088 | 99 | 99 versicolor | 1 | 0.9782609 | 0.02173913 |

|      |     |     |            |   |           |            |
|------|-----|-----|------------|---|-----------|------------|
| 1089 | 100 | 100 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1090 | 101 | 101 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1091 | 102 | 102 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1092 | 103 | 103 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1093 | 104 | 104 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1094 | 105 | 105 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1095 | 106 | 106 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1096 | 107 | 107 | versicolor | 1 | 0.9782609 | 0.02173913 |
| 1097 | 108 | 108 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1098 | 109 | 109 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1099 | 110 | 110 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1100 | 111 | 111 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1101 | 112 | 112 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1102 | 113 | 113 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1103 | 114 | 114 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1104 | 115 | 115 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1105 | 116 | 116 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1106 | 117 | 117 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1107 | 118 | 118 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1108 | 119 | 119 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1109 | 120 | 120 | versicolor | 1 | 0.5000000 | 0.50000000 |
| 1110 | 121 | 121 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1111 | 122 | 122 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1112 | 123 | 123 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1113 | 124 | 124 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1114 | 125 | 125 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1115 | 126 | 126 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1116 | 127 | 127 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1117 | 128 | 128 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1118 | 129 | 129 | virginica  | 1 | 0.9782609 | 0.02173913 |

|      |     |     |            |   |           |            |
|------|-----|-----|------------|---|-----------|------------|
| 1119 | 130 | 130 | versicolor | 1 | 0.5000000 | 0.50000000 |
| 1120 | 131 | 131 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1121 | 132 | 132 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1122 | 133 | 133 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1123 | 134 | 134 | versicolor | 1 | 0.5000000 | 0.50000000 |
| 1124 | 135 | 135 | versicolor | 1 | 0.5000000 | 0.50000000 |
| 1125 | 136 | 136 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1126 | 137 | 137 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1127 | 138 | 138 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1128 | 139 | 139 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1129 | 140 | 140 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1130 | 141 | 141 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1131 | 142 | 142 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1132 | 143 | 143 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1133 | 144 | 144 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1134 | 145 | 145 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1135 | 146 | 146 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1136 | 147 | 147 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1137 | 148 | 148 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1138 | 149 | 149 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1139 | 150 | 150 | virginica  | 1 | 0.9782609 | 0.02173913 |
| 1140 | >   |     |            |   |           |            |