# BUAN 6357 Exam 1 Classification (Johnston) Spring 2023

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> ###
> #
> # BUAN 6357 2023 Spring (Johnston)
> #
> # Exam 1: section 2 - classification
> #
> # A run log of this code is provided as a PDF file.
> # You may run this code, explore its actions, and add comments
> #  as you wish.
> #
> # Based on class discussions and homework assignments,
> # You should extend this code as needed in preparation for
> #  answering questions about the process presented here.
> #
> #
> options(width=70,scipen=15)
> setwd("c:/data/BUAN6357/exams/exam1") # change as needed
>
> require(data.table)
Loading required package: data.table
data.table 1.14.6 using 4 threads (see ?getDTthreads).  Latest news:
r-datatable.com
> require(partykit)
Loading required package: partykit
Loading required package: grid
Loading required package: libcoin
Loading required package: mvtnorm
>
> classif    <- c(1, 2, 3)
> byCols     <- 2
> byRows     <- 1
>
> in1        <- fread(file="classif.dat")
>
> fitLogit   <- function(df,i) {
+               df$y             <- 0
+               df$y[df$grp==i] <- 1
+               t                <- glm(y~.-
grp,family=binomial(),data=df)
+               return(t$fitted.values)
+               }
>
```

```
> (t         <- data.table(idx=1:3, i=1:3) )
   idx i
1:   1 1
2:   2 2
3:   3 3
> tLogit     <- t[,.(fitted=fitLogit(in1,i)), by=.(idx)]
Warning messages:
1: glm.fit: algorithm did not converge
2: glm.fit: fitted probabilities numerically 0 or 1 occurred
3: glm.fit: fitted probabilities numerically 0 or 1 occurred
> (mLogit    <- matrix(tLogit$fitted, ncol=length(classif),byrow=F) )
                              [,1]        [,2]                      [,3]
  [1,] 0.00000000000000022204460 0.446561196 0.00001481063826982804490
  [2,] 0.99999999999999977795540 0.084913218 0.00000000000000022204460
  [3,] 0.00000000000000022204460 0.095661544 0.99999995072044645105790
  [4,] 0.99999999999999977795540 0.144643488 0.00000000000000022204460
  [5,] 0.00000000485549876998600 0.629082784 0.00000000012904238035610
  [6,] 0.99999999994754995569220 0.203055831 0.00000000000000022204460
  [7,] 0.99999999999983812948300 0.182719028 0.00000000000000022204460
  [8,] 0.00000000000000022204460 0.098468930 0.99999316520659464746500
  [9,] 0.99999999999987332355290 0.146615506 0.00000000000000022204460
 [10,] 0.00000000000000022204460 0.152688686 0.40483809098475792565000
 [11,] 0.00000000000000022204460 0.896097587 0.92049229436352331124030
 [12,] 0.99999999999999977795540 0.122779536 0.00000000000000022204460
 [13,] 0.00000000000000022204460 0.338799903 0.82454403867722469989590
 [14,] 0.00000000000000022204460 0.446220505 0.00002309661554126592220
 [15,] 0.00000000000000022204460 0.351802660 0.00000078841467250874990
 [16,] 0.99999999999999977795540 0.171982672 0.00000000000000022204460
 [17,] 0.00000000000000022204460 0.377468596 0.99999923527411649359920
 [18,] 0.00000000000000022204460 0.646776813 0.00000043606141798490430
 [19,] 0.00000000000000022204460 0.071180487 0.99999516587049064320070
 [20,] 0.99999999999999977795540 0.253822895 0.00000000000000022204460
 [21,] 0.99999999999999977795540 0.011737848 0.00000000000000022204460
 [22,] 0.00000000000000022204460 0.105652352 0.00021298227243973479530
 [23,] 0.00000000000000022204460 0.434128932 0.00000141066025451405740
 [24,] 0.00000000000000022204460 0.217987813 0.99999998341395135437180
 [25,] 0.00000000000000022204460 0.457234907 0.00140847017723251316180
 [26,] 0.00000000000000022204460 0.902922390 0.00000009947106779836970
 [27,] 0.00000000000000022204460 0.032661153 0.99999999312936427298130
 [28,] 0.00000000000000022204460 0.827614779 0.00025513602793804076100
 [29,] 0.00000000000000022204460 0.136952754 0.99998238384520599097980
 [30,] 0.99999999999999977795540 0.282917869 0.00000000000000022204460
 [31,] 0.00000000000000022204460 0.809798929 0.05959819600834911218490
 [32,] 0.99999999999979227727210 0.095100612 0.00000000000000022204460
 [33,] 0.99999999999999977795540 0.033536563 0.00000000000000022204460
 [34,] 0.00000000000000022204460 0.888692503 0.96640465942804332222240
 [35,] 0.00000000000017334381910 0.802088276 0.00000000529881954701600
 [36,] 0.00000000000000022204460 0.302108585 0.99999903460896188978070
 [37,] 0.99999999999999977795540 0.023403244 0.00000000000000022204460
```

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[38,] 0.00000000000000002220446 0.733465616 0.0000000148115303928313
[39,] 0.00000000000000002220446 0.709205985 0.0000402380942425990660
[40,] 0.00000000000000002220446 0.456463346 0.9996139079152555062535
[41,] 0.00000000000000002220446 0.088172089 0.9999189144543219054384
[42,] 0.00000000000000002220446 0.480922554 0.0000023441496983679983
[43,] 0.00000000000000002220446 0.456463346 0.9996139079152555062535
[44,] 0.00000000000000002220446 0.049851313 0.9999956250443577943088
[45,] 0.00000000000000002220446 0.610427722 0.0001018577545693299903
[46,] 0.00000000000000002220446 0.198302894 0.0000485623729363392675
[47,] 0.99999999999999997779554 0.044795194 0.00000000000000002220446
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[75,] 0.00000000000000002220446 0.679672890 0.9999955011726675557782
[76,] 0.99999999999999997779554 0.088657334 0.00000000000000002220446
[77,] 0.00000000000000002220446 0.614632483 0.9999968747483631847928
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[83,] 0.99999999999999997779554 0.289239940 0.00000000000000002220446
[84,] 0.00000000000000002220446 0.647905008 0.8676298918876365062758
[85,] 0.00000000000000002220446 0.318589723 0.9776788520490160561138
[86,] 0.00000000000000002220446 0.424127086 0.0000003405811500248701
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 [87,] 0.00000000000000002220446 0.208865263 0.9989939133172369700731
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[103,] 0.00000000000000002220446 0.048006808 0.9999998635869795649000
[104,] 0.00000000000000002220446 0.345893720 0.996497263728451265 7629
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[106,] 0.99999999999998850919170 0.195330231 0.00000000000000002220446
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[109,] 0.00000000000000002220446 0.136647611 0.9999999194210439368291
[110,] 0.00000000000000002220446 0.079536211 0.9999999244908345241711
[111,] 0.00000000000000002220446 0.151268800 0.9998716978722825832193
[112,] 0.99999999999999997779554 0.004211069 0.00000000000000002220446
[113,] 0.99999999999999997779554 0.069419306 0.00000000000000002220446
[114,] 0.99999999999999997779554 0.053204234 0.00000000000000002220446
[115,] 0.99999999999999997779554 0.142639277 0.00000000000000002220446
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[117,] 0.00000000000000002220446 0.592190618 0.8908123266401964945871
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[120,] 0.00000000000000002220446 0.532624132 0.9991066847296994346550
[121,] 0.00000000000000002220446 0.514047617 0.0007988665369052930839
[122,] 0.00000000000000002220446 0.405640478 0.9976993691294526733770
[123,] 0.00000000000000002220446 0.429923968 0.9484339026178612019891
[124,] 0.00000000000000002220446 0.078715028 0.9999999997414765751103
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[126,] 0.00000000000000002220446 0.158802911 0.0013057267129579980865
[127,] 0.99999999999990922816551 0.085791654 0.00000000000000002220446
[128,] 0.00000000000000002220446 0.132543737 0.9999999547628737328608
[129,] 0.00000000000000002220446 0.249878252 0.9999999092846280079883
[130,] 0.00000000000000002220446 0.260298942 0.0000028288356192343059
[131,] 0.00000000000000002220446 0.597725020 0.9712012759767564284985
[132,] 0.00000000000000002220446 0.314720662 0.9999998771573337386087
[133,] 0.00000000000000002220446 0.116865184 0.9902584384898660552210
[134,] 0.00000000000000002220446 0.235251995 0.6691424640804923829052
[135,] 0.99999999999999997779554 0.067075197 0.00000000000000002220446
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[136,] 0.999999999997224442438 0.333623714 0.00000000000000002220446
[137,] 0.999999999687969598483 0.039110729 0.00000000000000002220446
[138,] 0.00000000000000002220446 0.216000555 0.9999799756926128768697
[139,] 0.00000000000000002220446 0.049634005 0.999999988270177886 3847
[140,] 0.00000000000000002220446 0.412215071 0.000159621634250943 5492
[141,] 0.00000000000000002220446 0.769229473 0.000039698312419055 0886
[142,] 0.00000000000006831499660 0.781815103 0.000000000815812125 1610
[143,] 0.00000000000000002220446 0.519508925 0.999718849674762211 0661
[144,] 0.999999999873161460329 0.371053818 0.00000000000000002220446
[145,] 0.999999999999997779554 0.024827392 0.00000000000000002220446
[146,] 0.00000000000000002220446 0.444075149 0.000030856792352330231
[147,] 0.999999999999997779554 0.144722026 0.00000000000000002220446
[148,] 0.999999999999997779554 0.054453818 0.00000000000000002220446
[149,] 0.00000000000000002220446 0.777806218 0.000000084693274399 8938
[150,] 0.00000000000000002220446 0.064498190 0.999943960976639 0679724
> (idxLogit  <- apply(mLogit,byRows,which.max) )
  [1] 2 1 3 1 2 1 1 3 1 3 3 1 3 2 2 1 3 2 3 1 1 2 2 3 2 2 3 2 3 1 2 1
 [33] 1 3 2 3 1 2 2 3 3 2 3 3 2 2 1 2 3 2 2 2 3 2 2 1 1 2 2 2 1 2 3 1
 [65] 3 2 1 2 2 1 1 3 2 2 3 1 3 1 2 1 2 2 1 3 3 2 3 1 1 3 2 1 2 3 1 1
 [97] 2 1 1 1 1 3 3 3 3 1 2 1 3 3 3 1 1 1 1 3 3 2 1 3 2 3 3 3 1 2 1 3
[129] 3 2 3 3 3 3 1 1 1 3 3 2 2 2 3 1 1 2 1 1 2 3
> (classLogit<- classif[idxLogit] )
  [1] 2 1 3 1 2 1 1 3 1 3 3 1 3 2 2 1 3 2 3 1 1 2 2 3 2 2 3 2 3 1 2 1
 [33] 1 3 2 3 1 2 2 3 3 2 3 3 2 2 1 2 3 2 2 2 3 2 2 1 1 2 2 2 1 2 3 1
 [65] 3 2 1 2 2 1 1 3 2 2 3 1 3 1 2 1 2 2 1 3 3 2 3 1 1 3 2 1 2 3 1 1
 [97] 2 1 1 1 1 3 3 3 3 1 2 1 3 3 3 1 1 1 1 3 3 2 1 3 2 3 3 3 1 2 1 3
[129] 3 2 3 3 3 3 1 1 1 3 3 2 2 2 3 1 1 2 1 1 2 3
> (rMargin   <- mLogit[,1]+mLogit[,2]+mLogit[,3] )
  [1] 0.4465760 1.0849132 1.0956615 1.1446435 0.6290828 1.2030558
  [7] 1.1827190 1.0984621 1.1466155 0.5575268 1.8165899 1.1227795
 [13] 1.1633439 0.4462228 0.3518034 1.1719827 1.3774678 0.6467772
 [19] 1.0711757 1.2538229 1.0117378 0.1058653 0.4341303 1.2179878
 [25] 0.4586434 0.9029225 1.0326611 0.8278699 1.1369351 1.2829179
 [31] 0.8693971 1.0951006 1.0335366 1.8550972 0.8020883 1.3021076
 [37] 1.0234032 0.7334656 0.7092462 1.4560773 1.0880910 0.4809249
 [43] 1.4560773 1.0498469 0.6105296 0.1983515 1.0447952 0.2835968
 [49] 1.4899001 0.9151323 0.3229625 0.6638236 1.7959611 0.8353860
 [55] 0.5200032 1.1069513 1.0374235 0.7755443 0.4436255 0.3879932
 [61] 1.2344535 0.9770851 1.7116829 1.2680146 1.3874323 0.2712501
 [67] 1.0947057 0.3462705 0.5051245 1.2844638 1.6718376 1.4849787
 [73] 0.2682486 0.7465129 1.6796684 1.0886573 1.6146294 1.0495652
 [79] 0.3582846 1.3480405 0.3298040 0.5483188 1.2892399 1.5155349
 [85] 1.2962686 0.4241274 1.2078592 1.0656678 1.2354935 1.0573104
 [91] 0.5740488 1.3099203 0.2480880 1.4999827 1.1254467 1.0424843
 [97] 0.5888642 1.0594096 1.2811590 1.0139716 1.0935907 1.1028528
[103] 1.0480067 1.3423910 1.7093256 1.1953302 0.5839361 1.0334775
[109] 1.1366475 1.0795361 1.1511405 1.0042111 1.0694193 1.0532042
[115] 1.1426393 1.2792559 1.4830029 0.7351974 1.0686959 1.5317308
[121] 0.5148465 1.4033398 1.3783579 1.0787150 1.0146270 0.1601086
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 [127] 1.0857917 1.1325437 1.2498782 0.2603018 1.5689263 1.3147205
 [133] 1.1071236 0.9043945 1.0670752 1.3336237 1.0391107 1.2159805
 [139] 1.0496340 0.4123747 0.7692692 0.7818151 1.5192278 1.3710538
 [145] 1.0248274 0.4440782 1.1447220 1.0544538 0.7778063 1.0644422
> t1         <- apply(mLogit,byRows,max)
> (pLogit    <- t1/rMargin )
   [1] 0.9999668 0.9217327 0.9126906 0.8736345 1.0000000 0.8312166
   [7] 0.8455094 0.9103575 0.8721319 0.7261321 0.5067144 0.8906468
  [13] 0.7087706 0.9999948 0.9999978 0.8532549 0.7259692 0.9999993
  [19] 0.9335492 0.7975608 0.9883983 0.9979882 0.9999968 0.8210263
  [25] 0.9969291 0.9999999 0.9683719 0.9996918 0.8795422 0.7794731
  [31] 0.9314488 0.9131581 0.9675516 0.5209456 1.0000000 0.7679849
  [37] 0.9771319 1.0000000 0.9999433 0.6865116 0.9189663 0.9999951
  [43] 0.6865116 0.9525156 0.9998332 0.9997552 0.9571254 0.9989493
  [49] 0.6711859 1.0000000 0.9999781 0.9999833 0.5568005 0.7547552
  [55] 0.9999720 0.9033821 0.9639265 0.9999456 0.9999994 0.9975124
  [61] 0.8100750 0.7698933 0.5842204 0.7886345 0.7204377 0.9999999
  [67] 0.9134875 0.9961706 1.0000000 0.7785350 0.5981442 0.6732372
  [73] 0.9999563 0.9999999 0.5953529 0.9185627 0.6193352 0.9527755
  [79] 0.9939455 0.7418175 0.9963656 0.9999998 0.7756508 0.5724909
  [85] 0.7542255 0.9999992 0.8270781 0.9383787 0.8093932 0.7588112
  [91] 0.9987590 0.7634052 0.9998491 0.6666525 0.8885361 0.9592470
  [97] 0.9999745 0.9439220 0.7805432 0.9862209 0.9144189 0.9067390
 [103] 0.9541923 0.7423301 0.5850261 0.8365889 0.5272398 0.9676069
 [109] 0.8797801 0.9263237 0.8685922 0.9958066 0.9350869 0.9494835
 [115] 0.8751668 0.7813237 0.6006814 1.0000000 0.9357199 0.6522730
 [121] 0.9984483 0.7109464 0.6880897 0.9270289 0.9855839 0.9918447
 [127] 0.9209870 0.8829681 0.8000779 0.9999891 0.6190229 0.7606178
 [133] 0.8944425 0.7398790 0.9371411 0.7498367 0.9623613 0.8223651
 [139] 0.9527130 0.9996129 0.9999484 1.0000000 0.6580441 0.7293660
 [145] 0.9757741 0.9999931 0.8735745 0.9483583 0.9999999 0.9394066
> (brLogit   <- 1-pLogit )
   [1] 0.0000331648768604 0.0782672906850692 0.0873093963559070
   [4] 0.1263655364055221 0.0000000009769655 0.1687833813909169
   [7] 0.1544906468073796 0.0896425380101445 0.1278680648882338
  [10] 0.2738678968872423 0.4932855765394171 0.1093532005369029
  [13] 0.2912293526820116 0.0000051760274826 0.0000022410657894
  [16] 0.1467450641232393 0.2740307885033132 0.0000006742064892
  [19] 0.0664508076073819 0.2024391926624798 0.0116016696542289
  [22] 0.0020118226055312 0.0000032493933632 0.1789737253734676
  [25] 0.0030709484686395 0.0000001101656778 0.0316281418042434
  [28] 0.0003081837175790 0.1204578429548873 0.2205268753069153
  [31] 0.0685511767796598 0.0868418946818585 0.0324483563427732
  [34] 0.4790544241639277 0.0000000066064957 0.2320150656080741
  [37] 0.0228680576027908 0.0000000201938987 0.0000567336038194
  [40] 0.3134884121323785 0.0810337452108377 0.0000048742531449
  [43] 0.3134884121323785 0.0474843624932129 0.0001668350854757
  [46] 0.0002448299292033 0.0428746174011642 0.0010506886121168
  [49] 0.3288140650253466 0.0000000436087819 0.0000218607075074
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 [52] 0.0000167102864457 0.4431994788553560 0.2452447859041418
 [55] 0.0000280429307471 0.0966178544161267 0.0360734936300182
 [58] 0.0000544140345583 0.0000005728374362 0.0024875502516765
 [61] 0.1899249604260093 0.2301066758605764 0.4157796468270698
 [64] 0.2113655355830748 0.2795622591871948 0.0000000508133301
 [67] 0.0865124900576872 0.0038293836551287 0.0000000011260628
 [70] 0.2214650151970440 0.4018557664228520 0.3267627864965197
 [73] 0.0000436785913812 0.0000001167116547 0.4046470681765759
 [76] 0.0814373185972522 0.3806647512508345 0.0472244946707984
 [79] 0.0060544651338261 0.2581825137300054 0.0036343574019821
 [82] 0.0000001588014353 0.2243491926397647 0.4275091310684828
 [85] 0.2457744706266052 0.0000008030160962 0.1729218660393302
 [88] 0.0616212576859517 0.1906068136538445 0.2411888025962501
 [91] 0.0012410267836660 0.2365947885932129 0.0001509281132401
 [94] 0.3333474747987993 0.1114639152446064 0.0407529711946577
 [97] 0.0000255086849659 0.0560780144465001 0.2194567731805621
[100] 0.0137791104727737 0.0855810676031673 0.0932610418545834
[103] 0.0458077308997865 0.2576698771646605 0.4149739385177702
[106] 0.1634111026682236 0.4727601734692568 0.0323931033216903
[109] 0.1202198638840003 0.0736762839718537 0.1314077646828805
[112] 0.0041934098103541 0.0649130844293544 0.0505165399338728
[115] 0.1248331643763420 0.2186762652195494 0.3993185720593087
[118] 0.0000000007285791 0.0642801304581883 0.3477269807934025
[121] 0.0015516596944093 0.2890536306749532 0.3119102646523914
[124] 0.0729711053578305 0.0144161292670995 0.0081552546513950
[127] 0.0790129978988520 0.1170318975423529 0.1999220880741415
[130] 0.0000108675235119 0.3809771190727831 0.2393821747314512
[133] 0.1055574837422693 0.2601210047097776 0.0628589222436522
[136] 0.2501633036950314 0.0376386534376878 0.1776348797088374
[139] 0.0472869638263166 0.0003870791223541 0.0000516052299030
[142] 0.0000000010443585 0.3419559155974100 0.2706340282819359
[145] 0.0242259252881312 0.0000069485036578 0.1264254747729907
[148] 0.0516417288895967 0.0000001088873597 0.0605934196133863
> (tbl1      <- table(in1$grp,classLogit,dnn=c("grp","class")) )
   class
grp  1  2  3
  1 50  0  0
  2  0 48  2
  3  0  1 49
>
>
> nmDat      <- in1
> nmDat$fac  <- as.factor(nmDat$grp)
> (mn        <- ctree(fac~.-grp,data=nmDat) )

Model formula:
fac ~ V1 + V2 + V3 + V4

Fitted party:
```

```
[1] root
|   [2] V3 <= 1.9: 1 (n = 50, err = 0.0%)
|   [3] V3 > 1.9
|   |   [4] V4 <= 1.7
|   |   |   [5] V3 <= 4.8: 2 (n = 46, err = 2.2%)
|   |   |   [6] V3 > 4.8: 2 (n = 8, err = 50.0%)
|   |   [7] V4 > 1.7: 3 (n = 46, err = 2.2%)

Number of inner nodes:    3
Number of terminal nodes: 4
> mnTree     <- as.matrix(predict(mn,type="prob"))
> attr(mnTree,"dimnames") <- NULL
> mnTree
      [,1]       [,2]       [,3]
 [1,]    0 0.97826087 0.02173913
 [2,]    1 0.00000000 0.00000000
 [3,]    0 0.02173913 0.97826087
 [4,]    1 0.00000000 0.00000000
 [5,]    0 0.97826087 0.02173913
 [6,]    1 0.00000000 0.00000000
 [7,]    1 0.00000000 0.00000000
 [8,]    0 0.02173913 0.97826087
 [9,]    1 0.00000000 0.00000000
[10,]    0 0.02173913 0.97826087
[11,]    0 0.50000000 0.50000000
[12,]    1 0.00000000 0.00000000
[13,]    0 0.02173913 0.97826087
[14,]    0 0.97826087 0.02173913
[15,]    0 0.97826087 0.02173913
[16,]    1 0.00000000 0.00000000
[17,]    0 0.02173913 0.97826087
[18,]    0 0.97826087 0.02173913
[19,]    0 0.02173913 0.97826087
[20,]    1 0.00000000 0.00000000
[21,]    1 0.00000000 0.00000000
[22,]    0 0.97826087 0.02173913
[23,]    0 0.97826087 0.02173913
[24,]    0 0.02173913 0.97826087
[25,]    0 0.97826087 0.02173913
[26,]    0 0.97826087 0.02173913
[27,]    0 0.02173913 0.97826087
[28,]    0 0.97826087 0.02173913
[29,]    0 0.02173913 0.97826087
[30,]    1 0.00000000 0.00000000
[31,]    0 0.97826087 0.02173913
[32,]    1 0.00000000 0.00000000
[33,]    1 0.00000000 0.00000000
[34,]    0 0.50000000 0.50000000
[35,]    0 0.97826087 0.02173913
```

```
[36,]    0 0.02173913 0.97826087
[37,]    1 0.00000000 0.00000000
[38,]    0 0.97826087 0.02173913
[39,]    0 0.97826087 0.02173913
[40,]    0 0.02173913 0.97826087
[41,]    0 0.02173913 0.97826087
[42,]    0 0.97826087 0.02173913
[43,]    0 0.02173913 0.97826087
[44,]    0 0.02173913 0.97826087
[45,]    0 0.97826087 0.02173913
[46,]    0 0.97826087 0.02173913
[47,]    1 0.00000000 0.00000000
[48,]    0 0.97826087 0.02173913
[49,]    0 0.02173913 0.97826087
[50,]    0 0.97826087 0.02173913
[51,]    0 0.97826087 0.02173913
[52,]    0 0.97826087 0.02173913
[53,]    0 0.02173913 0.97826087
[54,]    0 0.50000000 0.50000000
[55,]    0 0.97826087 0.02173913
[56,]    1 0.00000000 0.00000000
[57,]    1 0.00000000 0.00000000
[58,]    0 0.97826087 0.02173913
[59,]    0 0.97826087 0.02173913
[60,]    0 0.97826087 0.02173913
[61,]    1 0.00000000 0.00000000
[62,]    0 0.50000000 0.50000000
[63,]    0 0.02173913 0.97826087
[64,]    1 0.00000000 0.00000000
[65,]    0 0.02173913 0.97826087
[66,]    0 0.97826087 0.02173913
[67,]    1 0.00000000 0.00000000
[68,]    0 0.97826087 0.02173913
[69,]    0 0.97826087 0.02173913
[70,]    1 0.00000000 0.00000000
[71,]    1 0.00000000 0.00000000
[72,]    0 0.02173913 0.97826087
[73,]    0 0.97826087 0.02173913
[74,]    0 0.97826087 0.02173913
[75,]    0 0.02173913 0.97826087
[76,]    1 0.00000000 0.00000000
[77,]    0 0.02173913 0.97826087
[78,]    1 0.00000000 0.00000000
[79,]    0 0.97826087 0.02173913
[80,]    1 0.00000000 0.00000000
[81,]    0 0.50000000 0.50000000
[82,]    0 0.97826087 0.02173913
[83,]    1 0.00000000 0.00000000
[84,]    0 0.50000000 0.50000000
```

```
  [85,]    0 0.02173913 0.97826087
  [86,]    0 0.97826087 0.02173913
  [87,]    0 0.02173913 0.97826087
  [88,]    1 0.00000000 0.00000000
  [89,]    1 0.00000000 0.00000000
  [90,]    0 0.02173913 0.97826087
  [91,]    0 0.97826087 0.02173913
  [92,]    1 0.00000000 0.00000000
  [93,]    0 0.97826087 0.02173913
  [94,]    0 0.02173913 0.97826087
  [95,]    1 0.00000000 0.00000000
  [96,]    1 0.00000000 0.00000000
  [97,]    0 0.97826087 0.02173913
  [98,]    1 0.00000000 0.00000000
  [99,]    1 0.00000000 0.00000000
 [100,]    1 0.00000000 0.00000000
 [101,]    1 0.00000000 0.00000000
 [102,]    0 0.02173913 0.97826087
 [103,]    0 0.02173913 0.97826087
 [104,]    0 0.02173913 0.97826087
 [105,]    0 0.02173913 0.97826087
 [106,]    1 0.00000000 0.00000000
 [107,]    0 0.50000000 0.50000000
 [108,]    1 0.00000000 0.00000000
 [109,]    0 0.02173913 0.97826087
 [110,]    0 0.02173913 0.97826087
 [111,]    0 0.02173913 0.97826087
 [112,]    1 0.00000000 0.00000000
 [113,]    1 0.00000000 0.00000000
 [114,]    1 0.00000000 0.00000000
 [115,]    1 0.00000000 0.00000000
 [116,]    0 0.02173913 0.97826087
 [117,]    0 0.97826087 0.02173913
 [118,]    0 0.97826087 0.02173913
 [119,]    1 0.00000000 0.00000000
 [120,]    0 0.02173913 0.97826087
 [121,]    0 0.97826087 0.02173913
 [122,]    0 0.02173913 0.97826087
 [123,]    0 0.02173913 0.97826087
 [124,]    0 0.02173913 0.97826087
 [125,]    1 0.00000000 0.00000000
 [126,]    0 0.97826087 0.02173913
 [127,]    1 0.00000000 0.00000000
 [128,]    0 0.02173913 0.97826087
 [129,]    0 0.02173913 0.97826087
 [130,]    0 0.97826087 0.02173913
 [131,]    0 0.50000000 0.50000000
 [132,]    0 0.02173913 0.97826087
 [133,]    0 0.02173913 0.97826087
```

```
[134,]    0 0.02173913 0.97826087
[135,]    1 0.00000000 0.00000000
[136,]    1 0.00000000 0.00000000
[137,]    1 0.00000000 0.00000000
[138,]    0 0.02173913 0.97826087
[139,]    0 0.02173913 0.97826087
[140,]    0 0.97826087 0.02173913
[141,]    0 0.97826087 0.02173913
[142,]    0 0.97826087 0.02173913
[143,]    0 0.02173913 0.97826087
[144,]    1 0.00000000 0.00000000
[145,]    1 0.00000000 0.00000000
[146,]    0 0.97826087 0.02173913
[147,]    1 0.00000000 0.00000000
[148,]    1 0.00000000 0.00000000
[149,]    0 0.97826087 0.02173913
[150,]    0 0.02173913 0.97826087
> idxTr      <- apply(mnTree,byRows,which.max)
> (classTree <- classif[idxTr] )
  [1] 2 1 3 1 2 1 1 3 1 3 2 1 3 2 2 1 3 2 3 1 1 2 2 3 2 2 3 2 3 1 2 1
 [33] 1 2 2 3 1 2 2 3 3 2 3 3 2 2 1 2 3 2 2 2 3 2 2 1 1 2 2 2 1 2 3 1
 [65] 3 2 1 2 2 1 1 3 2 2 3 1 3 1 2 1 2 2 1 2 3 2 3 1 1 3 2 1 2 3 1 1
 [97] 2 1 1 1 1 3 3 3 3 1 2 1 3 3 3 1 1 1 1 3 2 2 1 3 2 3 3 3 1 2 1 3
[129] 3 2 2 3 3 3 1 1 1 3 3 2 2 2 3 1 1 2 1 1 2 3
> (pTree     <- apply(mnTree,byRows,max) )
  [1] 0.9782609 1.0000000 0.9782609 1.0000000 0.9782609 1.0000000
  [7] 1.0000000 0.9782609 1.0000000 0.9782609 0.5000000 1.0000000
 [13] 0.9782609 0.9782609 0.9782609 1.0000000 0.9782609 0.9782609
 [19] 0.9782609 1.0000000 1.0000000 0.9782609 0.9782609 0.9782609
 [25] 0.9782609 0.9782609 0.9782609 0.9782609 0.9782609 1.0000000
 [31] 0.9782609 1.0000000 1.0000000 0.5000000 0.9782609 0.9782609
 [37] 1.0000000 0.9782609 0.9782609 0.9782609 0.9782609 0.9782609
 [43] 0.9782609 0.9782609 0.9782609 0.9782609 1.0000000 0.9782609
 [49] 0.9782609 0.9782609 0.9782609 0.9782609 0.9782609 0.5000000
 [55] 0.9782609 1.0000000 1.0000000 0.9782609 0.9782609 0.9782609
 [61] 1.0000000 0.5000000 0.9782609 1.0000000 0.9782609 0.9782609
 [67] 1.0000000 0.9782609 0.9782609 1.0000000 1.0000000 0.9782609
 [73] 0.9782609 0.9782609 0.9782609 1.0000000 0.9782609 1.0000000
 [79] 0.9782609 1.0000000 0.5000000 0.9782609 1.0000000 0.5000000
 [85] 0.9782609 0.9782609 0.9782609 1.0000000 1.0000000 0.9782609
 [91] 0.9782609 1.0000000 0.9782609 0.9782609 1.0000000 1.0000000
 [97] 0.9782609 1.0000000 1.0000000 1.0000000 1.0000000 0.9782609
[103] 0.9782609 0.9782609 0.9782609 1.0000000 0.5000000 1.0000000
[109] 0.9782609 0.9782609 0.9782609 1.0000000 1.0000000 1.0000000
[115] 1.0000000 0.9782609 0.9782609 0.9782609 1.0000000 0.9782609
[121] 0.9782609 0.9782609 0.9782609 0.9782609 1.0000000 0.9782609
[127] 1.0000000 0.9782609 0.9782609 0.9782609 0.5000000 0.9782609
[133] 0.9782609 0.9782609 1.0000000 1.0000000 1.0000000 0.9782609
[139] 0.9782609 0.9782609 0.9782609 0.9782609 0.9782609 1.0000000
```

```
[145] 1.0000000 0.9782609 1.0000000 1.0000000 0.9782609 0.9782609
> (brTree    <- 1-pTree )
  [1] 0.02173913 0.00000000 0.02173913 0.00000000 0.02173913
  [6] 0.00000000 0.00000000 0.02173913 0.00000000 0.02173913
 [11] 0.50000000 0.00000000 0.02173913 0.02173913 0.02173913
 [16] 0.00000000 0.02173913 0.02173913 0.02173913 0.00000000
 [21] 0.00000000 0.02173913 0.02173913 0.02173913 0.02173913
 [26] 0.02173913 0.02173913 0.02173913 0.02173913 0.00000000
 [31] 0.02173913 0.00000000 0.00000000 0.50000000 0.02173913
 [36] 0.02173913 0.00000000 0.02173913 0.02173913 0.02173913
 [41] 0.02173913 0.02173913 0.02173913 0.02173913 0.02173913
 [46] 0.02173913 0.00000000 0.02173913 0.02173913 0.02173913
 [51] 0.02173913 0.02173913 0.02173913 0.50000000 0.02173913
 [56] 0.00000000 0.00000000 0.02173913 0.02173913 0.02173913
 [61] 0.00000000 0.50000000 0.02173913 0.00000000 0.02173913
 [66] 0.02173913 0.00000000 0.02173913 0.02173913 0.00000000
 [71] 0.00000000 0.02173913 0.02173913 0.02173913 0.02173913
 [76] 0.00000000 0.02173913 0.00000000 0.02173913 0.00000000
 [81] 0.50000000 0.02173913 0.00000000 0.50000000 0.02173913
 [86] 0.02173913 0.02173913 0.00000000 0.00000000 0.02173913
 [91] 0.02173913 0.00000000 0.02173913 0.02173913 0.00000000
 [96] 0.00000000 0.02173913 0.00000000 0.00000000 0.00000000
[101] 0.00000000 0.02173913 0.02173913 0.02173913 0.02173913
[106] 0.00000000 0.50000000 0.00000000 0.02173913 0.02173913
[111] 0.02173913 0.00000000 0.00000000 0.00000000 0.00000000
[116] 0.02173913 0.02173913 0.02173913 0.00000000 0.02173913
[121] 0.02173913 0.02173913 0.02173913 0.02173913 0.00000000
[126] 0.02173913 0.00000000 0.02173913 0.02173913 0.02173913
[131] 0.50000000 0.02173913 0.02173913 0.02173913 0.00000000
[136] 0.00000000 0.00000000 0.02173913 0.02173913 0.02173913
[141] 0.02173913 0.02173913 0.02173913 0.00000000 0.00000000
[146] 0.02173913 0.00000000 0.00000000 0.02173913 0.02173913
> (tbl2      <- table(in1$grp,classTree,dnn=c("grp","class")) )
    class
grp  1  2  3
  1 50  0  0
  2  0 49  1
  3  0  5 45
>
```