TD: Analyse des correspondances multiples

Exercice 1

Le tableau suivant représente la couleur des cheveux, celle des yeux, et le sexe dans une population de 12 individus.

	Cheveux	Yeux	Sexe
1	Noir	Bleu	Homme
2	Noir	Bleu	Femme
3	Noir	Brun	Homme
4	Noir	Brun	Homme
5	Brun	Bleu	Femme
6	Brun	Brun	Homme
7	Brun	Brun	Homme
8	Roux	Bleu	Homme
9	Roux	Bleu	Homme
10	Roux	Bleu	Femme
11	Roux	Brun	Femme
12	Roux	Brun	Femme

1. Déterminer les tableaux de contingence des variables croisées deux à deux.
2. Représenter les données sous forme de tableau disjonctif Z et calculer ses marges.
3. Calculer le tableau de Burt $B = Z^T Z$.

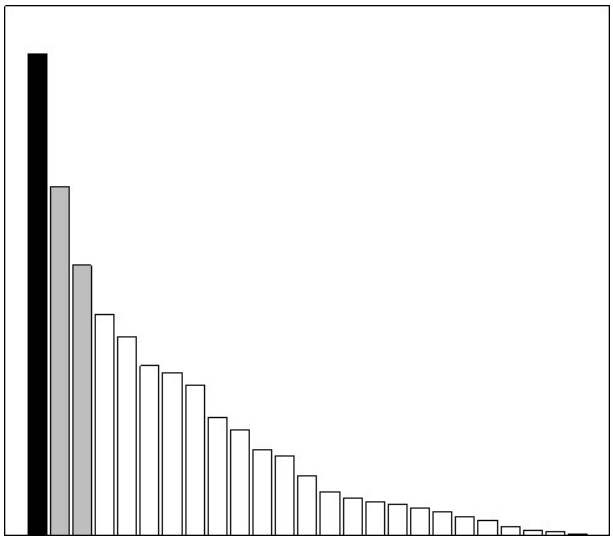
Exercice 2

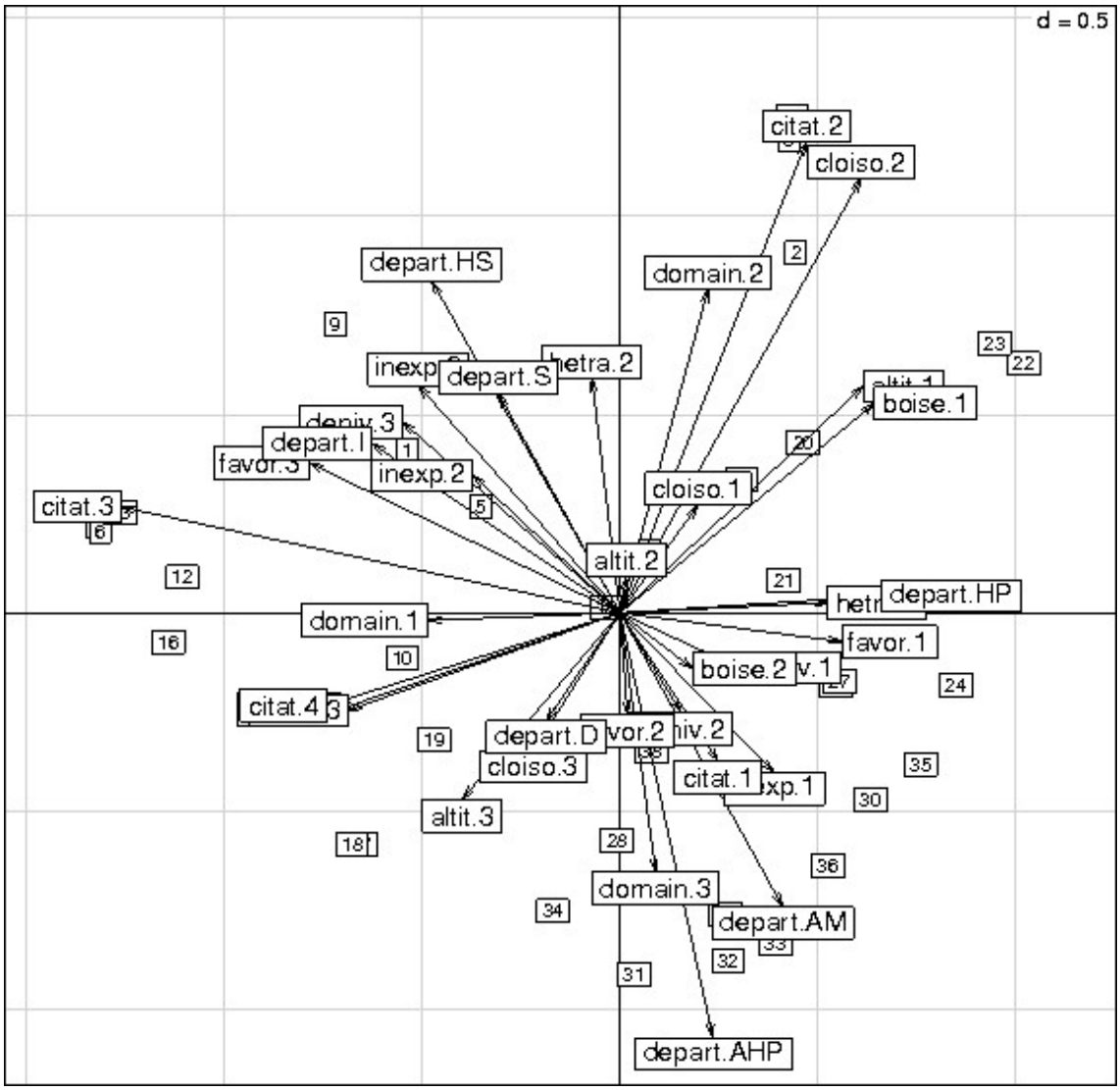
Les données suivantes proviennent d'une étude sur la disparition de l'ours brun dans les Alpes françaises.

```
The ours (bears) data frame has 38 rows, areas of the "Inventaire National
Forestier", and 10 columns.

This data frame contains the following columns:

   1. altit: importance of the altitudinal area inhabited by bears, a factor
with levels: 1 less than 50% of the area between 800 and 2000 meters; 2 between
50 and 70%; 3 more than 70%

   2. deniv: importance of the average variation in level by square of 50 km2, a
factor with levels: 1 less than 700m; 2 between 700 and 900m; 3 more than 900m

   3. cloiso: partitioning of the massif, a factor with levels: 1 a great valley
or a ridge isolates at least a quarter of the massif; 2 less than a quarter of
the massif is isolated; 3 the massif has no split

   4. domain: importance of the national forests on contact with the massif, a
factor with levels: 1 less than 400 km2; 2 between 400 and 1000 km2; 3 more than
1000 km2

   5. boise: rate of afforestation, a factor with levels: 1 less than 30%;
2 between 30 and 50%; 3 more than 50%

   6. hetra: importance of plantations and mixed forests, a factor with levels:
1 less than 5%; 2 between 5 and 10%; 3 more than 10% of the massif

   7. favor: importance of favorable forests, plantations, mixed forests, fir
plantations, a factor with levels: 1 less than 5%; 2 between 5 and 10%; 3 more
than 10% of the massif

   8. inexp: importance of unworked forests, a factor with levels: 1 less
than 4%; 2 between 4 and 8%; 3 more than 8% of the total area

   9. citat: presence of the bear before its disappearance, a factor with
levels: 1 no quotation since 1840; 2: 1 to 3 quotations before 1900 and none
after; 3: 4 quotations before 1900 and none after; 4: at least 4 quotations
before 1900 and at least 1 quotation between 1900 and 1940

  10. depart: district, a factor with levels: AHP Alpes-de-Haute-Provence;
AM Alpes-Maritimes; D Drome; HP Hautes-Alpes; HS Haute-Savoie; I Isere;
S Savoie

Source: Erome, G. (1989) L'ours brun dans les Alpes franaises. Historique de
sa disparition. Centre Ornithologique Rhone-Alpes, Villeurbanne. 120 p.
```

Interpréter les résultats de l'ACM suivante.

```
> ours.acm <-dudi.acm(ours, scann = FALSE, nf = 3)
> acmin <- inertia.dudi(ours.acm,col.inertia=T,row.inertia=T)
> acmin$TOT
       inertia       cum     ratio
1  0.445809666 0.4458097 0.1783239
2  0.322821219 0.7686309 0.3074524
3  0.250023933 1.0186548 0.4074619
4  0.204320821 1.2229756 0.4891903
5  0.183747109 1.4067227 0.5626891
6  0.157044406 1.5637672 0.6255069
7  0.150687859 1.7144550 0.6857820
8  0.139059296 1.8535143 0.7414057
9  0.108877787 1.9623921 0.7849568
10 0.097752121 2.0601442 0.8240577
11 0.079478800 2.1396230 0.8558492
12 0.073567819 2.2131908 0.8852763
13 0.055419820 2.2686107 0.9074443
14 0.040440525 2.3090512 0.9236205
15 0.035052208 2.3441034 0.9376414
16 0.031079669 2.3751831 0.9500732
17 0.029008046 2.4041911 0.9616764
18 0.024858103 2.4290492 0.9716197
19 0.022036630 2.4510858 0.9804343
20 0.017134598 2.4682204 0.9872882
21 0.014005836 2.4822263 0.9928905
22 0.008237655 2.4904639 0.9961856
23 0.004580786 2.4950447 0.9980179
24 0.003515076 2.4985598 0.9994239
25 0.001440212 2.5000000 1.0000000
```




d = 0.5
citat.2
cloiso.2
depart.HS
domain.2
2
9
inexp
depart.S
23
22
boise.1
favor.3
depart.I
inexp.2
20
cloiso.1
citat.3
6
5
altit.2
12
21
depart.HP
domain.1
16
favor.1
10
boise.2
24
citat.4
19
depart.D
cloiso.3
citat.1
35
altit.3
30
18
28
36
domain.3
34
depart.AM
32
31
depart.AHP

Contributions absolues des lignes et colonnes:

```
> acmin$row.abs
   Axis1 Axis2 Axis3
1    170   137     1
2    116   671   112
3    132   616   227
4   1028    39   419
5     73    59    85
6   1017    35   226
7      3    19     0
8    108  1160   139
9    304   434   878
10   179    11    83
11    56    92   229
12   721     7   478
13   939    52   431
14   112  1281   192
15     1     0   112
16   768     4    18
17   253   278   566
18   270   278   158
19   130    84  1059
20   127   150  1718
21   101     6  1584
22   613   323     2
23   527   378    31
24   424    27   112
25   218     0     3
26   175    28     0
27   181    24   223
28     0   269    10
29   318     1   178
30   236   181   175
31     1   678     3
32    44   627    34
33    91   570    21
34    17   462    30
35   340   119   336
36   162   331    21
37    42   471    13
38     4    99    93
```

```
> acmin$col.abs
            Comp1 Comp2 Comp3
altit.1       393   340   425
altit.2         1    18   141
altit.3       269   374     7
deniv.1       151    32   272
deniv.2        43   115   140
deniv.3       432   333    21
cloiso.1       61   115   800
cloiso.2      193   626   109
cloiso.3      136   346   270
domain.1      273     0   673
domain.2       84  1132   350
domain.3       17   891     7
boise.1       537   363   508
boise.2        67    39   283
boise.3       847   100     3
hetra.1       679     2   356
hetra.2         3   227  1491
hetra.3       857   110     1
favor.1       614    10     4
favor.2         1   102    24
favor.3       883   205     8
inexp.1       394   421    93
inexp.2       179   156   309
inexp.3       269   342    19
citat.1       175   399    30
citat.2       201  1283    15
citat.3       827    37   610
citat.4       354    35   846
depart.AHP     36   748    60
depart.AM      88   286   131
depart.D       23    48  1804
depart.HP     455     2    12
depart.HS     118   365    28
depart.I      256   119   138
depart.S       85   277     9
```

Contributions relatives (cosinus carrés, multipliés par 10000)

```
> acmin$row.rel
   Axis1 Axis2 Axis3 con.tra
1  -1197   700     3     253
2    631  2633   341     329
3   -654  2202  -628     361
4  -5090   141  1164     360
5   -540   317  -354     240
6  -5541   136   689     327
7     29   122     1     202
8    536  4185   388     358
9  -1538  1587 -2486     353
10 -1399   -62   366     227
11   379   451   873     263
12 -3951    26  1472     325
13 -5029   202  1293     333
14   516  4276   496     387
15    -5     0  -396     283
16 -4404   -19   -60     311
17 -1637 -1306 -2057     275
18 -1661 -1239  -547     290
19  -820  -385 -3741     283
20   743   640 -5659     304
21   680    27 -5985     265
22  4292  1640    -7     254
23  3214  1669   107     292
24  3884  -180   576     195
25  1605     2    13     242
26  1670  -191     0     187
27  1746  -170  1203     185
28     0 -1795   -50     193
29  3230     4 -1015     176
30  1818 -1009   758     231
31     7 -4246   -13     206
32   399 -4117   172     196
33   858 -3875   111     190
34  -135 -2673   134     223
35  2504  -632  1386     242
36  1429 -2112   106     203
37   345 -2812    59     216
38    27  -540   390     237
```

```
> acmin$col.rel
           Comp1 Comp2 Comp3 con.tra
altit.1     2218  1392  1346     316
altit.2        4   106  -638     221
altit.3    -1820 -1837   -25     263
deniv.1     1024  -158 -1036     263
deniv.2      305  -586   554     253
deniv.3    -2711  1512    74     284
cloiso.1     395   544 -2924     274
cloiso.2     962  2257   304     358
cloiso.3   -1444 -2652  1606     168
domain.1   -1597    -2  2206     305
domain.2     571  5555 -1330     263
domain.3     131 -4966   -29     232
boise.1     3252  1591  1725     295
boise.2      491  -208 -1170     242
boise.3    -5738  -491   -11     263
hetra.1     6050    10  1782     200
hetra.2      -17   846 -4292     347
hetra.3    -6047  -563     5     253
favor.1     4520   -55   -17     242
favor.2        4  -483    88     274
favor.3    -5539   932   -27     284
inexp.1     3706 -2872  -491     189
inexp.2    -1083   684  1049     295
inexp.3    -1522  1397   -62     316
citat.1     1856 -3059   179     168
citat.2     1098  5075   -45     326
citat.3    -4121   134  1705     358
citat.4    -1820  -131 -2436     347
depart.AHP   184 -2780   174     347
depart.AM    437 -1031   365     358
depart.D    -116  -180 -5193     347
depart.HP   2571     8    37     316
depart.HS   -587  1318    79     358
depart.I   -1312   441   398     347
depart.S    -466  1096    28     326
```