MANOVA

```
> ##########################################################################
> #one-way two groups
> ##########################################################################
>
> ddiscr <- read.table("C:/R/rmmva/data STEPDISCR SHARMA.txt", header=T, quote="\"")
> attach(ddiscr)
> ddiscr

   group mktbook   rotc    roe  reass
1      1   2.304  0.182  0.191  0.377
2      1   2.703  0.206  0.205  0.469
3      1   2.385  0.188  0.182  0.581
4      1   5.981  0.236  0.258  0.491
5      1   2.762  0.193  0.178  0.587
6      1   2.984  0.173  0.178  0.546
7      1   2.070  0.196  0.178  0.443
8      1   2.762  0.212  0.219  0.472
9      1   1.345  0.147  0.148  0.297
10     1   1.716  0.128  0.118  0.597
11     1   3.000  0.150  0.157  0.530
12     1   3.006  0.191  0.194  0.575
13     2   0.975 -0.031 -0.280  0.105
14     2   0.945  0.053  0.019  0.306
15     2   0.270  0.036  0.012  0.269
16     2   0.739 -0.074 -0.150  0.204
17     2   0.833 -0.119 -0.358  0.155
18     2   0.716 -0.005 -0.305  0.027
19     2   0.574  0.039 -0.042  0.268
20     2   0.800  0.122  0.080  0.339
21     2   2.028 -0.072 -0.836 -0.185
22     2   1.225  0.064 -0.430 -0.057
23     2   1.502 -0.024 -0.545 -0.050
24     2   0.714  0.026 -0.110  0.021
   ebitass
1    0.158
2    0.210
3    0.207
4    0.280
5    0.197
6    0.227
7    0.148
8    0.254
9    0.079
10   0.149
11   0.200
12   0.187
13  -0.012
14   0.036
15   0.038
16  -0.063
17  -0.054
```

```
18   0.000
19   0.005
20   0.091
21  -0.036
22   0.045
23  -0.026
24   0.016
```

```
> columns <- c(6,3)
> dmanova <- ddiscr[,columns]
> dmanovad <-as.matrix(dmanova)
> dmanovad
```

```
      ebitass   rotc
 [1,]   0.158  0.182
 [2,]   0.210  0.206
 [3,]   0.207  0.188
 [4,]   0.280  0.236
 [5,]   0.197  0.193
 [6,]   0.227  0.173
 [7,]   0.148  0.196
 [8,]   0.254  0.212
 [9,]   0.079  0.147
[10,]   0.149  0.128
[11,]   0.200  0.150
[12,]   0.187  0.191
[13,]  -0.012 -0.031
[14,]   0.036  0.053
[15,]   0.038  0.036
[16,]  -0.063 -0.074
[17,]  -0.054 -0.119
[18,]   0.000 -0.005
[19,]   0.005  0.039
[20,]   0.091  0.122
[21,]  -0.036 -0.072
[22,]   0.045  0.064
[23,]  -0.026 -0.024
[24,]   0.016  0.026
```

```
> fitd <- manova(dmanovad ~as.factor(group))
> fitd
```

```
Call:
   manova(dmanovad ~ as.factor(group))

Terms:
               as.factor(group) Residuals
resp 1                0.212064  0.053375
resp 2                0.199290  0.061691
Deg. of Freedom              1        22

Residual standard error: 0.0492560.052954
Estimated effects may be unbalanced
```

```
> testW <- summary(fitd, test = c("Wilks")) # or "Pillai", "Hotelling-Lawley", "Roy"
> testW

                Df Wilks approx F num Df
as.factor(group)  1 0.195     43.3      2
Residuals        22
                den Df  Pr(>F)
as.factor(group)     21 3.5e-08 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> testW$Eigenvalues

                   [,1]       [,2]
as.factor(group) 4.1239 2.2204e-16

> summary.aov(fitd)             # univariate ANOVA tables

 Response ebitass :
                Df Sum Sq Mean Sq F value
as.factor(group)  1 0.2121  0.2121    87.4
Residuals        22 0.0534  0.0024
                Pr(>F)
as.factor(group)  4e-09 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Response rotc :
                Df Sum Sq Mean Sq F value
as.factor(group)  1 0.1993  0.1993    71.1
Residuals        22 0.0617  0.0028
                 Pr(>F)
as.factor(group) 2.4e-08 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> summary.aov(fitd)             # univariate ANOVA tables

 Response ebitass :
                Df Sum Sq Mean Sq F value
as.factor(group)  1 0.2121  0.2121    87.4
Residuals        22 0.0534  0.0024
                Pr(>F)
as.factor(group)  4e-09 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Response rotc :
                Df Sum Sq Mean Sq F value
as.factor(group)  1 0.1993  0.1993    71.1
Residuals        22 0.0617  0.0028
```

```
                 Pr(>F)
as.factor(group) 2.4e-08 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
> ##########################################################################
> #two-way manova
> ##########################################################################
>
> dman2w <- read.table("C:/R/rmmva/data two-way manova.txt", header=T, quote="\"")
> attach(dman2w)
> dman2w
```

```
   y1 y2       ad gender
1   8  8 humurous   male
2   8  7 humurous   male
3  10  9 humurous   male
4  10 10 humurous   male
5   5  3 emotionl   male
6   5  4 emotionl   male
7   7  6 emotionl   male
8   7  7 emotionl   male
9   2  1 comparat   male
10  2  2 comparat   male
11  4  3 comparat   male
12  4  2 comparat   male
13  2  1 humurous female
14  2  2 humurous female
15  4  2 humurous female
16  4  3 humurous female
17  4  2 emotionl female
18  4  6 emotionl female
19  2  3 emotionl female
20  2  1 emotionl female
21 10 10 comparat female
22 10  9 comparat female
23  8  6 comparat female
24  8  7 comparat female
```

```
> data<-as.matrix(dman2w[,1:2])
> twowaymanova<-manova(data~as.factor(ad)*as.factor(gender))
> twowaymanova
```

```
Call:
   manova(data ~ as.factor(ad) * as.factor(gender))

Terms:
               as.factor(ad)
resp 1                    12
resp 2                 7.000
Deg. of Freedom            2
               as.factor(gender)
resp 1                         6
```

```
resp 2                       4.167
Deg. of Freedom                  1
               as.factor(ad):as.factor(gender)
resp 1                                   156
resp 2                                160.333
Deg. of Freedom                             2
               Residuals
resp 1                24
resp 2            43.000
Deg. of Freedom        18

Residual standard error: 1.15471.5456
Estimated effects may be unbalanced
```

```
> testW <- summary(twowaymanova, test = c("Wilks")) # or "Pillai", "Hotelling-Lawley", "Roy"
> testW
```

```
                               Df Wilks
as.factor(ad)                   2 0.641
as.factor(gender)               1 0.794
as.factor(ad):as.factor(gender)  2 0.119
Residuals                      18
                               approx F
as.factor(ad)                      2.11
as.factor(gender)                  2.20
as.factor(ad):as.factor(gender)   16.16
Residuals
                               num Df
as.factor(ad)                       4
as.factor(gender)                   2
as.factor(ad):as.factor(gender)     4
Residuals
                               den Df
as.factor(ad)                      34
as.factor(gender)                  17
as.factor(ad):as.factor(gender)    34
Residuals
                                Pr(>F)
as.factor(ad)                     0.10
as.factor(gender)                 0.14
as.factor(ad):as.factor(gender) 1.7e-07 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
> testW$Eigenvalues
```

```
                                  [,1]
as.factor(ad)                  0.54046
as.factor(gender)              0.25877
as.factor(ad):as.factor(gender) 6.50034
                                       [,2]
as.factor(ad)                   1.2173e-02
as.factor(gender)              -2.0817e-17
as.factor(ad):as.factor(gender)  1.2246e-01
```

```
> summary.aov(twowaymanova)             # univariate ANOVA tables

 Response y1 :
                               Df Sum Sq
as.factor(ad)                   2     12
as.factor(gender)               1      6
as.factor(ad):as.factor(gender)  2    156
Residuals                      18     24
                               Mean Sq
as.factor(ad)                      6.0
as.factor(gender)                  6.0
as.factor(ad):as.factor(gender)   78.0
Residuals                          1.3
                               F value
as.factor(ad)                      4.5
as.factor(gender)                  4.5
as.factor(ad):as.factor(gender)   58.5
Residuals
                                Pr(>F)
as.factor(ad)                    0.026 *
as.factor(gender)                0.048 *
as.factor(ad):as.factor(gender) 1.3e-08 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Response y2 :
                               Df Sum Sq
as.factor(ad)                   2    7.0
as.factor(gender)               1    4.2
as.factor(ad):as.factor(gender)  2  160.3
Residuals                      18   43.0
                               Mean Sq
as.factor(ad)                      3.5
as.factor(gender)                  4.2
as.factor(ad):as.factor(gender)   80.2
Residuals                          2.4
                               F value
as.factor(ad)                     1.47
as.factor(gender)                 1.74
as.factor(ad):as.factor(gender)  33.56
Residuals
                                Pr(>F)
as.factor(ad)                     0.26
as.factor(gender)                 0.20
as.factor(ad):as.factor(gender) 8.5e-07 ***
Residuals
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```