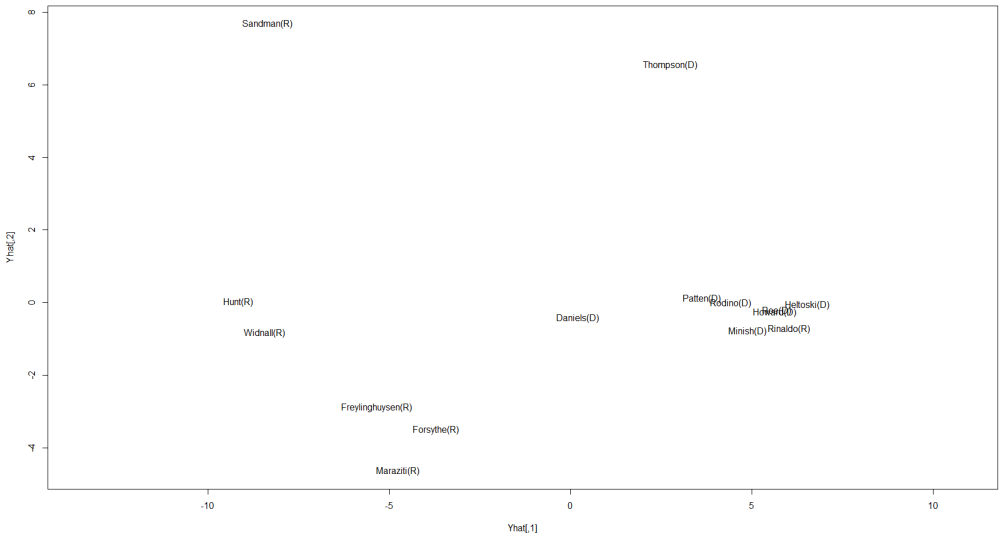
Assignment 8

Exercise 2

```
library(HSAUR)

# a)

dim(voting)
[1] 15 15

Delta = voting
Jn = matrix(rep(1,225),15)
In =diag(1, nrow = 15, ncol = 15)
H = In-(1/15)*Jn
Deltastar = Delta^2

B = -0.5*H%*%Deltastar%*%H
eigen(B)$values
[1]  4.977608e+02  1.461762e+02  1.029131e+02  7.687756e+01  5.511540e+01
2.474374e+01  8.005009e+00  6.171710e+00  2.358183e+00
[10] -4.263256e-14 -2.026091e+00 -1.521409e+01 -1.869433e+01 -2.040153e+01
-3.398575e+01

# negative eigenvalues --> matrix is not non-negative definite
# --> voting is not euclidean

# b)
Q = B
Lambdar = eigen(Q)$values[1:2]
Lambdasqrtr = diag(sqrt(Lambdar), nrow = 2,ncol = 2)
Er = eigen(Q)$vectors[,1:2]
Yhat = Er%*%Lambdasqrtr
congressmen = c("Hunt(R)", "Sandman(R)", "Howard(D)", "Thompson(D)", "Freylinghuysen(R)",
"Forsythe(R)", "Widnall(R)", "Roe(D)", "Heltoski(D)", "Rodino(D)", "Minish(D)", "Rinaldo(R)",
"Maraziti(R)", "Daniels(D)", "Patten(D)")
plot(Yhat, type = "n", asp = 1)
text(Yhat[,1], Yhat[,2], congressmen)
```



```
# c)
> ?cmdscale
> cmdscale(voting, k = 2)
                          [,1]        [,2]
Hunt(R)            -9.1640883  0.02161894
Sandman(R)         -8.3699537  7.68023459
Howard(D)           5.6277025 -0.26582292
Thompson(D)         2.7528216  6.55124865
Freylinghuysen(R) -5.3440596 -2.89073549
Forsythe(R)       -3.7133046 -3.49671135
Widnall(R)        -8.4431079 -0.83225871
Roe(D)             5.6935834 -0.22380571
Heltoski(D)        6.5311040 -0.05545261
Rodino(D)          4.4214984 -0.02052953
Minish(D)          4.8940977 -0.78542948
Rinaldo(R)         6.0315595 -0.71851563
Maraziti(R)       -4.7595652 -4.64131141
Daniels(D)         0.2098827 -0.42931460
Patten(D)          3.6318295  0.10678526
> Yhat # same results
            [,1]        [,2]
 [1,] -9.1640883  0.02161894
 [2,] -8.3699537  7.68023459
 [3,]  5.6277025 -0.26582292
 [4,]  2.7528216  6.55124865
 [5,] -5.3440596 -2.89073549
 [6,] -3.7133046 -3.49671135
 [7,] -8.4431079 -0.83225871
 [8,]  5.6935834 -0.22380571
 [9,]  6.5311040 -0.05545261
[10,]  4.4214984 -0.02052953
[11,]  4.8940977 -0.78542948
[12,]  6.0315595 -0.71851563
[13,] -4.7595652 -4.64131141
[14,]  0.2098827 -0.42931460
[15,]  3.6318295  0.10678526
```

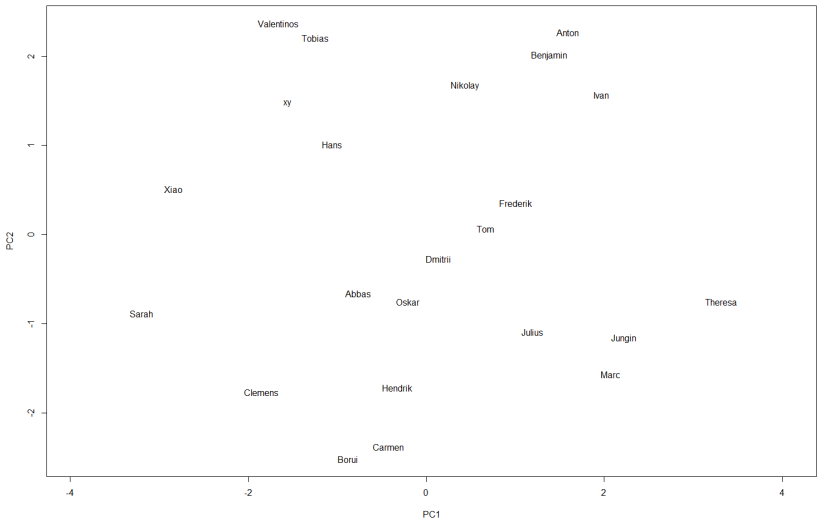
Exercise 3

```
Preferences = read.table("Preferences.txt", header = T)
names(Preferences)[1] = "Name"

# a) (i)

X = scale(Preferences[,2:21], center = T, scale = F)
Q = X%*%t(X)
Lambdar = eigen(Q)$values[1:2]
Lambdasqrtr = diag(sqrt(Lambdar), nrow = 2, ncol = 2)
Er = eigen(Q)$vectors[,1:2]
Yhat = Er%*%Lambdasqrtr
head(Yhat,4)
            [,1]        [,2]
[1,] -0.6713242 -0.06986646
[2,] -0.4397291 -1.67075200
[3,]  1.5584607 -1.47549195
[4,]  0.4263072  2.37895190

# (ii)

S = cov(Preferences[,2:21])
E=eigen(S)$vectors
Yhat = X%*%E
head(-Yhat[,1:2],4)
```

```
           [,1]        [,2]
[1,] -0.6713242 -0.06986646
[2,] -0.4397291 -1.67075200
[3,]  1.5584607 -1.47549195
[4,]  0.4263072  2.37895190
```

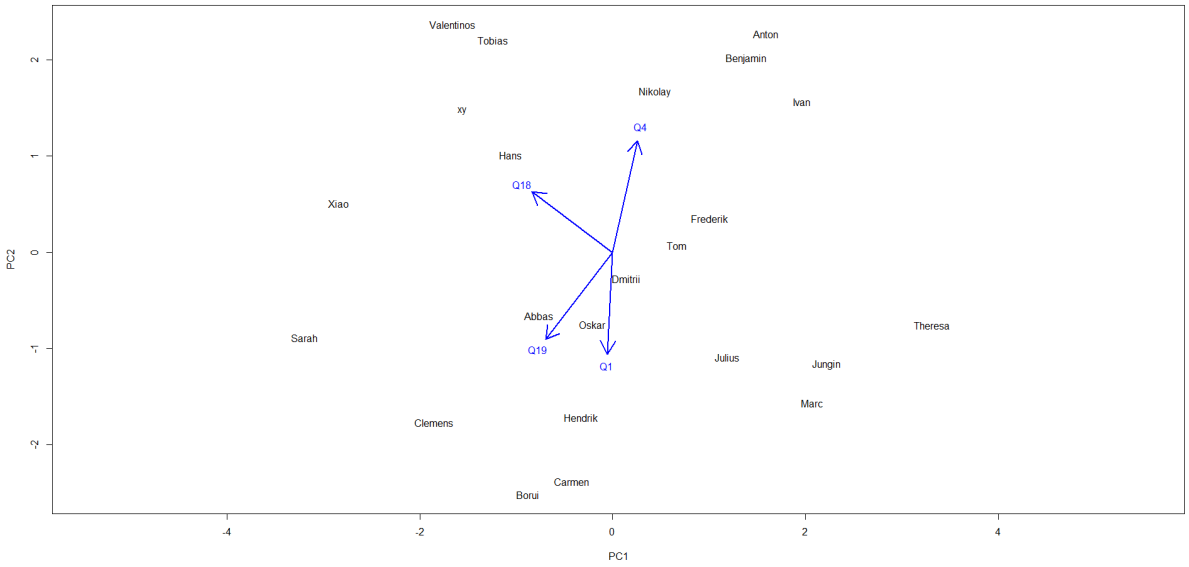
b)

```
y1hat = Yhat[,1]
y2hat = Yhat[,2]

plot(y1hat, y2hat, type = "n", asp = 1, xlab = "PC1", ylab = "PC2")
text(y1hat,y2hat, Preferences[,1])
```



c)

```
L = function(x)
{
sqrt(E[x,1]^2+E[x,2]^2)
}


Lengths = L(1:20)
names(Lengths)=names(Preferences)[2:21]

sort(Lengths, decreasing = T)
arrows(0,0,E[c(4,19,1,18),1]*2.5,E[c(4,19,1,18),2]*2.5, col = "blue", lwd = 2)
text(E[c(4,19,1,18),1]*2.8,E[c(4,19,1,18),2]*2.8,names(Preferences)[c(5,20,2,19)] , col = "blue")
```



d)

summary(Preferences)
conformist = c(1,1,-1,-1,-1,1,-1,1,-1,-1,1,-1,1,1,1,-1,-1,1,1,-1)
individualist = -conformist
means = colMeans((Preferences)[2:21], na.rm = FALSE, dims = 1)

Xc = conformist-means
Xi = individualist-means

Yhatc = Xc%*%E
Yhati = Xi%*%E

text(Yhatc[1,1],Yhatc[1,2], "conformist", col = "red")
text(Yhati[1,1],Yhati[1,2], "individualist", col = "red")