```
n = 20;
x = rand(n,1);
x = round(10*x)
x =[     6
     5
     9
     3
     3
     1
     9
     6
     5
     6
     5
     6
     5
     7
     5
    10
     2
     1
     1
     1];
```

```
   x =

      10
       2
       3
       4
       1
       7
       4
      10
       4
       6
       2
       4
       2
       8
       9
       4
       7
       3
       5
       8
```

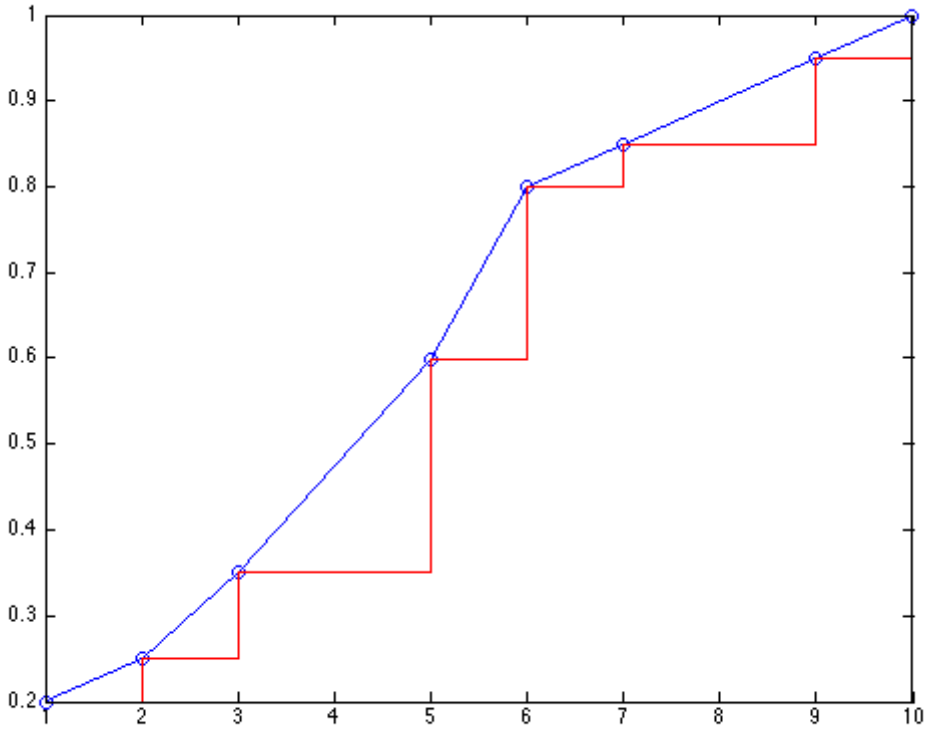
exo 1

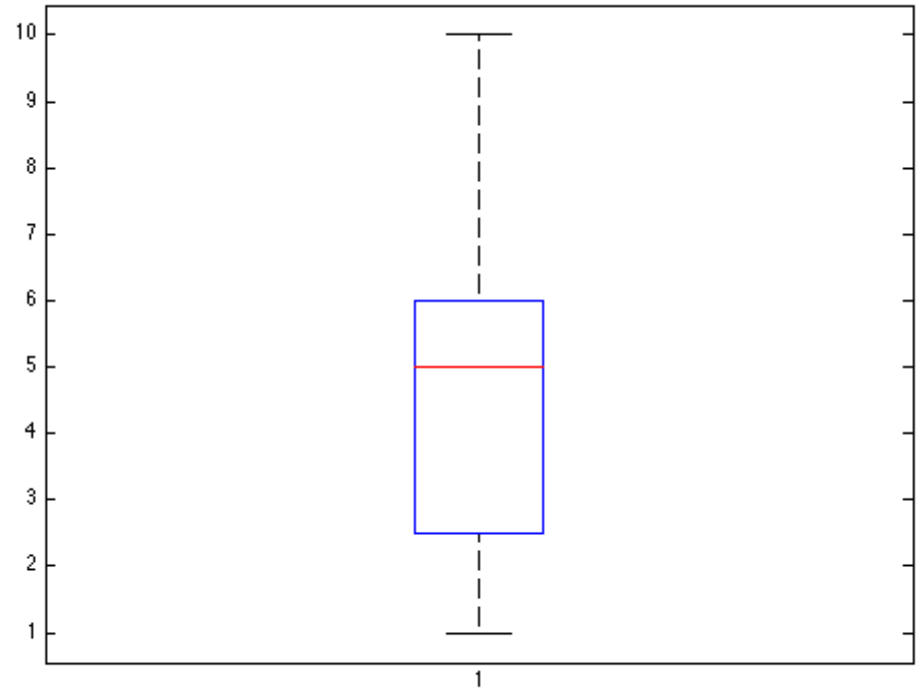
1 les modalité modalites possible 0-10 et observées :

```
m = unique(x)

% 2 les fréquences cumulé
xs = sort(x);
d = diff(xs);
F = find(d > 0);
F = [F ; n];
[m F]
F = F/n;
% 3 la fonction de répartition empirique
figure(1);
clf
set(gcf,'Color',[1,1,1])
plot(m,F,'o-') ; hold on
for i=1:length(m)-1
    plot([m(i) m(i+1)],[F(i) F(i)],'r');
    plot([m(i+1) m(i+1)],[F(i) F(i+1)],'r');
end

f = [F(1) ; diff(F)];

% 4 les fractile, la médiane
Q1 = 2;
M = 4.2
Q3 = 5.75
% 5 le DIQ
DIQ = Q3-Q1;
epure = 3*DIQ/2;
xm = Q1 - epure;
xM = Q3+epure;

% 6 dssinez, en le justifiant, la boite à moustache sur la feuille

figure(2)
clf
set(gcf,'Color',[1,1,1])
boxplot(x)

% 7 min \sum_i c(log(c/x_i - 1))

% application numérique: caculez $c$ pour ces observations
c = exp(mean(log(x)))
```

```
m =

     1
     2
     3
     5
     6
     7
     9
    10
```

```
ans =

     1     4
     2     5
     3     7
     5    12
     6    16
     7    17
     9    19
    10    20


M =

    4.2000


Q3 =

    5.7500


c =

    3.8090
```


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1
2
3
4
5
6
7
8
9
10


10
9
8
7
6
5
4
3
2
1
1

exo 2

```
 X = [10.85 7.63 13.64 2.09 49.46 14.54 41.43 4.85 62.38  24.79
10.64 7.88 15.19 2.15 49.05 13.99 47.21 4.75 67.23  35.06
10.31 7.76 15.43 2.18 49.02 14.02 53.22 4.60 61.59  59.43
10.69 7.93 15.26 2.03 49.74 14.56 47.85 5.15 58.92  32.49
10.70 7.41 15.32 2.14 48.91 14.27 45.81 5.10 63.45  59.74
11.19 6.83 14.33 2.03 48.39 14.55 45.26 5.20 61.55  12.14
10.68 7.63 15.57 2.07 47.78 14.33 44.53 5.00 64.16  41.60
10.84 7.37 15.09 1.91 49.54 14.62 40.92 4.55 68.16  30.12
11.02 7.12 15.05 1.98 48.78 14.75 47.34 4.57 56.51  27.62
10.82 7.37 14.80 1.97 47.25 14.24 43.24 5.00 66.34  39.91
11.07 7.53 14.20 2.00 48.56 14.56 41.00 4.90 50.70  25.90
10.69 7.78 14.14 1.97 47.18 14.37 44.16 5.55 69.10  35.59
10.54 7.90 16.78 2.04 48.08 13.73 48.33 4.90 72.32  37.20
11.15 7.26 14.12 2.10 49.98 14.25 44.81 5.10 56.16  36.68
10.82 7.59 14.14 2.01 48.99 14.20 44.24 5.06 67.63  31.76
10.64 7.24 15.72 2.18 48.13 14.87 45.64 4.65 63.57  23.13
10.60 8.07 13.60 2.04 48.34 13.47 45.04 4.80 66.86  31.41
10.99 7.59 14.75 2.06 49.83 14.16 44.56 5.15 62.27  29.93
10.69 7.48 15.14 2.12 46.72 14.35 43.78 4.60 64.03  29.31
10.66 7.42 15.67 2.03 48.65 13.97 46.55 5.20 56.55  30.27
11.19 7.26 14.90 2.03 49.07 14.39 46.38 4.70 58.05  33.14
10.66 7.48 13.96 2.01 49.52 14.14 41.38 4.60 64.20  26.56
10.50 7.26 16.05 2.11 47.63 13.82 49.70 4.90 60.32  35.09
11.09 7.35 12.70 2.06 49.86 14.56 39.66 5.00 58.80  19.62
10.64 6.96 14.55 2.01 47.99 13.95 44.04 4.60 60.20  31.99
11.25 7.24 14.42 2.09 48.82 14.59 40.25 4.80 63.94  25.44
10.60 7.24 14.39 2.01 49.86 14.25 41.82 5.00 56.93  50.77
10.61 7.34 14.64 1.96 48.20 14.48 45.84 5.00 61.82  20.12
10.98 6.71 15.26 2.11 48.22 14.87 46.26 3.90 56.40  44.46
10.84 7.59 13.34 2.13 48.25 14.20 43.99 5.10 58.95  55.65
11.14 7.52 15.49 2.06 51.64 14.54 46.50 5.00 60.43  43.10
10.83 7.16 15.16 1.96 51.21 15.37 45.13 4.90 59.31  03.03
11.05 7.52 14.22 2.00 50.13 14.48 44.65 5.50 69.01  26.81
11.63 6.89 15.10 2.10 50.31 15.18 46.85 4.80 66.20  26.70
10.93 7.57 14.11 1.90 49.23 14.88 40.81 5.00 68.50  30.82
10.72 7.45 14.57 1.92 48.10 13.83 46.12 5.00 65.37  26.81
11.00 7.32 14.19 1.88 48.80 14.78 44.60 5.05 59.44  21.06
10.77 7.58 14.34 1.98 48.25 14.97 43.07 4.70 64.68  25.71];

events = ['100m' ;'Long'; 'Shot'; 'High'; '400m'; '110m'; 'Disc'; 'Pole'; 'Jave';

Athlete = struct('name', { 'Sebrle',   'Clay',    'Karpov',   'Macey', 'Warners',
    'Schwarzl',     'Pogorelov',     'Schoenbeck',     'Barras' ,    'Smith' ,
    'Drews',    'Parkhomenko',     'Terek',    'Gomez',    'Turi',    'Lorenzo',
    'O Brien ' , 'Thompson' ,'Hingsen ', 'Freimuth', 'Hardee', 'Eaton ' ,'Suárez '

%1

figure(3)
clf
set(gcf,'Color',[1,1,1])
```

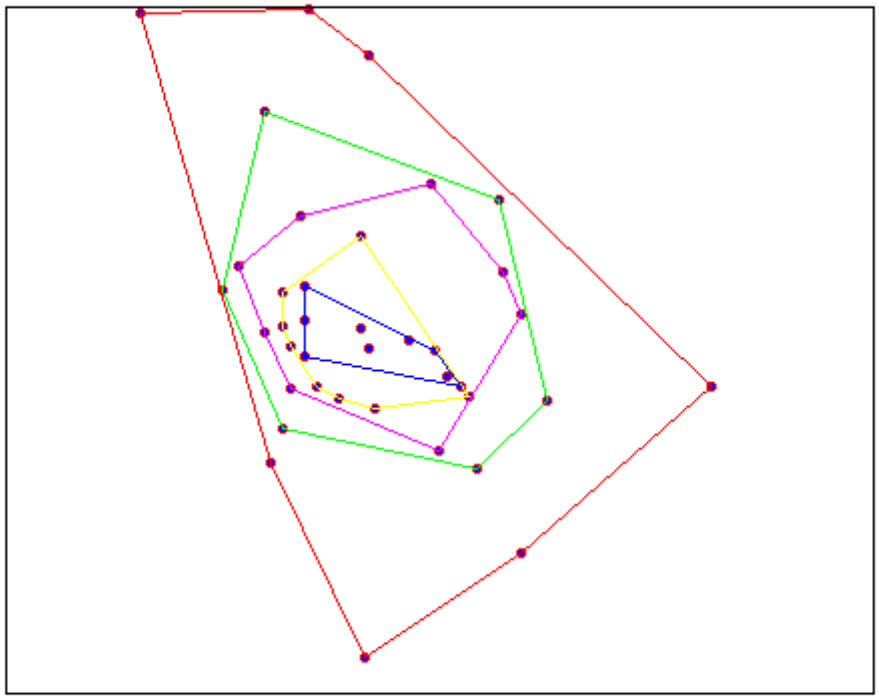
```
plot(X(:,1),X(:,end),'o','MarkerSize',5,'MarkerFaceColor','b','MarkerEdgeColor','r
set(gca,'FontSize',24,'FontName','Times','XTick',[],'YTick',[],'Box','on');
hold on
       k = convhull(X(:,1),X(:,end))
       hold on, plot(X(k,1),X(k,end), '-r');
 x = X(:,1);
 y = X(:,end);
 x(k) = [];
 y(k) = [];
        k = convhull(x,y)
       plot(x(k),y(k), '-g'),
 x(k) = [];
 y(k) = [];
        k = convhull(x,y)
       plot(x(k),y(k), '-m'),

 x(k) = [];
 y(k) = [];
        k = convhull(x,y)
       plot(x(k),y(k), '-y'),

        x(k) = [];
 y(k) = [];
        k = convhull(x,y)
       plot(x(k),y(k), '-b'), hold off


       %2
       % a pour normaliser les données
       % b

[n,p] = size(X);
Xn = (X - ones(n,1)*mean(X))./(ones(n,1)*std(X,1));

% 3
% a c'est la matrice des correlation
% b l'une est normalisée et l'autre non
% c
C= Xn'*Xn
%4
%a
[V,L] = eig(C);
[lam,ind] = sort(-diag(L));
lam = -lam;
%b
cumsum(lam)/sum(lam)*100

%5
V = V(:,ind);
U = Xn*V;
figure(4)
clf
set(gcf,'Color',[1,1,1])
plot(U(:,1),U(:,2),'o')
```

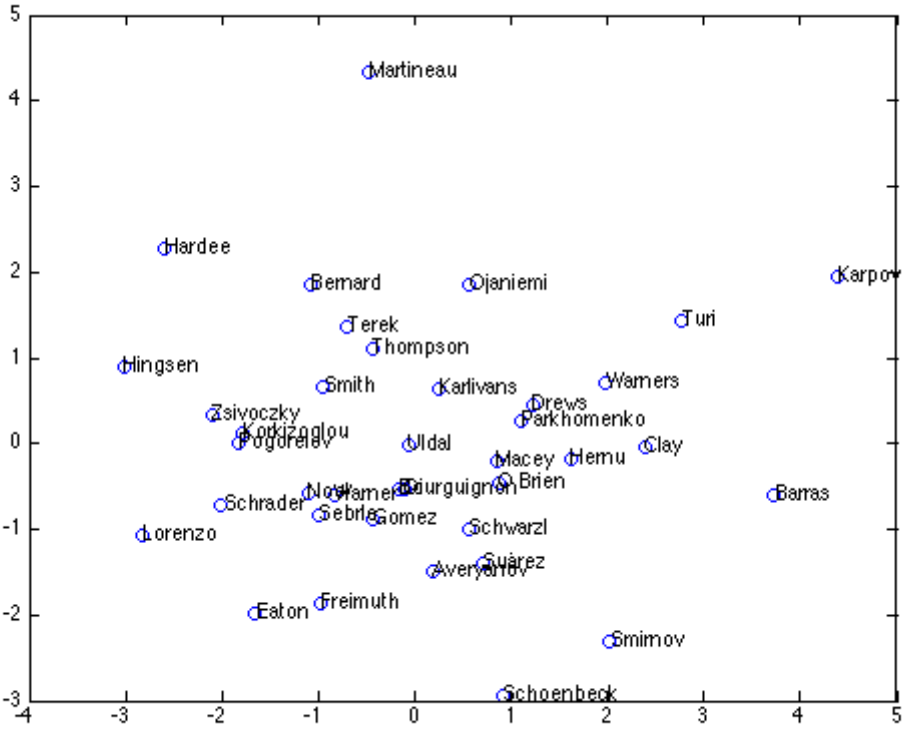
```
for i = 1:n
    text(U(i,1)+.005,U(i,2),Athlete(i).name);
end

%6
%a
figure(5)
clf
set(gcf,'Color',[1,1,1])
Vn = (V*sqrt(diag(lam))/sqrt(n));
plot(Vn(:,1),Vn(:,2),'*');
hold on
for j = 1:p
    text(Vn(j,1)+.005,Vn(j,2),events(j,:));
end
t = 0:1/1000:2*pi+0.1;
plot(cos(t),sin(t),'r');

%b elle opose 3 groupes de variables : des courses rapides (100m, 110m et 400m), l
%lancers (Disque, poids, 1500m, marteau et saut en hauteur) et le reste (la perche
%c ils sont bons en (la perche, le javelot et saut en longueur)
%d Smirnov est bon en perche, le javelot et saut en longueur (et en vodka)
%alors que Haree est plutot bon en course rapide (100m, 110m et 400m)


figure(6)
clf
set(gcf,'Color',[1,1,1])
plot(Vn(:,2),Vn(:,3),'*');
hold on
for j = 1:p
    text(Vn(j,2)+.005,Vn(j,3),events(j,:));
end
t = 0:1/1000:2*pi+0.1;
plot(cos(t),sin(t),'r');

%plot(Vn(:.2).Vn(:.3).'*');
```

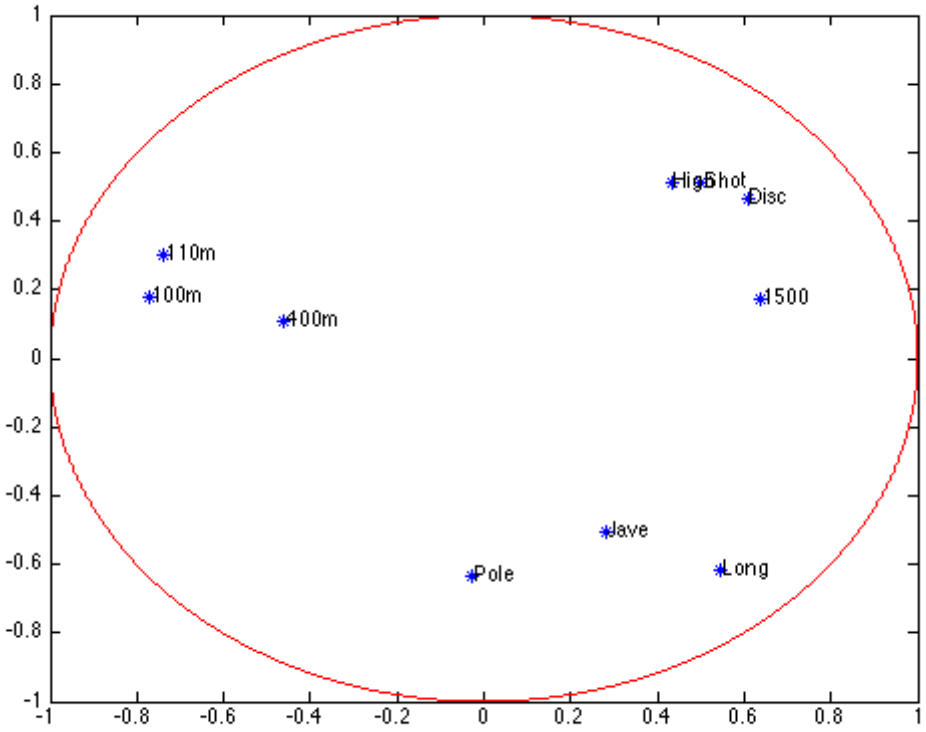
```
k =

     3
    28
    32
     6
    34
    30
     5
     3


k =

    13
```

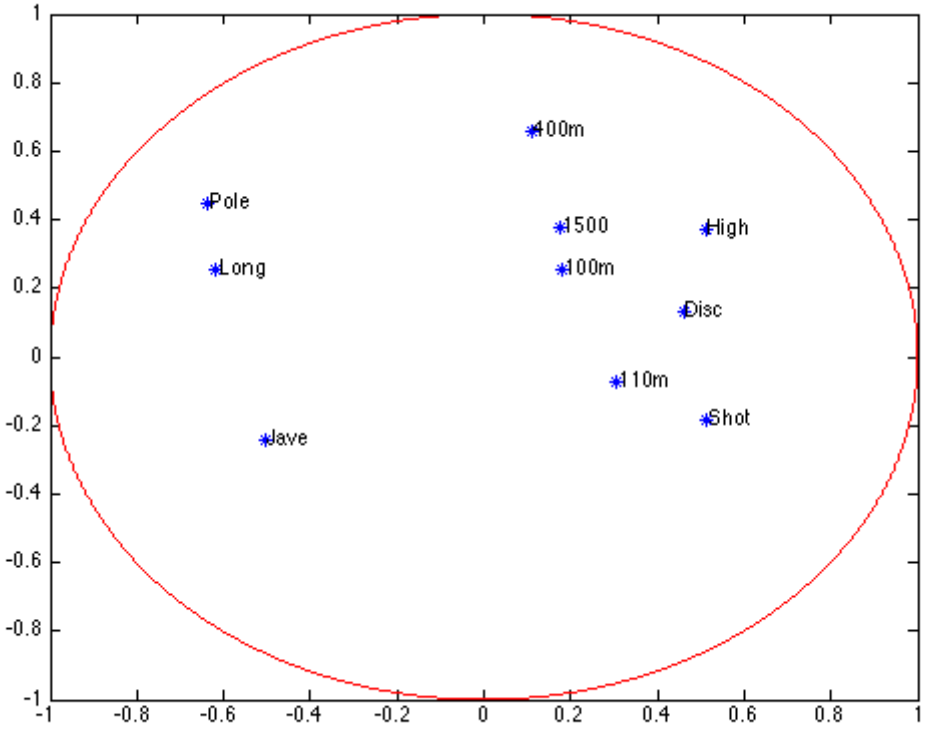
```
    21
    23
    26
    24
    20
    13


k =

     4
    10
    13
    18
    24
    17
    11
    20
     4


k =

     1
     7
     6
     2
    13
    12
    16
    17
     1


k =

     1
     7
     8
     6
     4
     1


C =

  Columns 1 through 7

   38.0000  -18.5666  -10.9666   -3.6259   16.2508   20.8800  -11.9428
  -18.5666   38.0000   -1.4116    0.9201   -2.5332  -17.9394    3.1970
  -10.9666   -1.4116   38.0000    9.2266   -4.3201   -2.7023   24.7831
   -3.6259    0.9201    9.2266   38.0000   -1.7705   -7.1332   13.9839
   16.2508   -2.5332   -4.3201   -1.7705   38.0000   13.9240   -2.4693
   20.8800  -17.9394   -2.7023   -7.1332   13.9240   38.0000   -9.9307
```

```
  -11.9428    3.1970   24.7831   13.9839   -2.4693   -9.9307   38.0000
    2.2919   13.0455   -8.5460   -8.9602    4.5632   -5.7359   -2.8933
   -6.9816   15.2897    4.1666   -4.5245   -6.6141   -6.7623   -0.6671
  -12.4282    9.2480    7.5988   16.7250   -5.3041  -16.0370   11.7305

  Columns 8 through 10

    2.2919   -6.9816  -12.4282
   13.0455   15.2897    9.2480
   -8.5460    4.1666    7.5988
   -8.9602   -4.5245   16.7250
    4.5632   -6.6141   -5.3041
   -5.7359   -6.7623  -16.0370
   -2.8933   -0.6671   11.7305
   38.0000    6.6027   -2.4926
    6.6027   38.0000   -0.3974
   -2.4926   -0.3974   38.0000


ans =

   29.5000
   48.9943
   60.5668
   71.7395
   79.4406
   85.7749
   90.7616
   94.7384
   97.5110
  100.0000
```




Martineau
Hardee
Bernard
Ojaniemi
Karpov
Terek
Turi
Thompson
Hingsen
Smith
Karlivans
Warners
Zsivoczky
Drews
Parkhomenko
Kotzinoglou
Pogorelov
Uldal
Clay
Macey
Hemu
Brien
Barras
Schrader
Gomez
Schwarzl
Lorenzo
Suarez
Freimuth
Eaton
Smirnov
Schoenbeck


1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
HighShot
Disc
110m
100m
1500
400m
Jave
Pole
Long


1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
400m
Pole
1500
High
Long
100m
Disc
110m
Shot
Jave

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