Présentation mathématiques R appliqué au Big Data

•••

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Exercice 1

$$\mathbf{A} = \begin{bmatrix} 0 & 2 & 2 \\ -1 & 2 & 2 \\ -1 & 1 & 3 \end{bmatrix}$$

Question 1

Les valeurs propres de A sont 1, et 2. Les multiplicités associées sont 1 et 2.

```
  [,1]
1    1
2    2
```

Question 2

```
          [,1]      [,2]          [,3]
[1,] 0.8164966 0.8164966  8.944272e-01
[2,] 0.4082483 0.4082483 -4.213000e-16
[3,] 0.4082483 0.4082483  4.472136e-01
```

Une valeur propre est double, la matrice n'est pas diagonalisable.

Exercice 1

Question 3

J =

	[,1]	[,2]	[,3]
[1,]	1	0	0
[2,]	0	2	1
[3,]	0	0	2

P =

	[,1]	[,2]	[,3]
[1,]	8.944272e-01	0.8164966	-0.1360828
[2,]	-4.213000e-16	0.4082483	0.1360828
[3,]	4.472136e-01	0.4082483	0.1360828

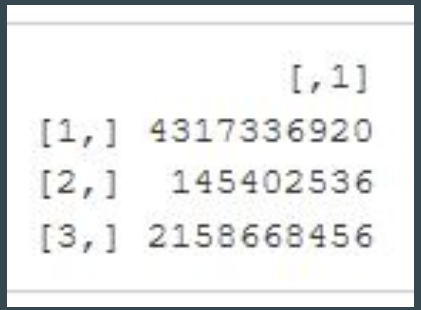
P^(-1)=

	[,1]	[,2]	[,3]
[1,]	-1.861901e-15	-2.236068e+00	2.236068
[2,]	8.164966e-01	2.449490e+00	-1.632993
[3,]	-2.449490e+00	5.329071e-15	4.898979

Exercice 1

Question 4

P^25 =

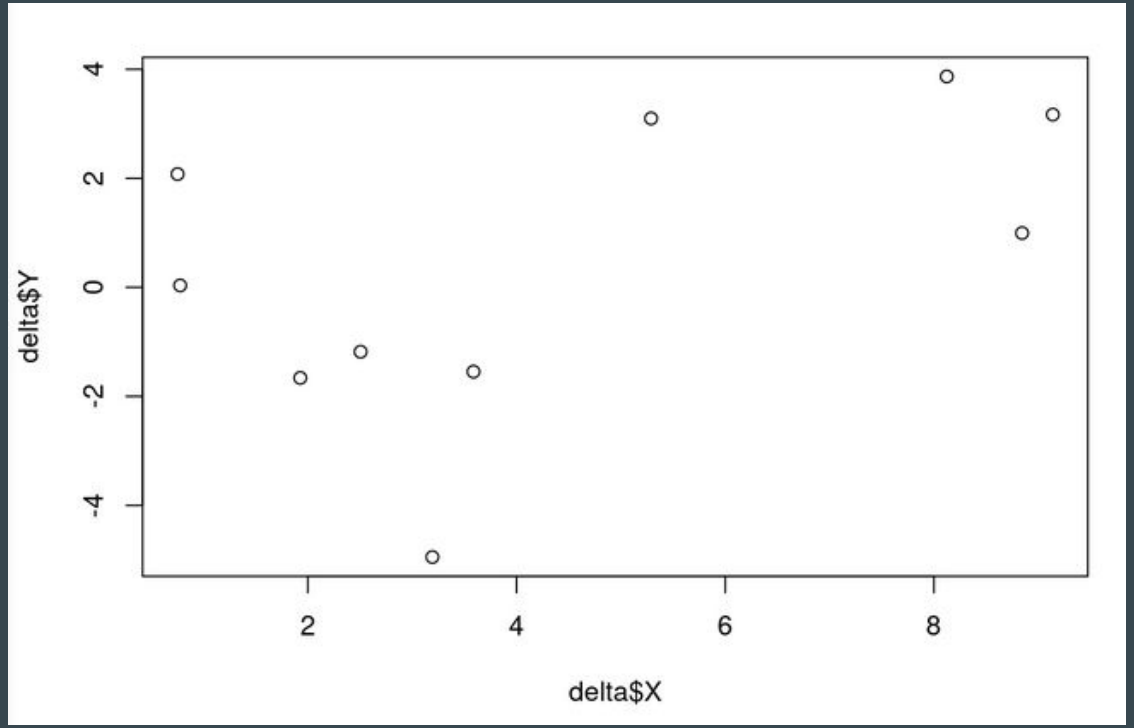


```
             [,1]
[1,] 4317336920
[2,]  145402536
[3,] 2158668456
```

Exercice 2

Question 1

delta=generate(10,0,10,-5,5)



Exercice 2

Question 2

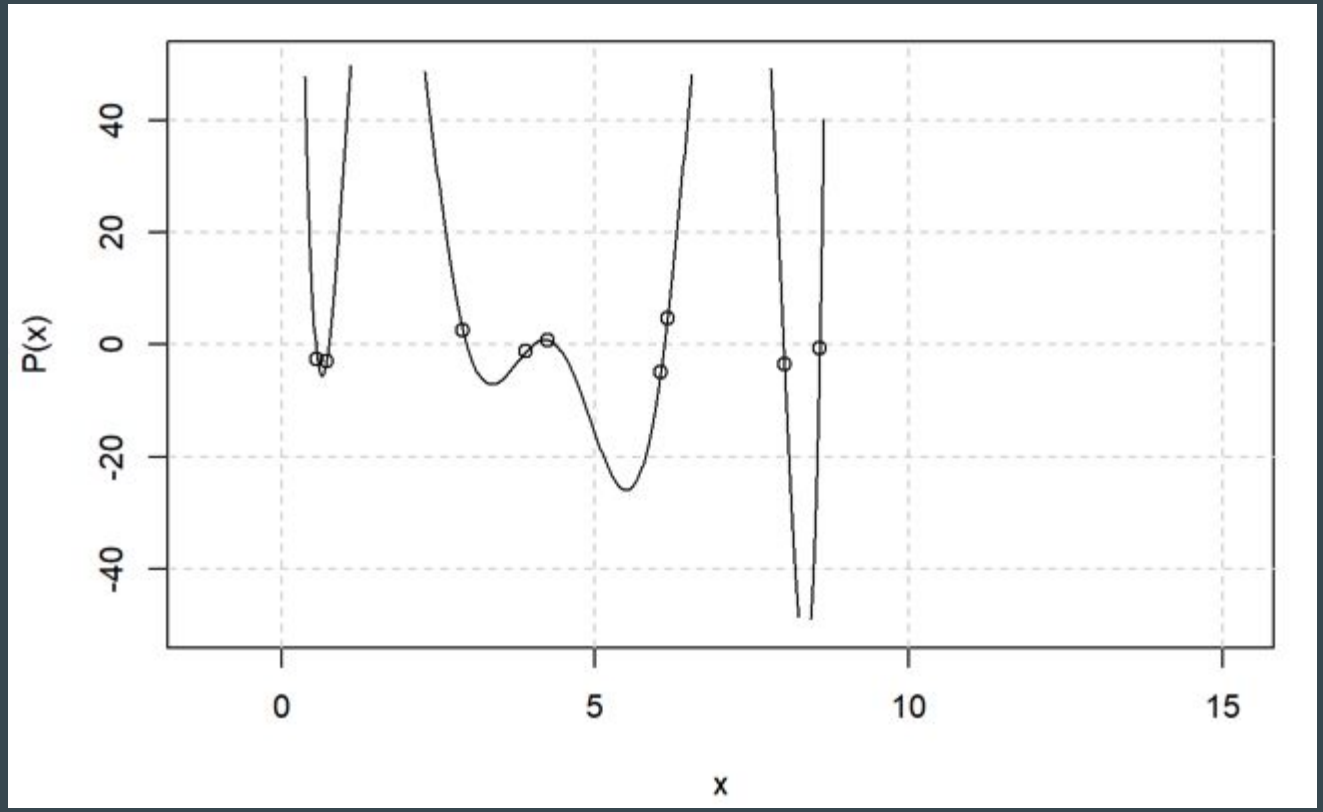
Vandermonde(n=9) =

	[,1]	[,2]	[,3]	[,4]	[,5]
[1,]	1	0.7514240568	0.5646381132	0.4242826617	0.3188161989
[2,]	1	0.7763211750	0.6026745668	0.4678690279	0.3632166335
[3,]	1	1.9272072846	3.7141279177	7.1578943787	13.7947461889
[4,]	1	2.5053816440	6.2769371822	15.7261231968	39.3999403888
[5,]	1	3.1933408599	10.1974258476	32.5638566249	103.9874939164
[6,]	1	3.5875130657	12.8702499964	46.1721900204	165.6433349688
[7,]	1	5.2894231599	27.9779973645	147.9874672278	782.7683365306
[8,]	1	8.1227600932	65.9792315313	535.9334688612	4353.2589934637
[9,]	1	8.8448092830	78.2306512521	691.9351904076	6120.0347953314
[10,]	1	9.1392030642	83.5250326481	763.3522343126	6976.4310788701

Exercice 2

Question 2

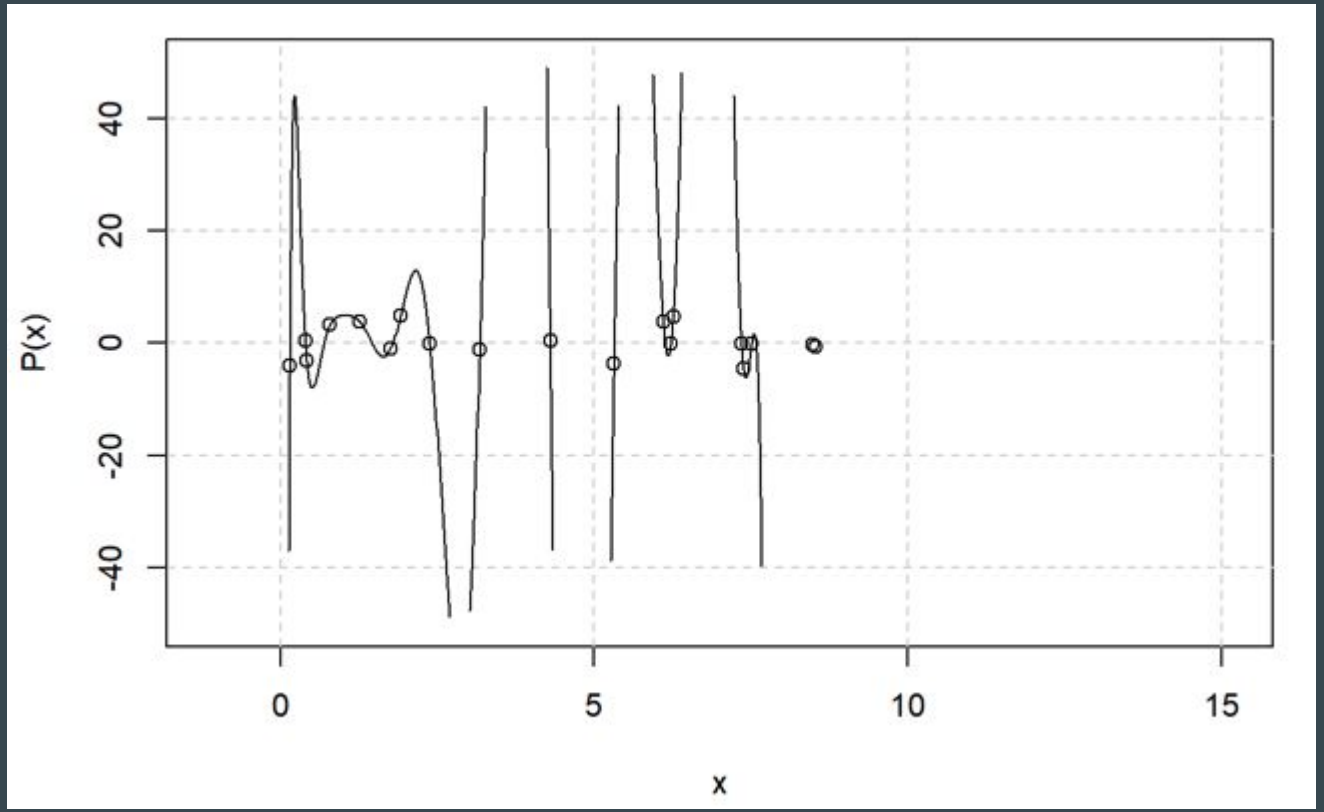
Interpolation n = 9 :



Exercice 2

Question 2

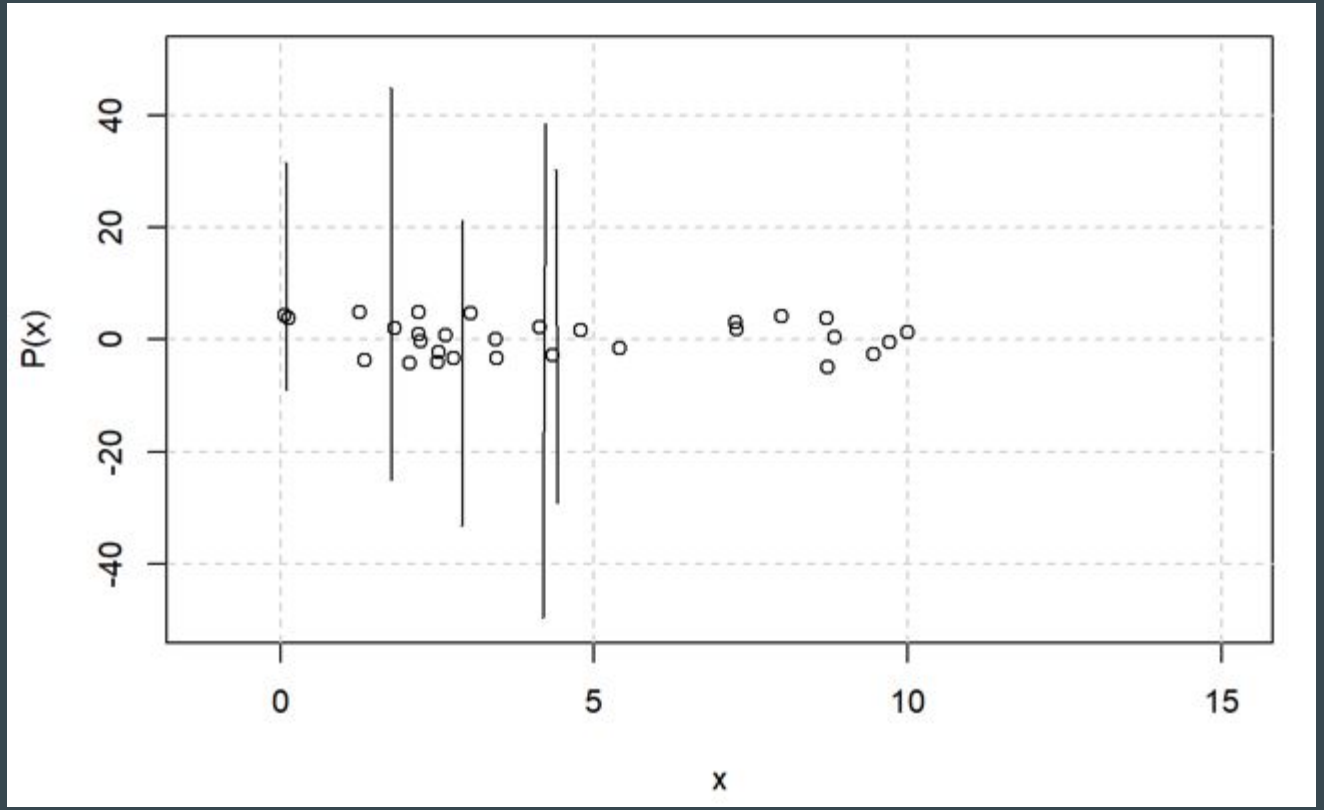
Interpolation n = 19 :



Exercice 2

Question 2

Interpolation n = 29 :



Exercice 2

Question 3

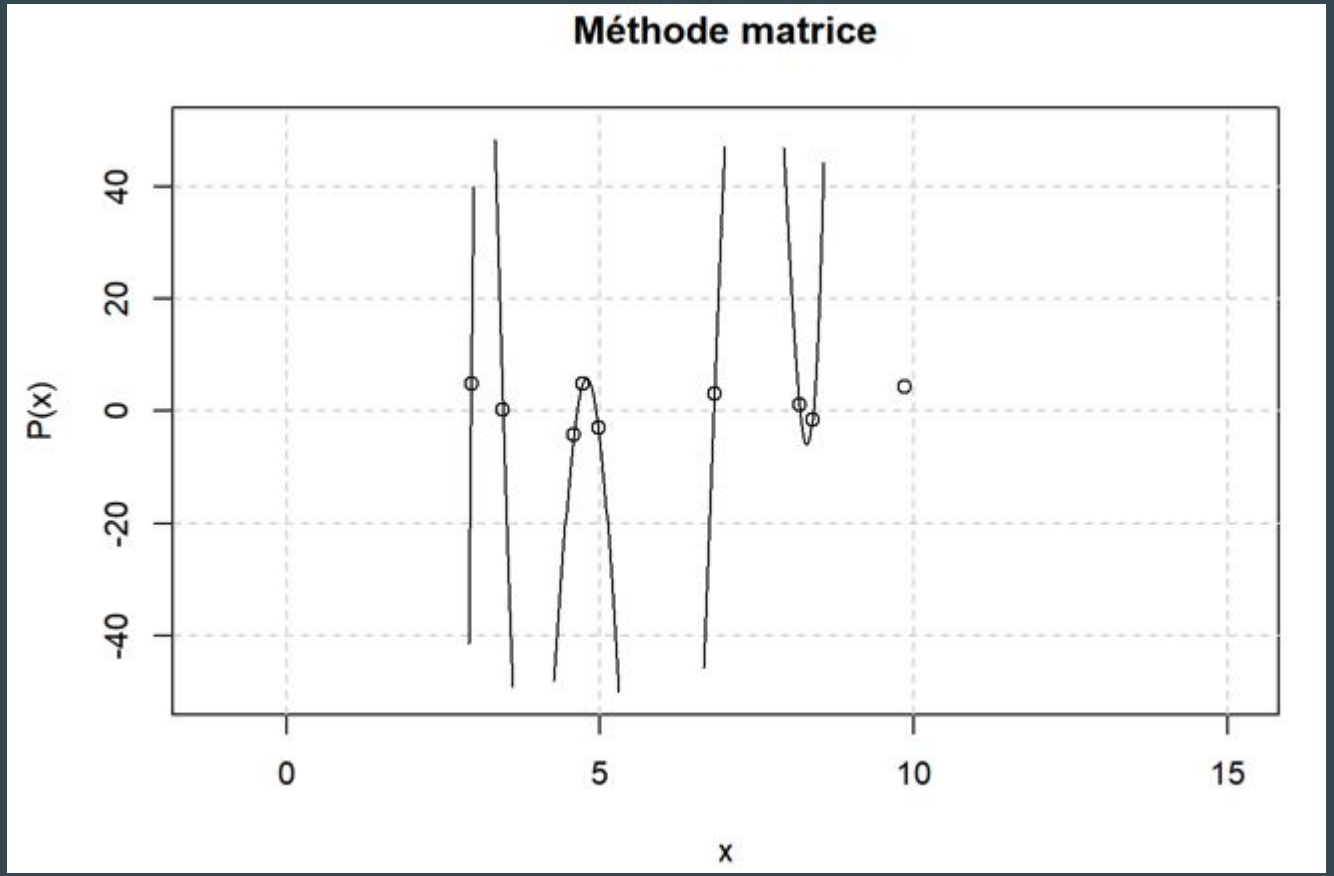
Matrice de Newton :

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]	[,9]
[1,]	1	0.0000000000	0.000000000	0.0000000000	0.0000000000	0.0000000	0.000000	0.0000000	0.00000
[2,]	1	0.5042890822	0.000000000	0.0000000000	0.0000000000	0.0000000	0.000000	0.0000000	0.00000
[3,]	1	1.6325527237	1.841949881	0.0000000000	0.0000000000	0.0000000	0.000000	0.0000000	0.00000
[4,]	1	1.7756312042	2.257434743	0.3229903328	0.0000000000	0.0000000	0.000000	0.0000000	0.00000
[5,]	1	2.0261465550	3.083506276	1.2136490488	0.3040377172	0.0000000	0.000000	0.0000000	0.00000
[6,]	1	3.8770071999	13.076052425	29.3486043967	61.6724527867	114.1471157	0.000000	0.0000000	0.00000
[7,]	1	5.2331269655	24.746609043	89.1020030927	308.0697980228	987.9738073	1339.810808	0.0000000	0.00000
[8,]	1	5.4351607081	26.800079718	101.9101971198	372.9433731153	1271.3692373	1980.988437	400.2265081	0.00000
[9,]	1	6.9112400662	44.279976342	233.7401506407	1200.3979890308	5864.0564270	17792.912741	29858.5199681	44073.54499

Exercice 2

Question 3

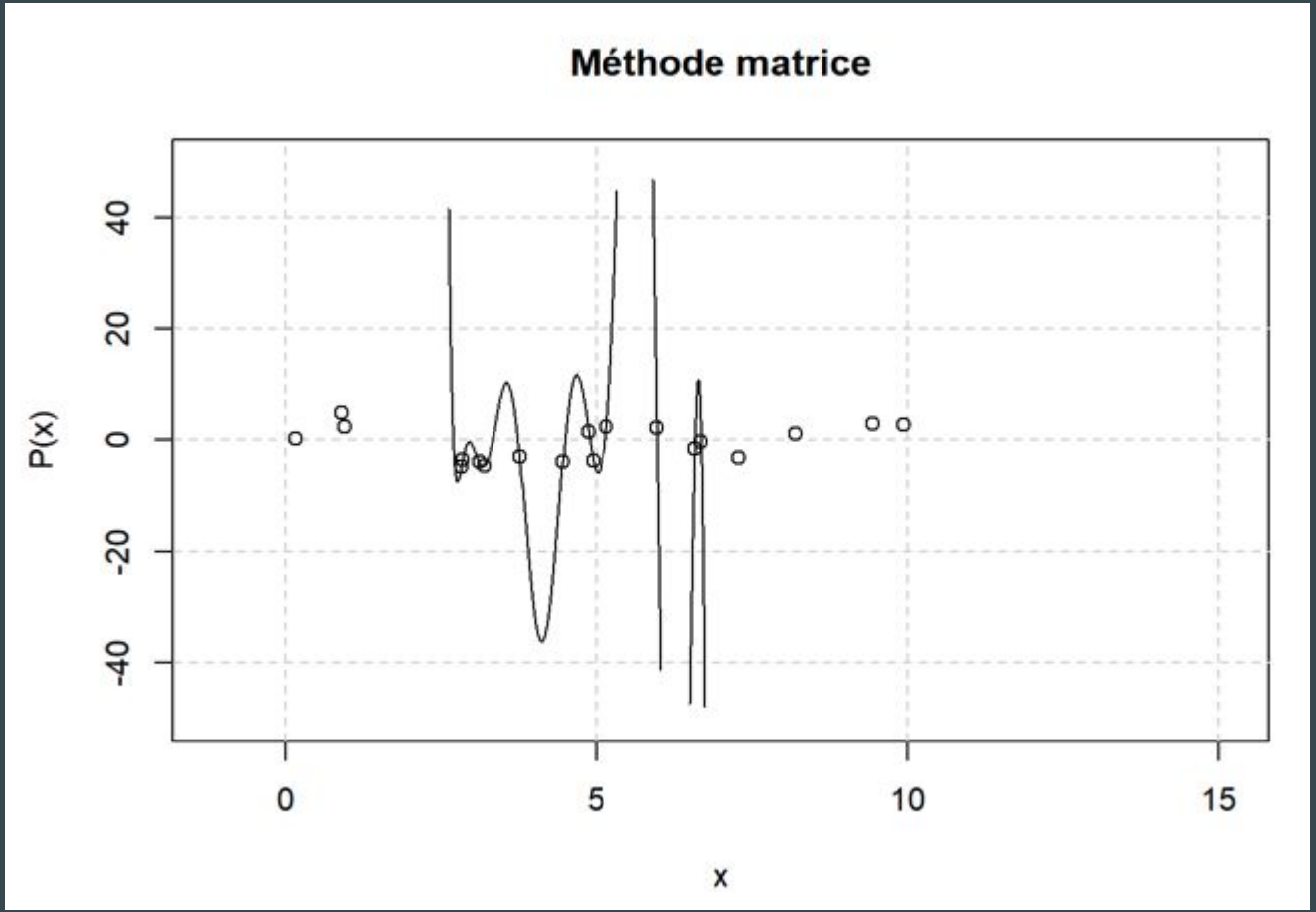
Interpolation n = 9 :



Exercice 2

Question 3

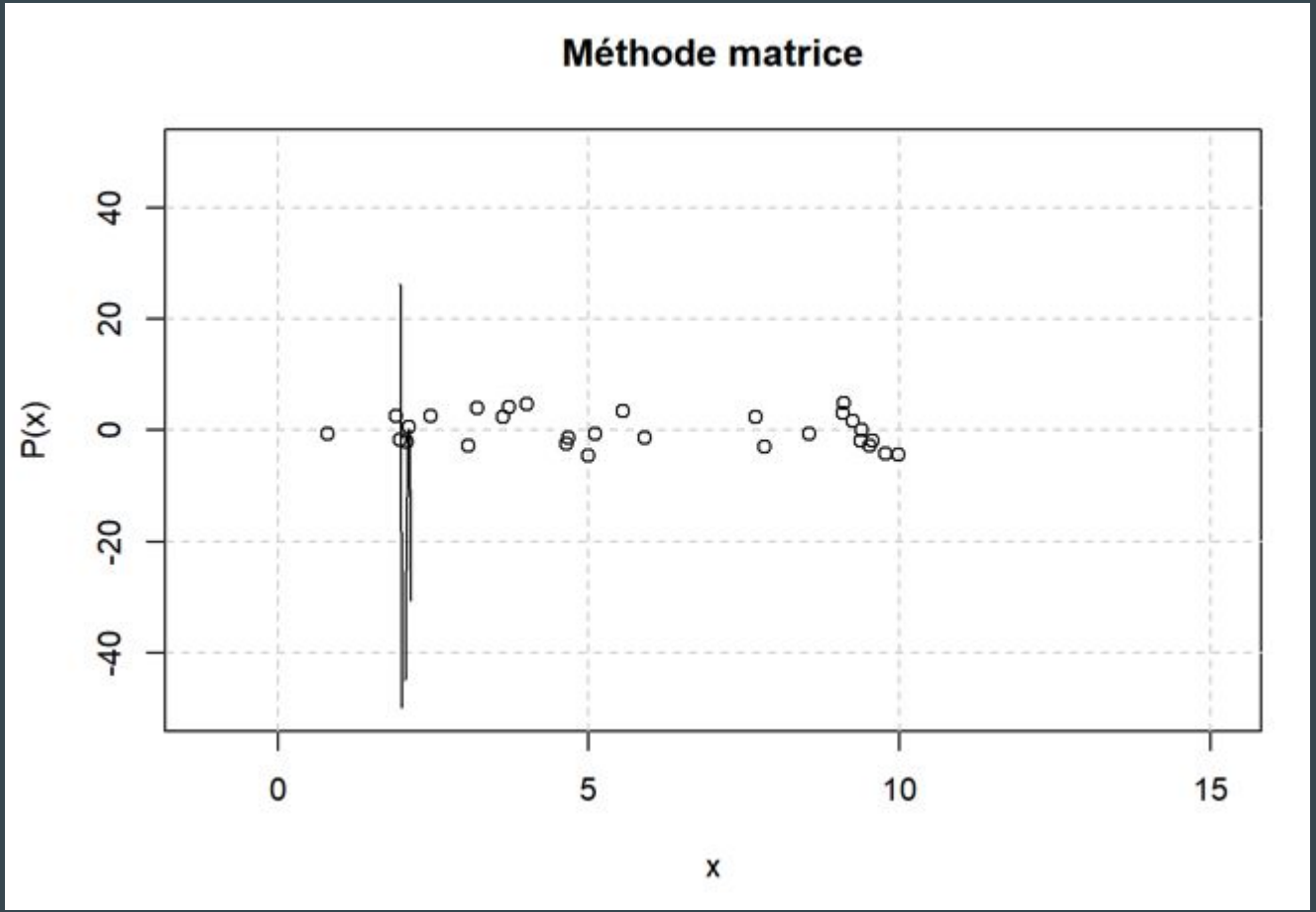
Interpolation n = 19 :



Exercice 2

Question 3

Interpolation n = 29 :



Exercice 2

Question 4

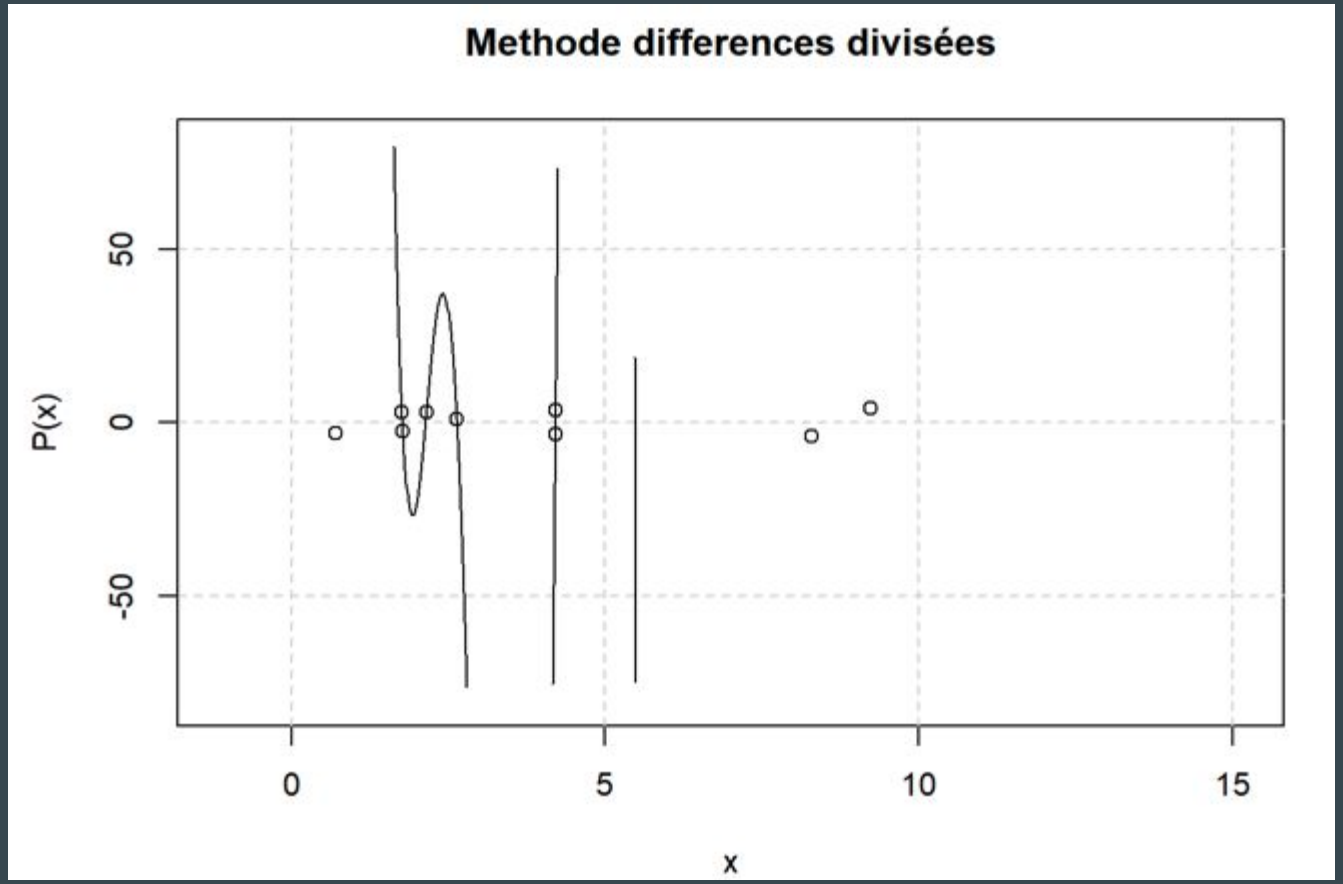
On ne conserve que les coefficients sur la diagonale de la matrice des différences divisée :

```
[1]    -2.957255198     5.514159578  -354.159455700   935.963688338
[5] -1096.407682717   451.461054178  -158.802688439    21.931176639
[9]    -2.513954123
```

Exercice 2

Question 4

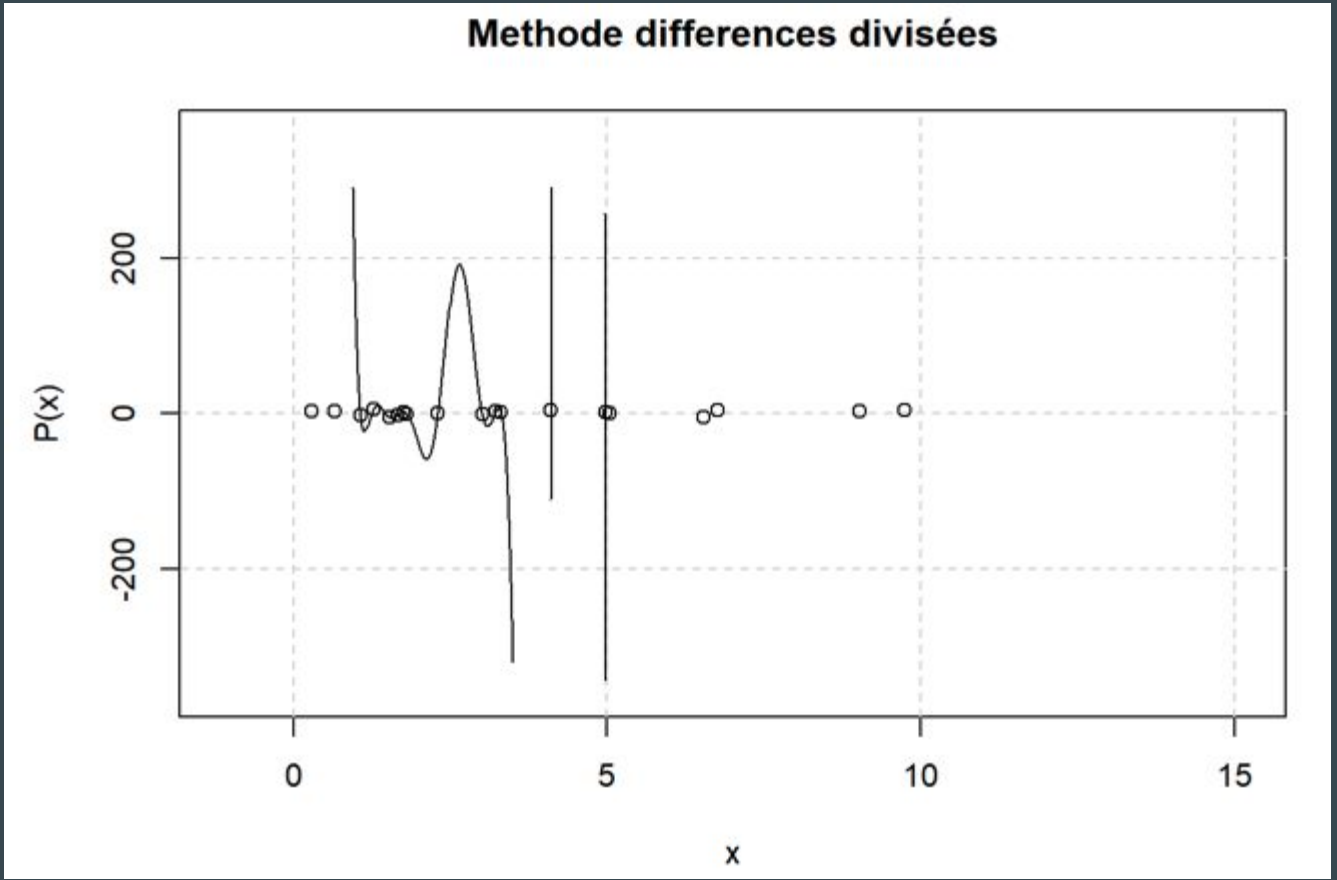
Interpolation n = 9 :



Exercice 2

Question 4

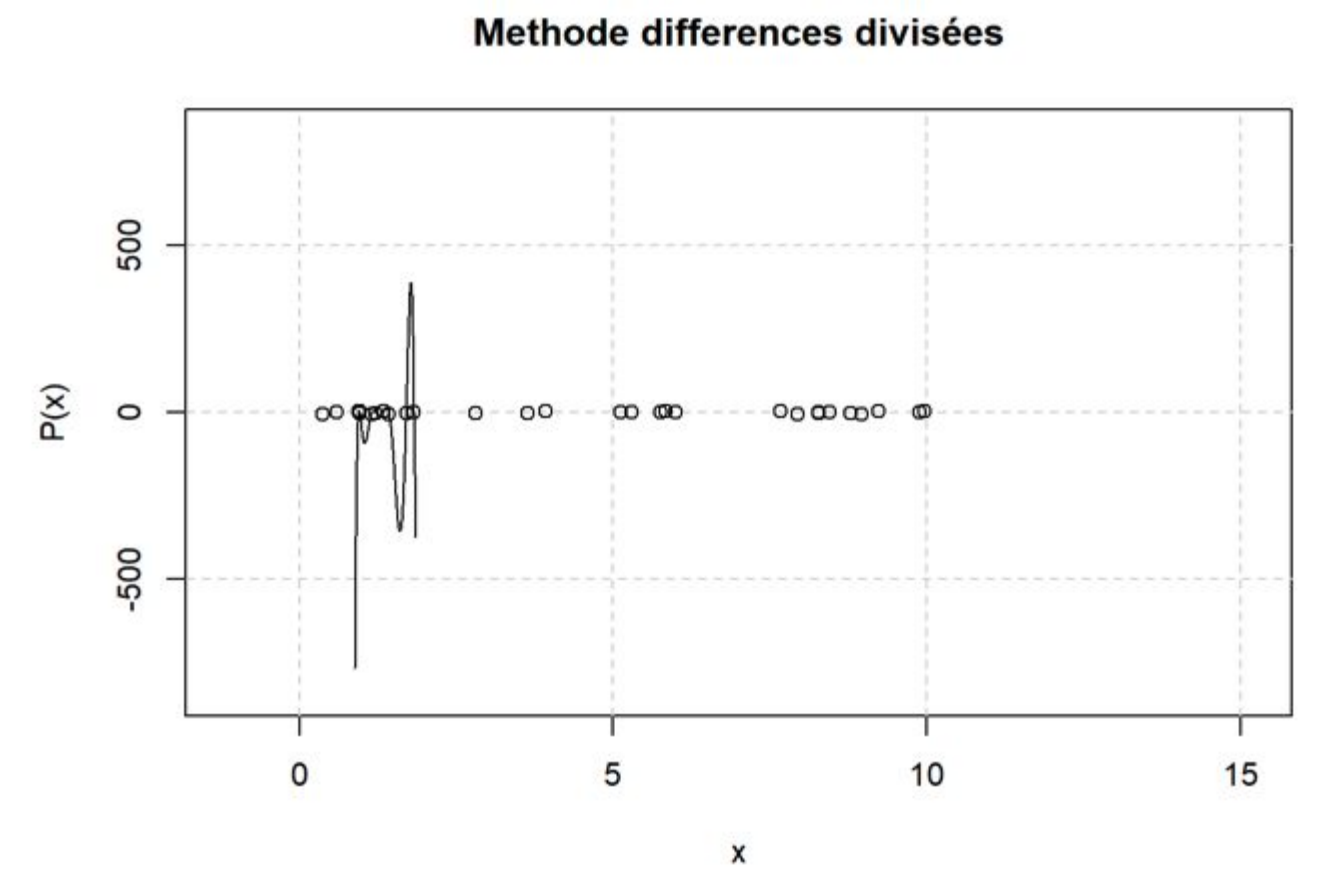
Interpolation n = 19 :



Exercice 2

Question 4

Interpolation n = 29 :

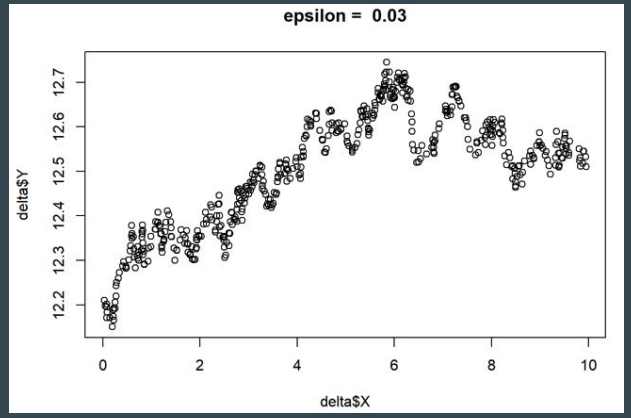


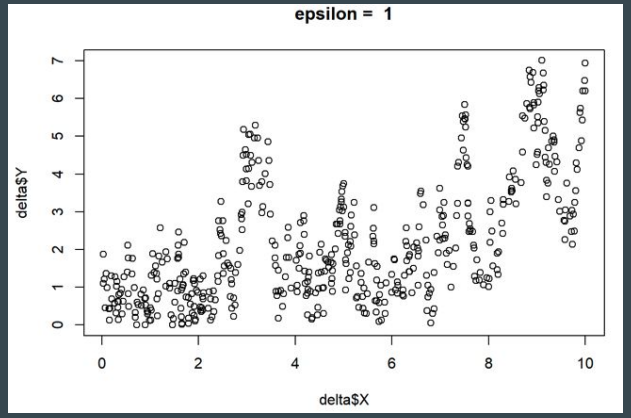
Exercice 2

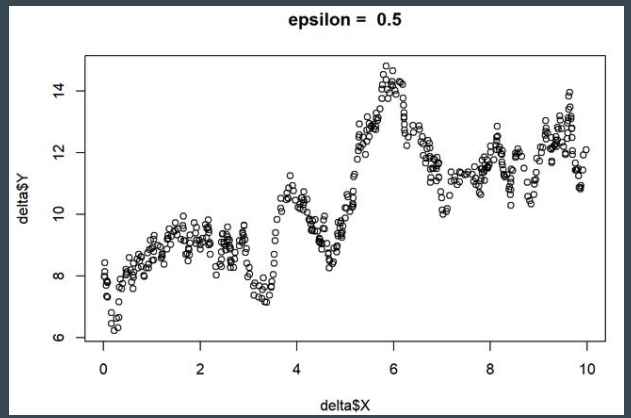
Question 5

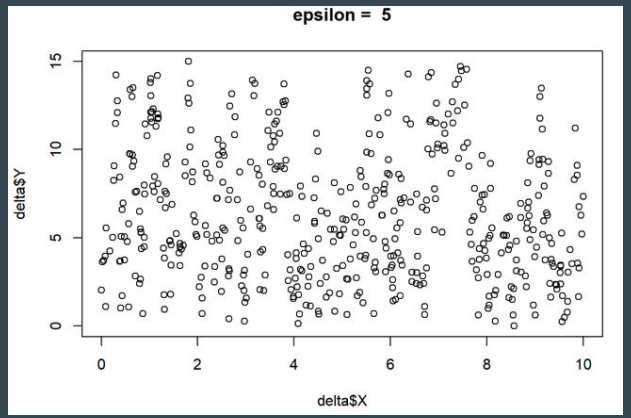
```
[1] "Vandermonde : Y = "
2 + 3*x + x^2 + 6.399008307e-14*x^3 - 4.179249539e-14*x^4 + 1.517058084e-14*x^5
- 3.212245284e-15*x^6 + 3.940410608e-16*x^7 - 2.590520391e-17*x^8 +
7.049035077e-19*x^9
[1] "Matrice de Newton : Y = "
2 + 3*x + x^2 - 5.985026876e-13*x^3 + 3.930098193e-13*x^4 - 1.411586522e-13*x^5
+ 2.777521654e-14*x^6 - 3.044752914e-15*x^7 + 1.740264954e-16*x^8 -
4.011548038e-18*x^9
[1] "Différences divisées : Y = "
2 + 3*x + x^2
Vandermonde : X =  5  P(X) =  42
Matrice de Newton : X =  5  P(X) =  42
Différences divisées : X =  5  P(X) =  42
Vandermonde : X =  10  P(X) =  132
Matrice de Newton : X =  10  P(X) =  132
Différences divisées : X =  10  P(X) =  132
Vandermonde : X =  15  P(X) =  272
Matrice de Newton : X =  15  P(X) =  272
Différences divisées : X =  15  P(X) =  272
```

Exercice 3 Question 1





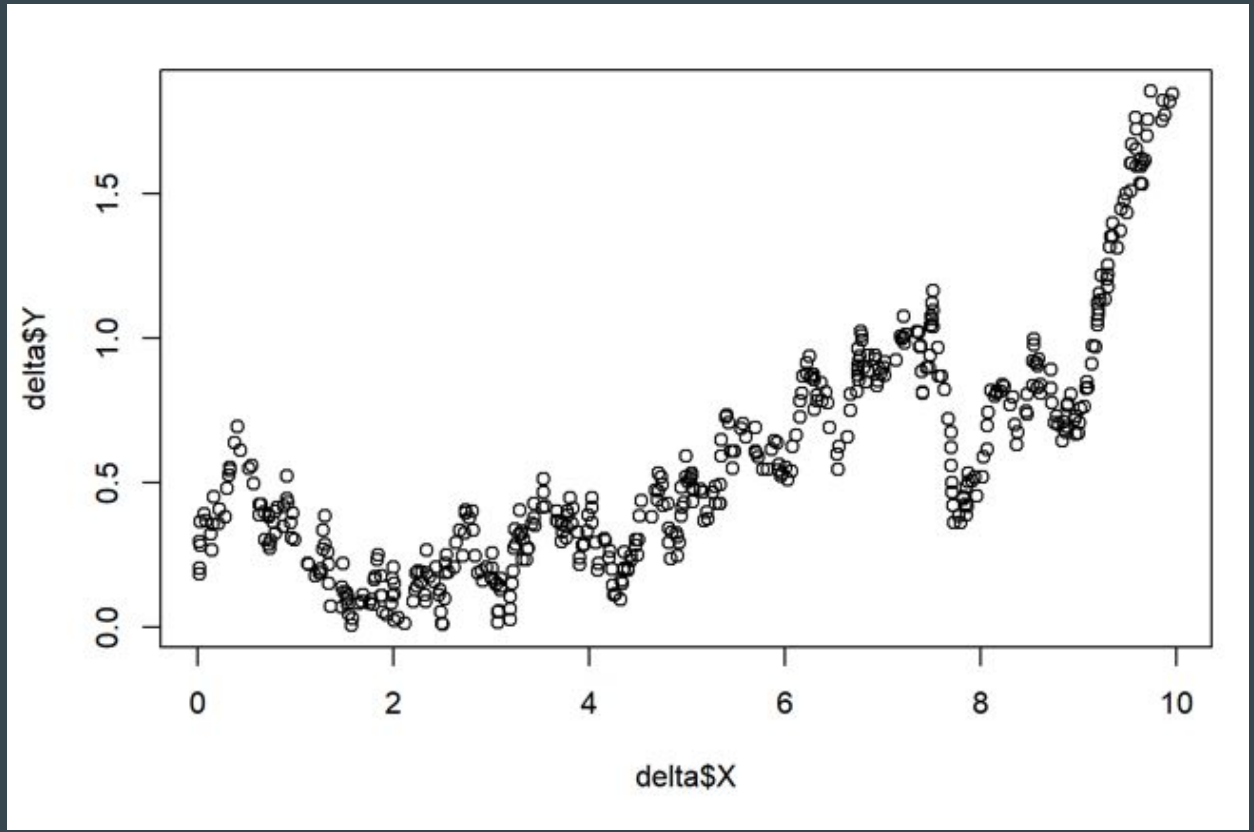




Exercice 3

Question 2

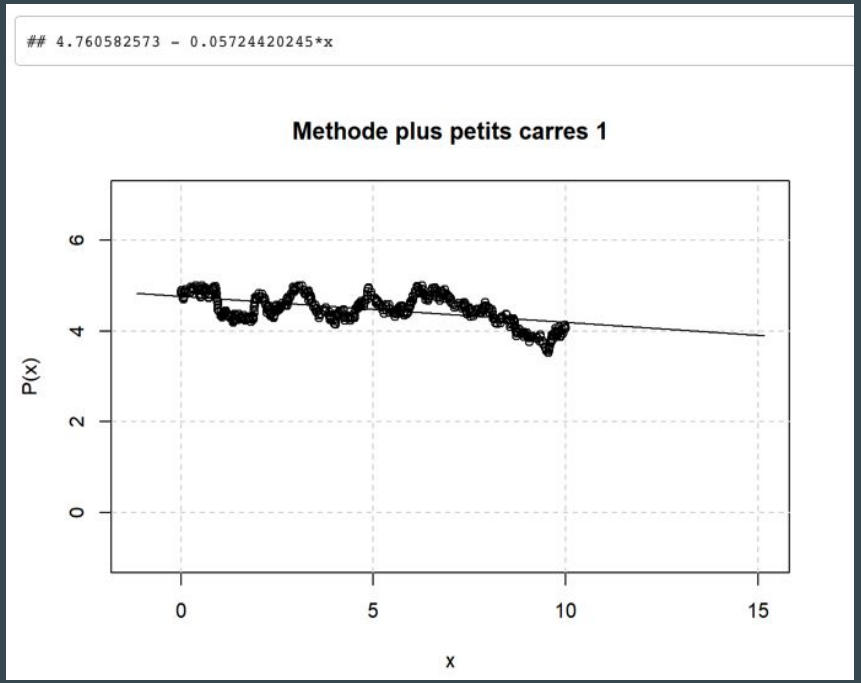
Nombre de pics +1



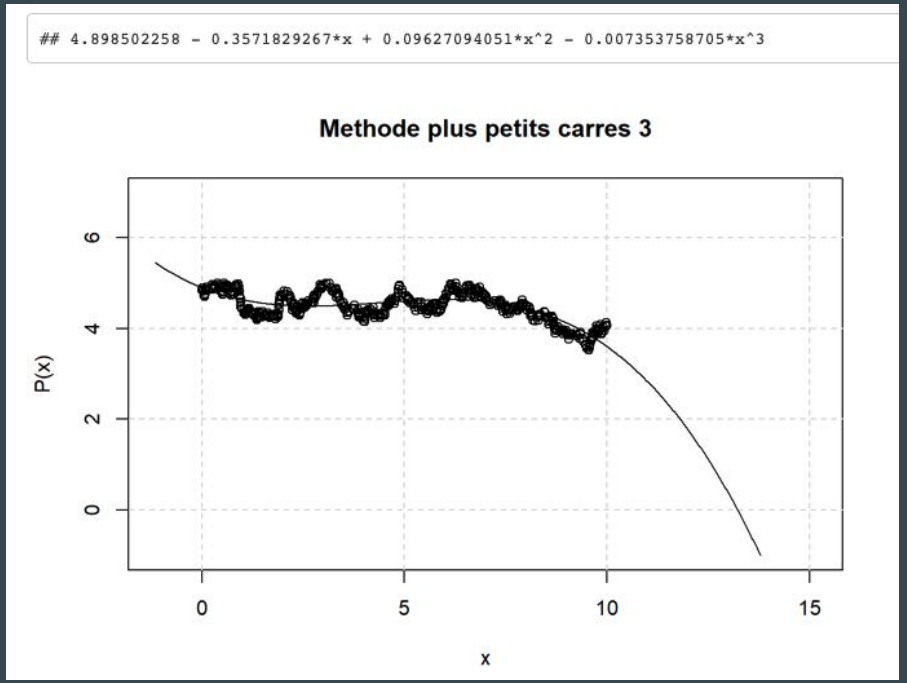
Exercice 3

Question 3

```
## 4.760582573 - 0.05724420245*x
```



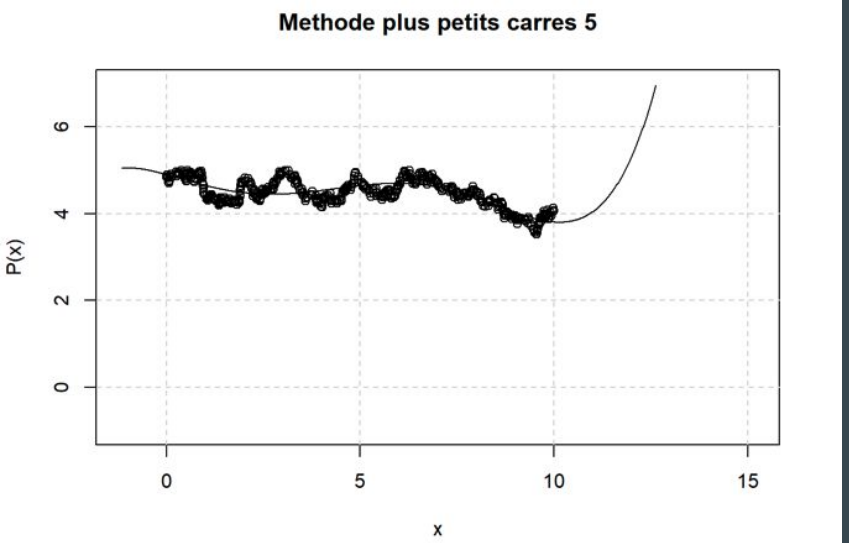

```
## 4.898502258 - 0.3571829267*x + 0.09627094051*x^2 - 0.007353758705*x^3
```



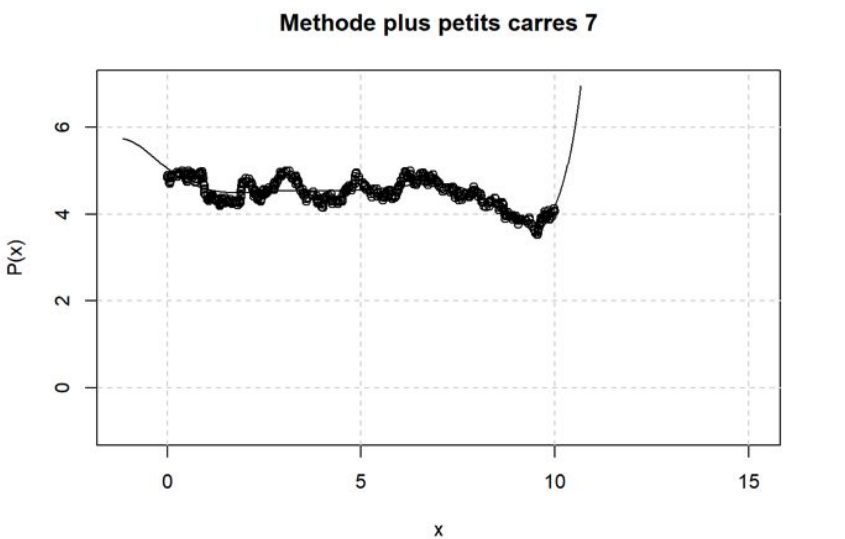
Exercice 3

Question 3

```
## 4.898985746 - 0.243998715*x - 0.04158241849*x^2 + 0.04129068575*x^3 -
## 0.006515636072*x^4 + 0.0002937084561*x^5
```



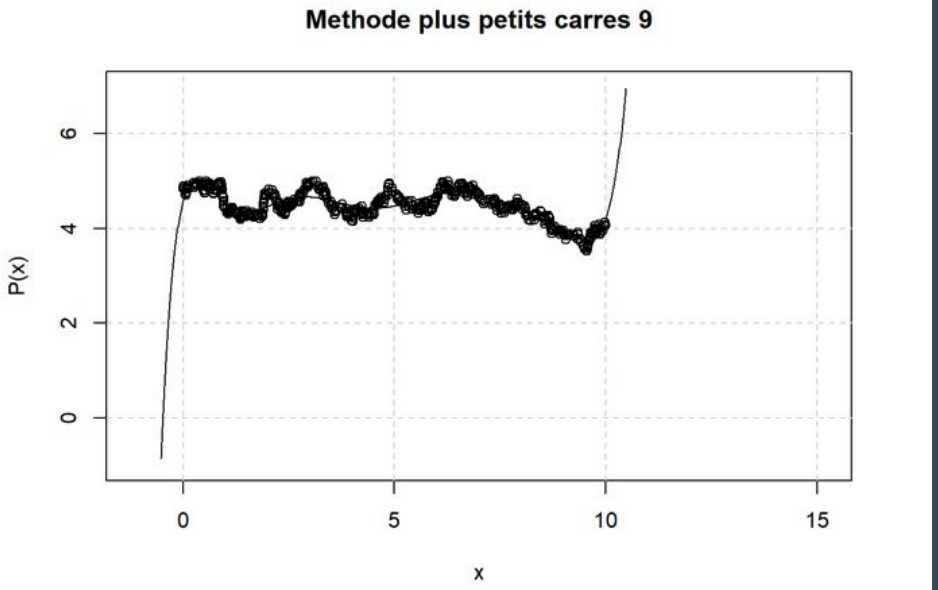

```
## 5.051056264 - 0.6889995614*x + 0.1571062051*x^2 + 0.1129294923*x^3 -
## 0.06796531517*x^4 + 0.0142251204*x^5 - 0.001319967776*x^6 + 4.545065561e-05*x^7
```



Exercice 3

Question 3

```
## 4.590558438 + 3.420227832*x - 8.339554938*x^2 + 7.524100433*x^3 -
## 3.448198671*x^4 + 0.9021842028*x^5 - 0.1406083251*x^6 + 0.01292839199*x^7 -
## 0.0006481548812*x^8 + 1.367874058e-05*x^9
```

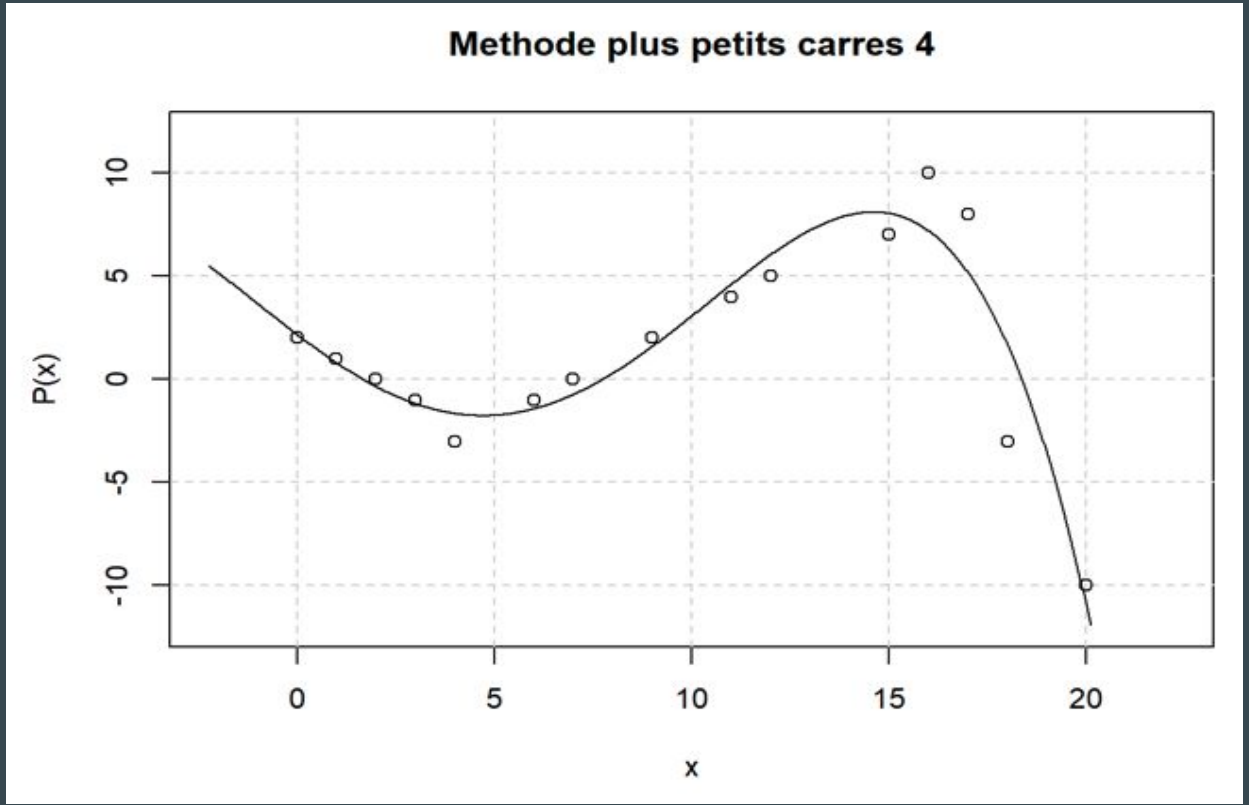


Exercice 3

Question 4

Epsilon =11

Degré choisi = 4



P =

```
## 2.171465892 - 1.4563374*x + 0.06257116153*x^2 + 0.01954282709*x^3 -
## 0.001033584341*x^4
```

Exercice 3

Question 4

P(22) = `[1] -33.61482518`

P(25) = `[1] -93.51720294`

P(50) = `[1] -3931.266243`

Exercice 4

Question 2

```
is_palindrome("radar")

## radar     : est un palindrome

is_palindrome("bonne année")

## bonne année   : n'est pas un palindrome

is_palindrome("sept")

## sept      : n'est pas un palindrome

is_palindrome("kayak")

## kayak     : est un palindrome
```

```
is_palindrome("la mariée ira mal")

## la mariée ira mal     : n'est pas un palindrome

is_palindrome("statistiques")

## statistiques      : n'est pas un palindrome

is_palindrome("engage le jeu que je le gagne")

## engage le jeu que je le gagne     : est un palindrome

is_palindrome("esope reste ici et se repose")

## esope reste ici et se repose      : est un palindrome
```

Exercice 4

Question 3

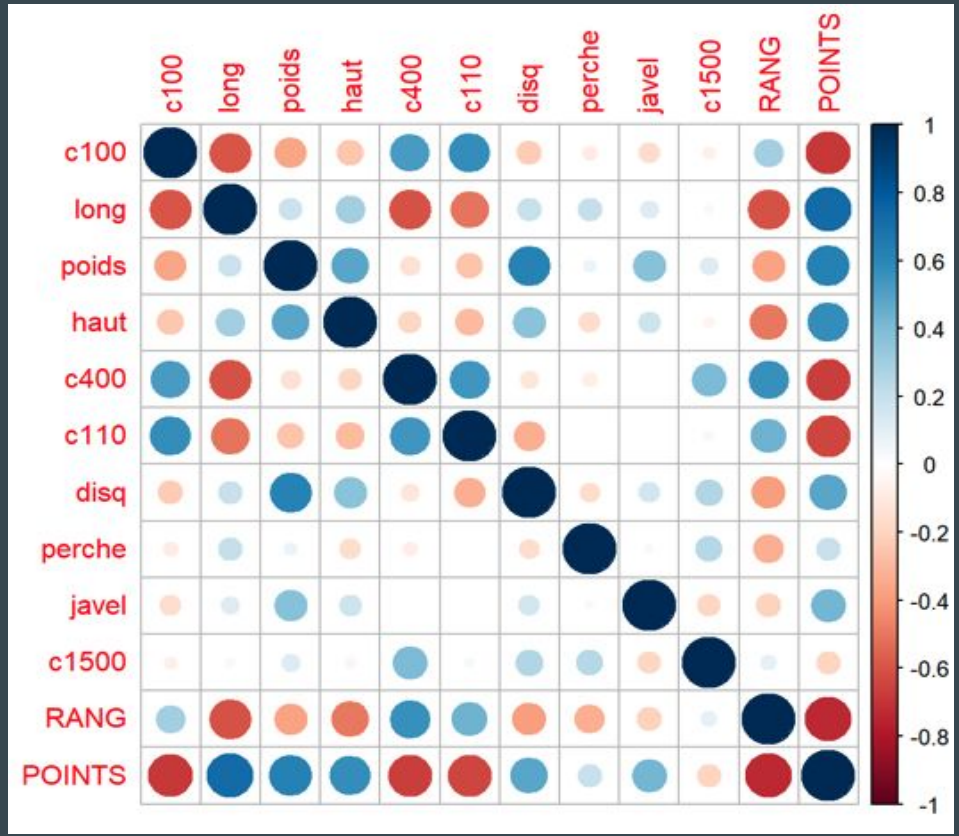
```
liste <- list("radar","bonne année","sept")
palindrome9(liste)
```

```
## radar
```

Exercice 5 A

Question 1

Matrice de corrélation des variables quantitatives



Exercice 5 A

Question 2

Les couples de variables les plus corrélés sont :

- POINTS –> LONGEUR
- POINTS –> POIDS
- C110 –> C100
- C400 –> C100
- Disque –> Poids
- C110 –> C400
- Rang –> C400

On voit que les épreuves de lancer et les épreuves de courses sont corrélées entre elles

Exercice 5 A

Question 2

Les moins corrélées sont :

- C1500 –> C100
- C1500 –> Long
- Perche –> Poids
- C1500 –> Poids
- C1500 –> Haut
- Perche –> C400
- Javel –> C400
- Perche –> C110
- Javel –> C110
- C1500 –> C110
- Rang –> C1500

Les moins corrélées sont les épreuves les plus différentes.

Exercice 5 A

Question 2

Les plus opposées :

- C100 –> long
- C100 –> POINTS
- long –> C400
- long –> Rang
- Point –> C400
- Point –> C110
- Point –> Rang

Exercice 5 A

Question 3

- Les épreuves concernant des sports similaires montrent une corrélation positive (course et lancer).
- Une corrélation négative apparaît entre le rang et le score, cela s'explique, car il faut avoir un score élevé pour avoir un rang faible.

Exercice 5 B

Question 4

les valeurs propres de la matrice de corrélation sont :

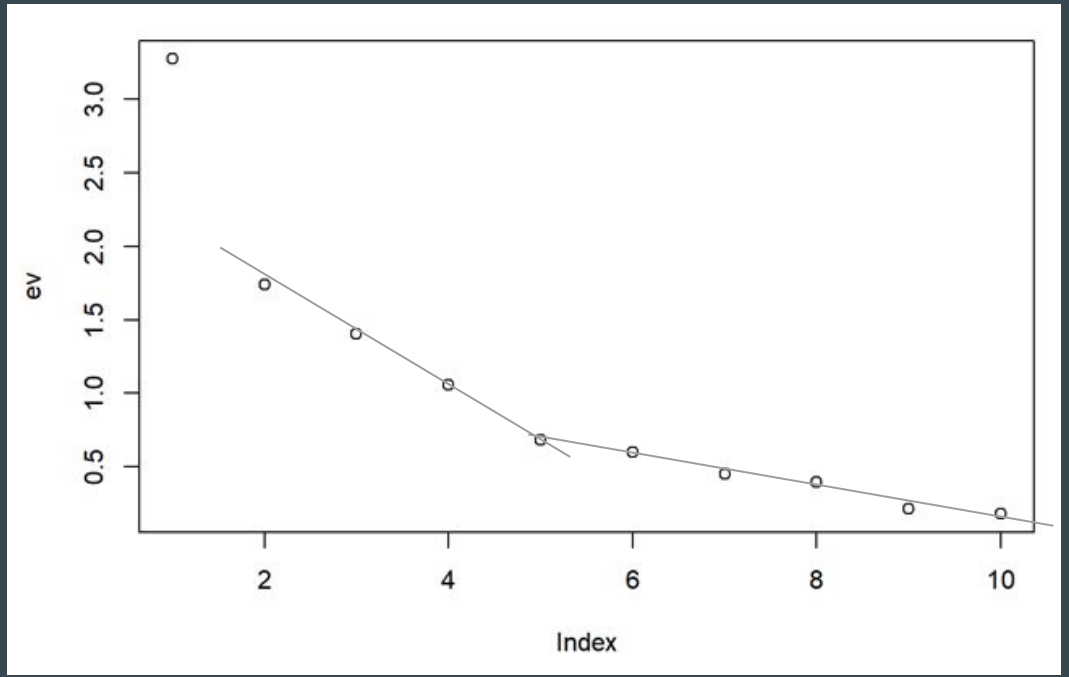
```
[1] 3.2719055380 1.7371310231 1.4049166821 1.0568503533 0.6847735349
[6] 0.5992686808 0.4512352638 0.3968765857 0.2148148532 0.1822274851
```

Exercice 5 B

Question 4

Règle du coude : 5 valeurs propres

3vp -> 64 % d'inertie



Exercice 5 B

Question 5

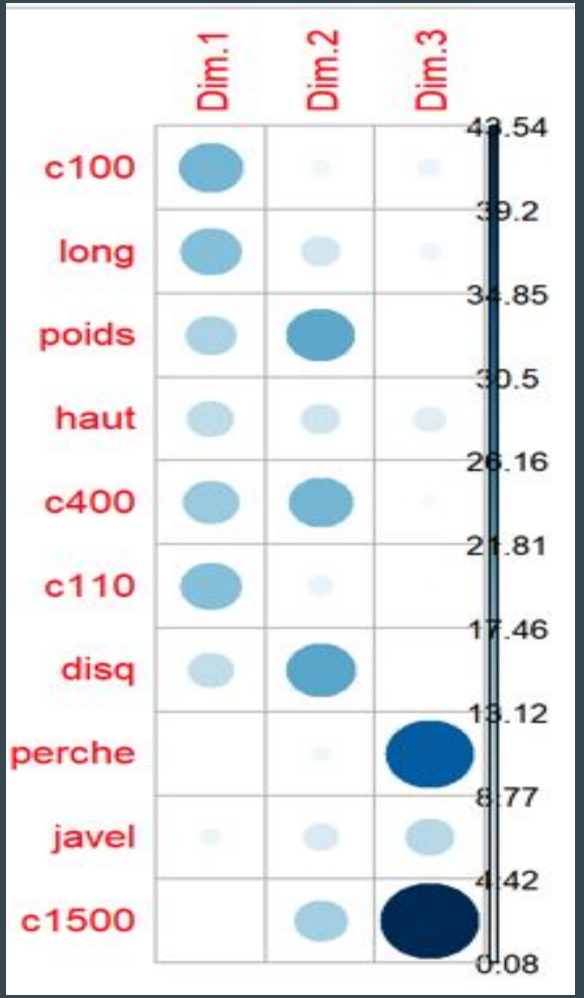
```
##                    Dim.1          Dim.2           Dim.3
## SEBRLE       0.791627716890  0.77161119552  0.8268411940268
## CLAY         1.234990562922  0.57457806534  2.1412469663713
## KARPOV       1.358214935758  0.48402090113  1.9562579868954
## BERNARD     -0.609515083106 -0.87462852884  0.8899406618588
## YURKOV      -0.585968337761  2.13095422255 -1.2251567968084
## WARNERS      0.356889530489 -1.68495666583  0.7665531449198
## ZSIVOCZKY    0.271774781024 -1.09377557750 -1.2827673831291
## McMULLEN     0.587516189056  0.23072991176 -0.4176329823038
## MARTINEAU   -1.995359298025  0.56099598158 -0.7299466010890
## HERNU       -1.546076461677  0.48838301094  0.8407858519275
## BARRAS      -1.341652726752 -0.31091157069 -0.0003683375477
## NOOL        -2.344973805586 -1.96637500055 -1.3364815492290
## BOURGUIGNON -3.979041864579  0.19986018993  1.3264851034113
## Sebrle       4.038448501441  1.36582606354 -0.2899565042806
## Clay         3.919365157228  0.83696136260  0.2311753204792
## Karpov       4.619987275045  0.03999522890 -0.0415857980014
## Macey        2.233460565598  1.04176620064 -1.8643620154049
## Warners      2.168396445406 -1.80320025033  0.8510173287098
## Zsivoczky    0.925132182894  1.16865179610 -1.4774802908286
## Hernu        0.889037851513 -0.61842521554 -0.8982953479746
## Nool         0.295305666684 -1.54561667242  1.3552601285624
## Bernard      1.906334367677 -0.08580429180 -0.7571859708851
## Schwarzl     0.081078659392 -1.35345709932  0.8224866222304
## Pogorelov    0.539677027745  0.77075098970  1.3476197769273
## Schoenbeck   0.114430984607 -0.03985060809  0.7404039810320
## Barras       0.002145202768  0.36033768481 -1.5696934887659
## Smith        0.870310569720  1.05932551998 -1.6434290616483
## Averyanov    0.349155137968 -1.55864999153  0.2825354036679
## Ojaniemi     0.380113998692 -0.77244734296 -0.3709431418934
## Smirnov     -0.484514212539 -1.06066118077 -1.2283378499303
## Qi          -0.434466690806 -0.32614689717 -1.0697978122896
## Drews       -0.248684024375 -3.08167683010  1.0548427374522
## Parkhomenko -1.069429104277  2.09318217909 -0.9999839028901
## Terek       -0.681953059148  0.53561439799  2.2091259997098
## Gomez       -0.289889207723 -1.19671610589 -1.3061025895306
## Turi        -1.541813055585  0.42716772525  0.5140859441357
## Lorenzo     -2.408509979550 -1.58292969328 -1.5023461069170
## Karlivans   -1.994368726831 -0.29418239625 -0.3427836936915
## Korkizoglou -0.957829813261  2.06638553650  2.5865525262672
## Uldal       -2.562259590728  0.24546870508 -0.4191406444668
## Casarsa     -2.857088268209  3.79784504993  0.0305611909207
```

Exercice 5 B

Question 6

Tableau de corrélation des variables

par rapport à C1, C2 et C3

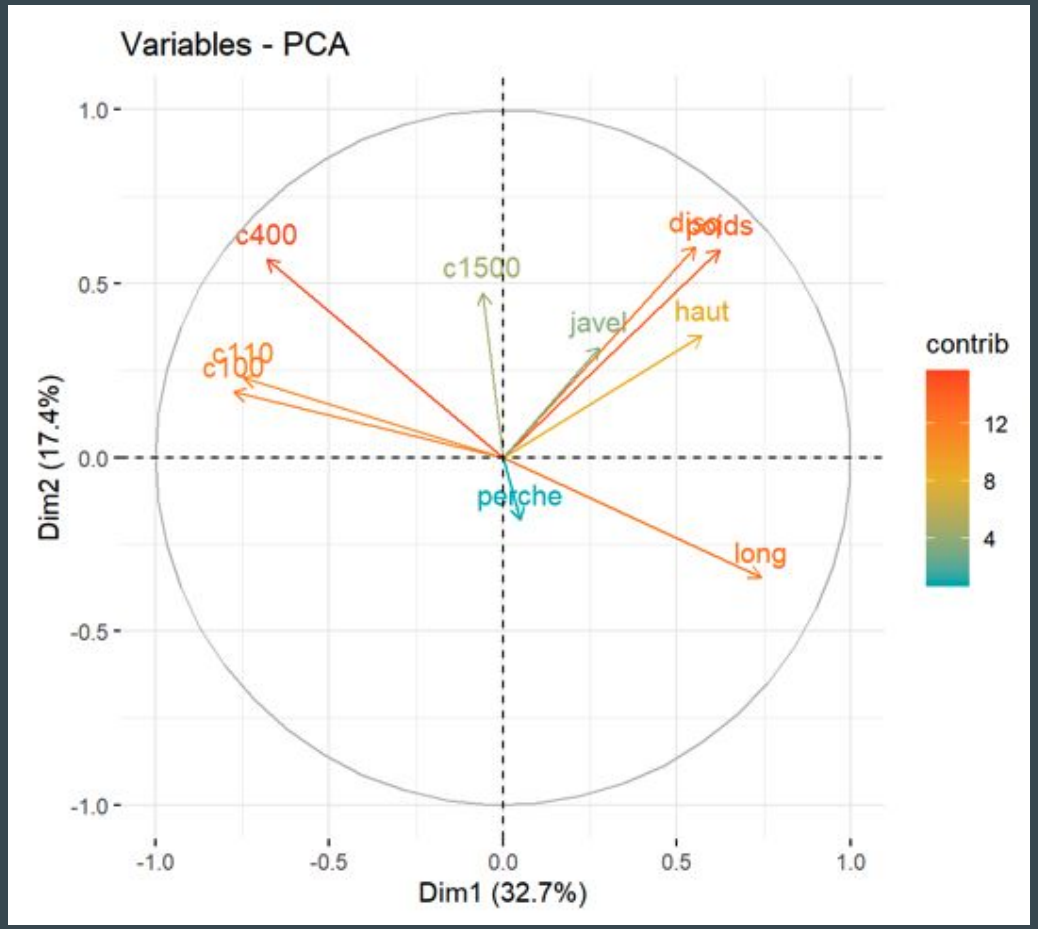


Exercice 5 B

Question 6

Cercle des corrélations des variables

par rapport à (C1,C2)

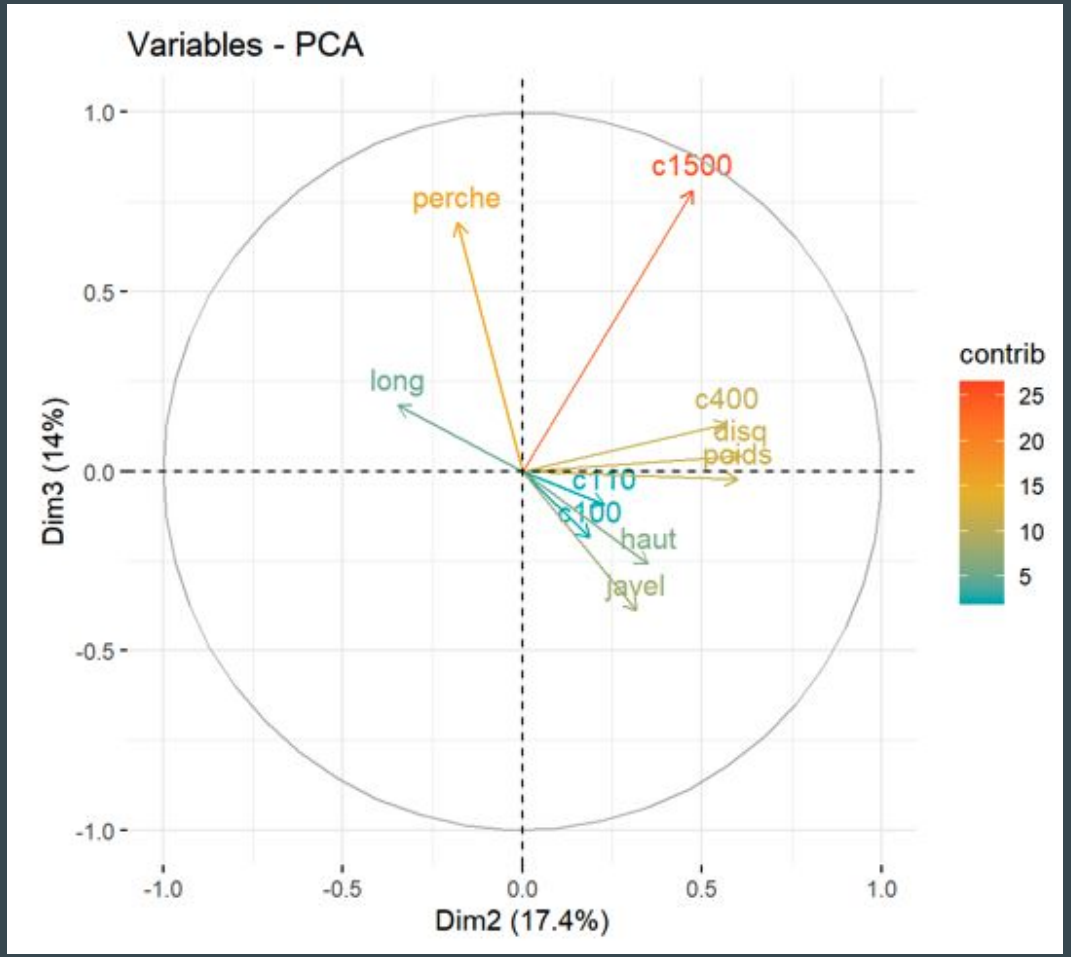


Exercice 5 B

Question 6

Cercle de corrélation des variables

par rapport à (C2,C3)



Exercice 5 B

Question 7

Composante 1

```
##          correlation         p.value
## long   0.7418997450 2.849885834e-08
## poids  0.6225025511 1.388320670e-05
## haut   0.5719452960 9.362284801e-05
## disq   0.5524665193 1.802219952e-04
## c400  -0.6796099427 1.028174558e-06
## c110  -0.7462453240 2.136961517e-08
## c100  -0.7747198283 2.778466580e-09
```

Composante 2

```
##          correlation         p.value
## disq   0.6063133911 2.650744528e-05
## poids  0.5983033207 3.603567348e-05
## c400   0.5694377766 1.020941249e-04
## c1500  0.4742237687 1.734405284e-03
## haut   0.3502936078 2.475025040e-02
## javel  0.3169890605 4.344974126e-02
## long  -0.3454212938 2.696968984e-02
```

Composante 3

```
##          correlation         p.value
## c1500   0.7821428011 1.554449692e-09
## perche  0.6917566549 5.480171723e-07
## javel  -0.3896554074 1.179330939e-02
```

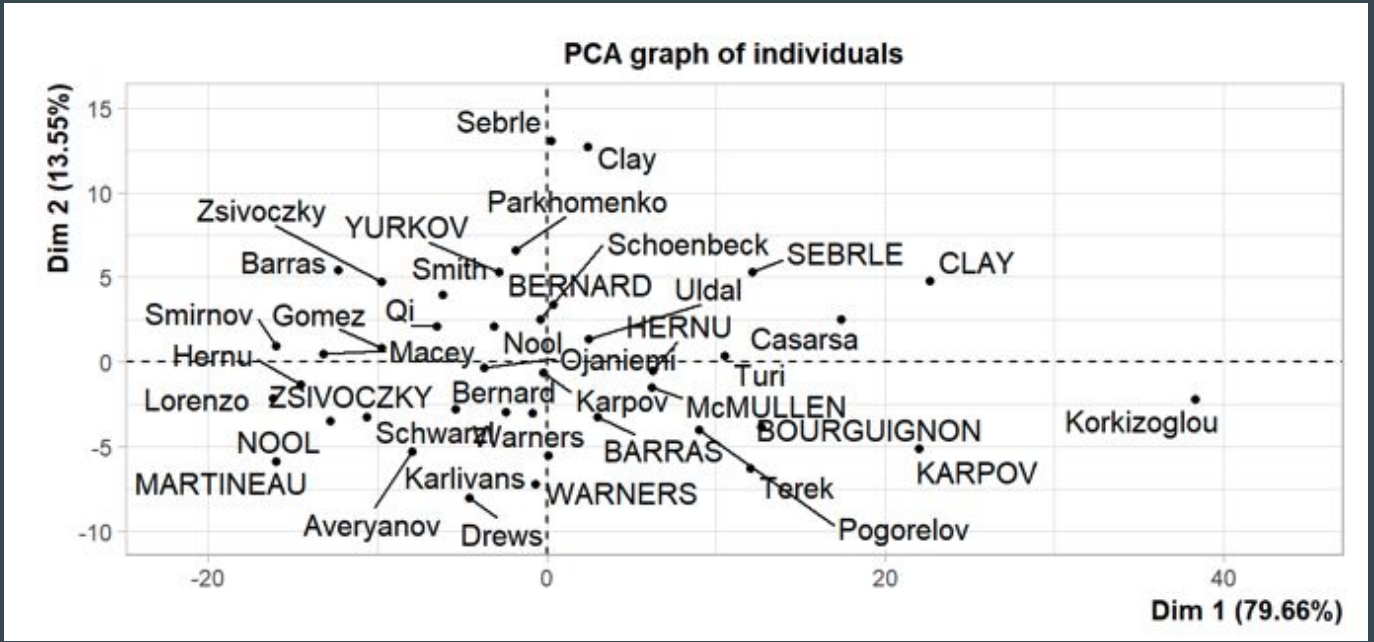
50% de corrélation en valeur absolue

Exercice 5 B

Question 8

Ne pas normaliser

les données



Exercice 5 B

Question 8

L'axe principale:

1500 mètres

Axe secondaire:

Javelot