sondage

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##Importation des données sur R

```
library(readxl)
library(knitr)
library(ggplot2)

## Warning: package 'ggplot2' was built under R version 3.6.3

donnees=read_xls("F:/sondage/ST-2020.xls")


str(donnees)

## Classes 'tbl_df', 'tbl' and 'data.frame':    24000 obs. of  5 variables:
##  $ PAYS: chr  "FR" "FR" "FR" "FR" ...
##  $ ZONE: chr  "AA" "AA" "AA" "AA" ...
##  $ VAR1: num  80 0 650 1980 0 0 1400 3100 68 0 ...
##  $ VAR2: num  77 520 800 2219 535 ...
##  $ VAR3: num  157 520 1450 4199 535 ...

summary(donnees)

##      PAYS               ZONE                VAR1              VAR2        
##  Length:24000       Length:24000       Min.   :    0.0   Min.   :    0.0  
##  Class :character   Class :character   1st Qu.:    0.0   1st Qu.:   47.0  
##  Mode  :character   Mode  :character   Median :    0.0   Median :  167.0  
##                                        Mean   :  288.6   Mean   :  562.1  
##                                        3rd Qu.:    0.0   3rd Qu.:  664.0  
##                                        Max.   :34700.0   Max.   :20839.0  
##       VAR3         
##  Min.   :    0.0  
##  1st Qu.:   80.0  
##  Median :  275.0  
##  Mean   :  850.7  
##  3rd Qu.: 1010.0  
##  Max.   :34700.0  

table(donnees$ZONE)

##
##   AA   BB   CC   DD 
## 4247 7092 7921 4740
```

```r
zoneFactor=as.factor(donnees$ZONE); levels(zoneFactor)

## [1] "AA" "BB" "CC" "DD"
```

##Étude de l'univers

```r
#Parametre de la population
N=length(donnees$PAYS)
sommes=c(sum(donnees$VAR1),sum(donnees$VAR2),sum(donnees$VAR3))
moyenne=c(mean(donnees$VAR1),mean(donnees$VAR2),mean(donnees$VAR3)); sommes/N

## [1] 288.6003 562.1131 850.7134

ecart=c(sd(donnees$VAR1),sd(donnees$VAR2),sd(donnees$VAR3))
ecart1=c(sd(donnees$VAR1)*sqrt((N-1)/N),sd(donnees$VAR2)*sqrt((N-
1)/N),sd(donnees$VAR3)*sqrt((N-1)/N))

cv=ecart/moyenne
cv1=ecart1/moyenne

univers=data.frame("effectifs"=N,"sommes des valeurs"=sommes,"moyenne des
valeurs"=moyenne,"ecart type"=ecart,"ecart type1"=ecart1,"coefficent de
variation"=cv,"coefficent de variation1"=cv1)

row.names(univers)=c("var1","var2","var3")

kable(univers)
```

	effectifs	sommes.des.valeurs	moyenne.des.valeurs	ecart.type	ecart.type1	coefficent.de.variation	coefficent.de.variation1
var1	24000	6926406	288.6003	1040.740	1040.719	3.606166	3.606091
var2	24000	13490715	562.1131	1053.103	1053.081	1.873471	1.873432
var3	24000	20417121	850.7134	1519.404	1519.372	1.786035	1.785998

##mise en œuvre d'un plan de sondage stratifié

```r
 zoneUnique=unique(donnees$ZONE);zoneUnique

## [1] "AA" "DD" "BB" "CC"

#Par zone pour ls variables
ZoneAA=subset(donnees,donnees$ZONE=="AA")
ZoneBB=subset(donnees,donnees$ZONE=="BB")
ZoneCC=subset(donnees,donnees$ZONE=="CC")
ZoneDD=subset(donnees,donnees$ZONE=="DD")

#effectifs des valeurs
```

```
Nh1=length(ZoneAA$PAYS)
Nh2=length(ZoneBB$PAYS)
Nh3=length(ZoneCC$PAYS)
Nh4=length(ZoneDD$PAYS)

#sommes par zone
SomAA=c(tapply(ZoneAA$VAR1,ZoneAA$ZONE,
sum),tapply(ZoneAA$VAR2,ZoneAA$ZONE,sum),tapply(ZoneAA$VAR3,ZoneAA$ZONE,sum))
SomBB=c(tapply(ZoneBB$VAR1,ZoneBB$ZONE,
sum),tapply(ZoneBB$VAR2,ZoneBB$ZONE,sum),tapply(ZoneBB$VAR3,ZoneBB$ZONE,sum))
SomCC=c(tapply(ZoneCC$VAR1,ZoneCC$ZONE,
sum),tapply(ZoneCC$VAR2,ZoneCC$ZONE,sum),tapply(ZoneCC$VAR3,ZoneCC$ZONE,sum))
SomDD=c(tapply(ZoneDD$VAR1,ZoneDD$ZONE,
sum),tapply(ZoneDD$VAR2,ZoneDD$ZONE,sum),tapply(ZoneDD$VAR3,ZoneDD$ZONE,sum))

#la moyenne
MoyAA=c(tapply(ZoneAA$VAR1,ZoneAA$ZONE,
mean),tapply(ZoneAA$VAR2,ZoneAA$ZONE,mean),tapply(ZoneAA$VAR3,ZoneAA$ZONE,mea
n))
MoyBB=c(tapply(ZoneBB$VAR1,ZoneBB$ZONE,
mean),tapply(ZoneBB$VAR2,ZoneBB$ZONE,mean),tapply(ZoneBB$VAR3,ZoneBB$ZONE,mea
n))
MoyCC=c(tapply(ZoneCC$VAR1,ZoneCC$ZONE,
mean),tapply(ZoneCC$VAR2,ZoneCC$ZONE,mean),tapply(ZoneCC$VAR3,ZoneCC$ZONE,mea
n))
MoyDD=c(tapply(ZoneDD$VAR1,ZoneDD$ZONE,
mean),tapply(ZoneDD$VAR2,ZoneDD$ZONE,mean),tapply(ZoneDD$VAR3,ZoneDD$ZONE,mea
n))

#l’écart - type corrigé
EcAA=c(tapply(ZoneAA$VAR1,ZoneAA$ZONE,
sd),tapply(ZoneAA$VAR2,ZoneAA$ZONE,sd),tapply(ZoneAA$VAR3,ZoneAA$ZONE,sd))
EcBB=c(tapply(ZoneBB$VAR1,ZoneBB$ZONE,
sd),tapply(ZoneBB$VAR2,ZoneBB$ZONE,sd),tapply(ZoneBB$VAR3,ZoneBB$ZONE,sd))
EcCC=c(tapply(ZoneCC$VAR1,ZoneCC$ZONE,
sd),tapply(ZoneCC$VAR2,ZoneCC$ZONE,sd),tapply(ZoneCC$VAR3,ZoneCC$ZONE,sd))
EcDD=c(tapply(ZoneDD$VAR1,ZoneDD$ZONE,
sd),tapply(ZoneDD$VAR2,ZoneDD$ZONE,sd),tapply(ZoneDD$VAR3,ZoneDD$ZONE,sd))

#l'ecart type

EcAA1=EcAA*sqrt((Nh1-1)/Nh1)
EcBB1=EcBB*sqrt((Nh2-1)/Nh2)
EcCC1=EcCC*sqrt((Nh3-1)/Nh3)
EcDD1=EcDD*sqrt((Nh4-1)/Nh4)

#coefficient de variation par zone
CvAA=EcAA/MoyAA
CvBB=EcBB/MoyBB
```

```
CvCC=EcCC/MoyCC
CvDD=EcDD/MoyDD

#cofficient de variation par zone
CvAA1=EcAA1/MoyAA
CvBB1=EcBB1/MoyBB
CvCC1=EcCC1/MoyCC
CvDD1=EcDD1/MoyDD


ZoneAA=data.frame("Nh"=Nh1,"Somme"=SomAA,"Moyenne"=MoyAA,"ecart
type"=EcAA,"ecart type1"=EcAA1,"Coefficient de Variation"=CvAA,"Coefficient
de Variation"=CvAA1); row.names(ZoneAA)=c("Var1","Var2","Var3")
kable(ZoneAA)
```

	Nh	Somme	Moyenne	ecart.type	ecart.type1	Coefficient.de.Variation	Coefficient.de.Variation.1
Var1	4247	2888103	680.0337	1542.372	1542.19	2.268081	2.267814
Var2	4247	2319580	546.1691	1111.961	1111.83	2.035928	2.035689
Var3	4247	5207683	1226.2027	1992.834	1992.60	1.625208	1.625016

```
ZoneBB=data.frame("Nh"=Nh2,"Somme"=SomBB,"Moyenne"=MoyBB,"ecart
type"=EcBB,"ecart type1"=EcBB1,"Coefficient de Variation"=CvBB,"Coefficient
de Variation"=CvBB1);row.names(ZoneBB)=c("Var1","Var2","Var3")

kable(ZoneBB)
```

	Nh	Somme	Moyenne	ecart.type	ecart.type1	Coefficient.de.Variation	Coefficient.de.Variation.1
Var1	7092	1323074	186.5587	808.4664	808.4094	4.333577	4.333272
Var2	7092	3854650	543.5209	969.8111	969.7428	1.784313	1.784187
Var3	7092	5177724	730.0795	1287.5100	1287.4192	1.763520	1.763396

```
ZoneCC=data.frame("Nh"=Nh3,"Somme"=SomCC,"Moyenne"=MoyCC,"ecart
type"=EcCC,"ecart type1"=EcCC1,"Coefficient de Variation"=CvCC,"Coefficient
de Variation"=CvCC1);row.names(ZoneCC)=c("Var1","Var2","Var3")

kable(ZoneCC)
```

	Nh	Somme	Moyenne	ecart.type	ecart.type1	Coefficient.de.Variation	Coefficient.de.Variation.1

Var1	7921	943754	119.1458	550.2208	550.1861	4.618046	4.617754
Var2	7921	473886	598.2660	1100.1207	1100.0513	1.838849	1.838733
Var3	7921	568261	717.4118	1323.7112	1323.6277	1.845120	1.845004

```
ZoneDD=data.frame("Nh"=Nh4,"Somme"=SomDD,"Moyenne"=MoyDD,"ecart
type"=EcDD,"ecart type1"=EcDD1,"Coefficient de Variation"=CvDD,"Coefficient
de Variation"=CvDD1);row.names(ZoneDD)=c("Var1","Var2","Var3")

kable(ZoneDD)
```

	Nh	Somme	Moyenne	ecart.type	ecart.type1	Coefficient.de.Variation	Coefficient.de.Variation.1
Var1	4740	1771475	373.7289	1289.048	1288.912	3.449153	3.448789
Var2	4740	2577620	543.8017	1036.921	1036.812	1.906800	1.906599
Var3	4740	4349095	917.5306	1594.280	1594.112	1.737577	1.737394

#Question 2 – mise en œuvre d'un plan de sondage stratifié

```
N=length(donnees$PAYS)
n=600
#Strate1
strate1AA=subset(donnees[,-c(3,4)],donnees$ZONE=="AA" & donnees$VAR3<100)
strate1BB=subset(donnees[,-c(3,4)],donnees$ZONE=="BB" & donnees$VAR3<100)
strate1CC=subset(donnees[,-c(3,4)],donnees$ZONE=="CC" & donnees$VAR3<100)
strate1DD=subset(donnees[,-c(3,4)],donnees$ZONE=="DD" & donnees$VAR3<100)

#Strate2
strate2AA=subset(donnees[,-c(3,4)],donnees$ZONE=="AA" & donnees$VAR3>=100 &
donnees$VAR3<500)
strate2BB=subset(donnees[,-c(3,4)],donnees$ZONE=="BB" & donnees$VAR3>=100 &
donnees$VAR3<500)
strate2CC=subset(donnees[,-c(3,4)],donnees$ZONE=="CC" & donnees$VAR3>=100 &
donnees$VAR3<500)
strate2DD=subset(donnees[,-c(3,4)],donnees$ZONE=="DD" & donnees$VAR3>=100 &
donnees$VAR3<500)

#strate3
strate3AA=subset(donnees[,-c(3,4)],donnees$ZONE=="AA" & donnees$VAR3>=500 &
donnees$VAR3<1000)
strate3BB=subset(donnees[,-c(3,4)],donnees$ZONE=="BB" & donnees$VAR3>=500 &
donnees$VAR3<1000)
strate3CC=subset(donnees[,-c(3,4)],donnees$ZONE=="CC" & donnees$VAR3>=500 &
```

```
donnees$VAR3<1000)
strate3DD=subset(donnees[,-c(3,4)],donnees$ZONE=="DD" & donnees$VAR3>=500 &
donnees$VAR3<1000)

#strate4
strate4AA=subset(donnees[,-c(3,4)],donnees$ZONE=="AA" & donnees$VAR3>=1000 &
donnees$VAR3<2000)
strate4BB=subset(donnees[,-c(3,4)],donnees$ZONE=="BB" & donnees$VAR3>=1000 &
donnees$VAR3<2000)
strate4CC=subset(donnees[,-c(3,4)],donnees$ZONE=="CC" & donnees$VAR3>=1000 &
donnees$VAR3<2000)
strate4DD=subset(donnees[,-c(3,4)],donnees$ZONE=="DD" & donnees$VAR3>=1000 &
donnees$VAR3<2000)

#strate5
strate5AA=subset(donnees[,-c(3,4)],donnees$ZONE=="AA" & donnees$VAR3>=2000 &
donnees$VAR3<10000)
strate5BB=subset(donnees[,-c(3,4)],donnees$ZONE=="BB" & donnees$VAR3>=2000 &
donnees$VAR3<10000)
strate5CC=subset(donnees[,-c(3,4)],donnees$ZONE=="CC" & donnees$VAR3>=2000 &
donnees$VAR3<10000)
strate5DD=subset(donnees[,-c(3,4)],donnees$ZONE=="DD" & donnees$VAR3>=2000 &
donnees$VAR3<10000)

#strate6
strate6AA=subset(donnees[,-c(3,4)],donnees$ZONE=="AA" & donnees$VAR3>=10000)
strate6BB=subset(donnees[,-c(3,4)],donnees$ZONE=="BB" & donnees$VAR3>=10000)
strate6CC=subset(donnees[,-c(3,4)],donnees$ZONE=="CC" & donnees$VAR3>=10000)
strate6DD=subset(donnees[,-c(3,4)],donnees$ZONE=="DD" & donnees$VAR3>=10000)
```

#TZoneAA

```
#fonction
shh=function(x){ nn=length(x)-1;yhn=mean(x);eca=((x-yhn)^2);return
(sqrt((1/nn)*sum(eca)))}

#zone AA
strate=c("AA1","AA2","AA3","AA4","AA5","AA6")

Nh1=c(length(strate1AA$VAR3),length(strate2AA$VAR3),length(strate3AA$VAR3),le
ngth(strate4AA$VAR3),length(strate5AA$VAR3),length(strate6AA$VAR3))

moy=c(mean(strate1AA$VAR3),mean(strate2AA$VAR3),mean(strate3AA$VAR3),mean(str
ate4AA$VAR3),mean(strate5AA$VAR3),mean(strate6AA$VAR3))

Somme=c(sum(strate1AA$VAR3),sum(strate2AA$VAR3),sum(strate3AA$VAR3),sum(strat
e4AA$VAR3),sum(strate5AA$VAR3),sum(strate6AA$VAR3))

Sh=c(shh(strate1AA$VAR3),shh(strate2AA$VAR3),shh(strate3AA$VAR3),shh(strate4A
A$VAR3),shh(strate5AA$VAR3),shh(strate6AA$VAR3))
```

```
nhAp=Nh1*n/N;nhAp=round(nhAp,0)

TzoneAA=data.frame("strate"=strate,"Nh"=Nh1,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)
```

#TzoneBB

```
strate=c("BB1","BB2","BB3","BB4","BB5","BB6")

Nh2=c(length(strate1BB$VAR3),length(strate2BB$VAR3),length(strate3BB$VAR3),le
ngth(strate4BB$VAR3),length(strate5BB$VAR3),length(strate6BB$VAR3))

moy=c(mean(strate1BB$VAR3),mean(strate2BB$VAR3),mean(strate3BB$VAR3),mean(str
ate4BB$VAR3),mean(strate5BB$VAR3),mean(strate6BB$VAR3))

Somme=c(sum(strate1BB$VAR3),sum(strate2BB$VAR3),sum(strate3BB$VAR3),sum(strat
e4BB$VAR3),sum(strate5BB$VAR3),sum(strate6BB$VAR3))

Sh=c(shh(strate1BB$VAR3),shh(strate2BB$VAR3),shh(strate3BB$VAR3),shh(strate4B
B$VAR3),shh(strate5BB$VAR3),shh(strate6BB$VAR3))


nhAp=Nh2*(n/N);nhAp=round(nhAp,0)


TzoneBB=data.frame("strate"=strate,"Nh"=Nh2,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp )
```

#TzoneCC

```
strate=c("CC1","CC2","CC3","CC4","CC5","CC6")

Nh3=c(length(strate1CC$VAR3),length(strate2CC$VAR3),length(strate3CC$VAR3),le
ngth(strate4CC$VAR3),length(strate5CC$VAR3),length(strate6CC$VAR3))

Somme=c(sum(strate1CC$VAR3),sum(strate2CC$VAR3),sum(strate3CC$VAR3),sum(strat
e4CC$VAR3),sum(strate5CC$VAR3),sum(strate6CC$VAR3))

moy=c(mean(strate1CC$VAR3),mean(strate2CC$VAR3),mean(strate3CC$VAR3),mean(str
ate4CC$VAR3),mean(strate5CC$VAR3),mean(strate6CC$VAR3))


Sh=c(shh(strate1CC$VAR3),shh(strate2CC$VAR3),shh(strate3CC$VAR3),shh(strate4C
C$VAR3),shh(strate5CC$VAR3),shh(strate6CC$VAR3))


nhAp=Nh3*(n/N);nhAp=round(nhAp,0)
```

```
TzoneCC=data.frame("strate"=strate,"Nh"=Nh3,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)
```

#TzoneDD

```
strate=c("DD1","DD2","DD3","DD4","DD5","DD6")

Nh4=c(length(strate1DD$VAR3),length(strate2DD$VAR3),length(strate3DD$VAR3),le
ngth(strate4DD$VAR3),length(strate5DD$VAR3),length(strate6DD$VAR3))

Somme=c(sum(strate1DD$VAR3),sum(strate2DD$VAR3),sum(strate3DD$VAR3),sum(strat
e4DD$VAR3),sum(strate5DD$VAR3),sum(strate6DD$VAR3))

moy=c(mean(strate1DD$VAR3),mean(strate2DD$VAR3),mean(strate3DD$VAR3),mean(str
ate4DD$VAR3),mean(strate5DD$VAR3),mean(strate6DD$VAR3))

Sh=c(shh(strate1DD$VAR3),shh(strate2DD$VAR3),shh(strate3DD$VAR3),shh(strate4D
D$VAR3),shh(strate5DD$VAR3),shh(strate6DD$VAR3))


nhAp=Nh4*(n/N);nhAp=round(nhAp,0)


TzoneDD=data.frame("strate"=strate,"Nh"=Nh4,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)
```

#fusion des tableaux

```
tb=rbind(TzoneAA,TzoneBB,TzoneCC,TzoneDD)

  sum(tb[,2])

## [1] 24000


NhSh=c(tb[,2]*tb[,5]);nhNey=(NhSh*n)/sum(NhSh);sum(nhNey);nhNey=round(nhNey,0
);sum(nhNey)

## [1] 600

## [1] 600

  nhAp1=(tb[,2]*n)/N; sum(nhAp1);sum(nhAp1)

## [1] 600

## [1] 600
```

```r
tb=cbind(rbind(TzoneAA,TzoneBB,TzoneCC,TzoneDD),data.frame(nhAp1,NhSh,nhNey))


#Totaux

Total=c(length(tb[,1]),sum(tb[,2]),sum(tb[,3]),sum(tb[,4]),sum(tb[,6]),sum(tb
[,7]),sum(tb[,9]))

tb11=cbind(tb,data.frame(nhAp1))



kable(tb)
```

strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
AA1	1139	42687	37.47761	29.33289	28	28.475	33410.16	3
AA2	1056	261081	247.23580	113.79350	26	26.400	120165.94	10
AA3	574	414591	722.28397	146.97068	14	14.350	84361.17	7
AA4	643	937863	1458.57387	289.99918	16	16.075	186469.47	15
AA5	806	3135493	3890.18983	1778.18925	20	20.150	1433220.54	116
AA6	29	415968	14343.72414	5085.22784	1	0.725	147471.61	12
BB1	2083	98688	47.37782	27.46534	52	52.075	57210.30	5
BB2	2339	558996	238.98931	111.39838	58	58.475	260560.82	21
BB3	1047	763267	729.00382	147.57801	26	26.175	154514.18	13
BB4	1008	1418325	1407.06845	278.04061	25	25.200	280264.93	23
BB5	588	1994704	3392.35374	1493.57071	15	14.700	878219.58	71
BB6	27	343744	12731.25926	3166.51804	1	0.675	85495.99	7
CC1	2448	109545	44.74877	28.19051	61	61.200	69010.36	6

CC2	2630	623705	237.15019	109.70829	66	65.750	288532.80	23
CC3	1150	831723	723.23739	144.24295	29	28.750	165879.39	13
CC4	1019	142114 7	1394.64868	277.86066	25	25.475	283140.01	23
CC5	655	242743 5	3706.00763	1739.0756 4	16	16.375	1139094.5 4	92
CC6	19	269064	14161.2631 6	4065.6370 5	0	0.475	77247.10	6
DD1	1323	62001	46.86395	27.59864	33	33.075	36513.00	3
DD2	1452	341527	235.21143	108.92908	36	36.300	158165.03	13
DD3	676	487829	721.64053	143.85679	17	16.900	97247.19	8
DD4	655	934106	1426.11603	278.28128	16	16.375	182274.24	15
DD5	617	228795 7	3708.19611	1733.2826 9	15	15.425	1069435.4 2	87
DD6	17	235675	13863.2352 9	6038.3275 2	0	0.425	102651.57	8

```
kable(tb[1:6,])
```

strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
AA1	1139	42687	37.47761	29.33289	28	28.475	33410.16	3
AA2	1056	261081	247.23580	113.79350	26	26.400	120165.94	10
AA3	574	414591	722.28397	146.97068	14	14.350	84361.17	7
AA4	643	937863	1458.57387	289.99918	16	16.075	186469.47	15
AA5	806	313549 3	3890.18983	1778.1892 5	20	20.150	1433220.5 4	116
AA6	29	415968	14343.7241 4	5085.2278 4	1	0.725	147471.61	12

```
kable(tb[7:12,])
```

strat	Nh	Total	Moyenne	Sh	nhA	nhAp	NhSh	nhNe

	e					p	1		y
7	BB1	2083	98688	47.37782	27.46534	52	52.075	57210.30	5
8	BB2	2339	558996	238.98931	111.39838	58	58.475	260560.82	21
9	BB3	1047	763267	729.00382	147.57801	26	26.175	154514.18	13
10	BB4	1008	141832 5	1407.06845	278.04061	25	25.200	280264.93	23
11	BB5	588	199470 4	3392.35374	1493.5707 1	15	14.700	878219.58	71
12	BB6	27	343744	12731.2592 6	3166.5180 4	1	0.675	85495.99	7

```
kable(tb[13:18,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
13	CC1	2448	109545	44.74877	28.19051	61	61.200	69010.36	6
14	CC2	2630	623705	237.15019	109.70829	66	65.750	288532.80	23
15	CC3	1150	831723	723.23739	144.24295	29	28.750	165879.39	13
16	CC4	1019	142114 7	1394.64868	277.86066	25	25.475	283140.01	23
17	CC5	655	242743 5	3706.00763	1739.0756 4	16	16.375	1139094.54	92
18	CC6	19	269064	14161.2631 6	4065.6370 5	0	0.475	77247.10	6

```
kable(tb[19:24,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
19	DD1	1323	62001	46.86395	27.59864	33	33.075	36513.00	3
20	DD2	1452	341527	235.21143	108.9290 8	36	36.300	158165.03	13
21	DD3	676	487829	721.64053	143.8567 9	17	16.900	97247.19	8
22	DD4	655	934106	1426.1160 3	278.2812 8	16	16.375	182274.24	15

23	DD5	617	2287957	3708.19611	1733.28269	15	15.425	1069435.42	87
24	DD6	17	235675	13863.23529	6038.32752	0	0.425	102651.57	8
#pres	icionrel	ative,	allocatio	n porportionne	lle				

```
#Precision relative de l'ensemble de zones
##Estimation de la moyenne et total au sein de l'echantion par allocation porportionnelle
MoySt=sum(tb[,3])/N;MoySt
```

```
## [1] 850.7134
```

```
mean(donnees$VAR3)
```

```
## [1] 850.7134
```

```
T=sum(tb[,3])
#Estimateur de variance de la moyenne

varianceStratifie=function(nhpetit,grandNh,Sh,N){
  cmp1=(grandNh*grandNh)/(N*N)
  cmp2=1-(nhpetit/grandNh)
  cmp3=(Sh * Sh)/nhpetit
  cmp=cmp1*cmp2*cmp3
  return(sum(cmp))
}

varianceT=function(nhpetit,grandNh,Sh){
  cmp1=(grandNh*grandNh * Sh *Sh)/(nhpetit)
  cmp2=(Sh * Sh * grandNh)
  cmp=cmp1- cmp2
  return(sum(cmp))
}


varianceStr=varianceStratifie(tb[,7],tb[,2],tb[,5],N);varianceStr
```

```
## [1] 682.5666
```

```
varianceTot=varianceT(tb[,7],tb[,2],tb[,5]);varianceTot
```

```
## [1] 393158360599
```

```
#precision relative
precisionRelative1=(sqrt(varianceStr)/MoySt)*100;precisionRelative1
```

```
## [1] 3.071067
```

```
precisionRelative2=(sqrt(varianceTot)/T)*100;precisionRelative2

## [1] 3.071067

TabloPrecisionAP=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative"=precisionRelative1)

kable(TabloPrecisionAP)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative
850.7134	682.5666	3.071067

#precision relative , allocation optimale

```
##Estimation de la moyenne et total au sein de l'echantion par allocation
porportionnelle
MoySt=sum(tb[,3])/N;MoySt

## [1] 850.7134

mean(donnees$VAR3)

## [1] 850.7134

#variance
varianceStr=varianceStratifie(tb[,9],tb[,2],tb[,5],N)


#precision relative
precisionRelative1=(sqrt(varianceStr)/MoySt)*100;precisionRelative1

## [1] 1.393772

TabloPrecisionOP=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative"=precisionRelative1)



kable(TabloPrecisionOP)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative
850.7134	140.5886	1.393772

#Precision par zoneAA

```
##Estimation de la moyenne et total au sein de l'echantion par allocation
porportionnelle
MoySt=sum(tb[1:6,3])/sum(Nh1);MoySt

## [1] 1226.203
```

```
#variance et Precision relative et precision relative  allocation proportionnelle
varianceStr=varianceStratifie(tb[1:6,7],tb[1:6,2],tb[1:6,5],sum(Nh1));varianceStr

## [1] 7307.427

precisionRelative1=(sqrt(varianceStr)/(sum(tb[1:6,4])/6))*100;precisionRelative1

## [1] 2.477844

##Estimation et precision relative  de l'echantion par allocation Optimale
varianceStr=varianceStratifie(tb[1:6,9],tb[1:6,2],tb[1:6,5],sum(Nh1))
precisionRelative11=(sqrt(varianceStr)/MoySt)*100;precisionRelative11

## [1] 2.801937

TPrecisionZoneAA=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=varianceStr,"Precision Relative AP"=precisionRelative1,"Precision Relative OP"=precisionRelative11)

kable(TPrecisionZoneAA)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative.AP	Precision.Relative.OP
1226.203	1180.433	2.477844	2.801937

#Precision pour BB

```
##Estimation de la moyenne et total au sein de l'echantion par allocation porportionnelle
MoySt=sum(tb[7:12,3])/sum(tb[7:12,2]);MoySt

## [1] 730.0795

#variance et Precision relative et precision relative  allocation proportionnelle
varianceStr=varianceStratifie(tb[7:12,7],tb[7:12,2],tb[7:12,5],sum(tb[7:12,2]));varianceStr

## [1] 1328.833

precisionRelative1=(sqrt(varianceStr)/(sum(tb[7:12,4])/6))*100;precisionRelative1

## [1] 1.179329

##Estimation et precision relative  de l'echantion par allocation Optimale
varianceStr=varianceStratifie(tb[7:12,9],tb[7:12,2],tb[7:12,5],sum(tb[7:12,2]))
precisionRelative11=(sqrt(varianceStr)/MoySt)*100;precisionRelative11

## [1] 2.685387
```

```
TPrecisionZoneBB=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative AP"=precisionRelative1,"Precision Relative
OP"=precisionRelative11)

kable(TPrecisionZoneBB)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative.AP	Precision.Relative.OP
730.0795	384.374	1.179329	2.685387

#Precision zone CC

```
##Estimation de la moyenne et total au sein de l'echantion par allocation
porportionnelle
MoySt=sum(tb[13:18,3])/sum(tb[13:18,2]);MoySt

## [1] 717.4118

#variance et Precision relative et precision relative  allocation
proportionnelle
varianceStr=varianceStratifie(tb[13:18,7],tb[13:18,2],tb[13:18,5],sum(tb[13:1
8,2]));varianceStr

## [1] 1511.231

precisionRelative1=(sqrt(varianceStr)/(sum(tb[13:18,4])/6))*100;precisionRela
tive1

## [1] 1.150869

##Estimation et precision relative  de l'echantion par allocation Optimale
varianceStr=varianceStratifie(tb[13:18,9],tb[13:18,2],tb[13:18,5],sum(tb[13:1
8,2]))
precisionRelative11=(sqrt(varianceStr)/MoySt)*100;precisionRelative11

## [1] 2.650311

TPrecisionZoneCC=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative AP"=precisionRelative1,"Precision Relative
OP"=precisionRelative11)

kable(TPrecisionZoneCC)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative.AP	Precision.Relative.OP
717.4118	361.5186	1.150869	2.650311

#Precision ZoneD

```
##Estimation de la moyenne et total au sein de l'echantion par allocation
porportionnelle
MoySt=sum(tb[19:24,3])/sum(tb[19:24,2]);MoySt

## [1] 917.5306
```

```r
#variance et Precision relative et precision relative  allocation proportionnelle
varianceStr=varianceStratifie(tb[19:24,7],tb[19:24,2],tb[19:24,5],sum(tb[19:24,2]));varianceStr
```

```
## [1] 4437.531
```

```r
precisionRelative1=(sqrt(varianceStr)/(sum(tb[19:24,4])/6))*100;precisionRelative1
```

```
## [1] 1.998318
```

```r
##Estimation et precision relative  de l'echantion par allocation Optimale
varianceStr=varianceStratifie(tb[19:24,9],tb[19:24,2],tb[19:24,5],sum(tb[19:24,2]))
precisionRelative11=(sqrt(varianceStr)/MoySt)*100;precisionRelative11
```

```
## [1] 3.056672
```

```r
TPrecisionZoneDD=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=varianceStr,"Precision Relative AP"=precisionRelative1,"Precision Relative OP"=precisionRelative11)

kable(TPrecisionZoneDD)
```

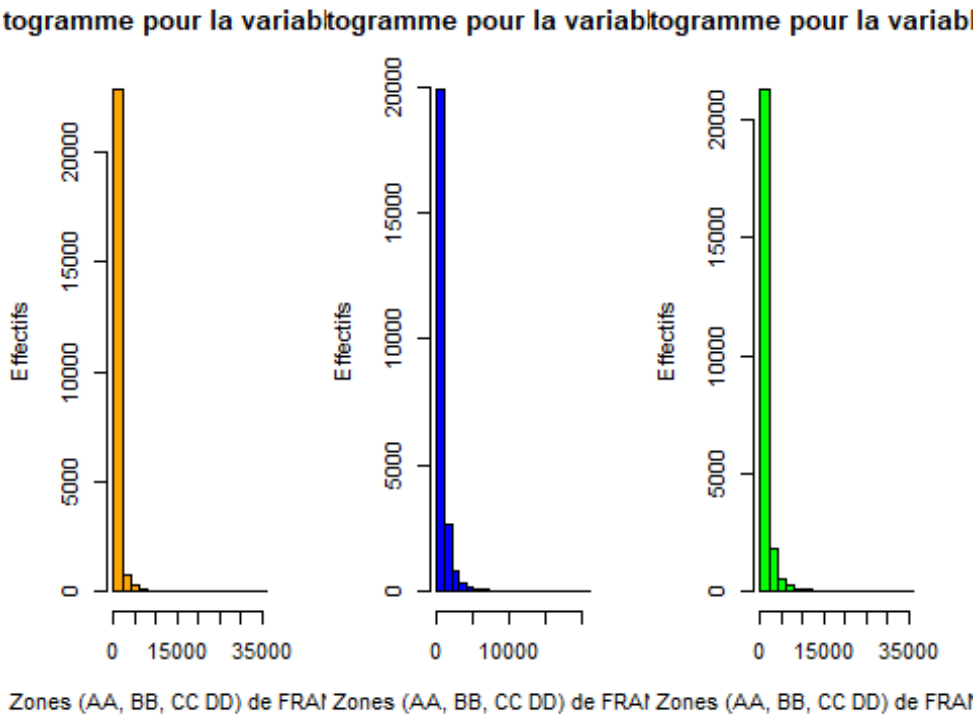
moyenneStrate	VarianceMoyenneStratifié	Precision.Relative.AP	Precision.Relative.OP
917.5306	786.5727	1.998318	3.056672

```r
#Fusion des tableaux
tbPr=rbind(TPrecisionZoneAA,TPrecisionZoneBB,TPrecisionZoneCC,TPrecisionZoneDD)
row.names(tbPr)=c("ZoneAAPrecision","ZoneBBPrecision","ZoneCCPrecision","ZoneDDPrecision")




kable(tbPr)
```

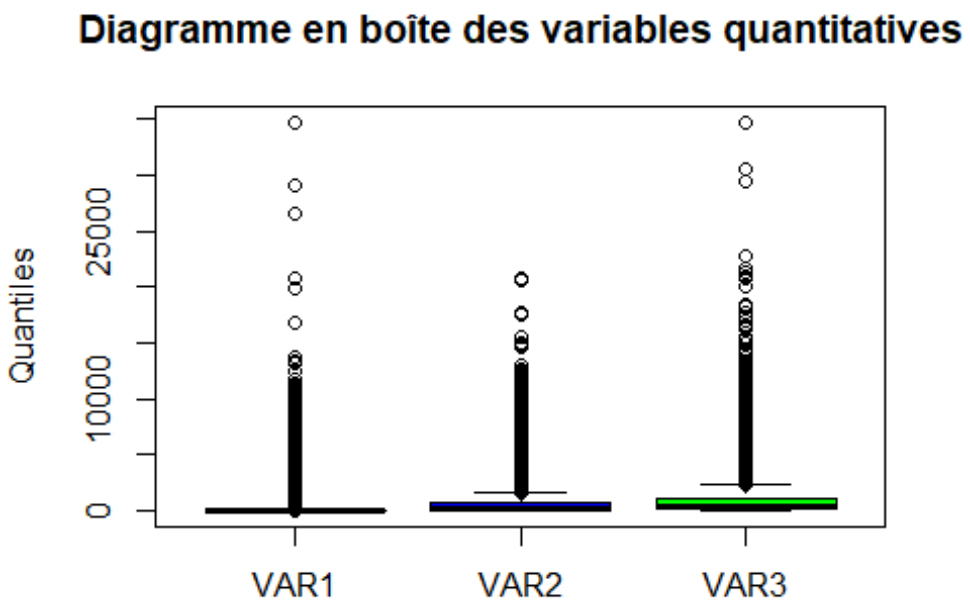
	moyenneStrate	VarianceMoyenneStratifié	Precision.Relative.AP	Precision.Relative.OP
ZoneAAPrecision	1226.2027	1180.4330	2.477844	2.801937
ZoneBBPrecision	730.0795	384.3740	1.179329	2.685387
ZoneCCPrecision	717.4118	361.5186	1.150869	2.650311
ZoneDDPrecision	917.5306	786.5727	1.998318	3.056672

#graphiques

```
X11()
par(mfrow=c(1,3))
#les donnees quantitatives
hist(donnees$VAR1, col = c("orange"),main = paste("Histogramme pour la
variable Var1"),ylab = "Effectifs",xlab = "Zones (AA, BB, CC DD) de FRANCE ")

hist(donnees$VAR2, col = c("blue"),main = paste("Histogramme pour la variable
Var2"),ylab = "Effectifs",xlab = "Zones (AA, BB, CC DD) de FRANCE ")

hist(donnees$VAR3, col = c("green"),main = paste("Histogramme pour la
variable Var3"),ylab = "Effectifs",xlab = "Zones (AA, BB, CC DD) de FRANCE ")
```

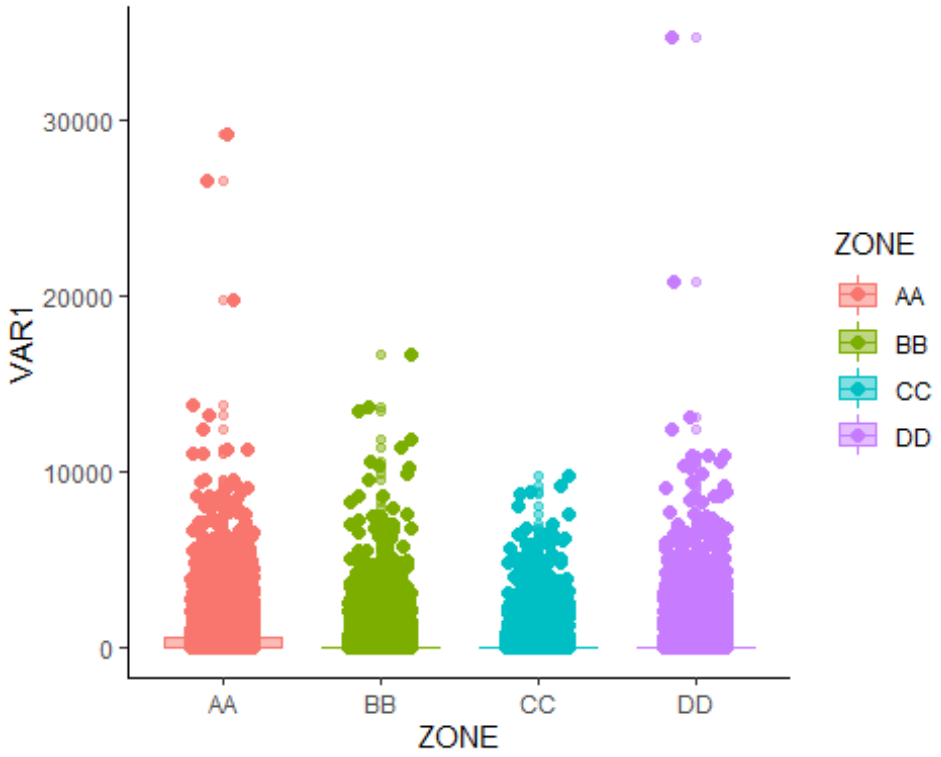



```
X11()

boxplot(donnees[,c("VAR1","VAR2","VAR3")],col = c("yellow","blue","green"),
main = paste("Diagramme en boîte des variables quantitatives"), ylab =
"Quantiles")
```



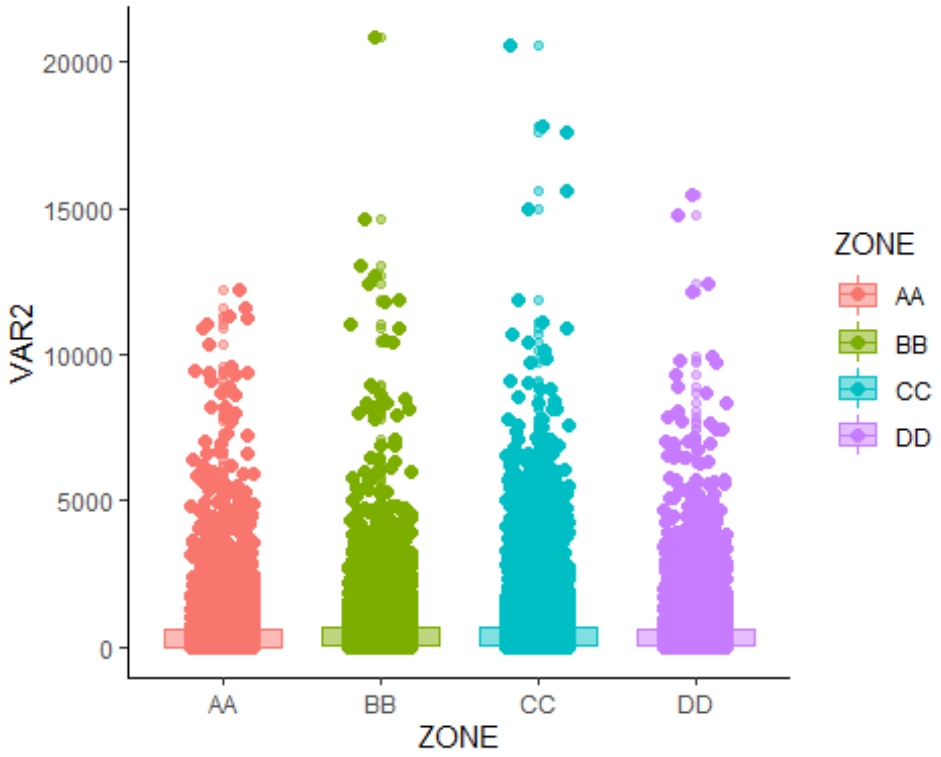

```r
#Zone AA

X11()
par(mfrow=c(1,3))

AA=donnees[donnees[,2]=="AA",]

boxplot(AA[,c("VAR1","VAR2","VAR3")],col = c("yellow","blue","green","light
blue"), main = paste("Boite de moustaches des variables quantitatives / Zone
AA"), ylab = "Quantiles")


#Zone BB

X11()
par(mfrow=c(1,3))

BB=donnees[donnees[,2]=="BB",]

boxplot(BB[,c("VAR1","VAR2","VAR3")],col = c("yellow","blue","green","light
blue"), main = paste("Boite de moustaches des variables quantitatives / Zone
BB"), ylab = "Quantiles")


#Zone CC
```

```r
X11()
par(mfrow=c(1,3))

CC=donnees[donnees[,2]=="CC",]

boxplot(CC[,c("VAR1","VAR2","VAR3")],col = c("yellow","blue","green","light
blue"), main = paste("Boite de moustaches des variables quantitatives / Zone
CC"), ylab = "Quantiles")

#Zone DD

X11()
par(mfrow=c(1,3))

DD=donnees[donnees[,2]=="CC",]

boxplot(DD[,c("VAR1","VAR2","VAR3")],col = c("yellow","blue","green","light
blue"), main = paste("Boite de moustaches des variables quantitatives / Zone
DD"), ylab = "Quantiles")

#zone

barplot(table(as.factor(donnees$ZONE)), main="Répartition des populations par
Zones",xlab="Zones",col="orange")



X11()
par(mfrow=c(1,3))
 ggplot(donnees, aes(x=ZONE, y=VAR1, colour=ZONE, fill=ZONE))+
        geom_point(position=position_jitterdodge(dodge.width=0.7), size=2) +
        geom_boxplot(alpha=0.5, position = position_dodge(width=0.8),
fatten=NULL)+
        theme_classic()

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).
```

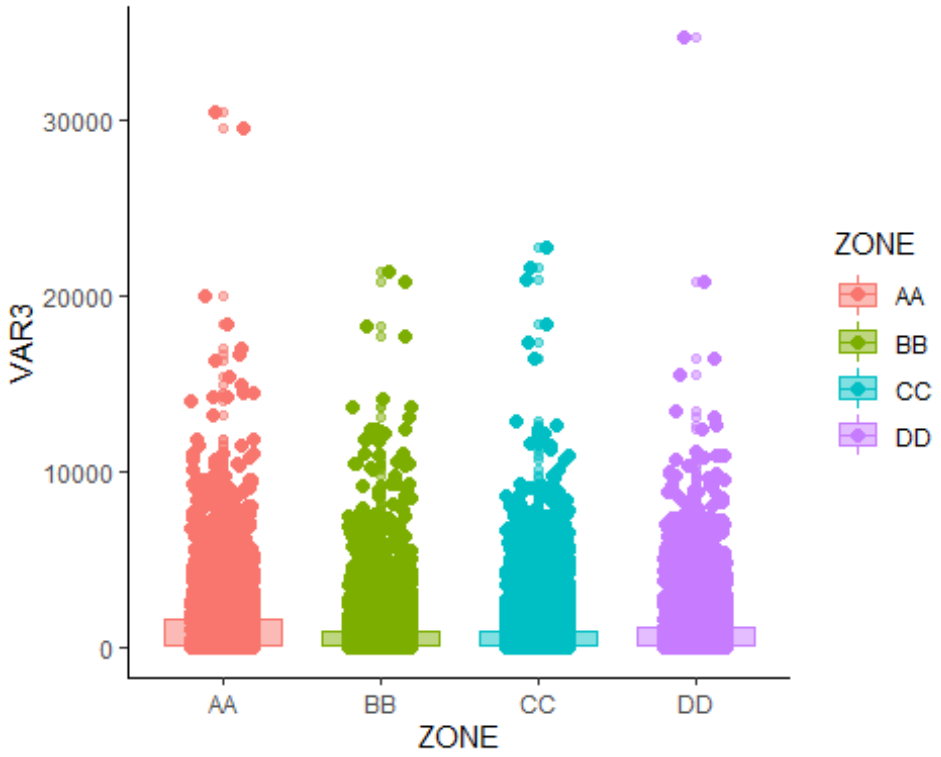



```
X11()
ggplot(donnees, aes(x=ZONE, y=VAR2, colour=ZONE, fill=ZONE))+
       geom_point(position=position_jitterdodge(dodge.width=0.7), size=2) +
       geom_boxplot(alpha=0.5, position = position_dodge(width=0.8),
fatten=NULL)+
       theme_classic()
```

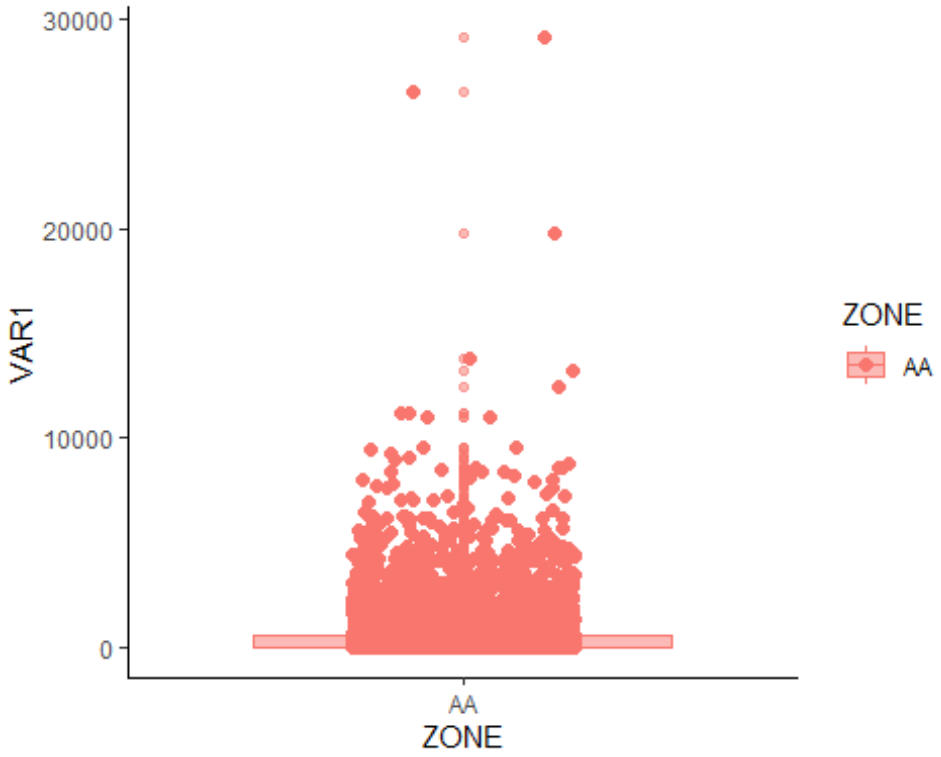
```
## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).
```




```
 X11()
ggplot(donnees, aes(x=ZONE, y=VAR3, colour=ZONE, fill=ZONE))+
        geom_point(position=position_jitterdodge(dodge.width=0.7), size=2) +
        geom_boxplot(alpha=0.5, position = position_dodge(width=0.8),
fatten=NULL)+
        theme_classic()

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).

## Warning: Removed 1 rows containing missing values (geom_segment).
```




```
 X11()
ggplot(AA, aes(x=ZONE, y=VAR1,, colour=ZONE, fill=ZONE))+
        geom_point(position=position_jitterdodge(dodge.width=0.7), size=2) +
        geom_boxplot(alpha=0.5, position = position_dodge(width=0.8),
fatten=NULL)+
        theme_classic()

## Warning: Removed 1 rows containing missing values (geom_segment).
```



#Complemntaire

```
#allocation proportionnelle

MoySt=sum(tb[,3])/N;MoySt

## [1] 850.7134

mean(donnees$VAR3)

## [1] 850.7134

T=sum(tb[,3])



#allocation proportionnelle nAP
calnAP=function(k,grandNh,Sh,N,MoyenneX){
  cmp1= N * sum((grandNh*Sh*Sh))
  cmp2=(k*N*MoyenneX)*(k*N*MoyenneX)
  cmp3=sum(Sh * Sh * grandNh)
  cmp=cmp1/(cmp2 + cmp3)
  return(cmp)
}



nAP=calnAP(2/100,tb[,2],tb[,5],N,MoySt);nAP; sum(nAP)
```

```
## [1] 1368.27
```

```
## [1] 1368.27
```

```
#allocation de Neymar

calnNey=function(k,grandNh,Sh,N,MoyenneX){
  cmp1= sum(grandNh*Sh) * sum(grandNh*Sh)
  cmp2=(k*N*MoyenneX)*(k*N*MoyenneX)
  cmp3=sum(Sh * Sh * grandNh)
  cmp=cmp1/(cmp2 + cmp3)
  return(cmp)
}

nNey=calnNey(2/100,tb[,2],tb[,5],N,MoySt);nNey; sum(nNey)
```

```
## [1] 308.8956
```

```
## [1] 308.8956
```

```
calN=data.frame("nombre de strate"=24,"K"=2/100,"nAP"=nAP,"nAP
arrondi"=round(nAP,0),"nNey"=nNey,"nNey arrondi"=round(nNey,0))

kable(calN)
```

nombre.de.strate	K	nAP	nAP.arrondi	nNey	nNey.arrondi
24	0.02	1368.27	1368	308.8956	309

```
#par strate

## allocation proportionnelle

calNhStAP=function(k,grandNh,Sh,T){
  cmp1=(grandNh*grandNh * Sh *Sh)
  cmp2=(Sh * Sh * grandNh)
  cmp3=(k*T)*(k*T)
  cmp=cmp1/(cmp2+ cmp3)
  return(cmp)
}

nhAP=calNhStAP(2/100,tb[,2],tb[,5],T);nhAP
```

```
##  [1]  0.006694307  0.086592078  0.042677987  0.208461411 12.133593278
##  [6]  0.129843130  0.019628870  0.407093001  0.143162176  0.470853297
## [11]  4.589382297  0.043766107  0.028561076  0.499182030  0.164996050
## [16]  0.480561125  7.690266399  0.035718910  0.007995460  0.150012367
## [21]  0.056711180  0.199190898  6.783578511  0.062960874
```

```
## allocation optimale

calNhStNey=function(grandNh,Sh,nNey){
```

```
  cmp1=(grandNh*Sh)
  cmp2=sum(grandNh*Sh)
  cmp3=cmp1/ cmp2
  cmp= cmp3*nNey
  return(cmp)
}

nhNeySt=calNhStNey(tb[,2],tb[,5],nNey);nhNeySt

##  [1]  1.396411  5.022454  3.525959  7.793676 59.902869  6.163722  2.391161
##  [8] 10.890397  6.458073 11.713950 36.706055  3.573389  2.884356 12.059513
## [15]  6.933093 11.834117 47.609582  3.228619  1.526097  6.610664  4.064542
## [22]  7.618332 44.698110  4.290424

calNh=data.frame( "Strate"=tb[,1],"K"=2/100,"nAP par Strate"=nhAP,"nAP
arrondi/Strate"=round(nhAP,0)  ,"nNey par Strate"=nhNeySt,"nNey arrondi
/Strate"=round(nhNeySt,0))

kable(calNh)
```

Strate	K	nAP.par.Strate	nAP.arrondi.Strate	nNey.par.Strate	nNey.arrondi..Strate
AA1	0.02	0.0066943	0	1.396411	1
AA2	0.02	0.0865921	0	5.022454	5
AA3	0.02	0.0426780	0	3.525959	4
AA4	0.02	0.2084614	0	7.793676	8
AA5	0.02	12.1335933	12	59.902869	60
AA6	0.02	0.1298431	0	6.163722	6
BB1	0.02	0.0196289	0	2.391161	2
BB2	0.02	0.4070930	0	10.890397	11
BB3	0.02	0.1431622	0	6.458073	6
BB4	0.02	0.4708533	0	11.713950	12
BB5	0.02	4.5893823	5	36.706055	37
BB6	0.02	0.0437661	0	3.573389	4
CC1	0.02	0.0285611	0	2.884356	3
CC2	0.02	0.4991820	0	12.059513	12
CC3	0.02	0.1649961	0	6.933093	7
CC4	0.02	0.4805611	0	11.834117	12
CC5	0.02	7.6902664	8	47.609582	48
CC6	0.02	0.0357189	0	3.228619	3
DD1	0.02	0.0079955	0	1.526097	2
DD2	0.02	0.1500124	0	6.610664	7
DD3	0.02	0.0567112	0	4.064542	4

DD4	0.02	0.1991909	0	7.618332	8
DD5	0.02	6.7835785	7	44.698110	45
DD6	0.02	0.0629609	0	4.290424	4

Precision et allocation VAR1

```
##VAR1

N=length(donnees$PAYS)
n=600
#Strate1
strate1AA=subset(donnees[,-c(4,5)],donnees$ZONE=="AA" & donnees$VAR1<100)
strate1BB=subset(donnees[,-c(4,5)],donnees$ZONE=="BB" & donnees$VAR1<100)
strate1CC=subset(donnees[,-c(4,5)],donnees$ZONE=="CC" & donnees$VAR1<100)
strate1DD=subset(donnees[,-c(4,5)],donnees$ZONE=="DD" & donnees$VAR1<100)

#Strate2
strate2AA=subset(donnees[,-c(4,5)],donnees$ZONE=="AA" & donnees$VAR1>=100 &
donnees$VAR1<500)
strate2BB=subset(donnees[,-c(4,5)],donnees$ZONE=="BB" & donnees$VAR1>=100 &
donnees$VAR1<500)
strate2CC=subset(donnees[,-c(4,5)],donnees$ZONE=="CC" & donnees$VAR1>=100 &
donnees$VAR1<500)
strate2DD=subset(donnees[,-c(4,5)],donnees$ZONE=="DD" & donnees$VAR1>=100 &
donnees$VAR1<500)

#strate3
strate3AA=subset(donnees[,-c(4,5)],donnees$ZONE=="AA" & donnees$VAR1>=500 &
donnees$VAR1<1000)
strate3BB=subset(donnees[,-c(4,5)],donnees$ZONE=="BB" & donnees$VAR1>=500 &
donnees$VAR1<1000)
strate3CC=subset(donnees[,-c(4,5)],donnees$ZONE=="CC" & donnees$VAR1>=500 &
donnees$VAR1<1000)
strate3DD=subset(donnees[,-c(4,5)],donnees$ZONE=="DD" & donnees$VAR1>=500 &
donnees$VAR1<1000)

#strate4
strate4AA=subset(donnees[,-c(4,5)],donnees$ZONE=="AA" & donnees$VAR1>=1000 &
donnees$VAR1<2000)
strate4BB=subset(donnees[,-c(4,5)],donnees$ZONE=="BB" & donnees$VAR1>=1000 &
donnees$VAR1<2000)
strate4CC=subset(donnees[,-c(4,5)],donnees$ZONE=="CC" & donnees$VAR1>=1000 &
donnees$VAR1<2000)
strate4DD=subset(donnees[,-c(4,5)],donnees$ZONE=="DD" & donnees$VAR1>=1000 &
donnees$VAR1<2000)

#strate5
strate5AA=subset(donnees[,-c(4,5)],donnees$ZONE=="AA" & donnees$VAR1>=2000 &
donnees$VAR1<10000)
```

```
strate5BB=subset(donnees[,-c(4,5)],donnees$ZONE=="BB" & donnees$VAR1>=2000 &
donnees$VAR1<10000)
strate5CC=subset(donnees[,-c(4,5)],donnees$ZONE=="CC" & donnees$VAR1>=2000 &
donnees$VAR1<10000)
strate5DD=subset(donnees[,-c(4,5)],donnees$ZONE=="DD" & donnees$VAR1>=2000 &
donnees$VAR1<10000)

#strate6
strate6AA=subset(donnees[,-c(4,5)],donnees$ZONE=="AA" & donnees$VAR1>=10000)
strate6BB=subset(donnees[,-c(4,5)],donnees$ZONE=="BB" & donnees$VAR1>=10000)
strate6CC=subset(donnees[,-c(4,5)],donnees$ZONE=="CC" & donnees$VAR1>=10000)
strate6DD=subset(donnees[,-c(4,5)],donnees$ZONE=="DD" & donnees$VAR1>=10000)



shh=function(x){ nn=length(x)-1;yhn=mean(x);eca=((x-yhn)^2);return
(sqrt((1/nn)*sum(eca)))}

#zone AA
strate=c("AA1","AA2","AA3","AA4","AA5","AA6")

Nh1=c(length(strate1AA$VAR1),length(strate2AA$VAR1),length(strate3AA$VAR1),le
ngth(strate4AA$VAR1),length(strate5AA$VAR1),length(strate6AA$VAR1))

moy=c(mean(strate1AA$VAR1),mean(strate2AA$VAR1),mean(strate3AA$VAR1),mean(str
ate4AA$VAR1),mean(strate5AA$VAR1),mean(strate6AA$VAR1))

Somme=c(sum(strate1AA$VAR1),sum(strate2AA$VAR1),sum(strate3AA$VAR1),sum(strat
e4AA$VAR1),sum(strate5AA$VAR1),sum(strate6AA$VAR1))

Sh=c(shh(strate1AA$VAR1),shh(strate2AA$VAR1),shh(strate3AA$VAR1),shh(strate4A
A$VAR1),shh(strate5AA$VAR1),shh(strate6AA$VAR1))


nhAp=Nh1*n/N;nhAp=round(nhAp,0)

TzoneAA=data.frame("strate"=strate,"Nh"=Nh1,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)


strate=c("BB1","BB2","BB3","BB4","BB5","BB6")

Nh2=c(length(strate1BB$VAR1),length(strate2BB$VAR1),length(strate3BB$VAR1),le
ngth(strate4BB$VAR1),length(strate5BB$VAR1),length(strate6BB$VAR1))

moy=c(mean(strate1BB$VAR1),mean(strate2BB$VAR1),mean(strate3BB$VAR1),mean(str
ate4BB$VAR1),mean(strate5BB$VAR1),mean(strate6BB$VAR1))
```

```
Somme=c(sum(strate1BB$VAR1),sum(strate2BB$VAR1),sum(strate3BB$VAR1),sum(strat
e4BB$VAR1),sum(strate5BB$VAR1),sum(strate6BB$VAR1))

Sh=c(shh(strate1BB$VAR1),shh(strate2BB$VAR1),shh(strate3BB$VAR1),shh(strate4B
B$VAR1),shh(strate5BB$VAR1),shh(strate6BB$VAR1))


nhAp=Nh2*(n/N);nhAp=round(nhAp,0)


TzoneBB=data.frame("strate"=strate,"Nh"=Nh2,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp )


strate=c("CC1","CC2","CC3","CC4","CC5","CC6")

Nh3=c(length(strate1CC$VAR1),length(strate2CC$VAR1),length(strate3CC$VAR1),le
ngth(strate4CC$VAR1),length(strate5CC$VAR1),length(strate6CC$VAR1))

Somme=c(sum(strate1CC$VAR1),sum(strate2CC$VAR1),sum(strate3CC$VAR1),sum(strat
e4CC$VAR1),sum(strate5CC$VAR1),sum(strate6CC$VAR1))

moy=c(mean(strate1CC$VAR1),mean(strate2CC$VAR1),mean(strate3CC$VAR1),mean(str
ate4CC$VAR1),mean(strate5CC$VAR1),0)


Sh=c(shh(strate1CC$VAR1),shh(strate2CC$VAR1),shh(strate3CC$VAR1),shh(strate4C
C$VAR1),shh(strate5CC$VAR1),shh(strate6CC$VAR1))


nhAp=Nh3*(n/N);nhAp=round(nhAp,0)


TzoneCC=data.frame("strate"=strate,"Nh"=Nh3,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)


strate=c("DD1","DD2","DD3","DD4","DD5","DD6")

Nh4=c(length(strate1DD$VAR1),length(strate2DD$VAR1),length(strate3DD$VAR1),le
ngth(strate4DD$VAR1),length(strate5DD$VAR1),length(strate6DD$VAR1))

Somme=c(sum(strate1DD$VAR1),sum(strate2DD$VAR1),sum(strate3DD$VAR1),sum(strat
e4DD$VAR1),sum(strate5DD$VAR1),sum(strate6DD$VAR1))

moy=c(mean(strate1DD$VAR1),mean(strate2DD$VAR1),mean(strate3DD$VAR1),mean(str
ate4DD$VAR1),mean(strate5DD$VAR1),mean(strate6DD$VAR1))
```

```
Sh=c(shh(strate1DD$VAR1),shh(strate2DD$VAR1),shh(strate3DD$VAR1),shh(strate4D
D$VAR1),shh(strate5DD$VAR1),shh(strate6DD$VAR1))


nhAp=Nh4*(n/N);nhAp=round(nhAp,0)


TzoneDD=data.frame("strate"=strate,"Nh"=Nh4,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)


tb1=rbind(TzoneAA,TzoneBB,TzoneCC,TzoneDD)

  sum(tb1[,2])

## [1] 24000


NhSh=c(tb1[,2]*tb1[,5]);nhNey=(NhSh*n)/sum(NhSh);sum(nhNey);nhNey=round(nhNey
,0);sum(nhNey)

## [1] 600

## [1] 600

  nhAp1=(tb1[,2]*n)/N; sum(nhAp1);sum(nhAp1)

## [1] 600

## [1] 600


tb1=cbind(rbind(TzoneAA,TzoneBB,TzoneCC,TzoneDD),data.frame(nhAp1,NhSh,nhNey)
)


  #Totaux

Total=c(length(tb1[,1]),sum(tb1[,2]),sum(tb1[,3]),sum(tb1[,4]),sum(tb1[,6]),s
um(tb1[,7]),sum(tb1[,9]))

tb11=cbind(tb1,data.frame(nhAp1))



kable(tb1)
```

strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
AA1	243	15277	6.266202	18.855651	61	60.950	45970.08	10

	8							
AA2	641	165405	258.042122	115.913154	16	16.025	74300.33	16
AA3	336	237157	705.824405	141.101600	8	8.400	47410.14	10
AA4	331	481413	1454.419940	286.543056	8	8.275	94845.75	20
AA5	491	1829518	3726.105906	1650.678877	12	12.275	810483.33	169
AA6	10	159333	15933.300000	6835.238207	0	0.250	68352.38	14
BB1	6128	12212	1.992820	11.028441	153	153.200	67582.29	14
BB2	383	92437	241.349870	111.470926	10	9.575	42693.36	9
BB3	198	141700	715.656566	147.724064	5	4.950	29249.36	6
BB4	163	234673	1439.711656	296.796845	4	4.075	48377.89	10
BB5	212	744066	3509.745283	1613.375441	5	5.300	342035.59	71
BB6	8	97986	12248.250000	2239.323543	0	0.200	17914.59	4
CC1	6861	18260	2.661420	12.661830	172	171.525	86872.81	18
CC2	602	141614	235.239203	111.722853	15	15.050	67257.16	14
CC3	202	137149	678.955445	136.927962	5	5.050	27659.45	6
CC4	122	164639	1349.500000	270.164757	3	3.050	32960.10	7
CC5	134	482092	3597.701492	1746.927344	3	3.350	234088.26	49
CC6	0	0	0.000000	0.000000	0	0.000	0.00	0
DD1	3905	3985	1.020487	7.811305	98	97.625	30503.15	6
DD2	171	45467	265.888889	119.642332	4	4.275	20458.84	4
DD3	138	98408	713.101449	146.289149	3	3.450	20187.90	4
DD4	194	278438	1435.247423	284.115919	5	4.850	55118.49	12
DD5	321	1189653	3706.084112	1647.398021	8	8.025	528814.76	110
DD6	11	155524	14138.545454	7464.689376	0	0.275	82111.58	17

```
kable(tb1[1:6,])
```

strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
AA1	243	15277	6.266202	18.85565	61	60.95	45970.08	10

	8					0		
AA2	641	165405	258.042122	115.91315	16	16.025	74300.33	16
AA3	336	237157	705.824405	141.10160	8	8.400	47410.14	10
AA4	331	481413	1454.419940	286.54306	8	8.275	94845.75	20
AA5	491	1829518	3726.105906	1650.67888	12	12.275	810483.33	169
AA6	10	159333	15933.300000	6835.23821	0	0.250	68352.38	14

```
kable(tb1[7:12,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
7	BB1	6128	12212	1.99282	11.02844	153	153.200	67582.29	14
8	BB2	383	92437	241.34987	111.47093	10	9.575	42693.36	9
9	BB3	198	141700	715.65657	147.72406	5	4.950	29249.36	6
10	BB4	163	234673	1439.71166	296.79684	4	4.075	48377.89	10
11	BB5	212	744066	3509.74528	1613.37544	5	5.300	342035.59	71
12	BB6	8	97986	12248.25000	2239.32354	0	0.200	17914.59	4

```
kable(tb1[13:18,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
13	CC1	6861	18260	2.66142	12.66183	172	171.525	86872.81	18
14	CC2	602	141614	235.23920	111.72285	15	15.050	67257.16	14
15	CC3	202	137149	678.95545	136.92796	5	5.050	27659.45	6
16	CC4	122	164639	1349.50000	270.16476	3	3.050	32960.10	7
17	CC5	134	482092	3597.70149	1746.92734	3	3.350	234088.26	49
18	CC6	0	0	0.00000	0.00000	0	0.000	0.00	0

```
kable(tb1[19:24,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
19	DD1	3905	3985	1.020487	7.811305	98	97.625	30503.15	6
20	DD2	171	45467	265.888889	119.642332	4	4.275	20458.84	4
21	DD3	138	98408	713.101449	146.289149	3	3.450	20187.90	4
22	DD4	194	278438	1435.247423	284.115919	5	4.850	55118.49	12
23	DD5	321	1189653	3706.084112	1647.398021	8	8.025	528814.76	110
24	DD6	11	155524	14138.545454	7464.689376	0	0.275	82111.58	17

```
#Precision relative de l'ensemble de zones
##Estimation de la moyenne et total au sein de l'echantion par allocation porportionnelle
MoySt=sum(tb1[,3])/N;MoySt

## [1] 288.6003

mean(donnees$VAR1)

## [1] 288.6003

T=sum(tb1[,3]);T

## [1] 6926406

#Estimateur de variance de la moyenne

varianceStratifie=function(nhpetit,grandNh,Sh,N){
  cmp1=(grandNh*grandNh)/(N*N)
  cmp2=1-(nhpetit/grandNh)
  cmp3=(Sh * Sh)/nhpetit
  cmp=cmp1*cmp2*cmp3
  return(sum(cmp))
}

varianceT=function(nhpetit,grandNh,Sh){
  cmp1=(grandNh*grandNh * Sh *Sh)/(nhpetit)
  cmp2=(Sh * Sh * grandNh)
  cmp=cmp1- cmp2
  return(sum(cmp))
}

cp1=(tb1[-18,2]*tb1[-18,2]*tb1[-18,5]*tb1[-18,5])/tb1[-18,7]
```

```
cp2=(tb1[-18,5]*tb1[-18,5]* tb1[-18,2])
cp=cp1- cp2;cp
```

```
##  [1]    33805035   335883043   260896206  1059918271 52176060739
18220987724
##  [7]    29067765   185603687   168512567   559977749 21521441236
1564545818
## [13]    42898783   293052300   147706723   347281642 15948472379
9292506
## [19]    95461984   115177573   610741559 33975567482 23904561026
```

```
varianceStr=varianceStratifie(tb1[-18,7],tb1[-18,2],tb1[-18,5],N);varianceStr
```

```
## [1] 297.9287
```

```
varianceTot=varianceT(tb1[-18,7],tb1[-18,2],tb1[-18,5]);varianceTot
```

```
## [1] 171606913795
```

```
#precision relative
precisionRelative1=(sqrt(varianceStr)/MoySt)*100;precisionRelative1
```

```
## [1] 5.980802
```

```
precisionRelative2=(sqrt(varianceTot)/T)*100;precisionRelative2
```

```
## [1] 5.980802
```

```
TabloPrecisionAP=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative"=precisionRelative1)

kable(TabloPrecisionAP)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative
288.6003	297.9287	5.980802

```
##Estimation de la moyenne et total au sein de l'echantion par allocation
porportionnelle
MoySt=sum(tb1[-18,3])/N;MoySt
```

```
## [1] 288.6003
```

```
mean(donnees$VAR1)
```

```
## [1] 288.6003
```

```
#variance
varianceStr=varianceStratifie(tb1[-18,9],tb1[-18,2],tb1[-18,5],N)


#precision relative
precisionRelative1=(sqrt(varianceStr)/MoySt)*100;precisionRelative1
```

```
## [1] 1.398404

TabloPrecisionOP=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative"=precisionRelative1)

kable(TabloPrecisionOP)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative
288.6003	16.28766	1.398404

```
#allocation proportionnelle

MoySt=sum(tb1[-18,3])/N;MoySt

## [1] 288.6003

mean(donnees$VAR3)

## [1] 850.7134

T=sum(tb1[-18,3])



#allocation proportionnelle nAP
calnAP=function(k,grandNh,Sh,N,MoyenneX){
  cmp1= N * sum((grandNh*Sh*Sh))
  cmp2=(k*N*MoyenneX)*(k*N*MoyenneX)
  cmp3=sum(Sh * Sh * grandNh)
  cmp=cmp1/(cmp2 + cmp3)
  return(cmp)
}



nAP=calnAP(2/100,tb1[-18,2],tb1[-18,5],N,MoySt);nAP; sum(nAP)

## [1] 4476.612

## [1] 4476.612

#allocation de Neymar

calnNey=function(k,grandNh,Sh,N,MoyenneX){
  cmp1= sum(grandNh*Sh) * sum(grandNh*Sh)
  cmp2=(k*N*MoyenneX)*(k*N*MoyenneX)
  cmp3=sum(Sh * Sh * grandNh)
  cmp=cmp1/(cmp2 + cmp3)
  return(cmp)
}
```

```r
nNey=calnNey(2/100,tb1[,2],tb1[-18,5],N,MoySt);nNey; sum(nNey)
```

```
## Warning in grandNh * Sh: la taille d'un objet plus long n'est pas multiple
de la
## taille d'un objet plus court

## Warning in grandNh * Sh: la taille d'un objet plus long n'est pas multiple
de la
## taille d'un objet plus court

## Warning in Sh * Sh * grandNh: la taille d'un objet plus long n'est pas
multiple
## de la taille d'un objet plus court

## [1] 714.9129

## [1] 714.9129
```

```r
calN=data.frame("nombre de strate"=24,"K"=2/100,"nAP"=nAP,"nAP
arrondi"=round(nAP,0),"nNey"=nNey,"nNey arrondi"=round(nNey,0))

kable(calN)
```

nombre.de.strate	K	nAP	nAP.arrondi	nNey	nNey.arrondi
24	0.02	4476.612	4477	714.9129	715

```r
#par strate

## allocation proportionnelle

calNhStAP=function(k,grandNh,Sh,T){
  cmp1=(grandNh*grandNh * Sh *Sh)
  cmp2=(Sh * Sh * grandNh)
  cmp3=(k*T)*(k*T)
  cmp=cmp1/(cmp2+ cmp3)
  return(cmp)
}

nhAP=calNhStAP(2/100,tb1[-18,2],tb1[-18,5],T);nhAP
```

```
##  [1]  0.11011716  0.28754827  0.11708875  0.46810714 31.99955273
0.23767563
##  [7]  0.23799786  0.09495923  0.04457170  0.12186895  5.92589943
0.01668902
## [13]  0.39324844  0.23563029  0.03985891  0.05658479  2.79592758
0.04848507
## [19]  0.02180875  0.02123439  0.15818469 13.93959175  0.34046961
```

```r
## allocation optimale
```

```
calNhStNey=function(grandNh,Sh,nNey){
  cmp1=(grandNh*Sh)
  cmp2=sum(grandNh*Sh)
  cmp3=cmp1/ cmp2
  cmp= cmp3*nNey
  return(cmp)
}

nhNeySt=calNhStNey(tb1[-18,2],tb1[-18,5],nNey);nhNeySt
```

```
##  [1]  11.430181  18.474327  11.788243  23.582821 201.521766  16.995405
##  [7]  16.803926  10.615446   7.272677  12.028868  85.045077   4.454354
## [13]  21.600399  16.723084   6.877354   8.195329  58.204628   7.584422
## [19]   5.086966   5.019600  13.704878 131.486585  20.416547
```

```
calNh=data.frame( "Strate"=tb1[-18,1],"K"=2/100,"nAP par Strate"=nhAP,"nAP
arrondi/Strate"=round(nhAP,0)  ,"nNey par Strate"=nhNeySt,"nNey arrondi
/Strate"=round(nhNeySt,0))

kable(calNh)
```

Strate	K	nAP.par.Strate	nAP.arrondi.Strate	nNey.par.Strate	nNey.arrondi..Strate
AA1	0.02	0.1101172	0	11.430181	11
AA2	0.02	0.2875483	0	18.474327	18
AA3	0.02	0.1170888	0	11.788243	12
AA4	0.02	0.4681071	0	23.582821	24
AA5	0.02	31.9995527	32	201.521766	202
AA6	0.02	0.2376756	0	16.995405	17
BB1	0.02	0.2379979	0	16.803926	17
BB2	0.02	0.0949592	0	10.615446	11
BB3	0.02	0.0445717	0	7.272677	7
BB4	0.02	0.1218689	0	12.028868	12
BB5	0.02	5.9258994	6	85.045077	85
BB6	0.02	0.0166890	0	4.454354	4
CC1	0.02	0.3932484	0	21.600399	22
CC2	0.02	0.2356303	0	16.723084	17
CC3	0.02	0.0398589	0	6.877354	7
CC4	0.02	0.0565848	0	8.195329	8
CC5	0.02	2.7959276	3	58.204628	58
DD1	0.02	0.0484851	0	7.584422	8
DD2	0.02	0.0218087	0	5.086966	5
DD3	0.02	0.0212344	0	5.019600	5

DD4	0.02	0.1581847	0	13.704878	14
DD5	0.02	13.9395917	14	131.486585	131
DD6	0.02	0.3404696	0	20.416547	20

Precision et allocation VAR2

```
##VAR2

N=length(donnees$PAYS)
n=600
#Strate1
strate1AA=subset(donnees[,-c(3,5)],donnees$ZONE=="AA" & donnees$VAR2<100)
strate1BB=subset(donnees[,-c(3,5)],donnees$ZONE=="BB" & donnees$VAR2<100)
strate1CC=subset(donnees[,-c(3,5)],donnees$ZONE=="CC" & donnees$VAR2<100)
strate1DD=subset(donnees[,-c(3,5)],donnees$ZONE=="DD" & donnees$VAR2<100)

#Strate2
strate2AA=subset(donnees[,-c(3,5)],donnees$ZONE=="AA" & donnees$VAR2>=100 &
donnees$VAR2<500)
strate2BB=subset(donnees[,-c(3,5)],donnees$ZONE=="BB" & donnees$VAR2>=100 &
donnees$VAR2<500)
strate2CC=subset(donnees[,-c(3,5)],donnees$ZONE=="CC" & donnees$VAR2>=100 &
donnees$VAR2<500)
strate2DD=subset(donnees[,-c(3,5)],donnees$ZONE=="DD" & donnees$VAR2>=100 &
donnees$VAR2<500)

#strate3
strate3AA=subset(donnees[,-c(3,5)],donnees$ZONE=="AA" & donnees$VAR2>=500 &
donnees$VAR2<1000)
strate3BB=subset(donnees[,-c(3,5)],donnees$ZONE=="BB" & donnees$VAR2>=500 &
donnees$VAR2<1000)
strate3CC=subset(donnees[,-c(3,5)],donnees$ZONE=="CC" & donnees$VAR2>=500 &
donnees$VAR2<1000)
strate3DD=subset(donnees[,-c(3,5)],donnees$ZONE=="DD" & donnees$VAR2>=500 &
donnees$VAR2<1000)

#strate4
strate4AA=subset(donnees[,-c(3,5)],donnees$ZONE=="AA" & donnees$VAR2>=1000 &
donnees$VAR2<2000)
strate4BB=subset(donnees[,-c(3,5)],donnees$ZONE=="BB" & donnees$VAR2>=1000 &
donnees$VAR2<2000)
strate4CC=subset(donnees[,-c(3,5)],donnees$ZONE=="CC" & donnees$VAR2>=1000 &
donnees$VAR2<2000)
strate4DD=subset(donnees[,-c(3,5)],donnees$ZONE=="DD" & donnees$VAR2>=1000 &
donnees$VAR2<2000)

#strate5
strate5AA=subset(donnees[,-c(3,5)],donnees$ZONE=="AA" & donnees$VAR2>=2000 &
donnees$VAR2<10000)
```

```
strate5BB=subset(donnees[,-c(3,5)],donnees$ZONE=="BB" & donnees$VAR2>=2000 &
donnees$VAR2<10000)
strate5CC=subset(donnees[,-c(3,5)],donnees$ZONE=="CC" & donnees$VAR2>=2000 &
donnees$VAR2<10000)
strate5DD=subset(donnees[,-c(3,5)],donnees$ZONE=="DD" & donnees$VAR2>=2000 &
donnees$VAR2<10000)

#strate6
strate6AA=subset(donnees[,-c(3,5)],donnees$ZONE=="AA" & donnees$VAR2>=10000)
strate6BB=subset(donnees[,-c(3,5)],donnees$ZONE=="BB" & donnees$VAR2>=10000)
strate6CC=subset(donnees[,-c(3,5)],donnees$ZONE=="CC" & donnees$VAR2>=10000)
strate6DD=subset(donnees[,-c(3,5)],donnees$ZONE=="DD" & donnees$VAR2>=10000)



shh=function(x){ nn=length(x)-1;yhn=mean(x);eca=((x-yhn)^2);return
(sqrt((1/nn)*sum(eca)))}

#zone AA
strate=c("AA1","AA2","AA3","AA4","AA5","AA6")

Nh1=c(length(strate1AA$VAR2),length(strate2AA$VAR2),length(strate3AA$VAR2),le
ngth(strate4AA$VAR2),length(strate5AA$VAR2),length(strate6AA$VAR2))

moy=c(mean(strate1AA$VAR2),mean(strate2AA$VAR2),mean(strate3AA$VAR2),mean(str
ate4AA$VAR2),mean(strate5AA$VAR2),mean(strate6AA$VAR2))

Somme=c(sum(strate1AA$VAR2),sum(strate2AA$VAR2),sum(strate3AA$VAR2),sum(strat
e4AA$VAR2),sum(strate5AA$VAR2),sum(strate6AA$VAR2))

Sh=c(shh(strate1AA$VAR2),shh(strate2AA$VAR2),shh(strate3AA$VAR2),shh(strate4A
A$VAR2),shh(strate5AA$VAR2),shh(strate6AA$VAR2))


nhAp=Nh1*n/N;nhAp=round(nhAp,0)

TzoneAA=data.frame("strate"=strate,"Nh"=Nh1,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)


strate=c("BB1","BB2","BB3","BB4","BB5","BB6")

Nh2=c(length(strate1BB$VAR2),length(strate2BB$VAR2),length(strate3BB$VAR2),le
ngth(strate4BB$VAR2),length(strate5BB$VAR2),length(strate6BB$VAR2))

moy=c(mean(strate1BB$VAR2),mean(strate2BB$VAR2),mean(strate3BB$VAR2),mean(str
ate4BB$VAR2),mean(strate5BB$VAR2),mean(strate6BB$VAR2))
```

```
Somme=c(sum(strate1BB$VAR2),sum(strate2BB$VAR2),sum(strate3BB$VAR2),sum(strat
e4BB$VAR2),sum(strate5BB$VAR2),sum(strate6BB$VAR2))

Sh=c(shh(strate1BB$VAR2),shh(strate2BB$VAR2),shh(strate3BB$VAR2),shh(strate4B
B$VAR2),shh(strate5BB$VAR2),shh(strate6BB$VAR2))


nhAp=Nh2*(n/N);nhAp=round(nhAp,0)


TzoneBB=data.frame("strate"=strate,"Nh"=Nh2,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp )


strate=c("CC1","CC2","CC3","CC4","CC5","CC6")

Nh3=c(length(strate1CC$VAR2),length(strate2CC$VAR2),length(strate3CC$VAR2),le
ngth(strate4CC$VAR2),length(strate5CC$VAR2),length(strate6CC$VAR2))

Somme=c(sum(strate1CC$VAR2),sum(strate2CC$VAR2),sum(strate3CC$VAR2),sum(strat
e4CC$VAR2),sum(strate5CC$VAR2),sum(strate6CC$VAR2))

moy=c(mean(strate1CC$VAR2),mean(strate2CC$VAR2),mean(strate3CC$VAR2),mean(str
ate4CC$VAR2),mean(strate5CC$VAR2),mean(strate6CC$VAR2))


Sh=c(shh(strate1CC$VAR2),shh(strate2CC$VAR2),shh(strate3CC$VAR2),shh(strate4C
C$VAR2),shh(strate5CC$VAR2),shh(strate6CC$VAR2))


nhAp=Nh3*(n/N);nhAp=round(nhAp,0)


TzoneCC=data.frame("strate"=strate,"Nh"=Nh3,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)


strate=c("DD1","DD2","DD3","DD4","DD5","DD6")

Nh4=c(length(strate1DD$VAR2),length(strate2DD$VAR2),length(strate3DD$VAR2),le
ngth(strate4DD$VAR2),length(strate5DD$VAR2),length(strate6DD$VAR2))

Somme=c(sum(strate1DD$VAR2),sum(strate2DD$VAR2),sum(strate3DD$VAR2),sum(strat
e4DD$VAR2),sum(strate5DD$VAR2),sum(strate6DD$VAR2))

moy=c(mean(strate1DD$VAR2),mean(strate2DD$VAR2),mean(strate3DD$VAR2),mean(str
ate4DD$VAR2),mean(strate5DD$VAR2),mean(strate6DD$VAR2))
```

```
Sh=c(shh(strate1DD$VAR2),shh(strate2DD$VAR2),shh(strate3DD$VAR2),shh(strate4D
D$VAR2),shh(strate5DD$VAR2),shh(strate6DD$VAR2))


nhAp=Nh4*(n/N);nhAp=round(nhAp,0)


TzoneDD=data.frame("strate"=strate,"Nh"=Nh4,"Total"=Somme,"Moyenne"=moy,"Sh"=
Sh,"nhAp"=nhAp)


tb2=rbind(TzoneAA,TzoneBB,TzoneCC,TzoneDD)

  sum(tb2[,2])

## [1] 24000


NhSh=c(tb2[,2]*tb2[,5]);nhNey=(NhSh*n)/sum(NhSh);sum(nhNey);nhNey=round(nhNey
,0);sum(nhNey)

## [1] 600

## [1] 599

  nhAp1=(tb2[,2]*n)/N; sum(nhAp1);sum(nhAp1)

## [1] 600

## [1] 600


tb2=cbind(rbind(TzoneAA,TzoneBB,TzoneCC,TzoneDD),data.frame(nhAp1,NhSh,nhNey)
)


  #Totaux

Total=c(length(tb2[,1]),sum(tb2[,2]),sum(tb2[,3]),sum(tb2[,4]),sum(tb2[,6]),s
um(tb2[,7]),sum(tb2[,9]))

tb21=cbind(tb2,data.frame(nhAp1))



kable(tb2)
```

strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
AA1	209	51182	24.47728	28.88378	52	52.27	60395.978	8

	1					5		
AA2	949	233716	246.27608	115.55179	24	23.725	109658.652	14
AA3	501	356920	712.41517	143.57774	13	12.525	71932.448	9
AA4	409	571813	1398.07579	283.14146	10	10.225	115804.856	15
AA5	290	102742	3542.83448	1688.64033	7	7.250	489705.696	63
AA6	7	78527	11218.14286	568.70772	0	0.175	3980.954	1
BB1	2618	104926	40.07869	30.11369	65	65.450	78837.646	10
BB2	2286	543241	237.63823	111.80389	57	57.150	255583.696	33
BB3	939	681405	725.67093	147.75503	23	23.475	138741.975	18
BB4	874	121492 0	1390.06865	272.09564	22	21.850	237811.592	31
BB5	364	117005 3	3214.43132	1386.9788 5	9	9.100	504860.300	65
BB6	11	140105	12736.8181 8	2964.9191 2	0	0.275	32614.110	4
CC1	2754	112173	40.73094	29.53432	69	68.850	81337.511	10
CC2	2629	619983	235.82465	109.46480	66	65.725	287782.971	37
CC3	1107	800571	723.18970	145.20024	28	27.675	160736.669	21
CC4	911	126965 1	1393.68935	277.89384	23	22.775	253161.291	33
CC5	509	178488 6	3506.65226	1606.2050 1	13	12.725	817558.349	105
CC6	11	151601	13781.9090 9	3671.0974 0	0	0.275	40382.071	5
DD1	1938	72343	37.32869	30.07983	48	48.450	58294.701	8
DD2	1455	336486	231.26186	107.97364	36	36.375	157101.641	20
DD3	567	409475	722.17813	142.95178	14	14.17	81053.657	10

						5		
DD4	486	690885	1421.57407	274.07490	12	12.150	133200.404	17
DD5	290	1013653	3495.35517	1632.84579	7	7.250	473525.279	61
DD6	4	54778	13694.50000	1660.60642	0	0.100	6642.426	1

```
kable(tb2[1:6,])
```

strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
AA1	2091	51182	24.47728	28.88378	52	52.275	60395.978	8
AA2	949	233716	246.27608	115.55179	24	23.725	109658.652	14
AA3	501	356920	712.41517	143.57774	13	12.525	71932.448	9
AA4	409	571813	1398.07579	283.14146	10	10.225	115804.856	15
AA5	290	102742	3542.83448	1688.64033	7	7.250	489705.696	63
AA6	7	78527	11218.14286	568.70772	0	0.175	3980.954	1

```
kable(tb2[7:12,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
7	BB1	2618	104926	40.07869	30.11369	65	65.450	78837.65	10
8	BB2	2286	543241	237.63823	111.80389	57	57.150	255583.70	33
9	BB3	939	681405	725.67093	147.75503	23	23.475	138741.97	18
10	BB4	874	1214920	1390.06865	272.09564	22	21.850	237811.59	31
11	BB5	364	1170053	3214.43132	1386.97885	9	9.100	504860.30	65
12	BB6	11	140105	12736.81818	2964.91912	0	0.275	32614.11	4

```
kable(tb2[13:18,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
13	CC1	2754	112173	40.73094	29.53432	69	68.850	81337.51	10
14	CC2	2629	619983	235.82465	109.46480	66	65.725	287782.97	37
15	CC3	1107	800571	723.18970	145.20024	28	27.675	160736.67	21
16	CC4	911	1269651	1393.68935	277.89384	23	22.775	253161.29	33
17	CC5	509	1784886	3506.65226	1606.20501	13	12.725	817558.35	105
18	CC6	11	151601	13781.90909	3671.09740	0	0.275	40382.07	5

```
kable(tb2[19:24,])
```

	strate	Nh	Total	Moyenne	Sh	nhAp	nhAp1	NhSh	nhNey
19	DD1	1938	72343	37.32869	30.07983	48	48.450	58294.701	8
20	DD2	1455	336486	231.26186	107.97364	36	36.375	157101.641	20
21	DD3	567	409475	722.17813	142.95178	14	14.175	81053.657	10
22	DD4	486	690885	1421.57407	274.07490	12	12.150	133200.404	17
23	DD5	290	1013653	3495.35517	1632.84579	7	7.250	473525.279	61
24	DD6	4	54778	13694.50000	1660.60642	0	0.100	6642.426	1

```
#Precision relative de l'ensemble de zones
##Estimation de la moyenne et total au sein de l'echantion par allocation porportionnelle
MoySt=sum(tb2[,3])/N;MoySt

## [1] 562.1131

mean(donnees$VAR2)

## [1] 562.1131

T=sum(tb2[,3])
#Estimateur de variance de la moyenne
```

```r
varianceStratifie=function(nhpetit,grandNh,Sh,N){
  cmp1=(grandNh*grandNh)/(N*N)
  cmp2=1-(nhpetit/grandNh)
  cmp3=(Sh * Sh)/nhpetit
  cmp=cmp1*cmp2*cmp3
  return(sum(cmp))
}

varianceT=function(nhpetit,grandNh,Sh){
  cmp1=(grandNh*grandNh * Sh *Sh)/(nhpetit)
  cmp2=(Sh * Sh * grandNh)
  cmp=cmp1- cmp2
  return(sum(cmp))
}


varianceStr=varianceStratifie(tb2[,7],tb2[,2],tb2[,5],N);varianceStr

## [1] 287.0739

varianceTot=varianceT(tb2[,7],tb2[,2],tb2[,5]);varianceTot

## [1] 165354591977

#precision relative
precisionRelative1=(sqrt(varianceStr)/MoySt)*100;precisionRelative1

## [1] 3.014208

precisionRelative2=(sqrt(varianceTot)/T)*100;precisionRelative2

## [1] 3.014208

TabloPrecisionAP=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative"=precisionRelative1)

kable(TabloPrecisionAP)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative
562.1131	287.0739	3.014208

```r
##Estimation de la moyenne et total au sein de l'echantion par allocation
porportionnelle
MoySt=sum(tb2[,3])/N;MoySt

## [1] 562.1131

mean(donnees$VAR2)

## [1] 562.1131

#variance
varianceStr=varianceStratifie(tb2[,9],tb2[,2],tb2[,5],N)
```

```r
#precision relative
precisionRelative1=(sqrt(varianceStr)/MoySt)*100;precisionRelative1
```

```
## [1] 1.32375
```

```r
TabloPrecisionOP=data.frame("moyenneStrate"=MoySt,"VarianceMoyenneStratifié"=
varianceStr,"Precision Relative"=precisionRelative1)

kable(TabloPrecisionOP)
```

moyenneStrate	VarianceMoyenneStratifié	Precision.Relative
562.1131	55.3681	1.32375

```r
#allocation proportionnelle

MoySt=sum(tb2[,3])/N;MoySt
```

```
## [1] 562.1131
```

```r
mean(donnees$VAR3)
```

```
## [1] 850.7134
```

```r
T=sum(tb2[,3])



#allocation proportionnelle nAP
calnAP=function(k,grandNh,Sh,N,MoyenneX){
  cmp1= N * sum((grandNh*Sh*Sh))
  cmp2=(k*N*MoyenneX)*(k*N*MoyenneX)
  cmp3=sum(Sh * Sh * grandNh)
  cmp=cmp1/(cmp2 + cmp3)
  return(cmp)
}



nAP=calnAP(2/100,tb2[,2],tb2[,5],N,MoySt);nAP; sum(nAP)
```

```
## [1] 1320.836
```

```
## [1] 1320.836
```

```r
#allocation de Neymar

calnNey=function(k,grandNh,Sh,N,MoyenneX){
  cmp1= sum(grandNh*Sh) * sum(grandNh*Sh)
  cmp2=(k*N*MoyenneX)*(k*N*MoyenneX)
```

```
  cmp3=sum(Sh * Sh * grandNh)
  cmp=cmp1/(cmp2 + cmp3)
  return(cmp)
}

nNey=calnNey(2/100,tb2[,2],tb2[,5],N,MoySt);nNey; sum(nNey)
```

```
## [1] 280.7524
```

```
## [1] 280.7524
```

```
calN=data.frame("nombre de strate"=24,"K"=2/100,"nAP"=nAP,"nAP
arrondi"=round(nAP,0),"nNey"=nNey,"nNey arrondi"=round(nNey,0))

kable(calN)
```

nombre.de.strate	K	nAP	nAP.arrondi	nNey	nNey.arrondi
24	0.02	1320.836	1321	280.7524	281

```
#par strate

## allocation proportionnelle

calNhStAP=function(k,grandNh,Sh,T){
  cmp1=(grandNh*grandNh * Sh *Sh)
  cmp2=(Sh * Sh * grandNh)
  cmp3=(k*T)*(k*T)
  cmp=cmp1/(cmp2+ cmp3)
  return(cmp)
}

nhAP=calNhStAP(2/100,tb2[,2],tb2[,5],T);nhAP
```

```
##  [1] 0.0501043805 0.1651506523 0.0710653895 0.1841314838 3.2571294255
##  [6] 0.0002176862 0.0853735247 0.8969452458 0.2643403982 0.7761582271
## [11] 3.4678090871 0.0145916587 0.0908735514 1.1371358965 0.3547813568
## [16] 0.8795189226 9.0186924031 0.0223544391 0.0466785948 0.3389458622
## [21] 0.0902290085 0.2435922258 3.0476715834 0.0006059791
```

```
## allocation optimale

calNhStNey=function(grandNh,Sh,nNey){
  cmp1=(grandNh*Sh)
  cmp2=sum(grandNh*Sh)
  cmp3=cmp1/ cmp2
  cmp= cmp3*nNey
  return(cmp)
}

nhNeySt=calNhStNey(tb2[,2],tb2[,5],nNey);nhNeySt
```

```
##  [1]  3.6459665  6.6198411  4.3423967  6.9908733 29.5624087  0.2403211
##  [7]  4.7592477 15.4290010  8.3755345 14.3561399 30.4772574  1.9688390
## [13]  4.9101588 17.3727973  9.7033037 15.2827660 49.3541207  2.4377729
## [19]  3.5191173  9.4838654  4.8930232  8.0410026 28.5856341  0.4009880
```

```
calNh=data.frame( "Strate"=tb2[,1],"K"=2/100,"nAP par Strate"=nhAP,"nAP
arrondi/Strate"=round(nhAP,0)  ,"nNey par Strate"=nhNeySt,"nNey arrondi
/Strate"=round(nhNeySt,0))

kable(calNh)
```

Strate	K	nAP.par.Strate	nAP.arrondi.Strate	nNey.par.Strate	nNey.arrondi..Strate
AA1	0.02	0.0501044	0	3.6459665	4
AA2	0.02	0.1651507	0	6.6198411	7
AA3	0.02	0.0710654	0	4.3423967	4
AA4	0.02	0.1841315	0	6.9908733	7
AA5	0.02	3.2571294	3	29.5624087	30
AA6	0.02	0.0002177	0	0.2403211	0
BB1	0.02	0.0853735	0	4.7592477	5
BB2	0.02	0.8969452	1	15.4290010	15
BB3	0.02	0.2643404	0	8.3755345	8
BB4	0.02	0.7761582	1	14.3561399	14
BB5	0.02	3.4678091	3	30.4772574	30
BB6	0.02	0.0145917	0	1.9688390	2
CC1	0.02	0.0908736	0	4.9101588	5
CC2	0.02	1.1371359	1	17.3727973	17
CC3	0.02	0.3547814	0	9.7033037	10
CC4	0.02	0.8795189	1	15.2827660	15
CC5	0.02	9.0186924	9	49.3541207	49
CC6	0.02	0.0223544	0	2.4377729	2
DD1	0.02	0.0466786	0	3.5191173	4
DD2	0.02	0.3389459	0	9.4838654	9
DD3	0.02	0.0902290	0	4.8930232	5
DD4	0.02	0.2435922	0	8.0410026	8
DD5	0.02	3.0476716	3	28.5856341	29
DD6	0.02	0.0006060	0	0.4009880	0