```r
### loi de grands nombres ###
###########
# 1. unif #
###########
#a) Generer une realisation ...
n = 50000; x = runif(n);
#b) Calculer ...
y = cumsum(x)/(1:n)
#c) Tracer ...
plot(y, type = "l", col = "blue")
abline(h = 0.5, col = "red")
#############
# 2. cauchy #
#############
x=rcauchy(n)
y=cumsum(x)/(1:n)
plot(y,type="l",col="blue")

t = seq(-2, 2, 0.01);
ft = dcauchy(t)
plot(t,ft, type = "l")
### theoreme central limite ###
###########
# 1. unif #
###########
#a) Generer R realisations ...
tcl <- function(R, n){
  a=matrix(1,nrow=R,ncol=n)
  for( i in 1 : R)
  {
    temp=runif(n)
    a[i,]=temp
  }
  x = apply(a,1,mean)
}
R = 5000; n = 1000
y = tcl(R, n)
```

```r
hist(y)
#b) Calculer ...
#c) Tracer un histogramme ...
m = 1/2; s = sqrt(1/12/n)
y = (y-m)/s
# hist(y,proba=T,col="blue")
hist(y,proba=T,col="grey",breaks = 50)
z=seq(min(y),max(y),0.01)
lines(z,dnorm(z),lty=1,col="red",lwd = 2)

#d) fonction de repartition
Fn=ecdf(y)
plot(Fn,verticals=T,do.p=F, col = 1)
lines(z,pnorm(z),lty=1,col=5)

R = c(50, 100, 500)
for(i in 1:3){
  y = tcl(R[i], n); y = (y-m)/s; Fn = ecdf(y)
  lines(Fn,verticals=T, do.p=F, col = i+1)
}
legend("bottomright", col = 1:4, lty =
rep(1,4), as.character(c(5000, R)))

par(mfrow = c(2,2))
Fn=ecdf(y)
plot(Fn,verticals=T,do.p=F, main = "10")
lines(z,pnorm(z,0,1),lty=1,col="red")
Fn=ecdf(y1)
plot(Fn,verticals=T,do.p=F, main = "100")
lines(z,pnorm(z,0,1),lty=1,col="red")
Fn=ecdf(y2)
plot(Fn,verticals=T,do.p=F, main = "1000")
lines(z,pnorm(z,0,1),lty=1,col="red")
Fn=ecdf(y3)
plot(Fn,verticals=T,do.p=F, main = "10000")
lines(z,pnorm(z,0,1),lty=1,col="red")
```

```r
#d) Proceder de meme ... E[X] = 10 * 0.8,
Var[X] = 10*0.8*0.2
n=1000
R=5000
a=matrix(1,nrow=R,ncol=n)
for( i in 1 : R)
{
  temp=rbinom(n,10,0.8)
  a[i,]=temp
}

x=apply(a,1,mean)

mu=10*0.8
sigma=sqrt(10*0.8*0.2)

y2=sqrt(n)*(x-mu)/sigma
#hist(y,proba=T,col="blue")
#z=seq(min(y),max(y),0.01)
#lines(z,dnorm(z,0,1),lty=1,col="red")

Fn=ecdf(y2)
lines(Fn,verticals=T,do.p=F, col="orange") #
5000
#lines(Fn,verticals=T,do.p=F, col="green") # 50
#lines(z,pnorm(z,0,1),lty=1,col="red")
```