# MCSM Problem 6.18

Pavlina Rumcheva

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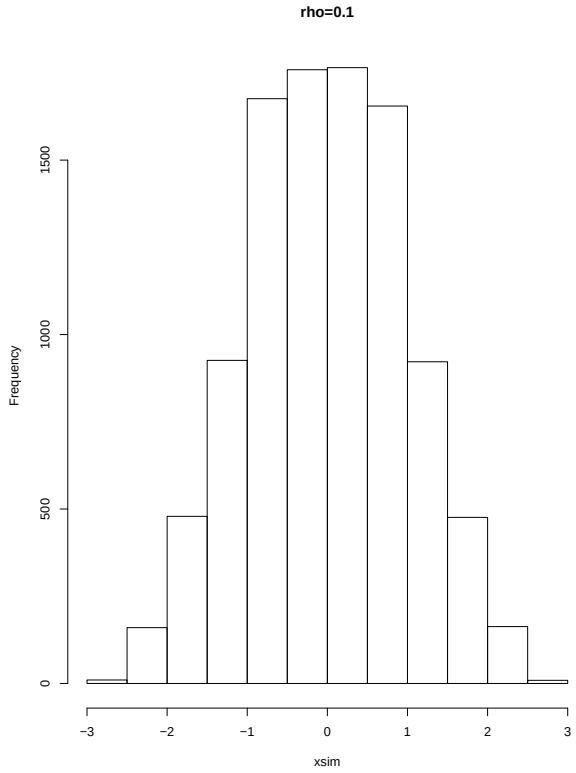
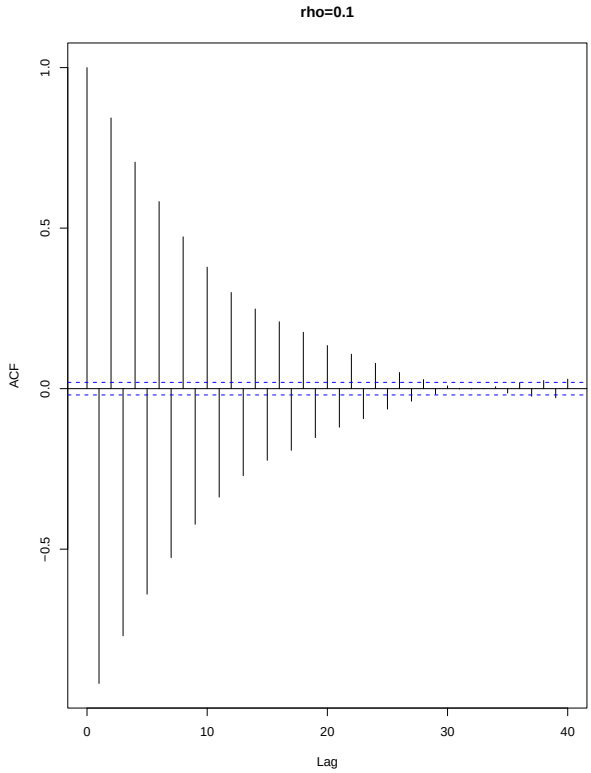
Implementation of the M-H Algorithm when $f$ is the $N(0,1)$ density and $q(\cdot|x)$ is the $U[-x-\delta, -x+\delta]$ density.

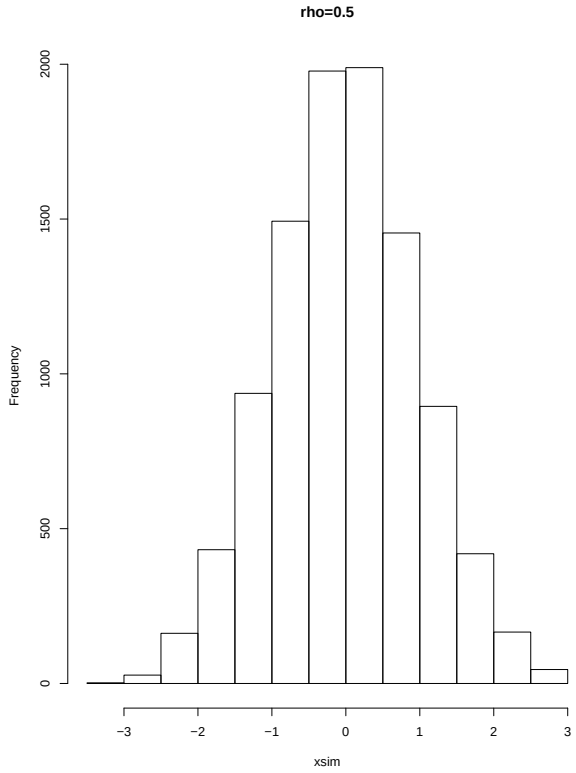
```
> library(ts)
> nsim <- 10000
> xsim <- array (0,dim=c(nsim,1))
> xsim[1]<- 0

# Simulation with rho=0.1

> for(j in 2:nsim){
+ xcand <- runif(1,min=-xsim[j-1]-0.1,max=-xsim[j-1]+0.1)
+ test <- min(dnorm(xcand)/dnorm(xsim[j-1]),1)
+ rho <- (runif(1)<test)
+ xsim[j]<- xcand*rho+xsim[j-1]*(1-rho)
+ }
> hist(xsim,main="rho=0.1")
> acf(xsim,main="rho=0.1")

# Simulation with rho=0.5

>for(j in 2:nsim){
+ xcand<- runif(1,min=-xsim[j-1]-0.5,max=-xsim[j-1]+0.5)
+ test <- min(dnorm(xcand)/dnorm(xsim[j-1]),1)
+ rho <- (runif(1) < test)
+ xsim[j] <- xcand*rho+xsim[j-1]*(1-rho)
+ }
> hist(xsim,main="rho=0.5")
> acf(xsim,main="rho=0.5")
```

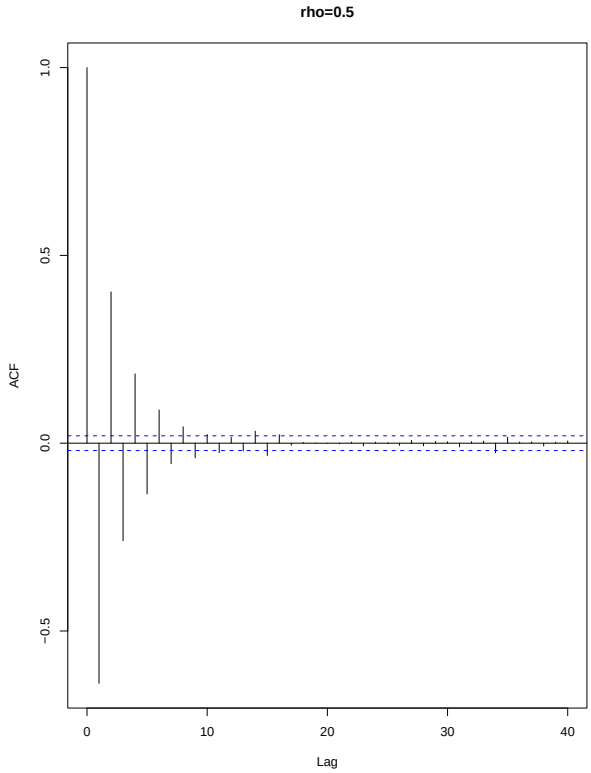
```
# Simulation with rho=1
> for(j in 2:nsim){
+ xcand <- runif(1,min=-xsim[j-1]-1,max=-xsim[j-1]+1)
+ test <- min(dnorm(xcand)/dnorm(xsim[j-1]),1)
+ rho <- (runif(1) < test)
+ xsim[j]<- xcand*rho+xsim[j-1]*(1-rho)
+ }
> hist(xsim,main="rho=1")
> acf(xsim,main="rho=1")
```

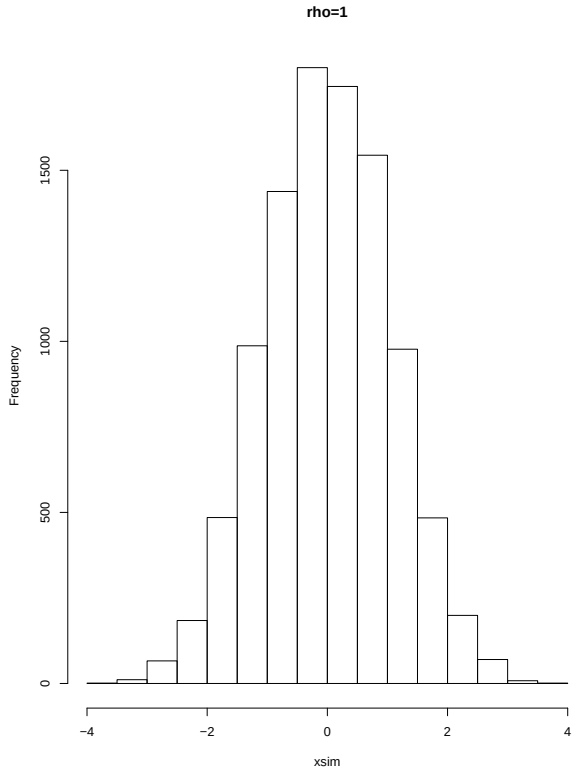
All the graphs are on the next three pages. We see that the correlation (in particular the negative correlation) between the $X^{(t)'}s$ becomes insignificant as $\delta$ increases.

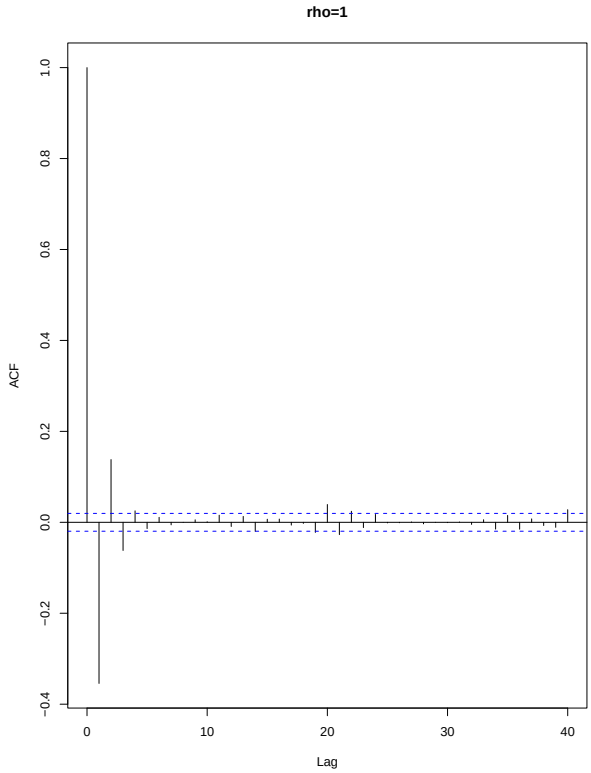

rho=0.1
Frequency
0
500
1000
1500
−3
−2
−1
0
1
2
3
xsim


rho=0.1
ACF
−0.5
0.0
0.5
1.0
0
10
20
30
40
Lag


rho=0.5
Frequency
0
500
1000
1500
2000
−3
−2
−1
0
1
2
3
xsim


rho=0.5
ACF
−0.5
0.0
0.5
1.0
0
10
20
30
40
Lag


rho=1
Frequency
0
500
1000
1500
−4
−2
0
2
4
xsim


rho=1
ACF
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Lag