

6.6

(b)

$N = 10^5$

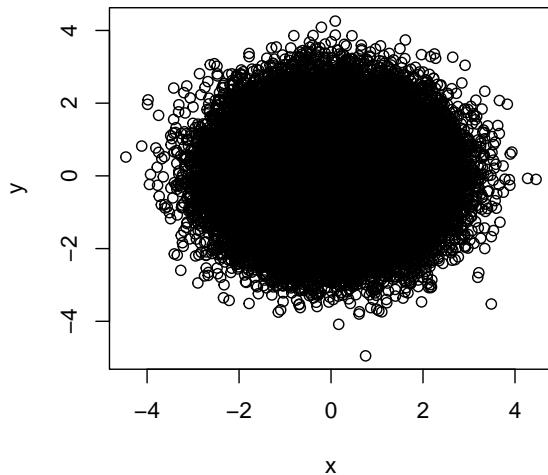
```
# initialize
y = x = rnorm(1, 0, 1)

for(r in c(0, 0.7, 0.9)){
  for(i in 1:N){
    y[i+1] = rnorm(1, r * x[i], sqrt(1 - r^2))
    x[i+1] = rnorm(1, r * y[i+1], sqrt(1 - r^2))
  }

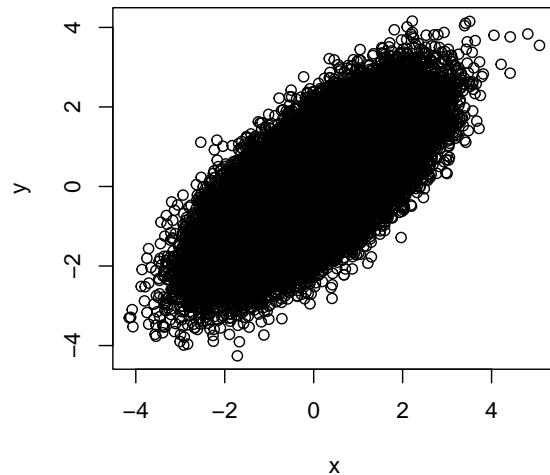
  x = x[-1]
  y = y[-1]

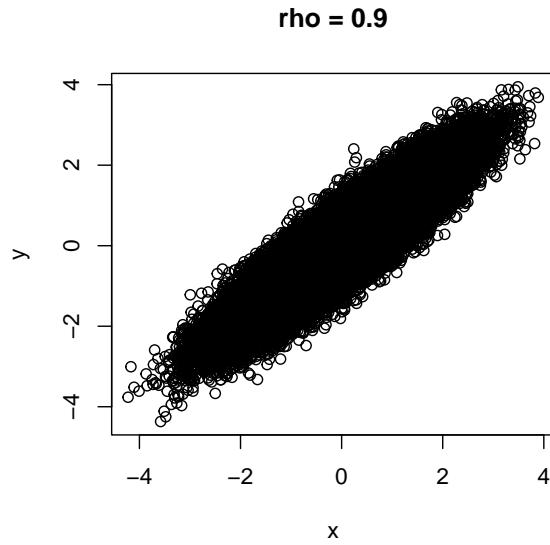
  plot(x, y, main = paste0("rho = ", r))
}
```

rho = 0



rho = 0.7





6.12

(c)

```
library(nimble)

## nimble version 0.12.1 is loaded.
## For more information on NIMBLE and a User Manual,
## please visit https://R-nimble.org.

##
## 다음의 패키지를 부착합니다: 'nimble'

## The following object is masked from 'package:stats':
## 
##     simulate

N = 10^5
n = 100
x = rnorm(n)

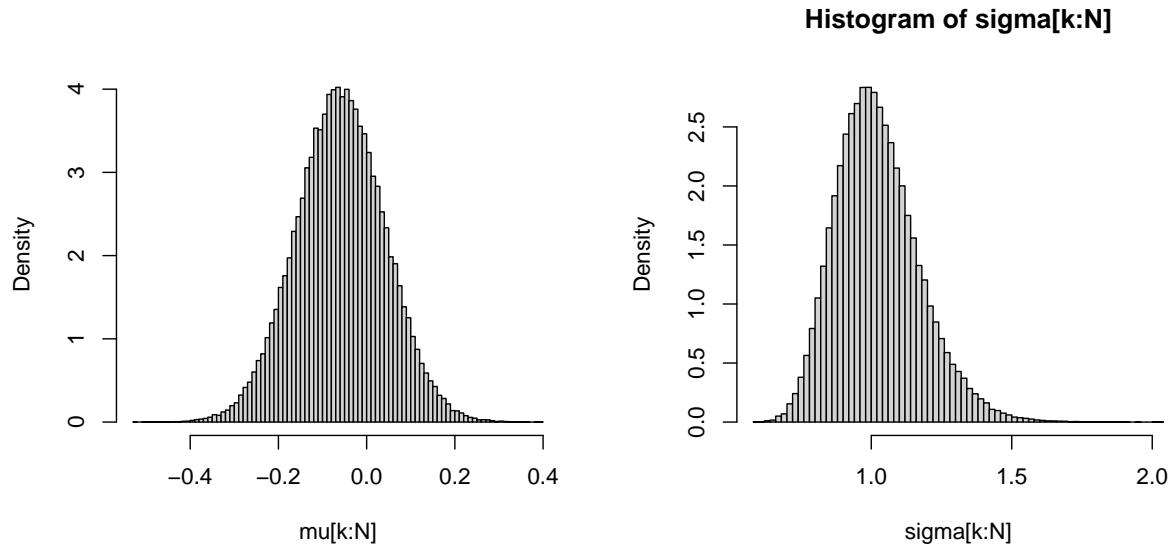
# initialize
mu = mean(x)
sigma = var(x)

for(i in 1:N){
  mu[i+1] = rnorm(1, mean(x), sqrt(sigma[i]/n))
  V = sum(x^2)/n - 2 * mu[i+1] * mean(x) + mu[i+1]^2
  sigma[i+1] = 1/rgamma(1, n / 2, n * V / 2)
}

mu = mu[-1]
sigma = sigma[-1]

k = 100
hist(mu[k:N], breaks = 100, freq = FALSE, main = "")
```

```
hist(sigma[k:N], breaks = 100, freq = FALSE)
```



6.14

- (b) generate random sample from ZIP model

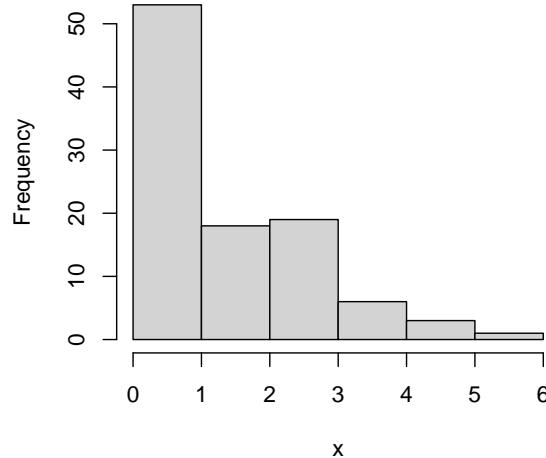
```
set.seed(111)

n = 100
p = 0.3
lambda = 2

ZIP = function(n){ sample(0:1, 1, prob = c(p, 1-p)) * rpois(1, lambda) }

x = replicate(n, ZIP(x))
hist(x, main = "random sampling for ZIP")
```

random sampling for ZIP



(c) Gibbs sampler for generate ZIP

```

set.seed(111)

N = 10^5
n = 100
p = 0.3
lambda = 2
a = b = 1

ZIP = function(n){ sample(0:1, 1, prob = c(p, 1-p)) * rpois(1, lambda) }
x = replicate(n, ZIP(x))

# initialize
r = sample(0:1, n, replace = TRUE, prob = c(p, 1 - p))

for(i in 1:N){
  lambda[i+1] = rgamma(1, a + sum(x), b + sum(r))
  p[i+1] = rbeta(1, 1 + sum(r), n + 1 - sum(r))
  pp = ifelse(x == 0, (p[i+1] * exp(-lambda[i+1]))/(p[i+1] * exp(-lambda[i+1]) + 1 - p[i+1]), 1)
  r = ifelse(runif(n) < pp, 0, 1)
}

k = 1000
hist(lambda[k:N], breaks = 100, main = "random sampling for ZIP")
quantile(lambda, c(0.025,0.975))

##      2.5%    97.5%
## 3.606363 4.965235

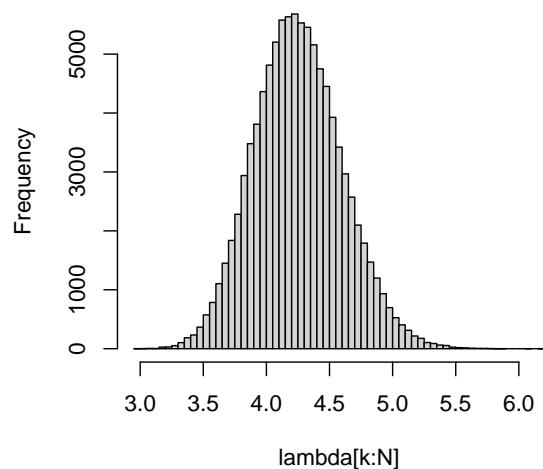
hist(p[k:N], breaks = 100, main = "random sampling for ZIP")
quantile(p, c(0.025,0.975))

##      2.5%    97.5%

```

```
## 0.2693674 0.4561234
```

random sampling for ZIP



random sampling for ZIP

