Computational Statistics

Lab 4

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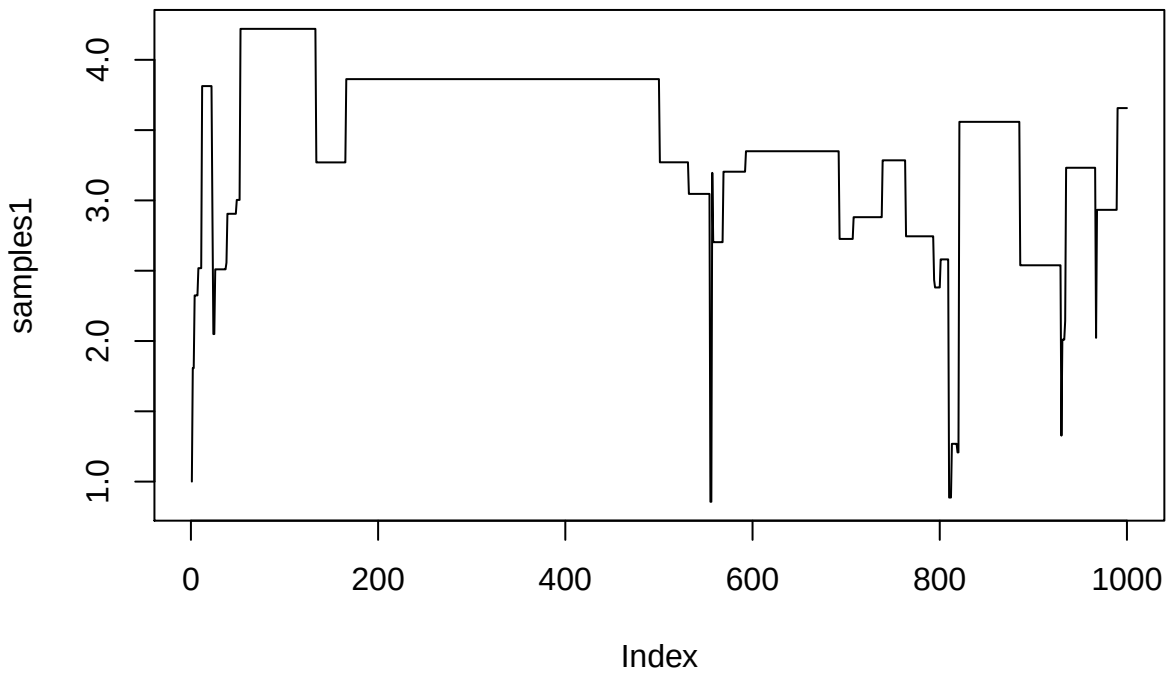
2017-02-15

```
targetdensity <- function(x) {
    x^5 * exp(-x)
}

lognormalfuncs <- list(propsample=function(x) { rlnorm(1, meanlog=x, sdlog=1) },
                       propdensity=function(x, y) { dlnorm(x, meanlog=y, sdlog=1) },
                       targdensity=targetdensity)

chisquarefuncs <- list(propsample=function(x) { rchisq(1, df=floor(x + 1)) },
                       propdensity=function(x, y) { dchisq(x, df=floor(y + 1)) },
                       targdensity=targetdensity)

metropolis_hastings <- function(X0, iters, funcs) {
    x <- X0
    values <- rep(0, iters)

    alpha <- function(x, y) {
        numerator <- funcs$targdensity(y) * funcs$propdensity(x, y)
        denominator <- funcs$targdensity(x) * funcs$propdensity(y, x)
        numerator / denominator
    }

    for (i in 1:iters) {
        y <- funcs$propsample(x)
        u <- runif(1)

        if (u < alpha(x, y)) {
            x = y
        }

        values[i] <- x
    }

    values
}

iters <- 1000
X0 <- 1

actual <- rgamma(iters, shape=6, rate=1)
```

```
set.seed(123456)
samples1 <- metropolis_hastings(X0=X0, iters=iters, funcs=lognormalfuncs)
mean(samples1)
```

```
## [1] 3.41514
```

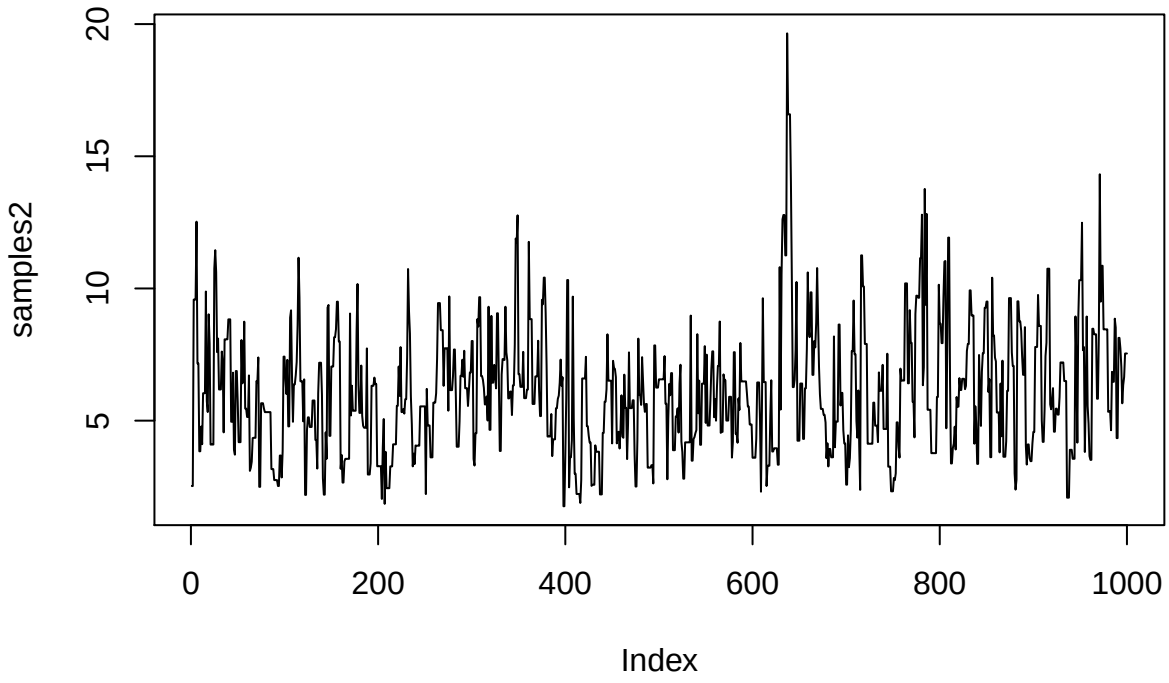
```r
plot(samples1, type="l")
```



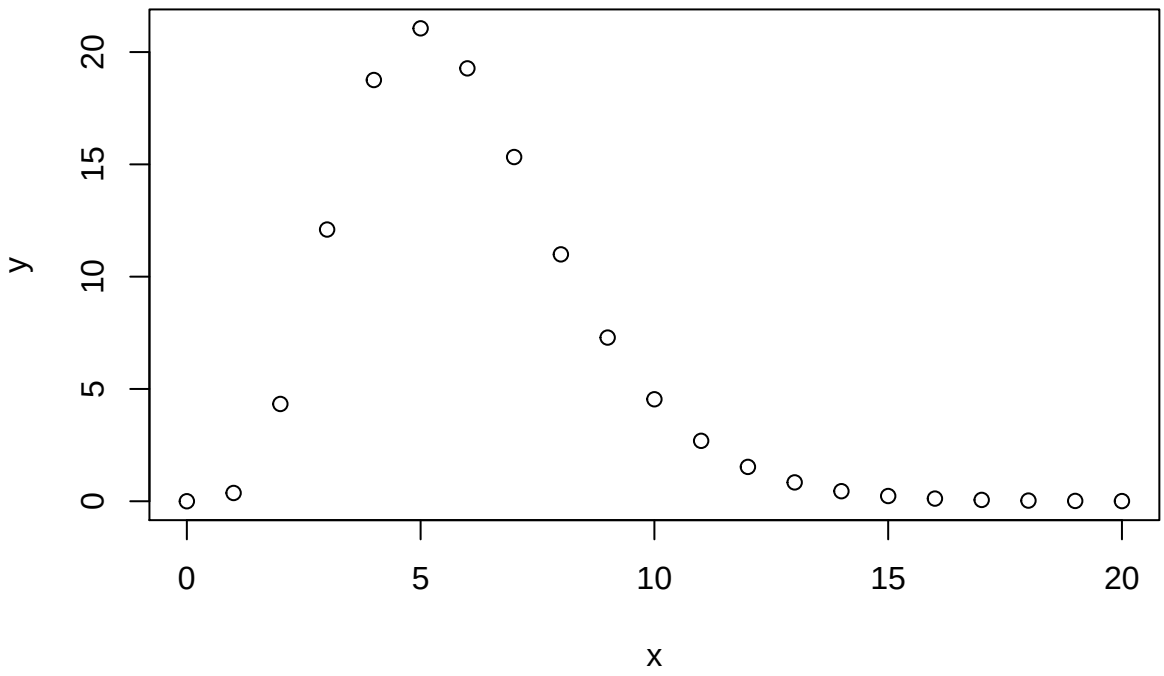

```r
set.seed(123456)
samples2 <- metropolis_hastings(X0=X0, iters=iters, funcs=chisquarefuncs)
mean(samples2)
```

```
## [1] 6.049705
```

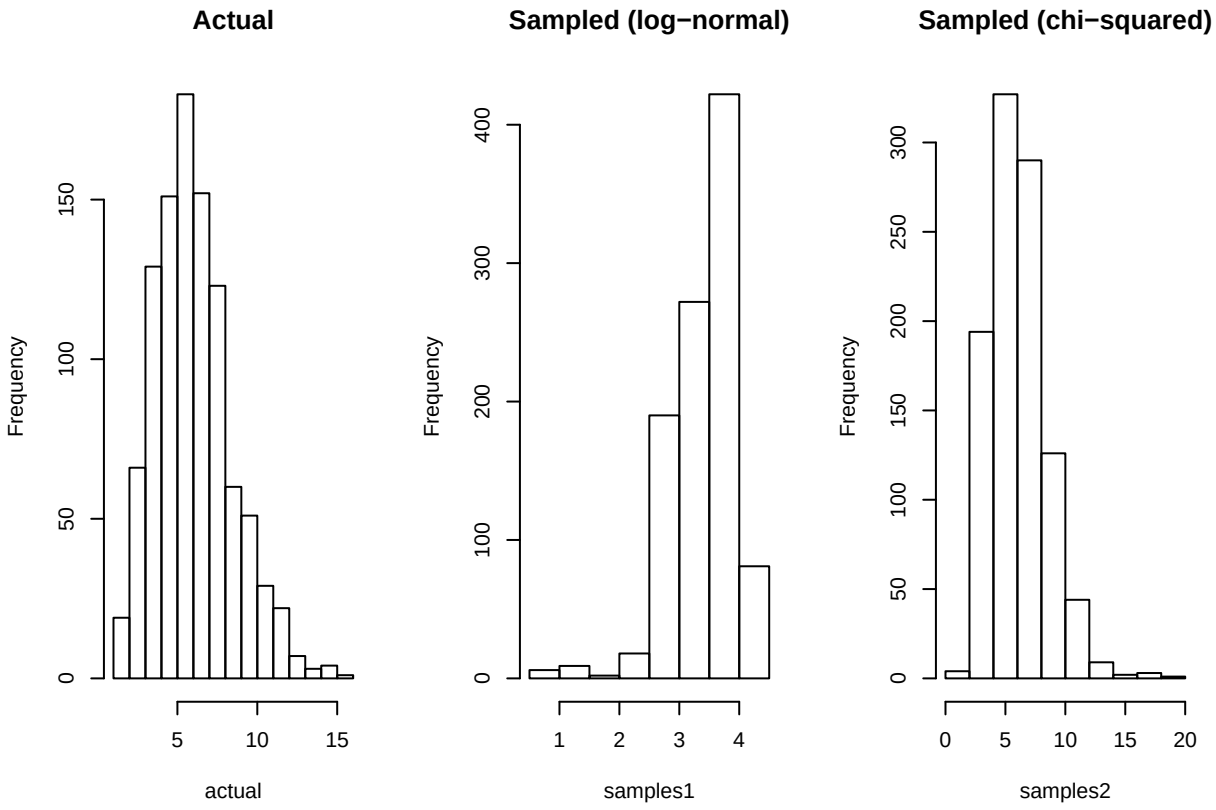
```r
plot(samples2, type="l")
```




```
x <- 0:20
y <- sapply(x, targetdensity)
plot(x, y)
```




```
oldpar <- par(mfrow = c(1, 3))

hist(actual, main="Actual")
hist(samples1, main="Sampled (log-normal)")
hist(samples2, main="Sampled (chi-squared)")
```


Actual
Frequency
0
50
100
150
5
10
15
actual
Sampled (log−normal)
Frequency
0
100
200
300
400
1
2
3
4
samples1
Sampled (chi−squared)
Frequency
0
50
100
150
200
250
300
0
5
10
15
20
samples2