histograms.R

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2022-10-23

```r
#https://bookdown.org/egarpor/NP-UC3M/kde-i-hist.html?fbclid=IwAR051kAZcAbnWJ-GdCRzVxWpqXQGAzuHB_2H9j0QGPZ1U3HLaF0gCCFJgpI
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.1.2
```

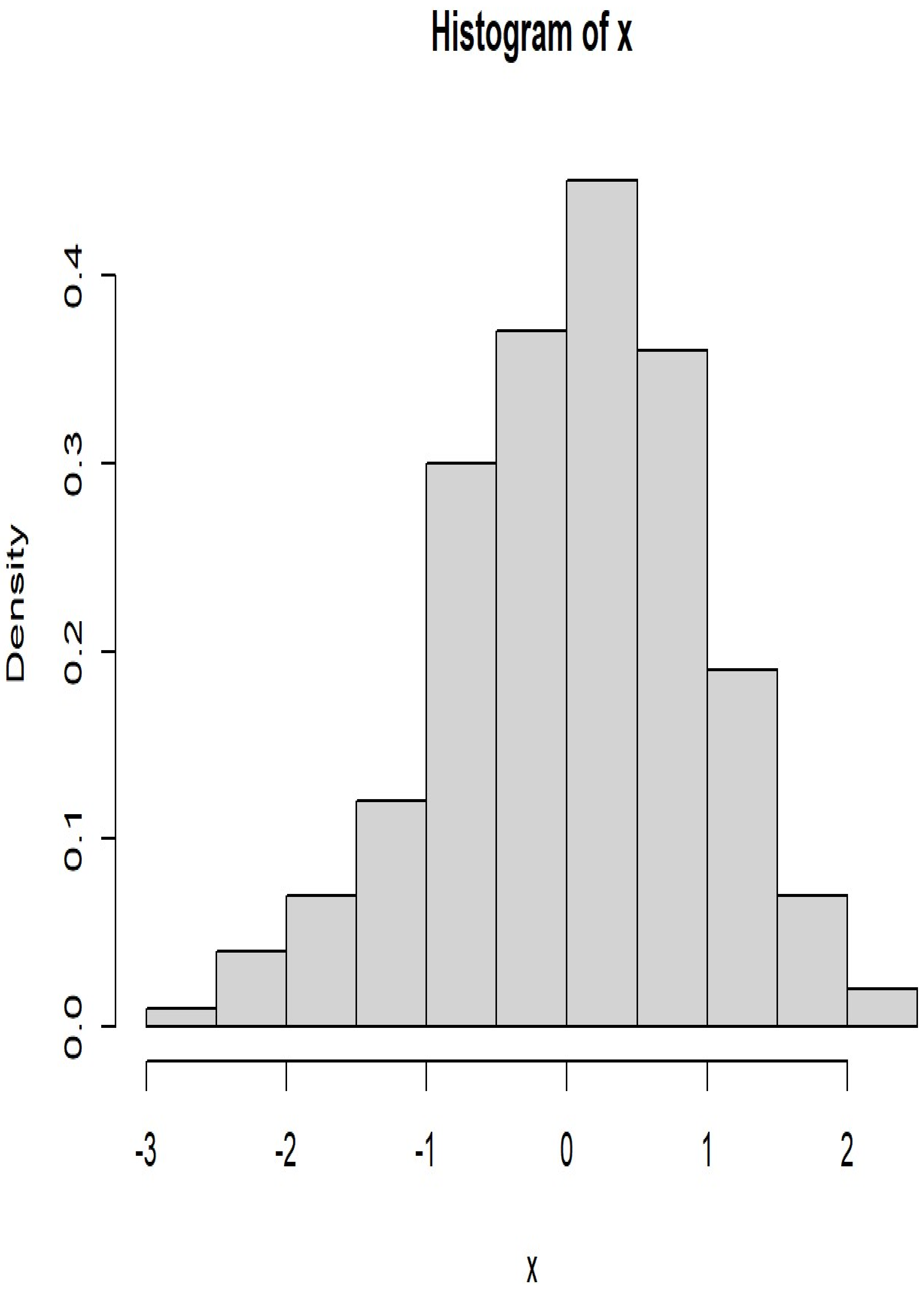
```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.6     v purrr   0.3.4
## v tibble  3.1.2     v dplyr   1.0.7
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1
```

```
## Warning: package 'ggplot2' was built under R version 4.1.3
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```r
n=200

x=rnorm(n)


hist(x,probability =TRUE)
```


Histogram of x
Density
0.0
0.1
0.2
0.3
0.4
-3
-2
-1
0
1
2
x

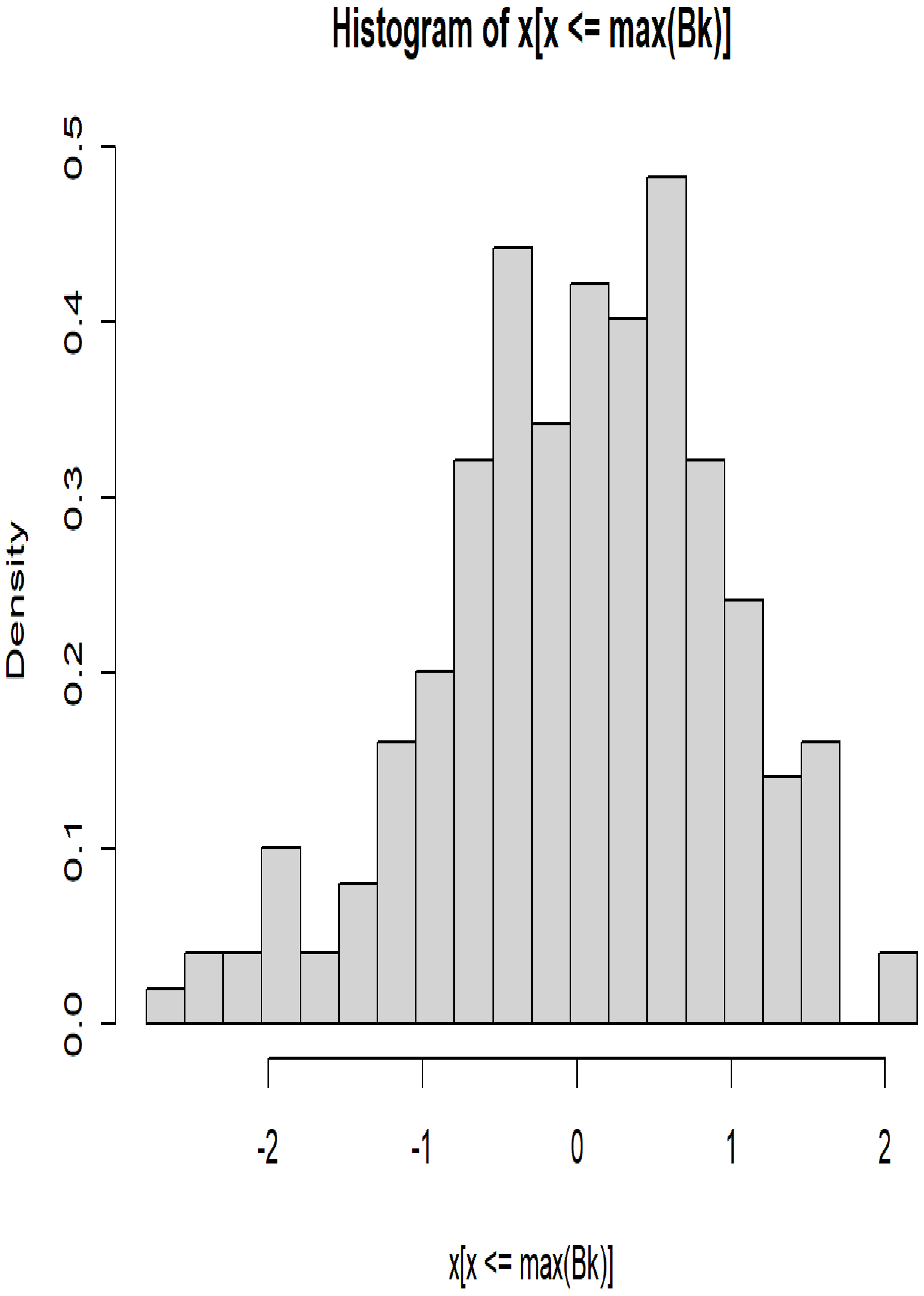
```
?hist
```

```
## starting httpd help server ...
```

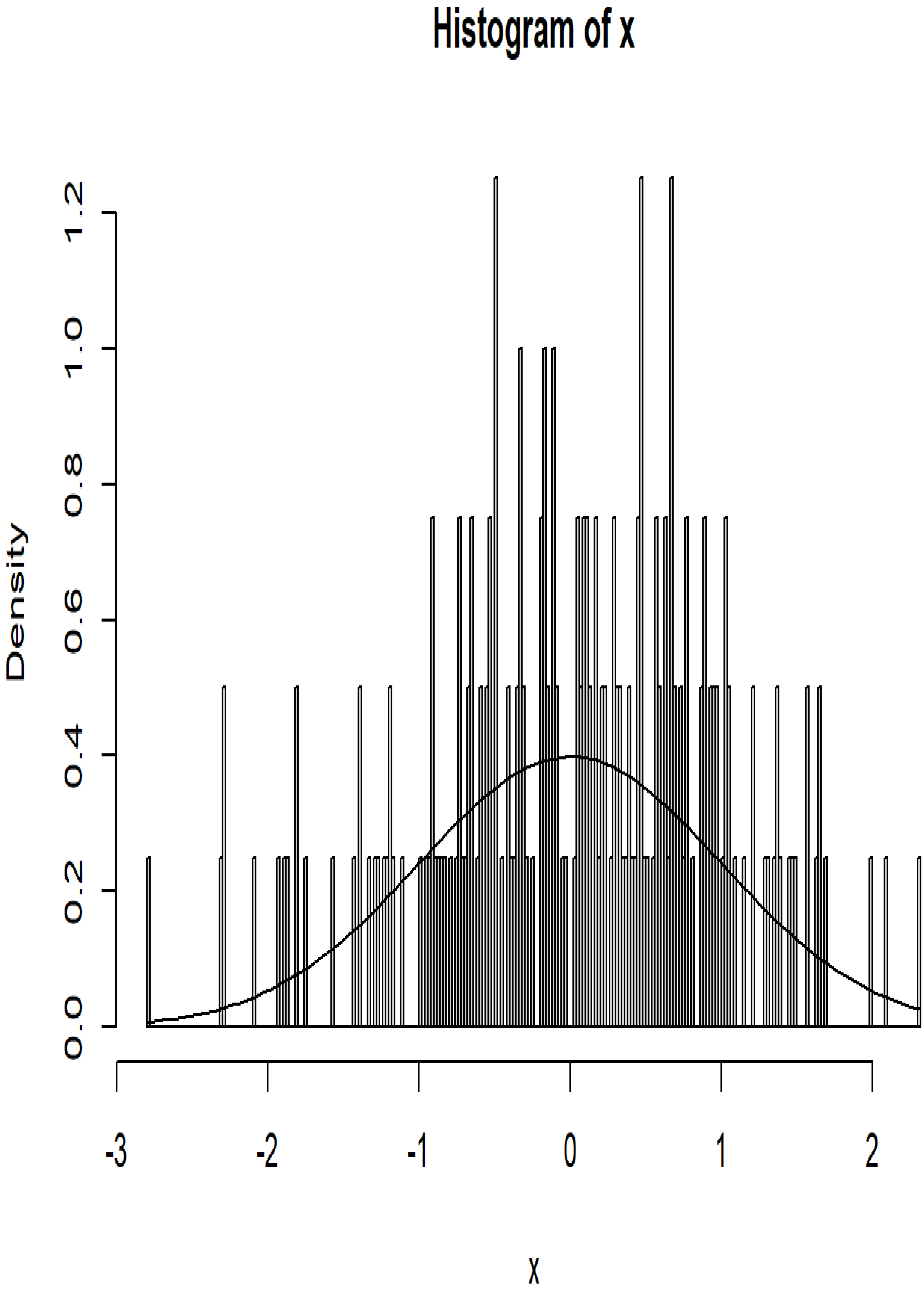
```
##  done
```

```
Bk <- seq(min(x), max(x), by = 0.25)
```

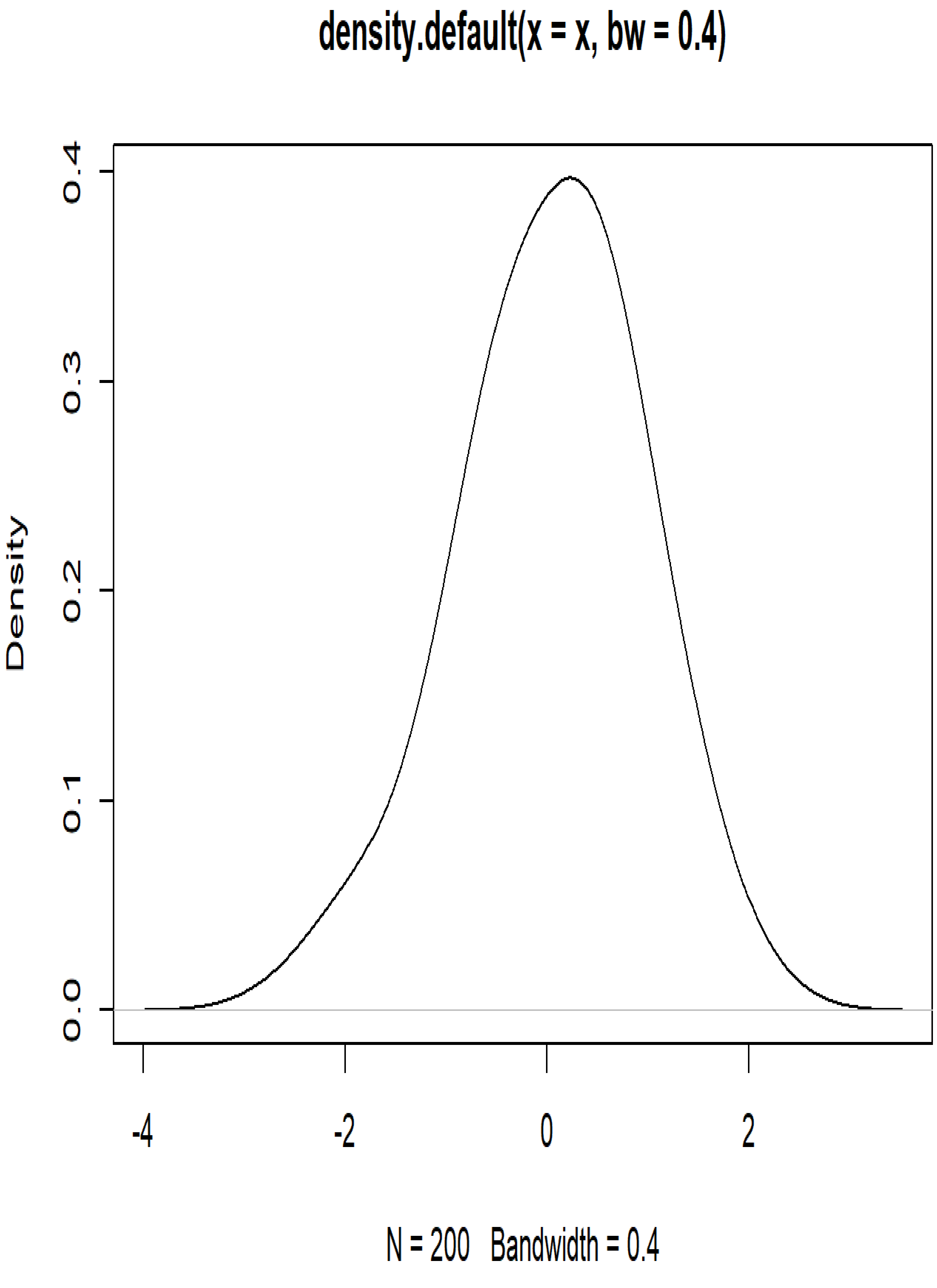
```
hist(x[x<=max(Bk)],probability=TRUE,breaks=Bk)
```


Histogram of x[x <= max(Bk)]
Density
0.0
0.1
0.2
0.3
0.4
0.5
-2
-1
0
1
2
x[x <= max(Bk)]

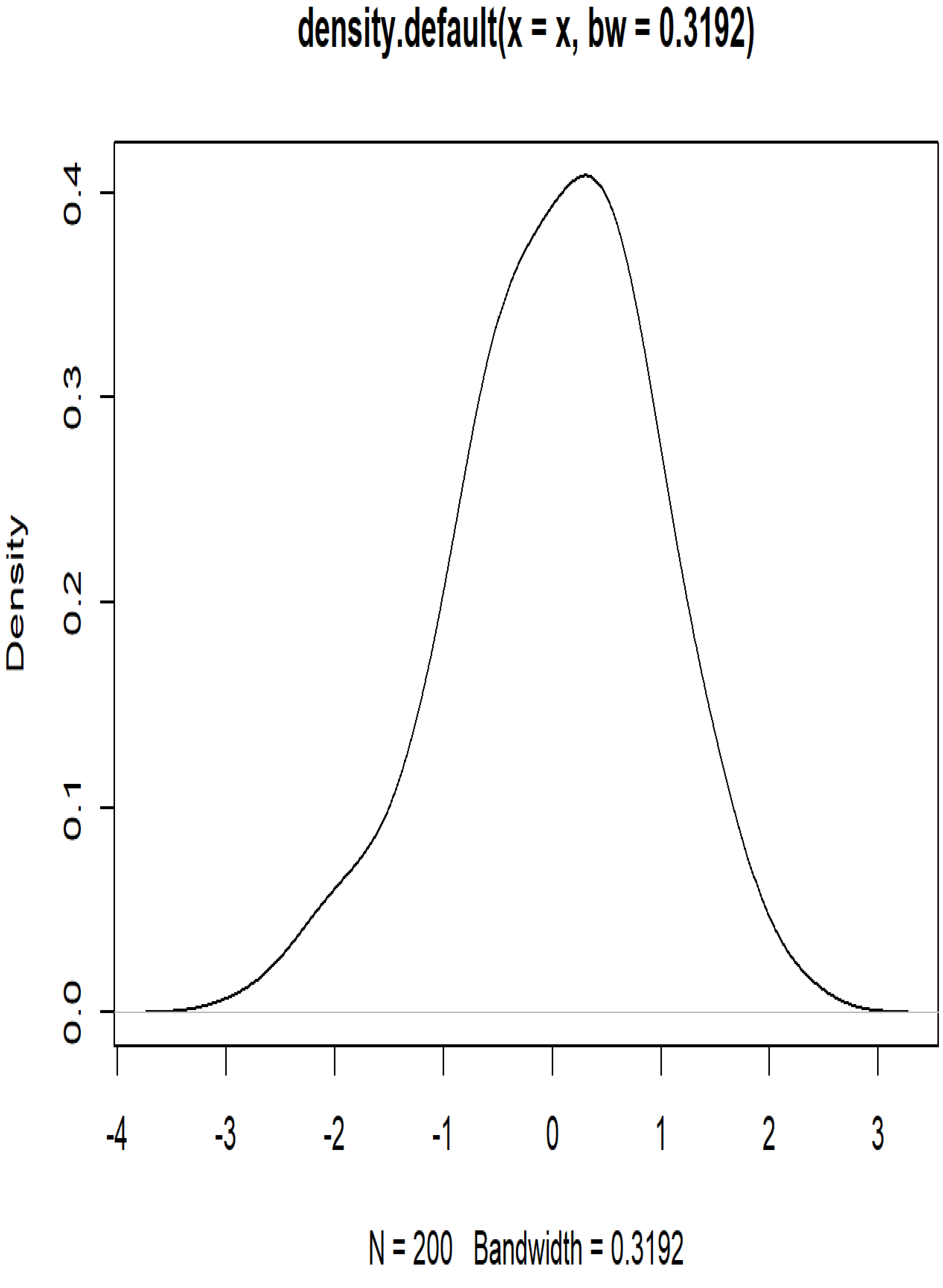
```
hist(x,probability=TRUE,breaks=n-1)
curve(dnorm(x, mean = 0, sd = 1),add=TRUE)
```


Histogram of x
Density
0.0
0.2
0.4
0.6
0.8
1.0
1.2
-3
-2
-1
0
1
2
x

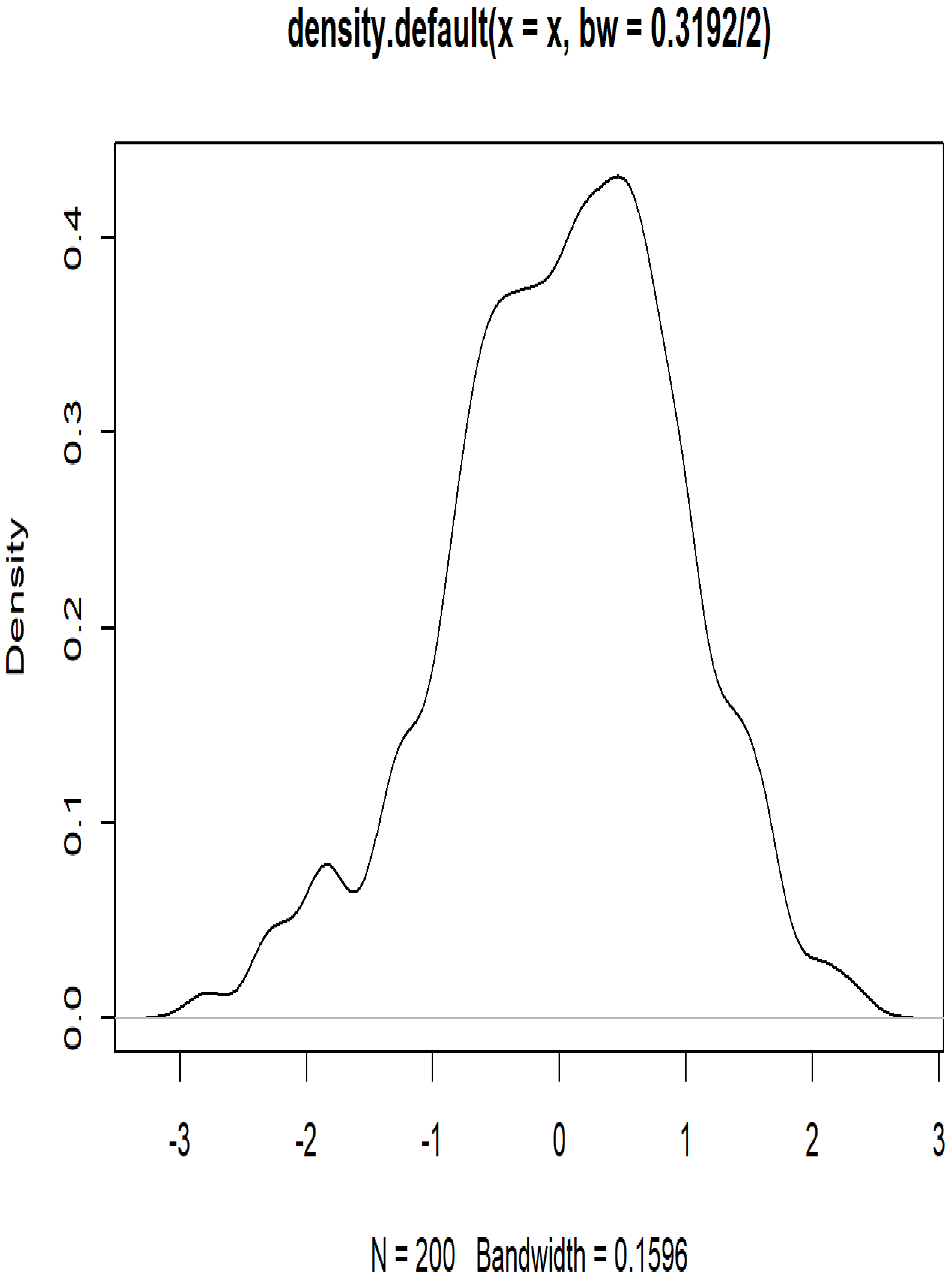
```
density(x,bw=0.4) %>% plot
```


density.default(x = x, bw = 0.4)
Density
0.0
0.1
0.2
0.3
0.4
-4
-2
0
2
N = 200   Bandwidth = 0.4

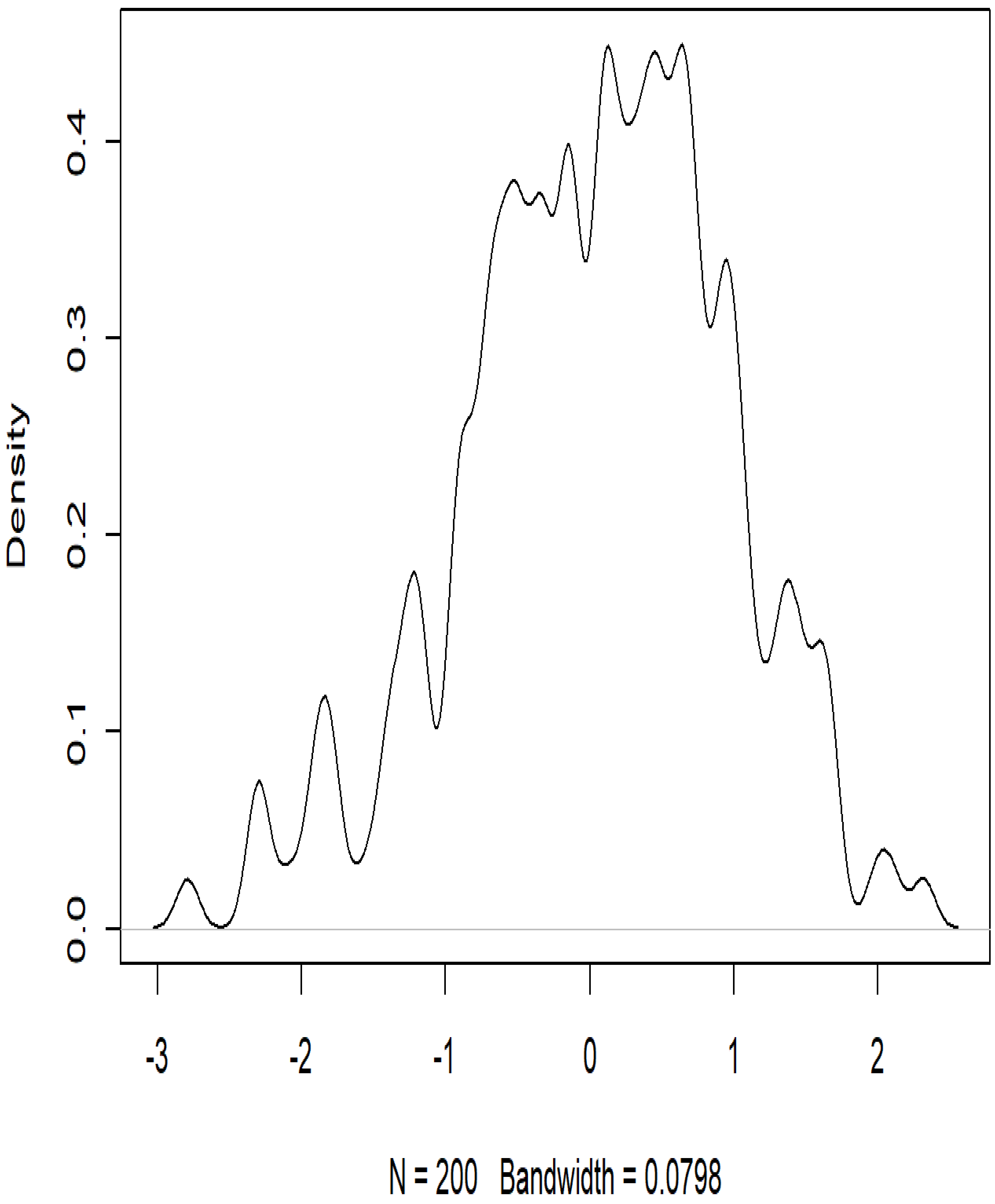
```
density(x,bw=0.3192) %>% plot
```


density.default(x = x, bw = 0.3192)
Density
0.0
0.1
0.2
0.3
0.4
-4
-3
-2
-1
0
1
2
3
N = 200   Bandwidth = 0.3192

```
density(x,bw=0.3192/2) %>% plot
```

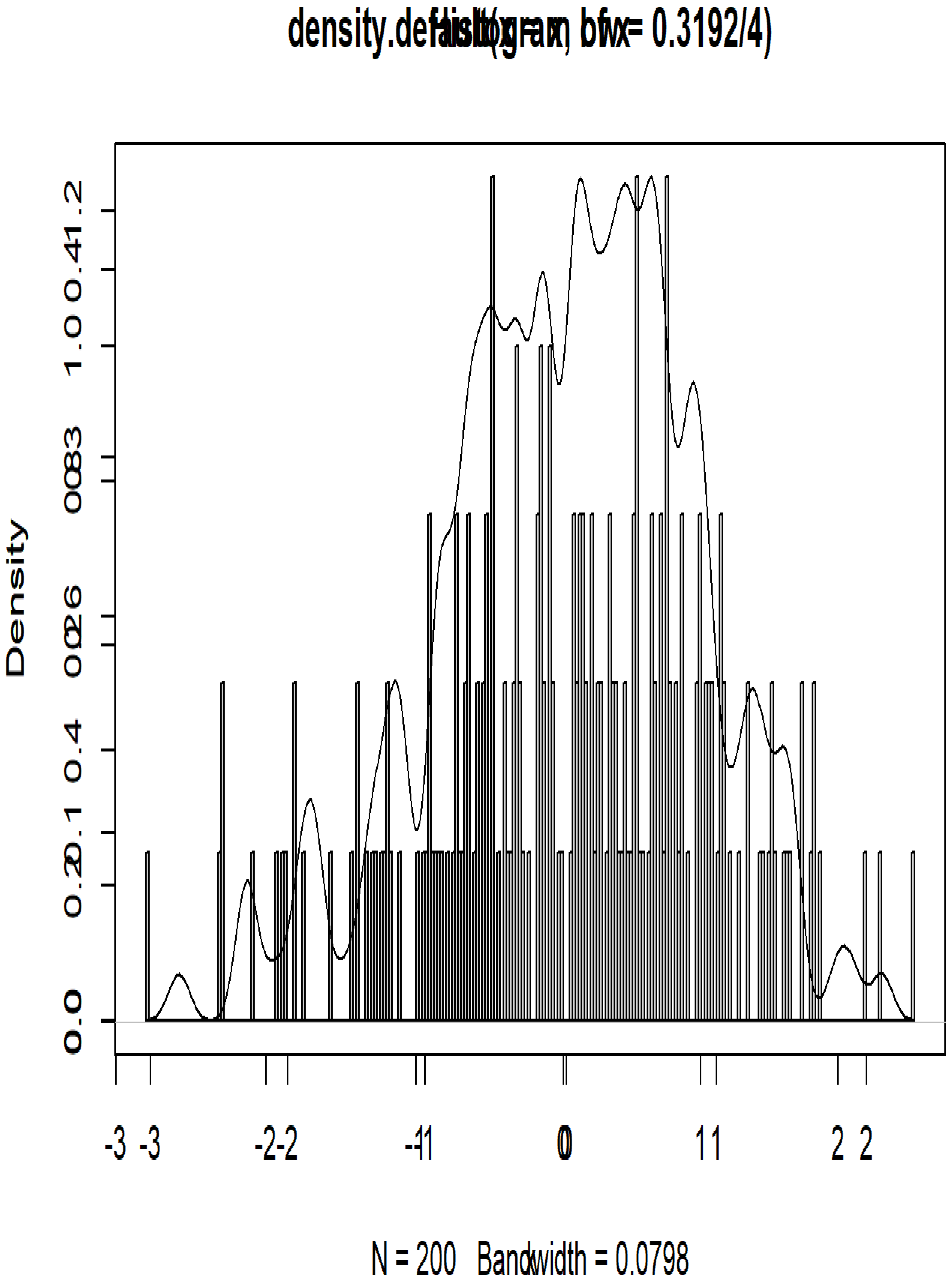

density.default(x = x, bw = 0.3192/2)
Density
0.0
0.1
0.2
0.3
0.4
-3
-2
-1
0
1
2
3
N = 200   Bandwidth = 0.1596

```
density(x,bw=0.3192/4) %>% plot
```



density.default(x = x, bw = 0.3192/4)

```
hist(x,probability=TRUE,breaks=n-1)
par(new=TRUE)
density(x,bw=0.3192/4) %>% plot()
```


density.default(x = x, bw = 0.3192/4)
Histogram of x
Density
0.0
0.1
0.2
0.3
0.4
0.2
0.4
0.6
0.8
1.0
1.2
-3
-3
-2
-2
-1
-1
0
0
1
1
2
2
N = 200   Bandwidth = 0.0798

```r
par(new=F)
```

```r
# Multivariate kernel density estimation ----------------------------------
```

```r
# Simulated data from a bivariate normal
n <- 200
set.seed(35233)

#mvtnorm::rmvnorm multivariate normal density random number generator

x <- mvtnorm::rmvnorm(n = n, mean = c(0, 0),
                      sigma = rbind(c(1.5, 0.25), c(0.25, 0.5)))


x %>% cor
```

```
##           [,1]      [,2]
## [1,] 1.0000000 0.2853801
## [2,] 0.2853801 1.0000000
```

```r
x[,1] %>% var
```

```
## [1] 1.558628
```

```r
x[,2] %>% var
```

```
## [1] 0.5344109
```

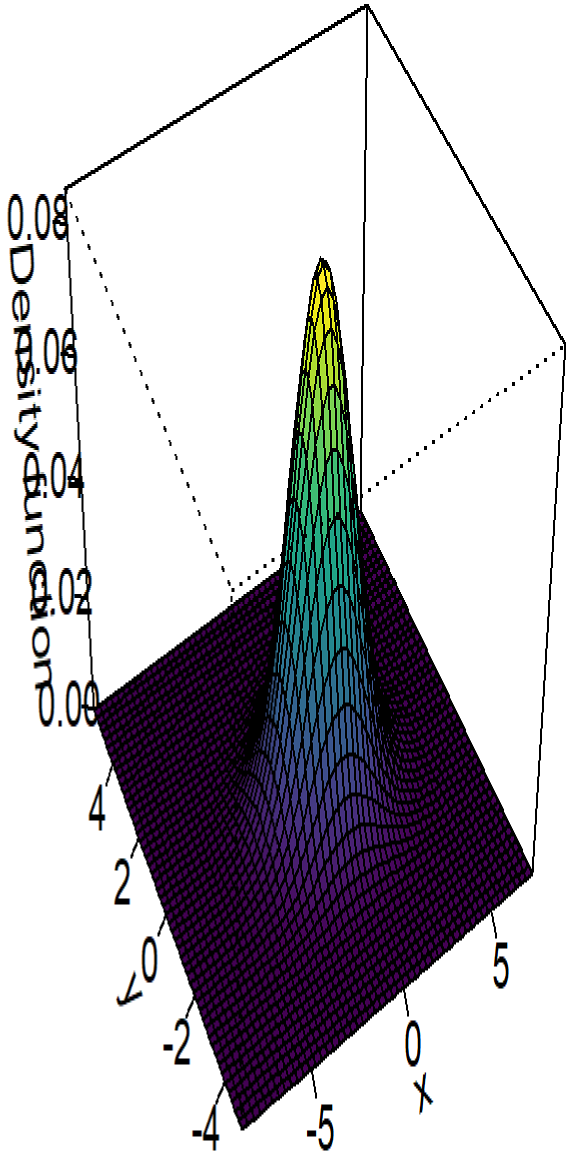
```r
x %>% cov
```

```
##           [,1]      [,2]
## [1,] 1.5586275 0.2604549
## [2,] 0.2604549 0.5344109
```

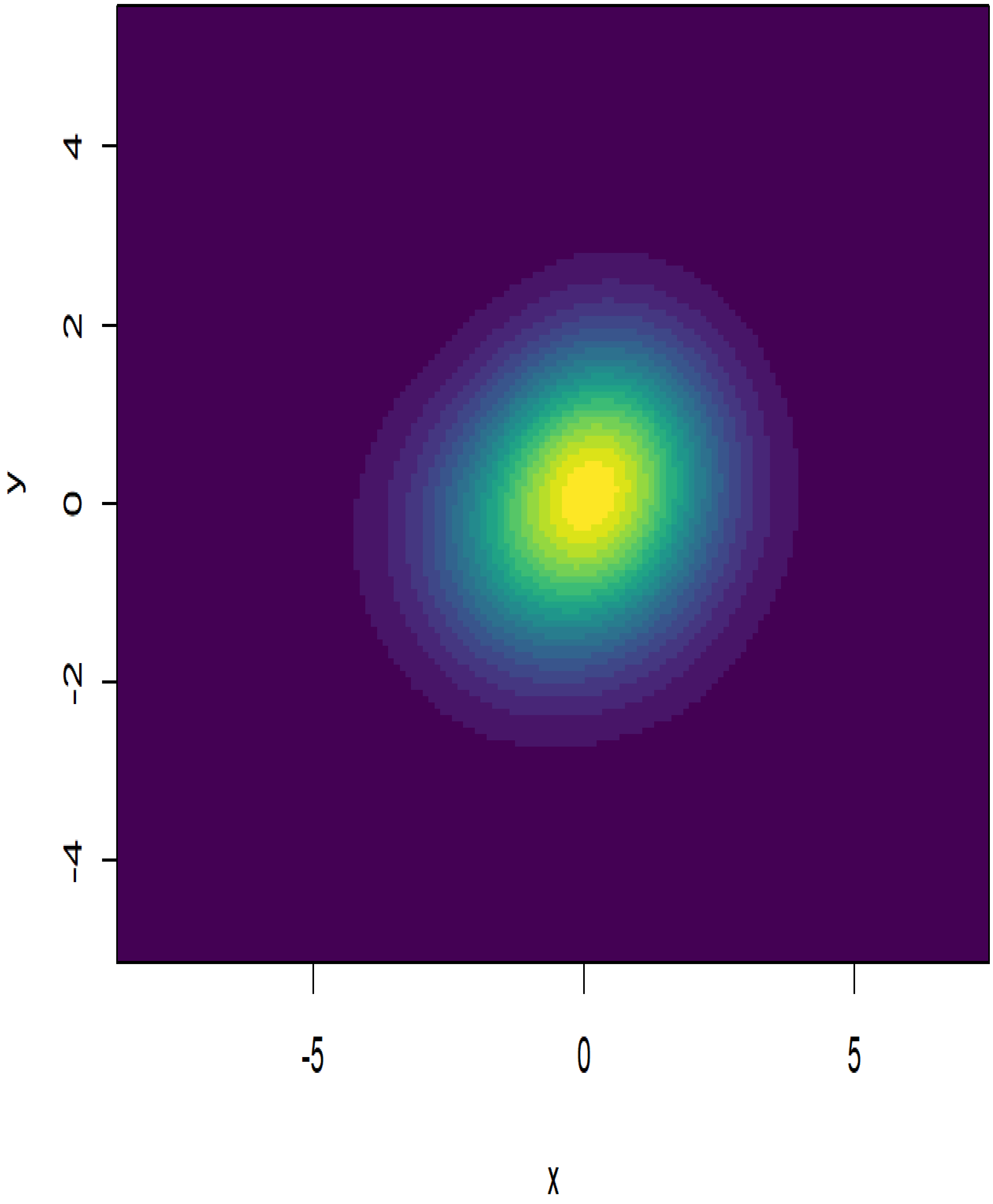
```r
pacman::p_load(ks)

H <- diag(c(1.25, 0.75)) # bandwidth matrix
```

```
kde <- ks::kde(x = x, H = H)
```

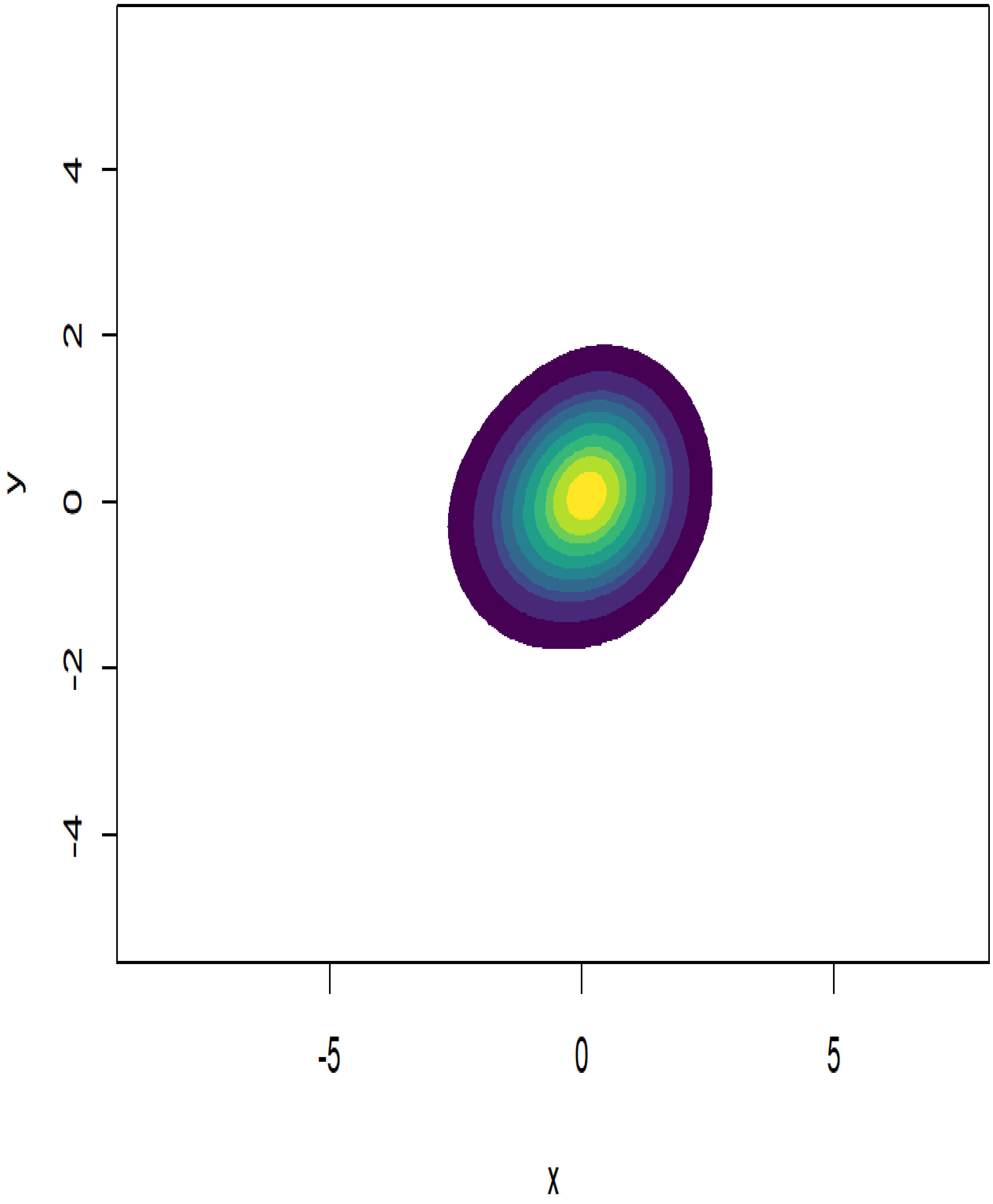
```
plot(kde, display = "persp", col.fun = viridis::viridis, xlab = "x", ylab = "y")
```


0.08
0.06
0.04
0.02
0.00
Density function
4
2
0
y
-2
-4
-5
0
x
5

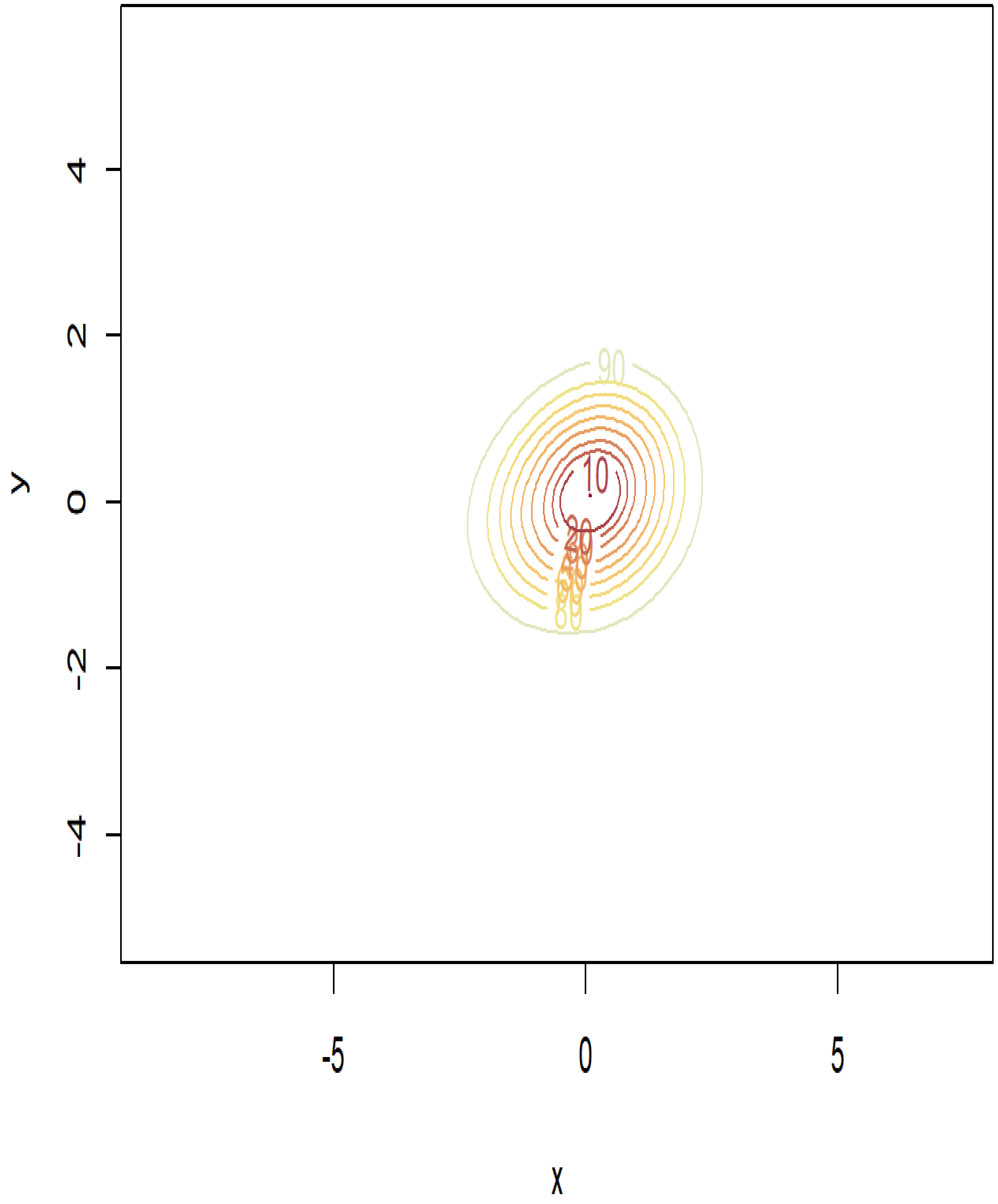
```r
plot(kde, display = "image", xlab = "x", ylab = "y", col = viridis::viridis(20))
```


4
2
0
-2
-4
y
-5
0
5
x

```
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```

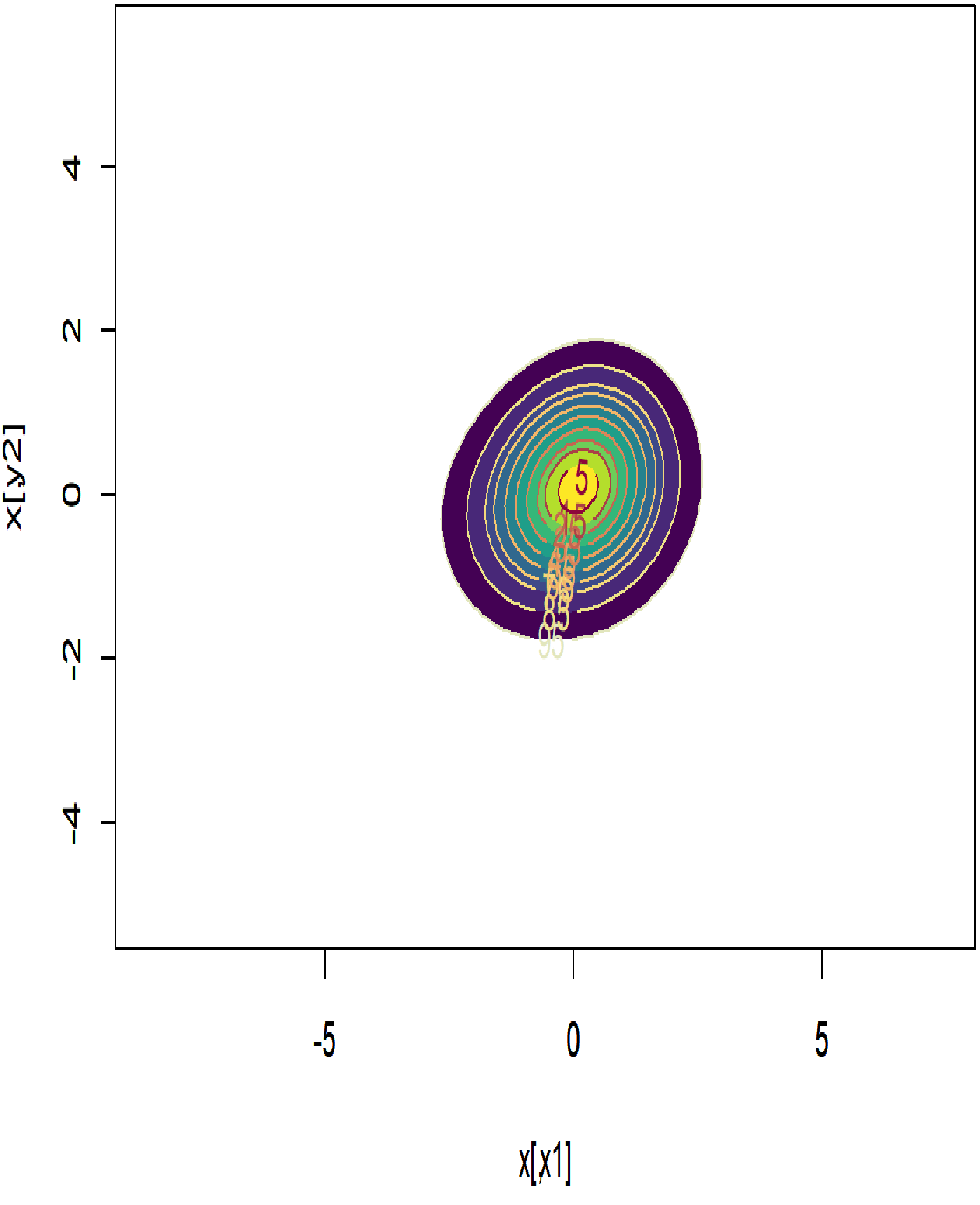

4
2
0
-2
-4
y
-5
0
5
x

```
plot(kde, display = "slice", cont = seq(0,95,by=10), xlab = "x", ylab = "y")
```



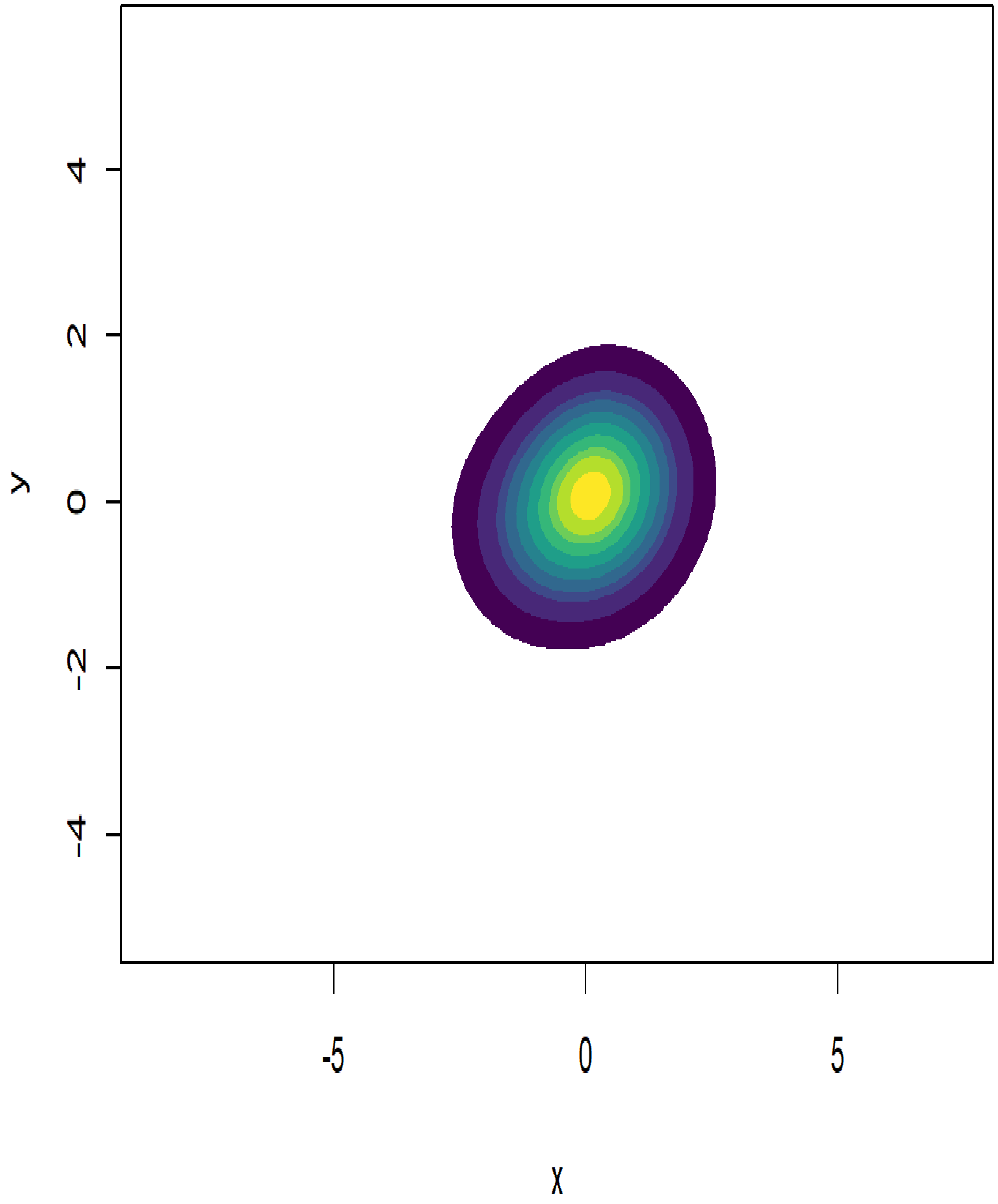
10
20
30
80
90
y
4
2
0
-2
-4
-5
0
5
x

```
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
par(new=T)
plot(kde, display = "slice", cont = seq(5, 95, by = 10))
```

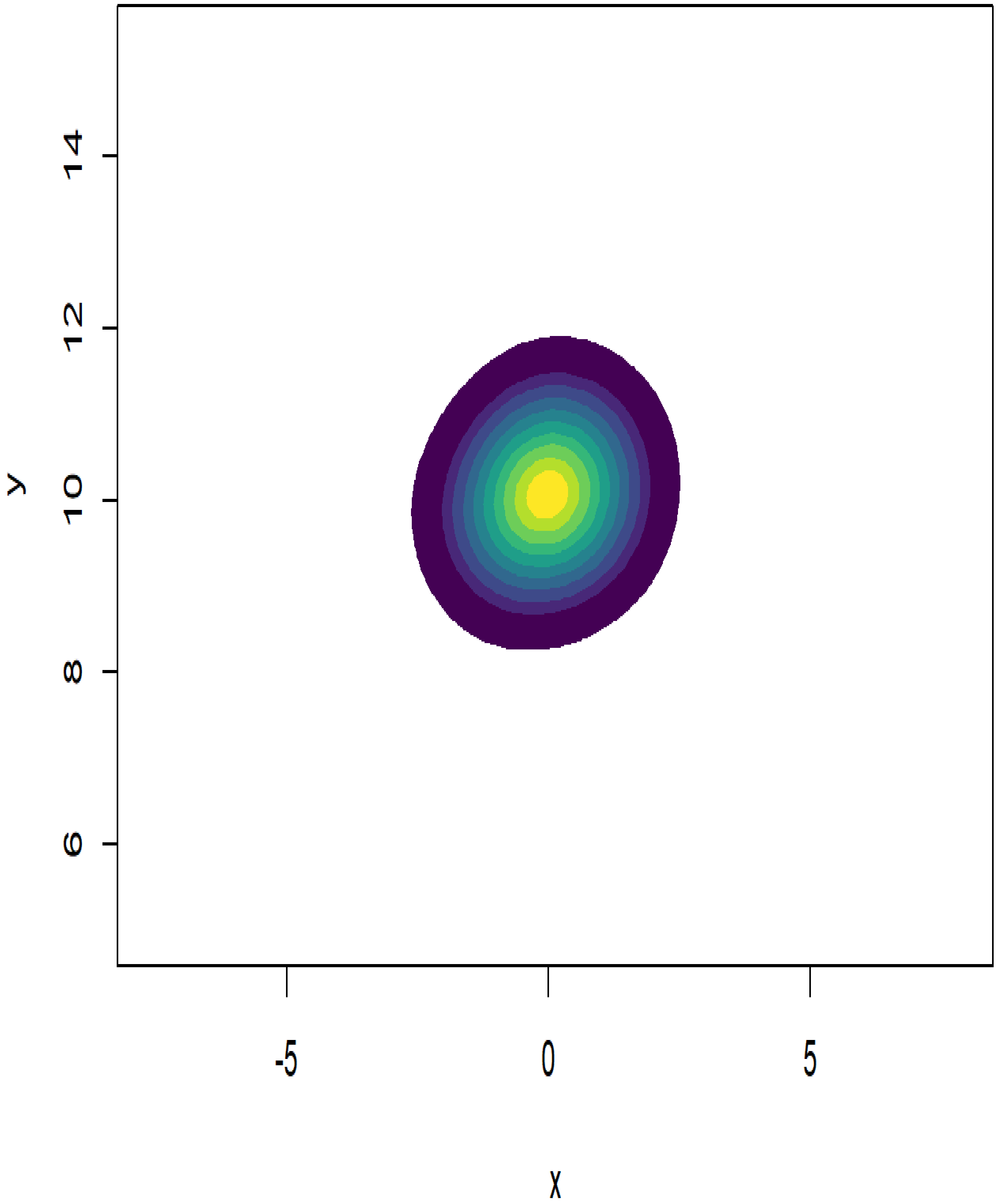

4
2
0
-2
-4
x[,y2]
-5
0
5
x[,x1]
5
15
25
95

```
par(new=F)
```

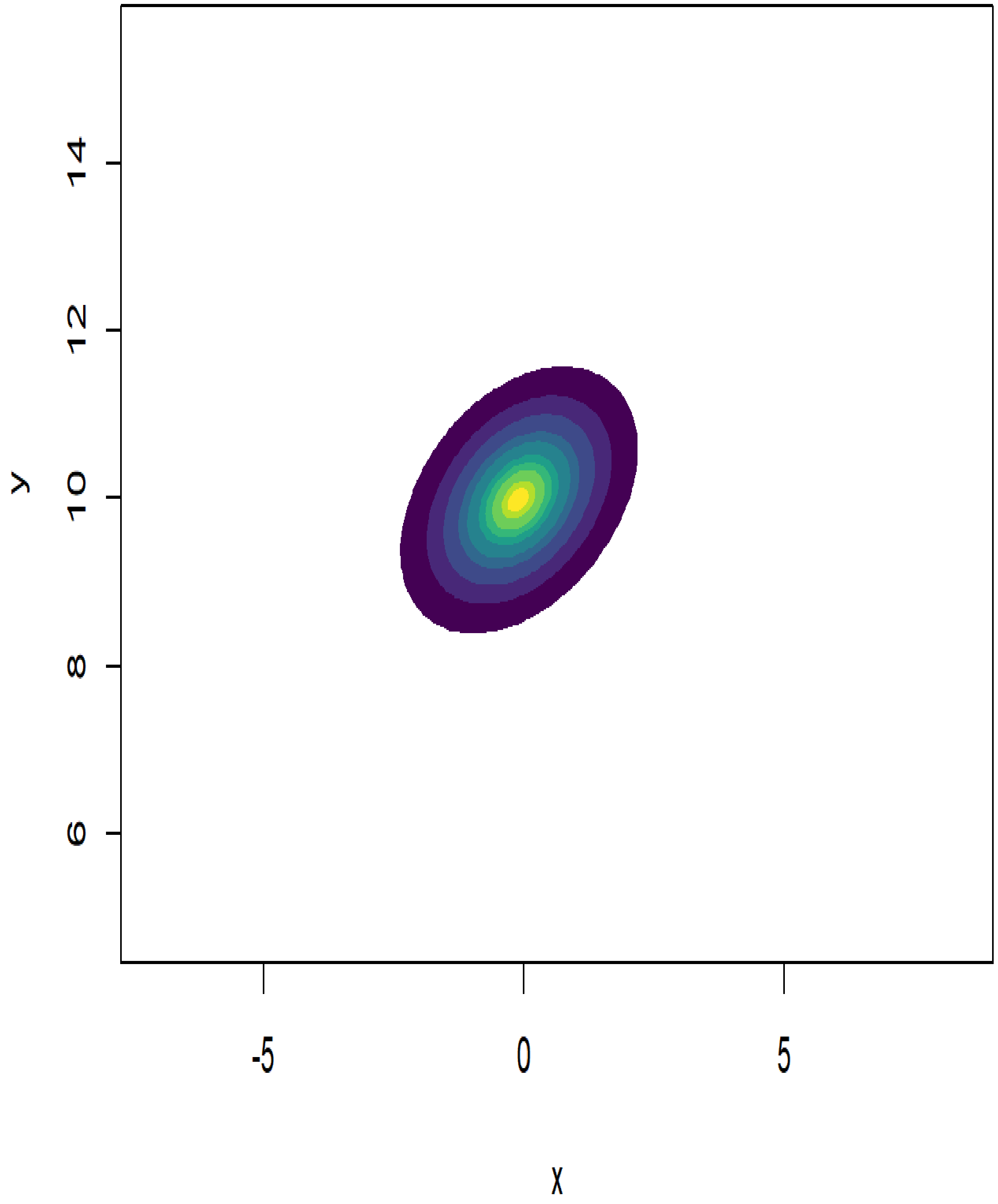
```
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```


4
2
0
-2
-4
y
-5
0
5
x

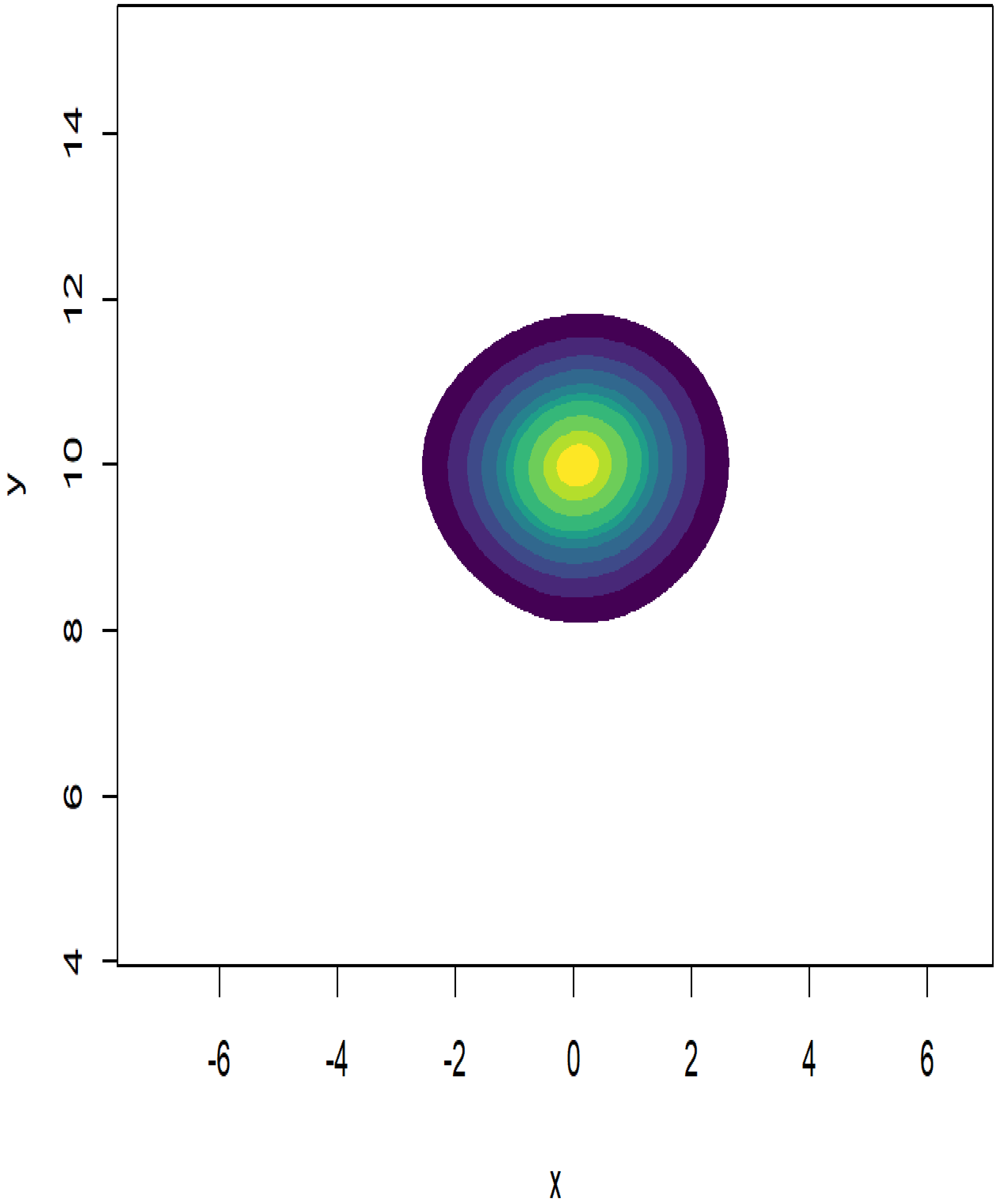
```
x <- mvtnorm::rmvnorm(n = n, mean = c(0, 10),
                      sigma = rbind(c(1.5, 0.25), c(0.25, 0.5)))

kde <- ks::kde(x = x, H = H)

plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```


y
14
12
10
8
6
-5
0
5
x

```
x <- mvtnorm::rmvnorm(n = n, mean = c(0, 10),
                      sigma = rbind(c(1.5, 0.8), c(0.8, 0.5)))

kde <- ks::kde(x = x, H = H)
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```

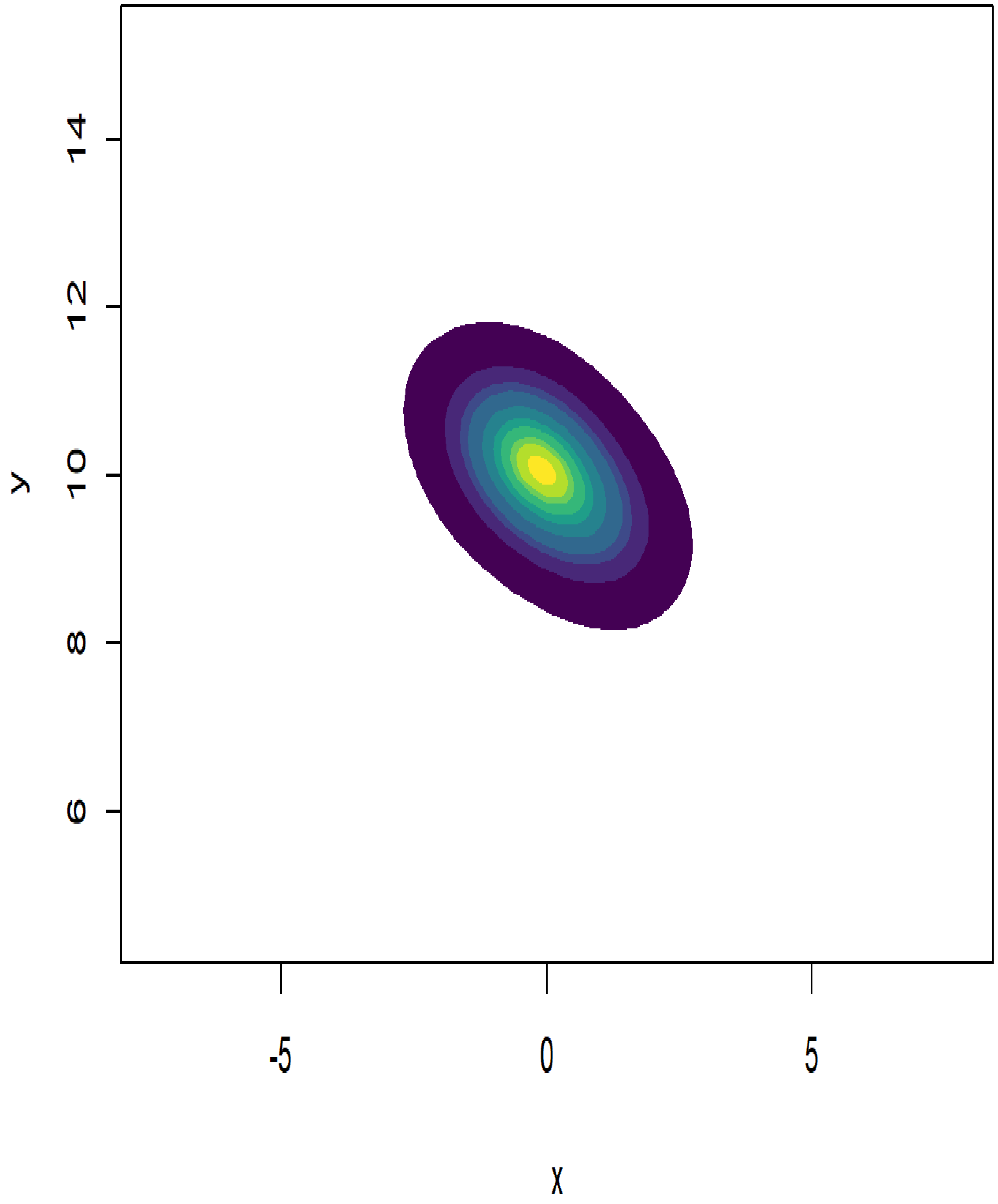

y
6
8
10
12
14
-5
0
5
x

```
x <- mvtnorm::rmvnorm(n = n, mean = c(0, 10),
                      sigma = rbind(c(1.5, 0.05), c(0.05, 0.5)))

kde <- ks::kde(x = x, H = H)
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```

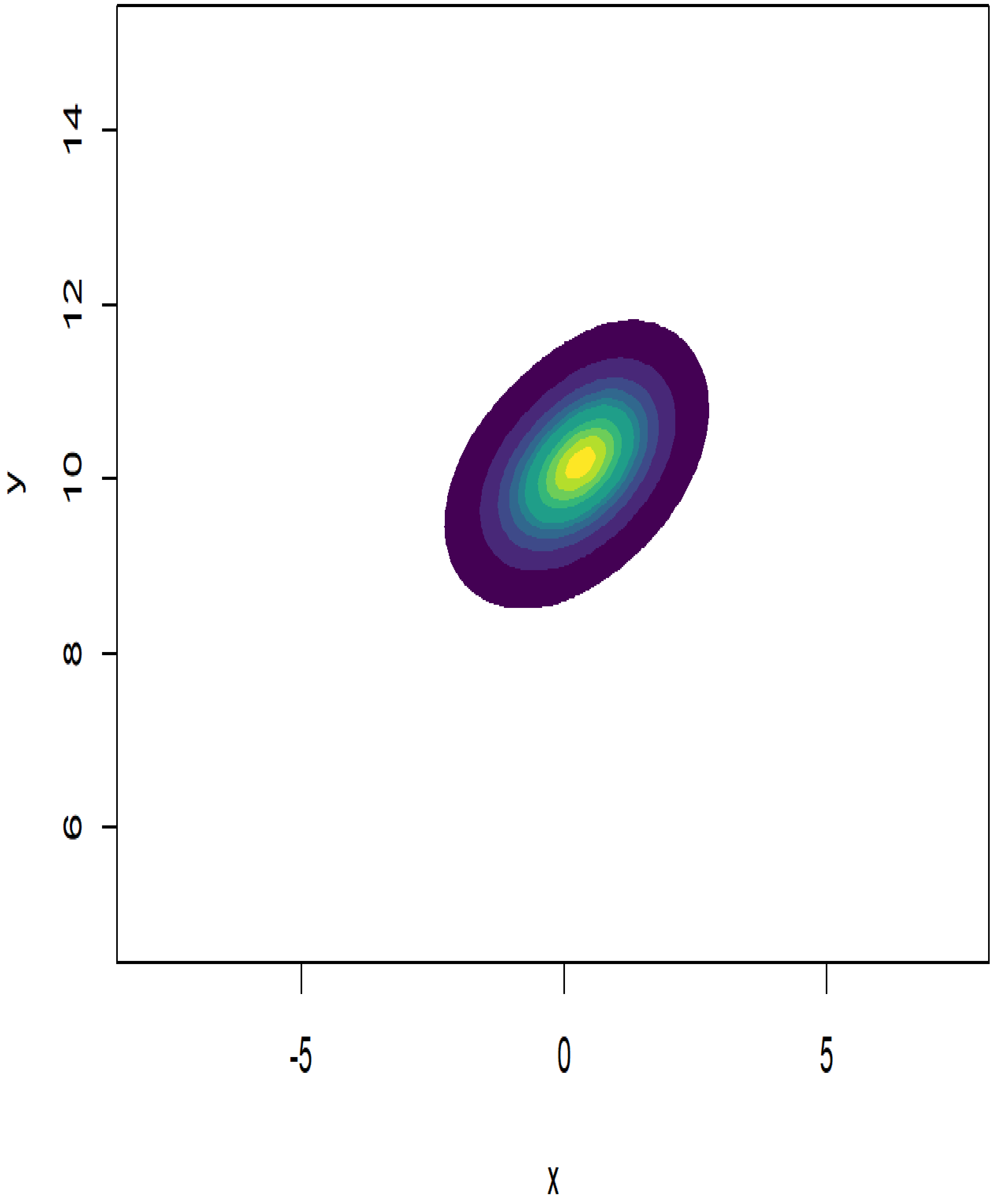


14
12
10
8
6
4
y
-6
-4
-2
0
2
4
6
x

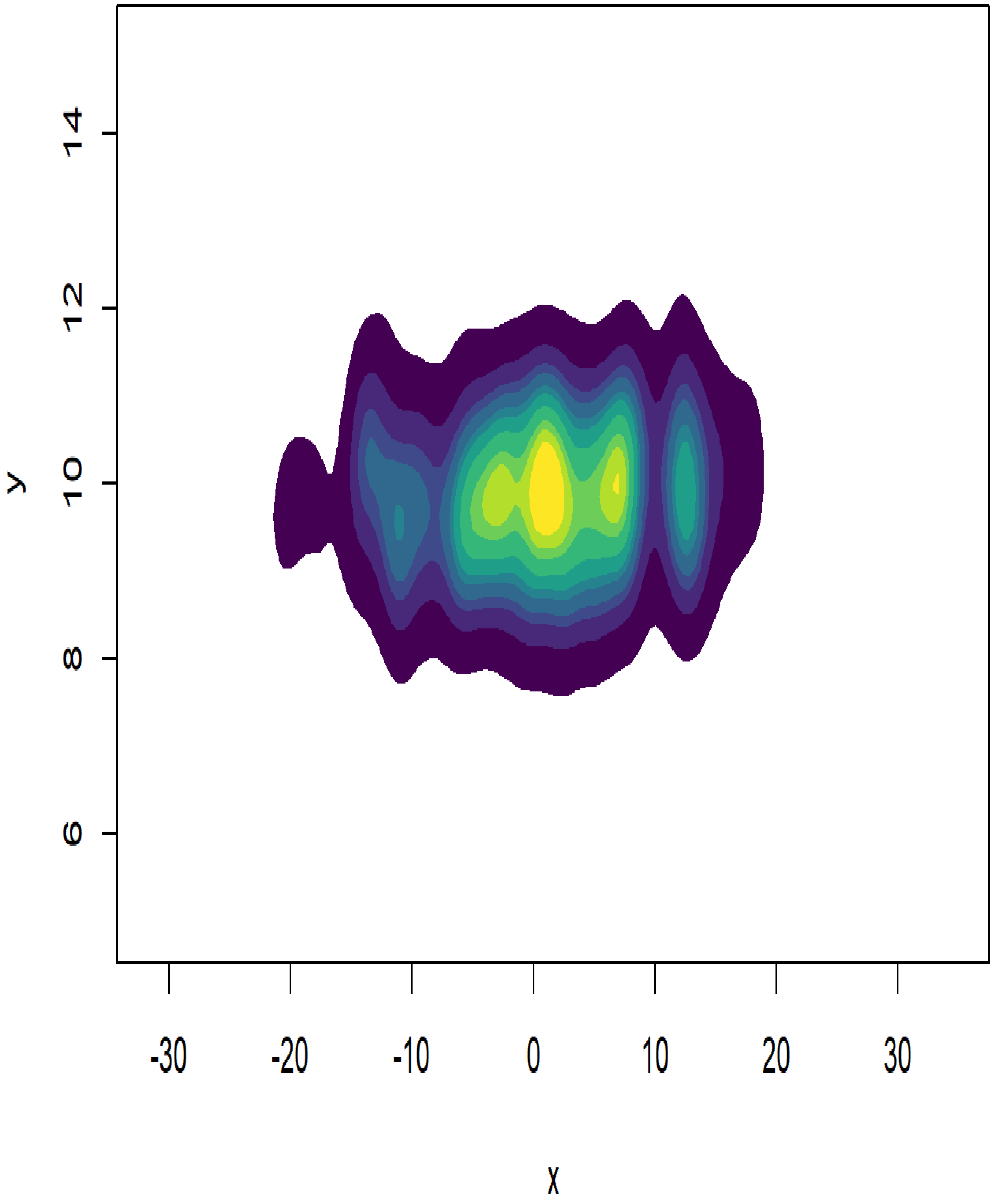
```
x <- mvtnorm::rmvnorm(n = n, mean = c(0, 10),
                      sigma = rbind(c(1.5, -0.8), c(-0.8, 0.5)))

kde <- ks::kde(x = x, H = H)
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```


14
12
10
8
6
y
-5
0
5
x

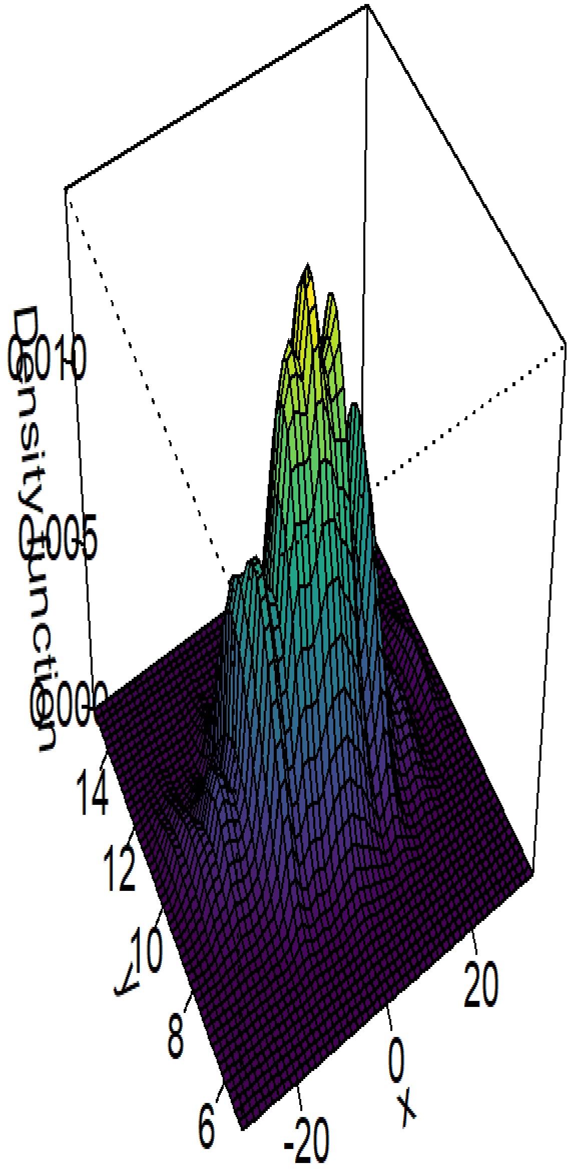
```
x <- mvtnorm::rmvnorm(n = n, mean = c(0, 10),
                      sigma = rbind(c(1.5, 0.8), c(0.8, 0.5)))

kde <- ks::kde(x = x, H = H)
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```


14
12
10
8
6
y
-5
0
5
x

```
x <- mvtnorm::rmvnorm(n = n, mean = c(0, 10),
                      sigma = rbind(c(100, 0.8), c(0.8, 0.5)))

kde <- ks::kde(x = x, H = H)
plot(kde, display = "filled.contour", cont = seq(5, 95, by = 10),
     xlab = "x", ylab = "y", col.fun = viridis::viridis)
```


14
12
10
8
6
y
-30
-20
-10
0
10
20
30
x

```r
plot(kde, display = "persp", col.fun = viridis::viridis, xlab = "x", ylab = "y")
```


Density function
0.010
0.005
0.000
y
14
12
10
8
6
x
-20
0
20