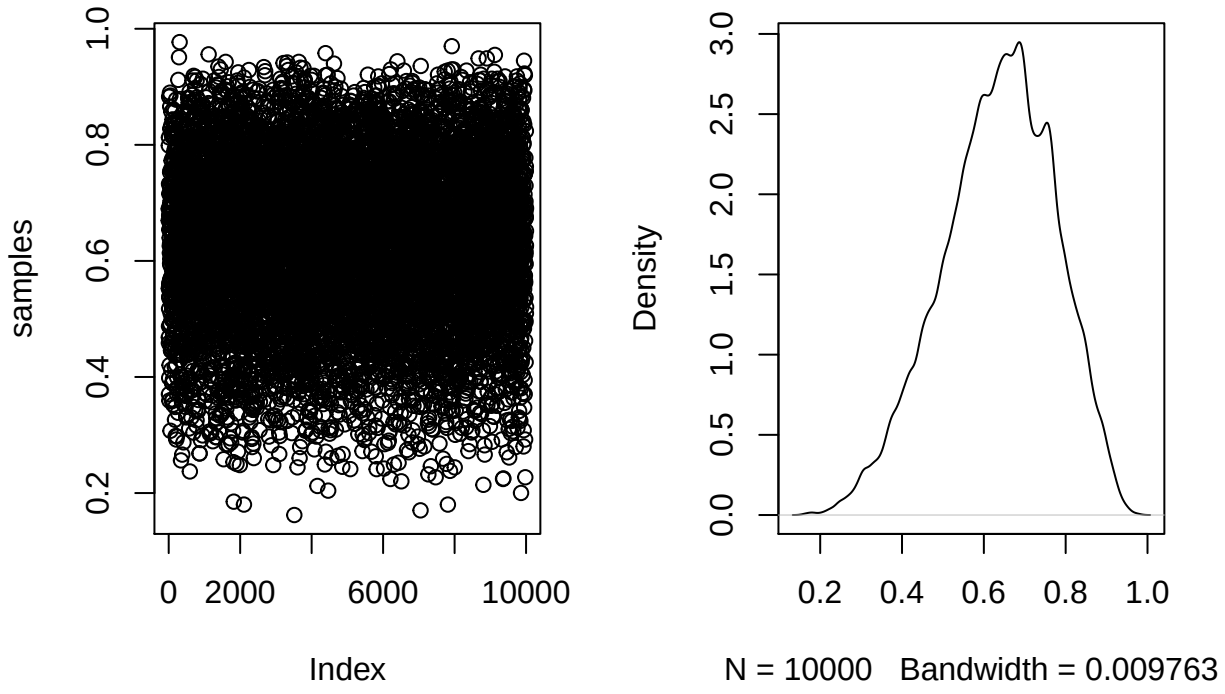
Chapter 3 – Practice

```
p_grid = seq(from=0, to=1, length.out=1000)
prior <- rep(1, 1000)
likelihood <- dbinom(6, size=9, prob=p_grid)
posterior <- likelihood * prior
posterior <- posterior / sum(posterior)
set.seed(100)
samples <- sample(p_grid, prob=posterior, size=1e4, replace=T)
```

```
par(mfrow=c(1, 2))
plot(samples)
plot(density(samples, adjust = 0.5), main="")
```



3E1. How much posterior probability lies below p = 0.2?

```
sum(posterior[p_grid < 0.2])
```

```
## [1] 0.0008560951
```

```
sum(samples < 0.2) / length(samples)
```

```
## [1] 5e-04
```

3E2. How much posterior probability lies above p = 0.8?

```
sum(posterior[p_grid > 0.8])
```

```
## [1] 0.1203449
```

```
sum(samples > 0.8) / length(samples)
```

```
## [1] 0.1117
```

3E3. How much posterior probability lies between p = 0.2 and p = 0.8?

```
sum(posterior[p_grid > 0.2 & p_grid < 0.8])
```

```
## [1] 0.878799
```

```
sum(samples > 0.2 & samples < 0.8) / length(samples)
```

```
## [1] 0.8878
```

3E4. 20% of the posterior probability lies below which value of p?

```
quantile(samples, 0.2)
```

```
##       20%
## 0.5195195
```

3E5. 20% of the posterior probability lies above which value of p?

```
quantile(samples, 0.8)
```

```
##       80%
## 0.7567568
```

3E6. Which values of p contain the narrowest interval equal to 66% of the posterior probability?

```
samples_for_hpdi <- coda::as.mcmc(samples)
# x <- sapply(0.66, function(p) coda::HPDinterval(samples_for_hpdi,  prob = p))
x <- coda::HPDinterval(samples_for_hpdi, prob=0.66)
c(x[1], x[2])
```

```
## [1] 0.5205205 0.7847848
```

```
HPDI(samples, prob=0.66)
```

```
##     |0.66     0.66|
## 0.5205205 0.7847848
```

3E7. Which values of p contain 66% of the posterior probability, assuming equal posterior probability both below and above the interval?

```
low = (1 - 0.66) / 2
up = low + 0.66
interval = c(low, up)
c(interval, interval[2] - interval[1])
```

```
## [1] 0.17 0.83 0.66
```

```
quantile(samples, interval)
```

```
##       17%       83%
## 0.5005005 0.7687688
```

If the distribution is not too skewed then the Percentile Interval (PI) will approximately equal to the Highest Posterior Density Interval (HPDI):

- PI: (0.501, 0.769)
- HPDI: (0.521, 0.785)