

Solutions assignment 2

Ex 4

Ex 5

Ex 6 Empirical mean and variance

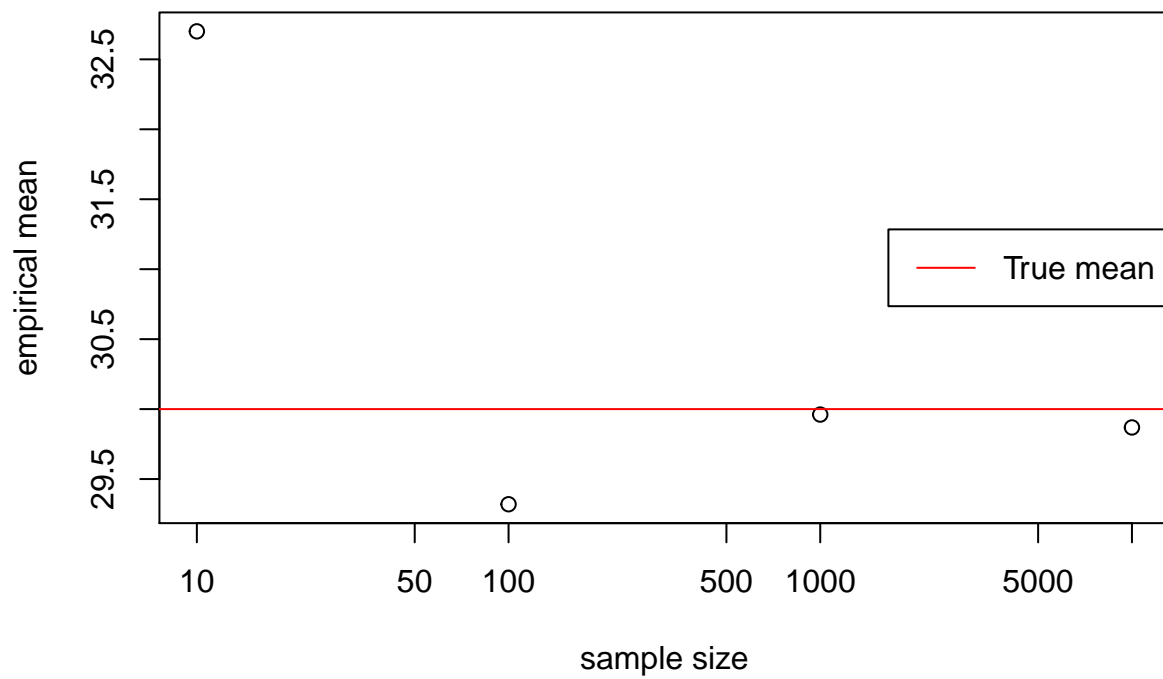
6.1

```
experiment <- function(n){  
  S <- rbinom(n, size = 100, prob = 0.3)  
  m <- mean(S)  
  v <- var(S)  
  sd <- sqrt(var(S))  
  return(c(m, v, sd))  
}  
experiment(100)
```

```
## [1] 30.360000 15.141818 3.891249
```

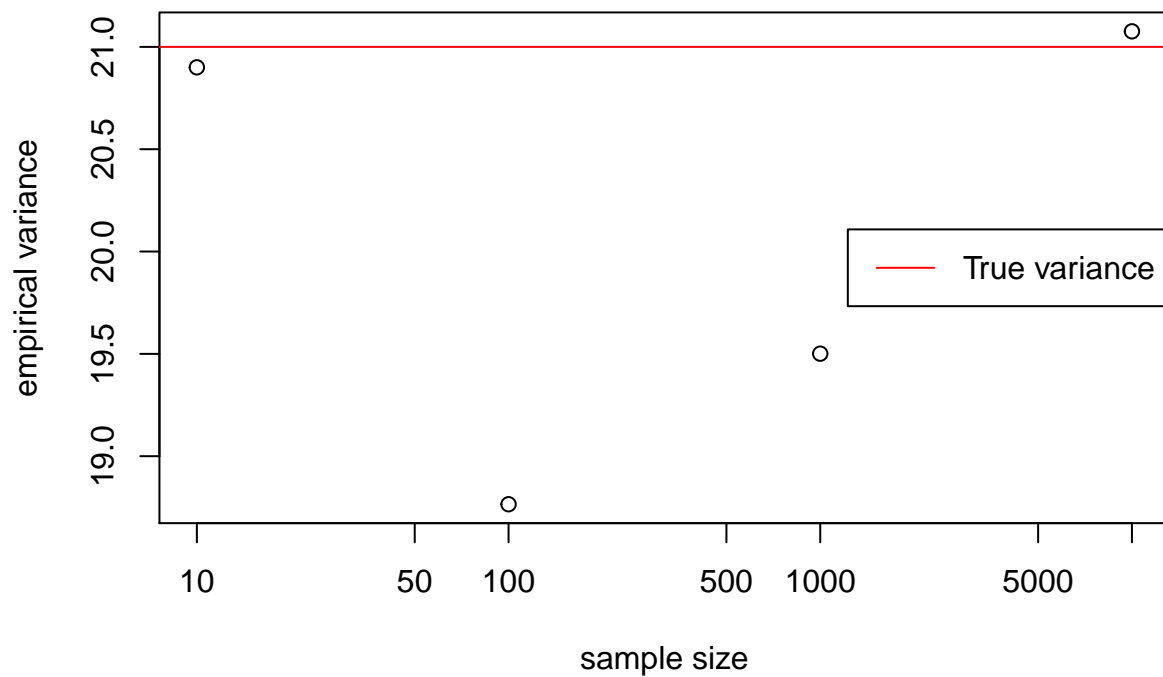
Comparing true mean $\mathbb{E}(X) = 100 \times 0.3 = 30$ and empirical mean,

```
D <- sapply(c(10, 100, 1000, 10000), experiment)  
plot(c(10, 100, 1000, 10000), D[1,],  
     xlab = "sample size", ylab = "empirical mean",  
     log = "x")  
abline(h = 30, col = "red")  
legend("right", legend = "True mean", col = "red",  
       lty = 1)
```



Comparing the true variance $\mathbb{V}(X) = 100 \times 0.3 \times (1 - 0.3) = 21$,

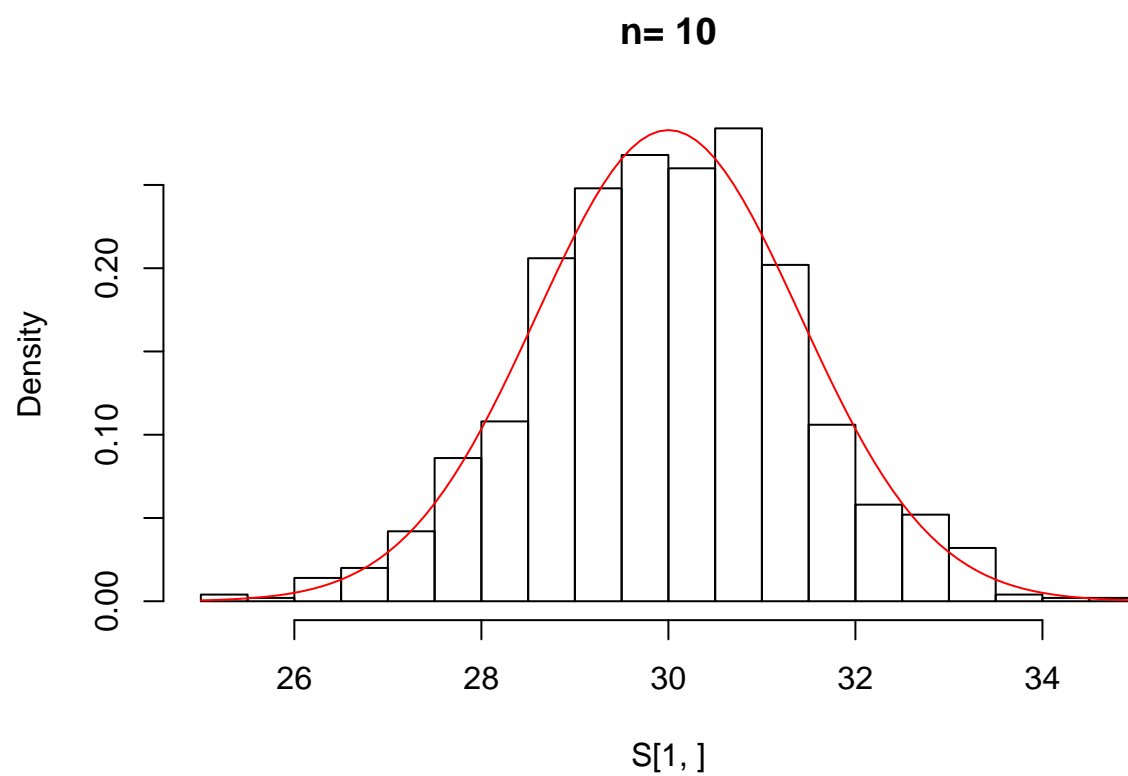
```
plot(c(10, 100, 1000, 10000), D[2,],
     xlab = "sample size", ylab = "empirical variance",
     log = "x")
abline(h = 21, col = "red")
legend("right", legend = "True variance",
      col = "red",
      lty = 1 )
```

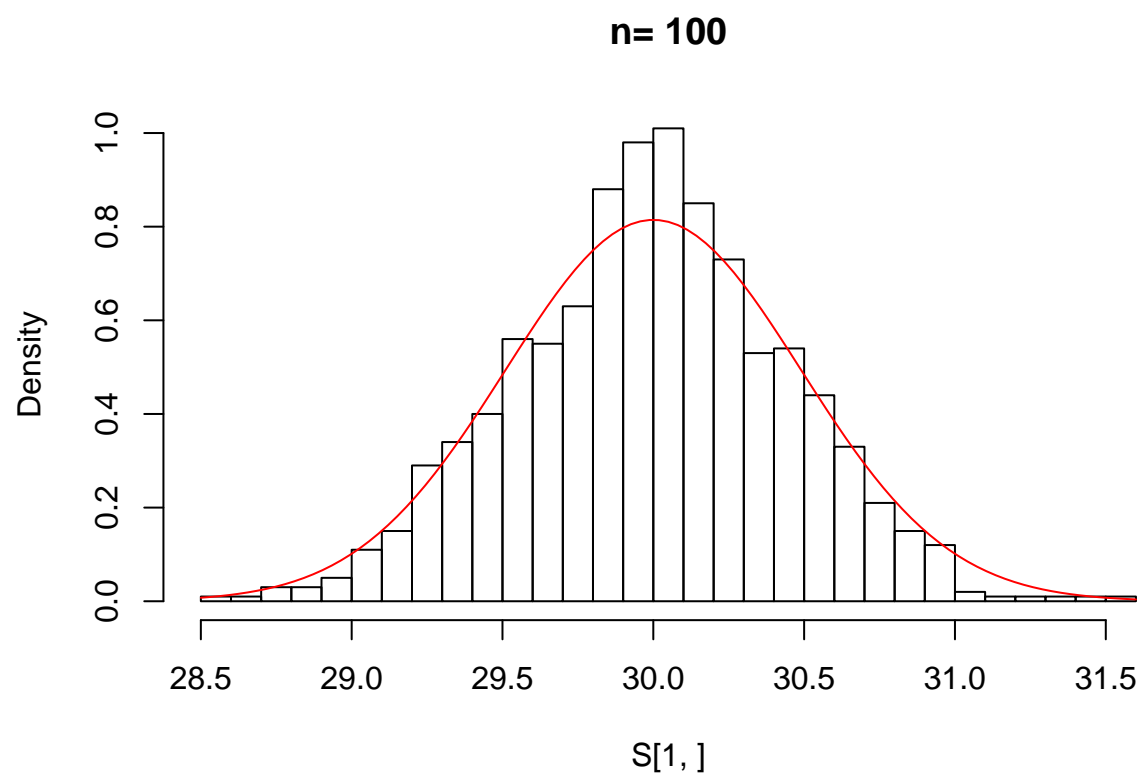


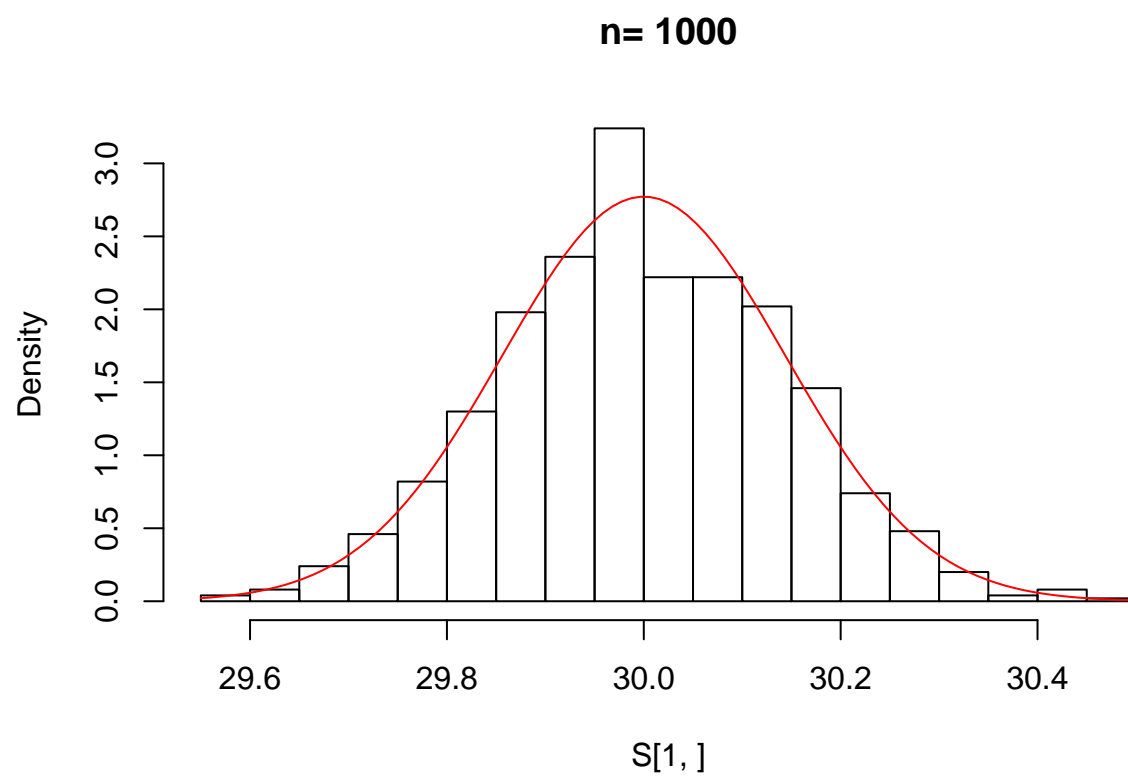
6.2

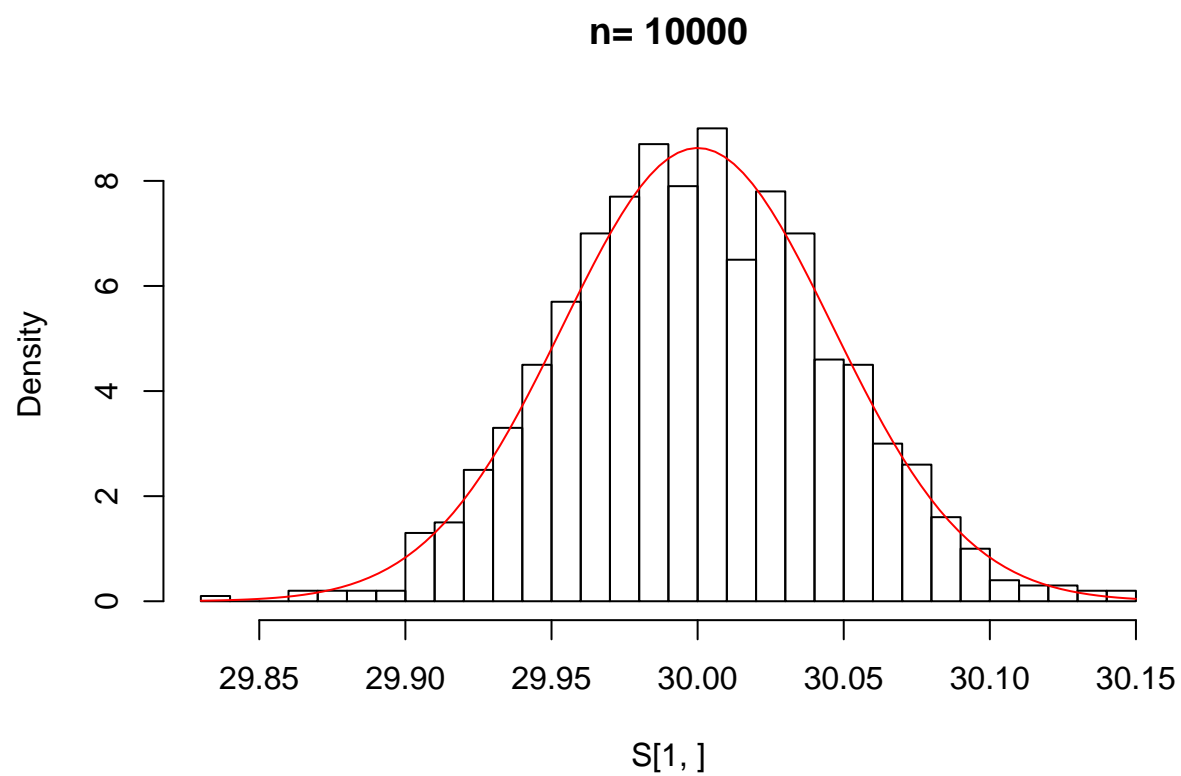
```
big_experiment <- function(n){
  S <- replicate(n = 1000, experiment(n))
  hist(S[1,], breaks = "FD", probability = TRUE,
       main = paste("n=", n))
  v <- var(S[1,])
  se <- S[3,1] / sqrt(n)
  curve( dnorm(x, mean = 30, sd = se), add = TRUE,
        col = "red")
  return( c(v, sqrt(v), se))
}

sapply( 10^(1:4), big_experiment)
```









```
##      [,1]      [,2]      [,3]      [,4]
## [1,] 2.012258 0.2018555 0.02085123 0.002116886
## [2,] 1.418541 0.4492833 0.14439954 0.046009629
## [3,] 1.409886 0.4897691 0.14391355 0.046245014
```