# Homework 3

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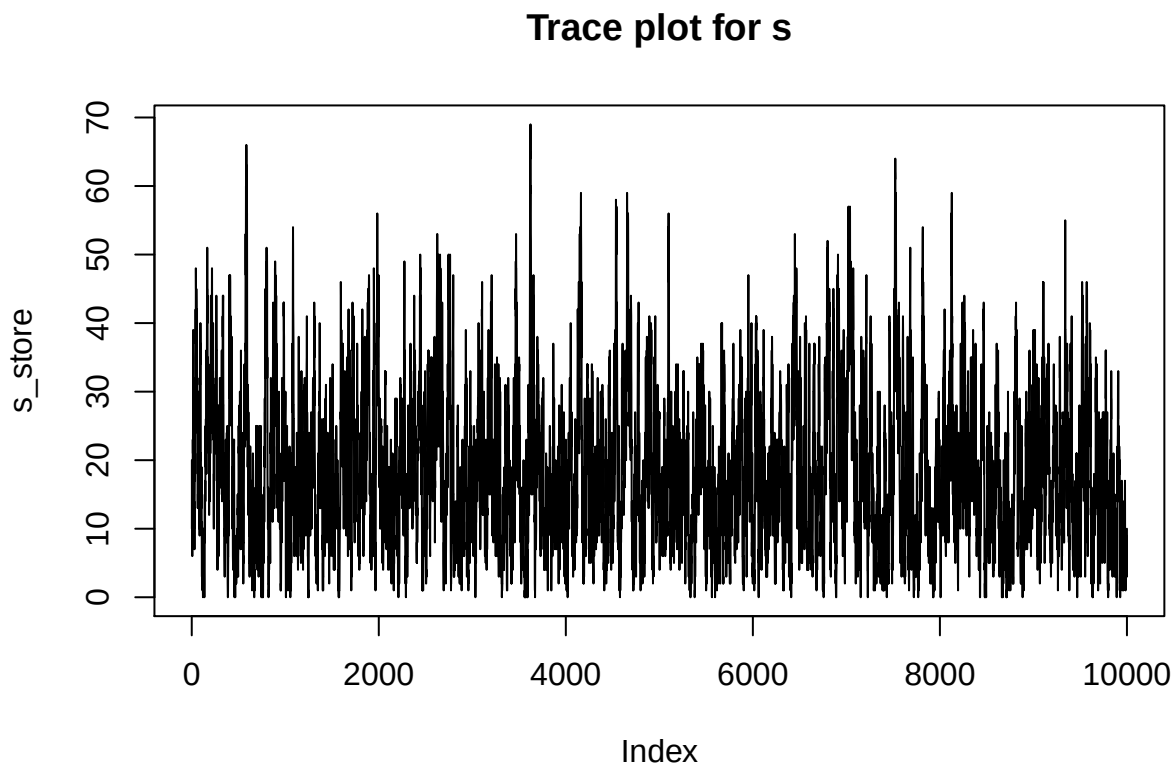
***Answer to the Question Number 1***

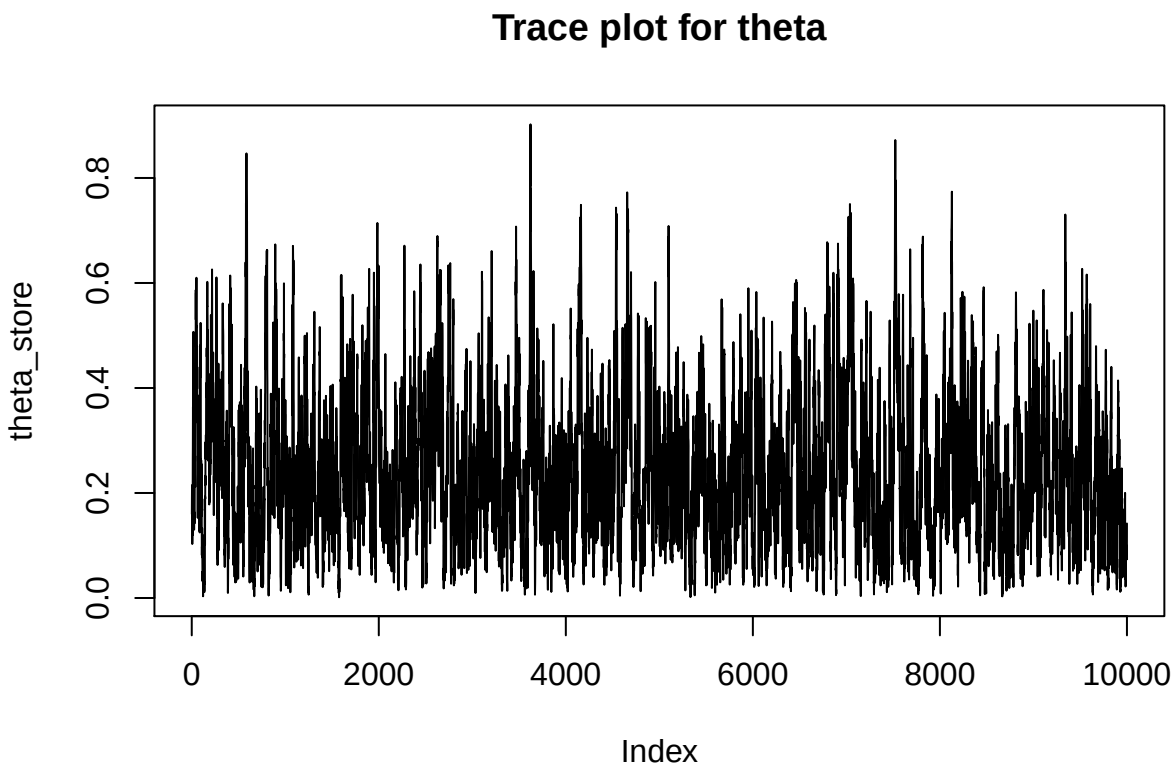
```
set.seed(7)
# Initial values

a0 = 2.0
b0 = 6.4
n = 74
s = 16

MLE_theta <- s/n
MLE_theta
```

```
## [1] 0.2162162
```

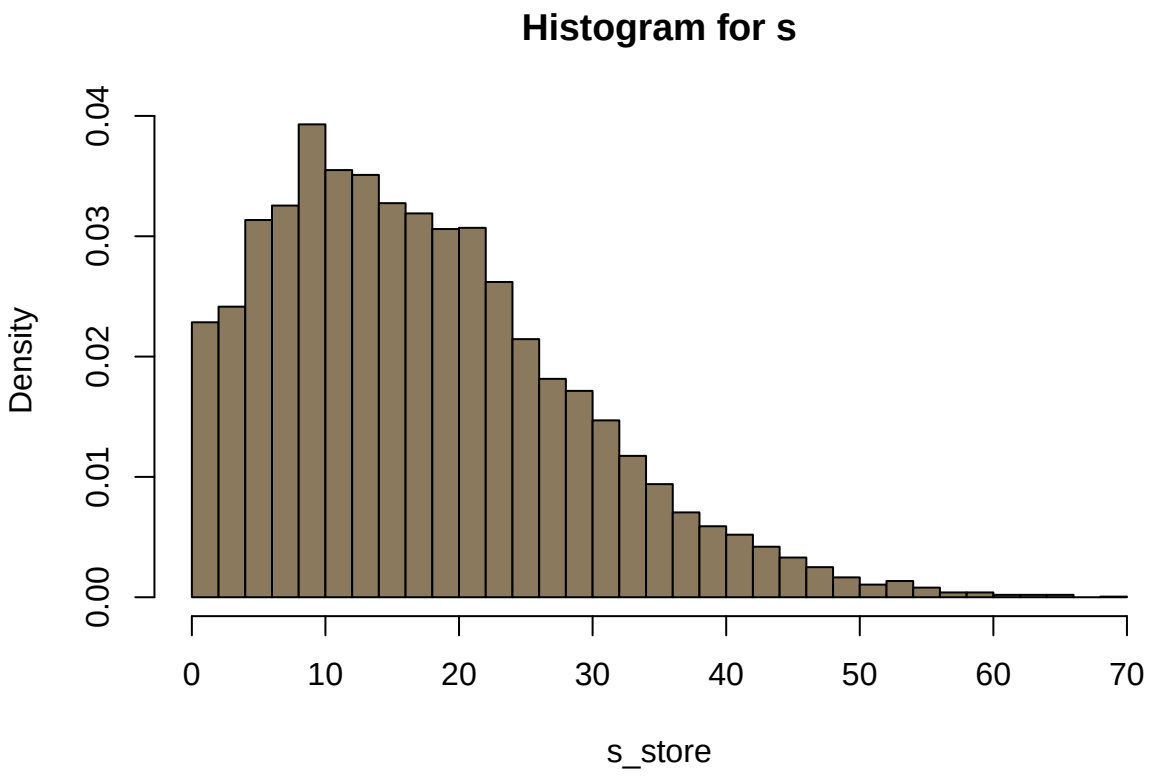
```
M = 10000

# storing simulated samples

s_store = matrix(0,M)
theta_store = matrix(0,M)

# for loop start

for (iter in 1:M)
{
  theta = rbeta(1, a0+s, b0+n-s)
  s = rbinom(1, n, theta)

  theta_store[iter,] = theta
  s_store[iter,] = s
}

density_s = table(s_store)/M

plot(s_store,type = "l", main = "Trace plot for s")
```




```
plot(theta_store,type = "l", main = "Trace plot for theta")
```




```
hist(s_store, breaks = 30, freq = F, col = "navajowhite4", main = "Histogram for s")
```




```
posterior_median_theta <- median(theta_store)
posterior_median_theta
```

```
## [1] 0.2211888
```

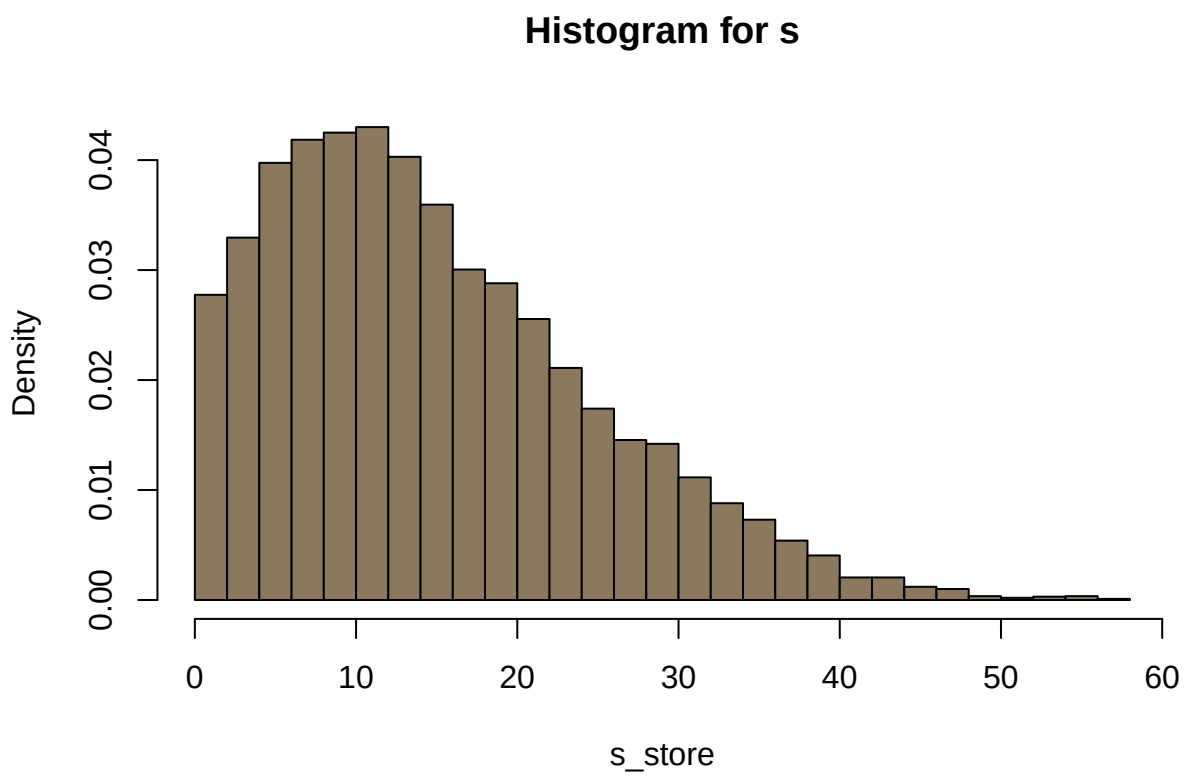
So, posterior median of $\theta$ based on is closed to the maximum likelihood estimate $s/n$.

We know median is insensitive to outlier. So, posterior median is insensitive to initial values.

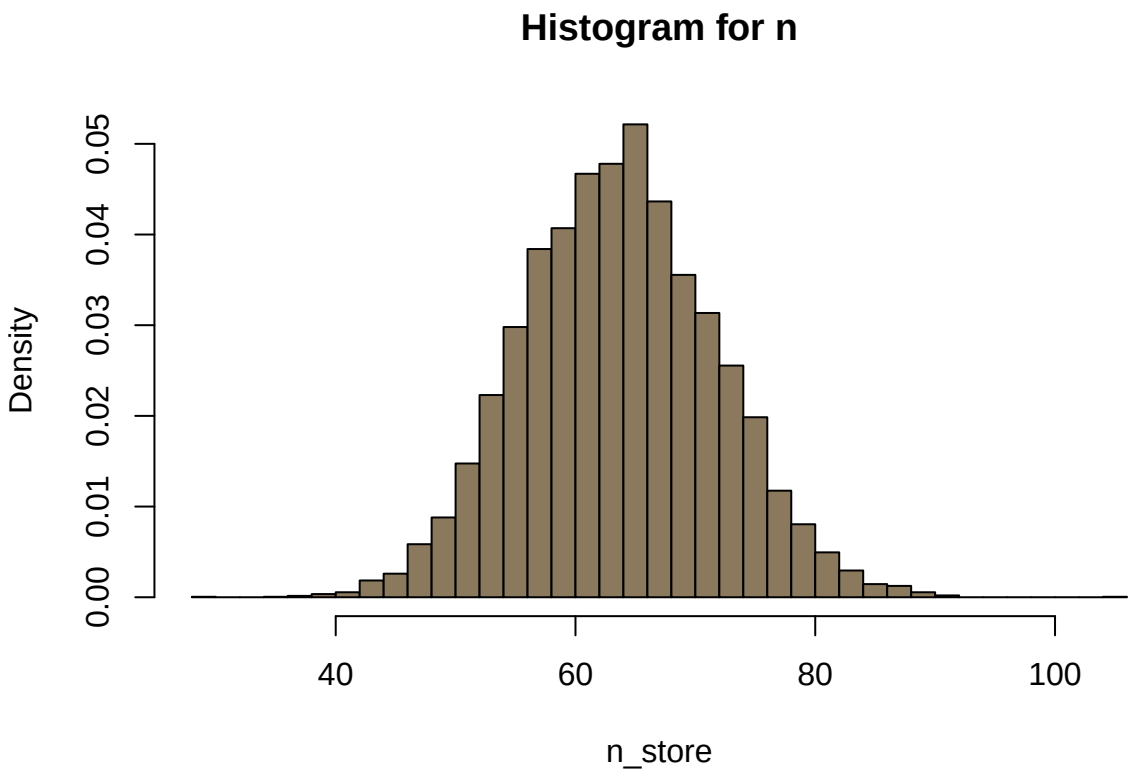
***Answer to the Question Number 2 (Bonus problem)***

```
set.seed(7)
# Initial values

a0 = 2.0
b0 = 6.4
s = 16
n = 20
lambda = 64

M = 10000

# storing simulated samples

s_store = matrix(0,M)
```

```r
theta_store = matrix(0,M)
n_store = matrix(0,M)

# for loop start

for (iter in 1:M)
{
  theta = rbeta(1, a0+s, b0+n-s)
  n = s + rpois(1,(1-theta)*lambda)
  s = rbinom(1, n, theta)

  theta_store[iter, ] = theta
  n_store[iter, ] = n
  s_store[iter, ] = s
}


hist(s_store, breaks = 30, freq = F, col = "navajowhite4", main = "Histogram for s")
```




```r
hist(n_store, breaks = 30, freq = F, col = "navajowhite4", main = "Histogram for n")
```




```
posterior_median_theta <- median(theta_store)
posterior_median_theta
```

```
## [1] 0.216351
```

Yes, this posterior median of theta is similar to the posterior median of the problem 1, because theta is independept of n but s depends on n.