Statistical inference course project

João Pedro Schmitt

3 de outubro de 2016

```
# Randomness parameter
set.seed(32016)

# Exponential distribution paramenters
lambda <- 0.2
exp_n <- 40

# Exponential distribution simulation
exp_sim_raw <- numeric()
exp_sim_mean <- numeric()
exp_sim_sd <- numeric()
for(i in 1:10000) {
  simulation <- rexp(exp_n, lambda)
  exp_sim_raw <- c(exp_sim_raw, simulation)
  exp_sim_mean <- c(exp_sim_mean, mean(simulation))
  exp_sim_sd <- c(exp_sim_sd, sd(simulation))
}
```

A little exploratory summary of the simulated distribution

```
summary(exp_sim_raw)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##  0.00001  1.44000  3.47100  4.99700  6.91500 68.27000
```

Show the sample mean and compare it to the theoretical mean of the distribution.

Comparing the theorical mean:

```
exp_theor_mean <- 1/lambda
exp_theor_mean
```

```
## [1] 5
```

With the mean of the simulations:

```
exp_sim_mean_est <- mean(exp_sim_mean)
exp_sim_mean_est
```

```
## [1] 4.996691
```

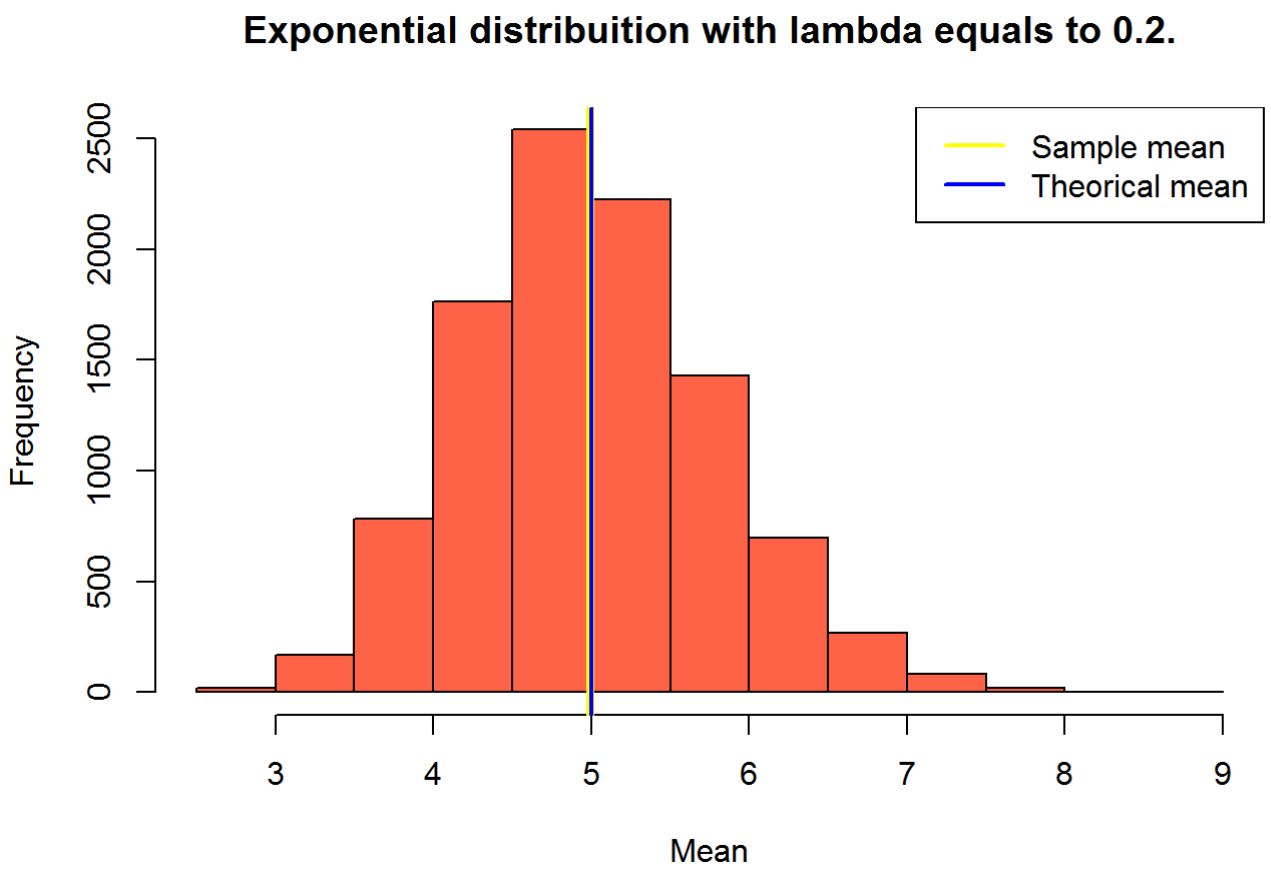
The mean difference between the simulated and of theory is:

```
abs(exp_theor_mean - exp_sim_mean_est)
```

```
## [1] 0.003309498
```

Below follow the histogram of the distribution:

```
hist(exp_sim_mean,
     main = "Exponential distribuition with lambda equals to 0.2.",
     xlab = "Mean",
     col = "tomato")
abline(v = exp_sim_mean_est,
       col = "yellow",
       lwd = 4)
abline(v = exp_theor_mean,
       col = "blue",
       lwd = 2)
legend("topright",
       legend = c("Sample mean", "Theorical mean"),
       col = c("yellow","blue"),
       lwd = c(2,2))
```



Show how variable the sample is (via variance) and compare it to the theoretical variance of the distribution.

The standard deviation of simulations is equals to:

```
exp_sim_sd_est <- mean(exp_sim_sd)/sqrt(exp_n)
exp_sim_sd_est
```

```
## [1] 0.7727475
```

The standard deviation of theory is equals to:

```
exp_theor_sd <- 1/lambda/sqrt(exp_n)
exp_theor_sd
```

```
## [1] 0.7905694
```

The standard deviation of the difference between the simulated and of theory is:

```
abs(exp_theor_sd - exp_sim_sd_est)
```

```
## [1] 0.01782191
```

The variance of the distribution simulation is:

```
exp_sim_var_est <- exp_sim_sd_est^2
exp_sim_var_est
```

```
## [1] 0.5971387
```

The variance of the distribution of theory is:

```
exp_theor_var <- exp_theor_sd^2
exp_theor_var
```

```
## [1] 0.625
```

The variance of the difference between the simulated and of theory is:

```
abs(exp_theor_var - exp_sim_var_est)
```

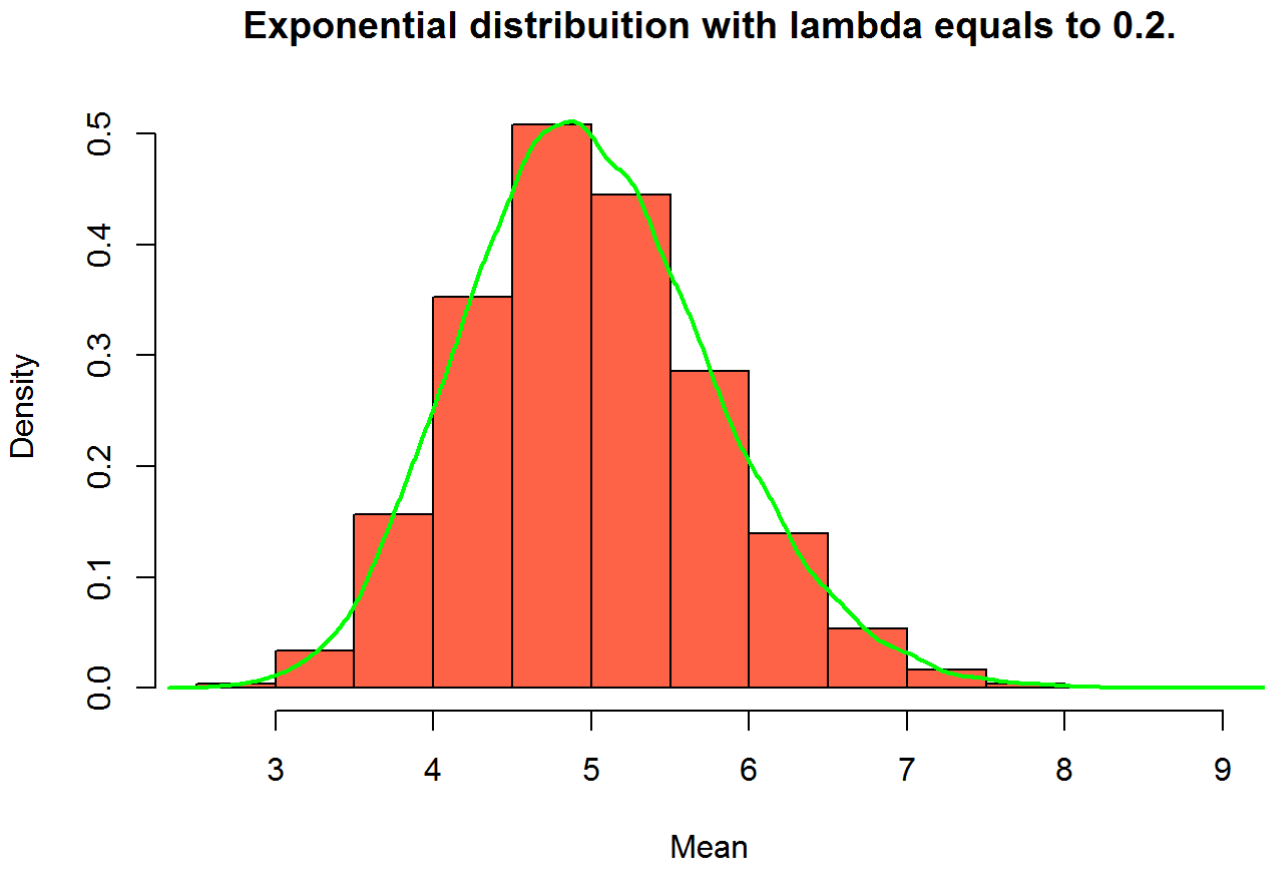
```
## [1] 0.0278613
```

Question 3

Show that the distribution is approximately normal.

The follow code demonstra the normal distribuition:

```
hist(exp_sim_mean,
     main = "Exponential distribuition with lambda equals to 0.2.",
     xlab = "Mean",
     col = "tomato",
     prob = T)
lines(density(exp_sim_mean),
      col="green",
      lwd = 2)
```


Exponential distribuition with lambda equals to 0.2.
Density
0.0
0.1
0.2
0.3
0.4
0.5
3
4
5
6
7
8
9
Mean