Assignment Statistical Inference - Part 1

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8 de abril de 2019

Part 1

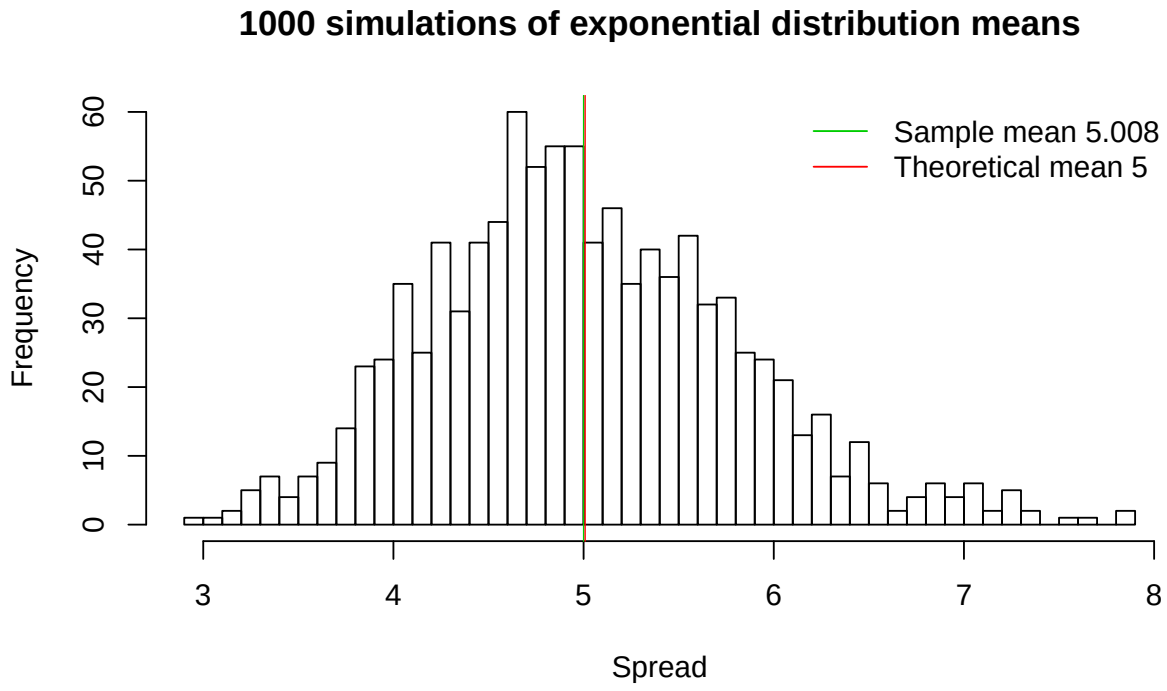
1. A simulation exercise
2. Basic inferential data analysis

The exponential distribution can be simulated in R with rexp(n, lambda) where lambda is the rate parameter. The mean of exponential distribution is 1/lambda and the standard deviation is also 1/lambda. Set lambda = 0.2 for all of the simulations. You will investigate the distribution of averages of 40 exponentials. Note that you will need to do a thousand simulations.

```
set.seed(215)
lambda <- 0.2; obs <- 40; sims <- 1000 ## var simulations
exp.sims <- NULL ## var used to store exponential simulations
for (i in seq(sims)) exp.sims <- c(exp.sims, mean(rexp(obs, lambda)))
exp.sims.mean <- mean(exp.sims)
round(exp.sims.mean, 3)
```

```
## [1] 5.008
```

The mean of the 1000 simulations is 5.008, meanwhile the theorical mean is 5 and can be compared in the following histogram.



See code here

Distributions comparison

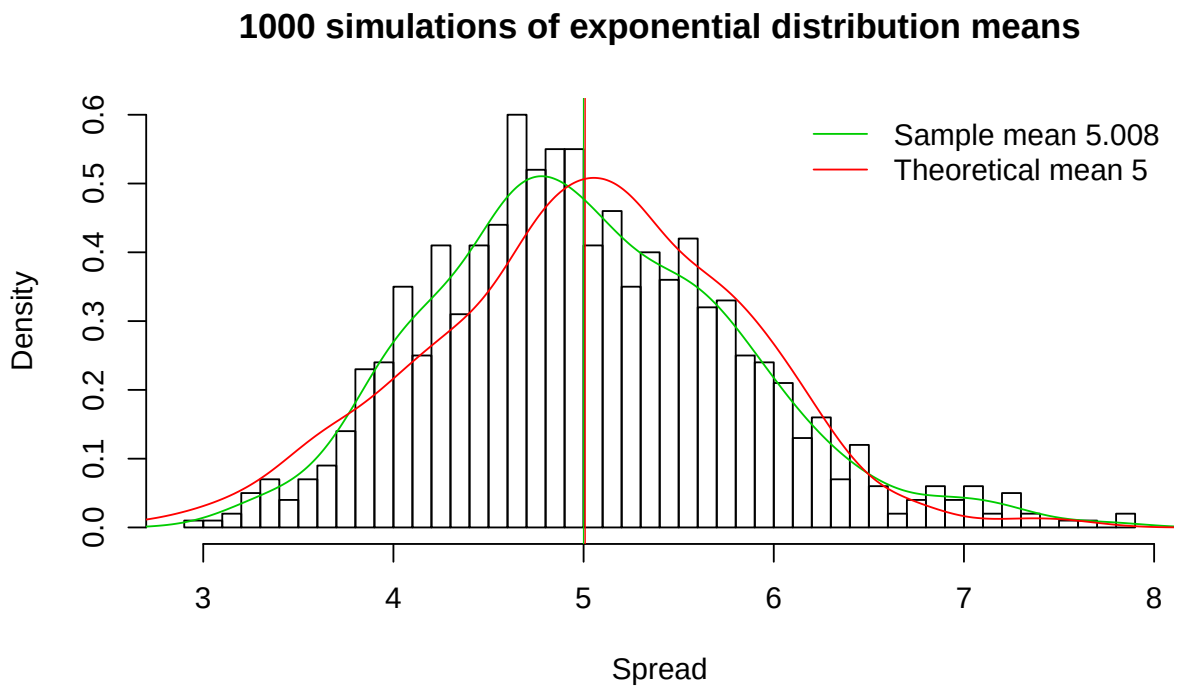
Compare how variable the sample is vs the expected distribution via variance

Expected variance

See code here

```
##          Expected    Sample
## Mean        5.000 5.0081038
## Variance    0.625 0.6602019
```

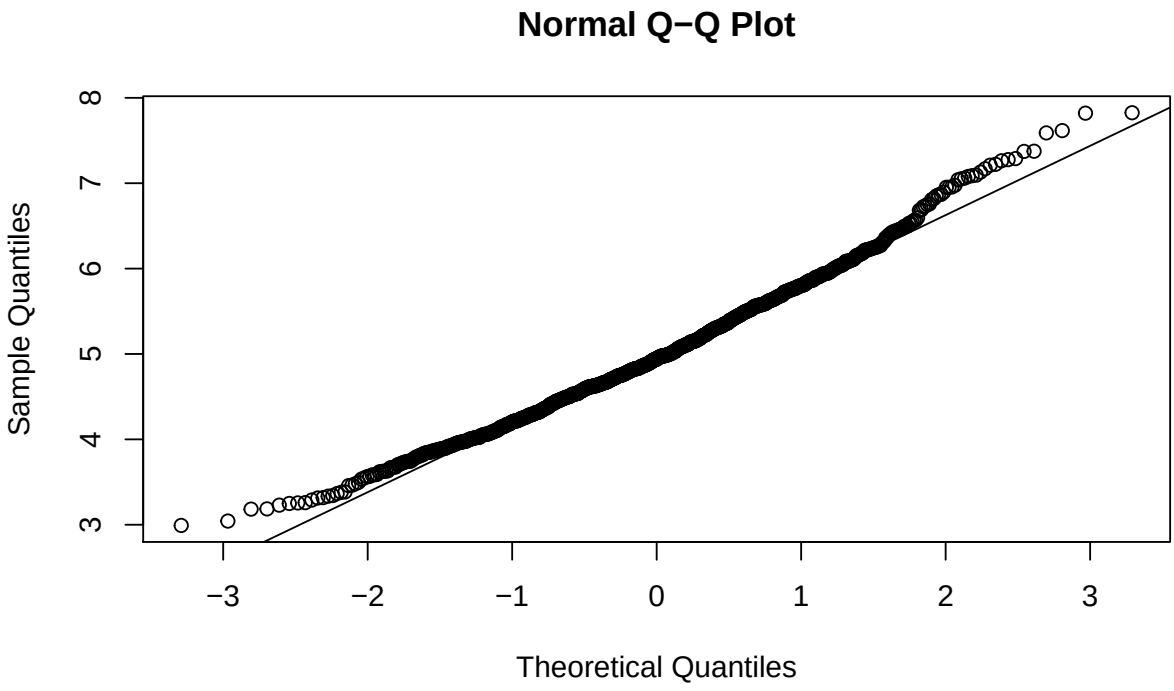
Showing distributions aproximately to the normal



See code here

Normal distribution aproximation

```
qqnorm(exp.sims)
qqline(exp.sims)
```



Appendix

Appendix 1

Code used in plot 1

```
hist(exp.sims, breaks = 50, probability = F,
     main="1000 simulations of exponential distribution means",
     xlab="Spread")
abline(v = 1/lambda, col= 3, lwd = 0.75)
abline(v = exp.sims.mean, col = 2, lwd = 0.75)
legend("topright",
       c(paste("Sample mean",
               round(exp.sims.mean, 3)),
         paste("Theoretical mean", 1/lambda)),
       bty = "n",
       lty = c(1,1),
       col = c(col = 3, col = 2))
```

Appendix 2

Code used in plot 2

```r
set.seed(215)
hist(exp.sims, breaks = 50, probability = T,
     main="1000 simulations of exponential distribution means",
     xlab="Spread")
abline(v = 1/lambda,  col= 3, lwd = 0.75)
abline(v = exp.sims.mean, col = 2, lwd = 0.75)
legend("topright",
       c(paste("Sample mean", round(exp.sims.mean, 3)),
         paste("Theoretical mean", 1/lambda)),
       bty = "n",
       lty = c(1,1),
       col = c(col = 3, col = 2))
lines(density(exp.sims), col = 3)
lines(density(rnorm(1000, 5,((1/lambda)/sqrt(obs)))), col = 2)
```

Appendix 3

Code used for the matrix

```r
matrix(c(1/lambda,
         ((1/lambda)/sqrt(obs))^2,
         exp.sims.mean,
         var(exp.sims)),
       nrow = 2,
       dimnames = list(c("Mean", "Variance"), c("Expected", "Sample")))
```