# Statistical Inference

### Course Project 1: CP1_template

### Introduction

This document presents the results of the Course Project for the Coursera course: Statistical Inference. This assessment makes use of simulation techniques in order to explore inference and do some simple inferential data analysis.

The student is to investigate the exponential distribution in R and to draw comparison against the Central Limit Theorem. 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.

The student is to investigate the distribution of averages of 40 exponentials, with a thousand simulations.

### 1. Load Packages

```
for (package in c('ggplot2')) {

    if (!require(package, character.only = TRUE, quietly = FALSE)) {
        install.packages(package)
        library(package, character.only = TRUE)
    }
}
```

### 2. Simulations

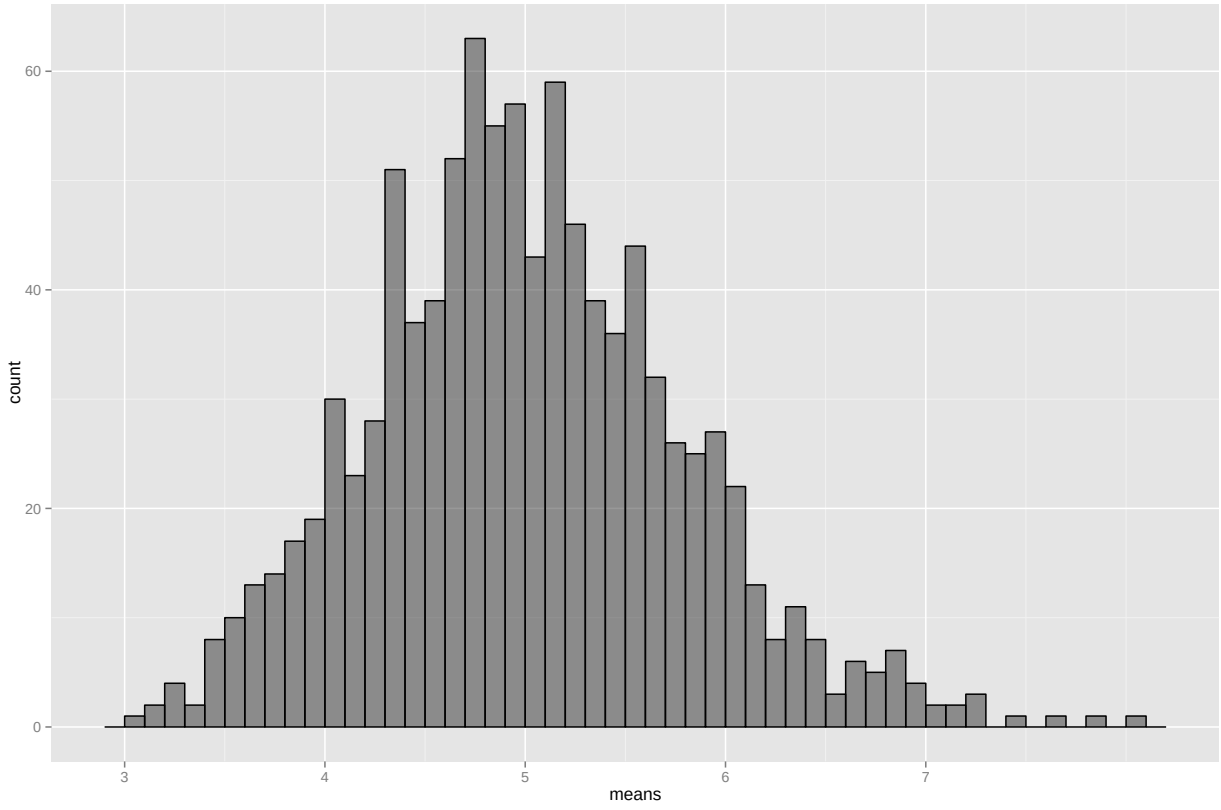
Set lambda for exponential function, number of exponentials and numbers of sample/tests.

```
set.seed(123456789)

val_lambda <- 0.2
val_n <- 40
val_sims <- 1000
```

Run sample/tests.

```
data_expdist <- data.frame(means = 1:val_sims)

for (i in 1:val_sims) {

  val_sim <- rexp(val_n, val_lambda)
  data_expdist[i, 1] <- mean(val_sim)

}

remove(val_sim)
```

Find range and plot sampled data.




### 3. Sample Mean vs. Theoretical Mean

Find the theoretical mean of the exponential distribution

```
val_truemu <- 1/val_lambda
val_truemu
```

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

Find the mean of the sampled distribution

```
val_samplemu <- mean(data_expdist$means)
val_samplemu
```

```
## [1] 5.005439
```

### 4. Sample Variance vs. Theoretical Variance

Find the theoretical variance of the exponential distribution

```
val_truevar <- (1/val_lambda/sqrt(val_n))^2
val_truevar
```

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

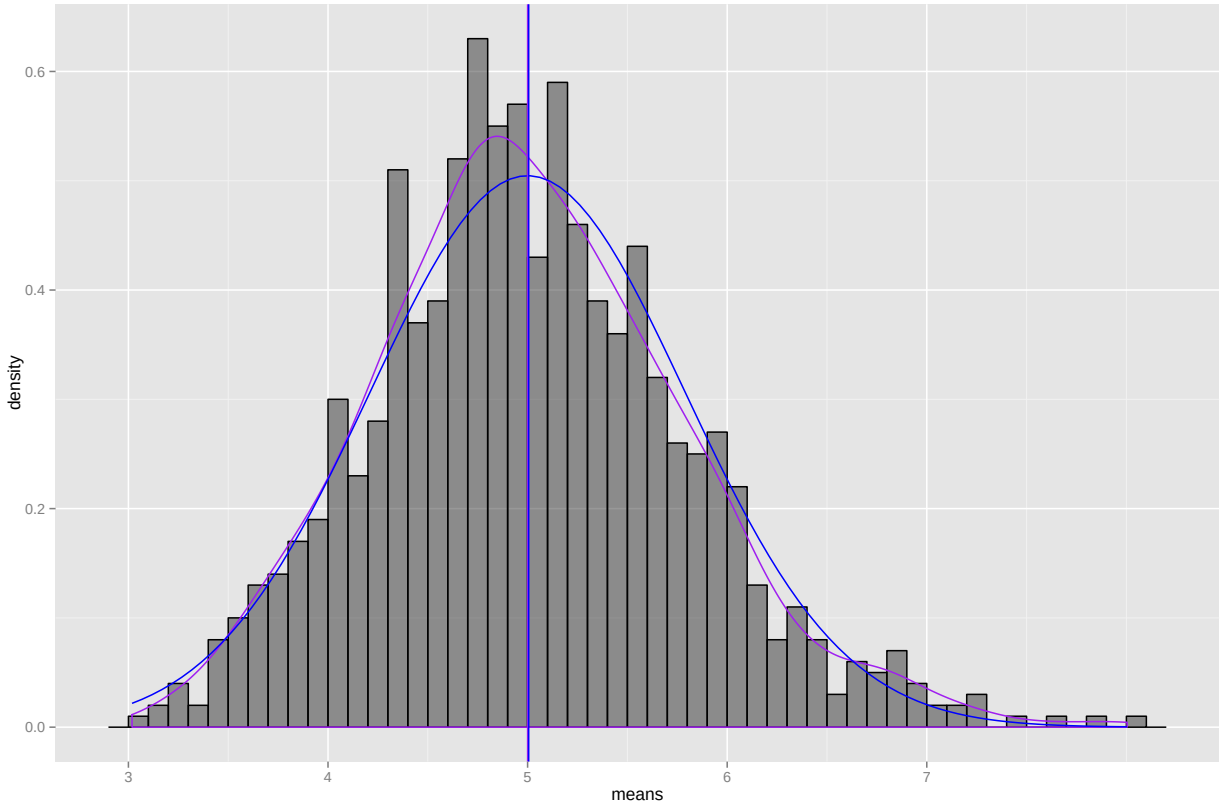
Find the variance of the sampled distribution

```
val_samplevar <- var(data_expdist$means)
val_samplevar
```

```
## [1] 0.6010095
```

### 5. Distribution

Plot sampled means against true mean distribution




Evaluate the coverage of confidence intervals for a standard normal distribution:

```
  mean(data_expdist$means) + c(-1,1) * 1.96 * sd(data_expdist$means)/sqrt(nrow(data_expdist))
```

```
## [1] 4.957389 5.053490
```