Comparing Theoretical and Simulated Mean and Standard Deviations from a Exponential Distribution

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Exploring the population

On a exponention distribution, the theoretical mean is 1/lambda. The theoretical standard deviation is also 1/lambda. We will usa a lambda of 0.2 for the simulations.

```
set.seed(18091979)
lambda <- 0.2;
theoreticalPopulationMean <- 1/lambda;
theoreticalPopulationStdDev <- 1/lambda;

randomexp <- rexp(1000, lambda)
simulatedPopulationmean <- mean(randomexp)
simulatedPopulationStddev <- sd(randomexp)
```

The population mean is `5.1391`, which is very close to the theoretical mean of `5`. The simulated standard deviation is `5.1513`, which is also very close to the theoretical standard deviation of `5`.

Exploring a sample mean and standard deviation.

The mean for a sample is, theoretically, the same as the population mean. The theoretical standard deviation for the sample is the stddev/sqrt(n), where n is the sample size.

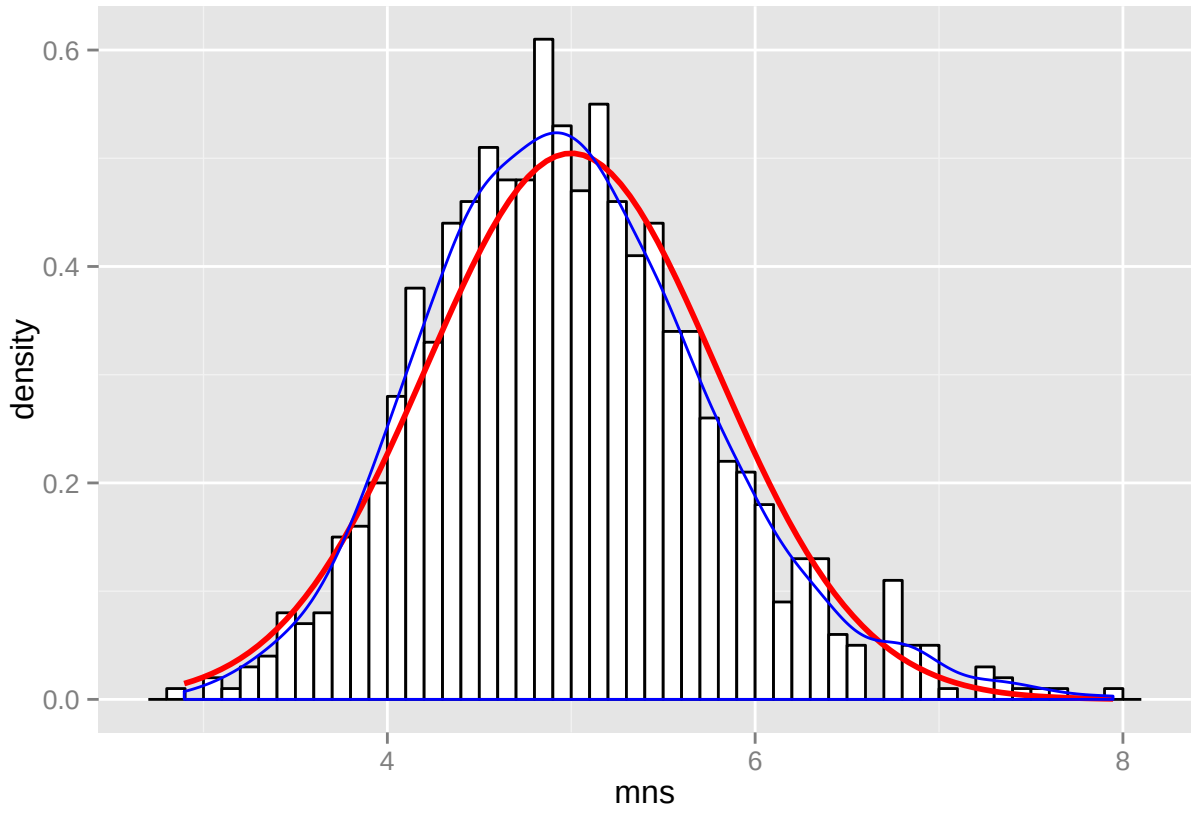
Lets simulate taking the means for 1000 samples of size 40 and compare it to the theoretical mean and the theoretical mean standard deviation.

```
library(ggplot2)

sampleSize <- 40;
theoreticalSampleStdDev <- 1/lambda/sqrt(sampleSize);

mns = NULL
for (i in 1 : 1000) mns = c(mns, mean(rexp(sampleSize,lambda)))

simulatedMeansMean <- mean(mns)
simulatedmeansStandardDeviation <- sd(mns)
```

The simulated mean for the 1000 means of 40 samples is `4.9849`, which is close to the expected mean of `5.1391`. The standard deviation for those samples is `0.7738`, which is also close to the expected value of `0.7906`

Checking if the means distribution is normal.

```
ggplot(data=data.frame(mns), aes(x=mns)) +
    geom_histogram(aes(y=..density..), binwidth= 0.1, fill="white", colour="black") +
    stat_function(fun=dnorm, colour="red", size=1,
                  args=list(mean = 5,sd = 1/(lambda)*(1/sqrt(40)))) +
    geom_density(colour="blue")
```




```
shapiro <- as.character( shapiro.test(mns)$p.value)
```

The graphic above shows that the simulation density, in blue, is close to the normal, in red. This is confirmed by the Shapiro-Wilk test value of 2.07149154897324e-06