Title: Project for Inferential Statistics: Simulating the Exponential Distribution

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Overview

This report summarizes some information about the exponential distribution. Specifically, it compares the sample mean with the theoretical mean, it compares the sample variance with the theoretical variance, and it illustrates normality aspects of the distribution.

Simulations

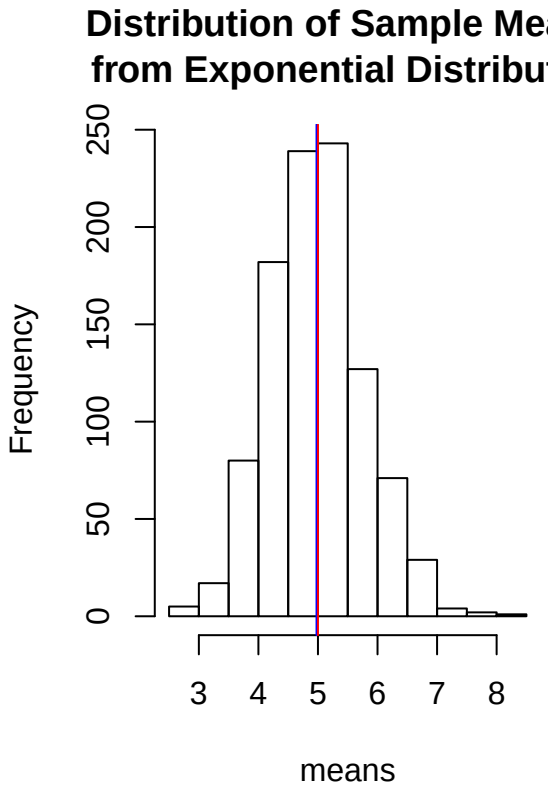
This section performs the simulations. Each sample is of 40 random exponential numbers and 1000 samples are taken. The first line in the loop shown below obtains the sample of 40 values. The next line calculates the mean of that sample and stores it in a vector. The last line in the loop calculates the variance for the sample and stores it.

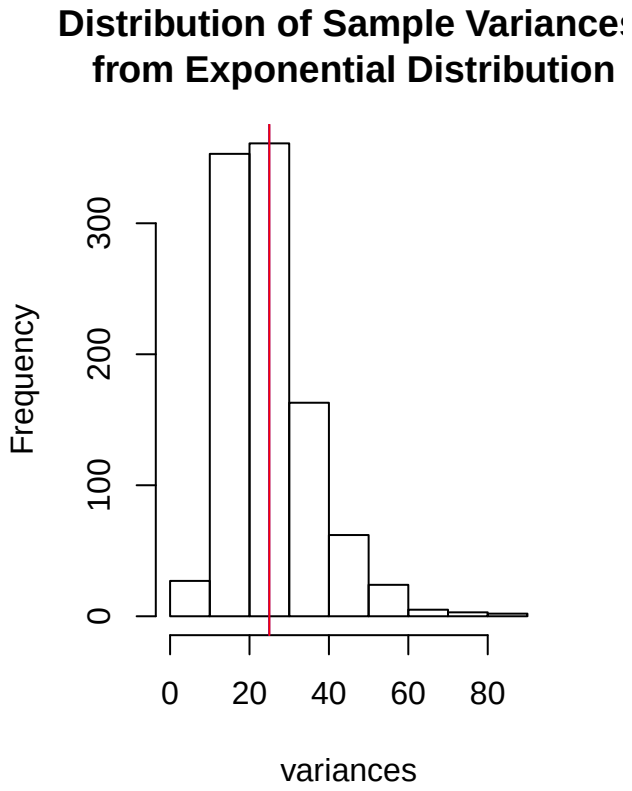
```
means <- NULL
variances <- NULL
for (i in 1:1000) {
    sample <- rexp(40, 0.2)
    means <- c(means, mean(sample))
    variances <- c(variances, var(sample))
}
```

Sample Mean versus Theoretical Mean and Sample Variance versus Theoretical Variance

The following charts show the distribution of the sample mean and sample variance. The blue vertical line on each plot shows, respectively, the sample mean and sample variance and the red vertical line on each plot shows the theoretical values. As you can see, the lines for the sampled values and the lines for the theoretical values are almost right on top of one another.

```
par(mfrow=c(1,2))
hist(means, main="Distribution of Sample Means\n from Exponential Distribution")
abline(v=mean(means), col="blue")
abline(v=5.0, col="red")
hist(variances, main="Distribution of Sample Variances\n from Exponential Distribution")
abline(v=mean(variances), col="blue")
abline(v=25.0, col="red")
```






```
cat("mean of sample means is", mean(means))
```

```
## mean of sample means is 4.976012
```

```
cat("theoretical mean is 5.0")
```

```
## theoretical mean is 5.0
```

```
cat("mean of sample variances is", mean(variances))
```

```
## mean of sample variances is 24.96515
```

```
cat("theoretical variance is 25.0")
```

```
## theoretical variance is 25.0
```

Normality of Distribution

In this final section, we explore the normality of the exponential distribution, the sample means from that distribution, and compare them with an actual normal distribution. The first plot below shows the distribution of the exponential function, the second plot shows the distribution of the sample means from that distribution, and the third plots shows the normal distribution. As you can see by comparing the plot of the exponential distribution with the plot of the normal distribution (first plot vs. third plot), the exponential distribution itself does not appear to be normal. However, by comparing the plot of the mean of the sample of the exponential distribution with the plot of the normal distribution (second plot vs. third plot), it does appear that the distribution of the sample means are normal.

```r
par(mfrow=c(1,3))
hist(rexp(1000, 0.2), main="Distribution of Exponential\n Function", xlab="random value")
hist(means, main="Distribution of Sample Means\n from Exponential Distribution", xlab="mean value")
hist(rnorm(1000), main="Normal Distribution", xlab="random value")
```