Statistical Interference - Exponentials

Gary Chamberlain

Saturday, October 25, 2014

Create 2000 averages of groups of 40 exponentials

```
## Set seed for reproducibility
set.seed(43)
## Generate 2000 averages of groups of 40 exponentials
lambda <- 0.2
no.samples <- 40
no.sims <- 2000
exp.means <- replicate(no.sims,mean(rexp(no.samples,lambda)))
```

1. Show where the distribution is centered at and compare it to the theoretical center of the distribution.

```
sample.mean <- round(mean(exp.means),3)
theoretical.mean <- 1/lambda
```

The sample mean is 4.998 and the theoretical mean is 5.

These are fairly equal.

2. Show how variable it is and compare it to the theoretical variance of the distribution.

```
sample.var <- round(var(exp.means),3)
theoretical.var <- (1/(no.samples*lambda**2))
```

The sample variance is 0.631 and the theoretical variance is 0.625.

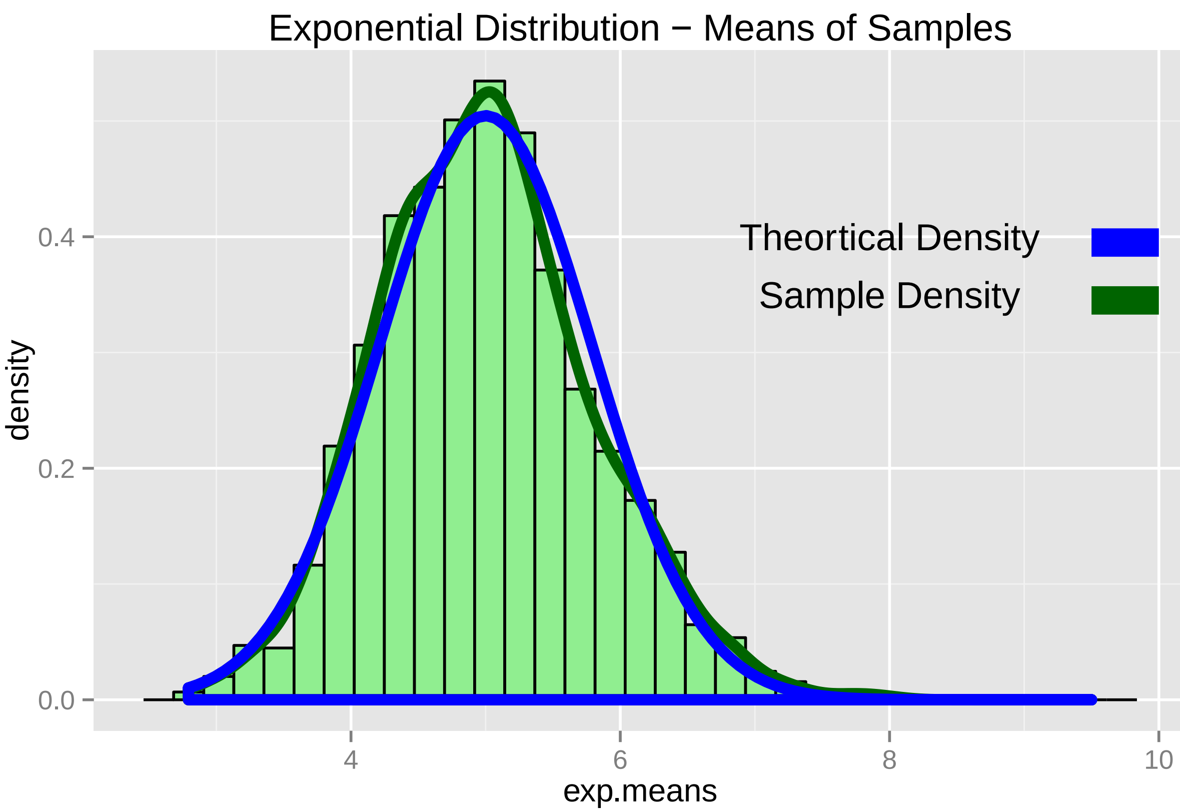
These are also fairly equal.

3. Show that the distribution is approximately normal.

```
library(ggplot2)
plot <- ggplot(data=data.frame(exp.means))
plot <- plot + aes(x=exp.means)
plot <- plot + geom_histogram(aes(y=..density..),fill="lightgreen",colour="black")
```

```
plot <- plot + geom_density(colour="darkgreen",size=2)
plot <- plot + ggtitle("Exponential Distribution - Means of Samples")
plot <- plot + stat_function(geom="density",fun=dnorm,colour="blue",size=2,
                args=(c(mean=theoretical.mean,sd=1/lambda*(1/sqrt(no.samples)))))
plot <- plot + annotate("text", x = c(8,8), y = c(0.4,0.35),
                label = c("Theortical Density","Sample Density"))
plot <- plot + annotate("segment", x = c(9.5,9.5), xend=c(10,10),y = c(0.395,0.345)
                ,yend=c(0.395,0.345),label = c("Theortical Density","Sample Density")
                ,size=5,colour=c("blue","darkgreen"))
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```



From this plot you can see the distribution against a normal distribution. As expected, they are similar. The sample distribution is normal.

4. Evaluate the coverage of the confidence interval for 1/lambda: X¯±1.96Snv.

```
ci <- sample.mean + c(-1,1) + 1.96 * sample.var/sqrt(no.samples)
```

The confidence interval as above is from 4.1935 to 6.1935.