Monte Carlo Approximation

Murali

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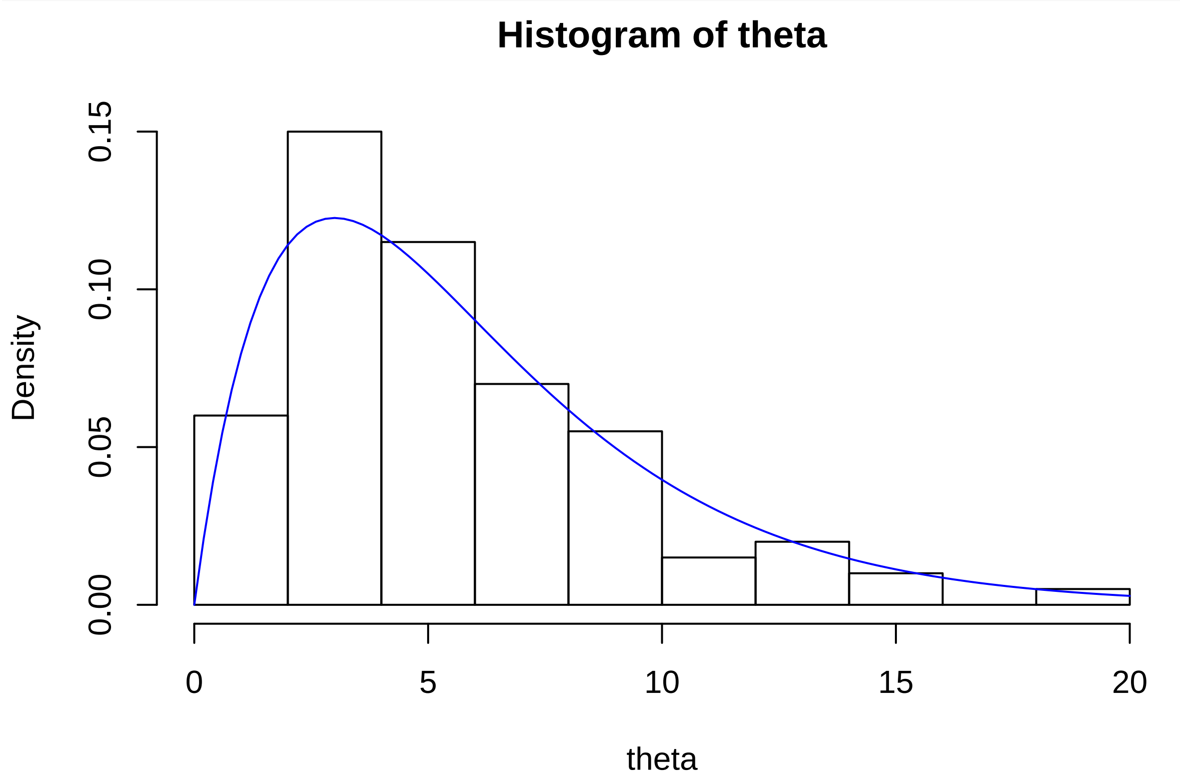
```r
set.seed(32)

m=100 #sample size
a=2
b = 1/3 #rate

theta <- rgamma(m,a,b)    # 100 draws of gamma distribution
head(theta)
```

```
## [1] 4.553954 8.280642 1.515590 9.160268 3.507859 5.606974
```

```r
tail(theta)
```

```
## [1] 2.432403 7.148443 2.715706 2.763691 5.413677 5.865641
```

```r
hist(theta, freq = FALSE) # freq = F gives probabilty densities
curve(dgamma(x,a,b), col = "blue", add = TRUE)
```




```r
# Expected Value(theta) = 2*3 = 6  - True Value of  mean
# Expected value of variance - a/b^2 - 2*9= 18 True Value of mean
```

```r
sum(theta)/m    # 5.514068   sample mean
```

```
## [1] 5.514068
```

```r
mean(theta)    # 5.514068
```

```
## [1] 5.514068
```

```r
var(theta) #13.10255  sample variance
```

```
## [1] 12.56345
```

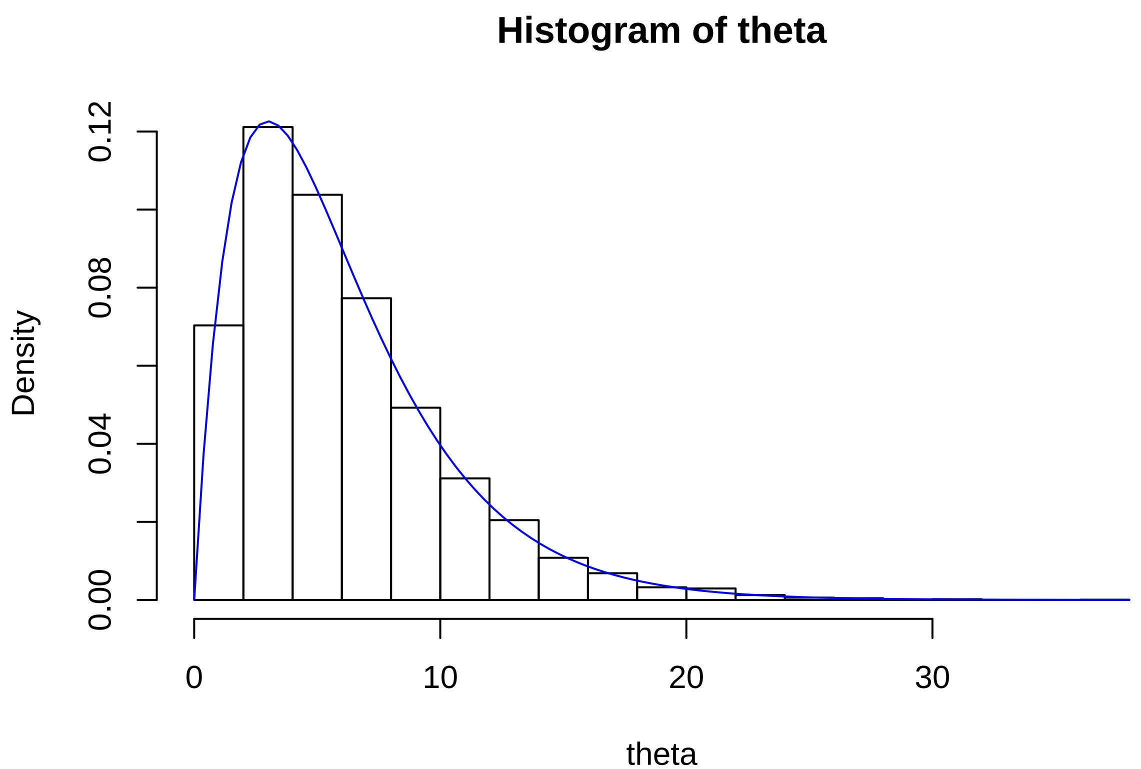
```r
# simulate more values by increasing sample size m = 10000

m=10000 #sample size
a=2
b = 1/3 #rate

theta <- rgamma(m,a,b)     # 100 draws of gamma distribution
head(theta)
```

```
## [1] 11.275715  6.267250  2.750041  1.060173  8.145714 13.265520
```

```r
tail(theta)
```

```
## [1]  7.4816103  8.1251813 10.5679076  0.4048316  9.7836341  7.4630491
```

```r
hist(theta, freq = FALSE) # freq = F gives probabilty densities
curve(dgamma(x,a,b), col = "blue", add = TRUE)
```




```r
sum(theta)/m    # 6.023273    much closer to true value
```

```
## [1] 6.023273
```

```r
mean(theta)
```

```
## [1] 6.023273
```

```r
var(theta) #18.04318 sample variance  much better
```

```
## [1] 18.04318
```

```r
#
#indicator variable

ind = theta < 5.0
head(ind)
```

```
## [1] FALSE FALSE  TRUE  TRUE FALSE FALSE
```

```r
head(theta)
```

```
## [1] 11.275715  6.267250  2.750041  1.060173  8.145714 13.265520
```

```r
mean(ind) # gives the probability  0.497
```

```
## [1] 0.497
```

```r
# True Probability - use pgamma - evaluates the CDF - cumulative distributive function 0.4963317

pgamma(q=5.0, a, b)
```

```
## [1] 0.4963317
```

```r
# 90th percentile quantile - monte carlo approximation 11.74338
quantile(theta, probs = 0.9)
```

```
##      90%
## 11.74338
```

```r
# True Quantile  qgamma function

qgamma(0.9,a,b)  #11.66916
```

```
## [1] 11.66916
```