Problems Sheet 3

Statistics 1

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Part A

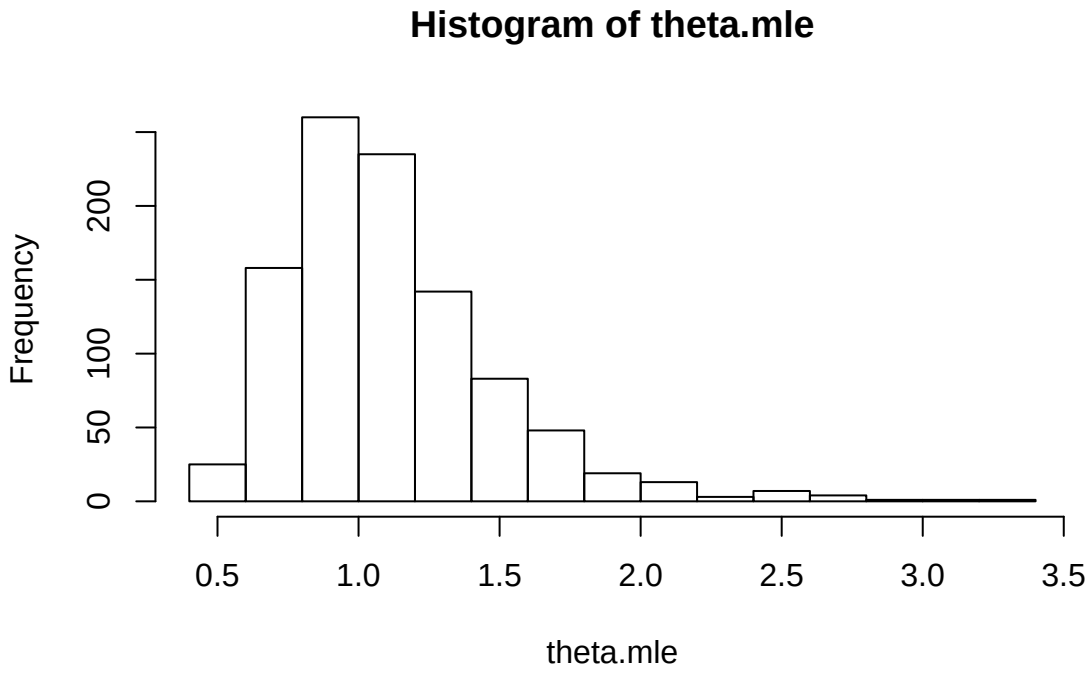
Question 2

a)

```
xvalues<-rexp(10000,rate=1)
xsamples<-matrix(xvalues,nrow=1000)
```

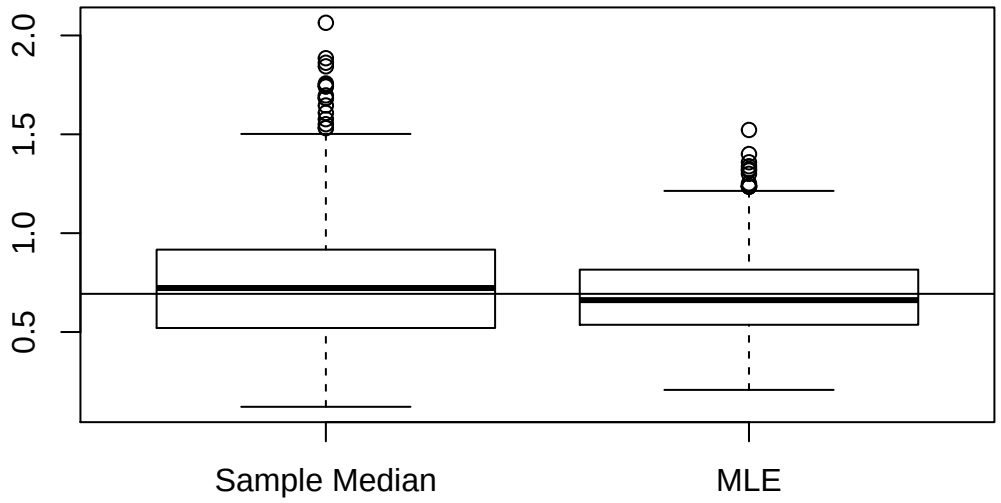
b)

```
sample.mean<-apply(xsamples,1,mean)
theta.mle<-1/sample.mean
hist(theta.mle)
```



c)

```
sample.median=apply(xsamples,1,median)
tau.mle<-log(2)/theta.mle
boxplot(sample.median,tau.mle, names=c("Sample Median","MLE"))
abline(h=log(2))
```



d)

Both calculations produce medians which are practicaly the same as the actual median. The sample median calculation has a much larger range & significantly more outliers than that of the maximum likelihood estimate.

e)

```
sample.mean<-mean(sample.median)
sample.var <-var(sample.median)
mle.mean   <-mean(tau.mle)
mle.var    <-var(tau.mle)

sample.mean
```

```
## [1] 0.748298
```

```
sample.var
```

```
## [1] 0.09457173
```

```
mle.mean
```

```
## [1] 0.6842141
```

```
mle.var
```

```
## [1] 0.04253249
```

```
sample.bias=sample.mean-log(2)
mle.bias   =mle.mean-log(2)
sample.bias
```

```
## [1] 0.05515081
```

```
mle.bias
```

```
## [1] -0.008933102
```

```
sample.mse=sample.var+sample.bias^2
mle.mse=mle.var+mle.bias^2
sample.mse
```

```
## [1] 0.09761334
```

```
mle.mse
```

```
## [1] 0.04261229
```

```
log(2)
```

```
## [1] 0.6931472
```

Both methods have a positive bias in their results, however maximum likelihood estimate has a much lower value. Maximum likelihood estimate has a lower variance & mean-square error