

Lab7

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First , let's look at exponential distribution:

P.d.f (Probability density function):

$$f(x) = \lambda e^{-\lambda x}$$

C.d.f (Cumulative distribution function):

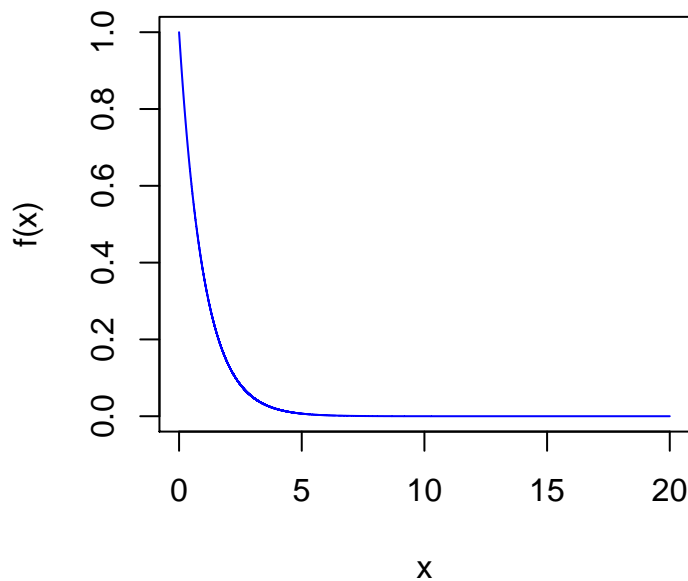
$$F(X) = Pr(x \leq X) = 1 - e^{-\lambda X}$$

when $\lambda = 1$ (That is when mean = 1):

```
lambda = 1

# create a sequence from 0 to 100 with distance 0.01
x = seq(0,20, by= 0.0001)

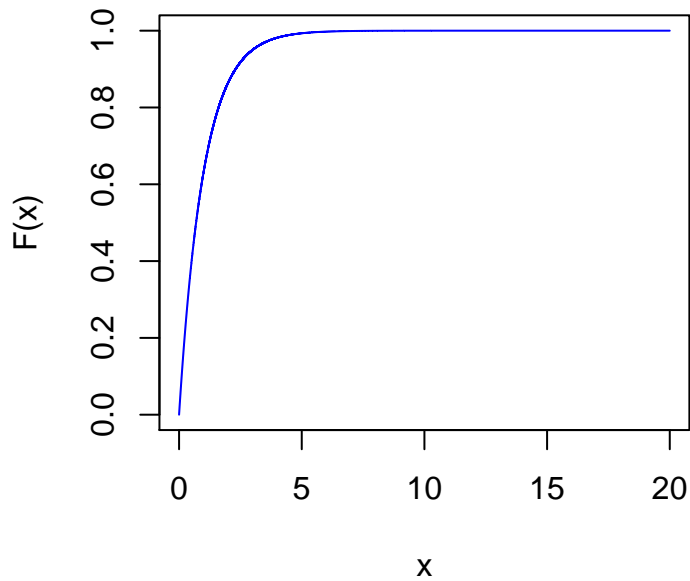
# create the p.d.f function of exponential for x
f = function(x){lambda*exp(-lambda * x)}
# plot f(x), p.d.f of x
plot(x,f(x),type = "l",col = "blue")
```



```

# create the C.d.f function for x
F = function(x){1 - exp(-lambda * x)}
# plot F(x), C.d.f of x
plot(x,F(x),type = "l",col = "blue")

```



Exponential distribution are usually used to model waiting time between independent events. Such as waiting time for passenger entering airport, waiting time to call customer service. Also , some material have an exponential decay.

simulate 500 exponential distribution

```

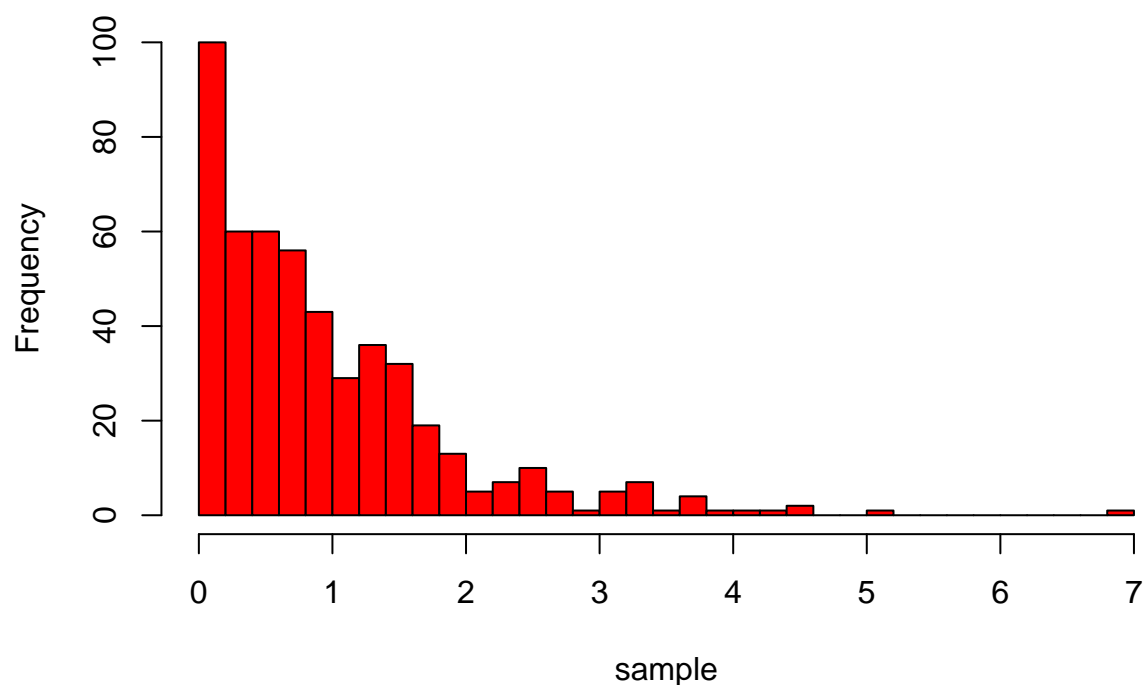
lambda = 1

# here we used the rexp function to generate 500 exponential distribution
sample = rexp( n = 500, rate = lambda)

# generate a histogram for the sample ( with 30 seperate bars)
hist(sample, breaks = 30 , col = "red")

```

Histogram of sample



```
# get mean of sample  
mean(sample)
```

```
## [1] 0.9511646
```

```
# get standard deviation of sample  
sd(sample)
```

```
## [1] 0.9217856
```

if we generate $n = 2$ exponential distribution each time, and look at the distribution of the mean

```
lambda = 1  
  
# define sample to be a vector  
sample = c()  
  
# a for loop, repeat 500 times  
for(i in 1:500){  
  # generate 2 exponential distribution  
  a = rexp( n = 2, rate = lambda)
```

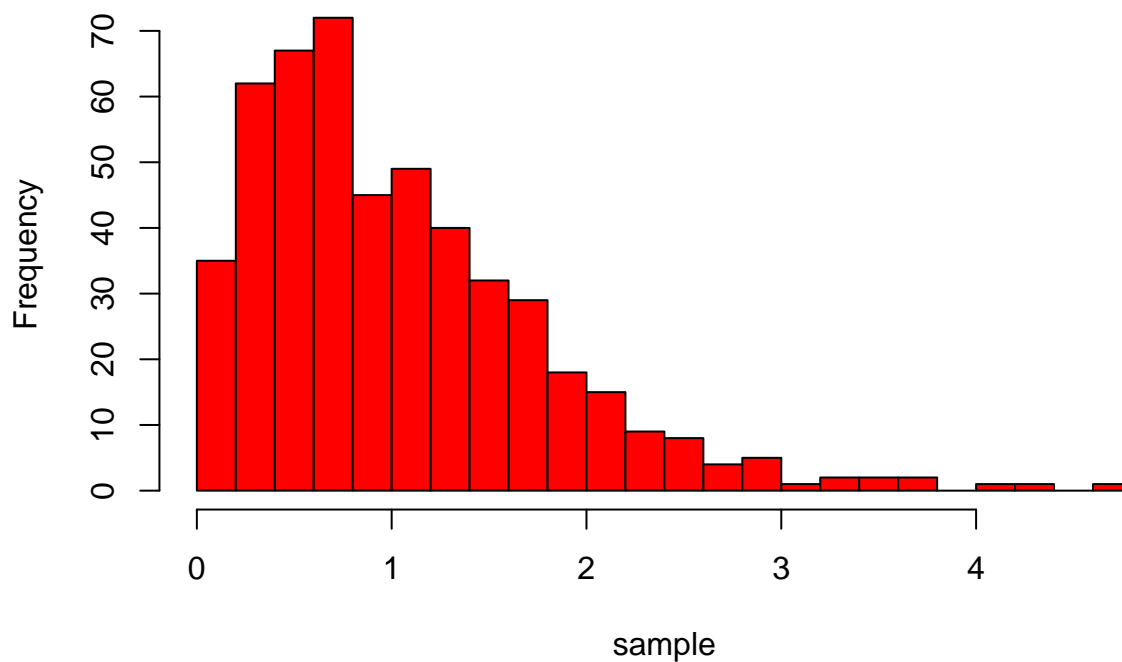
```

# take the average of them
b = mean(a)
# save our sample mean ( append value of b to our sample)
sample = c(sample , b)
}

# generate a histogram for the sample ( with 30 seperate bars)
hist(sample, breaks = 30 , col = "red")

```

Histogram of sample



```

# get mean of sample
mean(sample)

```

```
## [1] 1.035678
```

```

# get standard deviation of sample
sd(sample)

```

```
## [1] 0.7485025
```

First, try get the average $n = 30$ on your own, finish table 7.1

Second, try uniform and finish table 7.2

use `runif(n=500,min = 0 , max = 1)` to generate 500 uniform distribution with $a = 0$ and $b = 1$

Third, try normal and finish table 7.2

use `rnorm(n=500,mean = 0 , sd = 1)` to generate 500 standard normal distribution with $\text{mean} = 0$ and $\text{standard deviation} = 1$

Finish all discussion questions