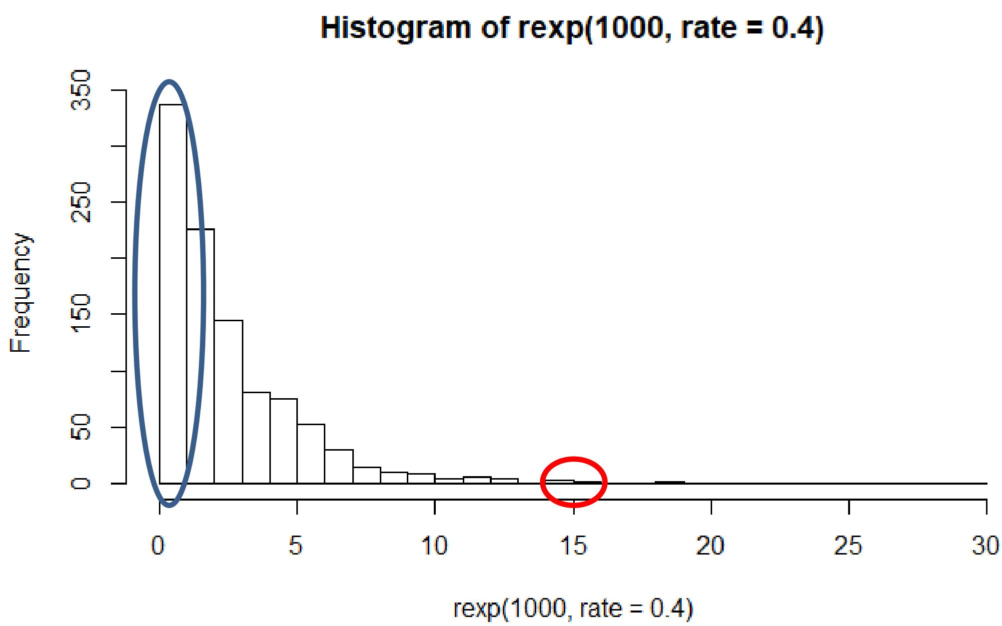
Exponential distribution Cheat Sheet:

This distribution describes the time between events.

Examples:

1. Length of time between metro arrivals.
2. Life of an asset (PP&E). How long it takes for a machine to go out of service.
3. Length of time between each new customer visiting a website.

The time between events is on the X axis and the count of events is on the Y axis.



The exponential distribution has only one parameter: λ (lambda)

Lambda describes the **RATE** of the events arriving. The higher the lambda, the steeper the exponential curve.

Run the following in R to see the differences between lambdas (the rate):

hist(rexp(1000, rate=.4), breaks = seq(from=0, to=30, by=1))

hist(rexp(1000, rate=1), breaks = seq(from=0, to=30, by=1))

```
hist(rexp(1000, rate=2), breaks = seq(from=0, to=30, by=1))
```

In R we can simulate a distribution using the rexp() function. The first argument is the number of events and the rate is our lambda parameter:

```
rexp(1000, rate=2)
```

Distribution characteristics:

Mean(x): $\frac{1}{\lambda}$

Variance(x): $\frac{1}{\lambda^2}$

Exercise: What is your rate (lambda) if the distribution mean (average) is 10 minutes? How does your distribution look like for 1000 events?

Example:

Let's assume that we are talking about the time between each bus (line #1 in SF) at a given stop (corner of California and Sansome). The X axis shows how many minutes elapsed since the previous bus. In the chart above, 350 buses arrived sooner than 1 minute after the previous bus (blue circle). There were also a few busses, maybe 10, that were 15 minutes apart (red circle). You know that the distribution is exponential with a $\lambda = 0.4$

The Muni CEO asked you to calculate the probability of the bus arriving:

1. In more than 10 minutes after the previous bus.
   $P(X>10)= \exp(-\lambda*10)$

2. In less than 5 minutes after the previous bus.
   $P(X<5) = 1 - \exp(-\lambda*5)$