

# Statistical Inference Project Part 1

First I simulated 1000 averages of 40 exponential with  $\lambda = 0.2$ .

```
lambda <- 0.2
sim <- replicate(1000, (mean(rexp(40, rate=lambda))))
```

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

We know that theoretical mean is  $1/\lambda$ . I calculated the mean of my simulated data and it is very close to the theoretical mean.

```
theoretical.mean <- 1/lambda
theoretical.mean
```

```
## [1] 5
```

```
sim.mean <- mean(sim)
sim.mean
```

```
## [1] 4.983
```

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

We know the standard deviation for a distribution of means is  $S/\sqrt{n}$ . So the standard deviation is  $(1/\lambda)/\sqrt{40}$ . The variance is just the standard deviation squared. I calculated the variance of my simulated data and it is very close to the theoretical variance.

```
theoretical.sd <- (1/lambda)/sqrt(40)
theoretical.var <- theoretical.sd^2
theoretical.var
```

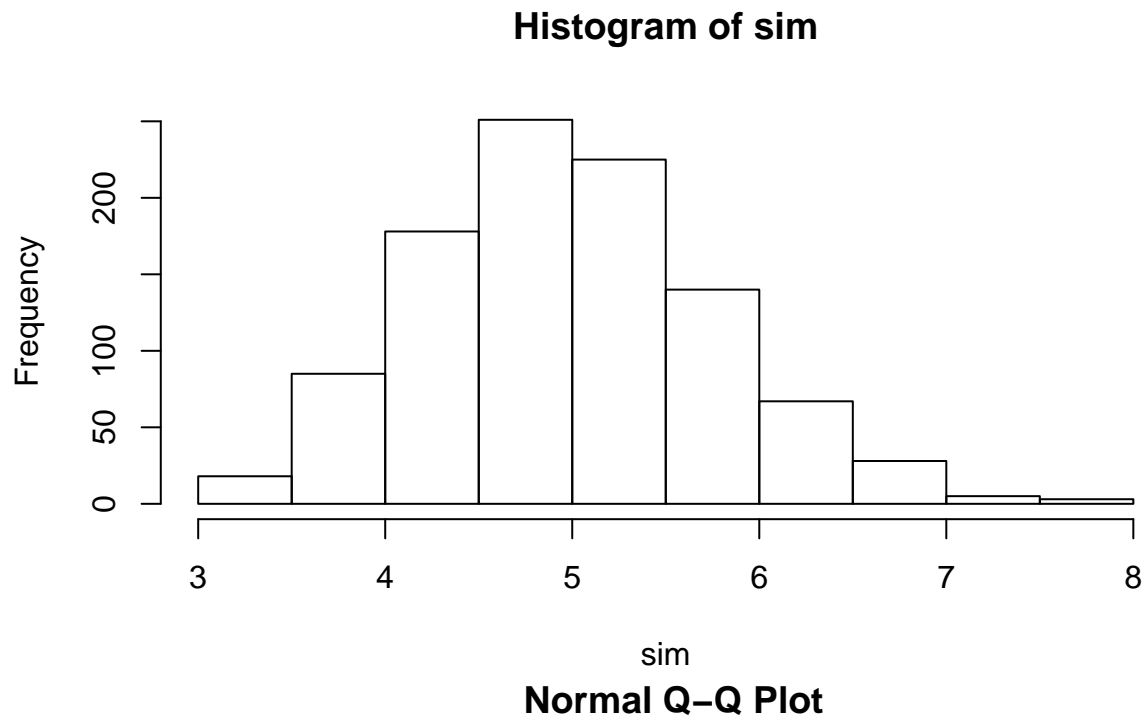
```
## [1] 0.625
```

```
sim.var <- var(sim)
sim.var
```

```
## [1] 0.6231
```

3. Show that the distribution is approximately normal.

I first created a histogram of my simulated data. It appeared symmetrical, centered around the mean of 5, and roughly normal. To show this more conclusively, I created a qqplot which compares a distribution (in this case my simulated data) to the normal distribution. A perfectly normal distribution should lie on the line. This shows that my data is very close to a normal distribution.



4. Evaluate the coverage of the confidence interval for  $1/\lambda$ . (This only needs to be done for the specific value of  $\lambda$ ).

I first created the 95% confidence interval. I then checked to see how many of my means of 40 exponentials fell within this interval. I found that approximately 95% of the means fell within this interval.

```
conf.interval <- theoretical.mean + c(-1,1)*1.96*theoretical.sd
mean(conf.interval[1] < sim & sim < conf.interval[2])
```

```
## [1] 0.952
```