Statistical Inference Project

Part1

Question1

```
set.seed(31)

# set lambda to 0.2
lambda <- 0.2

# 40 samples
n <- 40

# 1000 simulations
simulations <- 1000

# simulate
simulated exponentials <- replicate (simulations, rexp(n, lambda))

# calculate mean of exponentials
means_exponentials <- apply(simulated_exponentials, 2, mean
# distrribution mean
analytical_mean <- mean(means_exponentials)
```

analytical_mean

[1] 4.993867

 # analytical mean
theory_mean <- 1/lambda
theory_mean

 # visualization
hist(means_exponentials, xlab = "mean", main = "Exponential Function Simulations")
abline(v = analytical_mean, col = "red")
abline(v = theory_mean, col = "orange")

Answer 1

The analytics mean is 4.993867 the theoretical mean 5. The center of distribution of averages of 40 exponentials is very close to the theoretical center of the distribution.

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

 # standard deviation of distribution
standard_deviation_dist <- sd(means_exponentials)
standard_deviation_dist
[1] 0.7931608

 # standard deviation from analytical expression

```
standard_deviation_theory <- (1/lambda)/sqrt(n)
standard_deviation_theory
## [1] 0.7905694
# variance of distribution
variance_dist <- standard_deviation_dist^2
variance_dist
## [1] 0.6291041

# variance from analytical expression
variance_theory <- ((1/lambda)*(1/sqrt(n)))^2
variance_theory
## [1] 0.625
```

Answer 2

Standard Deviation of the distribution is 0.7931608 with the theoretical SD calculated as 0.7905694. The Theoretical variance is calculated as $(1\lambda*1n\surd)2(1\lambda*1n)2$ = 0.625. The actual variance of the distribution is 0.6291041