Stat 3202 Lab 3

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1A. An estimator is consistent if

$$\hat{\theta}$$

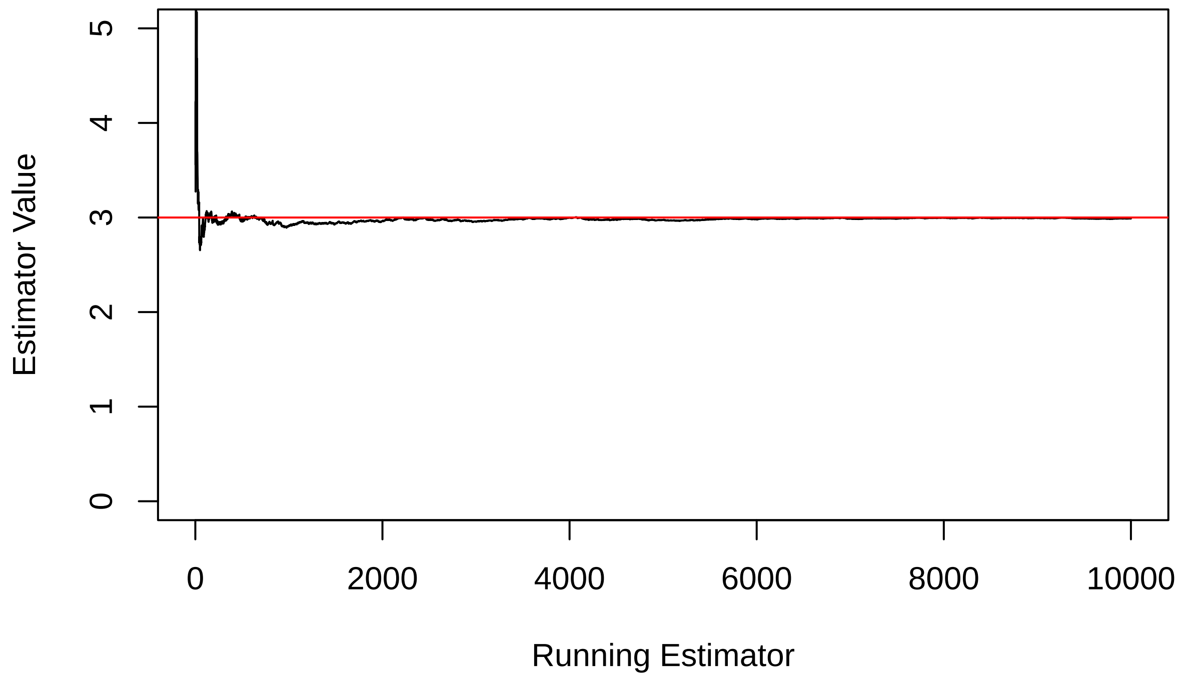
is unbiased for

$$\theta$$

and if as the sample size n increases, the variance goes to zero. This essentially means that as the sample size increases, the estimator will produce values that are close to the true parameter.

1B.

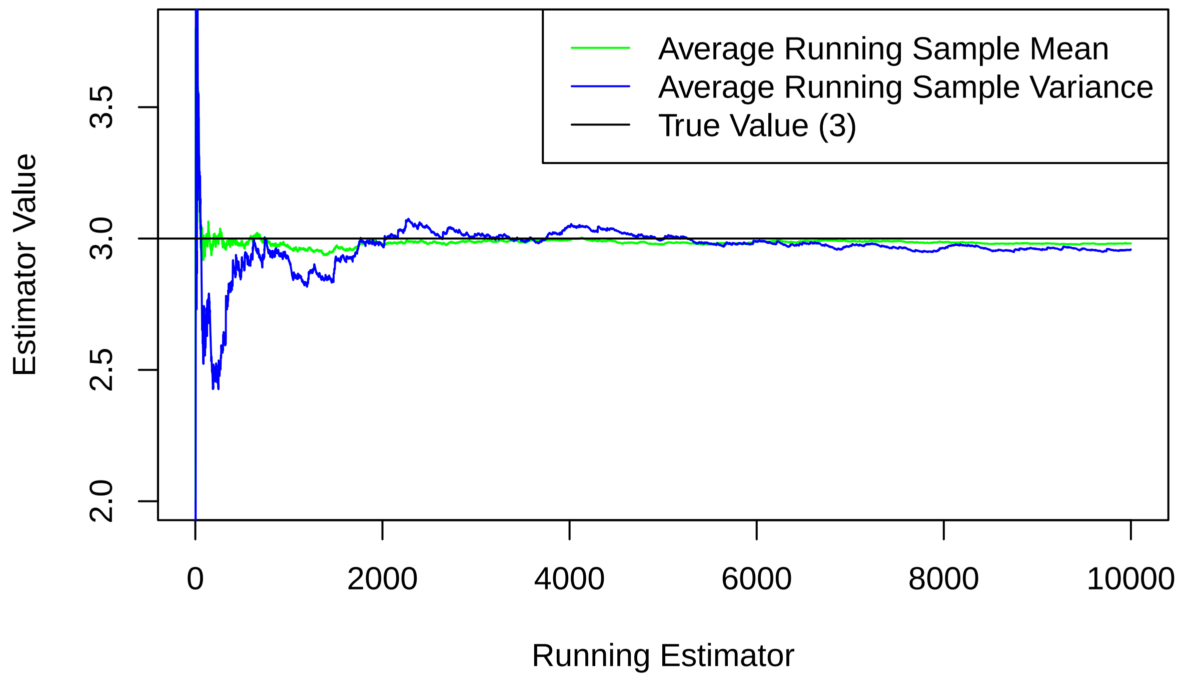
```
set.seed(123)
lambda <- 3
running_xbar <- c()
running_tests <- c()

for (i in 1:10000) {
  running_tests[i] <- rexp(1, 3)
  running_xbar[i] <- 1 / mean(running_tests[1:i])
}

plot(running_xbar, xlab = "Running Estimator", ylab = "Estimator Value", ylim=c(0,5), type="l")
abline(h=lambda, col = "red")
```



This plot shows how the average of all of the $\frac{1}{\bar{x}}$s converges to λ=3 as the sample size increases. This means that $\frac{1}{\bar{x}}$ is consistent for λ.

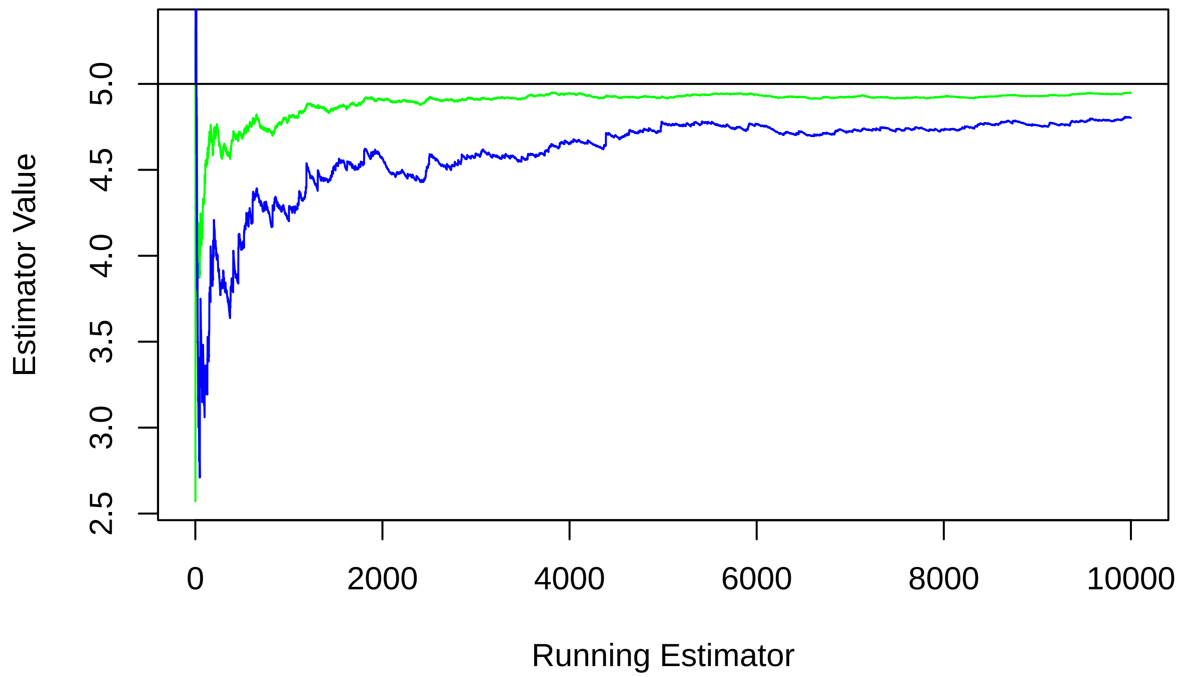
2.

```r
set.seed(123)
lambda <- 3
running_xbar <- c()
running_var <- c()
running_tests <- c()

for (i in 1:10000) {
  running_tests[i] <- rpois(1, lambda)
  running_xbar[i] <- mean(running_tests[1:i])
  running_var[i] <- var(running_tests[1:i])
}

plot(running_xbar, xlab = "Running Estimator", ylab = "Estimator Value", type="l", col="green")
lines(running_var, col="blue")
abline(h=lambda, col="black")
legend("topright", legend = c("Average Running Sample Mean", "Average Running Sample Variance", "True Va
```



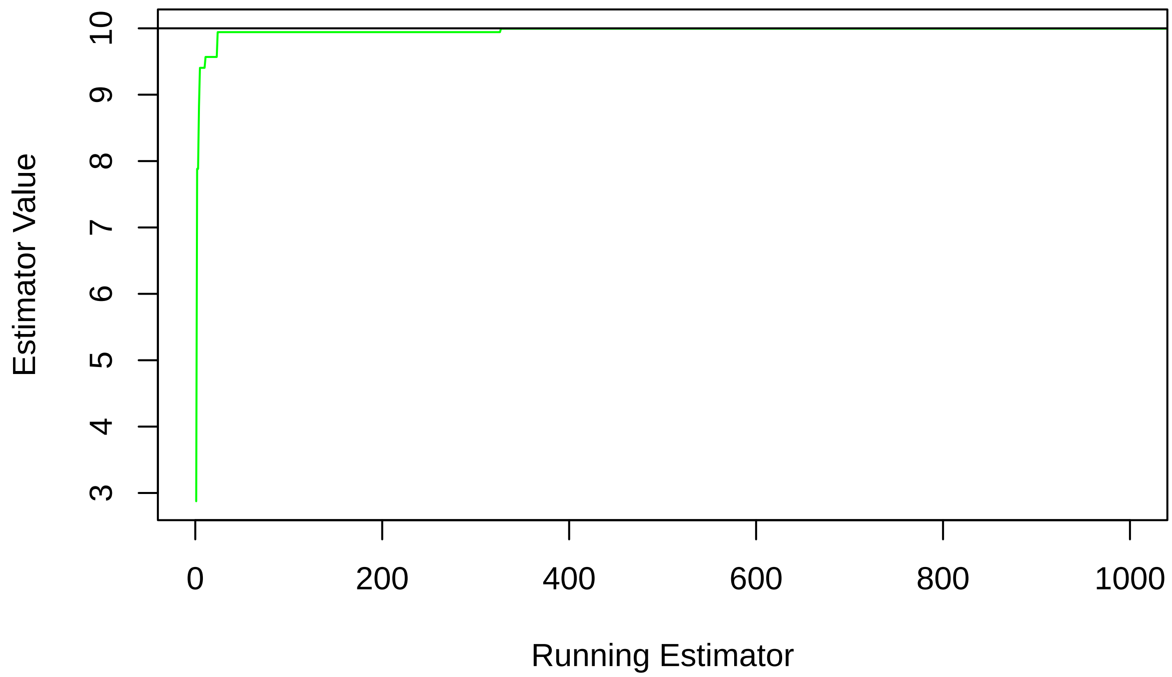
3.

```
set.seed(123)
k <- 5
running_xbar <- c()
running_var <- c()
running_tests <- c()

for (i in 1:10000) {
  running_tests[i] <- rchisq(1, df = k)
  running_xbar[i] <- mean(running_tests[1:i])
  running_var[i] <- var(running_tests[1:i]) / 2
}
plot(running_xbar, xlab = "Running Estimator", ylab = "Estimator Value", type="l", col="green")
lines(running_var, col="blue")
abline(h = k, col="black")
```



4.

```
set.seed(123)
running_max <- c()
running_tests <- c()
theta <- 10
for (i in 1:10000) {
  running_tests[i] <- runif(1, 0, theta)
  running_max[i] <- max(running_tests[1:i])
}
plot(running_max, xlab = "Running Estimator", ylab = "Estimator Value", type="l", col="green", xlim = c
abline(h=theta, col="black")
```



5. This plot looks different because there is only one maximum value. There are periods of stationary at the current maximum value until a new maximum value is observed.