

Homework 5

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## R code for the Monte Carlo simulations in HW5 math 563
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## GOAL: To estimate  $\pi = 3.14159\dots$ , the area of the unit circle.
## Strategy 1
pi.est1 <- function(n, reps) {
  pi.hat <- numeric(reps)
  for(i in 1:reps) pi.hat[i] <- 4 * mean((runif(n)**2 + runif(n)**2) < 1)
  return(pi.hat)
}
# TO RUN:
out1 <- pi.est1(n=10000, reps=1000)
print(c(mean(out1), var(out1)))
```

```
## [1] 3.1416720000 0.0002675654
```

```
# Strategy 2
pi.est2 <- function(n, reps) {
  pi.hat <- numeric(reps)
  for(i in 1:reps) pi.hat[i] <- 4 * mean(sqrt(1 - runif(n)**2))
  return(pi.hat)
}
# TO RUN:
myOutput <- pi.est2(n=10000, reps=1000)
print(c(mean(myOutput), var(myOutput)))
```

```
## [1] 3.141724e+00 7.426008e-05
```

We can see we have smaller variance in 2nd Strategy so π_2 (Pi-2) is the best estimators in this case. If you have a choice between two ways to estimate some quantity, choose the method that has the smaller variance. For Monte Carlo estimation, a smaller variance means that you can use fewer Monte Carlo iterations to estimate the quantity.

why the two estimators do estimate π . Both estimators provide a reasonable approximation of π , but estimate from the 2nd Strategy method is better. More importantly, the standard error for the 2nd Strategy method is lesser than the 1st Strategy.