ICA 4

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Question 1:

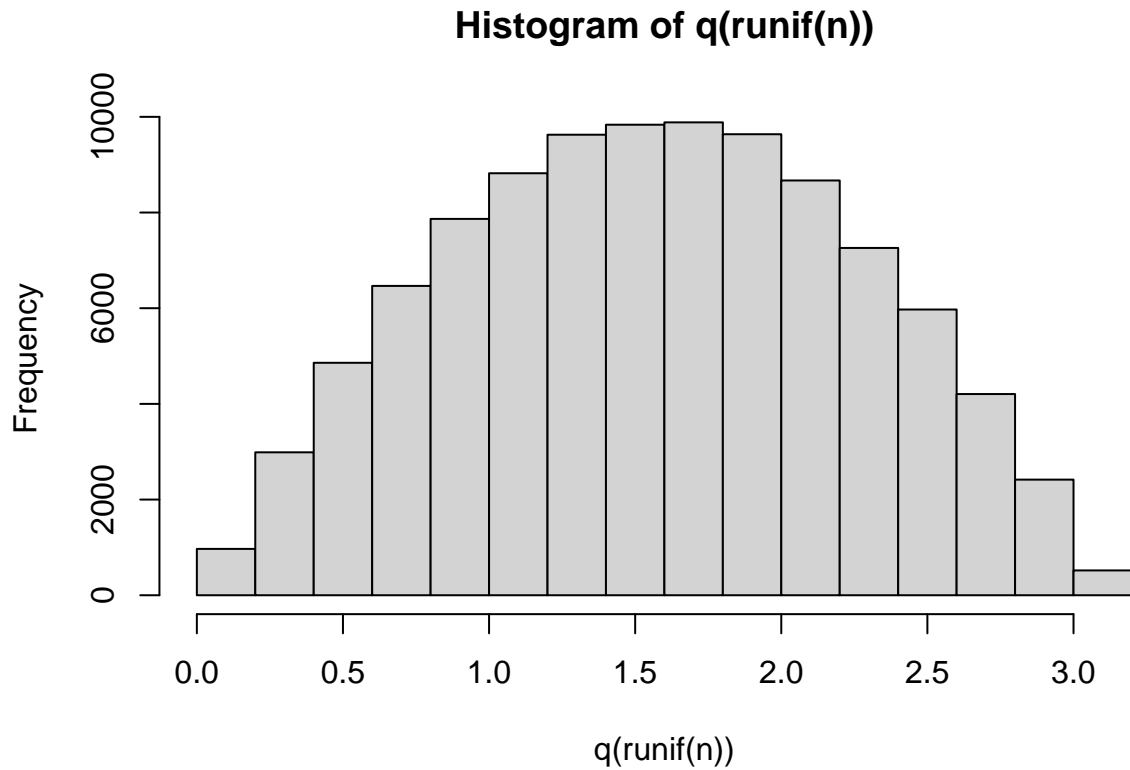Take a probability distribution p(x) = 0.5sin(x), 0 < x < pi.

CDF: 0.5(-cos(x)+ 1)

    a) Create the quantile function for this distribution. (be careful with finding the cdf)
    b) Use the quantile function to create a simulation of this distribution, using n = 100,000. Plot the simulation in a histogram. Does the shape match the original distribution?

```r
#integrand is 0.5sin(x), bounds from 0 to x
x = seq(0,pi,0.05)
n <- 100000
integral <- function(x) {
  result <- 0.5*sin(x)
  return(result)
}

cdf <- function(x){
  result <- 0.5*(-cos(x)+1)
  return(result)
}
q <- function(x){
  result <- acos(-2*x+1)
}
```

```r
q(runif(n))
hist(q(runif(n)))
```

Histogram of q(runif(n))

Question 2:

In this problem, we will calculate the following familiar integral: (integral from 0 to pi, sin(x)dx)

  a) Calculate the integral by hand

integrand(sin(x)dx) = -cos(x) = [-cos(x)]^pi_0 = 2 <- ANSWER

  b) Do 100 iterations of the integral value using standard Monte Carlo, using n = 100,000. What are the mean and standard deviation of the 100 iterations? (for i in 1:100)

  c) Do 100 iterations of the integral value using Acceptance/Rejection Monte Carlo, using n = 100,000. What are the mean and standard deviation of the 100 iterations?

  d) How do the values compare between (b) and (c)?

[1] 1.574815

[1] 0.6836374