**STT 810**

**ICA 8**

1. Let us take the probability distribution we worked with in the previous 2 ICA’s, p(x) = 1/8 \* x,  
   where x is between 0 and 4. Recall that the cdf is given by F(x) = 1/16 \* x2.
   1. Calculate (on paper) the inverse of the cdf function.
   2. Create a variable un which is 1,000,000 simulations of the uniform variable on the unit segment.

**un <- runif(1000000)**

* 1. Put this un variable into the inverse cdf, generating a new variable un\_4.

**un\_4 <- 4\*un^(1/2)**

* 1. Plot a histogram of un\_4. Does the shape correspond to the pdf of the original  
     function?

**hist(un\_4)**

Chart, histogram

Description automatically generated

* 1. Use the simulation to find E(X) and E(X2). Based on these results, what is the variance?

Graphical user interface, text, application

Description automatically generated

1. You are running a manufacturing plant which can produce 120,000 units per month. You are  
   told that the expected demand for next month is uncertain; it is normally distributed with mean 100,000 and standard deviation 25,000. Each unit sold generates $20 in profit.
   1. What is the expected amount of demand? (no calculation required)

**100000**

* 1. What is the profit associated with the expected amount of demand? ($20 x the answer in (a))

**2000000**

* 1. Generate 1,000,000 simulations of demand with rnorm. Store it in a variable called  
     demand.

**demand <- rnorm(1000000,100000,25000)**

* 1. Since sales are limited at 120,000 determine the actual amount of units sold for the  
     simulations. Call it sales\_vol. You can use the command sales\_vol = pmin(demand,  
     120000)

**sales\_vol <- pmin(demand,120000)**

* 1. Calculate for the simulations the total profit. Call it profit.

**profit <- sales\_vol\*20**

* 1. What is the average of the profit? How does it compare to the profit of the average  
     (answer in (b))? Discuss and explain the difference?

Graphical user interface

Description automatically generated with medium confidence

This result is an important consequence of calculations with random variables. It is common in business  
to calculate an expected profit like in (b), but (f) is a better calculation. This result has been called The  
Flaw of Averages by Sam Savage.