STT 380

ICA 7

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 * x^2.

    a. Calculate (on paper) the inverse of the cdf function.

        i. F(x) = 1/16 * x^2 => (F^−1(x))=x^3/8

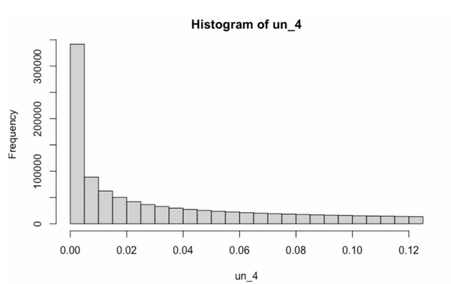
    b. Create a variable **un** which is 1,000,000 simulations of the uniform variable on the unit segment.

        i. un <- runif(1000000)

    c. Put this **un** variable into the inverse cdf, generating a new variable **un_4**.

        i. un_4 <- (runif(1000000)^3)/8

    d. Plot a histogram of **un_4**. Does the shape correspond to the pdf of the original function?



Yes it does correspond but the shape is similar and not completely related.

    e. Use the simulation to find E(X) and E(X^2). Based on these results, what is the variance?

        i. mean((runif(1000000)^3)/8)

            1. 0.03126959

        ii. mean(((runif(1000000)^3)/8)^2)

            1. 0.002230134

        iii. Variance = 0.002230134 - 0.03126959^2 = 0.00125234674

2. 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.

a. What is the expected number of units sold? (no calculation required)

    i. 100000

b. What is the profit associated with the expected number of units sold? ($20 x the answer in (a))

    i. 20*100000

    ii. [1] 2000000

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

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

d. 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 = pmax(demand, 120000)

    i. sales_vol = pmax(demand, 120000) =123019

e. Calculate for the simulations the total profit. Call it profit.

    i. profit <- rnorm(1000000,100000*20,25000*20)

f. 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?

    i. profit <- rnorm(1000000,100000*20,25000*20)

    ii. mean(profit) = 2000427

    iii. It is just about the same amount since they are being calculated using similar values. It is just off but the estimation gives a good clue we are on the right track with the value we found later on

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.