Project 1

MGMT 237G
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You will need to write codes for all the parts of the project. Make sure the codes work properly and understand the ideas behind each problem below. You may be asked to demonstrate how the codes work, by running them, and interpret the results. Code quality, speed, and accuracy will determine the grades.

Submit your codes and a PDF file of your answers to questions (including graphs, histograms, but no codes, in this PDF file) by 11PM PDT on Next Wednesday.

1. Use the Random Number generators discussed in the class to do the following:

   (a) Using the LGM method generate 10,000 Uniformly distributed random numbers on [0,1] and compute the empirical mean and the standard deviation of the sequence.

   (b) Use built-in functions of the software you are using to do the same thing as in (a).

   (c) Compare your findings in (a) and (b) and comment (be short, but precise).

2. Use the numbers of part (a) of question 1 to do the following:

   (a) Generate 10,000 random numbers with the following distribution:

$$X = \begin{cases} -1 \ \ with \ \ probability \ \ 0.30 \\ 0 \ \ with \ \ probability \ \ 0.35 \\ 1 \ \ with \ \ probability \ \ 0.20 \\ 2 \ \ with \ \ probability \ \ 0.15 \end{cases}$$

   (b) Draw the histogram and compute the empirical mean and standard deviation of the sequence of 10,000 numbers generated in part (a).

3. Using the LGM method generate Uniformly distributed random numbers on [0,1] to do the following:

   (a) Generate 1,000 random numbers with Binomial distribution with $n = 44$ and $p = 0.64$. (*Hint*: A random variable with Binomial distribution (n, p) is a sum of n Bernoulli (p) distributed random variables, so you will need to generate 44,000 Uniformly distributed random numbers, to start with).

   (b) Draw the histogram. Compute the probability that the random variable X that has Binomial (44, 0.64) distribution, is at least 40: $P(X \geq 40)$. Use any statistics textbook or online resources for the exact number for the above probability and compare it with your finding and comment.

4. Using the LGM method generate Uniformly distributed random numbers on [0,1] to:

   (a) Generate 10,000 Exponentially distributed random numbers with parameter $\lambda = 1.5$.

   (b) Compute $P(X \geq 1)$ and $P(X \geq 4)$.

(c) Compute the empirical mean and the standard deviation of the sequence of 10,000 numbers generated in part (a). Draw the histogram by using the 10,000 numbers of part (a).

5. Using the LGM method generate Uniformly distributed random numbers on [0,1] to:

   (a) Generate 5,000 Normally distributed random numbers with mean 0 and variance 1, by **Box-Muller** Method.
   (b) Now use the **Polar-Marsaglia** method to Generate 5,000 Normally distributed random numbers with mean 0 and variance 1.
   (c) Now compare the efficiencies of the two above-algorithms, by comparing the execution **times** to generate 5,000 normally distributed random numbers by the two methods. Which one is more efficient? If you do not see a clear difference, you need to increase the number of generated realizations of random variables to 10,000, 20,000, etc.