============================== Question 1 ==============================

============================== Question 1a ==============================

The empirical mean with X_0 = 5: 0.497711

The empirical standard deviation with X_0 = 5: 0.287001

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============================== Question 1b ==============================

The built in library uniform distribution mean: 0.497515

The built in library uniform distribution standard deviation: 0.289374

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============================== Question 1c ==============================

We see the values are very close, but different.

The absolute difference in the mean is: 0.000195916

The absolute difference in the standard deviation is: 0.00237311

We conclude the LGM algorithm performs very well.

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============================== Question 2 ==============================

============================== Question 2a ==============================

Computed the independent Bernoulli distribution

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============================== Question 2b ==============================

The empirical mean of independent bernoulli: 0.1858

The empirical standard deviation of independent bernoulli: 1.02268

Successfully wrote to text q2 for R plotting

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============================== Question 3 ==============================

============================== Question 3a ==============================

Generated the 1,000 random numbers of Binomial Distribution.

Successfully wrote to text q3b for R plotting

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============================== Question 3b ==============================

Empirical estimates of P(X >= 40): 0

==========

============================== Question 4 ==============================

============================== Question 4a ==============================

Generated the 10,000 random numbers of the Exponential Distribution.

Successfully wrote to text q4c for R plotting

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============================== Question 4b ==============================

P(X >= 1): 0.5111

P(X >= 4): 0.0717

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============================== Question 4c ==============================

The empirical mean of exponential: 1.49742

The empirical standard deviation of exponential: 1.52424

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============================== Question 5 ==============================

============================== Question 5a ==============================

The time (milliseconds) it took to run the Box Muller N(0,1): 15

==========

========== Question 5b ==========

The time (milliseconds) it took to run the Polar Marsaglia N(0,1): 11

==========

========== Question 5c ==========

Using this many Normally distributed random number: 500000

The time (milliseconds) it took to run the Box Muller N(0,1): 1467

The time (milliseconds) it took to run the Polar Marsaglia N(0,1): 1183

We see that the difference between the two methods is a few milliseconds in our initial run time to be not siginificantly different. It is within computationally varied speed that we cannot compare. However, when the sequences get larger, the difference is speed will differ greatly.

Polar Method is shown to be quicker method

R Plots are found below

Computational Method PDF

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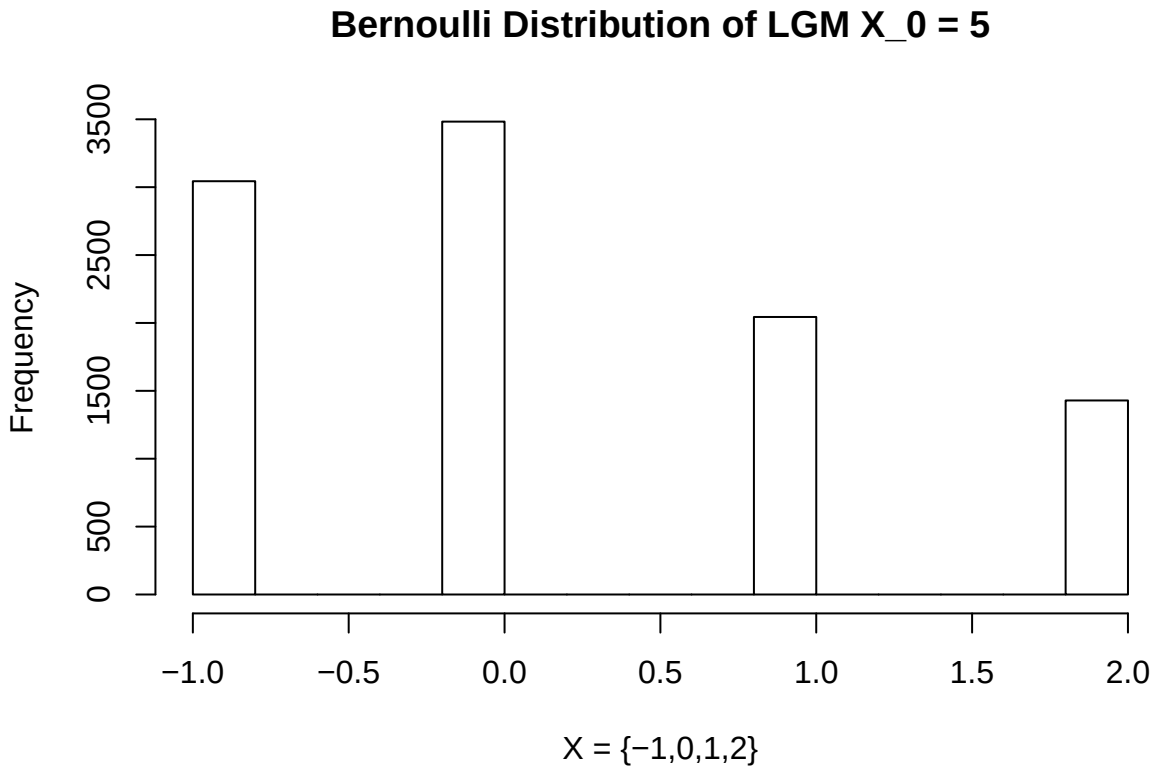
April 7, 2020

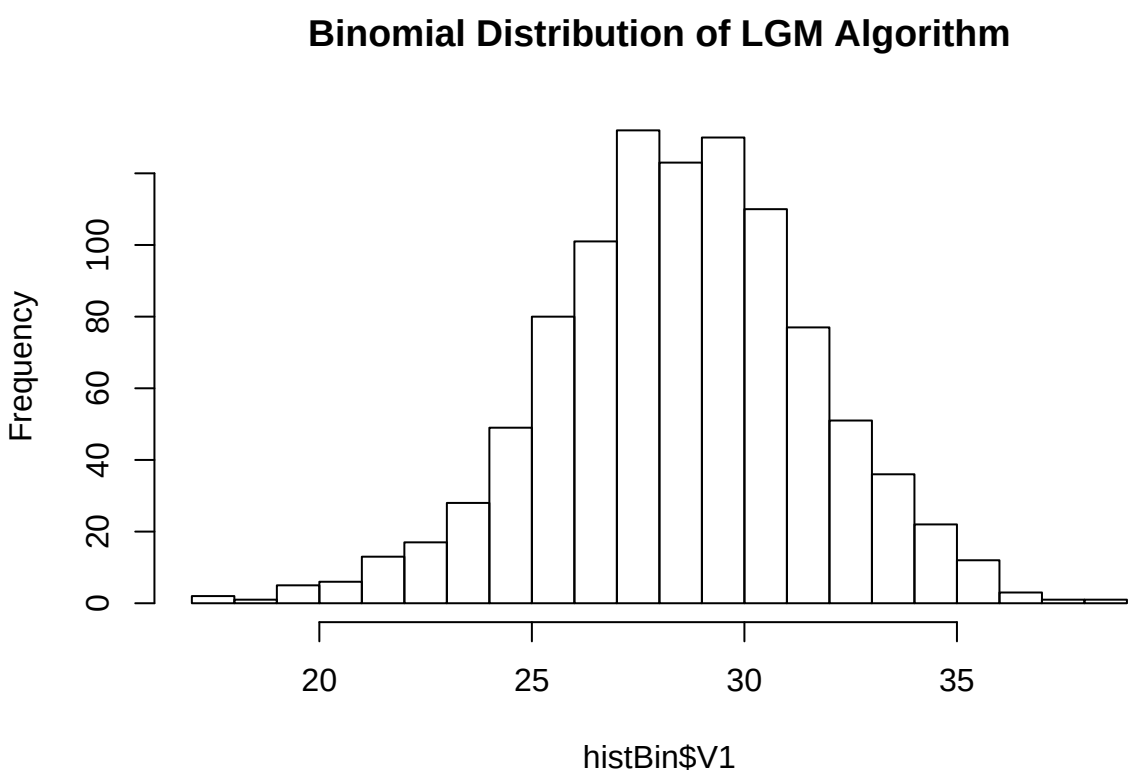
Problem 2(b)

```
histBern <- read.delim("q2.txt",sep = '\n', header = FALSE)
hist(histBern$V1, main = "Bernoulli Distribution of LGM X_0 = 5" , xlab = "X = {-1,0,1,2}")
```



Problem 3(b)

```
histBin <- read.delim("q3b.txt",sep = '\n', header = FALSE)
hist(histBin$V1, main = "Binomial Distribution of LGM Algorithm", breaks = 30)
```



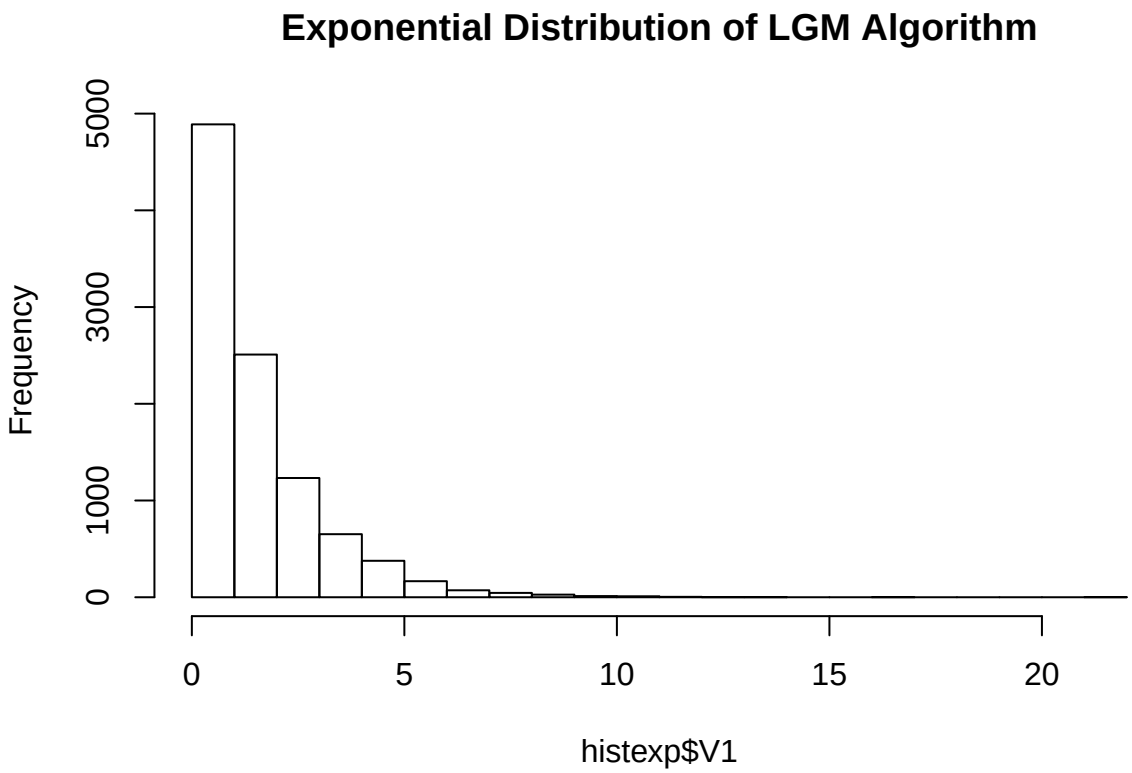

```
prob40Greater <- 1 - pbinom(39,size = 44, p = 0.64)
prob40Greater
```

```
## [1] 4.823664e-05
```

The Probability for P(X >= 40) is 4.823664e-05, which is very close to zero This is why we have zero in our C++. None of it passed 40.

Problem 4c

```
histexp <- read.delim("q4c.txt",sep = '\n', header = FALSE)
hist(histexp$V1, main = "Exponential Distribution of LGM Algorithm", breaks = 25)
```


Exponential Distribution of LGM Algorithm
Frequency
0
1000
3000
5000
0
5
10
15
20
histexp$V1