Report for lab3

1.Introduction:
In this lab, we studied how to generate the random number and perform the statistical test. In the code randomnumber.cpp, a standard normal distribution(SND) random number generator was build and the validation is analyzed using Chi-square test.

2. Methodology

In this assignment, Firstly a random number generator was created from scratch, which can generate uniform random numbers from 0 to 1. The H.W.Lewis method was used to generate random numbers. The random number generator was then used to build a SND random number generator, which generate random variables having standard normal distribution. For this part, the acceptance rejection method was used. To test whether the SND random number generator can produce samples which have standard normal distributions, 100000000 sample points was generated and separated into 6 bins, which is in the regions: [-Inf, -1], [-1, -0.5] ,[-0.5, 0], [0, 0.5], [0.5, 1] and [1, Inf] separately. The expected value is calculated for each of the regions(online Z table was used to get the data). The Chi-square was calculated and the p value was discussed.

3. Result

100000000 random numbers with normal distribution have been generated by the SND random number generator I developed, For each of the 6 bins, which represent the regions:[-Inf, -1], [-1, -0.5] ,[-0.5, 0], [0, 0.5], [0.5, 1] and [1, Inf], the results is in Table 1:

region id	observed	expected
1	15866869	1.58655e+07
2	14992663	1.49885e+07
3	19144972	1.9146e+07
4	19143310	1.9146e+07
5	14987443	1.49885e+07
6	15864743	1.58655e+07

Table 1: the observed and expected number of samples for each of the regions

Performing Chi-square test using the data in Table 1, the result is 1.81818. The degree of freedom of this Chi-square test is 5, which gives the p-value for P(X<=x) is 0.1263 (from online p-value table).

4. Conclusion
From Table 1, we can see that the numbers we observed in each of regions is similar to what we expected: the first 4 digits of observed and expected data are identical.

However, when performing the Chi-square test and p-value calculation, we cannot reject the null hypothesis: The null hypothesis is that the sample was not drawn from the standard normal distribution. The predetermined p-value threshold to reject null hypothesis is 0.05. The p-value I got is 0.1263 which is bigger than 0.05, which means that I fail to reject the null hypothesis. So it is still possible that the sample was not drawn from the standard normal distribution.