MA323 : Lab 4 Report

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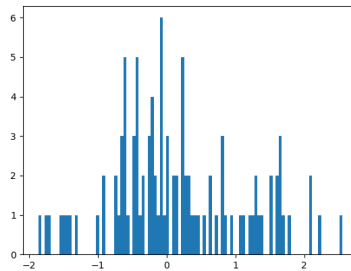
Q1

Box Muller Method

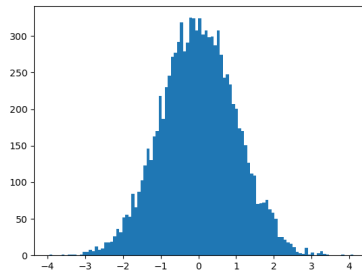Sample Mean and Variance :

N	Mean	Variance
100	0.14506	0.90630
10000	-0.00031	0.99025

- Time required to generate 100 values : 1.00028s

- Time required to generate 10000 values : 1.00728s

Histogram for 100 values :

Histogram for 10000 values :

Marsaglia and Bray Method

Sample Mean and Variance :

N	Mean	Variance
100	-0.09225	0.98168
10000	-0.00608	0.98785

- Time required to generate 100 values : 1.00053s

- Time required to generate 10000 values : 1.0123s
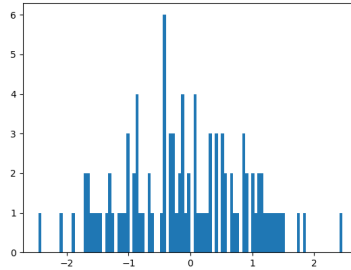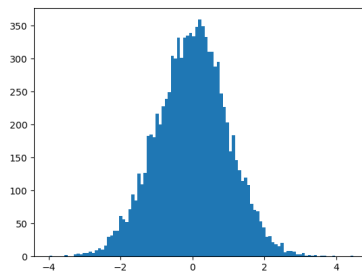
Histogram for 100 values :

Histogram for 10000 values :

Proportion of values rejected :

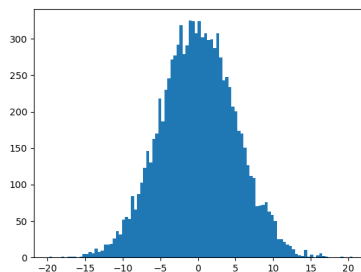- 100 values : 0.08834

- 10000 values : 0.11910

We can observe that **Box-Muller method is faster than Marsaglia & Bray method**.
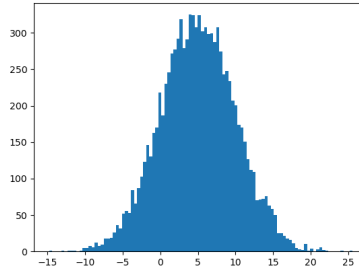We know that if $X \sim N(\mu, \sigma^2)$ then $\frac{X-\mu}{\sigma} \sim N(0,1)$
We utilise this fact to generate the values from $N(0,5)$ and $N(5,5)$
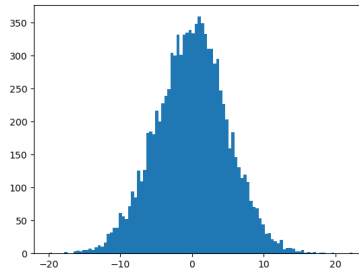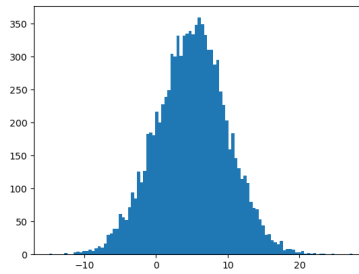Here are the histograms :

- Box-Muller $N(0,5)$

- Box-Muller $N(5,5)$

- Marsaglia Bray $N(0,5)$

- Marsaglia Bray $N(5,5)$

In both the cases, i.e. $N(0,5)$ and $N(5,5)$, the shape of both the plots is same. However we can see a horizontal shift as the peak is shifted from 0 to 5 because the mean has changed.

Q2

We know that :

$$\infty > |x| \geq 0 \implies \infty > 1 + |x| \geq 1 \implies 0 < \frac{1}{1+|x|} \leq 1 \implies 0 < \frac{e^{-x^2}}{1+|x|} \leq e^{-x^2}$$

We also know that a suitable upper bound for e^{-x^2} will be $e^{-2|x|+1}$
We seek

$\int_{-\infty}^{\infty} f(x)dx$

where $f(x) = \frac{e^{-x^2}}{1+|x|}$. To use acceptance-rejection method : $cg(x) = e^{-2|x|+1}$ where $c = \frac{e}{2}$ and $g(x) = 2e^{-2x}$
Approximate integral found : 0.9999999999999998