MA323(Lab-05)

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Problem 01

Part a)   Random numbers were generated using both Box-Muller method and Marsaglia & Bray method.
Box-Muller method is used in 180123060_Jatin_1.py
Marsaglia & Bray method is used in 180123060_Jatin_2.py

First of all 100 random numbers were generated from N(0,1), then 10,000 random numbers were generated from N(0,1).

Expected Mean: 0.0000 Expected Variance: 1.0000	When 100 Random numbers were generated	When 10,000 Random numbers were generated
Sample Mean (Using Box-Muller method)	0.0162	0.0019
Sample Variance (Using Box-Muller method)	1.0661	1.0241
Sample Mean (Using Marsaglia & Bray method)	0.0591	0.0097
Sample Variance (Using Marsaglia & Bray method)	0.9234	1.0479

Part b)   On the next page, graphs are drawn with value that have been sampled on x-axis and frequency on y-axis. Orange curve corresponds to actual density. It is clear from plots below that orange curve converges to obtained density as more samples are generated.
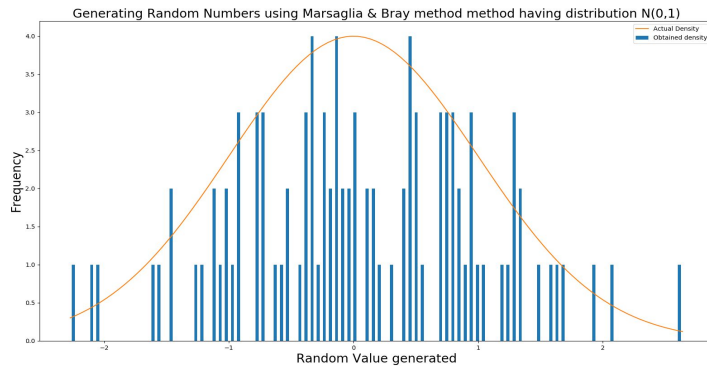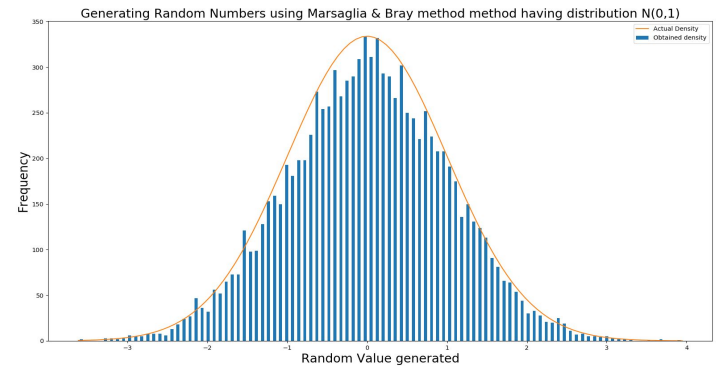
Generating 100 samples using Box-Muller method
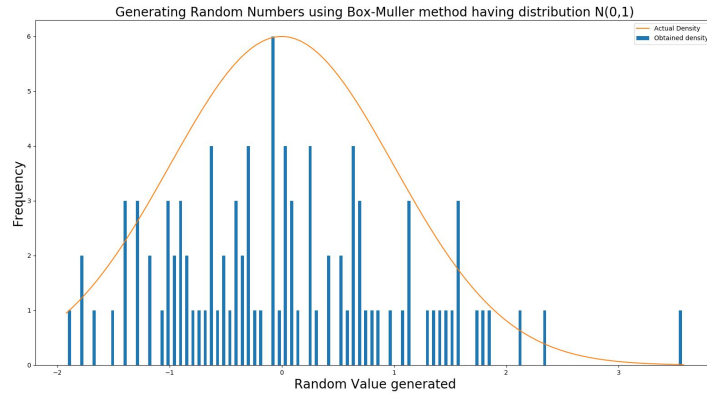
Generating Random Numbers using Box-Muller method having distribution N(0,1)

Generating 10,000 samples using Box-Muller method

Generating Random Numbers using Box-Muller method having distribution N(0,1)

Generating 100 samples using Marsaglia & Bray method

Generating Random Numbers using Marsaglia & Bray method method having distribution N(0,1)

Generating 10,000 samples using Marsaglia & Bray method
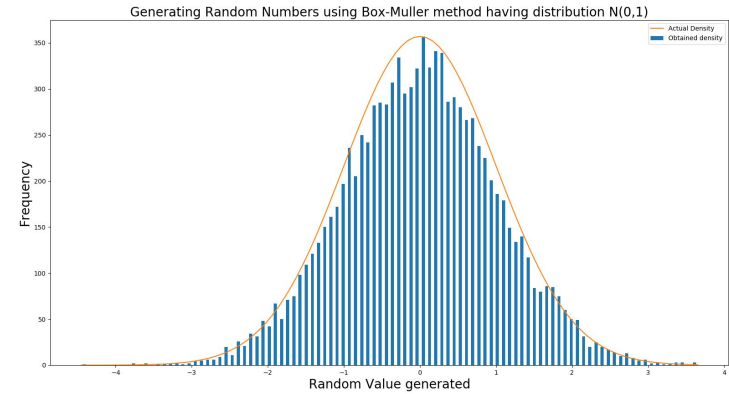
Generating Random Numbers using Marsaglia & Bray method method having distribution N(0,1)

Part c) If X is N(0,1), then (μ + σX) is N(μ,σ*σ). So, using Random numbers generated in previous parts(from both methods) and using μ=0 and σ*σ = 5, samples were generated which follow N(0,5) distribution.

Generating 100 samples using Box-Muller method

Generating 10,000 samples using Box-Muller method

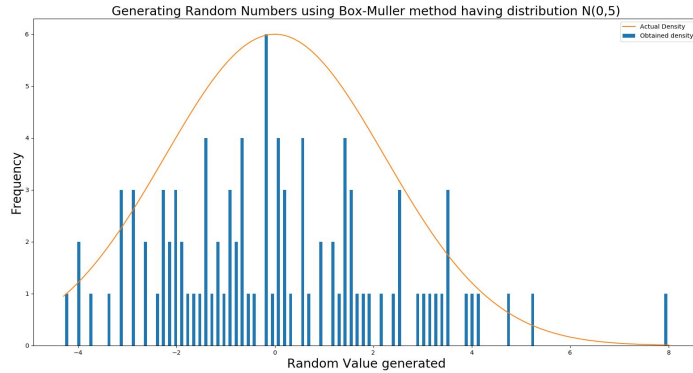## Generating 100 samples using Marsaglia & Bray method

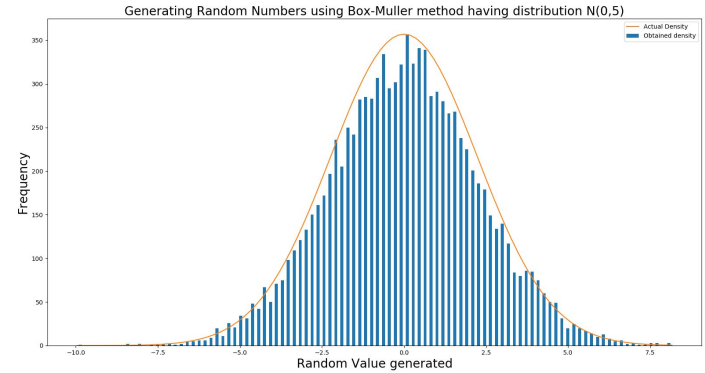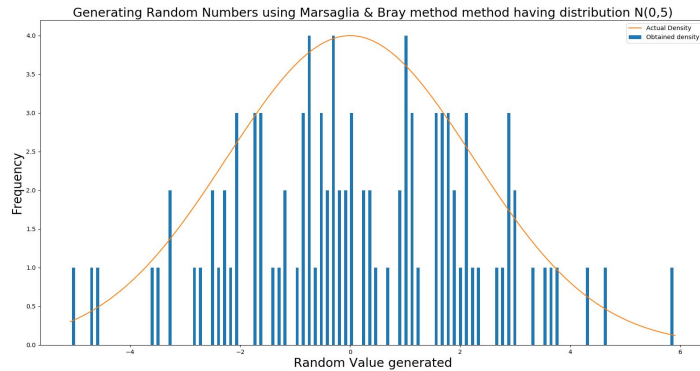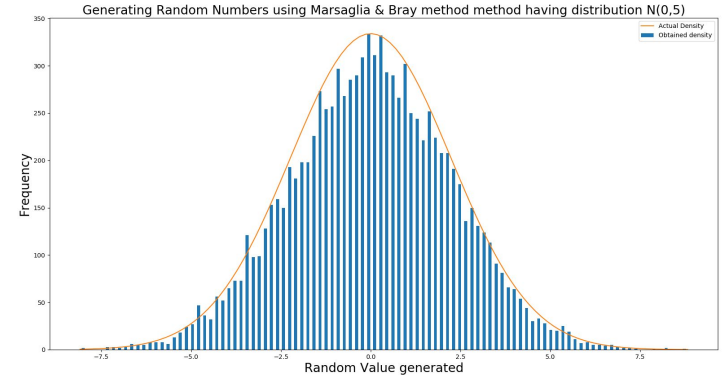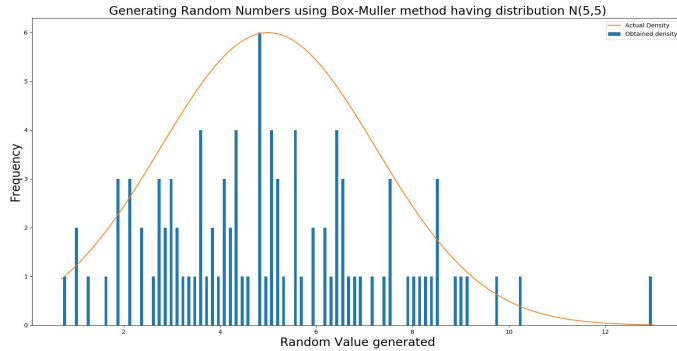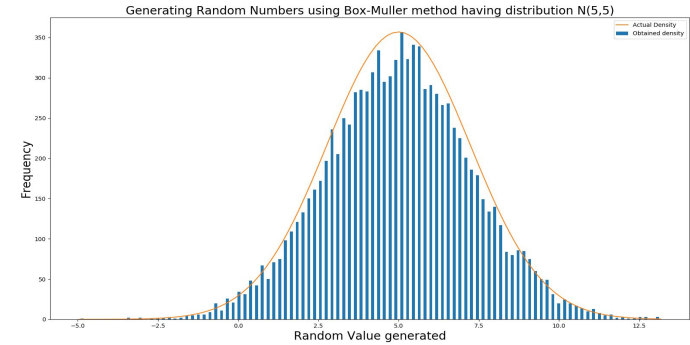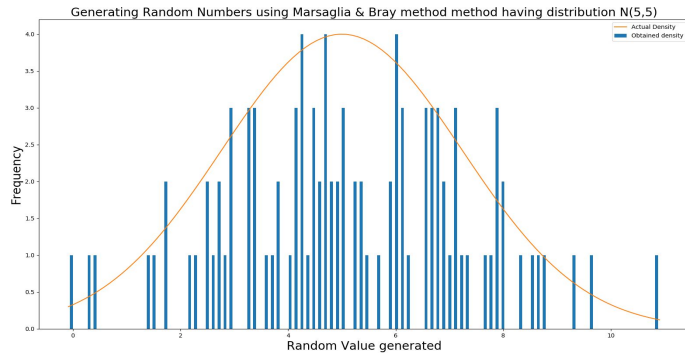## Generating 10,000 samples using Marsaglia & Bray method

Part c) Now using μ=5 and $\sigma * \sigma$ = 5 and using same formula as on previous page, samples were generated which follow N(5,5) distribution.

Generating 100 samples using Box-Muller method

Generating Random Numbers using Box-Muller method having distribution N(5,5)

Generating 10,000 samples using Box-Muller method

Generating Random Numbers using Box-Muller method having distribution N(5,5)

Generating 100 samples using Marsaglia & Bray method

Generating Random Numbers using Marsaglia & Bray method method having distribution N(5,5)

Generating 10,000 samples using Marsaglia & Bray method

Generating Random Numbers using Marsaglia & Bray method method having distribution N(5,5)
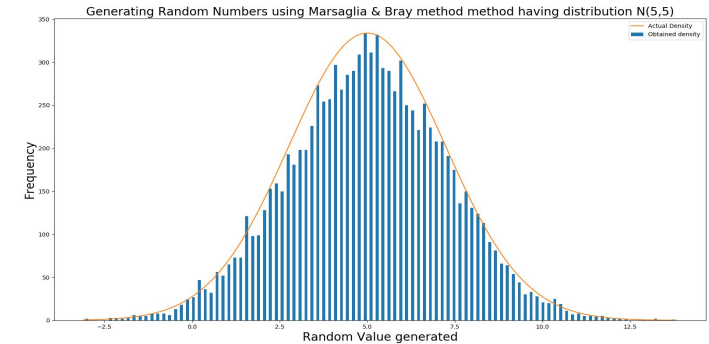
On the last 2 pages, Frequency distribution curve is shown for N(0,5) and N(5,5) distribution. It is clear that as we generate more samples, Orange curve(actual density) approaches to Blue bars(Observed density).

Difference between both the curves(for N(0,5) and N(5,5)) is just that bars are shifted towards right in case of N(5,5). It's just because of distribution takes maximum value and symmetry about μ(which is 5 in N(5,5) case and 0 in N(0,5) case).

Problem 02

Computational times for both methods(for both case 100 and 10,000) were scene and it was observed that **Marsaglia & Bray** method is faster than Box-Muller method. Main reason is that in Marsaglia & Bray method, it does not need to compute sin and cos.
Below shown are observed values of time taken for both methods.

Times are in second(as computed by python code)	When 100 Random numbers were generated	When 10,000 Random numbers were generated
Time taken (Using Box-Muller method)	0.0002281	0.0173301
Time taken (Using Marsaglia & Bray method)	0.0000810	0.0086390

Problem 03

In Marsaglia & Bray method, proportion of the rejected values were observed and it was observed that (in both case 100 and 10,000) the value is closed to 1-(pi/4).
Proportion of rejected value when 100 samples were generated= **0.206349**
Proportion of rejected value when 10,000 samples were generated= **0.211107**
Value of 1-(pi/4)= **0.214601**
It is because area of circle inside square of unit length is pi/4. And we are rejecting value in area of square minus area of circle which is 1-pi/4. Random number is generated inside square of unit length and that value is accepted only if that lies inside circle of radius ½ (or area pi/4).