Monte-Carlo Simulation Assignment 10

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Problem.

- To run the py file, run the command:
  $ python3 180123029_NamanGoyal_q.py

- **For Part1:**
  The expected value of. $I = E\left[\exp\left(\sqrt{U}\right)\right],$

  Calculated using

$$I_M = \frac{1}{M}\sum_{i=1}^{M} Y_i, \text{ where } Y_i = \exp\left(\sqrt{U_i}\right), \text{ with } U_i \sim \mathcal{U}[0,1].$$

- For **Part2:**
  Using Antithetic Variates.
  The expected value is calculated using

$$\widehat{I}_M = \frac{1}{M}\sum_{i=1}^{M} \widehat{Y}_i, \text{ where } \widehat{Y}_i = \frac{\exp\left(\sqrt{U_i}\right) + \exp\left(\sqrt{1-U_i}\right)}{2}, \text{ with } U_i \sim \mathcal{U}[0,1].$$

- For **Part1:**

Value of M	Mean	Variance	95% Confidence Interval
100	1.91588	0.18150	[1.83238, 1.99938]
1000	2.01161	0.19715	[1.98409, 2.03913]
10000	1.99989	0.19390	[1.99126, 2.00852]
100000	2.00028	0.19300	[1.99756, 2.00301]

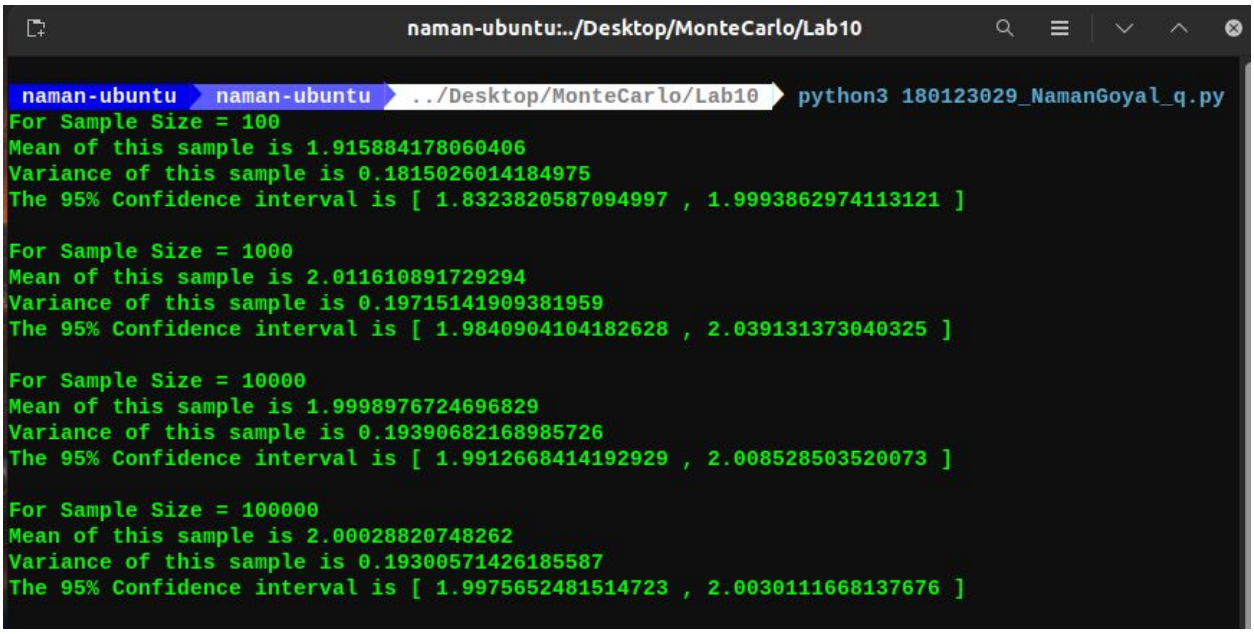
- For **Part2:**

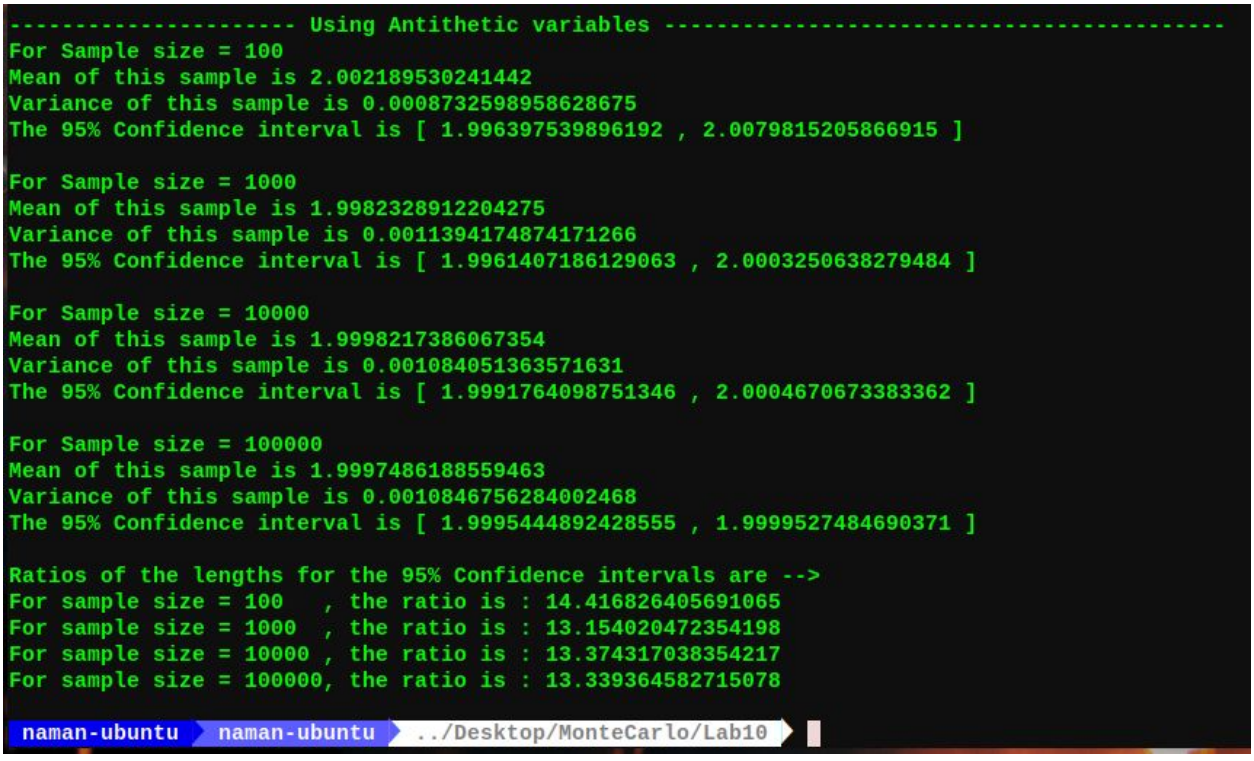
Value of M	Mean	Variance	95% Confidence Interval
100	2.00218	0.00087	[1.99639, 2.00798]
1000	1.99823	0.00113	[1.99614, 2.00032]
10000	1.99821	0.00108	[1.99917, 2.00046]
100000	1.99974	0.00108	[1.99954, 1.99995]

- Ratio of the length of the 95% Confidence Intervals:

Since, the length of Interval = **2*1.96*sqrt(Variance/M).**

Value of M	Ratio of the 2 lengths
100	14.41682
1000	13.15402
10000	13.37431
100000	13.33936


naman-ubuntu:../Desktop/MonteCarlo/Lab10
naman-ubuntu naman-ubuntu ../Desktop/MonteCarlo/Lab10 python3 180123029_NamanGoyal_q.py
For Sample Size = 100
Mean of this sample is 1.915884178060406
Variance of this sample is 0.1815026014184975
The 95% Confidence interval is [1.8323820587094997 , 1.9993862974113121]
For Sample Size = 1000
Mean of this sample is 2.011610891729294
Variance of this sample is 0.19715141909381959
The 95% Confidence interval is [1.9840904104182628 , 2.039131373040325]
For Sample Size = 10000
Mean of this sample is 1.9998976724696829
Variance of this sample is 0.19390682168985726
The 95% Confidence interval is [1.9912668414192929 , 2.008528503520073]
For Sample Size = 100000
Mean of this sample is 2.00028820748262
Variance of this sample is 0.19300571426185587
The 95% Confidence interval is [1.9975652481514723 , 2.0030111668137676]


---------- Using Antithetic variables ----------
For Sample size = 100
Mean of this sample is 2.002189530241442
Variance of this sample is 0.0008732598958628675
The 95% Confidence interval is [1.996397539896192 , 2.0079815205866915]
For Sample size = 1000
Mean of this sample is 1.9982328912204275
Variance of this sample is 0.0011394174874171266
The 95% Confidence interval is [1.9961407186129063 , 2.0003250638279484]
For Sample size = 10000
Mean of this sample is 1.9998217386067354
Variance of this sample is 0.0010840513635716 31
The 95% Confidence interval is [1.9991764098751346 , 2.0004670673383362]
For Sample size = 100000
Mean of this sample is 1.9997486188559463
Variance of this sample is 0.0010846756284002468
The 95% Confidence interval is [1.9995444892428555 , 1.9999527484690371]
Ratios of the lengths for the 95% Confidence intervals are -->
For sample size = 100 , the ratio is : 14.416826405691065
For sample size = 1000 , the ratio is : 13.154020472354198
For sample size = 10000 , the ratio is : 13.374317038354217
For sample size = 100000, the ratio is : 13.339364582715078
naman-ubuntu naman-ubuntu ../Desktop/MonteCarlo/Lab10